FLOOD INSURANCE STUDY

SAN DIEGO COUNTY, CALIFORNIA
AND INCORPORATED AREAS

VOLUME 2 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
May 16, 2012

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
06073CV002C

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Part or all of this FIS may be revised and republished at any time. In addition, part of this FIS may be revised by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS components.

Initial Countywide FIS Effective Date: June 19, 1997

Revised Countywide FIS Dates: June 16, 1999
January 19, 2001
July 16, 2002
September 29, 2006
May 16, 2012

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EXHIBITS

EXHIBIT 1 – FLOOD PROFILES

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were performed to provide estimates of the flood elevations of the selected recurrence intervals. Users should be aware that flood elevations shown on the FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data tables in the FIS report. Flood elevations shown on the FIRM are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation data presented in this FIS in conjunction with the data shown on the FIRM.

Cross sections were determined from topographic maps and field surveys. All bridges, dam, and culverts were field surveyed to obtain elevation data and structural geometry. All topographic mapping used to determine cross sections are referenced in Section 4.1.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles. For stream segments for which a floodway was computed, selected cross-section locations are also shown on the FIRM.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All qualifying bench marks within a given jurisdiction that are cataloged by the National Geodetic Survey (NGS) and entered into the National Spatial Reference System (NSRS) as First of Second Order Vertical and have a vertical stability classification of A, B, or C are shown and labeled on the Firm with their 6-character NSRS Permanent Identifier.

Bench marks cataloged by the NGS and entered into the NSRS vary widely in vertical stability classifications. NSRS vertical stability classifications are as follows:

- Stability A: Monuments of the most reliable nature, expected to hold position/elevation well (e.g., mounted in bedrock)

- Stability B: Monuments which generally hold their postion/elevation well (e.g., concrete bridge abutment)

- Stability C: Monuments which may be affected by surface ground movements (e.g., concrete monument blow frost line)

- Stability D: Mark of questionable or unknown vertical stability (e.g., concrete monument above frost line, or steel witness post)

In addition to NSRS bench marks, the FIRM may also show vertical control monuments established by a local jurisdiction; these monuments will be shown on the FIRM with the appropriate designations. Local monuments will only be placed on the FIRM if the community has requested that they be included, and if the monuments meet the aforementioned NSRS inclusion criteria.

To obtain current elevation, description, and/or location information for bench marks shown on the FIRM for this jurisdiction, please contact the Information Services Branch of the NGS at (301) 713-3242, or visit their website (www.ngs.noaa.gov).

It is important to note that temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purposes of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the Technical Support Data Notebook associated with this FIS and FIRM. Interested individuals may contact FEMA to access this data.

Where areas of riverine flooding are studied in detail, water-surface elevations for floods of the selected recurrence intervals were computed through use of the latest USACE hydraulic computation software available at the time of study. This includes the HEC-2 computer program (U.S. Department of the Army, Corps of Engineers, Hydrologic Engineering Center, March 1977) as well as versions of the more recent HEC-RAS program; which replaced HEC-2. Hand calculations were used in some places to supplement the computer program.

Flood elevations on Murray Canyon Creek at Friars Road were determined from combined outlet control and weir flow computations, and were then inputted into the HEC-2 model.

Flood elevations on Tecolote Creek downstream of Morena Boulevard were developed from rating curves at each bridge and from normal- depth calculations. Water-surface elevations at Balboa and Genesee Avenues were determined from rating curves and then were imputed into the HEC-2 model.

Flood elevations for the 0.2-percent annual chance breakouts on Rose Canyon Creek were determined from normal-depth calculations. Water-surface elevations at Genesee Avenue were developed from a rating curve for the three culverts and were entered as input into the HEC-2 model. For those reaches not analyzed using the HEC-2 program, normal- depth calculations were used in conjunction with extensive field investigations and improvement plan research. Normal-depth calculations were used to establish water-surface elevations for reaches of Switzer Creek, Las Puleta Creek, Home Avenue Branch of Las Chollas Creek, and Murphy Canyon Creek where relatively long underground conduits were encountered.

Water-surface elevations for Telegraph Canyon Creek Overflow were determined by normal-depth calculations.

Cross sections for the backwater analysis were located at small intervals upstream and downstream from bridges and culverts and other hydraulically significant features to establish the backwater effect of such structures in areas presently urbanized or potentially subject to development. All bridges and culverts were field surveyed to obtain elevation data and structural geometry.

Cross section data for Agua Hedionda and Buena Creeks were digitized from aerial surveys (San Diego County, California Topographic Maps, 1962-1983). Additional cross section data were taken from grading plans and field surveys. All bridges and culverts were investigated to obtain elevation data and structural geometry.

Cross section data for the Carroll Canyon Creek, Otay River, and part of Telegraph Canyon Creek were digitized from aerial photographs (San Diego County, California Topographic Maps, 1962-1983, City of San Diego, California Topographic Maps, 1976-1978). Additional cross section data were taken from grading plans and field surveys. All bridges and culverts were investigated to obtain elevation data and structural geometry.

Cross section data for Casa de Oro Creek and Spring Valley Creek were digitized from aerial photographs (Aero Service Corporation, February 1973) and supplemented by grading plans and field investigations.

Cross section data for Descanso Creek, Harbison Canyon Creek, Samagutuma Creek, part of the Sweetwater River, and the Sweetwater River (near Descanso) were field surveyed.

Cross section data for Escondido Creek were taken from digitized aerial surveys and supplemented with as-built plans for the concrete portion of the channel. Cross section data for Reidy Creek were taken from digitized aerial survey sections provided by San Diego County. Cross section data for Kit Carson Park Creek were taken from aerial photographs (San-Lo Aerial Surveyors, Inc., 1972 -1978).

Cross sections for Hatfield Creek, North Tributary to Santa Maria Creek, Santa Maria Creek (Santa Maria Valley area), South Tributary to Santa Maria Creek, and Tributary of South Tributary to Santa Maria Creek were digitized from aerial surveys (Inland Aerial Surveys, November 1974) and supplemented by grading plans and field investigations.

Cross sections for San Vicente Creek were taken from a previous study (California Department of Water Resources, February 1976).

Cross section data for Santa Maria Creek (San Pasqual Valley areas), South Fork Moosa Canyon Creek, and part of the Sweetwater River were digitized from aerial photogram metric surveys and supplemented with existing plans, topographic mapping, and field survey data (San Diego County, 1962-1983, Harl Pugh and Associates, October 1983).

Cross section data for Las Chollas Creek, Wabash Branch, Home Avenue Branch, South Las Chollas Creek, Encanto Branch, Switzer Creek, Florida Drive Branch, Las Puleta Creek, Rose Canyon Creek, San Clemente Canyon Creek, and Tecolote Creek were taken from topographic maps (San Diego County, 1962-1983, City of San Diego, 1976-1978).

Cross section data for Murray Canyon Creek were taken from topographic maps and map manuscripts (City of San Diego, 1976-1978, VTN, Inc., December 1970).

Cross section data for the San Diego River were taken from topographic maps (U.S. Department of the Army, Corps of Engineers, 1979).

Cross section data for Carmel Valley Creek were developed from topographic maps (San-Lo Aerial Surveys, April 1985, State of California Department of Transportation, Topographic Maps, August 1969) and from field surveys.

Cross section data for Nestor Creek, Tijuana River, Sunrise Overflow, Kit Carson Park Creek, Los Penasquitos Creek, Soledad Canyon, Otay River, Murphy Canyon Creek, Santa Ysabel Creek, Santa Maria Creek and San Diego River were digitized from aerial photographs (City of San Diego, 1976-1978, Aero Service Corporation, 1973, San-Lo Aerial Surveyors, Inc., 1972-1978, Mission Aerial Photos, 1979, Western Aerial Surveys, 1973 and 1974).

Cross section data for Buena Vista Creek were digitized from aerial surveys (San Diego County, California, October 1980). Additional cross section data were taken from grading plans and field surveys. All bridges and culverts were investigated to obtain elevation data and structural geometry. Cross section data for the revised portion of Buena Vista Creek were digitized from aerial surveys (San Diego County, September 17, 1975).

Cross section data for Poggi Canyon Creek, Rice Canyon Creek, part of Sweetwater River, and Telegraph Canyon Creek Overflow were digitized by aerial photogram metric surveys, supplemented with existing plans and topographic mapping, and field survey data (San Diego County, 1962-1983, Harl Pugh and Associates, October 1983). Cross sections for backwater analysis were located at small intervals upstream and downstream from bridges and culverts and other hydraulically significant features to establish the backwater effect of such structures in areas presently urbanized or potentially subject to development. Cross section data for Otay River and Telegraph Canyon Creek were digitized by aerial photogram metric surveys (Harl Pugh and Associates, October 1983). Additional cross sections on Telegraph Canyon Creek were taken from grading plans or field investigations.

Cross section data for a portion of the Sweetwater River were digitized by aerial photogram metric surveys, supplemented with existing plans and topographic mapping, and field survey data (San Diego County, 1962-1983, City of San Diego, 1976-1978, National City, March 1973, California Department of Transportation, April 1975).

Cross section data for Soledad Canyon were obtained from field surveys.

Cross section data for the San Dieguito River were obtained from digitized aerial surveys, field surveys, and local improvement plans (Harl Pugh and Associates, October 1983, San Diego County, January 1984).

Cross sections for the backwater analysis for Broadway Creek, County Ditch Creek, and Forester Creek were developed from available topographic maps (American Aerial Surveys, Incorporated, 1958, 1959), supplemented with as- built improvement plans (City Engineer, City of El Cajon, 1954-1973) and field investigations.

Cross section data for San Elijo Creek and Escondido Creek were digitized by aerial photogram metric surveys and supplemented with existing plans, topographic mapping, and field survey data (San Diego County, 1962-1983, Harl Pugh and Associates, October 1983).

Cross section data for the Tijuana River were digitized from aerial photographs (City of San Diego, 1976-1978, Harl Pugh and Associates, October 1983, San Diego County, 1962-1983, San-Lo Aerial Surveyors, Inc., 1972- 1978).

Cross section data for Spring Valley Creek were digitized by aerial photogram metric surveys and supplemented with existing plans, topographic mapping, and field survey data (Harl Pugh and Associates, October 1983, U.S. Department of the Interior, 1967-1988).

Cross section data for Paradise Creek were obtained from city orthophoto-topographic maps (National City, March 1973) and topographic maps (City of San Diego, 1976-1978, California Department of Transportation, April 1975). All bridges and culverts were surveyed to obtain elevation data and structural geometry.

Cross section data for the original study for the City of Oceanside were digitized from aerial surveys (Abrams Aerial Survey, Inc., August 1978). Additional cross section data were taken from grading plans and field surveys. All bridges and culverts were investigated to obtain elevation data and structural geometry.

Cross section data for the revised study of Garrison Creek and the San Luis Rey River were also digitized from aerial surveys (San Diego County, 1962-1983, Harl Pugh and Associates, October 1983).

Cross sections for flooding sources through Poway were digitized from aerial surveys (Western Aerial Surveys, March 1973 and January 1974) and supplemented by field investigations.

Cross sections were digitized from aerial surveys (San Diego County, 1962-1983) and supplemented by field investigations.

Cross section data for Buena Vista Creek Tributaries 1, 2, 3, and 4, and Buena Creek were digitized from aerial surveys (San Diego County, 1962-1983, Harl Pugh and Associates, October 1983). Additional cross section data were taken from grading plans and field surveys. All bridges and culverts were investigated to obtain elevation data and structural geometry.

Cross sections for the San Luis Rey River were digitized from aerial photographs taken in December 1973 (San Diego County, 1962-1983).

Roughness coefficients (Manning's "n") used in the hydraulic computations (shown in Table 9) were chosen by engineering judgment, based on both aerial photographs and field observations of the channels and floodplain areas.

Starting water-surface elevations for Carroll Canyon Creek were determined from the flood profile for Soledad Canyon.

Starting water-surface elevations for Santa Maria Creek were determined from the flood profile for Santa Ysabel Creek, which itself was determined from the elevation in Lake Hodges when the peak flow arrives.

Starting water-surface elevations for Buena Vista Creek were calculated assuming critical depth. For the detailed study of Buena Vista Creek Tributary 1, the starting water-surface elevation was derived from the downstream culvert analysis.

Starting water-surface elevations for Nestor Creek and Sunrise Overflow were computed using the slope-area methods.

Starting, water-surface elevations for Carmel Valley Creek and Carroll Canyon Creek were taken from the flood profile for Soledad Canyon.

Starting water-surface elevations for Kit Carson Park Creek are based on the resulting Lake Hodges elevation when the spillway discharges 50,000 cfs.

Starting water-surface elevations for Rose Canyon Creek and Tecolote Creek were taken from Mission Bay. Starting water-surface elevations on San Clemente Creek were taken from the flood profile for Rose Canyon Creek. Starting water-surface elevations for Murray Canyon Creek were taken from flood profiles for San Diego River.

Starting water-surface elevation for the Tijuana River is the MHHW for the Pacific Ocean.

Starting water-surface elevations for Santa Ysabel Creek are based on elevations resulting from routing of flood hydrographs from San Dieguito River Flood Studies (Leedshill-Herkenhoff, Inc., May 1985) through Lake Hodges.

Starting water-surface elevations for Santa Maria Creek were taken from the Santa Ysabel flood profiles, due to coincident flooding.

Starting water-surface elevations at the mouth of the San Diego River were computed assuming critical depth. Starting water- surface elevations for the San Diego River at Friars Road were taken from the flood profiles of the 1983 San Diego River Flood Insurance Study. Starting water-surface elevations for the upstream reach of the San Diego River were taken from a known 1-percent annual chance flood elevation at Mission Dam.

The starting water-surface elevation for Poggi Canyon Creek considered previously determined backwater conditions on Otay River. However, critical depth controls upstream of the confluence with Otay River. Starting water-surface elevations for Rice Canyon Creek were based on Sweetwater River flood elevations at the confluence. Sweetwater River starting water-surface elevations were determined by either the critical depth at the mouth or the tidal data in San Diego Bay, whichever is higher. Critical depth was used in the computation of the 2-, 1-, and 0.2-percent annual chance floods, while the mean higher high tide of 2.9 feet was used for the 10-percent annual chance flood. Starting water-surface elevations for Telegraph Canyon Creek were calculated assuming critical depth. Starting water- surface elevations for Telegraph Canyon Creek Overflow were derived from normal-depth calculations.

Starting water-surface elevations for the San Dieguito River were based on the MHHW for the Pacific Ocean.

Starting water-surface elevations for Escondido Creek were calculated by a reservoir-routing procedure at San Elijo Lagoon near the Pacific Ocean. Starting water-surface elevations for Reidy Creek were determined by calculating critical depth at Lincoln Avenue.

Starting water-surface elevations for the San Luis Rey River were calculated assuming critical depth and MBHW of the Pacific Ocean.

Starting water-surface elevations for Green Valley Creek were taken from a known the 1-percent annual chance flood elevation approximately 170 feet upstream of Pomerado Road in the community of Rancho Bernardo. Starting water-surface elevations for Green Valley Creek Tributary were taken from the main stem. Starting water-surface elevations for all other streams were determined by critical-depth calculations.

For Forester Creek, the initial water-surface elevation was determined by the slope-area method.

Starting water-surface elevations for the remaining streams studied by detailed methods were determined by either normal or critical depth calculations.

Flood profiles of the San Dieguito River are presented because of the aerial extent and severity of flooding from this source. The hydraulic analyses for the study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

Scouring of the riverbed at the mouth of the San Dieguito River was assumed to -4 feet. To simulate the 1980 flood, a discharge of 22,000 cfs was applied. The flooding results at the lower end of San Dieguito River are in close agreement with the flood map provided by the City of Del Mar.

There is little significant flooding problem in the City of National City from the two unnamed intermittent creeks (designated as Creek A and Creek B). In the area of El Toyon Park by Creek B, however, a small-capacity culvert at Interstate Highway 805 would cause shallow ponding. Therefore, water-surface profiles for the unnamed creeks were eliminated in the study. For Las Puleta Creek, elevations above the long underground conduit downstream of Delta Street in the City of National City were determined by normal depth calculations, in conjunction with extensive field investigations and improvement plan research. The capacity of the conduit was determined to be approximately 70 percent of the 1- percent annual chance discharge. This results in shallow flooding hazards with depths of approximately 1 foot in the residential area between Delta Street and 43rd Street.

Analysis indicated that the 1-percent annual chance flood on Rattlesnake Creek would be divided at the Heritage Hills Unit 4 Subdivision and at Midland Road.

At Heritage Hills, the divergence from the main channel occurs downstream of Community Road on the northern side of the development. Backwater at the entrance to the concrete-lined trapezoidal open channel through the subdivision forces significant amounts of flow around the eastern boundary of the subdivision. Although the concrete channel follows a somewhat steeper slope, the confining flow conditions cause the backwater to occur and result in over bank flow to the east.

It was determined that under existing conditions the 1-percent annual chance flood flow would be split, with l,000 cfs entering the concrete channel through Heritage Hills and the remaining 2,900 cfs occurring as overflow through the vacant fields east of the subdivision. Flooding on Wanesta Drive is based on backwater computations of the east split flow area. Plow reentering the western channel from Wanesta Drive and between houses was judged to be minor. Along the downstream side of Poway Road, a discharge of 800 cfs flows across Westy's Store parking lot to rejoin the main stem of Rattlesnake Creek, which changes to an earth-lined trapezoidal channel at Poway Road. The remainder of the split flow (2,100 cfs) reenters the main channel of Rattlesnake Creek along the future western extension of Remlap Way through grass and brush cover.

At Midland Road another split flow on Rattlesnake Creek occurs. Midland Road serves as a "side-channel spillway" for the channel located on the east side of Midland Road. The east channel is higher than the west channel; resulting in average water-surface elevation difference of 4 feet. Floodwaters from the east channel will have to flow laterally across the road into the west channel. Flow will, therefore, be continuously added to the west channel. A separate HEC-2 step-backwater computer analysis was performed for the east and west channels. Flow rates for use in the computer analysis were established at each cross section by creating weir flow rating curves for Midland Road. Computations resulted in a flow configuration of 1,500 cfs through the Midland Road bridge and of 1,800 cfs proceeding along the east side of Midland Road to become weir flow. The split flow to the east gradually reenters the main channel and converges with Rattlesnake Creek just northwest of the intersection of Midland Road and Aubrey Street.

Downstream of the Midland Road split flow area, in the vicinity of York Avenue and Sycamore Avenue, a low flow channel, which lies outside the main 1-percent annual chance floodplain, extends downstream of Edgemoor Street. This channel is capable of conveying only about 400 cfs; therefore, the main flow bypasses it and flows to the northwest of the area. This area was modified in the HEC-2 computer analysis using encroachments to restrict flow to the course it will actually take.

A flood profile is not provided for Lower Las Posas Creek. The regulatory 1-percent annual chance water-surface elevations in this area are based on the backwater effects of San Marcos Creek. The profile for San Marcos Creek should be used to determine the regulatory 1-percent annual chance water-surface elevations in this area.

The pipes passing underneath Echo Lane, Twin Oaks Valley Road, and San Marcos Boulevard were determined to be negligible in capacity, in comparison with the 1-percent annual chance flood discharge.

A detailed hydraulic analysis was performed by Boyle Engineering for the Woodland Parkway Culvert. This culvert contains the entire 1-percent annual chance flood discharge.

The controlling element at the entrance to the box culvert along Las Posas Creek is the balance between the orifice and weir capacities at Grand Avenue. For the 1-percent annual chance flood discharge of 1,850 cfs, approximately 1,300 cfs will flow into the culvert, with the remaining 550 cfs an overtopping Grand Avenue.

Areas of shallow flooding were determined using the HEC-2 computer program (U.S. Department of the Army, Corps of Engineers, March 1977), normal-depth calculations, rating curves for bridges and culverts, and engineering judgment.

Overtopping of the south channel bank of Descanso Creek occurs between Cross Sections 0 and S. The minimum channel capacity before the flow overtops the south channel bank is 1,100 cfs, which is less than the 10-percent annual chance flood. Therefore, any flows in excess of 1,100 cf a will escape from Descanso Creek and spread out as sheet flow in the flatlands on the left over bank before being collected by Samagutuma Creek to the south.

The most serious flood problem in Ramona is caused by a shallow swale which carries runoff from the low hills at the east end of the town through the central residential section to a southeasterly tributary of Santa Maria Creek. Flows exceeding 500 cfs (a 10-percent annual chance flood) will leave the channel and cause sheet flow downstream of Cross Section BU. These flows reenter the main channel near .the intersection of Black Canyon Road and Pile Street.

The culvert under Fifth Avenue on Telegraph Canyon Creek can only pass the 800 cfs 10-percent annual chance flood. From Fifth Avenue upstream to Cross Section K, the channel capacity is limited by low banks and cannot handle the 1-percent annual chance flood. Restriction in flow capacity downstream of Cross Section IC causes sheet flow to the south in the vicinity of the east side of Fifth Avenue. This sheet flow covers a wide area and is approximately 1 foot deep. These flows reenter the main channel in the vicinity of Woodlawn Avenue and Moss Street.

The long culvert for Telegraph Canyon Creek under Interstate Highway 5 will carry approximately 2,000 cfs under flood conditions. The 1-percent annual chance discharge at the culvert for Telegraph Canyon Creek is 2,800 cfs. Some of the excess discharge backs up behind the culvert and creates a shallow flooding area between the San Diego and Arizona Eastern Railroad and Colorado Avenue. This excess discharge was labeled Telegraph Canyon Overflow for this report. The overflow flows north, across “L” Street, and into a natural ditch between the railroad and Colorado Avenue. The ditch flows directly into a rectangular concrete channel that terminates at a 4-foot-diameter corrugated metal pipe. The corrugated metal pipe carries the flow into the drainage system under Industrial Boulevard and Interstate Highway 5, eventually discharging into San Diego Bay.

On Sweetwater River, the 1- and 0.2-percent annual chance floods overflow onto Bonita Road and proceed under Interstate Highway 805. The low area around Bonita Road west of Interstate Highway 805 is drained by two 42-inch diameter reinforced concrete pipes with flap gates. The drainage pipes cannot carry the full amount of the overflow, so ponding occurs west of Interstate Highway 805. Since the 10-percent annual chance event does not overflow into this area, the zone designation is based on the difference between the 1-percent annual chance ponding elevation and the average ground elevation within the ponded area.

On the San Diego River, 0.2-percent annual chance flooding occurs in the southern over bank between North Magnolia Avenue and Abraham Way.

Shallow flooding depths on Buena Creek just downstream of State Highway 78 and Buena Vista Creek and its tributaries in the City of Vista were determined by engineering judgment. Much of the shallow flooding in the City of Vista is contained in the streets.

Debris potential was considered in the analysis of the Las Chollas area in the City of San Diego. The current policies of several agencies with expertise in hydraulic analysis, including the USACE, were researched. Based on these data, the following criteria were adopted for consideration of the debris potential in the streams studied. The debris potential for each stream was classified as high, medium, or low, based on historic flood data, an analysis of the characteristics of the drainage area, and a field investigation of the flooding source by hydraulic engineers. On streams with low debris potential, no provisions for debris were made in the hydraulic analysis. For stream reaches where debris potential was determined as medium, the bridge geometry was altered using the following criteria:

1. If the existing structure had no debris walls, the pier wall area was increased by 1.0 foot of width multiplied by the full depth of water.

2. If the existing structure had debris walls, the pier wall area was increased by 1.0 foot of width multiplied by 6.0 feet of depth.

The debris analysis of circular conduits involved a reduction in the effective flow area of up to 30 percent, based on field reconnaissance. A summary of the debris potential for some flooding sources studied in detail are as follows:

Stream	Debris Potential
Las Chollas Creek	Medium
Wabash Branch	Medium
Home Avenue Branch	Medium
South Las Chollas Creek	Medium
Encanto Branch	Low
Switzer Creek	Low

Stream	Debris Potential
Florida Drive Branch	Medium
Las Puleta Creek	Medium

A brief discussion of some flooding sources follows.

Las Chollas Creek

The main branch of Las Chollas Creek was analyzed from its upstream limit of study approximately 0.3 mile upstream of 54th Street to the corporate limits of the City of San Diego downstream of the confluence with South Las Chollas Creek. The study was completed in 1979. The existing topography provided a strong basis for the use of the HEC-2 computer program (U.S. Department of the Army, Corps of Engineers, March 1977). In the upstream segment, the 1-percent annual chance discharge is conveyed by a well-defined, natural channel, with backwater effects occurring at 54th Street, Euclid Avenue, and Fairmont Avenue. At these crossings, the roads are overtopped due to inadequate culvert conveyance and topographic constraints. Most of the 1-percent annual chance discharge enters a lined channel system just upstream of Interstate Highway 805 and is conveyed to State Highway 94. The flow breakout that occurs at the Interstate Highway 805 crossing is caused by the lack of upstream channel confinement. The flow enters a defined, natural channel just downstream of State Highway 94, and is confined by relatively steep channel banks until it reaches the Market Street crossing. At this point, a lined channel system begins, which conveys the flows to National Avenue, just upstream of the confluence with South Las Chollas Creek. 1-percent annual chance flooding depths in excess of 5 feet exist in the right over bank of this reach and are caused by inadequate conveyance at the bridge crossings. The unlined channel reach from National Avenue to the corporate limits is subject to inundation from backwater effects at the confluence.

Wabash Branch

Flows collected north of State Highway 94 at Wabash Boulevard are conveyed to Las Chollas Creek through a wide, well-defined natural channel. The existing topography provided a strong basis for the use of the HEC-2 computer program. From State Highway 94 to the confluence of Las Chollas Creek, a series of underground conduits and lined channels was analyzed using normal-depth calculations. Backwater effects upstream of State Highway 94 create shallow flooding hazards with depths to 3 feet in the right over bank. Downstream of State Highway 94, the 1-percent annual chance discharge breaks out over Wabash Boulevard due to inadequate culvert capacity.

Home Avenue Branch

Upstream of Auburn Drive, storm flows are conveyed by a natural channel. The 1-percent annual chance discharge, is not contained by the lined channel downstream of Auburn Drive, due' to inadequate culvert capacity at Auburn Drive caused by silting. Shallow flooding conditions with depths of approximately 1 foot exist in a residential area until the flow reenters the lined channel downstream of Euclid Avenue. This reach of lined channel was analyzed assuming a supercritical flow regime. The discharge is contained in a well-defined natural channel from 900 feet downstream of Euclid Avenue to 300 feet upstream of the Interstate Highway 805 crossing, with weir flow occurring at Fairmont Avenue where debris accumulation reduces culvert conveyance. Hand calculations were used to substantiate the 1- percent annual chance flow capacity of the Interstate Highway 805 conduit. Downstream of Interstate Highway 805, the 1-percent annual chance discharge is contained in a natural channel to Federal Boulevard. Debris accumulation at the Federal Boulevard culvert creates shallow flooding conditions in the east over bank. The flow then enters the main branch of Las Chollas Creek.

South Las Chollas Creek

The hydraulic analysis of South Las Chollas Creek was accomplished using the HEC-2 step-backwater computer program for three independent channel reaches. The upstream lined channel reach, beginning at the corporate limits and ending upstream at Federal Boulevard, was analyzed assuming supercritical flow. Shallow flooding conditions in the left over bank result from inadequate channel improvements upstream of the corporate limits. The 1-percent annual chance discharge is then conveyed in a well-defined natural channel to the inlet of a lined channel system at Lenox Drive. This lined channel reach was also analyzed using supercritical flow regime. The 1-percent annual chance discharge creates shallow flooding conditions in the over banks of this reach due to debris clogging the culverts. The subcritical flow regime was used to analyze the remaining portion of South Las Chollas Creek. Shallow flooding conditions in this reach are mainly due to backwater effects caused by inadequate culvert and bridge conveyance. Debris buildup at these structures reduces the effective flow areas of the conduits, resulting in weir flow conditions. A proposed 1-percent annual chance design dike with slope paving is planned for the reach between Interstate 805 and Imperial Avenue. This channel improvement was included in the analysis and mapping. From 40th Street to the confluence with Las Chollas Creek, the flow is conveyed in an improved channel with approximately 1-percent annual chance capacity. Shallow flooding hazards are included in the lower reaches due to backwater effects at the confluence of the two creeks.

For the June 1991 revision, the hydraulic analysis was performed using the USACE HEC-2 step-backwater computer program. Revised cross-sectional information was obtained from as-built construction drawings of a recently completed residential development in the area.

An island formed by fill divides the 1-percent annual chance flood between Interstate Highway 805 and 47th Street. Approximately 4,780 cfs remains in the main channel, and approximately 520 cfs flows to the south of the island. The island is designated as Zone X.

Encanto Branch

Encanto Branch of South Las Chollas Creek runs easterly from its confluence with the main channel west of Euclid Avenue. The channel reach upstream of Merlin Drive was analyzed using a combination of normal- depth calculations and the HEC-2 step-backwater computer program, assuming a supercritical flow regime. Shallow flooding conditions which exist in the over bank are created by inadequate culvert conveyance at the various crossings. Downstream of Merlin Drive, the flow is essentially contained by a well-defined natural channel to its confluence with South Las Chollas Creek. Debris and silting problems, particularly at 54th Street, are responsible for flooding hazards to an industrial area downstream of 54th Street. Also, backwater effects at the confluence create shallow flooding conditions downstream of Euclid Avenue.

Switzer Creek

The HEC-2 step-backwater computer program was used from the limit of detailed study at 26th Street to the inlet of the 10-foot-diameter underground conduit near Russ Boulevard (U.S. Water Resources Council, March 1976). For this reach, the 1-percent annual chance discharge is conveyed by a lined channel section to the inlet of the underground conduit. Normal-depth calculations were used to establish that approximately 60 percent of the 1-percent annual chance discharge enters the underground conduit and is conveyed to San Diego Bay. The remaining 40 percent, or approximately 750 cfs, will produce shallow flooding hazards up to 1 foot deep through the eastern downtown business district.

Florida Drive Branch

The 1-percent annual chance discharge breaks out at the Florida Place crossing due to heavy debris clogging the box culvert. Downstream of Florida Place, the flow is contained in a well-defined natural channel. A short reach of lined channel downstream of the Pershing Drive crossing conveys the 1-percent annual chance discharge into the main channel of Switzer Creek.

Las Puleta Creek

Normal-depth calculations were used to supplement the HEC2 step backwater program throughout the study area. The capacity of the underground conduit downstream of Delta Street was determined to be approximately 70 percent of the 1-percent annual chance discharge. This results in shallow flooding hazards with depths approximating 1 foot in the residential area between Delta Street and 43rd Street The lined channel between 43rd Street and Interstate Highway 5 was found to have approximately 1-percent annual chance capacity. The shallow flooding conditions which exist in the over bank in this reach are caused by inadequate conveyance at the bridge crossings.

Tijuana River - Nestor Creek - Sunrise Overflow

Diversion of water from Nestor Creek to the Tijuana River occurs during 10-, 2-, and 1-percent annual chance events. A shallow flooding situation occurs as flow continues south toward the Sunrise Overflow area. Elevations in this area were determined. using engineering judgment, field inspection of existing conditions, and historical information.

Murray Canyon Creek

Breakouts occur on Murray Canyon Creek for floods greater than a 2-percent annual chance event at two locations. Breakouts occur both just upstream of a gravel pit and at Friars Road.

The breakout upstream of the gravel pit area was analyzed by assuming equal elevation of flow from the breakout section to the asphalt road weir. Weir calculations were used to plot rating curves for weir flow over road, weir flow back to the channel, and total weir flow. The HEC-2 computer program was used to compute the channel flow rating curve. The combined flow rating curve was formed by adding the total weir flow rating curve to the channel flow rating curve. Since equal elevation of flow was assumed, the rating curves were used to determine the amount of flow that leaves the main channel, reenters the main channel, and permanently leaves the main channel over the asphalt road.

The breakout at Friars Road was analyzed by assuming that all culvert flow remains in the channel and all weir flow over Friars Road permanently leaves the channel. Rating curves for culvert outlet control, weir flow, and combined weir and culvert outlet control flow were plotted on the same graph. Discharges entering the Friars Road overpass were added to the combined flow curve, and corresponding culvert flow and weir flow was read off the culvert flow rating curve and weir flow rating curve.

Rose Canyon Creek

The 0.2-percent annual chance flood, on Rose Canyon Creek breaks out of the channel at two locations. The first breakout occurs upstream of the Interstate Highway 5 bridge; the second breakout occurs at the Mission Bay Bridge. The depths of flooding due to the two breakouts were determined from normal-depth calculations.

San Diego River

Near Mission Valley Shopping Center, approximately 30 percent (12,000 cfs) of the 1-percent annual chance discharge breaks out of the channel, resulting in shallow flooding at the shopping center. Floodwaters flow south along North Camino Del Rio Road, filling the underground parking facility to its ceiling. The depth of flooding along North Camino del Rio Road was determined from normal depth calculations. The analysis assumed the Conrock Low River Channel fill would not wash out during major floods. The City of San Diego agreed to this concept.

Tecolóte Creek

Normal-depth calculations and rating curves for the bridges downstream of Cross Street were used to determine flood elevations in the channel and over bank areas.

Coastal flood hazard areas subject to inundation by the Pacific Ocean were determined on the basis of water-surface elevations established from regression relations defined by Thomas (Federal Emergency Management Agency, July 1984). These regression relations were defined as a practical method for establishing inundation elevations at any site along the southern California mainland coast. They were defined through analysis of water-surface elevations established for 125 locations in a complex and comprehensive model study by Tetra Tech, Inc. (Tetra Tech, Inc., 1982). The regression relations establish wave run up and wave setup elevations in Seal Beach for the 10-, 1- and 0.2-percent annual chance flood events.

Wave run up elevations were used to determine flood hazard areas for sites along the open coast that are subject to direct assault by deep-water waves. Run up elevations which range with locations and local beach slope were computed at 0.5-mile intervals, or more frequently in areas where the beach profile changes significantly over short distances. Areas with ground elevations 3.0 feet or more below the 1-percent annual chance wave run up elevation are subject to velocity hazard.

Wave setup elevations determined from the regression equations on the basis of location along the coast were used to identify flood hazard areas along bays, coves, and areas sheltered from direct action of deep-water waves.

Coastal floodplain boundaries were delineated using the wave run up or wave setup elevations computed at each 0.5-mile interval. Between these points, the boundaries were interpolated using topographic maps and aerial photos (Abrams Aerial Surveys, Inc., October 1978, U.S.

Department of the Interior, 1967-1988). Structural modifications along the coast post-dating the above- mentioned maps were not considered in the coastal analysis.

Computed elevations for wave run up, wave setup, and other inundation hazard characteristics were shown in a previous table.

Tidal elevations from the Pacific Ocean via San Diego Bay control flooding along the portion of the Otay River located in the southeast corner of Coronado.

To obtain runup values for the various flood-producing mechanisms, data on offshore bathymetry and beach profiles were obtained from U.S. Coast and Geodetic Survey and the NOAA bathymetric charts, USGS topographic maps, surveys of beach profiles, and from aerial photographs of the study area (U.S. Department of Commerce, various dates, U.S. Department of the Interior, 1967-1988, Abrams Aerial Surveys, Inc., August 1978, respectively).

The City of National City waterfront along San Diego Bay is owned or controlled by the U.S. Navy. Over the years, the entire reach has been bulk headed and filled to an elevation of approximately 12 feet from 19th Street to the Sweetwater River, and varies from 8 feet at Division Street (the northern corporate limits) to 10 feet at 19th Street. In a previous study (State of California, September 1964), the 1- and 0.2-percent annual chance tidal elevations were found to be below the elevation of the bulkhead. Thus, for National City, there is no inland tidal flooding problem from either the 1- and 0.2-percent annual chance tidal floods.

Elevations for areas studied by approximate methods were determined using the HEC-2 computer program, normal depth calculations, field investigation, and engineering judgment.

The base flood, 1-percent annual chance, elevations for the approximate study reach of Los Penasquitos Creek were determined by linear interpolation between the adjacent detailed study reaches.

Nestor Creek

For the 1989 revision of Nestor Creek, the starting water-surface elevation for Nestor Creek was set at critical depth without the use of the coincident flow analysis on the Otay River. The Otay River floodplain determined for the previous FIS essentially overrides the Nestor Creek 1-percent annual chance floodplain west of Palm Avenue, where it causes backwater for over 1,000 feet.

The hydraulic analysis for Nestor Creek was evaluated using the HEC-2 Computer Program. Cross section data for Nestor Creek were obtained from the 1973 orthophotos (San Diego County, 1962-1983) and the as-built plans for the new developments.

Roughness coefficients (Manning's ”n”) used in the hydraulic computations for the revised study were chosen by engineering judgment, based on field observations of the stream and floodplain areas. Chow's handbook on open channel hydraulics (Ven Te Chow, 1959) was also used as a guide to select the “n” values. The roughness coefficients used for Nestor Creek are listed in the Manning's n-value table.

Nestor Creek watershed is mostly developed with minimal natural debris in the floodplain. Bridge analyses were done with no debris at the piers. Nestor Creek above Interstate Highway 5 has a low flow rectangular concrete channel about 25 feet wide by 10 feet deep. This channel becomes a double 7 foot wide by 3 foot high reinforced concrete box that goes through the Interstate

Highway 5 embankment. A separate inlet control -analysis was done to compute the 1-percent annual chance water- surf ace elevation, the analysis showed Nestor Creek will pond to an elevation of 34.0 feet NAVD. No floodway was computed for this backwater area.

For the 1993 revision, water-surface elevations for the 1-percent annual chance flood were computed using the HEC-2 computer program and were computed by normal depth methods, except for Twin Oaks Valley Creek for which the starting water-surface elevation was taken from the FIRM.

The cross section data were obtained from topographic maps (Rick Engineering Company, 1992) that were compiled by photogram metric methods from aerial photography. Dimensions of all hydraulic structures were obtained from field investigation.

Hydraulic roughness coefficients (Manning's "n") were selected on the basis of field inspection and engineering judgment.

Agua Hedionda Creek and Calavera Creek

For the 1994 restudy of Agua Hedionda Creek and Calavera Creek, the water-surface profiles were determined using the USACE HEC-2 hydraulic computer model. Cross section information was determined from field surveys. Manning's "n" values were based on field investigations. The starting water-surface elevation was determined using the slope-area method. The floodways were based on equal conveyance reduction. Due to the steep slopes, the rise in the water-surface elevation and energy grade line was limited to one foot.

Within the study area there are existing floodwalls in the following locations: along El Camino Real, near the downstream end of the Agua Hedionda along the right bank, and along Calavera Creek on the northwest side of the mobile home park. None of these walls meet the criteria for providing protection from the 1-percent annual chance flood; therefore, the worst case scenario of the with and without embankment analysis was mapped in each area.

Pomerado Creek

For the 1995 restudy of Pomerado Creek, water-surface elevations for the 1-percent annual chance flood were computed using the USACE HEC-2 computer program. The starting water-surface elevation was based on the slope-area method.

Channel and overbank cross sections were determined from field surveys, topographic mapping, and various improvement plans. Dimensions, geometry, and elevations of all bridges and culverts were field surveyed or obtained from construction drawings.

There is a wall that extends from Robinson Road to McFerron Road along the east side of Pomerado Road. This wall does not provide protection from the 1-percent annual chance flood; therefore, in accordance with FEMA criteria, the wall was evaluated under two conditions: reflecting the wall intact and the wall failed. Plotted profiles represent the worst-case condition in the channel and overbanks.

Alvarado Creek

For the 1996 restudy of Alvarado Creek, water-surface elevations (WSELs) for floods of the selected recurrence intervals along Alvarado Creek were computed using the USACE HEC-2 computer program (U.S. Department of the Army, Corps of Engineers, September 1990). Cross sections were compiled using 1-foot-contour-interval topographic mapping and as-built plans. Starting WSELs at the stream confluence with the San Diego River were established using the normal-depth method.

Roughness coefficients (Manning's "n" values) were assigned to the channels and over banks using photographs obtained from field visits and methodology described in USGS Water-Supply Paper 2339, "Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Flood Plains (U.S. Department of the Interior, Geological Survey, 1989). The roughness coefficients used for Alvarado Creek are shown in Table 9, "Summary of Manning's "n" Values."

Some of the data used in the restudy were taken from the FIS for San Diego County, dated August 1989, and the City of San Diego FIS dated May 1993 (Federal Emergency Management Agency, August 3, 1989 and May 17, 1993).

For the 2000 restudy of Alvarado Creek, water-surface elevations for selected recurrence intervals were determined by analyzing the hydraulic characteristics of flooding. The HEC-RAS step-backwater program of the USACE was used to determine the WSELs for the 10-, 2-, 1-, and 0.2-percent chance flood events (U.S. Army Corps of Engineers, April 2000). The starting WSELs were determined by normal depth computations. The existing upstream elevations from the City of San Diego FIS were not used due to a reduction in flows from the original FEMA hydrology for the upper reach of Alvarado Creek.

The split-flow routine from HEC-2 was used to approximate the reduced flows for the four flood events that result in water overtopping the channel between Baltimore Drive and Fletcher Parkway (U.S. Department of the Army, Corps of Engineers, September 1990). These breakouts will flow down the westbound on-ramp of Interstate 8 and will not return to the channel due to the Jersey median barrier that extends throughout the study reach.

Cross sections for the step backwater analyses along Alvarado Creek were obtained from a topographic map developed from aerial photography flown on November 10, 1987 and from a more recent 1998 topographic map obtained from Mission Valley Designers. Additional culvert data were taken from field surveys and from Mission Valley Designers' existing HEC-RAS model.

Cross sections were located just upstream and downstream of culverts and at hydraulically significant locations. Locations of cross sections used are shown on the Flood Profiles and on the FIRM.

Hydraulic roughness factors (Manning's "n") were assigned based on field inspections of the floodplain area and USGS guidelines (City of Coronado, January 1974). The values varied from 0.015 to 0.06 in the channel and from 0.045 to 0.1 for the over bank areas. Contraction and expansion coefficients of 0.1 to 0.3 and 0.3 to 0.5 were used for open-channel sections. Although supercritical flow conditions occurred in many sections, the subcritical flow option was used to determine and plot critical depth.

Eight culverts exist in the upper Alvarado Creek study area: Fletcher Parkway off-ramp from Interstate 8, Interstate 8, Alvarado Road on and off ramps to and from Interstate 8 at the east end of the study, Comanche Drive, Alvarado Road at the east end of the mobile home park, Alvarado Road at the west end of the mobile home park, Alvarado Road on and off ramps to and from Interstate 8 at the west end of the study, and 70th Street/Lake Murray Boulevard. Due to the close proximity of the last two culverts, full expansion and contraction of the flow is not possible therefore the two culverts were combined. The majority of culverts along Alvarado Creek do not have the capacity to convey the 1-percent annual chance flood.

The 1-percent annual chance floodwater exiting the culvert at Baltimore Drive will overtop the channel before reaching Fletcher Parkway. The flow will split and approximately a third of the flow will be lost down the westbound on-ramp of Interstate 8. The remaining flow will continue down the channel and overtop the culvert at Fletcher Parkway. Water will pond in this area before continuing under Interstate 8. As the flow exits the Interstate 8 culvert, it will overtop and pond around the Alvarado on-ramp culvert. The 1-percent annual chance flood event will continue down the channel and pass completely through the Comanche Drive culvert. After passing a point opposite an automobile dealership, water will spread out and pond in the area east of the mobile home park culvert. This culvert can not convey the full 1-percent annual chance event and water will flow down Alvarado Road and into the mobile home park. The floodwater will continue westward and pass over the west mobile home park culvert and back into the channel. The 1-percent annual chance event will pass through one circular and two box culverts located at the west end of the study at 70th Street/Lake Murray Boulevard, but will overtop the channel and pond in the paved parking area servicing two commercial establishments.

Flood profiles were drawn showing computed WSELs to an accuracy of 0.5 foot for floods of selected recurrence intervals. Users should be aware that flood elevations shown on the FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data tables in the FIS report. Flood elevations shown on the FIRM are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation data presented in this FIS in conjunction with the data shown on the FIRM.

The hydraulic analysis for this study was based on unobstructed flow. The flood elevations shown on the profiles are therefore valid only if hydraulic structures remain free of accumulated debris such as uprooted trees, brushes, and trash.

Agua Hedionda Creek

For the 2002 restudy of Agua Hedionda Creek, within the City of Vista, the purpose of performing the hydraulic analysis was to determine the 10-, 2-, 1-, and 0.2-percent annual chance flood elevations and to delineate the 1- and 0.2-percent annual chance floodplain boundaries along the study reach. To achieve this objective, the USACE HEC-GeoRAS (U.S. Army Corps of Engineers, April 2000) computer program in conjunction with the HEC-RAS (U.S. Army Corps of Engineers, January 2001) program were selected to perform the analysis and the floodplain delineation.

The starting WSELs for the 10-, 2-, 1-, and 0.2-percent annual chance flood profiles used in HEC-RAS are known elevations at the downstream limit of the study. The selections of the known WSELs were based on establishing the normal depth flow regime downstream of the limit of study. A slope of 0.008, obtained from the USGS topographic maps downstream of the limit of the aerial mapping, was used.

The roughness coefficients (Manning's "n") used in the hydraulics were chosen based on field observations of the channel and floodplain areas. The USGS publication (U.S. Department of the Interior, Geological Survey, *Roughness Characteristics of Natural Channels*, 1987) was used to make initial estimates of Manning's "n" values. The final values were refined by locating all cross-sections on the aerial map, which showed the extent of the dense vegetation in the channel and in the left and right over bank areas. The range of Manning’s “n” in the channel was from 0.035 to 0.065, the range in the left overbank was from 0.035 to 0.065, and the right overbank was from 0.035 to 0.055.

Because FEMA did not publish an FIS for this reach, no comparisons of the roughness coefficients were made. During the field visits, it was noted that the channel in most of the reach was covered by very dense trees and brushes. Meanwhile, the floodplain areas were relatively clear. This explains the higher roughness coefficients selected for the channel area compared to the roughness coefficients selected for the left and right overbank areas.

Field inspections suggested that overtopping of Green Oak Road Bridge in the model would be expected. Therefore, the pressure and weir flow modeling option was selected. Because the bridge is made from a railroad boxcar with no anchors on either side, it is likely that it would be swept away when overtopped. However, the hydraulic model is based on the assumption that the bridge will stay in place during high flows. The 1-, and 0.2-percent annual chance floods, which are the primary concern in the FIS, overtop the channel banks by approximately 3 feet and 6 feet, respectively. This bridge is a “drowned” bridge, so that removing this bridge from the model would have no major impact on the WSELs.

The situation is different for Melrose Drive Bridge. The bridge there is elevated, and hydraulic modeling shows that the bridge opening has enough capacity to pass high flows without overtopping. Although overtopping the bridge was not expected to occur, as a matter of technical accuracy, the top of the parapet was modeled as a weir in the bridge model.

Because there was no existing floodway to be updated within the study reach, and the city did not request a floodway, no hydraulic analysis was made to determine the floodway boundary.

Pilgrim Creek

For the 1994 restudy of Pilgrim Creek, the water-surface profile was determined using the HEC-2 hydraulic computer model. Cross section information was taken from the Preliminary Drainage Analysis for Lusk Oceanside II, prepared by Rick Engineering Company, dated December 1989. The Manning’s “n” value used for the channel was 0.015. All other values were based on field inspection and range between 0.04 and 0.10. The starting water-surface elevation was determined using the slope-area method.

Table 9 contains a summary of Manning’s “n” values used in this countywide FIS study.

TABLE 9: MANNING'S "N" VALUES

	N-Value Ranges in Floodplain		
Stream	**Left Overbank**	**Channel**	**Right Overbank**
Agua Hedionda Creek	0.020 – 0.040	0.014 – 0.040	0.020 – 0.040
Alvarado Creek	0.035 – 0.075	0.015 – 0.065	0.035 – 0.075
Beaver Hollow Creek	--	--	--

TABLE 9: MANNING'S "N" VALUES

	N-Value Ranges in Floodplain		
Stream	**Left Overbank**	**Channel**	**Right Overbank**
Beeler Creek	0.030 – 0.060	0.041 – 0.060	0.030 – 0.060
Broadway Creek	--	--	--
Buena Creek	0.015 – 0.050	0.020 – 0.050	0.015 – 0.050
Buena Vista Creek	0.024 – 0.050	0.015 -0.045	0.024 – 0.050
Buena Vista Creek Tributary 1	0.024 – 0.050	0.015 -0.045	0.024 – 0.050
Carmel Valley Creek	0.040 – 0.100	0.040 – 0.070	0.040 – 0.100
Carroll Canyon Creek	0.037 – 0.070	0.037 – 0.070	0.037 – 0.070
Coleman Creek	--	--	--
County Ditch Creek	--	--	--
Deer Springs Creek	--	--	--
Descanso Creek	0.030 – 0.050	0.027 – 0.050	0.030 – 0.050
Encanto Branch	0.025 – 0.080	0.015 – 0.045	0.025 – 0.080
Escondido Creek	0.040 – 0.050	0.016 – 0.025	0.040 – 0.050
Eucalyptus Hills (East Branch)	--	--	--
Eucalyptus Hills (West Branch)	--	--	--
Florida Drive Branch	0.040 – 0.070	0.015 – 0.045	0.040 – 0.070
Forester Creek	0.022	0.022	0.022
Garrison Creek	0.030 – 0.050	0.018 – 0.050	0.030 – 0.050
Gopher Creek	--	--	--

-- Data Not Available

TABLE 9: MANNING'S "N" VALUES

	N-Value Ranges in Floodplain		
Stream	**Left Overbank**	**Channel**	**Right Overbank**
Green Valley Creek	0.015 – 0.050	0.015 – 0.050	0.015 – 0.050
Green Valley Creek Tributary	0.015 – 0.035	0.015 – 0.035	0.015 – 0.035
Harbison Canyon Creek	--	--	--
Hatfield Creek	0.015 – 0.065	0.015 – 0.090	0.015 – 0.065
Home Avenue Branch	0.035 – 0.065	0.013 – 0.035	0.035 – 0.065
Kit Carson Park Creek	0.020 – 0.060	0.032 – 0.070	0.020 – 0.060
Las Chollas Creek	0.030 – 0.150	0.015 – 0.045	0.030 – 0.150
Las Posas Creek Upper	--	--	--
Las Puleta Creek	0.025 – 0.070	0.013 – 0.060	0.025 – 0.070
Lawson Valley Creek	--	--	--
Loma Alta Creek	0.035 – 0.045	0.018 – 0.070	0.035 – 0.045
Los Penasquitos Creek	0.020 – 0.080	0.030 – 0.060	0.020 – 0.080
Lusardi Creek	--	--	--
Mexican Canyon Creek	0.030 – 0.050	0.025 – 0.040	0.030 – 0.050
Moosa Creek (North Branch)	--	--	--
Moosa Creek (South Branch)	--	--	--
Murphy Canyon Creek	0.030 – 0.040	0.015 – 0.035	0.030 – 0.040
Murray Canyon Creek	0.080	0.020 – 0.050	0.080
Nestor Creek	0.030 – 0.100	0.030 – 0.045	0.030 – 0.100

-- Data Not Available

TABLE 9: MANNING'S "N" VALUES

	N-Value Ranges in Floodplain		
Stream	**Left Overbank**	**Channel**	**Right Overbank**
North Branch Poway Creek	0.018 – 0.035	0.014 – 0.035	0.018 – 0.035
North Tributary to Santa Maria Creek	0.015 – 0.060	0.015 – 0.090	0.015 – 0.060
Olive Creek	--	--	--
Otay River	0.040	0.040	0.040
Pala Mesa Golf Course	--	--	--
Paradise Creek	0.018	0.016 – 0.030	0.018
Poggi Canyon Creek	0.020 – 0.040	0.013 – 0.050	0.020 – 0.040
Poway Creek	0.018 – 0.040	0.014 – 0.050	0.018 – 0.040
Rainbow Creek (Main Branch)	--	--	--
Rainbow Creek (West Branch)	--	--	--
Rattlesnake Creek	0.010 – 0.060	0.014 – 0.040	0.010 – 0.060
Rattlesnake Creek Split Flow			
At Heritage Hills	0.010 – 0.060	0.014 – 0.040	0.010 – 0.060
At Midland Road	0.010 – 0.060	0.014 – 0.040	0.010 – 0.060
Reidy Creek	0.025 – 0.060	0.014 – 0.040	0.025 – 0.060
Rice Canyon Creek	0.013	0.013	0.013
Rose Canyon Creek	0.035 – 0.040	0.040	0.035 – 0.040
Samagutuma Creek	0.030 – 0.040	0.035 – 0.040	0.030 – 0.040
San Clemente Canyon Creek	0.015 – 0.040	0.035 – 0.040	0.015 – 0.040

-- Data Not Available

TABLE 9: MANNING'S "N" VALUES

	N-Value Ranges in Floodplain		
Stream	**Left Overbank**	**Channel**	**Right Overbank**
San Diego River	0.030 – 0.125	0.025 – 0.125	0.030 – 0.125
San Dieguito River	0.030 – 0.045	0.030 – 0.035	0.030 – 0.045
San Elijo Creek	--	--	--
San Luis Rey River	0.030 – 0.125	0.025 – 0.120	0.030 – 0.125
San Marcos Creek	--	--	--
San Marcos Creek Highway 78 Split Flow	--	--	--
San Vicente Creek	0.042 – 0.050	0.045 – 0.050	0.042 – 0.050
Santa Maria Creek			
(San Pasqual Valley Area)	0.035 – 0.045	0.025 – 0.035	0.035 – 0.045
(Santa Maria Valley Area)	0.015 – 0.090	0.015 – 0.090	0.015 – 0.090
Santa Ysabel Creek	0.035 – 0.040	0.025 – 0.035	0.035 – 0.040
Slaughterhouse Creek	--	--	--
Soledad Canyon	0.035 – 0.150	0.020 – 0.070	0.035 – 0.150
South Branch Poway Creek	0.018 – 0.035	0.014 – 0.035	0.018 – 0.035
South Fork Moosa Canyon Creek	0.030 – 0.100	0.015 – 0.050	0.030 – 0.100
South Las Chollas Creek	0.025 – 0.080	0.015 – 0.045	0.025 – 0.080
South Tributary to Santa Maria Creek	0.015 – 0.060	0.015 – 0.090	0.015 – 0.060
Spring Valley Creek	--	--	--
Steele Canyon	--	--	--

-- Data Not Available

TABLE 9: MANNING'S "N" VALUES

Stream	N-Value Ranges in Floodplain		
	Left Overbank	**Channel**	**Right Overbank**
Stevenson Creek	--	--	--
Sunrise Overflow	0.025 – 0.040	0.025 – 0.040	0.025 – 0.040
Sweetwater River (Above Reservoir)	0.030 – 0.070	0.015 – 0.060	0.030 – 0.070
Sweetwater River (At National City)	0.030 – 0.060	0.025 – 0.035	0.030 – 0.060
Sweetwater River (Descanso Area)	0.030 – 0.060	0.035 – 0.055	0.030 – 0.060
Switzer Creek	0.030	0.013 – 0.030	0.030
Tecolote Creek	0.035 – 0.050	0.014 – 0.050	0.035 – 0.050
Telegraph Canyon Creek	0.015 – 0.065	0.015 – 0.045	0.015 – 0.065
Tijuana River	0.040	0.040	0.040
Tributary of South Tributary to Santa Maria Creek	0.015 – 0.060	0.015 – 0.090	0.015 – 0.060
Tributary to Sweetwater River Twin Oaks Valley Creek	--	--	--
Wabash Branch	0.065	0.013 – 0.035	0.065
Witch Creek	--	--	--

-- Data Not Available

Levee Hazard Analysis

Some flood hazard information presented in prior FIRMs and in prior FIS reports for San Diego County and its incorporated communities was based on flood protection provided by levees. Based on the information available and the mapping standards of the National Flood Insurance Program at the time that the prior FISs and FIRMs were prepared, FEMA accredited the levees as providing protection from the flood that has a 1-percent annual chance of being equaled or exceeded in any given year. For FEMA to continue to accredit the identified levees with providing protection from the base flood, the levees must meet the criteria of the Code of Federal Regulations, Title 44, Section 65.10 (44 CFR 65.10), titled "Mapping of Areas Protected by Levee Systems."

On August 22, 2005, FEMA issued *Procedure Memorandum No. 34 - Interim Guidance for Studies Including Levees*. The purpose of the memorandum was to help clarify the responsibility of community officials or other parties seeking recognition of a levee by providing information identified during a study/mapping project. Often, documentation regarding levee design, accreditation, and the impacts on flood hazard mapping is outdated or missing altogether. To remedy this, Procedure Memorandum No. 34 provides interim guidance on procedures to minimize delays in near-term studies/mapping projects, to help our mapping partners properly assess how to handle levee mapping issues.

While 44 CFR Section 65.10 documentation is being compiled, the release of more up-to-date FIRM panels for other parts of a community or county may be delayed. To minimize the impact of the levee recognition and certification process, FEMA issued *Procedure Memorandum No. 43 - Guidelines for Identifying Provisionally Accredited Levees* on March 16, 2007. These guidelines will allow issuance of preliminary and effective versions of FIRMs while the levee owners or communities are compiling the full documentation required to show compliance with 44 CFR Section 65.10. The guidelines also explain that preliminary FIRMs can be issued while providing the communities and levee owners with a specified timeframe to correct any maintenance deficiencies associated with a levee and to show compliance with 44 CFR Section 65.10.

FEMA contacted the communities within San Diego County to obtain data required under 44 CFR 65.10 to continue to show the levees as providing protection from the flood that has a 1-percent-chance of being equaled or exceeded in any given year.

FEMA understood that it may take time to acquire and/or assemble the documentation necessary to fully comply with 44 CFR 65.10. Therefore, FEMA put forth a process to provide the communities with additional time to submit all the necessary documentation. For a community to avail itself of the additional time, it had to sign an agreement with FEMA. Levees for which such agreements were signed are shown on the final effective FIRM as providing protection from the flood that has a 1-percent-chance of being equaled or exceeded in any given year and labeled as a Provisionally Accredited Levee (PAL). Communities have two years from the date of FEMA's initial coordination to submit to FEMA final accreditation data for all PALs. Following receipt of final accreditation data, FEMA will revise the FIS and FIRM as warranted.

FEMA coordinated with the U.S. Army Corps of Engineers, the local communities, and other organizations to compile a list of levees and embankments that exist within San Diego County. Table 11, "List of Levees Requiring Flood Hazard Revisions" lists all levees shown on the FIRM, to include PALs, for which corresponding flood hazard revisions were made.

Approximate analyses of “behind levee” flooding were conducted for all the levees in Table 11 to indicate the extent of the “behind levee” floodplains. The methodology used in these analyses is discussed below.

The approximate levee analysis was conducted using information from existing hydraulic models (where applicable) and USGS topographic maps.

The extent of the 1-percent-annual-chance flood in the event of levee failure was determined. Base flood elevations and topographic information (where available) were used to estimate an approximate 1-percent-annual-chance floodplain and traced along the contour line representing the base flood elevation. If base flood elevations were not available they were estimated from effective FIRM maps and available information.

Several levees within San Diego County and its incorporated communities meet the criteria of the Code of Federal Regulations, Title 44, Section 65.10 (44 CFR 65.10), titled “Mapping of Areas Protected by Levee Systems.” Table 11, “List of Certified and Accredited Levees” lists all levees shown on the FIRM that meet the requirements of 44 CFR 65.10 and have been determined to provide protection from the flood that has a 1-percent-chance of being equaled or exceeded in any given year.

The flood risk behind the two de-accredited levees can be more accurately defined following the guidance from FEMA on the new levee policy, when it is available, and any resultant SFHA changes will revise the impacted panels via a LOMR or subsequent PMR process.

TABLE 10: LIST OF LEVEES REQUIRING FLOOD HAZARD REVISIONS

Community	Flood Source	Levee Inventory ID	Coordinates Latitude/Longitude	FIRM Panel	USACE Levee
City of Oceanside[2]	San Luis Rey River	1	(-117.28, 33.26)	469	No
			(-117.27, 33.26)		
City of Poway[2]	North Branch Poway Creek	5	(-117.01, 32.96)	1359	No
			(-117.01, 32.96)		
City of San Diego	San Diego River	7	(-117.25, 32.75)	1594	No
			(-117.21, 32.76)	1613	
				1614	
City of San Diego[1]	Rose Canyon Creek	8	(-117.24, 32.85)	1601	No
			(-117.24, 32.84)	1603	
City of San Diego[1]	Rose Canyon Creek	9	(-117.23, 32.84)	1603	No
			(-117.23, 32.84)		
City of San Diego[1]	Rose Canyon Creek	10	(-117.23, 32.83)	1603	No
			(-117.23, 32.83)		
City of San Diego	San Diego River	11	(-117.16, 32.77)	1618	No
			(-117.15, 32.77)	1619	
City of San Diego	San Diego River	12	(-117.16, 32.77)	1618	No
			(-117.14, 32.77)	1619	
City of San Diego	San Diego River	13	(-117.15, 32.77)	1619	No
			(-117.14, 32.77)		
City of San Diego[2]	Arroyo Drive Tributary	16	(-117.17, 32.73)	1885	No
			(-117.17, 32.74)		
City of San Diego[1]	Las Chollas Creek	17	(-117.12, 32.71)	1903	No
			(-117.12, 32.71)		
City of San Diego[1]	Encanto Branch	20	(-117.06, 32.71)	1904	No
			(-117.06, 32.71)	1908	
San Diego County[2]	Mexican Canyon Creek	22	(-116.89, 32.74)	1932	No
			(-116.89, 32.74)		

[1] Railroad Embankment

[2] Road Embankment

TABLE 10: LIST OF LEVEES REQUIRING FLOOD HAZARD REVISIONS

Community	Flood Source	Levee Inventory ID	Coordinates Latitude/Longitude	FIRM Panel	USACE Levee
City of Chula Vista	San Diego Bay	23	(-117.10, 32.61)	2152	No
City of National City			(-117.10, 32.61)		
City of Coronado	Otay River	24	(-117.12, 32.60)	2151	No
City of San Diego			(-117.12, 32.59)	2153	
City of Chula Vista	Telegraph Canyon Creek	26	(-117.07, 32.62)	2152	No
			(-117.07, 32.62)		
City of Chula Vista	Telegraph Canyon Creek	27	(-117.07, 32.62)	2152	No
			(-117.07, 32.62)		
City of San Diego	Nestor Creek	28	(-117.10, 32.58)	2153	No
			(-117.10, 32.59)		
City of San Diego[1]	Nestor Creek	29	(-117.07, 32.57)	2154	No
			(-117.07, 32.57)		
City of San Diego	Tijuana River	30	(-117.06, 32.56)	2166	Yes
			(-117.04, 32.54)		
City of San Diego	Tijuana River	31	(-117.06, 32.54)	2166	Yes
			(-117.04, 32.54)		
City of San Diego[1]	Rose Canyon Creek	33	(-117.23, 32.85)	1601	No
			(-117.23, 32.85)		
City of San Diego[1]	Encanto Branch	34	(-117.05, 32.71)	1908	No
			(-117.05, 32.71)		
City of Chula Vista	Sweetwater River	36	(-117.11, 32.65)	1911	No
City of National City			(-117.07, 32.66)	1912	
San Diego County				1913	
				1914	
City of Carlsbad	Agua Hendionda Creek	37	(-117.30, 33.15)	768	No
	(At City of Carlsbad)		(-117.29, 33.15)		

[1] Railroad Embankment
[2] Road Embankment

TABLE 11: LIST OF CERTIFIED AND ACCREDITED LEVEES

Community	Flood Source	Levee Inventory ID	Coordinates Latitude/Longitude	FIRM Panel	USACE Levee
City of Escondido San Diego County	Escondido Creek	A1	(-117.12, 33.11) (-117.11, 33.11)	1076	No
City of Oceanside City of Carlsbad	Buena Vista Creek	A2	(-117.30, 33.18) (-117.307, 33.18)	766	No

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 to three panels: 06073C2151J, 06073C2152J, and 06073C2153J. 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)
Deer Springs Creek	+2.4
Descanso Creek	+2.4
Escanto Branch	+2.1
Escondido Creek (Above Lake Wohlford)	+2.2
Escondido Creek (At Encinitas)	+2.3
Escondido Creek (At Escondido)	+2.3
Escondido Creek (Left Reach)	+2.3
Eucalyptus Hills (East Branch)	+2.0
Eucalyptus Hills (West Branch)	+2.0
Florida Drive Branch	+2.1
Forester Creek	+2.1
Garrison Creek	+2.3
Gopher Canyon Creek	+2.3
Gonzales Canyon Creek	+2.1
Green Valley Creek	+2.2
Green Valley Creek Tributary	+2.2
Harbison Canyon Creek	+2.1
Hatfield Creek	+2.2
Home Avenue Branch	+2.1
Johnson Canyon Creek	+2.2
Keys Canyon Creek	+2.3
Keys Canyon Creek Tributary 1	+2.3
Keys Canyon Creek Tributary 2	+2.3
Kit Carson Park Creek	+2.2
Las Chollas Creek	+2.1
Las Posas Creek (Lower)	+2.3
Las Posas Creek (Upper)	+2.3
Las Puleta Creek	+2.1
Lawson Valley Creek	+2.3
Loma Alta Creek	+2.3
Los Penasquitos Creek	+2.1
Lusardi Creek	+2.2
McGonigle Canyon Creek	+2.2
McGonigle Canyon Creek Tributary A	+2.2
Mexican Canyon 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

TABLE 12: FLOODING SOURCE DATUM SHIFT VALUES

Stream Name	Elevation (feet NAVD above NGVD)
San Vicente Creek	+2.1
Santa Maria Creek (San Pasqual Valley Area)	+2.1
Santa Maria Creek (Santa Maria Valley Area)	+2.2
Santa Ysabel Creek (City of San Diego)	+2.1
Santa Ysabel Creek (County of San Diego)	+2.4
Slaughterhouse Creek	+2.1
Soledad Canyon	+2.1
South Branch Poway Creek	+2.1
South Fork Moosa Canyon Creek	+2.4
South Las Chollas Creek	+2.1
South Tributary to Santa Maria Creek	+2.1
Steele Canyon Creek	+2.2
Stevenson Creek	+2.4
Sweetwater River (Above Reservoir)	+2.2
Sweetwater River (At National City)	+2.1
Sweetwater River (Descanso Area)	+2.4
Switzer Creek	+2.1
Tecolote Creek	+2.1
Telegraph Canyon Creek	+2.2
Tijuana River	+2.2
Tributary to Forester Creek	+2.1
Tributary to Forester Creek (South Branch)	+2.1
Tributary to South Tributary to Santa Maria Creek	+2.1
Tributary to Sweetwater River	+2.1
Twin Oaks Valley Creek	+2.3
Unnamed Tributary to San Dieguito River	+2.2
Wabash Branch	+2.1
Witch Creek	+2.3

For information regarding conversion between the NGVD and NAVD, visit the National Geodetic Survey website at 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, MD 20910-3282

(301) 713-3242

Temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the Technical Support Data Notebook (TSDN) associated with the FIS report and FIRM for this community. Interested individuals may contact FEMA to access these data.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. To assist in this endeavor, each FIS provides 1-percent annual chance floodplain data, which may include a combination of the following: 10-, 2-, 1-, and 0.2-percent annual chance flood elevations; delineations of the 1-percent annual chance and 0.2-percent annual chance floodplains; and 1-percent annual chance floodway. This information is presented on the FIRM and in many components of the FIS, including Flood Profiles, Floodway Data tables, and Summary of Stillwater Elevation tables. Users should reference the data presented in the FIS as well as additional information that may be available at the local community map repository before making flood elevation and/or floodplain boundary determinations.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied by detailed methods, the 1- and 0.2-percent annual chance floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:2,400, 1:1,200, and 1:24,000, with a contour interval of 2, 5, 10, and 20 feet (San Diego County, 1962-1983, City of San Diego, 1976-1978, Harl Pugh and Associates, October 1983, U.S. Department of the Army, Corps of Engineers, 1979, San-Lo Aerial Surveys, April 1985, San Diego County, September 1975, National City, March 1973, American Aerial Surveys, 1958, 1959, U.S. Department of the Interior, 1968-1988, Abrams Aerial Surveys, Inc., October 1978, Rick Engineering Company, July 1979, Teledyne Geotronics for San Diego County, California, 1973 and 1974).

For coastal areas studied in detail, the boundaries of the 1- and 0.2-percent annual chance floods have been delineated using topographic maps at a scale of 1:2,400, 1:4,800, and 1:24,000, with a contour interval of 2, 10, and 20 feet (San Diego County, 1962-1983, U.S. Department of the Interior, 1968-1988, Abrams Aerial Surveys, Inc., October 1978, U.S. Department of Commerce, various dates).

The 1- and 0.2-percent annual chance floodplain boundaries are shown on the Flood Insurance Rate Map. On this map, the 1-percent annual chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE, All, A0, A99, V, and VE); and the 0.2-percent annual chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1- and 0.2-percent annual chance floodplain boundaries are close together, only the 1-percent annual chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

It was determined that approximately 1,350 cfs of the 0.2-percent annual chance flood along Forester Creek would be hindered from entering the channel from the south side of Interstate 8. This is due basically to the overloaded collector systems along the south side of the freeway and the high energy level of Forester Creek under 0.2-percent annual chance flows. The extent of flooding was determined by hand calculations for flow along the south side of Interstate 8.

Similarly, Forester Creek will be hindered in crossing Highway 67, causing backup and breakout of approximately 1,500 cfs to the north for the 0.2-percent annual chance flood. Determination of flood limits for this breakout flow west of the freeway is uncertain due to extensive grading since the topographic maps were prepared. Flood limits were determined by hand calculations and judgment based on field investigations.

It was also determined that approximately 700 cfs of the 1-percent annual chance and 2,200 cfs of the 0.2-percent annual chance flood along Broadway Creek overflows the north bank between Joe Crossen Drive and Bradley Avenue. This breakout flow is generally less than 1 foot deep and follows the old creek meander. Additionally, approximately 600 cfs of the 0.2-percent annual chance flood is lost over the north bank between Donald Gordon Drive and the Airfield Runway. This latter area, however, is within the backwater effects of Forester Creek.

Because of the length of over bank breakout along the north bank of Broadway Creek, determinations of the shallow flooding limits are uncertain. Hand calculations were used to approximate the area inundated.

Recent channelization of Washington Creek has confined the 1-percent annual chance flows to the channel. Determination of the 0.2-percent annual chance flood limits for this area was accomplished using hand calculations.

Approximate flood boundaries were delineated using topographic maps at a scale of 1:2,400, with a contour interval of 5 feet (San Diego County, 1962-1983, City of San Diego, 1976-1978). Approximate flood boundaries on Murphy Canyon Creek were delineated using the Basic Design Plan for Interstate Highway 15, at a scale of 1:2,400, with a contour interval of 2 feet (State of California, May 1971), and map manuscripts at a scale of 1:1,200, with a contour interval of 2 feet (U.S. Department of the Army, December 1970).

The west side of the Borrego Valley is an area of many coalescent alluvial fans. Approximate flood boundaries in this area were refined with the HEC-2 computer program and delineated using topographic maps at a scale of 1:2,400 and a contour interval of 5 feet (San Diego County, 1962-1983, City of San Diego, 1976-1978).

Approximate floodplain boundaries for Los Penasquitos Creek were delineated on the previously cited 1:2,400 scale orthophoto topographic maps (Teledyne Geotronics for San Diego County, 1973).

Floodplain boundaries on Murphy Canyon Creek were delineated using USGS 7.5-Minute Series Topographic Maps (U.S. Department of the Interior, 1967-1988). Floodplain boundaries on the Tijuana River were delineated using USGS 7.5-Minute Series Topographic Maps (U.S. Department of the Interior, 1967-1988) and Grading Plans for Dairy Mart International (Carles W. Christensen and Associates, March 1983).

The approximate 1-percent annual chance floodplain boundaries along a reach of Chicarita Creek above Highway 56 (North City Parkway) were revised based on hydrologic and hydraulic analyses prepared by the Mclntire Group in January 1988. Topographic maps prepared by the Mclntire Group at a scale of 1:1,200 were utilized to redelineate the floodplain boundaries for this reach of Chicarita Creek.

Approximate floodplain boundaries in some portions of the study area were delineated using topographic maps at a scale of 1:2,400, with a contour interval of 5 feet (San Diego County, 1962-1983, City of San Diego, 1976-1978).

Approximate floodplain boundaries in some portions of the study area were taken from Flood Hazard Boundary Maps (U.S. Department of Housing and Urban Development, February 1978, April 1978, Federal Emergency Management Agency, October 1981, November 1982, 1982) and USGS Flood Prone Area Maps at a scale of 1:24,000, with a contour interval of 20 feet (U.S. Department of the Interior, 1960-1971).

For the streams studied by approximate methods, only the 1-percent annual chance floodplain boundary is shown on the Flood Insurance Rate Map.

For the 1989 restudy of Nestor Creek, the 1-percent annual chance floodplain and floodway boundaries were delineated on topographic maps at scales of 1:2,400 and 1:1,200, with a contour interval of 5 feet (San Diego County, 1962-1983 and U.S. Department of the Army, Corps of Engineers, 1987)

For the 1994 restudy of Pilgrim Creek, the the 1-percent annual chance floodplain boundaries were delineated using topographic maps provided by the City of Oceanside (Topographic Mapping, 1990). The floodway was determined based on equal conveyance reduction. No floodway was determined through the golf course. Encroachment in this area will result in an increase in downstream flood hazard.

For the 1996 restudy of Alvarado Creek, flood boundaries were delineated using topographic maps at a scale of 1:2,400, with a contour interval of 1 foot, provided by the City of San Diego (City of San Diego, 1992).

4.2 Floodway

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 1- percent annual chance floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 1- percent annual chance flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (Table 12). In cases where the floodway and 1- percent annual chance floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

The floodways presented in this report were developed through a series of procedural steps that included:

1. Evaluation of equal-conveyance reduction from each side of the floodplain

2. Negotiation and coordination with local and regional agencies

3. Comparison of 1- percent annual chance discharges with design discharges for existing and proposed structural improvements

For all streams studied by detailed methods, the computation of floodways by equal conveyance from each side of the floodplain was used, except as noted in the following discussion:

For those areas where the 1- percent annual chance floodplain was confined by a well-defined natural channel, no encroachment was computed due to resulting hazardous velocities. In lined channel reaches with approximately 1- percent annual chance design capacity, the channel banks were adopted as the floodway.

The lined channel widths adopted as the floodway vary according to the channel on which they are calculated.

In the 1980 flood on the Tijuana River, several bridges washed out and the alignment of the low river flow channel downstream of the Hollister Street Bridge shifted. The topography was also changed by deposition of riverbed material. As a result, the river was restudied and a new floodway established. Because topographic changes are likely to continue, the new floodway is a composite of the floodway previously established and the requirements of the new alignment, whichever is wider.

Due to the substantial spill flow from Santa Ysabel Creek to Santa Maria Creek at Monument Road, a common floodway has been established for a distance of 1,370 feet. A common floodway allows the spill to continue by eliminating encroachment where it occurs. Encroaching Santa Ysabel Creek at this point and stopping the spill would cause elevation increases beyond the surcharge limits.

It was determined that the floodways for Rose Canyon Creek and Tecolote Creek upstream of Cross Street are contained in their respective channels; therefore, no floodway data are presented.

A floodway was not computed for Nestor Creek upstream of bluster
Street due to extensive existing development within the floodplain.
A floodway is inapplicable in the Sunrise Overflow area due to the type of flooding that exists.

A floodway was not computed for Las Puleta Creek due to excessive ponding created by road embankments.

A floodway was not computed for Murray Canyon Creek and Tecolote Creek downstream of Cross Street due to excessive over bank losses.

A floodway was not delineated for San Clemente Canyon Creek due to resulting hazardous high flow velocities in the channel.

For reaches where long, underground conduits were encountered, a floodway is not applicable and was, therefore, not computed. This situation occurs on Home Avenue Branch and Murphy Canyon Creek.

The existing high velocities in Poggi Canyon Creek and Sweetwater River result in a large area that must be kept free of encroachment. Therefore, increases in flood heights are below the 1.0 foot-allowable rise.

Along Sweetwater River, between the San Diego and Arizona Eastern Railroad on the upstream side of Interstate Highway 5 and Broadway, a floodway was not delineated because of ponding created by road embankments. A floodway analysis was not performed on Telegraph Canyon Creek Overflow because of shallow flooding areas.

On Paradise Creek, upstream of Palm Avenue, where the floodplain is fully developed, the floodway was delineated in consultation with the City of National City. Along Paradise Creek, between the confluence with the Sweetwater River and D Avenue, a floodway was not delineated because overflow from the Sweetwater River would cause ponding in this area.

A floodway was not computed for Las Puleta Creek due to excessive ponding created by road embankment s.

At the upstream end of Poway Creek at Park Poway Unit 2, Poway Oaks Unit 1, and Garden City Unit 2 Subdivisions, it was found that, in addition to -the low flow channel, several streets serve as effective flow areas. Consequently, separate floodways were calculated on the basis of equal-conveyance reduction from each side of the effective flow areas.

A floodway was determined for Lower. Las Posas Creek without consideration of the backwater effects from San Marcos Creek. A floodway was not determined f or Las Posas Creek from Grand Avenue to Mission Road.

The concept of a floodway is not applicable in areas of shallow flooding; therefore, no floodways were developed for Buena Vista Creek Tributaries 2, 3, and 4 and the downstream portion of Buena Vista Creek Tributary 1.

Floodway analysis was performed for the reach of Pomerado Creek between Oak Knoll Road and Poway Road, and the reach upstream of Pomerado Road. Floodway limits were not determined downstream of Oak Knool Road because overbank flows area diverted by Oak Knoll Road away from Pomerado Creek to Poway Creek and cannot be contained within Pomerado Creek floodway without exceeding the maximum permissible water-surface elevation increase of one foot.

Also, floodway limits were not determined immediately downstream of Pomerado Road because overflows cannot be contained without causing an upstream water-surface rise greater than one foot.

For the 1996 revision of Alvarado Creek, a floodway was not delineated as part of the Alvarado Creek restudy because they were not included in the scope of the restudy. Some of the data used in the restudy were taken from Flood Insurance Studies for San Diego County, California, dated

August 1989, and the City of San Diego, California, dated May 1993 (Federal Emergency Management Agency, August 1989, and May 1993).

The area between the floodway and the boundary of the 1-percent annual chance floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 1-percent annual chance flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 1.

Encroachment into areas subject to inundation by floodwater having hazardous velocities aggravates the risk of flood damage, and heightens potential flood hazards by further increasing velocities. A listing of stream velocities at selected cross sections is provided in Table 13, "Floodway Data." In order to reduce the risk of property damage in areas where the stream velocities are high, the community may wish to restrict development in areas outside floodway.

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, "Without Floodway" elevations presented in Table13, for certain downstream cross sections of Descanso Creek, Eucalyptus Hills Creek (West Branch), Nestor Creek, Olive Creek, San Elijo Creek, and Santa Ysabel Creek,

Rice Canyon Creek, and South Branch Poway Creek are lower than the regulatory flood elevations in that area, which must take into account the 1-percent annual chance flooding due to backwater from other sources.

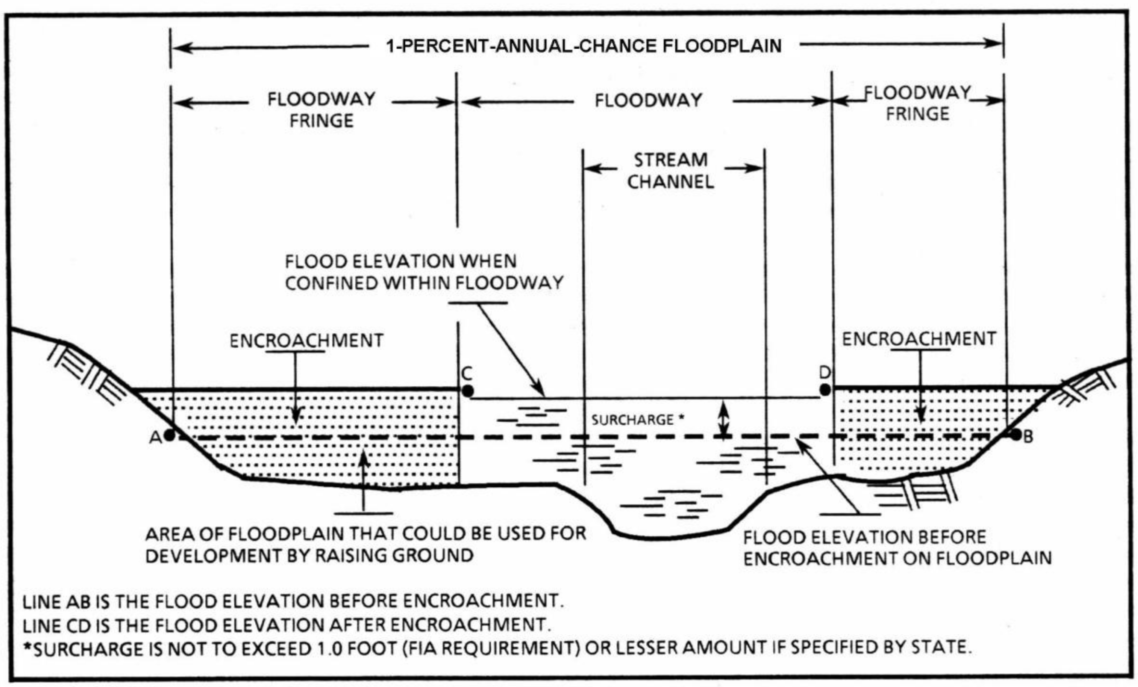

FIGURE 1: FLOODWAY SCHEMATIC

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 1-percent annual chance floodplain that is determined in the FIS report by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no BFEs or base flood depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 1-percent annual chance floodplain that is determined in the FIS report by detailed methods. Whole-foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to areas of 1-percent annual chance shallow flooding (usually areas of ponding) where average depths are between 1 foot and 3 feet. Whole-foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance risk zone that corresponds to the areas of 1-percent annual chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average Whole-foot base flood depths derived from the detailed hydraulic analyses are within this zone.

Zone A99

Zone A99 is the flood insurance risk zone that corresponds to areas of the 1-percent annual chance floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No BFEs of depths are shown within this zone.

Zone VE

Zone VE is the flood insurance risk zone that corresponds to the 1-percent annual chance coastal floodplains that have additional hazards associated with storm waves. Whole-foot-BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 0.2-percent annual chance floodplain, areas within the 0.2-percent annual chance floodplain, areas of 1-percent annual chance flooding where average depths are less than 1 foot, areas of 1-percent annual chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent annual chance flood by levees. No BFEs or base flood depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The FIRM is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 1-percent annual chance floodplains that were studied by detailed methods, shows selected whole-foot BFEs or average depths. Insurance agents use the zones and BFEs in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols the 1- and 0.2-percent annual chance floodplains, floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

The current FIRM presents flooding information for the entire geographic area of San Diego County. Previously, FIRM panels were prepared for each incorporated community and the unincorporated areas of the county identified as flood-prone. The countywide FIRM also includes flood hazard information that was presented separately on Flood Boundary and Floodway Maps (FBFM panels), where applicable. Historical data relating to the maps prepared for each community are presented in Table 14, "Community Map History."

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE(S)	FLOOD INSURANCE RATE MAP EFFECTIVE DATE	FLOOD INSURANCE RATE MAP REVISION DATE(S)
San Diego County (Unincorporated Areas)	July 19, 1977	October 20, 1981	June 15, 1984	August 3, 1989
Carlsbad, City of	May 31, 1974	None	May 31, 1974	June 14, 1977 August 15, 1983
Chula Vista, City of	April 8, 1977	March 14, 1978	August 15, 1983	August 5, 1986 April 5, 1988
Coronado, City of	September 10, 1976	None	July 15, 1988	April 15, 1986

TABLE 14

FEDERAL EMERGENCY MANAGEMENT AGENCY

SAN DIEGO COUNTY, CA

AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE(S)	FLOOD INSURANCE RATE MAP EFFECTIVE DATE	FLOOD INSURANCE RATE MAP REVISION DATE(S)
Del Mar, City of	February 22, 1974	October 17, 1975	August 15, 1983	April 15, 1986
El Cajon, City of	March 8, 1974	June 25, 1976	September 15, 1977	January 19, 1982
Encinitas, City of	July 15, 1988	None	July 15, 1988	None
Escondido, City of	October 26, 1973	None	September 15, 1983	June 17, 1986 July 4, 1988
Imperial Beach, City of	April 5, 1974	None	June 1, 1978	September 30, 1983 September 30, 1987
La Mesa, City of	March 14, 1978	None	March 14, 1978	None

TABLE 14

FEDERAL EMERGENCY MANAGEMENT AGENCY

SAN DIEGO COUNTY, CA

AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE(S)	FLOOD INSURANCE RATE MAP EFFECTIVE DATE	FLOOD INSURANCE RATE MAP REVISION DATE(S)
Lemon Grove, City of	March 16, 1988	None	March 16, 1988	None
National City, City of	March 22, 1974	July 18, 1975	February 15, 1979	February 1, 1983 December 18, 1984 August 4, 1988
Oceanside, City of	May 10, 1974	October 29, 1976	September 5, 1984	June 18, 1987
Poway, City of	November 30, 1982	None	August 19, 1985	None

TABLE 14

FEDERAL EMERGENCY MANAGEMENT AGENCY

SAN DIEGO COUNTY, CA

AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISION DATE(S)	FLOOD INSURANCE RATE MAP EFFECTIVE DATE	FLOOD INSURANCE RATE MAP REVISION DATE(S)
San Diego, City of	February 28, 1978	None	August 15, 1983	May 17, 1993 September 29, 1989 September 27, 1991
San Marcos, City of	May 24, 1974	December 13, 1974, April 23, 1976	August 1, 1978	July 15, 1988 September 2, 1993
Santee, City of	September 7, 1982	None	September 28, 1984	None
Solana Beach, City of	June 3, 1988	None	June 3, 1988	None
Vista, City of	June 14, 1974	April 1, 1977	August 15, 1983	June 17, 1986

TABLE 14

FEDERAL EMERGENCY MANAGEMENT AGENCY

SAN DIEGO COUNTY, CA

AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

7.0 OTHER STUDIES

Information pertaining to revised and unrevised flood hazards for each jurisdiction within San Diego County has been compiled into this FIS. Therefore, this FIS supersedes all previously printed FIS Reports, FBFM panels, and FIRM panels for all of the incorporated and unincorporated jurisdictions within San Diego County.

This report either supersedes or is compatible with all previous studies published on streams studied in this report and should be considered authoritative for the purposes of the NFIP.

This study revises and updates the previous FIS for the unincorporated areas of San Diego County and incorporated communities within San Diego County (Federal Emergency Management Agency, 1983, Revised August 1989, September 1987, Revised April 1988, Revised July 1988, Revised April 1986, July 1988, Revised July 1988, Revised January 1982, September 1987, March 1988, Revised August 1988, June 1987, April, 1985, Revised September 1993, Revised May 1993, March 1984, June 1988, Revised 1986).

The USACE has performed a hydrologic study for Las Chollas Creek, South Las Chollas Creek, Switzer Creek, and Paradise Creek, in which estimates of the 1 -percent annual chance flood is provided (U.S. Department of the Army, Corps of Engineers, September 1972). Differences in the 1-percent annual chance flood peak discharges exist between the USACE report and the hydrology contained in this study. These differences can be attributed to the different methodologies used to develop the discharges, but the differences in overflow boundaries on the floodplain are negligible. The USACE hydrology was used for floodplain computations on Las Chollas Creek between the downstream corporate limits of the City of San Diego and Federal Boulevard.

A hydrologic study of Forester Creek within the City of Santee (Earth Tech, October 1999) was used as a source of 1-percent annual chance peak flow information for floodplain computation along Forester Creek.

A Flood Plain Information report (U.S. Department of the Army, April 1973) was prepared for the Las Chollas Creek drainage basin by the USACE, Los Angeles District, in April 1973. The 1-percent annual chance and Standard Project Flood boundaries are delineated for portions of Las Chollas and South Las Chollas Creeks in that report. These flood boundaries match those shown in this study quite closely, with minor discrepancies occurring due to recent development and channel improvements.

Peak discharges for the 1-percent annual chance for Los Penasquitos Creek upstream of the confluence with Chicarita Creek are in agreement with values determined by San Diego County (San Diego County, 1977).

A Floodway Information Study for Otay River (U.S. Department of the Army, December 1974) and a Flood Hazard Information Report for Rose and San Clemente Canyon Creeks (U.S. Department of the Army, July 1970) were published in 1974 and 1970, respectively. These reports are in general agreement with this Flood Insurance Study.

Hydrology reports for various streams in San Diego (Federal Emergency Management Agency, July 1984, U.S. Department of the Army, Corps of Engineers, January 1973, June 1973, July 1975, January 1976, 1972, April 1973) are in general agreement with this Flood Insurance Study.

A report on flood control for the Tijuana River was prepared by the USACE (U.S. Department of the Army, Corps of Engineers, 1964). This was updated by a later report on flooding problems along the Tijuana River by the USACE, at the request of the IBWC, United States Section, in 1974 (U.S. Department of the Army, Corps of Engineers, October 1974).

U.S. Public Law 89-640, October 10, 1966, authorized the IBWC to conclude an agreement with the government of Mexico for an international flood-control project on the Tijuana River. The IBWC henceforth requested that the USACE, Los Angeles District, conduct engineering, economic, and environmental studies for the flood-control project. A draft environmental statement was Bent out for formal coordination with Federal and State agencies and local groups on April 12, 1971 (U.S. Department of the Army, Corps of Engineers, April 1971). As a result of various beneficial and adverse comments to the originally proposed border-to-ocean concrete flood-control channel, the San Diego City Council, on December 21, 1971, suspended support of the channel project. The City of San Diego shortly thereafter requested that IBWC and USACE study various flood-control alternatives. Analyses were made of six alternatives, with one recommended plan emerging as economically, environmentally, and structurally superior to the others. The latest proposed plan (now built) for flood control On the Tijuana River was a concrete energy dissipater, with levees to slow the incoming floodwaters from Mexico as they enter the United States (U.S. Department of the Army, Corps of Engineers, May 1986). The original border-to-ocean concrete channel would have virtually eliminated the riverine flooding threat to the City of Imperial Beach, but the now-built improvement noted above will offer no flood protection to the city.

The USACE also completed a floodway information study on the Otay River in December 1974 (U.S. Department of the Army, Corps of Engineers, December 1974). The USACE study presents the downstream limit of study of the 1-percent annual chance flood as terminating within a salt evaporation pond, immediately upstream of the city's northern corporate limits. Therefore, the data presented in the USACE study do not affect Imperial Beach.

The Department of Water Resources of the State of California (State of California, Resources Agency, September 1964) and the Department of Sanitation and Flood Control of San Diego County (San Diego County, California, March 1973) have estimated the 1-percent annual chance flood for the Sweetwater River. Differences in 1 -percent annual chance flood peak discharges exist between the State, the county, and USACE. The differences can be attributed to the different methodologies used by the agencies, but the differences in overflow boundaries on the floodplain are negligible.

Discharge information for Telegraph Canyon Creek was taken from a report prepared by the USACE in 1976 (U.S. Department of the Army, Corps of Engineers, January 1976). The information in this FIS is in general agreement with the 1976 report. The 1-percent annual chance discharge information for Otay River was taken from a USACE report prepared in 1974 (San Diego Union, various dates). The information in this FIS is in general agreement with the 1974 report.

The San Diego County Flood Plain Maps (San Diego County, Flood Plan Maps, 1976-1978) for Poggi Canyon Creek are based on future hydrologic conditions that result in higher flow rates than existing hydrologic conditions. Since this study is based on existing conditions, flood elevations in this FIS for Poggi Canyon Creek are lower than the elevations shown on the San Diego County Flood Plain Maps.

The County of San Diego has floodplain and floodway maps for San Dieguito River. Their analyses were based on a fluvial (movable bed) model with significant scouring at bridge. The flow rate used by the county is 46,000 cfs at the river mouth and 50,000 cfs upstream. These flow rates were higher than those used in this FIS.

The fluvial model does not show the same cross sections as the fixed-bed model; therefore, the water-surface elevations are different, especially at the bridge crossings.

In 1968, a report on drainage in the City of El Cajon (Currie Engineering Company, 1968) was adopted by the city and has been used as the basis for stream improvements within the City. The 1 -percent annual chance discharges from that report range from 4 percent to 42 percent higher than those in the present report. The disagreement is due to consideration of ultimate land development and the use of the rational equation to compute the discharges in the 1968 report.

A report for flood-control improvements (Flood Control Division, County of San Diego, 1969) published in 1969, has 2-percent annual chance discharges ranging from 102 percent to 216 percent greater than those in the present report and 1-percent annual chance discharges ranging from 71 percent to 194 percent greater than those in the present report for portions of Forester Creek and Broadway Creek. The 1969 report considered ultimate basin development and used a different methodology in computing the discharges, and is considered to be more accurate than the 1968 report.

The discharges used for Escondido and Reidy Creeks in this FIS were taken from three hydrology reports published in 1971 and 1973 (U.S. Department of the Army, Corps of Engineers, Los Angeles District, January 1973, June 1973, November 1971).

The previous FIS performed in 1981 on the San Luis Rey River was not accepted by FEMA; however, this study generally matches the results of the previous study. Some exceptions to the above occur upstream of the Monastery Bridge, upstream of the north Foussat Road Bridge, upstream of the Douglas Drive Bridge, and upstream of Loretta Street. At the time the previous study was prepared, the Monastery Bridge and the North Foussat Road Bridge were not completed. The northern bank upstream of the Douglas Drive Bridge had been improved to contain the 1-percent annual chance flood since the last study. Finally, the previous study accounted for the backwater created by Loretta Street. At the time that this study was begun, the Loretta Street crossing had been washed out; therefore, no backwater due to Loretta Street was considered.

Other reports that were utilized in the preparation of this study include: *Hydrology for Flood Insurance Studies, Soledad Canyon and Tributaries, San Diego County, California* (U.S. Department of the Army, Corps of Engineers, April 1976), and Comprehensive Plan for Flood Control and Drainage. Zone 1, San Diego County Flood Control District, (Koebig, Inc., July 1976).

A Flood Plain Information report (U.S. Department of the Army, Corps of Engineers, April 1971) for the San Marcos Creek in the vicinity of San Marcos, California, was prepared by the USACE in April 1971.. The results presented in the report are not in complete agreement with this FIS, however, this study is based on updated information.

A Flood Plain Information report on Buena Vista Creek (U.S. Department of the Army, Corps of Engineers, July 1973) and a hydrology report for Buena Vista Creek (San Diego County, Department of Sanitation and Flood Control, 1976) were published in 1973 and 1976, respectively. The 10- and 1-percent annual chance discharges used for Buena Vista Creek in this FIS were taken from the 1976 hydrology report. These discharges, along with the 2 - and 0.2-percent annual chance discharges, are based on the 1973 Flood Plain Information report.

A Flood Plain Information report on Buena Vista and Agua Hedionda Creeks (U.S. Department of the Army, Corps of Engineers, 1972) and a hydrology report for Agua Hedionda Creek (San Diego County, Department of Sanitation and Flood Control, 1976) were published in 1972 and 1976, respectively. The 10- and 1-percent annual chance discharges used for Agua Hedionda Creek and Buena Creek in this FIS were taken from the 1976 hydrology report. The 2 - and 0.2-percent annual chance discharges were taken from the 1972 Flood Plain Information report.

Hydrologic calculations were performed for the Upper Reaches of Buena Vista Creek from State Highway 78 to Arcadia Avenue, since no hydrology information existed. These calculations are not in total agreement with the 1973 Flood Plain Information Report on Buena Vista Creek (U.S. Department of the Army, Corps of Engineers, July 1973), the 1976 Hydrology Report on Buena Vista Creek (San Diego County, Department of Sanitation and Flood Control, 1976), or the 1983 -FIS. The hydrology information in the above reports uses a single drainage basin with its point of concentration located approximately 10,000 feet downstream of State Highway 78. This basin provides larger flows than what would typically be seen upstream of the highway, since there is no reduction of tributary area. Thus, the hydrologic calculations, for this study, were based on smaller local drainage basins upstream of the highway to determine the approximate flows.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting FEMA, Region IX, Federal Insurance and Mitigation Administration, 1111 Broadway, Suite 1200, Oakland, California 94607-4052.

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