REDLANDS
PASSENGER RAIL PROJECT
Existing Drainage Conditions Memo
San Bernardino & Redlands, San Bernardino County, California

DRAFT

July 2013

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1.0 DRAINAGE SYSTEM

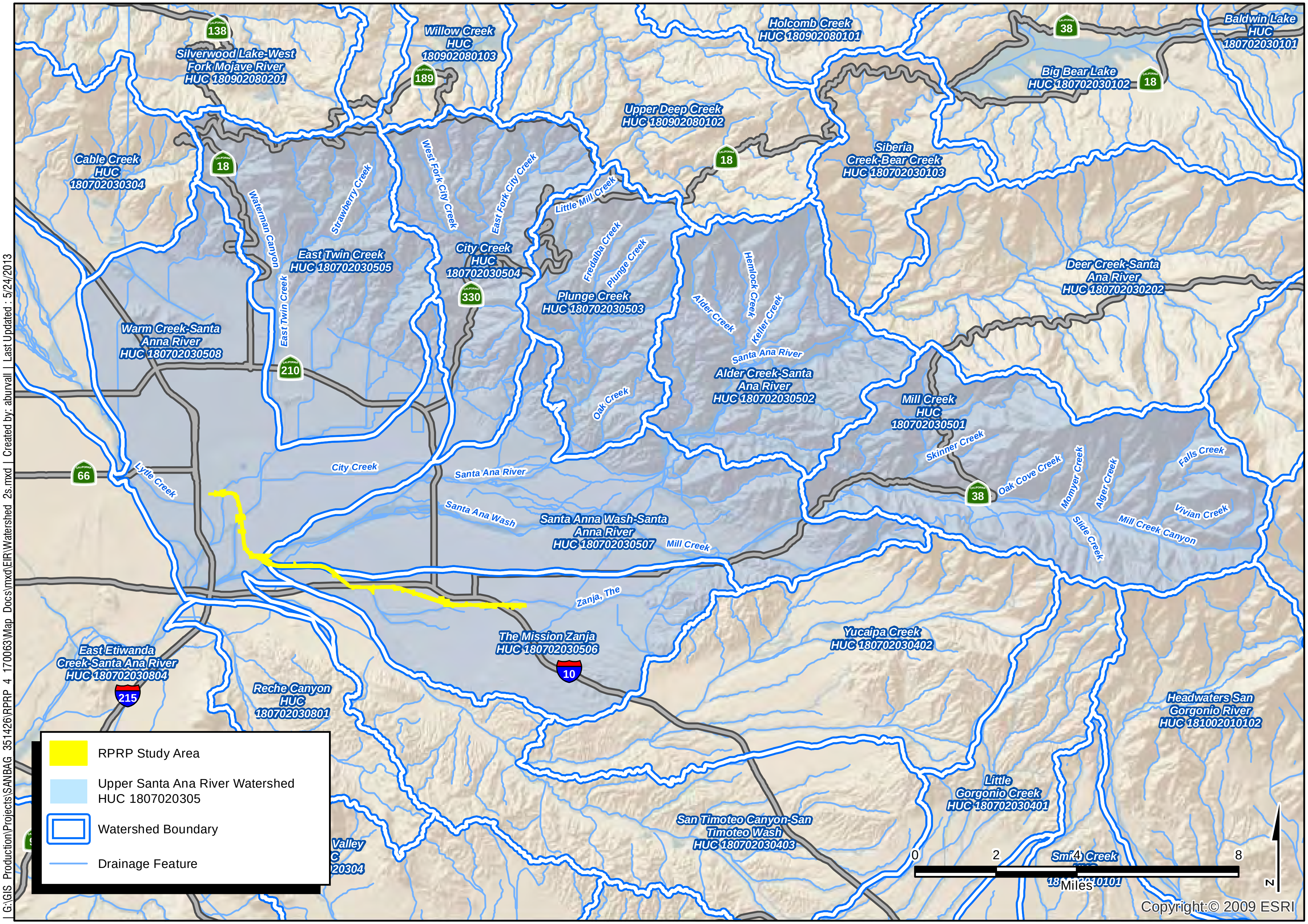
Drainage refers to surface water systems that convey stormwater runoff, including watersheds, floodplains, channels, and rivers. This section identifies the drainage setting and sets the tone for the subsequent discussion on the existing and proposed drainage facilities. See Figure 1.

1.1 WATERSHED BACKGROUND

Watersheds refer to areas of land, or basin, in which all waterways drain to one specific outlet, or body of water, such as a river, lake, ocean, or wetland. Watersheds have topographical divisions such as ridges, hills or mountains. All precipitation that falls within a given watershed, or basin, eventually drains into the same body of water.

The Santa Ana Watershed includes much of Orange County, the northwestern corner of Riverside County, the southwestern corner of San Bernardino County, and a small portion of Los Angeles County, draining a total of 2,650 square miles. The Study Area is located within the Upper Santa River Watershed, which is hydraulically disconnected from the lower watershed by San Prado Dam. The Study Area corresponds with the Santa Ana River Wash (HUC 18070203507), Mission Zanja (HUC 180702030506), and the Warm Creek (HUC 180702030508 sub-watershed units. The watershed is bounded on the south by the San Jacinto Watershed, on the east by the Salton Sea and Southern Mojave Watersheds, and on the north and west by the Mojave and San Gabriel Watersheds. The highest elevations in the Watershed occur in the San Bernardino Mountains at San Gorgonio Peak at 11,485 feet and the eastern San Gabriel Mountains at Mt. Baldy at 10,080 feet. The mainstem of the Santa Ana Watershed is the Santa Ana River (SAR) which is about 96 miles long. The headwaters of the SAR are in the San Bernardino Mountains with two of its major tributaries, Bear Creek and Mill Creek. Other tributaries include Lytle Creek originating in the San Gabriel Mountains and the San Jacinto River originating in the San Jacinto Mountains. These major tributaries confluence to form the SAR in the San Bernardino Valley located at the southern base of the Transverse Ranges of the San Bernardino Mountains. Surface waters start in this mountainous zone and flow northeast to southwest. The SAR traverses through the San Bernardino Valley before cutting through the Santa Ana Mountains and flowing to the Coastal Plain in Orange County. Eventually the river discharges to the Pacific Ocean in the City of Huntington Beach. Santa Ana Watershed is home to the most developed portion of Orange County and much of the built-up portions of Riverside and San Bernardino Counties.

The Project is located in the Santa Ana Watershed and is divided by the SAR, the mainstem, at approximate Mile Post (MP) 3.4. This corresponds to SAR River Mile 28.62 (approximate) and is part of System No. 2-701-1A (SBCFCD System Index, January 2010). Specifically located within the Upper Santa Ana Watershed, the SAR divides the project into the north/west segment (3.4 miles, 34 %) and the south/east segment (6.6 miles, 66 %), with each side draining tributary onsite and offsite areas into the SAR either by surface flow, local drainage facilities, or major stormwater conveyance systems. The project is tributary to Reach 4 (downstream - minority) and Reach 5 (upstream - majority) of the SAR.



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Upper Santa Ana River Watersheds and Regional Hydrology

Figure 3-1

FTA/SANBAG | Redlands Passenger Rail Project | EIS/EIR

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San Bernardino County Flood Control District (SBCFCD), as established by the San Bernardino Flood Control Act of 1939, manages the major stormwater conveyance systems within San Bernardino County. The SBCFCD is subdivided into six flood control zones with interests, responsibilities or geographical divisions distinctive of the particular zone. Consequently, the project is located in Flood Control Zone 2 (318 square miles) and 3 (366 square miles) with the boundary between these zones lying along the SAR. Zones 2 and 3 lie west and east of the SAR and correspond to the north/west and south/east segment of the project, respectively. From this point forward in the document, the north/west and the south/east segment of the tributary drainage of the project will be referred to as the Zone 2 Drainage Area (Z2DA) and Zone 3 Drainage Area (Z3DA), respectively. Within the project, the major stormwater conveyance systems that cross or are adjacent to the project are Warm Creek (Historic), Twin Creek, SAR, Mission Zanja Creek, and Mill Creek Zanja (see Section 1.5 for more information). The Z2DA and the Z3DA are part of the Warm Creek/Twin Creek and Zanja basins, respectively. Portions of City of San Bernardino and City of Redlands are located in both zones. Beside SBCFCD, related drainage infrastructure tributary to the project is also under the jurisdiction of City of San Bernardino, City of Redlands, Caltrans and U.S. Army Corps of Engineers (USACE).

Within the Z2DA, the project is tributary to the Warm Creek and Twin Creek watershed (15.7 square miles) via two main channel facilities. First, the westerly drainage area flows to Warm Creek (Historic) [part of Subarea J which is part of the below report] and outlets to Warm Creek via the Warm Creek Bypass Channel. This part of Z2DA is tributary to Reach 4 of the SAR. Second, the easterly drainage area flows to the East Twin Creek and Warm Creek Channel (also known as Twin Creek Channel) [part of Subarea M which is part of the below report] and outlets to Reach 5 of the SAR. The small remainder of the Z2DA south of the above drainage area surface flows directly to Reach 5 of the SAR. The Z2DA lies entirely within the City of San Bernardino (USACE, Review Report, Lytle and Warm Creek). Refer to Appendix E.

Similarly, the drainage from the Z3DA is part of the Mission Zanja drainage basin. Located along the southern boundaries of San Bernardino County, the Mission Zanja drainage basin comprises approximately 26 square miles, as shown in Appendix E. Shaped like a half circle, the basin starts at the Zanja Peak in the Crafton Hills area and extends westward for about 12 miles until it confluences with Reach 5 of the SAR. In the north-south direction, the basin generally lies between State Route 38 and the San Bernardino/Riverside County line. The mainstem of the Mission Zanja drainage basin is the Zanja Creek which is the principal flood control facility for the City of Redlands. In various historical and technical documents, the Zanja Creek is also referred to as Mission Zanja Creek, Mission Channel, Mill Creek Zanja, and the Zanja. The Zanja Creek crosses the County of San Bernardino, City of Redlands, and City of San Bernardino.

The Zanja Creek used to convey excess flows from Mill Creek (a main tributary to the SAR), but now only conveys flows from within its drainage basin due to an existing levee constructed along Mill Creek at the SAR designed to prevent flood flows from entering the Mission Zanja drainage basin (no further consideration is given in this report to Mill Creek flows). The corresponding watershed originates in Crafton Hills east of Redlands and flows westerly through the City of Yucaipa, County of San Bernardino, City of Redlands (majority) and City of San Bernardino until it flows into the SAR (14 miles). It consists of three segments. The Creek is a partially improved open channel from the SAR to 1st Street (City of Redlands) and is referred to as the Mission Zanja Channel. The Creek continues upstream under downtown Redlands from 1st Street to 9th Street (City of Redlands) as the Mission Storm Drain. Finally, the Mill Creek Zanja is the upstream segment of the Creek system and extends from 9th Street to the Mill Creek confluence at the upstream (east) end (San Bernardino County). According to railroad documentation, Mill Creek Zanja is also referred to as Sylvan Creek.

1.2 MASTER PLAN OF DRAINAGE

Throughout SBCFCD, a number of Master Plans of Drainage (MPD) and Comprehensive Storm Drain Plans (CSDP) have been developed. These documents are prepared by SBCFCD, their consultants or the Cities. The purpose of these documents is as follows:

- A coordinated plan of flood control improvements for an area based on its future planned development;
- Identifies existing flood control facilities which are inadequate to convey the 100 year peak storm flows, existing facilities needing improvements and new facilities that need to be constructed;
- Provides construction priorities for facilities based on need and preliminary planning cost estimates.

As described above, the Project is included within CSDP No. 7 and 4, both documents of which cover Z2DA and Z3DA, respectively. As documents that address the future master drainage lines for the City of San Bernardino and City of Redlands, the Cities do not prepare their own Master Drainage Plan (MPD) but instead contract with the SBCFCD to prepare the related document on their behalf. CSDP No. 7 covers most of the City of San Bernardino and CSDP No. 4 covers the majority of City of Redlands.

CSDP No. 7 identifies the existing and proposed storm drain systems within Zone 2 of San Bernardino County and includes most of the City of San Bernardino (Z2DA). It should be recognized that this CSDP does not reflect the methodology in the current San Bernardino County Hydrology Manual (1986), and hence is overdue for an update. Z2DA is included as part of Area A which is tributary to Warm Creek (Historic) and as part of Area C which is tributary to Twin Creek Channel (CSDP No. 7, 1982).

CSDP No. 4 was prepared in May 1975 by Omer H. Brodie and Associates, for SBCFCD, to conceive a comprehensive system of storm drains within Zone 3 of San Bernardino County and covers the City of Redlands (as well as Z3DA). The plan presents preliminary hydrology, mainline storm drain sizes and alignments, and construction cost estimates. As of 1987, proposed storm drain projects not yet constructed have been identified (CSDP No. 4, May 1975, Figure 4-2). It should be noted that the updated methodology in hydrologic modeling techniques and data, as presented in the San Bernardino County Hydrology Manual (1986), would generate runoff flows that are approximately 25 to 50 percent higher than those generated in this 1975 study (Mission Zanja Creek Channel Improvement Study). Hence, this is one reason necessitates an update of this document and was not available from the City of Redlands or SBCFCD. However, the updated informal CSDP No. 4 was made available from SBCFCD. It is pending approval from City of Redlands and SBCFCD and only includes raw data, calculations and node exhibits, and does not include a narrative (CSDP No. 4, Pending Approval, January 22, 2010).

1.3 HYDROLOGIC SETTING

This Subsection sets the hydrologic setting such as climate, rainfall, topography, soil data, and vegetation.

1.3.1 Climate

The SAR Watershed has a Mediterranean climate with hot, dry summers and cooler wet and sometimes snowy winters. Rainfall ranges from 12 inches per year in the coastal plain, to 18 inches per year in the inland valleys, to 40 inches per year in the mountains. Due to the climate, there is little natural perennial surface water in the watershed. The upper part of the watershed in the mountains has the highest gradient and water quality is usually of high quality. Flows in the Upper Valley from the Seven Oaks Dam to the

City of San Bernardino consist of storm flows and rising groundwater. From the City of San Bernardino to the City of Riverside, the SAR flows perennially and includes publicly owned treatment works discharge.

The Santa Ana winds blow into the valley from the Cajon Pass, which exits the valley's north end between the San Gabriel and San Bernardino Mountains. The seasonal Santa Ana winds are felt particularly strongly in the San Bernardino area as warm and dry air is channeled through nearby Cajon Pass at times during the autumn months.

1.3.2 Rainfall

Rainfall season is from October 1 to May 1 with average rainfall depths of 14.5 inches to 25.1 inches.

Little streamflow occurs along Mission Zanja Creek except during and immediately after precipitation because climate and drainage area characteristics are not conducive to continuous runoff. During large storms, streamflow increases rapidly in response to effective precipitation.

1.3.3 Topography

The project's topography is typical of low land valley areas with gentle slopes. The general slope of the area is towards the SAR with slopes ranging from 1 percent to 3 percent. Specifically, the project ranges from elevation 1022 to 1020 for Z2DA and from elevation 1020 to 1040 for Z3DA.

The average slope of the Mission Zanja Creek is approximately 3.8 percent. Within downtown Redlands, it is about 1.9 percent.

1.3.4 Soil Data

Soils within the project survey boundary were mapped using the Natural Resources Conservation Service (NRCS) Web Soil Survey (USDA 2003). The proposed project crosses eight different soil types that include Grangeville Fine Sandy Loam, Tujunga Gravelly Loamy Sand, Hanford Coarse Sandy Loam, Psamments and Fluvents, Tujunga Loamy Sand, Hanford Sandy Loam, and Ramona Sandy Loam (Jurisdictional Wetland Delineation Report). The tributary drainage areas also consist of urbanized alluvial fan areas emanating from the San Bernardino Mountain ranges. According to the San Bernardino County Hydrology Manual, the project area is located in Hydrologic Soil Groups A (minority) and B (majority) with moderate runoff potential.

1.3.5 Vegetation

The sporadic vegetation varies throughout the project. Onsite, the existing rail alignment is already disturbed and absent of most vegetation. The project consists of pockets of unmaintained vegetation which consist of weeds. Offsite, the survey area supports 14 distinct vegetation communities; however, the predominant land cover was identified as being urban/developed. The majority of the survey area is made up of paved roadways, man-made structures, adjacent lands that are un-vegetated, and landscaped parcels.

1.4 Local Drainage

Onsite drainage is storm runoff generated within the project's existing ROW limits. In contrast, offsite drainage is storm runoff that originates outside of the existing railroad ROW, but tributary to the project site either by way of surface and/or subsurface conveyance. However, once onsite and offsite drainage is collected in an onsite system, it will discharge to either an existing or proposed local storm drain system, or modification thereof, or an existing major flood control facility. Local drainage consists of either public water or private water and may comingle depending on its location. Local storm drain systems are under the jurisdiction of City of San Bernardino, City of Redlands or Caltrans. Drainage along I-10, from the West I-10 Overpass to the East I-10 Overpass, is part of the offsite drainage tributary to the project at various locations. Caltrans has jurisdiction of the I-10 drainage. See Section 2, Existing Conditions for more information; also see Appendix B for Hydrology Maps.

1.5 MAJOR FLOOD CONTROL FACILITIES

A total of five major flood control facilities either cross or are located longitudinally to the project. The crossings from west to east are known as Warm Creek (Historic) [Bridge 1.1], Twin Creek [Bridge 2.2], Santa Ana River [Bridge 3.4], and Mill Creek Zanja [Bridge 9.4]. Mission Zanja Creek is the one major offsite facility located adjacent to a segment of the project. The numbers associated with the bridge designations correspond to the railroad Mile Post. See EIR and Floodplain Technical Memorandum.

These facilities are either owned or maintained by the local agency or the SBCFCD. This information along with identifying which agency constructed the facility, and other related rights and responsibilities of the facilities is described below. A short description of these facilities follows. For additional information, refer to the Floodplain Evaluation Technical Memorandum.

Warm Creek (Historic), Bridge 1.1

Warm Creek extends from north of the City of Highland downstream to its confluence with the SAR at the southwest quadrant of the I-10/I-215 separation. However, the East Twin and Warm Creek improvements by the USACE in 1961 delivered most of the Warm Creek flows to the SAR at a point 1.4 miles upstream of its original confluence, resulting in a rerouting of the portion of Warm Creek from about 5th Street south to Central Avenue. The Warm Creek Bypass Channel today connects the Twin Creek Channel to the downstream Warm Creek Channel. Consequently, the remaining portion of Warm Creek no longer serves as a regional flood control facility, but only conveys tributary local drainage (about 18 square miles) from the City of San Bernardino (USACE, Review Report, Lytle and Warm Creeks). From this point forward, this remaining portion of the channel will be referred to as Warm Creek (Historic). After the rerouting of Warm Creek occurred, Warm Creek (Historic) itself and all related studies and record drawings have since been relinquished from SBCFCD to the City of San Bernardino (per conversation with Steve Gibson, SBCFCD, 2011). However, none of the Warm Creek (Historic) documentation was available from the City. Currently, the City of San Bernardino owns, operates and maintains Warm Creek (Historic). At the point where Warm Creek (Historic) crosses the project, the facility is a rectangular concrete channel (RCC) (17 feet wide by 9 feet high – as surveyed) with a chain link fence on top that crosses underneath the railroad trestle bridge. The railroad has prior rights at this location.

Twin Creek, Bridge 2.2

Twin Creek (also known as “East Twin Creek and Warm Creek Channel”) is a major channel that conveys flows from the Twin Creek Spreading Grounds in northern San Bernardino to its confluence with the SAR at the northeast quadrant of I-10/I-215 separation. Twin Creek was constructed by USACE, and is owned, operated and maintained by the SBCFCD. According to USACE record drawings, Twin Creek was confirmed to be a 60-foot wide by 14-foot high RCC through the project. Further downstream, the channel transitions to an unimproved 202-foot wide base trapezoidal channel (with 2:1 side slopes). The portion crossing the project was constructed in 1958. The Standard Project Flood (SPF) is 22,000 cfs (FEMA Levee Certification Report). The railroad has prior rights at this location.

Santa Ana River, Bridge 3.4

The SAR bridge crossing is located between Waterman Avenue and Tippecanoe Avenue in the City of San Bernardino. The project location corresponds to SAR River Mile 28.6. The SAR is operated and maintained by the SBCFCD where it has ROW to do so. Adjacent to and upstream of the railroad crossing (at Mission Zanja Creek) on the south side of the SAR, a private entity owns a 500-foot long frontage along the SAR which extends out to the center of the SAR. Surrounding that, the SBCFCD owns the rest of the SAR in that area. During a recent field visit, the project team confirmed that the SAR is unimproved though the project area with no dry weather flows evident in the channel (at least not during the field visit). According to the SAR Mainstem Project, Feature Design Memorandum No. 2, Seven Oaks Dam, Floodway Delineation Report, prepared by USACE, dated August 1991, the existing and future 100-year recurrence frequency flows (near and downstream of the project site at E Street) are estimated to be 67,000 and 70,000 cfs, respectively. The railroad has prior rights at this location.

Mill Creek Zanja, Bridge 9.4

The Mill Creek Zanja bridge crossing is located just west of the East I-10 Overpass (Caltrans BR 54.0472, PM 31.52, Redlands OH) and east of Church Street in the City of Redlands. The Mill Creek Zanja is part of the overall Mission Zanja Creek system, the principal flood control facility for the City of Redlands. This bridge is part of the Creek’s designation as a State and Federal Historic Structure. The bridge is located at the intersection with the abandoned Southern Pacific Railroad within railroad ROW (50 feet wide). As referenced in related USACE documentation, this bridge is also referred to as Santa Fe Railroad bridge.

BNSF railroad records designate that the bridge crossing Mill Creek Zanja as Sylvan Creek. (Note: local Redlands historian Tom Atchley mentioned that Mill Creek Zanja has never been called Sylvan Creek, so for purposes of this report, Mill Creek Zanja will be used to designate this wash crossing).

SBCFCD owns the portion of the Creek upstream and downstream of the project. During a recent field visit, the Creek was confirmed to be unimproved (with no consistent geometry) though the project area with no dry weather flows evident (at least not during the field visit). Just upstream in Caltrans ROW, the Creek is covered with grouted rip rap as it conveys flows under East I-10 Overpass (east crossing).Where the Creek intersects 9th Street in the City of Redlands, the SPF and 100-year flows are determined to be 6,400 cfs and 3,600 cfs, respectively (USACE, Reconnaissance Study for Mission Zanja Creek).

The railroad has prior rights at this location; however, the SBCFCD has operation and maintenance responsibilities of the Creek.

Mission Zanja Channel (MP 3.4 to MP 6.1)

The Mission Zanja Channel parallels the project along the south side from the SAR confluence to approximately 1,000 feet west of California Street. Owned and maintained by SBCFCD, it is mostly improved as a trapezoidal earthen channel with some segments including wire revetment. The Channel is vegetated from the SAR outlet to Gage Canal. The capacity of the channel ranges from 3,000 to 4,000 cfs. During field visits in 2011, the project team identified pockets of scouring that resulted in encroaching onto the railroad property (SANBAG, Redlands First Mile, Draft Existing Conditions Report).

Mission Zanja Channel is an open channel downstream from California Street to the SAR except where some local road bridges cross the channel (Tippecanoe Avenue, Richardson Street, Mountain View Avenue, and Bryn Mawr Avenue). According to discussions with David Lovell (SBCFCD), the local road culverts are undersized and most likely exacerbate the flooding conditions along the Channel. The road bridges limit the flow-carrying capacity to about 2,200 cfs in several places (USACE, Reconnaissance Study for Mission Zanja Creek). Between the Mountain View Avenue and Bryn Mawr Avenue bridges, the Channel also crosses under the West I-10 Overpass (Caltrans BR 54.0570, PM 27.64, West Redlands OH) at MP 5.61.

It is uncertain what maintenance obligations SBCFCD has to the north bank of the Mission Zanja Channel between the SAR and just west of California Street. A portion of this north bank is within SANBAG and SBCFCD ROW. The project data does not reflect a ROW line south of the Channel from the SAR to Richardson Street. However, the project data does reflect a south ROW line for the Channel from Richardson Street to Bryn Mawr bridge that varies from 75 feet to 100 feet. This ROW is located south and adjacent to the SANBAG ROW. There are agreements in place that SBCFCD is responsible for operating and maintaining the Channel including the north channel bank which is located partially in SANBAG and SBCFCD ROW. There is history of the north channel bank eroding into the SANBAG ROW after heavy seasonal storm events.

The following table summarizes the existing major flood control facilities discussed above.

Table 2-1. Existing Major Flood Control Facilities

Name	Mile Post	Jurisdiction	Q100 (cfs)	Description
Warm Creek (Historic)	1.1	City of San Bernardino	2,525 cfs	17 ft wide by 9 ft high RCC
Twin Creek	2.2	SBCFCD, Zone 2	22,000 cfs SPF	60 ft wide by 14 ft high RCC
Santa Ana River	3.4	SBCFCD, Zone 2 & 3	67,000 cfs	Unimproved trapezoidal channel
Mill Creek Zanja (aka Sylvan Creek)	9.4	City of Redlands	3,000 – 4,000 cfs	Unimproved channel, no fixed geometry
Mission Zanja Channel	3.4 to 6.1	SBCFCD, Zone 3	1,000 – 6,000 cfs	Unimproved trapezoidal channel

Gage Canal (Bridge 3.9) crosses the project and the Mission Zanja Creek between the SAR and Tippecanoe Avenue, near the extension of Gage Street. Gage Canal is a potable water conveyance system (owned by the City of Riverside) that transports water from the San Bernardino area to the City of Riverside for domestic use. Along the Mission Zanja Channel is a stair-stepped drop structure just downstream of Gage Canal. Gage Canal used to be an open concrete-lined channel but in 1970 was rerouted underground as a 48-inch pipe.

1.6 Review of Key Documents

Many documents were reviewed for the tributary drainage systems, and policies and programs that may be impacted by the project. Of these documents, only certain key documents are summarized in Appendix E and include applicable exhibits and figures from these documents.

1.7 COORDINATION WITH IMPACTED PLANNED/DESIGNED/CONSTRUCTED PROJECTS

There are certain projects that are planned, designed or constructed that are impacted by RPRP and require coordination. These projects are described in this Subsection below with emphasis on related drainage issues.

Arrowhead Parking Lot (MP 1.3)

Ludwig Engineering is contracted with the City of San Bernardino to provide final engineering plans for a proposed temporary parking lot at the southeast corner of Rialto Avenue and Arrowhead Avenue, which is adjacent to the north side of the RPRP in the City of San Bernardino. The purpose of the lot is to provide temporary parking for the construction workers of the new Justice Center at 3rd Street and Arrowhead Avenue. The Justice Center construction is scheduled to last approximately 2 years and should be constructed by March 2014. Once the Justice Center is completed, the temporary parking lot will be removed and the parcel will be restored to its original condition (City of San Bernardino, March/May, 2012).

The proposed parking lot will be paved and will consist of a 351-foot long by 62-foot wide by 0.5-foot (minimum) high detention basin located in the northwest portion of the temporary parking lot to which the entire lot will drain. The basin will outlet to an existing 12-inch diameter storm drain at the southeast corner of Rialto Avenue and Arrowhead Avenue. A proposed 2:1 slope embankment will be constructed along the north railroad ROW to separate the railroad offsite flows from the project flows. In the existing condition, the parcel drains to a low point just north of the south property line and about 150 feet east of the west property line. The north side of RPRP also drains to this low point.

Central Avenue Corridor Storm Drain Improvements and Utility Master Plan (MP 2.85)

The Inland Valley Development Agency (IVDA) desires to improve the existing roads and infrastructure of the North and South Gateway area of City of San Bernardino as part of the master planned development of the Inland Empire Goods Movement Bill. To accomplish this, IVDA, the lead agency in the development of this project, will provide preliminary engineering and environmental documentation for the proposed improvements. Thiesen Engineering is the consultant responsible for preparing these documents. The project is bounded by Mill Street on the north, Orange Show Road and SAR on the south, Waterman Avenue to the west, and Tippecanoe Avenue to the east.

The purpose of this project is to identify the core infrastructure that may be required to help facilitate future development in the project area. The scope includes topographic survey, research of existing utilities and storm drains, storm drain hydrology and hydraulics, sewer layout and analysis, water network analysis and layout, storm drain, sewer, and water master plan, cost estimates, traffic impact analysis, ROW delineation and data sheets, alternative analysis, preliminary plans and profiles, geotechnical investigation, and environmental document.

Related to drainage, the exhibit in the RFP identifies proposed storm drains. These proposed storm drains include a line along Central Avenue which drains east into a line along Waterman Avenue which drains south. Adding a proposed storm drain along Lena Road which drains south, both of these lines will convey flows to a proposed storm drain along Orange Show Road which will continue west, crossing the Project, at MP 2.85, until it discharges to Twin Creek. This project will determine tributary areas, associated discharge, and the size and location of the proposed storm drain along Orange Show Road.

I-10 High Occupancy Vehicle (HOV) Project (MP 5.61/9.45)

http://www.sanbag.ca.gov/projects/mi_fwy_I-10-HOV.html

SANBAG is working with Caltrans to prepare a project report and environmental document to add a carpool lane, also known as an express lane or HOV lane, in each direction of I-10 between Haven Avenue (PM 8.20) in Ontario and Ford Street (PM 33.43) in Redlands, a 25-mile span. The I-10 HOV project will extend the carpool lanes east from where the existing carpool lanes end. In addition to the carpool lanes, the project proposes to widen outside existing lanes, pave medians, widen several existing under-crossings, rebuild over-crossings where needed, construct a concrete median barrier, improve drainage and add auxiliary lanes to improve weaving between on-ramps and off-ramps. The Caltrans project number is EA 08-0C2500.

As part of the Project Approval and Environmental Documentation (PA&ED) phase, Parsons Transportation Group (PTG) is evaluating several alternatives for the project under contract with SANBAG. SANBAG estimates that the PA&ED will be approved by 2017. Final design and acquisition of ROW is tentatively set to be approved and certified by 2014. If funds are available, construction could start by 2015, and portions of the project could be completed by 2020. This schedule is based on funding availability and subject to change.

The drainage scope of this phase is a high level hydrologic analysis that does not include hydrologic discharges or delineate offsite and onsite drainage areas. Additionally, detailed hydraulic analysis is not part of the drainage scope. However, the associated Concept Drainage Report provides a general overview of the existing drainage conditions and facilities of the project for this phase. Ultimately, a comprehensive and detailed drainage report will be prepared, including hydrologic and hydraulic analysis, during the PS&E phase of this project. To the extent possible, this project will be considered as existing conditions for the RPRP.

Mill Creek Zanja Expanded Inlet (MP 9.15)

In 2005, the SBCFCD, in coordination with the City of Redlands, completed construction of the Mill Creek Zanja Expanded Inlet and the 9th Street Culvert. The SBCFCD and City of Redlands had an agreement to administer the design the construction of the project. The purpose of the project was to address frequent flooding in Redlands by implementing one of the recommendations in the USACE Reconnaissance Study prepared in 1994. This implementation included constructing a 6-foot high by 11-foot wide RCB from 425 feet west of 9th Street to just east of 9th Street.

Reconstruction of the project was made possible after the stakeholders received required funding from the federal government. Under terms of the required agreement, the City reviewed and approved the project’s plans and specifications, prepared required environmental documentation, and provided funding to the county in an amount not to exceed $1 million, less any environmental costs. The county prepared all plans, specifications and cost estimates, advertised, awarded and administered the construction contract, and paid all project costs exceeding $1 million, less any environmental costs.

This project is identified as Project No. 7 and was driven by a Disaster Initiative Grant (City of Redlands Local Hazard Mitigation Plan). SBCFCD owns, operates and maintains the project, except for that portion within the ROW for 9th Street which City of Redlands maintains.

Mission Storm Drain Bypass (MP 8.17/9.74)

This future storm drain is expected to alleviate the flooding in downtown Redlands (Lead Agency) by adding capacity to the existing inadequate Mission Storm Drain. This future storm drain is also referred to as the Recommended Plan, Downtown Storm Drain Project, Mill Creek Zanja By-Pass Storm Drain, or proposed culvert in related documentation. The Mission Storm Drain Bypass will provide a drainage conveyance system for the downtown area and will include the construction of an approximately 4,500 feet of 10-foot diameter RCP storm drain system constructed in City-owned ROW. Starting between 9th Street and I-10, the proposed project will run west and parallel to (and south of) Redlands Boulevard for approximately one mile to the confluence with the existing Mission Zanja Channel west of Texas Street. The system will include construction of storm drain related appurtenances, including junction structures and manholes with connections to the existing system at both the upstream and downstream ends.

The project will provide approximately 25-year flood protection to the project area upon completion (for Phase 1) and 100-year flood protection once all program facilities (and all phases) are completed. Funding in the amount of $5.2 million is being sought by the City to construct the project. It is assumed this amount includes both capital and soft costs. Annual O&M costs are estimated to be around $5,000.

Recently, the City of Redlands is competing to fund this project via the One Water One Watershed (OWOW) 2.0 Project Solicitation process which is part of the voter-approved Proposition 84. OWOW is a new and innovative Integrated Regional Water Management Plan (IRWMP) planning process being developed within the Santa Ana Watershed by the Santa Ana Watershed Project Authority (SAWPA).

This storm drain will cross the project at two locations: (1) just east of the East I-10 Overpass via a 9-foot RCP (rerouting of the Oriental Drain), and (2) just west of the East I-10 Overpass via a 13.5-foot high by 14-foot wide RCB. See Appendix E for additional information.

The Carrot Drain will be connected to the Mission Storm Drain Bypass at 9th Street by joining a collar structure over a connection to the existing pipe. This additional flow would amount to 300 cfs.

Mission Zanja Creek Feasibility Study (MP 3.4 to beyond eastern terminus of Project)

SBCFCD (Lead Agency) has plans to perform this study to determine the most feasible solution to the existing flooding issues along Mission Zanja Channel from the SAR upstream through Redlands. The objective of the study will be to build upon the previous watershed planning efforts and provide viable alternatives, and implement water quality and water supply aspects on a regional scale for the next generation. The goals of the study focus on solving the flooding issues, groundwater recharge, and implementing economic and environmentally viable alternatives for the long-term vision.

Without success, SBCFCD has been trying for years to obtain funding at the local, state and federal level to pay for the study and associated capital improvements ($2 million in total costs; it's assumed this includes both capital and soft costs). Annual O&M costs are estimated to be around $20,000. Recently, the SBCFCD is competing to fund this project via the OWOW 2.0 Project Solicitation process which is part of the voter-approved Proposition 84. OWOW is a new and innovative Integrated Regional Water Management Plan (IRWMP) planning process being developed within the Santa Ana Watershed by the Santa Ana Watershed Project Authority (SAWPA).

Mountain View Avenue Street Improvements (MP 5.2)

In 2006, IVDA awarded a contract to T.Y. Lin for professional services to design improvements for Mountain View Avenue from Palm Meadows Drive/Central Avenue to Interstate 10 (I-10). The project is currently designed to be constructed in two phases. The first phase (design completed) will consist of the bridge structure over the SAR and includes road and infrastructure improvements southbound to Riverview Avenue/San Bernardino Avenue. The second phase of the project (design 95 percent complete) will complete the road improvements from Riverview Avenue/San Bernardino Avenue southbound to the I-10 interchange and includes a second, smaller bridge structure at the Mission Zanja Creek crossing (culvert to convey Creek flows). Phase 1 construction began in October 2012 with Phase 2 planned to commence construction shortly thereafter. Both phases are scheduled to be completed by 2013.

The project drains from south to north along the street; specifically, from I-10 to Mission Zanja Creek, and from Mission Zanja Creek north to SAR. Drainage from the southern portion will be intercepted at a sump by a proposed catch basin just south of Mission Zanja Creek, then will be intercepted by an existing 69-inch RCP before it is discharged to Mission Zanja Creek.

This project will not impact local drainage related to RPRP. The proposed grade crossing for RPRP will perpetuate drainage patterns along the street and the Creek.

Opal Detention Basin (beyond east terminus of Project)

In July 2012, the City of Redlands approved a contract with TKE Engineering for professional services to design improvements for Opal Detention Basin, including environmental services. To expand on previous related studies completed by USACE, the SBCFCD, and City of Redlands, the purpose of the project is to provide added flood protection to the area, and downtown Redlands, when combined with the City's future Mission Storm Drain Bypass project. In April 2012 the City received written confirmation of being conditionally selected for a grant of $5 million for the project. The project estimated delivery budget is set at $5.7 million. The start and end construction dates are slated for February 2014 and November 2014, respectively. For additional discussion on the Opal Detention Basin, see Section 1.6; refer to the Mission Storm Drain Bypass discussion in this Subsection.

Redlands Boulevard/Alabama Street Intersection Improvements (MP 7.3)

http://www.cityofredlands.org/redlandsalabamaintersection

The City of Redlands is currently coordinating improvements to the intersection of Redlands Boulevard, Alabama Street, and Colton Avenue to improve the level of service. Parsons Brinckerhoff (PB) is the City's contracted consultant and is in the final design phase. Currently, the capital budget is around $10 million and is slated to begin construction in 2014 at the earliest. The project will require concurrence from SANBAG on the proposed Colton Avenue crossing before approval and construction is granted.

Based on preliminary information from PB, proposed drainage improvements include an 18-inch and 36-inch diameter RCP along Redlands Boulevard, joining to the existing 48-inch diameter RCP along Alabama Boulevard, and other laterals and catch basins. The project will cross RPRP with a proposed storm drain along a redesigned Colton Avenue and will have to be coordinated with tributary drainage areas east of the project that drain along Colton Avenue and Redlands Boulevard. As of the date of this RPRP report, requested hydrology study and associated drainage computations/maps for the City project was not made available to HDR.

University of Redlands, A Center for the Arts (MP 9.8)

The improvements associated with this project were constructed in 2008 and one of the elements constructed was a basin, owned by the University. Bounded by Park Avenue to the south, Sylvan Boulevard to the north, the Arts buildings to the west and vacant land to the east, the basin only has a pipe inlet structure and does not have a pipe outlet system. During an emergency, the basin will spill over the parking lot and Sylvan Boulevard until it drains into the Mill Creek Zanja. Based on a review of the documents, it appears that the basin serves for both flood control and water quality. About 3.46 acres of the Arts building site is tributary to the basin and it is designed to treat 3,745 cubic feet of runoff volume for water quality. Hydrology based on the storm event discharge associated with a 10 and 100 year frequency recurrence interval (Q10 and Q100, respectively) was the basis of design for flood control. There may be an opportunity to coordinate use of this basin for the proposed RPRP improvements such as the platform/station fronting Park Avenue.

1.8 Drainage/Flooding History and Perspective

To appreciate the drainage issues related to the project, it is important to understand the flooding history surrounding the region. As such, this Subsection will describe the related history.

1.8.1 Flood History

Historical records of floods along Mission Zanja Creek and adjoining streams date back to 1819 when missionaries settled in the area. However, most historical data is qualitative; very little quantitative data is available. Records since 1900 indicate that medium to large floods occurred in the area in 1910, 1916, 1929, 1935, 1937, 1938, 1943, 1965, 1969, 1976, and 1980. A stream gaging station was established on Mission Zanja Creek at Tippecanoe Avenue near its mouth in 1942; at Iowa Street, about 1 mile downstream from the lower end of the proposed project in 1969; and at 9th Street, within the project area, in 1970. The lower two gages are affected by urbanization and inadequate channel capacity upstream which allows flow to divert around one gage while the other gage has a relatively short period of record.

Prior to 1961, major flows from Mill Creek, a much larger watercourse than Mission Zanja Creek, escaped the Mill Creek channel and flooded the community of Mentone and the City of Redlands. Construction of the Mill Creek levees has provided protection to the City of Redlands from Mill Creek flows since that date. Therefore, an examination of major floods prior to 1961 is not relevant.

The following are descriptions of known major storm events since 1961. These descriptions are based on streamgage records, newspaper accounts, and field investigations (USACE, Mission Zanja Creek, Detailed Project Report and Environmental Assessment).

1. Flood of August 11, 1965: During the afternoon of the 11th, an intense local thunderstorm occurred in the Redlands-Mentone area. Intense precipitation occurred for about a 45 minute period in the afternoon resulting in a high rate of runoff and causing overflow from Mission Zanja Creek. Approximately 76 structures received flood damages which included apartment complexes and mobile homes. Damages also occurred to local storm drains, bridges, and utilities. Flood depths averaged a foot causing extensive damage to the downtown business district. Total damages related to the flood reached an estimated $120,000.
2. Flood of January 18-27, 1969: A series of storms began on January 18 and ended January 27. Except for a lull occurring on January 22 and 23, heavy precipitation occurred during most of the period from January 18-26 and was climaxed by an intense downpour on January 25. The storm churned muddy water through the city upstream of the project area with the creek jumping its banks near Judson Street and Sylvan Boulevard and at Dearborn Street. The creek overflow was minor and damage was confined to levees, dip crossings, and agricultural land. Total damage was estimated at $51,000.
3. Flood of February 22-25, 1969: The late February 1969 storm series was the climax of more than a month of extremely heavy, recurring rainfall in southern California. The 4-day storm totals ranged from less than 5 inches in the Redlands area to over 17 inches in the higher surrounding mountains, with the bulk of these totals occurring on February 24 and 25. The following discharges were recorded in the project area: Mission Zanja at Iowa Street, 1,228 cfs; and Mission Zanja Creek at Tippecanoe, 976 cfs. The following break-down of damages (in dollars) occurred along Mission Zanja Creek: Residential; 6,000, Business; 1,000, Industrial; 25,000, agricultural; 20,000, Highways and roads; 40,000, Flood control; 166,000, business loss and emergency cost; 42,000. Total damages amounted to $400,000.
4. Flood of September 24, 1976: A flood with peak discharges along Mission Zanja Creek at 9th Street, Iowa Street, and Tippecanoe Avenue of 3000 cfs, 1,952 cfs, and 1,024 cfs, respectively, caused major damages in the City of Redlands. The existing channel and storm drains were inadequate and major flooding occurred in the downtown area. Depths of water and mud ranged from 1 to 3 feet. The flood caused damages totaling about $2,000,000, including $590,000 to residential property, $362,000 to business property, $133,000 to public properties, $150,000 to

highways, roads and streets, and $84,000 to flood control channels and drains. Approximately 250 homes were damaged in the flood. The flood was estimated to have been a 40 year event. No breakdown is available of damages along the project reach.

5. Flood of February 13-22, 1980: During a one week period in mid-February, a series of 6 storms moved through the Redlands area causing flooding conditions in Mission Zanja Creek. The maximum peak discharge along the creek at the Iowa Street gage was 1,255 cfs, and the 9th Street gage recorded a flow of 105 cfs. Reported damages caused by this flood, reached $49,000.

Additional Flood History: In September 1976, Redlands experienced water flows of up to three feet deep that caused flooding of the downtown business area and more than 200 homes. There was an estimated $1,750,000 worth of damage; $1 million to private and public property; and $750,000 to SBCFCD Facilities. Information on additional storms is available (SBCFCD General Information Book).

Additional information is provided for historical floods more recent than 1980 (City of Redlands Local Hazard Mitigation Plan) as follows.

1. Flood of February 1992: In February 1992, significant flooding occurred as a result of major storm systems moving through Southern California. The three-day storm system produced most of the 14.96 inches in rainfall for 1991-92.

   Historically, the SAR and Mission Zanja were the cause of the most significant damages, and due to extensive build out of the southeast area, storm runoff produced increased flooding of the Country Club area. Most significantly, water run-off from the populated Country Club area traversed a private elementary school as well as Ford Street and developed subdivisions to the north. School property was damaged as a result of flood waters flowing through the school's parking lot and only street entrance, resulting in a lawsuit against the City. In 1993-94 the City constructed the Ford Street Storm Drain at a cost of $450,000, and future flooding in that area has been nonexistent. The Bear Valley Pipeline, generally located in Mill Creek near Greenspot Road and Florida Street, sustained $92,000 in damage to approximately 400 feet of steel pipe and supports. The Mill Creek Zanja at Sylvan Blvd. at Judson Street eroded significantly, threatening flooding of neighborhood homes as floodwaters spilled over into the public ROW, and causing $12,000 in damage. Public safety, spillway erosions, landfill tipping fees, and debris removal alone resulted in $160,000 in damages for a 3-day period of time. There was no loss of life or public property.

2. Flood of January 1993: The Winter Floods of 1993 produced the most significant damage to the City of Redlands in recent history. Recurrent flooding during the months of December through March resulted in an over saturation of soil which promoted long-term effects of storm waters in the City and region. Tropical rains melted a heavy snow pack at the higher elevations, producing increased flood activity.

   With approximately $6.5 Million in damages, but no loss of life, these storms finally claimed both the Alabama Street and Orange Street bridges. Demolition of the old Orange Street Bridge, and construction of temporary replacement dip crossings resulted in costs of $570,000 and both crossings were opened in July 1993; replacement of the bridges is estimated to cost approximately $5.0 million by 1995. The Mission Zanja again produced flooding along its banks at Sylvan Blvd. and Judson Street, resulting in channel improvements at that intersection in excess of $27,000. Partial collapse of the Zanja occurred again in Sylvan Park. Landslides crushed the Monkey Face Falls waterline, which provides water to residents of Mountain Home Village. One additional water line, serving sparse residences north of the SAR, was washed out. Repair was affected in October 1993, following subsidence of the SAR. Tipping fees to the County landfill exceeded $185,000. Several city-owned buildings sustained water damage, including the Smiley Library, which is on the National Register of Historic Places. Fire and Police Department emergency services topped $95,000, with no loss of life. Emergency Protective Measures and Debris Removal accounted for another $125,000 in emergency services. Landslides occurred in the San Timoteo/Live Oak Canyon area, resulting in road closures for a portion of the three-month Declaration period. Final clean up efforts were accomplished in April 1993 at a cost of $30,000.

3. Flood of March 1995: The second storm series resulted in more than $12,000 in damage costs associated with Emergency Protective Measures and Debris Removal. A small storm drain collapse at Church and State Streets created another $4,000 in damage, and another mudslide in San Timoteo Canyon created damages associated with debris removal of approximately $20,000. Additionally, severe ditch and shoulder erosion and culvert damage occurred between Pilgrim Road and Rancho Caballo, at an approximate cost of $200,000. The water line, which supplies potable water from Monkey Face Falls to the residents of Mountain Home Village, was further buried after damage from two previous disasters. Due to a potential $500,000 cost for debris removal, the water line was relocated at a cost of less than $50,000. The most significant damage, however, was the loss of the temporary emergency crossings at Orange and Alabama Streets. Warm tropical rain, coupled with an extreme snowmelt, created severe flooding conditions in the SAR. Mud, debris, and boulders swept away both roads, which were replaced in 1993 (FEMA 979) at a cost of $570,000. New replacement costs were incurred for $529,000.
4. Flood of February 1998: Redlands experienced a continuing series of storms. On February 27&28, 1998 the strongest storm created a 2-day event that resulted in considerable damage and private property loss.

1.8.2 Mill Creek Levees

A flood control survey report of the entire SAR Basin was prepared by the USACE Los Angeles District dated November 1, 1946 (House Document 135, 81st Congress, 1st Session). This report considered the flood problem along Mission Zanja Creek resulting from flood flows escaping Mill Creek and flooding the City of Redlands. The report recommended the construction of levees on Mill Creek. The Mill Creek levee project was authorized by Congress in 1950 as a part of the Santa Ana flood control project. The Mill Creek levees were constructed in 1961 to protect property in and around Redlands, Crafton and Mentone against floods and debris overflowing from Mill Creek. The principal features of the project include (a) about 2.6 miles of levee improvements, including a side-drainage inlet levee, along the south bank of Mill Creek and (b) protection for existing masonry walls, which were utilized without modification. The levees end near the confluence of Mill Creek and the SAR. The Mill Creek Levees are designed to confine flows up to the SPFlevel, but are not designed to control floods originating in the Mission Zanja Creek drainage area.

1.8.3 Zanja Creek

Use of the Zanja for flood control began as early as 1892 when the portion through downtown Redlands was first channelized. Further improvements that placed the Zanja in a large underground culvert were made in 1935, when Redlands Boulevard was constructed as U.S. Highway 60, 70, and 99, one of the principal U.S. highways from Los Angeles to the east in the 1930’s.

The segment of the Zanja within and adjacent to the project area has been completely changed from its original alignment due to previous flood control activities spanning the time period from 1892 to 1962.

1.8.4 Mill Creek Zanja

Mill Creek Zanja was originally built by Native Americans as a ditch for water supply in 1819. The water diverted from Mill Creek supported the San Bernardino Assistencia and surrounding farms and ranches. As the area has developed, the use of the Creek transformed from water supply to a flood control and drainage channel, and is manifested in pockets being owned by the SBCFCD. The Mill Creek Zanja, from 9th Street to Mill Creek, is designated as a State and Federal Historic Structure.

One of the constraints downstream of the crossing is the inlet capacity to the storm drain system at 9th Street, which is limited to 300 cfs. Current efforts (with the County and City of Redlands as stakeholders) to update CSDP No. 4, the County's master drainage plan that covers this area, are currently on hold. One of the critical components of this update is a viable flood control solution to Mill Creek Zanja. Similarly, the Redlands Conservancy is currently planning for preparation of a Mill Creek Zanja Master Plan (only from upstream of 9th Street) that may incorporate flood control solutions to the Creek. Given the City's flooding history and its association with the Mill Creek Zanja, further study is recommended to determine feasible options for this project.

1.8.5 Downtown Redlands

For a number of years, the City of Redlands has been concerned about the severe flooding of Mission Zanja Creek in the downtown area. Recent floods have caused over $4.3 million of damage in the area. As a result of this flooding problem, the downtown area is currently in a depressed state of development: vacant and condemned areas abound and existing land utilization is not at an optimum. Any new development in the floodplain is restricted by local ordinances. The City has prepared a Redevelopment Plan, but cannot fully implement the plan without effectively eliminating the flood hazard. However, given the current dissolution of Redevelopment agencies in the state, this plan is in a state of uncertainty. In the end, complete implementation is dependent upon elimination of the flooding problem. Flood control is essential to the City of Redlands for eliminating potential flood damages as well as stimulating economic growth. More recently, the City of Redlands has initiated work on a Flood Control Master Plan to develop a program for implementing flood control improvements for the entire city, including downtown.

Mission Storm Drain

Use of the Zanja for flood control purposes began as early as 1892 when the portion through downtwown Redlands was first channelized. Further improvements that placed the Zanja in a large underground box culvert were made in 1935 when Redlands Boulevard was constructed as U.S. 99 (USACE, Mission Zanja Creek, Detailed Project Report and Environmental Assessment).

The existing RCB under Redlands Boulevard is of inadequate capacity to convey runoff during a major storm event. In order to mitigate the severe flooding problem in downtown Redlands, a number of storm drain projects have been proposed by way of various studies.

The results indicate that the upper reach of the Zanja is listed on the National Register of Historic Places, but the upper portion of the Zanja is not included within the currently proposed project. The segment of the Zanja within and adjacent to the current study area has been completely changed from its original configuration and, in many areas, from its original alignment due to previous flood control projects spanning the time from 1892 to 1962.

2.0 EXISTING CONDITIONS

This section covers existing conditions for the Project such as land use, onsite/offsite hydrology, floodplain, storm drains, grade crossings, ditches and stormwater quality.

2.1 LAND USE

Land use has a direct nexus to the runoff coefficient (or runoff curve number), an important parameter for determining the runoff discharge for drainage areas. Part of the research included correlating the agency land use components to the appropriate hydrology program land use code or development type (AES). For existing land use, HDR based existing development type on existing land use conditions from land use maps.

Table 2-1. City of Redlands Existing Land Use Category Matching vs. AES Software

City Land Use Categories	AES Code Number	AES Land Use or Development Type
A-1, Agricultural District (5 acre minimum lots)	11	0.4 DU/Ac
A-1-20, Agricultural District (20 acre minimum lots)	11	0.4 DU/Ac
A-2, Estate Agricultural (11/2 acre lots)	10	1 DU/Ac
R-R, Residential Rural District (1 acre lots)	10	1 DU/Ac
R-R-A, Residential Rural - Animal District (1 acre lots)	10	1 DU/Ac
R-A, Residential Estate (20,000 SF lots)	9	2 DU/Ac
R-A-A, Residential Estate –Animals (20,000 SF lots)	9	2 DU/Ac
R-E, Residential Estate (14,000 SF lots)	8	3-4 DU/Ac
R-S, Suburban Residential (10,000 SF lots)	8	3-4 DU/Ac
R-1, Single Family Residential (7,200 SF lots)	7	5-7 DU/Ac
R-1D, Single Family Residential (8,100 SF lots)	7	5-7 DU/Ac
R-2, Multiple Family Residential (8,000 SF lots)	7	5-7 DU/Ac
R-2,2000, Multiple Family Residential (12,000 SF lots)	4	Condominiums
R-3, Multiple Family Residential (10,000 SF lots)	3	Apartments
Table notes		

2.2 HYDROLOGY

This section describes the existing hydrology for both onsite and offsite drainage. It is organized in drainage area segments along the RPRP alignment from west to east (mostly between streets, but also between major flood control facilities and freeways). Refer to Appendix B for applicable drainage area designations identified in the hydrology maps. Unless noted otherwise, quoted discharge rates in cfs are for 100-year storm events (Q100) and the referenced stationing is to the existing track alignment.

Unless noted otherwise, the referenced stations below relate to the existing track stations. Existing stations increase towards Redlands. Left and right sides of the tracks are relative to looking upstation towards Redlands. Stations are identified in the format xxx+xx (e.g., 280+32). The existing stations do not match the proposed stations.

E Street to Sierra Way

This section of track extends approximately from station 83+00 to 121+00 and travels from east to west. The area is divided into three separate drainage systems with the flow of each system eventually draining into Warm Creek (Historic). This segment interfaces with the Downtown San Bernardino Passenger Rail Project (DSBPRP) at E Street. As part of the DSBPRP, SANBAG is proposing to extend Metrolink regional passenger rail service approximately one mile east from its current terminus at the existing San Bernardino Metrolink Station/Santa Fe Depot at 1170 West 3rd Street to new Metrolink commuter rail platforms near Downtown San Bernardino at the intersection of Rialto Avenue and E Street. The primary features of the Project include: construction of a second track, rail platforms, parking lots, a pedestrian overpass at the Depot, Omnitrans Bus Facility; grade crossing improvements; railroad signalization; and roadway closures. The proposed Project's secondary features include: construction of drainage improvements, utility accommodation, and implementation of safety controls. Related to the DSBPRP, the improvements for the San Bernardino Transit Center (SBTC) at E Street and Rialto Avenue are currently ongoing. Limited coordination of drainage improvements is taking place with the SBTC project as well.

<u>Drainage Area 1000</u>

Drainage Area 1000 is comprised of runoff collected from the DSBPRP located west of the RPRP. This drainage area includes commercial properties located as far north as 2nd Street and as far west as G Street (see Sheet 1, Appendix B). The runoff from these offsite developments are conveyed along curb and gutter improvements at Rialto Avenue, crossing Rialto Avenue through an existing culvert at the intersection of Rialto Avenue and E Street, continues southward on E Street where a 30-foot long catch basin collects a majority of the runoff prior to reaching the rail ROW (see Sheet 1, Appendix B). It is assumed the uncollected flow drains onto the rail ROW and is discharged into the rail ROW on either side of the E Street at-grade crossing. The existing 42-inch RCP storm drain system is also used to collect the runoff from the DSBPRP west of the RPRP. The total flow within the 42-inch RCP storm drain prior to the RPRP is 59 cfs.

The existing 42-inch RCP continues eastward along the rail ROW, north of the main track (see Sheet 1, Appendix B). The existing drainage improvements east of E Street are comprised of earthen ditch improvements located on both sides of the tracks, with the flow collected within drop inlet structures at Stoddard Avenue and D Street. In addition to the onsite flow, the existing drainage ditches also collect offsite flow from the developed commercial properties north of the rail ROW. The total flow collected prior to Stoddard Avenue is 64 cfs. The storm drain increases to a 48-inch RCP east of Stoddard Avenue and the collected flow is increased to 65 cfs prior to D Street and is discharged into Warm Creek (Historic).

<u>Drainage Areas 1100, 1300 and 1400</u>

Drainage Area 1100 models runoff conveyed within an offsite storm drain system north of the rail ROW that includes surface runoff from D Street, south of Rialto Avenue, to the rail ROW and the properties adjacent to the street (see Sheet 1, Appendix B). The flow is discharged into an asphalt swale north of the tracks and discharged into Warm Creek (Historic). The total flow conveyed within this drainage area is 10 cfs.

Drainage Area 1300 models the portion of the rail ROW between D Street and Warm Creek (Historic) (see Sheet 1, Appendix B). The flow within this area surface drains along the rail ROW towards Warm Creek (Historic); the tributary area is approximately 0.3 acres and generates less than 1 cfs of flow.

Drainage Area 1400 is comprised of the onsite area between Warm Creek (Historic) and Arrowhead Avenue. Based on a review of available topographic information, the adjacent properties drain away from the rail ROW (see Sheet 1, Appendix B). The area tributary to Drainage Area 1400 is 0.3 acres and generates less than 1 cfs of flow.

Drainage Area 2000

Drainage Area 2000 extends from Sierra Avenue to Arrowhead Avenue. It is comprised of unimproved open space parcels, identified as a former superfund site, north of the rail ROW and are graded to drain towards the rail ROW (see Sheet 1, Appendix B). The area does not have an improved drainage swale adjacent to the track, however the existing ground is generally sloped from east to west towards Sierra Avenue. Original surface topographical data obtained for the project indicated the existence of a localized sump within the open space parcel north of the tracks and it appears the flow drains into the open space parcel where the runoff either infiltrated into the ground and/or discharged onto the adjacent roadway. However, recent improvements for the Arrowhead Parking Lot discussed in Section 1.7 raised the surface grades within this area. It appears that the runoff now drains through the ballast and onto Hilda Street and/or Sierra Avenue.

The area tributary to the northern portion of the rail ROW is 5.0 acres and generates a discharge of 8 cfs. The area tributary to the southern portion of the rail ROW is 0.8 acres and generates a discharge of 2 cfs.

Sierra Way to Mill Street

The track alignment from station 122+00 to 134+00 is sloped from north to south with the track grades varying but averages 0.3 percent. The track ROW is bounded by Dorothy Street to the east and a mixture of developed and undeveloped parcels to the west. Onsite runoff west of the tracks appears to drain onto the adjacent offsite properties while the onsite runoff east of the tracks is collected within a drainage swale (unimproved earthen ditch) (see Sheet 2, Appendix B).

Dorothy Street, a local street with a curb-to-curb width of 27 feet, intersects with Julia Street, Cluster Street and Valley Street to the east and drain east to west towards Dorothy Street. Dorothy Street has a crowned section without curb and gutter improvements on either side, runoff is conveyed via drainage swales. The street is relatively flat with an average gradient of 0.1 percent. Dorothy Street terminates at the intersection with Valley Street near existing track station 134+00 (see Sheet 2, Appendix B). The runoff from the east leg of Dorothy Street crosses the street via an asphalt cross gutter and confluences with the runoff from west of Dorothy Street and continues south along the track alignment (see Sheet 2, Appendix B).

South of station 134+00, the track continues southward towards Mill Street, near station 152+00. The track is bounded by unimproved earthen swales located on both sides of the track (see Sheet 2, Appendix B). The track gradient increases to an average of 0.5 percent. The drainage swale west of the tracks eventually discharges into the adjacent offsite property near station 144+00 and does not appear to directly drain onto Mill Street. The drainage swale east of the track discharges onto Mill Street where an offsite curb inlet located 150 feet from the tracks conveys the runoff via a storm drain into Twin Creek (see Sheet 2, Appendix B).

The Mill Street storm drain system is a 42-inch CMP collecting runoff from two existing sump catch basins along Allen Street and two existing sump catch basins along Mill Street. The system also conveys the runoff from a private catch basin within the commercial property just north of Mill Street (see Sheet 2, Appendix B).

The hydrology for the track ditches are modeled in Drainage Areas 5000, 5100 and 7000. Drainage Areas 5000 and 5100 include the offsite runoff beginning from the eastern half-street portion of Sierra Way, north of Dorothy Street, and include properties east of Dorothy Street from the high point, estimated to be midblock between Dorothy Street and Waterman Avenue. These drainage areas also include the onsite runoff generated from the eastern half of the track ROW (see Sheet 2, Appendix B). The drainage areas extend southward to the discharge point at Mill Street. The combined tributary area for these basins is 26.9 acres with 40 cfs entering Mill Street.

Drainage Area 7000 analyzes the onsite runoff conveyed within the drainage swale west of the track, beginning near station 146+00 southward to its point of discharge onto the adjacent properties west of the track near station 150+00 (see Sheet 2, Appendix B). The overall tributary drainage area is 0.2 acres with a total flow of 1 cfs discharged into the adjacent parcels.

Drainage Area 5500 analyzes the offsite portion tributary to the Mill Street storm drain system. The drainage area has 58 acres tributary to two catch basins on Allen Street and generates a discharge of 96 cfs. The combined offsite tributary area for the inlets on Mill Street is less than an acre (excludes the rail ROW). Inlet calculations indicate the existing catch basins on Allen Street and the 42-inch storm drain are not adequately sized to collect and convey the 100-year storm flows, resulting in ponding along the street frontages near the intersection. The emergency overflow from these ponded areas would expand onto Mill Street and into the parking lot of the commercial property just north and east of the Mill Street at-grade crossing prior to extending onto the at-grade crossing, impacting the track. Future analysis is needed to determine the extent of the ponding (see Sheet 2, Appendix B).

Mill Street to Twin Creek

This reach begins just south of the Mill Street at-grade crossing. The track alignment from station 147+75 to 152+00 is sloped from north to south with the track grades varying, but averaging 0.3 percent to the south. The track ROW is bound by existing commercial properties on either side of the tracks and does not drain directly onto the rail ROW (see Sheet 3, Appendix B). The onsite runoff west of the tracks drains southward and onto the existing access road leading to Twin Creek. The onsite runoff east of the track drains onto the existing access road and onto the concrete swale at the top of Twin Creek channel wall where it comingles with offsite runoff east of the rail ROW prior to draining into the channel (see Sheet 3, Appendix B).

The hydrology for this portion of the rail ROW is modeled in Drainage Areas 8000 and 8100. Drainage Area 8000 has a tributary of 0.4 acres and a discharge of 2 cfs. Drainage Area 8100 has a tributary area of 0.7 acres and a discharge of 2 cfs (see Sheet 3, Appendix B).

Twin Creek to Central Avenue

This section of track extends from station 159+00 to 174+50. There does not appear to be graded ditch improvements on either side of the track (see Sheet 3, Appendix B). The area west of the track centerline is graded to drain offsite onto adjacent properties at different points. The area east of the track is graded to drain towards a low point near track station 166+30 where a culvert conveys the flow across the tracks and onto the adjacent property west of the rail ROW (see Sheet 3, Appendix B). The rail ROW is bounded by developed commercial properties on both sides of the rail ROW with a majority of the properties east of the rail ROW draining onto the rail ROW (see Sheet 3, Appendix B).

An existing 36-inch CMP pipe is located at the low point near existing station 166+30 and conveys the flow west of the existing track towards an improved swale located offsite (see Sheet 3, Appendix B). The downstream flowline of the existing 36-inch CMP storm drain is at elevation 1002.8 feet with the adjacent asphalt swale at elevation 1004 feet. The runoff within the rail ROW ponds up to the 1004-foot elevation prior to discharging to the improved offsite swale. The existing swale improvement drains at a 0.5 percent gradient towards Lugo Avenue located west of the rail ROW; the runoff is then discharged onto the curb and gutter improvements on Lugo Avenue and ultimately to Twin Creek (see Sheet 3, Appendix B). Based on a review of available topographic information, ponding resulting from blockage of the existing culvert would build up behind the track ballast, but would discharge onto Allen Street prior to overtopping the track. The hydrology for the track ditches are modeled in Drainage Areas 8300 and 9000. Drainage Area 8300 models the portion west of the existing track centerline from existing station 159+00 to 166+00. The onsite flow comingles with offsite runoff west of the rail ROW before discharging to Twin Creek (see Sheet 3, Appendix B). The drainage area consists of 0.8 acres with a discharge of 2 cfs. Drainage Area 9000 models the remaining portion of onsite runoff leading to the culvert. The tributary area leading to the culvert is 4.2 acres with a discharge of 9.3 cfs. The drainage area continues downstream and includes the offsite flow draining onto Lugo Avenue and ultimately into Twin Creek (see Sheet 3, Appendix B). The total tributary area of the catch basin at Lugo Avenue is 14 acres and generates a discharge of 31 cfs.

Central Avenue is a four-lane collector street with a 65-foot curb-to-curb street width. The street has curb and gutter improvements just east of the rail at-grade crossing. West of the at-grade crossing, the curb and gutter improvements are only located on the north side. Inlets structures are located on both sides of the street just east of the at-grade crossing (see Sheet 3, Appendix B). The inlet on the south has a 6-foot opening and an 18-foot wide depression. The inlet on the north side has an 8-foot opening with a 21-foot wide depression. The height of the inlet opening is not available.

The hydrology for Central Avenue is modeled in Drainage Area 11000. Based on a review of the available topography and a field walk, the tributary area extends from the Central Avenue at-grade crossing eastward to Lena Road. The tributary area is calculated to be 36.1 acres, with a majority being undeveloped mixed use properties north of and including Central Avenue. The flow is primarily conveyed along curb and gutter improvements along Central Avenue. Catch basins are located at the intersection of Central Avenue and Waterman Avenue where the runoff is collected. The flow is then discharged onto the Central Avenue curb and gutter improvements approximately 100 feet west of the intersection. The flow continues westward towards the at-grade crossing and is collected in sump catch basins. The captured runoff is conveyed within a 22-inch x 38-inch arch pipe through the grade crossing and discharged onto the north side of Central Avenue. The runoff eventually drains into the Twin Creek channel (see Sheet 3, Appendix B).

Central Avenue to Orange Show Road

This section of track extends from track station 175+00 to 192+50. There does not appear to be graded ditch improvements on either side of the track. The area west of the track centerline along this section is graded to drain westward onto the adjacent properties and it does not appear the flow is concentrated at any point along this stretch. The area east of the track is graded to drain towards a low point near track station 181+00. The track ROW is bounded by mixed use properties, a majority of which remain undeveloped. A majority of the properties east of the rail ROW drain towards the rail ROW, however a review of the topographical information indicates existence of a sump area within the properties east of the rail ROW near station 179+50 (see Sheet 4, Appendix B). The sump is approximately 1.5 feet below the rail ROW and collects runoff from properties near station 178+50 to 181+00. The properties west of the rail ROW drain away from the rail ROW (see Sheet 4, Appendix B).

An existing 4-foot wide x 3-foot high wooden culvert is located at the low point near existing station 186+50 and is used to convey the flow west of the track towards the offsite properties west of the rail ROW (see Sheet 4, Appendix B). The wooden culvert is practically buried and a small opening exists where flow is allowed to drain.

The hydrology for the onsite flow is modeled in the 12000, 12100 and 12200 drainage areas. Drainage Areas 12100 and 12200 model the flow generated west of the rail ROW. The tributary area in each drainage area is less than 1 acre each and directly drains onto the properties west of the rail ROW (see Sheet 4, Appendix B). It does not appear the flows are concentrated prior to discharging onto the adjacent properties. Drainage Area 12000 models the runoff currently draining into the wooden box culvert. The area tributary to the wooden culvert is 13.8 acres, generating a discharge of 25 cfs. Due to the inability of the buried wooden culvert to convey this flow, the runoff most likely ponds east of the rail ROW until the runoff is conveyed through the culvert or percolates into the ground. With the track ballast 3 feet higher than the adjacent grades and the flat terrain adjacent to the rail ROW, it does not appear likely that the runoff would overtop the tracks during an intense storm. Site photos of the track ballast adjacent to existing culvert do not show evidence of erosion related to runoff overtopping the track ballast.

Orange Show Road to Waterman Avenue

This section of track extends from station 199+00 to 208+00 and travels north to south. There does not appear to be graded ditch improvements on either side of the track within the rail ROW. The adjacent property east of the track is a fully developed commercial site. The site is graded to drain westward and towards the track ROW. The area west of the track appears to be residentially zoned with a mixture of open space and developed properties. The site surface is graded to drain away from the rail ROW. The existing rail ROW west of the track is sloped westward and drains onto the adjacent properties west of the rail ROW. The existing rail ROW east of the track is graded to drain from south to north, and flattens out near existing station 200+00 (see Sheet 4, Appendix B). It appears that the runoff ponds at this point and percolates into the ground as there does not appear to be a point of discharge. Based on a review of available topographic information, the runoff would overtop the track centerline prior to draining onto Orange Show Road.

The hydrology for the flow within this section is modeled in Drainage Area 14000. The total tributary area is 4.2 acres and generates a discharge of 10 cfs.

Waterman Avenue to SAR

This section of track extends from station 209+00 to 228+00 and travels west to east. There does not appear to be graded ditch improvements on either side of the track within the rail ROW. The adjacent property north of the track is open space zoned for commercial. The offsite area north of the tracks is graded to drain north and west away from the track ROW (see Sheet 4, Appendix B). The offsite area south of the track is a developed commercial site with curb and gutter improvements and a combination wall/tube steel fence separating it from the rail ROW. The site surface improvements convey the runoff away from the rail ROW. The existing rail ROW is graded to drain from east to west towards the concrete drainage structures at the Waterman Avenue at-grade crossing (see Sheet 4, Appendix B). The drainage structures discharge the flow into a 30-inch RCP storm drain (per available record documents).

The hydrology for the onsite flow is modeled in Drainage Areas 16500 and 16600. Drainage Area 16500 models the onsite runoff north of the track. The total tributary is 1.8 acres and generates a discharge of 3 cfs. Drainage Area 16600 models the runoff south of the existing track (see Sheet 4, Appendix B). The total tributary area in this drainage area is 1.6 acres and generates a discharge of 2 cfs. Drainage flow within the existing 30-inch RCP storm drain has not been determined as additional information regarding the detention basins upstream, near Norman Road is required to determine the flow tributary to the storm drain.

SAR to Tippecanoe Avenue

This section of track extends from station 237+00 to 269+00 and travels west to east. The offsite properties north of the track are primarily developed commercial properties. The existing ground drains away from the rail ROW, except for the property located adjacent to Tippecanoe Avenue (see Sheet 5, Appendix B). The track is bounded by the Mission Zanja Channel to the south. The existing rail ROW is graded to drain from east to west and discharges onto the SAR (see Sheet 5, Appendix B).

The hydrology for the onsite flow is modeled in Drainage Area 18000 which focuses on the runoff north of the track. The total tributary is 5.0 acres and generates a discharge of 7 cfs which drains to the SAR.

Tippecanoe Avenue to Richardson Street

This section of track extends from station 270+00 to 291+00 and travels west to east. The adjacent properties north of the track are developed commercial properties. A majority of the adjacent properties drain towards the rail ROW except for the parcels immediately adjacent to Tippecanoe Avenue and Richardson Street which are surrounded by a concrete swale (see Sheet 6, Appendix B). The track is bounded by the Mission Zanja Channel to the south. The existing rail ROW is graded to drain from east to west and is tributary to the SAR (see Sheet 6, Appendix B).

The area just south of the track is modeled in Drainage Area 19000. The drainage area has a tributary area of 1.2 acres with a total runoff of 1.8 cfs which drains directly into the Mission Zanja Channel. The hydrology for the area north of the track is modeled in Drainage Area 20000. The total tributary is 7.8 acres with a total runoff of 10 cfs. The runoff drains into a concrete ditch along the existing parking lot of the parcel just east of Tippecanoe Avenue (see Sheet 6, Appendix B). The concrete ditch drains onto Tippecanoe Avenue and northward towards the SAR.

Richardson Street to Mountain View Avenue

This section of track extends from station 292+00 to 320+50 and travels west to east. The adjacent properties north of the track are comprised of residential properties, except for the parcels adjacent to Richardson Street and Mountain View Avenue which appear to be mixed use (see Sheet 6 and Sheet 7, Appendix B). A majority of the properties drain towards the rail ROW except for the parcels immediately adjacent to Richardson Street (see Sheet 7, Appendix B). The track is bounded by the Mission Zanja Channel to the south. The existing rail ROW is graded to drain from east to west and discharges onto Richardson Street (see Sheet 6 and Sheet 7, Appendix B).

The hydrology for the onsite flow north of the track is modeled in Drainage Area 21000. The total tributary is 28.6 acres and generates a flow of 53 cfs. The runoff sheet flows onto the existing curb and gutter improvements at Richardson Street, which eventually drains west onto Tippecanoe Avenue and northward towards the SAR. The tracks are very close to the Mission Zanja Channel embankment resulting in a very small area that is collected within a drainage swale, the majority directly drains towards the channel embankment (see Sheet 6 and Sheet 7, Appendix B). Drainage Area 22000 models this area, having a tributary area of 0.6 acres and generates a flow of 1.1 cfs. This runoff drains into the channel.

Mountain View Avenue to West I-10 Overpass

This section of the track extends from station 321+00 to 345+00 and travels from northeast to southwest. The adjacent properties north of the track are primarily commercial with a few residential properties, as well as some open fields. There is also a detention basin at the northeast intersection of Mountain View

Avenue and Lugonia Avenue. A majority of the offsite properties drain toward the rail ROW except for the parcels north of Lugonia Avenue (including the detention basin). The track is bounded by the Mission Zanja Channel to the south. The existing rail ROW is graded to drain from east to west and drains towards the SAR by way of Mission Zanja Channel (see Sheet 7, Appendix B).

The hydrology for the onsite flow is modeled in Drainage Areas 23000, 24100 and 26000. Drainage Area 23000 models onsite runoff east of the track and north of Lugonia Avenue (see Sheet 7, Appendix B). The drainage area has a tributary area of 0.6 acres and generates a total flow less than 2 cfs. The onsite runoff drains into the detention basin east of Mountain View Avenue. Drainage Area 24100 models the runoff north of the track (see Sheet 7, Appendix B). The total tributary area is 24.8 acres and generates a discharge of 31 cfs. The onsite runoff drains into a concrete channel with a 3-foot x 2-foot drop inlet and into 72-inch storm drain where it confluences with offsite flow from Lugonia Avenue and drains into the Mission Zanja Channel. The ditch uses a 3-foot wide x 4-foot high wooden culvert crossing the tracks as an emergency overflow spillway. The total flow entering the Mission Zanja Channel from this system, including the runoff from Lugonia Avenue is approximately 450 cfs. Drainage Area 26000 models the runoff west of the tracks, which is primarily onsite runoff (see Sheet 7, Appendix B). The tributary area is 1.2 acres and generates a runoff of 2.0 cfs.

West I-10 Overpass to Alabama Street

This section of the track extends from station 347+50 to 433+00 and travels from east to west. The tributary parcels north of the track consist of open space parcels from 347+50 to 406+00 and commercial properties from 407+00 to 433+50. The track is bounded by the Mission Zanja Channel to the south from 347+50 to 370+00 and a mixture of commercial and open space properties for the remainder. These parcels drain away from the rail ROW. The existing rail ROW is graded to drain from east to west with the flow eventually discharging into the Mission Zanja Channel (see Sheet 7 through Sheet 9, Appendix B).

<u>West I-10 Overpass to California Street</u>

The tributary area within this section drains from east to west and begins at California Street and includes the area offsite north of the track ROW, as the area south of the tracks drains southward into the Mission Zanja Channel (see Sheet 7 and Sheet 8, Appendix B). The offsite area north of the tracks consists primarily of open space. The offsite area drains east to west with only a portion draining onto the rail ROW, near station 349+00 and the remainder draining directly into the Caltrans trapezoidal concrete-lined ditch adjacent to the toe of the south I-10 slope. The onsite flow is collected and conveyed in an earthen swale located north of the tracks and drains into the Caltrans ditch at station 350+00 and is conveyed into a 42-inch RCP storm drain prior to being discharged into the Mission Zanja Channel (see Sheet 7 and Sheet 8, Appendix B). The flow collected within the earthen channel is modeled as part of Drainage Area 50000. This portion of the drainage area has a tributary area of 8.7 acres and has a discharge of 13 cfs. The total flow draining into the Caltrans ditch prior to discharging into the Mission Zanja Channel is 330 cfs. The onsite area south of the track is modeled in Drainage Area 27000 and has a tributary drainage area of 1.9 acres with a flow of 3 cfs, draining directly into the Mission Zanja Channel.

<u>California Street to Nevada Street</u>

The tributary area within this stretch drains from east to west and begins at Nevada Street and north of the track ROW, as the area south of the tracks drains southward and away from the project. The offsite area north of the tracks consists of open space with a majority consisting of an orange grove. A portion of this offsite area drains into the Caltrans ditch adjacent to the I-10 and the remainder drains onto the rail ROW. The runoff within the rail ROW is collected and conveyed in an earthen swale which drains into the Caltrans ditch which conveys the flow westward beyond California Street (see Sheet 8, Appendix B). The Caltrans ditch also collects and conveys the runoff from the I-10.

The tributary area to the earthen ditch within the rail ROW is 5.8 acres generating less than 9 cfs. The runoff confluences with 3.8 acres from the orange grove parcel which does not drain towards the rail ROW (see Sheet 8, Appendix B). An additional 20 acres drain directly into the Caltrans ditch from the portion of I-10 within this section. Assuming all flows are able to enter the ditch during the 100-year event, the total flow in the Caltrans ditch at California Street is 310 cfs.

Nevada Street to Alabama Street

The tributary area for the track runoff begins at Alabama Avenue and is modeled as part of Drainage Area 50000. The track runoff is collected and conveyed in an irregular earthen ditch north of the track. The earthen ditch also collects and conveys offsite flows from a portion of the commercial properties immediately north of the tracks and conveys the flow west towards Nevada Street (see Sheet 9, Appendix B). The runoff is drained onto the street and confluences with runoff from Industrial Park Avenue. In addition, there is flow from the area north of the I-10 which consists primarily of commercial properties extending as far north as Plum Lane. The offsite runoff flows east and south towards the I-10 overpass at Nevada Avenue. Eventually all the runoff at the I-10 overpass drains into the Caltrans concrete ditch immediately south of the I-10 and drains westward where it confluences with Mission Zanja Channel.

The total tributary area from the rail ROW and the commercial properties draining onto the rail ROW is 10 acres and generates a discharge of 22 cfs (see Sheet 9, Appendix B). The offsite flow from Industrial Park Avenue is 16.9 acres and generates a discharge of 33 cfs. When the flows confluence, the total runoff is 51 cfs. The total flow within the Caltrans ditch upstream of Nevada Street is 100 cfs and the runoff from the area north of the I-10 is 149 cfs and has a tributary area of 69.3 acres. Assuming all flows are able to enter the ditch during the 100-year event, the total flow within the Caltrans ditch downstream of Nevada Street is 295 cfs.

Alabama Street to Texas Street

This section of track extends from station 434+00 to 489+00 and travels east to west. The adjacent properties north of the track are comprised of commercial and industrial properties, except for the parcels adjacent to Stuart Avenue which is a school and a park. The offsite flow from the school, park, and the industrial properties drain to a storm drain system at the corner of New York Street and Stuart Avenue, and then outlets into a ditch in the rail ROW (see Sheet 10 and Sheet 11, Appendix B). It then continues west towards Tennessee Street. The heavy flow has eroded the subgrade and crossed under the tracks. The auto body shop drains through the ROW and onto Redlands Boulevard (see Sheet 10 and Sheet 11, Appendix B). The flow traveling west in the ditch crosses through a culvert at Tennessee Street. The commercial properties north of the tracks from Tennessee Street to Colton Avenue drain south onto the tracks and enter the ditch (see Sheet 10 and Sheet 11, Appendix B). The ditch then enters a culvert at Colton Avenue. The flow then continues to Alabama Street where it enters into the storm drain system north of the grade crossing.

The hydrology for the onsite flow is modeled in Drainage Area 60000. The Drainage Area 60000 models the onsite runoff and offsite runoff north of the track (see Sheet 10 and Sheet 11, Appendix B). The total tributary is 100 acres and generates a discharge of 138 cfs. The runoff outlets at a culvert on Colton Avenue and flows along existing curb and gutter improvements along Redlands Boulevard, which eventually flow into the Mission Zanja Channel.

Texas Street to Church Street

This section of track extends from station 489+50 to 542+00 and slopes from east to west. Based on a review of the available topography, it appears that the offsite properties adjacent to the tracks drain away from rail ROW. As a result, the existing rail ROW only accommodates the runoff generated onsite (see Sheet 11 through Sheet 13, Appendix B). West of Eureka Street, the rail ROW begins to accept offsite flows from properties adjacent on both sides. These properties consist primarily of commercial and open space properties.

Existing storm drain infrastructure along this stretch consists primarily of the storm drain which begins at Texas Street and branches off into Stuart Avenue and Eureka Avenue. Other systems are found at Orange Avenue, 9th Street and Church Street.

<u>Texas Street to Eureka Street</u>

The tributary area begins at Eureka Street and is modeled in Drainage Area 70000. A majority of the adjacent properties north of the rail ROW drain onto the tracks, with only the undeveloped properties draining onto the track from the south (see Sheet 11 and Sheet 12, Appendix B). The runoff is collected and conveyed in unimproved drainage ditches located on either side of the tracks and is discharged onto the curb and gutter improvements on Texas Street before it continues flowing into the existing catch basin improvements near the intersections.

The total flow within the unimproved drainage swales is 9 cfs along the northern swale prior to being discharged onto Texas Street and 5 cfs along the swale south of the rail ROW.

<u>Eureka Street to Orange Street</u>

The tributary area begins at 6th Street and is modeled in Drainage Area 70000. There is no offsite areas tributary to the rail ROW in this stretch. Instead, runoff within the rail ROW drains onto the adjacent open space property north of the tracks (see Sheet 12, Appendix B). The flow is conveyed towards the existing catch basin located at the intersection of Stuart Avenue and Eureka Street. The flow south of the track drains towards the existing catch basin improvements on Eureka Street.

<u>Orange Street to 6th Street</u>

The tributary area for the drainage area begins at 6th Street and is modeled in Drainage Area 80000. There is no offsite area tributary to the rail ROW in this section. The runoff within the rail ROW is conveyed primarily within unimproved swales on both sides of the track and drains onto Orange Street on either side of the track (see Sheet 12, Appendix B). The runoff is then collected in the catch basin inlets on either side of the tracks.

The onsite drainage areas are 0.3 acres on either side of the track and generate a total flow of 1.5 cfs.

<u>6th Street to 7th Street</u>

6th Street is located approximately 250 feet west of 7th Street. There are no offsite properties tributary to the rail ROW within this section. The onsite flows are conveyed in unimproved drainage swales on either side of the track and drain onto 6th Street on either side of the track (see Sheet 12, Appendix B). The runoff south of the tracks drains towards Redlands Boulevard and the runoff north of the tracks drains northward along 6th Street.

The area tributary to 6th Street is less than 0.2 acres on either side and the flow would be less than 1 cfs.

7th Street to 9th Street

The tributary area for the drainage area begins at 9th Street and is modeled in Drainage Area 70000. There is no offsite areas tributary to the rail ROW in this stretch. The runoff within the rail ROW is conveyed primarily within unimproved ditches on both sides of the track and drain onto 7th Street on either side of the track (see Sheet 12, Appendix B). This flow drains onto Stuart Avenue where it continues to flow westward. The runoff south of the track drains onto Redlands Boulevard and the flow north of the tracks drains onto Stuart Avenue.

The area tributary to 7th Street is less than 0.2 acres on either side of the tracks and the total flow would be less than 1 cfs. For the purposes of this study, the flows have been calculated to continue along the track ROW to 6th Street.

9th Street to Church Street

The tributary area for the drainage area begins north of Church Street and includes the commercial property immediately north of the at-grade crossing. The flows drain into the rail ROW via an asphalt swale. The flows drain along the rail ROW in an unimproved drainage swale north of the tracks and discharge onto the 9th Street surface improvements. This flow drains onto Stuart Avenue where it continues to flow westward (see Sheet 12 and Sheet 13, Appendix B).

The drainage is modeled in Drainage Area 70000. Based on calculations, the unimproved swale discharges 5 cfs from 1.3 acres onto 9th Street. The total flow on Stuart Avenue is 60 cfs.

Church Street to Cook Street

This section of track extends approximately from existing track station 545+00 to 575+00 and travels from east to west. Based on a review of the available topography, the drainage tributary includes offsite improvements, up to 2,000 feet from Cook Street at-grade crossing (see Sheet 13 and Sheet 14, Appendix B). These improvements include a 5-acre mobile home park north of the rail ROW and fronting Judson Street, and a portion of a single residential subdivision west of Judson Street. The runoff sheet flows westward across Grove Street along an unimproved ditch north of the rail ROW (see Sheet 13 and Sheet 14, Appendix B). A 24-inch Corrugated Steel Pipe (CSP) culvert conveys the flow under Cook Street where an unlined ditch continues the flow west towards University Street. The total flow conveyed through the culvert is 27 cfs. Based on a review of the existing contours, it appears the concentrated flow dissipates due to a lack of drainage improvements near University Street, and it is possible the flow could either drain south or north along University Street, or continue westward along Park Avenue. For the purposes of this study, it is assumed the flow continues westward across University Street and along Park Avenue. The total flow at University Street is 32 cfs and flows westward along Park Avenue and eventually drains into the Mill Creek Zanja; the total flow draining into the channel is 32 cfs.

The second area within this section is between Church Street and Mill Creek Zanja, from existing track station 537+00 to 540+00. The portion from 541+00 to 542+00 drains into Mill Creek Zanja and the track from 542+00 to 545+00 is under the East I-10 Overpass.

In summary, for existing conditions, the average discharge per area ratio west and east of the SAR is 1 and 2.4 cfs per acre, respectively.

2.2.1 Caltrans

Drainage along certain sections of I-10 (Caltrans ROW) flow along Caltrans ditches and eventually discharges into culverts that outlet to Mission Zanja Channel. This is identified in the applicable subsections of Section 2.2. Tributary drainage along I-10 was taken into account in determining existing drainage areas and discharges. Existing H&H reports describing the tributary drainage areas to I-10 were requested from Caltrans but are not available.

2.3 Floodplain

Regional flooding has an impact on local drainage especially in the floodplain. Additional information is available in the Floodplain Evaluation Technical Memorandum prepared by HDR Engineering. Based on this information, downtown Redlands area presents the greatest flooding risk to the project. Flood control projects implemented by the USACE, SBCFCD, and the City of Redlands have greatly reduced potential flood hazards. However, the potential for flooding during moderate (i.e., not unusually heavy) storm events still exists and is of primary concern for the Project.

2.4 Storm Drains

The existing major and minor storm drains within the project area or affecting the project are identified in this section.

2.4.1 Onsite

The only onsite storm drain system is located at the west end of the project from E Street to Historic Warm Creek and was constructed in August 20, 2001, as part of the Metrolink Commuter Rail System Project and covered most of the area for DSBPRP (Contract C3056). It was designed for Southern California Regional Rail Authority (SCRRA) by the Commuter Rail Engineering Team (CRET). An existing 48-inch RCP drains the area from the high point between F Street and E Street of DSBPRP and is located within railroad ROW. The existing storm drain begins along the north side of the tracks, conveys flows easterly, crosses to the south side of the tracks just east of D Street, and continues east until it outlets through the west wall of Historic Warm Creek.

The remaining onsite systems consist of culverts as identified on Table 2-2. These culverts drain runoff outside of grade crossings. See Appendix D for related photos. Culverts located at grade crossings and that are part of local drainage systems under the jurisdiction of local agencies basically convey offsite flows. Refer to Table 2-3 for additional information.

Table 2-2. Existing Culverts

MP	Location	Size / Geometry / Material	Documentation Source	Notes
2.0	Mill Street	8-foot wide x 4.5-foot high x 34.8-foot CAP	Redlands District Track Chart, Sept 1981	Not found in the field.
2.25		36-inch CMP		Found culvert in field investigation. See Sheet 3 in Appendix B.
2.4	Central Avenue	22-inch x 13-inch Squashed CMP	Plan 69-231, sheet 4263	It has been verified in the field. See Sheet 3 in Appendix B.
2.6	Between Central Avenue and Ennis Street	4-foot wide x 3-foot high x 32-foot Wood Box	Redlands District Track Chart, Sept 1981	Confirmed in field investigation. Culvert has been buried and has a smaller opening to allow flow to seep through. See Sheet 3 in Appendix B.
2.9	Between Ennis Street & Orange Show Road	1-foot wide x 1-foot high x 6.6-foot Wood Box	Redlands District Track Chart, Sept 1981	Not found in field.

MP	Location	Size / Geometry / Material	Documentation Source	Notes
3.9	West of Tippecanoe Avenue	Unknown		Found in field. Culvert under industrial spur track for UPS building. Size/material needs to be confirmed. The pipe runs parallel to the main track and is about 120 feet long. See Sheet 5 in Appendix B.
4.2	East of Tippecanoe Avenue	2 – 36-inch x 22-inch Squashed CSP 1 – 24-inch x 36-inch Squashed CSP	Redlands District Track Chart, Sept 1981	All three pipe locations were verified in the field investigation. They serve as culverts under industrial spur tracks and run parallel to the main track. See Sheet 6 in Appendix B.
5.1		Size Undetermined, Concrete Encased	Redlands District Track Chart, Sept 1981	Confirmed in field investigation. The pipe has been plugged and is not in use. The size of the pipe could not be verified.
5.2	Mountain View Avenue	1 – 72-inch RCP 1 – 3-foot x 4-foot squash CMP 1 - 24-inch RCP at Lugonia Avenue extension	Storm Drain Improvements Lugonia Avenue RR Xing & Channel Connection. Plan 1097-7-B Redlands District Track Chart, Sept 1981	Confirmed storm drains in field investigation. 72-inch RCP comes from Lugonia Avenue, where it is joined by 24-inch RCP which picks up flow from the 3-foot x 2-foot drop inlet. There is also an older 3-foot x 4-foot squashed pipe culvert, which picks up whatever flow that doesn't make it into the 3-foot x 2-foot drop inlet. See Sheet 7 in Appendix B.
5.7	North of west I-10 overpass	2 culverts 48-inch RCP	Redlands District Track Chart, Sept 1981 Storm Drain Improvement Plans for Line 'C'	Two culverts from track charts were not found in field investigation. It seems that 2 culverts have been replaced by Line 'C,' which is a 48-inch RCP. There is also a second culvert south of the I-10 that is under the storm drain crossings. See Sheet 7 in Appendix B.
6.05	Between Bryn Mawr Avenue and California Street	15-inch RCP	Redlands District Track Chart, Sept 1981	Verified a 14-inch CMP from field investigation. See Sheet 8 in Appendix B.
6.8	Nevada Street	22-inch wide x 16-inch high Wood Box	Redlands District Track Chart, Sept 1981	Could not field verify.
7.4	Colton Avenue	2 – 24-inch x 18-inch Wood Box	Redlands District Track Chart, Sept 1981	Both boxes were verified in field investigation. See Sheet 10 in Appendix B.
7.8	Tennessee Street	18-inch RCP and 24-inch RCP	Redlands District Track Chart, Sept 1981	In field investigation, HDR found an 18-inch RCP which carries flow from Tennessee Avenue onto the railroad ROW. HDR also found a 24-inch RCP which carries flow parallel to the tracks across Tennessee Avenue. See Sheet 11 in Appendix B.
7.8	Tennessee Street	6-inch RCP		Private crossing has culvert which runs parallel to the tracks.

MP	Location	Size / Geometry / Material	Documentation Source	Notes
8.2	Stuart Avenue	18-inch RCP 12-inch CMP (longitudinal – north side)		In field investigation, the 18-inch RCP was found to take flow from New York Street and Stuart Avenue and discharges flow into onsite ditch. There is also a 12-inch CMP parallel to the tracks on the north side that conveys flow from the ditch under the pedestrian walkway. See Sheet 11 in Appendix B.
8.36	Texas Street	24-inch CMP	Redlands District Track Chart, Sept 1981	Could not field verify.
8.43	Texas Street	2-foot wide x 1-foot high x 30.2-foot CWB	Redlands District Track Chart, Sept 1981	Could not field verify.
8.85	Orange Street	18-inch wide x 18-inch high x 47.6-foot CWB	Redlands District Track Chart, Sept 1981	Could not field verify.
9.2	9th Street	60-inch x 44.3-foot long CIP	Redlands District Track Chart, Sept 1981	Could not field verify. Survey of area is required.
Notes: CAP, Concrete Arched Pipe; CIP, Cast Iron Pipe; CMP, Corrugated Metal Pipe; CSP, Corrugated Steel Pipe; CWB, Creosote Wood Box; RCP, Reinforced Concrete Pipe				

2.4.2 Offsite

Culverts located at grade crossings and that are part of local drainage systems under the jurisdiction of local agencies basically convey offsite flows. These crossings are identified in Table 2-3.

Table 2-3. Existing Local Storm Drain Crossings

MP	Location	Size / Geometry / Material	Notes
2.05	Along north side of Twin Creek south of Mill Street	78-inch RCP	See Sheet 3 in Appendix B.
2.4	Central Avenue	22-inch x 36-inch Squashed CMP	Storm drain discharges into curb and gutter west of crossing. Future analysis should include review of the condition of system as it appears storm drain may be breached by existing palm trees west of tracks. See Sheet 3 in Appendix B.
2.8	Orange Show Road	36-inch RCP	See Sheet 4 in Appendix B.
3.0	Waterman Avenue and Dumas Street	30-inch RCP (Estimated)	Need a site visit to access existing manhole and verify size of storm drain. See Sheet 4 in Appendix B.
5.2	Mountain View Avenue	Unknown	There is a storm drain system on Mountain View Avenue, but plans for storm drain system were not found at the City. See Sheet 7 in Appendix B.
5.25	Lugonia Avenue	72-inch RCP 3-foot x 4-foot Squashed CMP	The 3-foot x 4-foot squashed pipe CMP is used as a back up for the flow that cannot be accommodated into the 72-inch RCP. See Sheet 7 in Appendix B.
5.6	North of I-10 west overpass	48-inch RCP	See Sheet 7 in Appendix B.
5.6	Concrete channel south of I-10	42-inch RCP	See Sheet 7 in Appendix B.
7.3	Alabama Street	39-inch RCP	Coordination required with PB to see if any changes will be made to the storm drain in Colton realignment. We will have to see if we can join the existing pipe and discharge RPRP onsite drainage. See Sheet 10 in Appendix B.
7.4	Colton Avenue	36-inch RCP	Proposed project by PB which will be constructed by the time RPRP is constructed. Need to coordinate with PB to possibly upsize storm drain pipes. See Sheet 10 in Appendix B.
8.4	Texas Street	66-inch RCP	See Sheet 11 in Appendix B.
8.8	Orange Street	24-inch RCP	36-inch steel casing around pipe at track crossing. See Sheet 12 in Appendix B.
9.0	6th Street	24-inch RCP	32-inch steel casing pipe at crossing. See Sheet 12 in Appendix B.
9.2	9th Street	48-inch x 30-inch Rock and Concrete Arch	Per conversations with the City of Redlands, the culvert used to be an open channel and has since been covered through the development process. HDR was notified that records were burned in a fire at the City. Records of the Mission Zanja Channel identifies a 4-foot x 5-foot box outlet from the north, presumably the system at 9th Street. See Sheet 12 in Appendix B.
Notes: CMP, Corrugated Metal Pipe; RCP, Reinforced Concrete Pipe			

2.5 GRADE CROSSINGS

Grade crossings occur where the railroad crosses street intersections. There are two scenarios to convey drainage onsite (rail ROW) and across grade crossings to perpetuate the drainage pattern. Drainage towards grade-crossings is either directed parallel to the railroad and across the street via culverts or is directed to drain into the intersected street (by turning left or right) via the curb and gutter and/or the local storm drain system located within the street. The intersected street at most existing grade-crossings create a high point instead of a sump condition, and none of the grade crossings includes a median. The agency requirement used to design the existing grade-crossings is not known at this time but was probably based on BNSF requirements.

2.6 WAYSIDE DITCHES

As discussed in Section 2.2, most ditches are functioning as intended to convey drainage away from the railroad ballast. However, there are some sections whereby sedimentation has compromised the ballast section or has resulted in very flat ditches to the point where they longer convey flow in a concentrated manner. The ballast in these areas are saturated with fines and could probably be cleaned, screened and reused.

2.7 STORMWATER QUALITY

This document does not address stormwater quality or applicable mitigation for the project. Please refer to the project Preliminary Water Quality Management Plan for additional information.

3.0 REGULATORY SETTING

This section establishes the drainage regulatory setting of the Project from a federal, state, regional and local perspective.

3.1 FEDERAL

3.1.1 Flood Insurance Rate Maps

FIRMs are prepared after a risk study for a community has been completed and the risk premium rates have been established. The maps indicate the risk premium zones applicable in the community and when those rates are effective. They are used in making floodplain determinations and to determine if a proposed action is located in the base or critical action flood plain, as appropriate. The base floodplain is defined as “the area subject to flooding by the flood or tide having a one percent chance of being exceeded in any given year.” An encroachment is defined as “an action within the limits of the base floodplain.”

3.2 STATE

3.2.1 California Drainage Law

California Drainage Law is essentially case law. Therefore, it is complex, but the courts have established the following general principles that apply to development projects:

- The downstream property owner is obligated to accept and make provisions for those waters that are the natural flow from the land above.
- The upstream property owner shall not concentrate water where it was not concentrated before without making proper provision for its disposal without damage to the downstream property owner.
- The upstream property owner may reasonably increase drainage runoff by paving or construction of other impervious surfaces, including buildings without liability. The upstream property owner may not further increase drainage runoff by diversion of water that previously drained to another area. Reasonableness is often based on prevailing standards of practice in the community or region.
- No property owner shall block, or permit to be blocked, any drainage channel, ditch, or pipe. No property owner shall divert drainage water without properly providing for its disposal.

3.3 REGIONAL

There are no regional regulatory requirements that dictate local drainage design.

3.4 LOCAL

3.4.1 City of Redlands Municipal Code

The Redlands Municipal Code (RMC), Title 13 Public Services, Chapter 13.54 Storm Drains, was modified to include a comprehensive stormwater ordinance that prohibits illicit discharges to the storm drain system. It is prohibited to:

- Discharge directly or indirectly into the storm drain system any stormwater or other solid, liquid or gaseous matter in violation of any law, rule, regulation, permit, order or other requirement of any federal, state, county, municipal or other governmental entity or agency;
- Discharge nonstormwater directly or indirectly to the storm drain system or any street, or lined or unlined drainage ditch which leads to a public storm drain, unless such discharge is permitted by an NPDES permit or a city permit. If such discharge is permitted by an NPDES permit, but causes the city to violate any portion of its NPDES permit for stormwater discharges, such discharge is also prohibited;
- Throw, deposit, leave, maintain, keep or permit to be thrown, deposited, placed, left or maintained, any refuse, rubbish, garbage, or other discarded or abandoned objects, articles, and accumulations, in or upon any street, alley, sidewalk, storm drain, inlet, catch basin, conduit or other drainage structures, business place, or upon any public or private lot of land in the city, so that the same might be or become a pollutant; or
- Throw or deposit litter in any fountain, pond, lake, stream or any other body of water in any park, or elsewhere within the city. (Ord. 2274 § 1, 1995)

3.4.2 City of Redlands General Plan

The City of Redlands' General Plan contains several policies regarding the risks associated with flooding in the Health and Safety Element. Specifically, it provides assessment of natural and manmade hazards associated with flooding and dam inundation, as well as providing a framework and guiding policies to guide future development and strengthen existing regulations within the City. The guiding policies in regards to flooding are as follows:

- Policy 8.20c: Where feasible given flood control requirements, maintain the natural condition of waterways and flood plains to ensure adequate groundwater recharge and water quality. This policy is a restatement of a part of Policy 8.40d in Section 8.40, Drainage and Flooding. An increase in impervious surfaces works to diminish percolation of water into the aquifer. The flushing action of adequate flows is necessary to preserve water quality. Preservation of soft or natural-bottom channels aids in percolation and recharge, maintaining water quality.
- Policy 8.40a: Protect lives and property and ensure that structures proposed for sites located on floodplains subject to the 100-year flood are provided adequate protection from floods.
- Policy 8.40b: Preserve as open space those areas which cannot be mitigated for flood hazard.
- Policy 8.40d: Where feasible given flood control requirements, maintain the natural condition of waterways and floodplains to ensure adequate groundwater recharge and water quality, preservation of habitat, and access to mineral resources.
- Policy 8.40f: Support the intent of the County of San Bernardino's flood control policies as specified in the County General Plan.
- Policy 8.40e: Coordinate with the U.S. Army Corps of Engineers and San Bernardino throughout construction, mitigation, and operation of the various components/projects that make up the "Santa Ana River Mainstem Project" that will directly affect the Planning area. These projects includes, but not limited to, improvements along Mission Zanja Creek. In addition, the City of Redlands Public Works Department must be actively included in the development of any/all proposed flood control facilities along the reaches of the Mission Zanja Creek system.

3.4.3 City of San Bernardino Municipal Code

The San Bernardino Municipal Code (SBMC), Title 19 Development Code, Chapter 19.16 Flood Plain Overlay District includes a comprehensive floodplain management ordinance that protects public health, safety, and general welfare, and to minimize hazards due to flooding in specific areas as identified by the latest adopted Flood Insurance Rate Maps. In order to accomplish its purposes, this Chapter includes methods and provisions for:

1. Restricting or prohibiting uses which are dangerous to health, safety, and property due to water or erosion hazards, or which result in damaging increases in erosion of flood heights or velocities;
2. Requiring that uses vulnerable to floods, including facilities which serve such uses, be protected against flood damage at the time of initial construction;
3. Controlling the alteration of natural floodplains, stream channels, and natural protective barriers, which help accommodate or channel flood waters;
4. Controlling filling, grading, dredging, and other development which may increase flood damage; and
5. Preventing or regulating the construction of flood barriers which will unnaturally divert flood waters or which may increase flood hazards in other areas.

Similarly, Title 8 Health and Safety, Chapter 8.80 Storm Water Drainage System of the SBMC focuses on water quality but mentions basic information on local drainage issues. Some of the basic drainage objectives include:

1. Control discharges from spills, dumping or disposal of materials other than storm water;
2. Establish penalties for violations of the provisions of this chapter; and
3. Provide for the equitable distribution of the cost of the storm water drainage system and storm water pollution abatement programs, and all related services through the establishment of fair and equitable fees and charges.

3.4.4 City of San Bernardino General Plan

The City of San Bernardino's General Plan contains several policies regarding the risks associated with storm drains and flood control facilities in the Utilities Element (Chapter 9). Specifically, it provides assessment of natural and manmade hazards associated with storm drains and flooding, as well as providing a framework and guiding policies to guide future development and strengthen existing regulations within the City. It also addresses water quality; however, those related items are not included in this summary. See the PWQMP for more information.

To prevent flooding of the City, the capacity of the storm drain system must consistently be evaluated and improved as needed. Storm drains and flood control facilities within the City include: channels, storm drains, street waterways, natural drainage courses, dams, basins, and levees. Storm drain and flood control facilities (natural and man-made components) in the planning area are administered by four different entities:

- City of San Bernardino (Public Works and Public Services Departments);
- San Bernardino County Flood Control District;
- Army Corps of Engineers; and
- San Bernardino International Airport and Trade Center.

Design and construction of storm drain and flood control facilities are the responsibility of the City Public Works Department. The Public Services Department is responsible for the operation and maintenance of storm drain and flood control facilities. The guiding policies in regards to storm drains and flooding are as follows:

Goal 9.4 Provide appropriate storm drain and flood control facilities where necessary.

Policies:

- 9.4.1 Ensure that adequate storm drain and flood control facilities are provided in a timely manner to protect life and property from flood hazards.
- 9.4.2 Upgrade and expand storm drain and flood control facilities to eliminate deficiencies and protect existing and new development.
- 9.4.3 Maintain existing storm drain and flood control facilities.
- 9.4.4 Require that adequate storm drain and flood control facilities are in place prior to the issuance of certificates of occupancy. Where construction of master planned facilities is not feasible, the Mayor and Common Council may permit the construction of interim facilities sufficient to protect present and short-term future needs. (LU-1)
- 9.4.5 Implement flood control improvements that maintain the integrity of significant riparian and other environmental habitats.
- 9.4.6 Minimize the disturbance of natural water bodies and natural drainage systems. (LU-1)
- 9.4.7 Develop San Bernardino's flood control system for multipurpose uses, whenever practical and financially feasible.
- 9.4.8 Minimize the amount of impervious surfaces in conjunction with new development. (LU-1)

3.4.5 San Bernardino County Flood Control Act of 1939

The SBCFCD was created by the California Legislature by the San Bernardino County Flood Control Act (Act), Chapter 73, Statutes of 1939, adopted and effective April 20, 1939.

SBCFCD was formed as an urgency and progressive measure for the preservation and promotion of public peace, health and safety as the direct aftermath of the disastrous floods of March 1938, which caused loss of lives and millions of dollars of property damage within the County. The SBCFCD is countywide, the external boundaries coinciding with those of the County of San Bernardino.

Some of the objectives and purposes of SBCFCD as they related to floods and storm drains are

1. To provide for the control of flood and storm waters of SBCFCD;
2. To protect from flood and storm waters the water courses, watersheds, public highways, life and property in SBCFCD;
3. To obtain, retain, and reclaim drainage, storm, flood and other waters for beneficial use in the District.

SBCFCD has the following program as it relates to storm drain construction:

1. Comprehensive storm drain planning
2. Construction and operation of main trunk storm drains
3. Cooperative storm drain project with incorporated cities

4.0 REFERENCES

BNSF, *Redlands District, Mentone to San Bernardino, Track Chart*, September 1981.

BNSF, *Track Chart, Redlands Spur, San Bernardino, CA (MP 0.0) to Redlands, CA (MP 9.5).*

City of Redlands and SBCFCD, *Mill Creek Zanja Detention Basin Study*, prepared by Williamson & Schmid, March 18, 1986.

City of Redlands, Public Works Department, *Standard Specifications & Detail Drawings for Design and Construction of Public Works Improvements*, January 2006.

City of Redlands, *Downtown General Plan and Specific Plan No. 45 Amendments, Draft Program EIR, 4.13 Water Resources*, prepared by Terry A. Hayes Associates Inc., March 2011.

City of Redlands, *Downtown Specific Plan, Specific Plan No. 45, Section VI.D.3 (Storm Drains)*, July 15, 2008.

City of Redlands, General Plan, December 12, 1997

City of Redlands, *Hydrology Study, Mill Creek Zanja Storm Drain*, prepared by BSI Consultants, June 17, 1991.

City of Redlands, *Local Hazard Mitigation Plan*, March 4, 2005.

City of Redlands, *Municipal Code*, Title 13 Public Services, Chapter 13.52 Storm Drains

City of Redlands, *North Redlands Master Storm Drain Analysis, Hydrology and Hydraulics Summary Report*, prepared by Hicks & Hartwick, June 1994.

City of Redlands, *Storm Drain Atlas Maps*, January 2011.

City of San Bernardino, *Arrowhead and Rialto Temporary Parking Lot, Hydrology Study*, March 14, 2012.

City of San Bernardino, *Arrowhead and Rialto Temporary Parking Lot, Precise Grading and Construction Plans*, May 21, 2012.

City of San Bernardino, *General Plan*, Chapter 9 Utilities Element, Storm Drains and Flood Control Facilities.

City of San Bernardino, *Municipal Code*, Title 19 Development Code, Chapter 19.16 Flood Plain Overlay District, and Title 8 Health and Safety, Chapter 8.80 Storm Water Drainage System.

City of San Bernardino, *Storm Drain Atlas Maps*, no date.

City of San Bernardino, *Storm Drain Design Policy*, March 14, 1988.

County of San Bernardino Department of Public Works, *Long-Term Maintenance of Flood Control and Transportation Facilities Located Throughout San Bernardino County*, Environmental Impact Report, (no date; in process).

County of San Bernardino, *San Bernardino County Facility Tracking Interactive Map*, http://sbcounty.permitrack.com/HCOC2/

County of San Bernardino, *San Bernardino County Hydrology Manual*, August 1986.

County of San Bernardino, *San Bernardino County Stormwater Facility Mapping Tool*, http://sbcounty.permitrack.com/WAP/

Federal Emergency Management Agency, *Flood Insurance Rate Maps*, August 28, 2008.

Hillwood Investments, *Hydrology & Hydraulic Calculations, Gateway North & Central Avenue Storm Drain*, prepared by Thienes Engineering, Job no. 2537, revised December 15, 2005

Inland Valley Development Agency, *Mountain View Avenue Street Improvements, Drainage Report*, prepared by Willdan, September 2011.

Redlands Conservancy, *Mill Creek Zanja Driving Tour and Brief History*, Tom Atchley, March 2010.

San Bernardino Associated Governments, *Downtown San Bernardino Passenger Rail Project, Final Hydrology & Hydraulics Study*, prepared by HDR Engineering, _____, 2012.

SANBAG, *I-10 HOV Concept Drainage Report (PM 8.20/33.20, EA 08-0C2500)*, prepared by Parsons, May 28, 2009.

SANBAG, *Mission Zanja Channel Erosion along the Redlands Branch Line, FEMA Claim Technical Memorandum*, prepared by HDR Engineering, June 28, 2011.

SANBAG, *Redlands Corridor Alternatives Analysis, Phase 1 Environmental Site Assessment (ESA)*, prepared by HDR Engineering, September 2010.

SANBAG, *Redlands Corridor Alternatives Analysis, Phase 1 Environmental Site Assessment Update (ESAU)*, prepared by HDR Engineering, February 2012.

SANBAG, *Redlands First Mile, Draft Existing Conditions Report - Drainage*, prepared by HDR Engineering, July 23, 2010.

SANBAG, *Redlands Passenger Rail Project, Design Criteria Manual*, Section 8.0 Drainage and Grading, prepared by HDR Engineering, _____ 2012.

SANBAG, *Redlands Passenger Rail Project, Screencheck Environmental Impact Statement/Environmental Impact Report*, prepared by HDR Engineering, _____ 2013.

SANBAG, *Redlands Passenger Rail Project, Floodplain Evaluation Technical Memorandum*, prepared by HDR Engineering, August 2012

SANBAG, *Redlands Passenger Rail Project, Draft Geotechnical Report*, prepared by HDR Engineering, _____ 2012.

SANBAG, *Redlands Passenger Rail Project, Jurisdictional Wetland Delineation Report*, HDR Engineering, September 2012.

SANBAG, *Redlands Passenger Rail Project, Land Use Technical Memorandum*, HDR Engineering, September 2012.

SANBAG, *Redlands Passenger Rail Project, Preliminary Engineering Plans (30%)*, prepared by HDR Engineering, Inc., _______ 2012.

SANBAG, *Redlands Passenger Rail Project, Preliminary Water Quality Management Plan*, prepared by HDR Engineering, December 2012.

Santa Ana Water Project Authority (SAWPA), One Water One Watershed (OWOW) Project Solicitation Application, *City of Redlands Downtown Storm Drain Project*, October 16, 2012.

SAWPA, OWOW Project Solicitation Application, *Mission Zanja Creek Feasibility Study*, September 28, 2012.

San Bernardino County Flood Control District (SBCFCD), *Comprehensive Storm Drain Plan No. 4*, prepared for SBCFCD and City of Redlands, January 22, 2010 (pending approval).

SBCFCD, *Comprehensive Storm Drain Plan No. 7*, prepared by CM Engineering Associates, December 29, 1982.

SBCFCD, *FEMA Levee Certification Report, Lower Warm Creek Levees*, prepared by Tetra Tech, July 2009.

SBCFCD, *Mission Zanja Creek Area Drainage Plan*, August 1991.

SBCFCD, *Mission Zanja Creek Channel Improvement Study, Final*, prepared by Metcalf & Eddy, October 5, 1987.

SBCFCD, *SBCFCD Flood Control System Number Index and General File Codes*, January 2010.

SBCFCD, *SBCFCD General Information Book*, January 2010.

Southern California Association of Governments, *2012-2035 Regional Transportation Plan (RTP) Final Program EIR* (3.13 Water Resources Section), March 2012.

Southern California Regional Rail Authority, *Design Criteria Manual, Pre-Final, Section 8 Drainage and Grading*, July 2010.

SCRRA, *Eastern Maintenance Facility, Phase 3, Perforated Under Drain Pipe Design Exceptions*, prepared by HDR Engineering, March 7, 2012.

SCRRA, *Metrolink-SCRRA Design Criteria Manual*, Section 8.0 Drainage and Grading, Pre-Final, July 2010.

University of Redlands, *Hydrology & Hydraulics Summary Report, A Center for the Arts Improvements, CUP 922*, prepared by Hicks and Hartwick, Inc, April 2008.

University of Redlands, *Plot and Precise Grading Plans, A Center for the Arts Improvements, CUP 922*, July 28, 2008.

University of Redlands, *Review of History of Mill Creek Zanja*, November 9, 2006.

U.S. Army Corps of Engineers, Los Angeles District, *Mission Zanja Creek, Detailed Project Report and Environmental Assessment*, November 1986.

USACE, Los Angeles District, *Reconnaissance Study for Mission Zanja Creek*, February 1994.

USACE, Los Angeles District, *Review Report, Lytle and Warm Creeks*, October 30, 1964.

USACE, Los Angeles District, *Review Report, Warm Creek and Tributaries Upstream from East Twin Creek*, March 20, 1968.

USACE, Los Angeles District, *Warm Creek and Tributaries Upstream from East Twin Creek*, March 20, 1968.

Appendix A

Existing Conditions H&H Calculations

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****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
         (c) Copyright 1983-2008 Advanced Engineering Software (aes)
             Ver. 15.0  Release Date: 04/01/2008  License ID 1555

                           Analysis prepared by:




 ************************** DESCRIPTION OF STUDY **************************
* REDLANDS PASSENGER RAIL PROJECT                                          *
* EXISTING 100 YEAR ANALYSIS                                               *
* BASIN 1000                                                               *
 **************************************************************************

  FILE NAME: C:\RPRP\1000.DAT
  TIME/DATE OF STUDY: 17:14 05/22/2012
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2500

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======   ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  2   13.0      8.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  3   25.0     15.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  4   35.0     25.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  5   20.0     15.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.20 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE   1000.00 TO NODE   1001.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   640.00
  ELEVATION DATA: UPSTREAM(FEET) =   1047.70  DOWNSTREAM(FEET) =   1043.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   11.014
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.457
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp        Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
```

```
  COMMERCIAL                   B        0.70      0.42     0.100    76   11.01
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      2.15
  TOTAL AREA(ACRES) =      0.70   PEAK FLOW RATE(CFS) =      2.15

****************************************************************************
  FLOW PROCESS FROM NODE   1001.00 TO NODE   1002.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  4 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1043.50  DOWNSTREAM ELEVATION(FEET) = 1037.70
  STREET LENGTH(FEET) =   590.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 35.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  25.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

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

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.78
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.36
    HALFSTREET FLOOD WIDTH(FEET) =   10.73
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.26
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.80
  STREET FLOW TRAVEL TIME(MIN.) =   4.35   Tc(MIN.) =   15.36
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.831
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                   B        0.50      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.50      SUBAREA RUNOFF(CFS) =    1.25
  EFFECTIVE AREA(ACRES) =      1.20    AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        1.2        PEAK FLOW RATE(CFS) =       3.01

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.36   HALFSTREET FLOOD WIDTH(FEET) =  11.12
  FLOW VELOCITY(FEET/SEC.) =  2.30   DEPTH*VELOCITY(FT*FT/SEC.) =   0.84
  LONGEST FLOWPATH FROM NODE   1000.00 TO NODE   1002.00 =    1230.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   1002.00 TO NODE   1002.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   15.36
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.831
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                   B        9.60      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    9.60      SUBAREA RUNOFF(CFS) =   24.09
  EFFECTIVE AREA(ACRES) =     10.80   AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =       10.8       PEAK FLOW RATE(CFS) =      27.10

****************************************************************************
  FLOW PROCESS FROM NODE   1002.00 TO NODE   1003.00 IS CODE =  37
----------------------------------------------------------------------------
  >>>>>COMPUTE CULVERT TRAVEL TIME THRU SUBAREA<<<<<
```

```
  >>>>>USING COMPUTER-ESTIMATED CULVERT SIZE<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1037.70  DOWNSTREAM(FEET) =  1035.50
  FLOW LENGTH(FEET) =   100.00   MANNING'S N =  0.014
  Notes:
    1. Reference: "Hydraulic Charts for the Selection of
       Highway Culverts", Hydraulic Engineering Circular No. 5,
       December 1965, Federal Highway Administration.
    2. INLET control for all Culvert Analysis.
    3. Headwater depth is ASSUMED to be 3 FEET above the culvert soffit.
  GIVEN BOX CULVERT HEIGHT(FEET) =   1.00
  ESTIMATED BOX CULVERT BASEWIDTH(FEET) =    2.85
  CULVERT-FLOW VELOCITY(FEET/SEC.) =   9.50
  CULVERT-FLOW(CFS) =      27.10
  CULVERT-FLOW TRAVEL TIME(MIN.) =   0.18    Tc(MIN.) =   15.54
  LONGEST FLOWPATH FROM NODE   1000.00 TO NODE   1003.00 =    1330.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   1003.00 TO NODE   1003.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   15.54
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.811
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                  B        1.40      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    1.40      SUBAREA RUNOFF(CFS) =    3.49
  EFFECTIVE AREA(ACRES) =     12.20   AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =       12.2       PEAK FLOW RATE(CFS) =      30.41

****************************************************************************
  FLOW PROCESS FROM NODE   1003.00 TO NODE   1004.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  4 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1035.50  DOWNSTREAM ELEVATION(FEET) = 1030.80
  STREET LENGTH(FEET) =   560.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 35.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  25.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

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

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      31.54
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.70
    HALFSTREET FLOOD WIDTH(FEET) =   31.91
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.77
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    2.65
  STREET FLOW TRAVEL TIME(MIN.) =   2.47   Tc(MIN.) =   18.01
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.573
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                  B        1.00      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    1.00      SUBAREA RUNOFF(CFS) =    2.28
  EFFECTIVE AREA(ACRES) =     13.20    AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
```

```
 TOTAL AREA(ACRES) =       13.2        PEAK FLOW RATE(CFS) =      30.41
 NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

 END OF SUBAREA STREET FLOW HYDRAULICS:
 DEPTH(FEET) = 0.69   HALFSTREET FLOOD WIDTH(FEET) =  30.98
 FLOW VELOCITY(FEET/SEC.) =  3.76   DEPTH*VELOCITY(FT*FT/SEC.) =   2.61
 LONGEST FLOWPATH FROM NODE   1000.00 TO NODE   1004.00 =    1890.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   1004.00 TO NODE   1004.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =   18.01
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.573
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                 B        8.40      0.42     0.100    76
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA AREA(ACRES) =    8.40      SUBAREA RUNOFF(CFS) =   19.13
 EFFECTIVE AREA(ACRES) =     21.60   AREA-AVERAGED Fm(INCH/HR) =  0.04
 AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =       21.6       PEAK FLOW RATE(CFS) =      49.20

****************************************************************************
 FLOW PROCESS FROM NODE   1004.00 TO NODE   1005.00 IS CODE =  31
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =  1030.80  DOWNSTREAM(FEET) =  1030.00
 FLOW LENGTH(FEET) =   100.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  36.0 INCH PIPE IS  26.0 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   9.02
 ESTIMATED PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      49.20
 PIPE TRAVEL TIME(MIN.) =   0.18    Tc(MIN.) =   18.20
 LONGEST FLOWPATH FROM NODE   1000.00 TO NODE   1005.00 =    1990.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   1005.00 TO NODE   1005.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =   18.20
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.557
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                 B        2.80      0.42     0.100    76
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA AREA(ACRES) =    2.80      SUBAREA RUNOFF(CFS) =    6.34
 EFFECTIVE AREA(ACRES) =     24.40   AREA-AVERAGED Fm(INCH/HR) =  0.04
 AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =       24.4       PEAK FLOW RATE(CFS) =      55.23

****************************************************************************
 FLOW PROCESS FROM NODE   1005.00 TO NODE   1006.00 IS CODE =  62
----------------------------------------------------------------------------
 >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>(STREET TABLE SECTION #  4 USED)<<<<<
============================================================================
 UPSTREAM ELEVATION(FEET) = 1030.00  DOWNSTREAM ELEVATION(FEET) = 1025.20
 STREET LENGTH(FEET) =   250.00   CURB HEIGHT(INCHES) =  8.0
 STREET HALFWIDTH(FEET) = 35.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  25.00
 INSIDE STREET CROSSFALL(DECIMAL) =  0.018
```

```
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

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

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      55.67
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.74
    HALFSTREET FLOOD WIDTH(FEET) =   35.25
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    5.91
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    4.34
  STREET FLOW TRAVEL TIME(MIN.) =   0.71   Tc(MIN.) =   18.91
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.500
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.40      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.40      SUBAREA RUNOFF(CFS) =    0.88
  EFFECTIVE AREA(ACRES) =     24.80    AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =       24.8        PEAK FLOW RATE(CFS) =      55.23
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.73   HALFSTREET FLOOD WIDTH(FEET) =  35.06
  FLOW VELOCITY(FEET/SEC.) =  5.90   DEPTH*VELOCITY(FT*FT/SEC.) =   4.32
  LONGEST FLOWPATH FROM NODE   1000.00 TO NODE   1006.00 =    2240.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   1006.00 TO NODE   1007.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1018.20  DOWNSTREAM(FEET) =  1011.30
  FLOW LENGTH(FEET) =    95.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  36.0 INCH PIPE IS  14.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  21.53
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      55.23
  PIPE TRAVEL TIME(MIN.) =   0.07    Tc(MIN.) =   18.98
  LONGEST FLOWPATH FROM NODE   1000.00 TO NODE   1007.00 =    2335.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   1007.00 TO NODE   1007.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   18.98
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.494
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.80      0.42     0.100    76
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        3.60      0.42     0.600    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.509
  SUBAREA AREA(ACRES) =    4.40      SUBAREA RUNOFF(CFS) =    9.02
  EFFECTIVE AREA(ACRES) =     29.20   AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.16
  TOTAL AREA(ACRES) =       29.2       PEAK FLOW RATE(CFS) =      63.74

****************************************************************************
  FLOW PROCESS FROM NODE   1007.00 TO NODE   1010.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
```

```
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
==============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1010.50  DOWNSTREAM(FEET) =  1006.47
  FLOW LENGTH(FEET) =   250.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  42.0 INCH PIPE IS  21.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  12.75
  GIVEN PIPE DIAMETER(INCH) =  42.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      63.74
  PIPE TRAVEL TIME(MIN.) =   0.33    Tc(MIN.) =   19.31
  LONGEST FLOWPATH FROM NODE   1000.00 TO NODE   1010.00 =    2585.00 FEET.

******************************************************************************
  FLOW PROCESS FROM NODE   1010.00 TO NODE   1010.00 IS CODE =  81
------------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
==============================================================================
  MAINLINE Tc(MIN.) =   19.31
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.468
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        2.40      0.42     0.100    76
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        0.30      0.42     0.600    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.156
  SUBAREA AREA(ACRES) =    2.70      SUBAREA RUNOFF(CFS) =    5.84
  EFFECTIVE AREA(ACRES) =     31.90   AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.16
  TOTAL AREA(ACRES) =       31.9       PEAK FLOW RATE(CFS) =      68.91

******************************************************************************
  FLOW PROCESS FROM NODE   1010.00 TO NODE   1020.00 IS CODE =  41
------------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
==============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1006.47  DOWNSTREAM(FEET) =  1003.30
  FLOW LENGTH(FEET) =   400.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  48.0 INCH PIPE IS  25.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   9.96
  GIVEN PIPE DIAMETER(INCH) =  48.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      68.91
  PIPE TRAVEL TIME(MIN.) =   0.67    Tc(MIN.) =   19.97
  LONGEST FLOWPATH FROM NODE   1000.00 TO NODE   1020.00 =    2985.00 FEET.

******************************************************************************
  FLOW PROCESS FROM NODE   1020.00 TO NODE   1020.00 IS CODE =  81
------------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
==============================================================================
  MAINLINE Tc(MIN.) =   19.97
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.418
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.70      0.42     0.100    76
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        0.30      0.42     0.600    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.250
  SUBAREA AREA(ACRES) =    1.00      SUBAREA RUNOFF(CFS) =    2.08
  EFFECTIVE AREA(ACRES) =     32.90   AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.16
  TOTAL AREA(ACRES) =       32.9       PEAK FLOW RATE(CFS) =      69.55

******************************************************************************
  FLOW PROCESS FROM NODE   1020.00 TO NODE   1030.00 IS CODE =  41
------------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
```

```
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1003.30  DOWNSTREAM(FEET) =   999.50
  FLOW LENGTH(FEET) =   350.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  48.0 INCH PIPE IS  23.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  11.24
  GIVEN PIPE DIAMETER(INCH) =  48.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      69.55
  PIPE TRAVEL TIME(MIN.) =   0.52    Tc(MIN.) =   20.49
  LONGEST FLOWPATH FROM NODE   1000.00 TO NODE   1030.00 =    3335.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       32.9  TC(MIN.) =     20.49
  EFFECTIVE AREA(ACRES) =     32.90  AREA-AVERAGED Fm(INCH/HR)=  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap = 0.164
  PEAK FLOW RATE(CFS)   =      69.55
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
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             Ver. 15.0  Release Date: 04/01/2008  License ID 1555

                           Analysis prepared by:




 ************************** DESCRIPTION OF STUDY **************************
 * REDLANDS PASSENGER RAIL PROJECT                                          *
 * EXISTING 100 YEAR ANALYSIS                                               *
 * BASIN 1100                                                               *
 **************************************************************************

  FILE NAME: C:\RPRP\1100.DAT
  TIME/DATE OF STUDY: 07:51 05/23/2012
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2500

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======   ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  2   13.0      8.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  3   25.0     15.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  4   35.0     25.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  5   20.0     15.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.20 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE   1100.00 TO NODE   1110.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   190.00
  ELEVATION DATA: UPSTREAM(FEET) =   1027.60  DOWNSTREAM(FEET) =   1020.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.000
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.552
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
```

```
  COMMERCIAL                 B        0.40      0.42     0.100    76    5.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      1.98
  TOTAL AREA(ACRES) =      0.40   PEAK FLOW RATE(CFS) =      1.98

****************************************************************************
  FLOW PROCESS FROM NODE   1110.00 TO NODE   1120.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1020.00  DOWNSTREAM(FEET) =   1014.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =   347.00   CHANNEL SLOPE =  0.0159
  CHANNEL BASE(FEET) =    4.00   "Z" FACTOR =  13.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   0.50
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.619
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.80      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      3.64
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.23
  AVERAGE FLOW DEPTH(FEET) =   0.18   TRAVEL TIME(MIN.) =   1.79
  Tc(MIN.) =    6.79
  SUBAREA AREA(ACRES) =     0.80       SUBAREA RUNOFF(CFS) =    3.30
  EFFECTIVE AREA(ACRES) =      1.20     AREA-AVERAGED Fm(INCH/HR) =   0.04
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =       1.2        PEAK FLOW RATE(CFS) =      4.94

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.21   FLOW VELOCITY(FEET/SEC.) =   3.52
  LONGEST FLOWPATH FROM NODE   1100.00 TO NODE   1120.00 =     537.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   1120.00 TO NODE   1130.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1014.50  DOWNSTREAM(FEET) =  1012.00
  FLOW LENGTH(FEET) =   106.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  36.0 INCH PIPE IS   5.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   7.20
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       4.94
  PIPE TRAVEL TIME(MIN.) =   0.25    Tc(MIN.) =    7.04
  LONGEST FLOWPATH FROM NODE   1100.00 TO NODE   1130.00 =     643.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   1130.00 TO NODE   1130.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    7.04
  RAINFALL INTENSITY(INCH/HR) =   4.52
  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       1.20
  TOTAL STREAM AREA(ACRES) =       1.20
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       4.94

****************************************************************************
  FLOW PROCESS FROM NODE   1140.00 TO NODE   1145.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
```

```
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   250.00
  ELEVATION DATA: UPSTREAM(FEET) =   1027.40  DOWNSTREAM(FEET) =   1017.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.227
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.406
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 B        0.30      0.42     0.100    76    5.23
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      1.45
  TOTAL AREA(ACRES) =      0.30   PEAK FLOW RATE(CFS) =      1.45

****************************************************************************
  FLOW PROCESS FROM NODE   1145.00 TO NODE   1135.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1017.00  DOWNSTREAM(FEET) =  1016.50
  FLOW LENGTH(FEET) =    69.00   MANNING'S N =  0.024
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   6.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   2.30
  GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.45
  PIPE TRAVEL TIME(MIN.) =   0.50    Tc(MIN.) =    5.73
  LONGEST FLOWPATH FROM NODE   1140.00 TO NODE   1135.00 =     319.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   1135.00 TO NODE   1135.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    5.73
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.118
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.80      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.80      SUBAREA RUNOFF(CFS) =    3.65
  EFFECTIVE AREA(ACRES) =      1.10   AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        1.1       PEAK FLOW RATE(CFS) =       5.02

****************************************************************************
  FLOW PROCESS FROM NODE   1135.00 TO NODE   1130.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1016.50  DOWNSTREAM(FEET) =  1012.70
  FLOW LENGTH(FEET) =   154.00   MANNING'S N =  0.024
  DEPTH OF FLOW IN  24.0 INCH PIPE IS   8.6 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.97
  GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       5.02
  PIPE TRAVEL TIME(MIN.) =   0.52    Tc(MIN.) =    6.24
  LONGEST FLOWPATH FROM NODE   1140.00 TO NODE   1130.00 =     473.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   1130.00 TO NODE   1130.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
```

```
TOTAL NUMBER OF STREAMS =  2
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
TIME OF CONCENTRATION(MIN.) =    6.24
RAINFALL INTENSITY(INCH/HR) =   4.86
AREA-AVERAGED Fm(INCH/HR) =  0.04
AREA-AVERAGED Fp(INCH/HR) =  0.42
AREA-AVERAGED Ap =  0.10
EFFECTIVE STREAM AREA(ACRES) =       1.10
TOTAL STREAM AREA(ACRES) =       1.10
PEAK FLOW RATE(CFS) AT CONFLUENCE =       5.02

** CONFLUENCE DATA **
 STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
 NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
    1        4.94    7.04    4.522  0.42( 0.04) 0.10       1.2    1100.00
    2        5.02    6.24    4.859  0.42( 0.04) 0.10       1.1    1140.00

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

** PEAK FLOW RATE TABLE **
 STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
 NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
    1        9.74    6.24    4.859  0.42( 0.04) 0.10       2.2    1140.00
    2        9.62    7.04    4.522  0.42( 0.04) 0.10       2.3    1100.00

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
PEAK FLOW RATE(CFS) =       9.74    Tc(MIN.) =     6.24
EFFECTIVE AREA(ACRES) =       2.16   AREA-AVERAGED Fm(INCH/HR) =  0.04
AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
TOTAL AREA(ACRES) =        2.3
LONGEST FLOWPATH FROM NODE   1100.00 TO NODE   1130.00 =     643.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   1130.00 TO NODE   1160.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1012.70  DOWNSTREAM(FEET) =  1012.00
  FLOW LENGTH(FEET) =    81.00   MANNING'S N =  0.024
  DEPTH OF FLOW IN  36.0 INCH PIPE IS  13.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.96
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       9.74
  PIPE TRAVEL TIME(MIN.) =   0.34    Tc(MIN.) =    6.58
  LONGEST FLOWPATH FROM NODE   1100.00 TO NODE   1160.00 =     724.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   1160.00 TO NODE   1170.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1012.00  DOWNSTREAM(FEET) =   1007.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   140.00   CHANNEL SLOPE =  0.0357
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.537
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                B        2.00      0.42     0.850    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      13.50
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   5.62
  AVERAGE FLOW DEPTH(FEET) =   0.70   TRAVEL TIME(MIN.) =   0.42
  Tc(MIN.) =    7.00
  SUBAREA AREA(ACRES) =     2.00       SUBAREA RUNOFF(CFS) =    7.52
  EFFECTIVE AREA(ACRES) =      4.16     AREA-AVERAGED Fm(INCH/HR) =   0.19
```

```
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.46
  TOTAL AREA(ACRES) =        4.3         PEAK FLOW RATE(CFS) =      16.28

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.78   FLOW VELOCITY(FEET/SEC.) =   5.91
  LONGEST FLOWPATH FROM NODE   1100.00 TO NODE   1170.00 =     864.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        4.3  TC(MIN.) =      7.00
  EFFECTIVE AREA(ACRES) =      4.16  AREA-AVERAGED Fm(INCH/HR)=  0.19
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap = 0.460
  PEAK FLOW RATE(CFS)   =      16.28

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       16.28    7.00    4.537  0.42( 0.19) 0.46       4.2    1140.00
      2       15.72    7.80    4.253  0.42( 0.19) 0.45       4.3    1100.00
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
____________________________________________________________________________
****************************************************************************
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             Ver. 15.0  Release Date: 04/01/2008  License ID 1555

                           Analysis prepared by:







 ************************** DESCRIPTION OF STUDY **************************
* REDLANDS PASSENGER RAIL PROJECT                                          *
* EXISTING HYDROLOGY 100 YEAR STORM                                        *
* BASIN 2000                                                               *
 **************************************************************************

  FILE NAME: C:\RPRP\EPRP\2000.DAT
  TIME/DATE OF STUDY: 15:21 09/11/2012
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 1.00
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2500

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.20 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE   2100.00 TO NODE   2110.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   180.00
  ELEVATION DATA: UPSTREAM(FEET) =   1020.80  DOWNSTREAM(FEET) =   1020.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   13.858
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.012
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK                B        1.00      0.42     0.850    76   13.86
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA RUNOFF(CFS) =      2.39
```

```
  TOTAL AREA(ACRES) =      1.00   PEAK FLOW RATE(CFS) =      2.39

****************************************************************************
  FLOW PROCESS FROM NODE   2110.00 TO NODE   2120.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1020.50  DOWNSTREAM(FEET) =   1019.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   330.00   CHANNEL SLOPE =  0.0045
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   3.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.668
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                B        1.50      0.42     0.850    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      3.95
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.77
  AVERAGE FLOW DEPTH(FEET) =   0.59   TRAVEL TIME(MIN.) =   3.10
  Tc(MIN.) =   16.96
  SUBAREA AREA(ACRES) =     1.50       SUBAREA RUNOFF(CFS) =    3.12
  EFFECTIVE AREA(ACRES) =      2.50     AREA-AVERAGED Fm(INCH/HR) =   0.36
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.85
  TOTAL AREA(ACRES) =        2.5         PEAK FLOW RATE(CFS) =       5.19

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.67   FLOW VELOCITY(FEET/SEC.) =   1.91
  LONGEST FLOWPATH FROM NODE   2100.00 TO NODE   2120.00 =     510.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   2120.00 TO NODE   2130.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1019.00  DOWNSTREAM(FEET) =   1014.80
  CHANNEL LENGTH THRU SUBAREA(FEET) =  1290.00   CHANNEL SLOPE =  0.0033
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  1.980
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                B        2.50      0.42     0.850    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      7.03
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.97
  AVERAGE FLOW DEPTH(FEET) =   0.93   TRAVEL TIME(MIN.) =  10.91
  Tc(MIN.) =   27.86
  SUBAREA AREA(ACRES) =     2.50       SUBAREA RUNOFF(CFS) =    3.65
  EFFECTIVE AREA(ACRES) =      5.00     AREA-AVERAGED Fm(INCH/HR) =   0.36
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.85
  TOTAL AREA(ACRES) =        5.0         PEAK FLOW RATE(CFS) =       7.29

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.94   FLOW VELOCITY(FEET/SEC.) =   1.99
  LONGEST FLOWPATH FROM NODE   2100.00 TO NODE   2130.00 =    1800.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        5.0  TC(MIN.) =     27.86
  EFFECTIVE AREA(ACRES) =      5.00  AREA-AVERAGED Fm(INCH/HR)=  0.36
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap = 0.850
  PEAK FLOW RATE(CFS)   =      7.29
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
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                            Analysis prepared by:




 ************************** DESCRIPTION OF STUDY **************************
* REDLANDS PASSENGER RAIL PROGRAM                                          *
* EXISTING 100 YEAR ANALYSIS                                               *
* DRAINAGE AREA 3000                                                       *
 **************************************************************************

  FILE NAME: C:\RPRP\3000.DAT
  TIME/DATE OF STUDY: 10:31 05/23/2012
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 1.00
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2500

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN- / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)     (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.20 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE   3000.00 TO NODE   3010.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =  1350.00
  ELEVATION DATA: UPSTREAM(FEET) =   1021.00  DOWNSTREAM(FEET) =   1015.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   21.750
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.298
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        0.80      0.42     0.600    76   21.75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
```

```
  SUBAREA RUNOFF(CFS) =      1.47
  TOTAL AREA(ACRES) =      0.80   PEAK FLOW RATE(CFS) =      1.47
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        0.8  TC(MIN.) =     21.75
  EFFECTIVE AREA(ACRES) =      0.80  AREA-AVERAGED Fm(INCH/HR)=  0.25
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap = 0.600
  PEAK FLOW RATE(CFS)   =       1.47
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
         (c) Copyright 1983-2008 Advanced Engineering Software (aes)
             Ver. 15.0  Release Date: 04/01/2008  License ID 1555

                          Analysis prepared by:




 ************************** DESCRIPTION OF STUDY **************************
* REDLANDS PASSENGER RAIL PROJECT                                          *
* EXISTING 100 YEAR ANALYSIS                                               *
* DRAINAGE AREA 5000                                                       *
 **************************************************************************

  FILE NAME: C:\RPRP\5000.DAT
  TIME/DATE OF STUDY: 11:31 06/01/2012
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 1.00
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2500

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.20 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE   5000.00 TO NODE   5005.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   194.00
  ELEVATION DATA: UPSTREAM(FEET) =   1024.00  DOWNSTREAM(FEET) =   1022.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   10.505
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.556
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK                B       1.00      0.42     0.850    76   10.51
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA RUNOFF(CFS) =      2.88
```

```
  TOTAL AREA(ACRES) =      1.00   PEAK FLOW RATE(CFS) =      2.88

****************************************************************************
  FLOW PROCESS FROM NODE   5005.00 TO NODE   5010.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1022.60  DOWNSTREAM(FEET) =   1020.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   490.00   CHANNEL SLOPE =  0.0053
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =   3.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.951
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                B        4.80      0.42     0.850    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       8.52
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.13
  AVERAGE FLOW DEPTH(FEET) =   0.59   TRAVEL TIME(MIN.) =   3.83
  Tc(MIN.) =   14.34
  SUBAREA AREA(ACRES) =     4.80       SUBAREA RUNOFF(CFS) =   11.19
  EFFECTIVE AREA(ACRES) =      5.80     AREA-AVERAGED Fm(INCH/HR) =   0.36
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.85
  TOTAL AREA(ACRES) =        5.8         PEAK FLOW RATE(CFS) =      13.53

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.76   FLOW VELOCITY(FEET/SEC.) =   2.45
  LONGEST FLOWPATH FROM NODE   5000.00 TO NODE   5010.00 =     684.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   5010.00 TO NODE   5015.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1020.00  DOWNSTREAM ELEVATION(FEET) = 1018.60
  STREET LENGTH(FEET) =   309.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

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

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      18.43
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.66
    HALFSTREET FLOOD WIDTH(FEET) =   27.62
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.63
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.73
  STREET FLOW TRAVEL TIME(MIN.) =   1.96   Tc(MIN.) =   16.30
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.733
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "2 DWELLINGS/ACRE"         B        4.47      0.42     0.700    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.700
  SUBAREA AREA(ACRES) =    4.47      SUBAREA RUNOFF(CFS) =    9.80
  EFFECTIVE AREA(ACRES) =     10.27    AREA-AVERAGED Fm(INCH/HR) =  0.33
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.78
  TOTAL AREA(ACRES) =       10.3        PEAK FLOW RATE(CFS) =      22.19
```

```
  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.69   HALFSTREET FLOOD WIDTH(FEET) =  30.92
  FLOW VELOCITY(FEET/SEC.) =  2.75   DEPTH*VELOCITY(FT*FT/SEC.) =   1.91
  LONGEST FLOWPATH FROM NODE   5000.00 TO NODE   5015.00 =     993.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   5015.00 TO NODE   5020.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1018.60  DOWNSTREAM ELEVATION(FEET) = 1017.30
  STREET LENGTH(FEET) =   328.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

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

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      25.78
    ***STREET FLOW SPLITS OVER STREET-CROWN***
    FULL DEPTH(FEET) =    0.70   FLOOD WIDTH(FEET) =   31.58
    FULL HALF-STREET VELOCITY(FEET/SEC.) =    2.59
    SPLIT DEPTH(FEET) =    0.45   SPLIT FLOOD WIDTH(FEET) =   16.13
    SPLIT FLOW(CFS) =    4.44   SPLIT VELOCITY(FEET/SEC.) =    1.76
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.70
    HALFSTREET FLOOD WIDTH(FEET) =   31.58
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.59
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.81
  STREET FLOW TRAVEL TIME(MIN.) =   2.11   Tc(MIN.) =   18.41
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.540
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "2 DWELLINGS/ACRE"         B        3.56      0.42     0.700    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.700
  SUBAREA AREA(ACRES) =    3.56      SUBAREA RUNOFF(CFS) =    7.19
  EFFECTIVE AREA(ACRES) =     13.83    AREA-AVERAGED Fm(INCH/HR) =  0.32
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.76
  TOTAL AREA(ACRES) =       13.8        PEAK FLOW RATE(CFS) =      27.59

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.70   HALFSTREET FLOOD WIDTH(FEET) =  31.58
  FLOW VELOCITY(FEET/SEC.) =  2.59   DEPTH*VELOCITY(FT*FT/SEC.) =   1.81
  LONGEST FLOWPATH FROM NODE   5000.00 TO NODE   5020.00 =    1321.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   5020.00 TO NODE   5025.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1017.30  DOWNSTREAM ELEVATION(FEET) = 1017.00
  STREET LENGTH(FEET) =   308.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

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

```
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      30.14
    ***STREET FLOWING FULL***
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.76
    HALFSTREET FLOOD WIDTH(FEET) =   34.79
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.45
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.11
  STREET FLOW TRAVEL TIME(MIN.) =   3.54   Tc(MIN.) =   21.95
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.285
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        2.78      0.42     0.600    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  SUBAREA AREA(ACRES) =    2.78      SUBAREA RUNOFF(CFS) =    5.08
  EFFECTIVE AREA(ACRES) =     16.61    AREA-AVERAGED Fm(INCH/HR) =  0.31
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.74
  TOTAL AREA(ACRES) =       16.6        PEAK FLOW RATE(CFS) =      29.51

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.76   HALFSTREET FLOOD WIDTH(FEET) =  34.60
  FLOW VELOCITY(FEET/SEC.) =  1.44   DEPTH*VELOCITY(FT*FT/SEC.) =   1.09
  LONGEST FLOWPATH FROM NODE   5000.00 TO NODE   5025.00 =    1629.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   5025.00 TO NODE   5030.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1017.00  DOWNSTREAM ELEVATION(FEET) = 1016.00
  STREET LENGTH(FEET) =   487.22   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

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

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      32.43
    ***STREET FLOWING FULL***
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.71
    HALFSTREET FLOOD WIDTH(FEET) =   32.04
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.90
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.34
  STREET FLOW TRAVEL TIME(MIN.) =   4.28   Tc(MIN.) =   26.23
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.054
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        3.60      0.42     0.600    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  SUBAREA AREA(ACRES) =    3.60      SUBAREA RUNOFF(CFS) =    5.83
  EFFECTIVE AREA(ACRES) =     20.21    AREA-AVERAGED Fm(INCH/HR) =  0.30
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.71
  TOTAL AREA(ACRES) =       20.2        PEAK FLOW RATE(CFS) =      31.88

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.71   HALFSTREET FLOOD WIDTH(FEET) =  31.92
  FLOW VELOCITY(FEET/SEC.) =  1.88   DEPTH*VELOCITY(FT*FT/SEC.) =   1.33
```

```
  LONGEST FLOWPATH FROM NODE   5000.00 TO NODE   5030.00 =    2116.22 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   5030.00 TO NODE   5030.00 IS CODE =  82
----------------------------------------------------------------------------
  >>>>>ADD SUBAREA RUNOFF TO MAINLINE, AT MAINLINE Tc,<<<<<
  >>>>>(AND COMPUTE INITIAL SUBAREA RUNOFF)<<<<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =  1190.00
  ELEVATION DATA: UPSTREAM(FEET) =   1020.50  DOWNSTREAM(FEET) =   1016.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   15.760
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.788
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 B        1.10      0.42     0.100    76   15.76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    1.10   INITIAL SUBAREA RUNOFF(CFS) =    2.72

  ** ADD SUBAREA RUNOFF TO MAINLINE AT MAINLINE Tc:
  MAINLINE Tc(MIN.) =   26.23
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.054
  SUBAREA AREA(ACRES) =    1.10      SUBAREA RUNOFF(CFS) =    1.99
  EFFECTIVE AREA(ACRES) =     21.31   AREA-AVERAGED Fm(INCH/HR) =  0.29
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.68
  TOTAL AREA(ACRES) =       21.3       PEAK FLOW RATE(CFS) =      33.87

****************************************************************************
  FLOW PROCESS FROM NODE   5030.00 TO NODE   5040.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1016.00  DOWNSTREAM(FEET) =   1014.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   904.60   CHANNEL SLOPE =  0.0022
  CHANNEL BASE(FEET) =    3.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  1.819
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                B        0.90      0.42     0.850    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      34.46
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.56
  AVERAGE FLOW DEPTH(FEET) =   1.95   TRAVEL TIME(MIN.) =   5.89
  Tc(MIN.) =   32.11
  SUBAREA AREA(ACRES) =     0.90       SUBAREA RUNOFF(CFS) =    1.18
  EFFECTIVE AREA(ACRES) =     22.21     AREA-AVERAGED Fm(INCH/HR) =   0.29
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.69
  TOTAL AREA(ACRES) =       22.2         PEAK FLOW RATE(CFS) =      33.87
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  1.94   FLOW VELOCITY(FEET/SEC.) =   2.55
  LONGEST FLOWPATH FROM NODE   5000.00 TO NODE   5040.00 =    3020.82 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   5040.00 TO NODE   5040.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   32.11
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  1.819
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
```

```
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        4.40      0.42     0.600    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  SUBAREA AREA(ACRES) =    4.40      SUBAREA RUNOFF(CFS) =    6.20
  EFFECTIVE AREA(ACRES) =     26.61   AREA-AVERAGED Fm(INCH/HR) =  0.28
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.67
  TOTAL AREA(ACRES) =       26.6       PEAK FLOW RATE(CFS) =      36.75

****************************************************************************
  FLOW PROCESS FROM NODE   5040.00 TO NODE   5050.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1014.00  DOWNSTREAM(FEET) =   1010.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   565.00   CHANNEL SLOPE =  0.0071
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =   3.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  1.736
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                B        0.40      0.42     0.850    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      36.99
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.64
  AVERAGE FLOW DEPTH(FEET) =   1.19   TRAVEL TIME(MIN.) =   2.59
  Tc(MIN.) =   34.70
  SUBAREA AREA(ACRES) =     0.40       SUBAREA RUNOFF(CFS) =    0.50
  EFFECTIVE AREA(ACRES) =     27.01     AREA-AVERAGED Fm(INCH/HR) =   0.29
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.68
  TOTAL AREA(ACRES) =       27.0         PEAK FLOW RATE(CFS) =      36.75
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  1.19   FLOW VELOCITY(FEET/SEC.) =   3.62
  LONGEST FLOWPATH FROM NODE   5000.00 TO NODE   5050.00 =    3585.82 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   5050.00 TO NODE   5050.00 IS CODE =  82
----------------------------------------------------------------------------
  >>>>>ADD SUBAREA RUNOFF TO MAINLINE, AT MAINLINE Tc,<<<<<
  >>>>>(AND COMPUTE INITIAL SUBAREA RUNOFF)<<<<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   584.00
  ELEVATION DATA: UPSTREAM(FEET) =   1016.00  DOWNSTREAM(FEET) =   1010.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.707
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.729
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 B        3.30      0.42     0.100    76    9.71
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    3.30   INITIAL SUBAREA RUNOFF(CFS) =   10.95

  ** ADD SUBAREA RUNOFF TO MAINLINE AT MAINLINE Tc:
  MAINLINE Tc(MIN.) =   34.70
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  1.736
  SUBAREA AREA(ACRES) =    3.30      SUBAREA RUNOFF(CFS) =    5.03
  EFFECTIVE AREA(ACRES) =     30.31   AREA-AVERAGED Fm(INCH/HR) =  0.26
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.61
  TOTAL AREA(ACRES) =       30.3       PEAK FLOW RATE(CFS) =      40.29

****************************************************************************
  FLOW PROCESS FROM NODE   5050.00 TO NODE   5050.00 IS CODE =  82
----------------------------------------------------------------------------
```

```
 >>>>>ADD SUBAREA RUNOFF TO MAINLINE, AT MAINLINE Tc,<<<<<
 >>>>>(AND COMPUTE INITIAL SUBAREA RUNOFF)<<<<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   267.00
 ELEVATION DATA: UPSTREAM(FEET) =   1013.40  DOWNSTREAM(FEET) =   1010.00

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.800
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.616
 SUBAREA Tc AND LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 COMMERCIAL                 B        0.80      0.42     0.100    76    6.80
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA AREA(ACRES) =    0.80   INITIAL SUBAREA RUNOFF(CFS) =    3.29

 ** ADD SUBAREA RUNOFF TO MAINLINE AT MAINLINE Tc:
 MAINLINE Tc(MIN.) =   34.70
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  1.736
 SUBAREA AREA(ACRES) =    0.80      SUBAREA RUNOFF(CFS) =    1.22
 EFFECTIVE AREA(ACRES) =     31.11   AREA-AVERAGED Fm(INCH/HR) =  0.25
 AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.60
 TOTAL AREA(ACRES) =       31.1       PEAK FLOW RATE(CFS) =      41.51
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)     =       31.1  TC(MIN.) =     34.70
 EFFECTIVE AREA(ACRES) =     31.11  AREA-AVERAGED Fm(INCH/HR)=  0.25
 AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap = 0.599
 PEAK FLOW RATE(CFS)   =      41.51
============================================================================
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

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****************************************************************************
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                           Analysis prepared by:




 ************************** DESCRIPTION OF STUDY **************************
* REDLANDS PASSENGER RAIL PROJECT                                          *
* 100 YEAR STORM EVENT                                                     *
* BASIN 5500                                                               *
 **************************************************************************

  FILE NAME: C:\RPRP\EPRP\5500.DAT
  TIME/DATE OF STUDY: 17:21 07/13/2012
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2500

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======   ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   20.0     15.0    0.020/0.020/0.020   0.50    1.50 0.0312 0.125 0.0170

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.20 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE   5501.00 TO NODE   5502.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   283.50
  ELEVATION DATA: UPSTREAM(FEET) =   1030.00  DOWNSTREAM(FEET) =   1028.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   12.453
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.211
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK                B       0.90      0.42     0.850    76   12.45
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
```

```
  SUBAREA RUNOFF(CFS) =      2.31
  TOTAL AREA(ACRES) =      0.90   PEAK FLOW RATE(CFS) =      2.31

****************************************************************************
  FLOW PROCESS FROM NODE   5502.00 TO NODE   5503.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1028.00  DOWNSTREAM(FEET) =   1024.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  1472.00   CHANNEL SLOPE =  0.0027
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =   5.000
  MANNING'S FACTOR = 0.017   MAXIMUM DEPTH(FEET) =   5.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.427
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B       27.50      0.42     0.600    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      29.63
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.31
  AVERAGE FLOW DEPTH(FEET) =   0.93   TRAVEL TIME(MIN.) =   7.41
  Tc(MIN.) =   19.86
  SUBAREA AREA(ACRES) =    27.50       SUBAREA RUNOFF(CFS) =   53.78
  EFFECTIVE AREA(ACRES) =     28.40     AREA-AVERAGED Fm(INCH/HR) =   0.26
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =  0.61
  TOTAL AREA(ACRES) =       28.4         PEAK FLOW RATE(CFS) =      55.45

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  1.26   FLOW VELOCITY(FEET/SEC.) =   3.91
  LONGEST FLOWPATH FROM NODE   5501.00 TO NODE   5503.00 =    1755.50 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   5503.00 TO NODE   5503.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   19.86
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.427
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                B       11.10      0.42     0.850    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA AREA(ACRES) =   11.10      SUBAREA RUNOFF(CFS) =   20.65
  EFFECTIVE AREA(ACRES) =     39.50   AREA-AVERAGED Fm(INCH/HR) =  0.29
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.68
  TOTAL AREA(ACRES) =       39.5       PEAK FLOW RATE(CFS) =      76.10

****************************************************************************
  FLOW PROCESS FROM NODE   5503.00 TO NODE   5504.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  2 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1024.00  DOWNSTREAM ELEVATION(FEET) = 1015.00
  STREET LENGTH(FEET) =  1482.60   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  15.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  2
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0170
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0170
```

```
    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      92.67
    ***STREET FLOWING FULL***
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.81
    HALFSTREET FLOOD WIDTH(FEET) =   35.75
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.75
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    3.05
  STREET FLOW TRAVEL TIME(MIN.) =   6.60   Tc(MIN.) =   26.46
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.043
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B       18.40      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =   18.40      SUBAREA RUNOFF(CFS) =   33.13
  EFFECTIVE AREA(ACRES) =     57.90    AREA-AVERAGED Fm(INCH/HR) =  0.21
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.49
  TOTAL AREA(ACRES) =       57.9        PEAK FLOW RATE(CFS) =      95.60

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.82   HALFSTREET FLOOD WIDTH(FEET) =  36.17
  FLOW VELOCITY(FEET/SEC.) =  3.77   DEPTH*VELOCITY(FT*FT/SEC.) =   3.10
  *NOTE: INITIAL SUBAREA NOMOGRAPH WITH SUBAREA PARAMETERS,
         AND L = 1482.6 FT WITH ELEVATION-DROP =   9.0 FT, IS   45.7 CFS,
         WHICH EXCEEDS THE TOP-OF-CURB STREET CAPACITY AT NODE   5504.00
  LONGEST FLOWPATH FROM NODE   5501.00 TO NODE   5504.00 =    3238.10 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       57.9  TC(MIN.) =     26.46
  EFFECTIVE AREA(ACRES) =     57.90  AREA-AVERAGED Fm(INCH/HR)=  0.21
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap = 0.493
  PEAK FLOW RATE(CFS)   =      95.60
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

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****************************************************************************
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                           Analysis prepared by:






 ************************** DESCRIPTION OF STUDY **************************
* REDLANDS PASSENGER RAIL PROJECT                                          *
* EXISTING HYDROLOGY 100 YEAR                                              *
* BASIN 7000                                                               *
 **************************************************************************

  FILE NAME: C:\RPRP\EPRP\7000.DAT
  TIME/DATE OF STUDY: 18:03 02/13/2012
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2500

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======   ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   13.0      8.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  3   25.0     15.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  4   35.0     25.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  5   20.0     15.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.20 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE   7000.00 TO NODE   7010.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   162.00
  ELEVATION DATA: UPSTREAM(FEET) =   1016.00  DOWNSTREAM(FEET) =   1013.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.208
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.123
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
```

```
  PUBLIC PARK                B        0.10      0.42     0.850    76    8.21
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA RUNOFF(CFS) =      0.34
  TOTAL AREA(ACRES) =      0.10   PEAK FLOW RATE(CFS) =      0.34

****************************************************************************
  FLOW PROCESS FROM NODE   7010.00 TO NODE   7020.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1013.00  DOWNSTREAM(FEET) =   1010.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =   276.00   CHANNEL SLOPE =  0.0091
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.355
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                B        0.20      0.42     0.850    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      0.61
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.37
  AVERAGE FLOW DEPTH(FEET) =   0.19   TRAVEL TIME(MIN.) =   3.37
  Tc(MIN.) =   11.58
  SUBAREA AREA(ACRES) =     0.20       SUBAREA RUNOFF(CFS) =    0.54
  EFFECTIVE AREA(ACRES) =      0.30     AREA-AVERAGED Fm(INCH/HR) =   0.36
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.85
  TOTAL AREA(ACRES) =        0.3         PEAK FLOW RATE(CFS) =       0.81

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.22   FLOW VELOCITY(FEET/SEC.) =   1.52
  LONGEST FLOWPATH FROM NODE   7000.00 TO NODE   7020.00 =     438.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   7020.00 TO NODE   7020.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   11.58
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.355
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                B        0.10      0.42     0.850    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA AREA(ACRES) =    0.10      SUBAREA RUNOFF(CFS) =    0.27
  EFFECTIVE AREA(ACRES) =      0.40   AREA-AVERAGED Fm(INCH/HR) =  0.36
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.85
  TOTAL AREA(ACRES) =        0.4       PEAK FLOW RATE(CFS) =      1.08
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        0.4  TC(MIN.) =     11.58
  EFFECTIVE AREA(ACRES) =      0.40  AREA-AVERAGED Fm(INCH/HR)=  0.36
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap = 0.850
  PEAK FLOW RATE(CFS)   =      1.08
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
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                           Analysis prepared by:





 ************************** DESCRIPTION OF STUDY **************************
* REDLANDS PASSENGER RAIL PROJECT                                          *
* EXISTING 100 YEAR ANALYSIS                                               *
* DRAINAGE AREA 8000                                                       *
 **************************************************************************

  FILE NAME: C:\RPRP\8000.DAT
  TIME/DATE OF STUDY: 12:18 06/01/2012
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2500

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  2   13.0      8.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  3   25.0     15.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  4   35.0     25.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  5   20.0     15.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.20 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE   8000.00 TO NODE   8010.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   300.00
  ELEVATION DATA: UPSTREAM(FEET) =   1011.50  DOWNSTREAM(FEET) =   1002.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.047
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.173
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
```

```
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        0.40      0.42     0.600    76    8.05
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  SUBAREA RUNOFF(CFS) =      1.41
  TOTAL AREA(ACRES) =      0.40   PEAK FLOW RATE(CFS) =      1.41
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        0.4  TC(MIN.) =      8.05
  EFFECTIVE AREA(ACRES) =      0.40  AREA-AVERAGED Fm(INCH/HR)=  0.25
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap = 0.600
  PEAK FLOW RATE(CFS)   =       1.41
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
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                            Analysis prepared by:






 ************************** DESCRIPTION OF STUDY **************************
* REDLANDS PASSENGER RAIL PROJECT                                          *
* EXISTING HYDROLOGY 100 YEAR                                              *
* BASIN 8100                                                               *
 **************************************************************************

  FILE NAME: C:\RPRP\EPRP\8100.DAT
  TIME/DATE OF STUDY: 18:16 02/13/2012
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2500

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======   ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   13.0      8.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  3   25.0     15.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  4   35.0     25.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  5   20.0     15.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.20 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE   8100.00 TO NODE   8110.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   103.00
  ELEVATION DATA: UPSTREAM(FEET) =   1012.00  DOWNSTREAM(FEET) =   1010.60

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.285
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.429
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
```

```
 PUBLIC PARK                B        0.10      0.42     0.850    76    7.28
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
 SUBAREA RUNOFF(CFS) =      0.37
 TOTAL AREA(ACRES) =      0.10   PEAK FLOW RATE(CFS) =      0.37

****************************************************************************
 FLOW PROCESS FROM NODE   8110.00 TO NODE   8120.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   1010.60  DOWNSTREAM(FEET) =   1002.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =   300.00   CHANNEL SLOPE =  0.0287
 CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   2.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.760
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 PUBLIC PARK                B        0.30      0.42     0.850    76
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      0.83
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.18
 AVERAGE FLOW DEPTH(FEET) =   0.16   TRAVEL TIME(MIN.) =   2.29
 Tc(MIN.) =    9.57
 SUBAREA AREA(ACRES) =     0.30       SUBAREA RUNOFF(CFS) =    0.92
 EFFECTIVE AREA(ACRES) =      0.40     AREA-AVERAGED Fm(INCH/HR) =   0.36
 AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.85
 TOTAL AREA(ACRES) =        0.4         PEAK FLOW RATE(CFS) =       1.22

 END OF SUBAREA CHANNEL FLOW HYDRAULICS:
 DEPTH(FEET) =  0.20   FLOW VELOCITY(FEET/SEC.) =   2.53
 LONGEST FLOWPATH FROM NODE   8100.00 TO NODE   8120.00 =     403.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE   8120.00 TO NODE   8120.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =    9.57
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.760
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 PUBLIC PARK                B        0.30      0.42     0.850    76
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
 SUBAREA AREA(ACRES) =    0.30      SUBAREA RUNOFF(CFS) =    0.92
 EFFECTIVE AREA(ACRES) =      0.70   AREA-AVERAGED Fm(INCH/HR) =  0.36
 AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.85
 TOTAL AREA(ACRES) =        0.7       PEAK FLOW RATE(CFS) =       2.14
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)     =        0.7  TC(MIN.) =      9.57
 EFFECTIVE AREA(ACRES) =      0.70  AREA-AVERAGED Fm(INCH/HR)=  0.36
 AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap = 0.850
 PEAK FLOW RATE(CFS)   =       2.14
============================================================================
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

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****************************************************************************
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                           Analysis prepared by:




 ************************** DESCRIPTION OF STUDY **************************
* REDLANDS PASSENGER RAIL PROJECT                                          *
* EXISTING 100 YEAR ANALYSIS                                               *
* DRAINAGE AREA 8300                                                       *
 **************************************************************************

  FILE NAME: C:\RPRP\8300.DAT
  TIME/DATE OF STUDY: 13:14 06/01/2012
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2500

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======   ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  2   13.0      8.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  3   25.0     15.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  4   35.0     25.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  5   20.0     15.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.20 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE   8300.00 TO NODE   8310.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   620.00
  ELEVATION DATA: UPSTREAM(FEET) =   1007.00  DOWNSTREAM(FEET) =   1001.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   13.636
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.041
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
```

```
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        0.80      0.42     0.600    76   13.64
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  SUBAREA RUNOFF(CFS) =      2.01
  TOTAL AREA(ACRES) =      0.80   PEAK FLOW RATE(CFS) =      2.01
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        0.8  TC(MIN.) =     13.64
  EFFECTIVE AREA(ACRES) =      0.80  AREA-AVERAGED Fm(INCH/HR)=  0.25
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap = 0.600
  PEAK FLOW RATE(CFS)   =       2.01
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
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                           Analysis prepared by:




 ************************** DESCRIPTION OF STUDY **************************
* REDLANDS PASSENGER RAIL PROJECT                                          *
* EXISTING 100 YEAR ANALYSIS                                               *
* DRAINAGE AREA 9000                                                       *
 **************************************************************************

  FILE NAME: C:\RPRP\9000.DAT
  TIME/DATE OF STUDY: 12:51 06/01/2012
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2500

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======   ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  2   13.0      8.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  3   25.0     15.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  4   35.0     25.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  5   20.0     15.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.20 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE   9000.00 TO NODE   9020.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   799.00
  ELEVATION DATA: UPSTREAM(FEET) =   1010.50  DOWNSTREAM(FEET) =   1004.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   15.626
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.802
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
```

```
 RESIDENTIAL
 "3-4 DWELLINGS/ACRE"       B        0.60      0.42     0.600    76   15.63
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
 SUBAREA RUNOFF(CFS) =      1.38
 TOTAL AREA(ACRES) =      0.60   PEAK FLOW RATE(CFS) =      1.38

****************************************************************************
 FLOW PROCESS FROM NODE   9020.00 TO NODE   9020.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =   15.63
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.802
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                 B        1.00      0.42     0.100    76
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA AREA(ACRES) =    1.00      SUBAREA RUNOFF(CFS) =    2.48
 EFFECTIVE AREA(ACRES) =      1.60   AREA-AVERAGED Fm(INCH/HR) =  0.12
 AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.29
 TOTAL AREA(ACRES) =        1.6       PEAK FLOW RATE(CFS) =       3.86

****************************************************************************
 FLOW PROCESS FROM NODE   9020.00 TO NODE   9020.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =   15.63
 RAINFALL INTENSITY(INCH/HR) =   2.80
 AREA-AVERAGED Fm(INCH/HR) =  0.12
 AREA-AVERAGED Fp(INCH/HR) =  0.42
 AREA-AVERAGED Ap =  0.29
 EFFECTIVE STREAM AREA(ACRES) =       1.60
 TOTAL STREAM AREA(ACRES) =       1.60
 PEAK FLOW RATE(CFS) AT CONFLUENCE =       3.86

****************************************************************************
 FLOW PROCESS FROM NODE   9030.00 TO NODE   9040.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   363.00
 ELEVATION DATA: UPSTREAM(FEET) =   1009.00  DOWNSTREAM(FEET) =   1007.30

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   12.728
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.169
 SUBAREA Tc AND LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 RESIDENTIAL
 "3-4 DWELLINGS/ACRE"       B        0.30      0.42     0.600    76   12.73
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
 SUBAREA RUNOFF(CFS) =      0.79
 TOTAL AREA(ACRES) =      0.30   PEAK FLOW RATE(CFS) =      0.79

****************************************************************************
 FLOW PROCESS FROM NODE   9040.00 TO NODE   9040.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =   12.73
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.169
 SUBAREA LOSS RATE DATA(AMC III):
```

```
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                  B       0.70      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.70      SUBAREA RUNOFF(CFS) =    1.97
  EFFECTIVE AREA(ACRES) =      1.00   AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.25
  TOTAL AREA(ACRES) =        1.0       PEAK FLOW RATE(CFS) =       2.76

****************************************************************************
  FLOW PROCESS FROM NODE   9040.00 TO NODE   9050.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1007.30  DOWNSTREAM(FEET) =   1007.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   237.00   CHANNEL SLOPE =  0.0013
  CHANNEL BASE(FEET) =    4.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.662
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"        B       0.10      0.42     0.600    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.87
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   0.92
  AVERAGE FLOW DEPTH(FEET) =   0.51   TRAVEL TIME(MIN.) =   4.29
  Tc(MIN.) =   17.02
  SUBAREA AREA(ACRES) =     0.10       SUBAREA RUNOFF(CFS) =    0.22
  EFFECTIVE AREA(ACRES) =      1.10     AREA-AVERAGED Fm(INCH/HR) =   0.12
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.28
  TOTAL AREA(ACRES) =        1.1         PEAK FLOW RATE(CFS) =       2.76
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.50   FLOW VELOCITY(FEET/SEC.) =   0.92
  LONGEST FLOWPATH FROM NODE   9030.00 TO NODE   9050.00 =     600.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   9050.00 TO NODE   9050.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   17.02
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.662
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                  B       1.10      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    1.10      SUBAREA RUNOFF(CFS) =    2.59
  EFFECTIVE AREA(ACRES) =      2.20   AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.19
  TOTAL AREA(ACRES) =        2.2       PEAK FLOW RATE(CFS) =       5.11

****************************************************************************
  FLOW PROCESS FROM NODE   9050.00 TO NODE   9020.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1007.00  DOWNSTREAM(FEET) =   1004.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   168.00   CHANNEL SLOPE =  0.0179
  CHANNEL BASE(FEET) =    4.00   "Z" FACTOR =   3.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.575
```

```
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        0.10      0.42     0.600    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.22
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.89
  AVERAGE FLOW DEPTH(FEET) =   0.36   TRAVEL TIME(MIN.) =   0.97
  Tc(MIN.) =   17.99
  SUBAREA AREA(ACRES) =     0.10       SUBAREA RUNOFF(CFS) =    0.21
  EFFECTIVE AREA(ACRES) =      2.30     AREA-AVERAGED Fm(INCH/HR) =   0.09
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.21
  TOTAL AREA(ACRES) =        2.3         PEAK FLOW RATE(CFS) =       5.15

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.35   FLOW VELOCITY(FEET/SEC.) =   2.87
  LONGEST FLOWPATH FROM NODE   9030.00 TO NODE   9020.00 =     768.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   9020.00 TO NODE   9020.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   17.99
  RAINFALL INTENSITY(INCH/HR) =   2.58
  AREA-AVERAGED Fm(INCH/HR) =  0.09
  AREA-AVERAGED Fp(INCH/HR) =  0.42
  AREA-AVERAGED Ap =  0.21
  EFFECTIVE STREAM AREA(ACRES) =       2.30
  TOTAL STREAM AREA(ACRES) =       2.30
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       5.15

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        3.86   15.63    2.802  0.42( 0.12) 0.29       1.6    9000.00
      2        5.15   17.99    2.575  0.42( 0.09) 0.21       2.3    9030.00

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

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        8.74   15.63    2.802  0.42( 0.10) 0.24       3.6    9000.00
      2        8.68   17.99    2.575  0.42( 0.10) 0.24       3.9    9030.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       8.74    Tc(MIN.) =    15.63
  EFFECTIVE AREA(ACRES) =       3.60   AREA-AVERAGED Fm(INCH/HR) =  0.10
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.24
  TOTAL AREA(ACRES) =        3.9
  LONGEST FLOWPATH FROM NODE   9000.00 TO NODE   9020.00 =     799.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   9020.00 TO NODE   9060.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1004.00  DOWNSTREAM(FEET) =  1003.90
  FLOW LENGTH(FEET) =    40.00   MANNING'S N =  0.024
  DEPTH OF FLOW IN  36.0 INCH PIPE IS  18.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   2.44
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       8.74
```

```
  PIPE TRAVEL TIME(MIN.) =   0.27    Tc(MIN.) =   15.90
  LONGEST FLOWPATH FROM NODE   9000.00 TO NODE   9060.00 =     839.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   9060.00 TO NODE   9060.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   15.90
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.773
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        0.30      0.42     0.600    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  SUBAREA AREA(ACRES) =    0.30      SUBAREA RUNOFF(CFS) =    0.68
  EFFECTIVE AREA(ACRES) =      3.90   AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.27
  TOTAL AREA(ACRES) =        4.2       PEAK FLOW RATE(CFS) =       9.33

****************************************************************************
  FLOW PROCESS FROM NODE   9060.00 TO NODE   9410.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1003.90  DOWNSTREAM(FEET) =   1002.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   345.00   CHANNEL SLOPE =  0.0055
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.642
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.10      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       9.44
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   4.30
  AVERAGE FLOW DEPTH(FEET) =   0.66   TRAVEL TIME(MIN.) =   1.34
  Tc(MIN.) =   17.24
  SUBAREA AREA(ACRES) =     0.10       SUBAREA RUNOFF(CFS) =    0.23
  EFFECTIVE AREA(ACRES) =      4.00     AREA-AVERAGED Fm(INCH/HR) =   0.11
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.27
  TOTAL AREA(ACRES) =        4.3         PEAK FLOW RATE(CFS) =       9.33
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.66   FLOW VELOCITY(FEET/SEC.) =   4.27
  LONGEST FLOWPATH FROM NODE   9000.00 TO NODE   9410.00 =    1184.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   9410.00 TO NODE   9410.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   17.24
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.642
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        6.50      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    6.50      SUBAREA RUNOFF(CFS) =   15.21
  EFFECTIVE AREA(ACRES) =     10.50   AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.16
  TOTAL AREA(ACRES) =       10.8       PEAK FLOW RATE(CFS) =      24.31
```

```
****************************************************************************
  FLOW PROCESS FROM NODE   9410.00 TO NODE   9420.00 IS CODE =  61
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STANDARD CURB SECTION USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1002.00  DOWNSTREAM ELEVATION(FEET) = 1000.00
  STREET LENGTH(FEET) =   352.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  15.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  2
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0130
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      28.15
    ***STREET FLOWING FULL***
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.56
    HALFSTREET FLOOD WIDTH(FEET) =   20.00
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.12
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.74
  STREET FLOW TRAVEL TIME(MIN.) =   1.88   Tc(MIN.) =   19.12
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.483
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        3.50      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    3.50      SUBAREA RUNOFF(CFS) =    7.69
  EFFECTIVE AREA(ACRES) =     14.00    AREA-AVERAGED Fm(INCH/HR) =  0.06
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.15
  TOTAL AREA(ACRES) =       14.3        PEAK FLOW RATE(CFS) =      30.49

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.57   HALFSTREET FLOOD WIDTH(FEET) =  20.00
  FLOW VELOCITY(FEET/SEC.) =  3.22   DEPTH*VELOCITY(FT*FT/SEC.) =   1.83
  LONGEST FLOWPATH FROM NODE   9000.00 TO NODE   9420.00 =    1536.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       14.3  TC(MIN.) =     19.12
  EFFECTIVE AREA(ACRES) =     14.00  AREA-AVERAGED Fm(INCH/HR)=  0.06
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap = 0.148
  PEAK FLOW RATE(CFS)   =      30.49

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       30.49   19.12    2.483  0.42( 0.06) 0.15      14.0    9000.00
      2       28.94   21.53    2.312  0.42( 0.06) 0.15      14.3    9030.00
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
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             Ver. 15.0  Release Date: 04/01/2008  License ID 1555

                           Analysis prepared by:





 ************************** DESCRIPTION OF STUDY **************************
* REDLANDS PASSENGER RAIL PROJECT                                          *
* EXISTING 100 YEAR ANALYSIS                                               *
* DRAINAGE AREA 11000                                                      *
 **************************************************************************

  FILE NAME: C:\RPRP\11000.DAT
  TIME/DATE OF STUDY: 12:45 05/23/2012
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2500

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  2   13.0      8.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  3   25.0     15.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  4   35.0     25.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  5   20.0     15.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.20 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE  11000.00 TO NODE  11010.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =  1180.00
  ELEVATION DATA: UPSTREAM(FEET) =   1035.00  DOWNSTREAM(FEET) =   1030.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   15.354
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.832
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
```

```
  COMMERCIAL                  B        1.00      0.42     0.100    76   15.35
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      2.51
  TOTAL AREA(ACRES) =      1.00   PEAK FLOW RATE(CFS) =      2.51

****************************************************************************
  FLOW PROCESS FROM NODE  11010.00 TO NODE  11020.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  4 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1030.00  DOWNSTREAM ELEVATION(FEET) = 1026.00
  STREET LENGTH(FEET) =   730.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 35.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  25.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

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

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.22
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.40
    HALFSTREET FLOOD WIDTH(FEET) =   13.08
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    1.86
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.74
  STREET FLOW TRAVEL TIME(MIN.) =   6.55   Tc(MIN.) =   21.90
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.288
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                  B        0.70      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.70      SUBAREA RUNOFF(CFS) =    1.42
  EFFECTIVE AREA(ACRES) =      1.70    AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        1.7        PEAK FLOW RATE(CFS) =       3.44

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.40   HALFSTREET FLOOD WIDTH(FEET) =  13.47
  FLOW VELOCITY(FEET/SEC.) =  1.88   DEPTH*VELOCITY(FT*FT/SEC.) =   0.76
  LONGEST FLOWPATH FROM NODE  11000.00 TO NODE  11020.00 =    1910.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  11020.00 TO NODE  11020.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   21.90
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.288
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  ".4 DWELLING/ACRE"          B       13.30      0.42     0.900    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.900
  SUBAREA AREA(ACRES) =   13.30      SUBAREA RUNOFF(CFS) =   22.84
  EFFECTIVE AREA(ACRES) =     15.00   AREA-AVERAGED Fm(INCH/HR) =  0.34
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.81
  TOTAL AREA(ACRES) =       15.0       PEAK FLOW RATE(CFS) =      26.27

****************************************************************************
  FLOW PROCESS FROM NODE  11020.00 TO NODE  11030.00 IS CODE =  62
----------------------------------------------------------------------------
```

```
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  4 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1026.00  DOWNSTREAM ELEVATION(FEET) = 1019.00
  STREET LENGTH(FEET) =   800.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 35.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  25.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

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

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      27.29
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.67
    HALFSTREET FLOOD WIDTH(FEET) =   28.38
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.71
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    2.49
  STREET FLOW TRAVEL TIME(MIN.) =   3.60   Tc(MIN.) =   25.50
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.089
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        1.10      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    1.10      SUBAREA RUNOFF(CFS) =    2.03
  EFFECTIVE AREA(ACRES) =     16.10    AREA-AVERAGED Fm(INCH/HR) =  0.32
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.76
  TOTAL AREA(ACRES) =       16.1        PEAK FLOW RATE(CFS) =      26.27
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.66   HALFSTREET FLOOD WIDTH(FEET) =  27.72
  FLOW VELOCITY(FEET/SEC.) =  3.69   DEPTH*VELOCITY(FT*FT/SEC.) =   2.44
  LONGEST FLOWPATH FROM NODE  11000.00 TO NODE  11030.00 =    2710.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE   1130.00 TO NODE   1130.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   25.50
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.089
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        6.40      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    6.40      SUBAREA RUNOFF(CFS) =   11.79
  EFFECTIVE AREA(ACRES) =     22.50   AREA-AVERAGED Fm(INCH/HR) =  0.24
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.57
  TOTAL AREA(ACRES) =       22.5       PEAK FLOW RATE(CFS) =      37.39

****************************************************************************
  FLOW PROCESS FROM NODE  11030.00 TO NODE  11040.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1015.00  DOWNSTREAM(FEET) =  1014.50
  FLOW LENGTH(FEET) =   210.00   MANNING'S N =  0.017
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  14.17
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  22.00    NUMBER OF PIPES =   1
```

```
  PIPE-FLOW(CFS) =      37.39
  PIPE TRAVEL TIME(MIN.) =   0.25    Tc(MIN.) =   25.74
  LONGEST FLOWPATH FROM NODE  11000.00 TO NODE  11040.00 =    2920.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  11040.00 TO NODE  11040.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   25.74
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.077
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        2.40      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    2.40      SUBAREA RUNOFF(CFS) =    4.39
  EFFECTIVE AREA(ACRES) =     24.90   AREA-AVERAGED Fm(INCH/HR) =  0.22
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.53
  TOTAL AREA(ACRES) =       24.9       PEAK FLOW RATE(CFS) =      41.54

****************************************************************************
  FLOW PROCESS FROM NODE  11040.00 TO NODE  11050.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1014.50  DOWNSTREAM ELEVATION(FEET) = 1008.50
  STREET LENGTH(FEET) =   850.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

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

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      42.05
    ***STREET FLOW SPLITS OVER STREET-CROWN***
    FULL DEPTH(FEET) =    0.70   FLOOD WIDTH(FEET) =   31.58
    FULL HALF-STREET VELOCITY(FEET/SEC.) =    3.45
    SPLIT DEPTH(FEET) =    0.56   SPLIT FLOOD WIDTH(FEET) =   22.46
    SPLIT FLOW(CFS) =   13.56   SPLIT VELOCITY(FEET/SEC.) =    2.89
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.70
    HALFSTREET FLOOD WIDTH(FEET) =   31.58
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.45
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    2.41
  STREET FLOW TRAVEL TIME(MIN.) =   4.11   Tc(MIN.) =   29.85
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  1.900
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.60      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.60      SUBAREA RUNOFF(CFS) =    1.00
  EFFECTIVE AREA(ACRES) =     25.50    AREA-AVERAGED Fm(INCH/HR) =  0.22
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.52
  TOTAL AREA(ACRES) =       25.5        PEAK FLOW RATE(CFS) =      41.54
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.70   HALFSTREET FLOOD WIDTH(FEET) =  31.58
  FLOW VELOCITY(FEET/SEC.) =  3.45   DEPTH*VELOCITY(FT*FT/SEC.) =   2.41
  LONGEST FLOWPATH FROM NODE  11000.00 TO NODE  11050.00 =    3770.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE  11050.00 TO NODE  11050.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   29.85
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  1.900
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        4.90      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    4.90      SUBAREA RUNOFF(CFS) =    8.19
  EFFECTIVE AREA(ACRES) =     30.40   AREA-AVERAGED Fm(INCH/HR) =  0.19
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.45
  TOTAL AREA(ACRES) =       30.4       PEAK FLOW RATE(CFS) =      46.79

****************************************************************************
  FLOW PROCESS FROM NODE  11050.00 TO NODE  11060.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1008.50  DOWNSTREAM(FEET) =  1007.90
  FLOW LENGTH(FEET) =    44.00   MANNING'S N =  0.024
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.66
  (PIPE FLOW VELOCITY CORRESPONDING TO FULL PIPE CAPACITY FLOW)
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      46.79
  PIPE TRAVEL TIME(MIN.) =   0.13    Tc(MIN.) =   29.98
  LONGEST FLOWPATH FROM NODE  11000.00 TO NODE  11060.00 =    3814.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  11060.00 TO NODE  11060.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   29.98
  RAINFALL INTENSITY(INCH/HR) =   1.90
  AREA-AVERAGED Fm(INCH/HR) =  0.19
  AREA-AVERAGED Fp(INCH/HR) =  0.42
  AREA-AVERAGED Ap =  0.45
  EFFECTIVE STREAM AREA(ACRES) =      30.40
  TOTAL STREAM AREA(ACRES) =      30.40
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      46.79

****************************************************************************
  FLOW PROCESS FROM NODE  11065.00 TO NODE  11070.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =  2090.00
  ELEVATION DATA: UPSTREAM(FEET) =   1034.00  DOWNSTREAM(FEET) =   1016.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   16.746
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.688
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 B        1.90      0.42     0.100    76   16.75
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      4.52
  TOTAL AREA(ACRES) =      1.90   PEAK FLOW RATE(CFS) =      4.52
```

```
****************************************************************************
  FLOW PROCESS FROM NODE  11070.00 TO NODE  11080.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1016.00  DOWNSTREAM(FEET) =  1011.50
  FLOW LENGTH(FEET) =   580.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS   8.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.94
  GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       4.52
  PIPE TRAVEL TIME(MIN.) =   1.96    Tc(MIN.) =   18.70
  LONGEST FLOWPATH FROM NODE  11065.00 TO NODE  11080.00 =    2670.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  11080.00 TO NODE  11080.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   18.70
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.516
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.40      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.40      SUBAREA RUNOFF(CFS) =    0.89
  EFFECTIVE AREA(ACRES) =      2.30   AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        2.3       PEAK FLOW RATE(CFS) =       5.12

****************************************************************************
  FLOW PROCESS FROM NODE  11080.00 TO NODE  11090.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1011.50  DOWNSTREAM ELEVATION(FEET) = 1008.80
  STREET LENGTH(FEET) =   525.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

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

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.51
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.46
    HALFSTREET FLOOD WIDTH(FEET) =   16.68
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.06
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.95
  STREET FLOW TRAVEL TIME(MIN.) =   4.25   Tc(MIN.) =   22.95
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.225
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.40      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.40      SUBAREA RUNOFF(CFS) =    0.79
  EFFECTIVE AREA(ACRES) =      2.70    AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        2.7        PEAK FLOW RATE(CFS) =       5.30
```

```
  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.46   HALFSTREET FLOOD WIDTH(FEET) =  16.45
  FLOW VELOCITY(FEET/SEC.) =  2.03   DEPTH*VELOCITY(FT*FT/SEC.) =   0.93
  LONGEST FLOWPATH FROM NODE  11065.00 TO NODE  11090.00 =    3195.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  11090.00 TO NODE  11090.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   22.95
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.225
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B       1.50      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    1.50      SUBAREA RUNOFF(CFS) =    2.95
  EFFECTIVE AREA(ACRES) =      4.20   AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        4.2       PEAK FLOW RATE(CFS) =       8.25

****************************************************************************
  FLOW PROCESS FROM NODE  11090.00 TO NODE  11060.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1008.80  DOWNSTREAM(FEET) =  1007.90
  FLOW LENGTH(FEET) =    66.00   MANNING'S N =  0.024
  DEPTH OF FLOW IN  22.0 INCH PIPE IS  14.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.49
  GIVEN PIPE DIAMETER(INCH) =  22.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       8.25
  PIPE TRAVEL TIME(MIN.) =   0.24    Tc(MIN.) =   23.20
  LONGEST FLOWPATH FROM NODE  11065.00 TO NODE  11060.00 =    3261.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  11060.00 TO NODE  11060.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   23.20
  RAINFALL INTENSITY(INCH/HR) =   2.21
  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       4.20
  TOTAL STREAM AREA(ACRES) =       4.20
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       8.25

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)   NODE
      1       46.79   29.98    1.896  0.42( 0.19) 0.45      30.4   11000.00
      2        8.25   23.20    2.211  0.42( 0.04) 0.10       4.2   11065.00

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

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)   NODE
      1       51.15   23.20    2.211  0.42( 0.17) 0.40      27.7   11065.00
      2       53.84   29.98    1.896  0.42( 0.17) 0.41      34.6   11000.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
```

```
  PEAK FLOW RATE(CFS) =      53.84    Tc(MIN.) =    29.98
  EFFECTIVE AREA(ACRES) =      34.60   AREA-AVERAGED Fm(INCH/HR) =  0.17
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.41
  TOTAL AREA(ACRES) =       34.6
  LONGEST FLOWPATH FROM NODE  11000.00 TO NODE  11060.00 =    3814.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  11060.00 TO NODE  11065.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1007.90  DOWNSTREAM(FEET) =  1005.00
  FLOW LENGTH(FEET) =   224.00   MANNING'S N =  0.024
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.52
  (PIPE FLOW VELOCITY CORRESPONDING TO FULL PIPE CAPACITY FLOW)
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      53.84
  PIPE TRAVEL TIME(MIN.) =   0.68    Tc(MIN.) =   30.65
  LONGEST FLOWPATH FROM NODE  11000.00 TO NODE  11065.00 =    4038.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       34.6  TC(MIN.) =     30.65
  EFFECTIVE AREA(ACRES) =     34.60  AREA-AVERAGED Fm(INCH/HR)=  0.17
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap = 0.408
  PEAK FLOW RATE(CFS)   =      53.84

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       51.15   23.88    2.173  0.42( 0.17) 0.40      27.7   11065.00
      2       53.84   30.65    1.870  0.42( 0.17) 0.41      34.6   11000.00
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
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                           Analysis prepared by:




 ************************** DESCRIPTION OF STUDY **************************
* REDLANDS PASSENGER RAIL                                                  *
* EXISTING HYDROLOGY 100 YEAR STORM                                        *
* BASIN 12000                                                              *
 **************************************************************************

  FILE NAME: C:\RPRP\12000.DAT
  TIME/DATE OF STUDY: 09:45 11/12/2012
----------------------------------------------------------------------------
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
----------------------------------------------------------------------------
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2500

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======   ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  2   20.0     15.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0170

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.20 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE  12000.00 TO NODE  12010.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   700.00
  ELEVATION DATA: UPSTREAM(FEET) =   1009.00  DOWNSTREAM(FEET) =   1007.30

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   18.874
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.502
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        0.40      0.42     0.600    76   18.87
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
```

```
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  SUBAREA RUNOFF(CFS) =      0.81
  TOTAL AREA(ACRES) =      0.40   PEAK FLOW RATE(CFS) =      0.81

****************************************************************************
  FLOW PROCESS FROM NODE  12010.00 TO NODE  12010.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   18.87
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.502
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B       0.40      0.42     0.100    76
  RESIDENTIAL
  "1 DWELLING/ACRE"          B       0.90      0.42     0.800    76
  RESIDENTIAL
  ".4 DWELLING/ACRE"         B       0.90      0.42     0.900    76
  PUBLIC PARK                B       1.70      0.42     0.850    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.773
  SUBAREA AREA(ACRES) =    3.90      SUBAREA RUNOFF(CFS) =    7.63
  EFFECTIVE AREA(ACRES) =      4.30   AREA-AVERAGED Fm(INCH/HR) =  0.32
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.76
  TOTAL AREA(ACRES) =        4.3       PEAK FLOW RATE(CFS) =      8.44

****************************************************************************
  FLOW PROCESS FROM NODE  12010.00 TO NODE  12020.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1007.30  DOWNSTREAM(FEET) =   1005.80
  CHANNEL LENGTH THRU SUBAREA(FEET) =   420.00   CHANNEL SLOPE =  0.0036
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.235
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B       0.20      0.42     0.600    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       8.62
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.79
  AVERAGE FLOW DEPTH(FEET) =   0.64   TRAVEL TIME(MIN.) =   3.91
  Tc(MIN.) =   22.79
  SUBAREA AREA(ACRES) =     0.20       SUBAREA RUNOFF(CFS) =    0.36
  EFFECTIVE AREA(ACRES) =      4.50     AREA-AVERAGED Fm(INCH/HR) =   0.32
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.75
  TOTAL AREA(ACRES) =        4.5         PEAK FLOW RATE(CFS) =      8.44
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.63   FLOW VELOCITY(FEET/SEC.) =   1.78
  LONGEST FLOWPATH FROM NODE  12000.00 TO NODE  12020.00 =    1120.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  12020.00 TO NODE  12020.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   22.79
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.235
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  ".4 DWELLING/ACRE"         B       0.70      0.42     0.900    76
```

```
RESIDENTIAL
"1 DWELLING/ACRE"          B        0.70      0.42     0.800    76
RESIDENTIAL
"1 DWELLING/ACRE"          B        2.20      0.42     0.800    76
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.819
SUBAREA AREA(ACRES) =    3.60      SUBAREA RUNOFF(CFS) =    6.12
EFFECTIVE AREA(ACRES) =      8.10   AREA-AVERAGED Fm(INCH/HR) =  0.33
AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.78
TOTAL AREA(ACRES) =        8.1       PEAK FLOW RATE(CFS) =      13.88

****************************************************************************
  FLOW PROCESS FROM NODE  12020.00 TO NODE  12020.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   22.79
  RAINFALL INTENSITY(INCH/HR) =   2.23
  AREA-AVERAGED Fm(INCH/HR) =  0.33
  AREA-AVERAGED Fp(INCH/HR) =  0.42
  AREA-AVERAGED Ap =  0.78
  EFFECTIVE STREAM AREA(ACRES) =       8.10
  TOTAL STREAM AREA(ACRES) =       8.10
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      13.88

****************************************************************************
  FLOW PROCESS FROM NODE  12030.00 TO NODE  12020.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =  1140.00
  ELEVATION DATA: UPSTREAM(FEET) =   1012.00  DOWNSTREAM(FEET) =   1005.80

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   19.524
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.452
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        0.60      0.42     0.600    76   19.52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  SUBAREA RUNOFF(CFS) =      1.19
  TOTAL AREA(ACRES) =      0.60   PEAK FLOW RATE(CFS) =      1.19

****************************************************************************
  FLOW PROCESS FROM NODE  12030.00 TO NODE  12030.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   19.52
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.452
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                B        3.10      0.42     0.850    76
  PUBLIC PARK                B        0.60      0.42     0.850    76
  RESIDENTIAL
  "1 DWELLING/ACRE"          B        0.70      0.42     0.800    76
  PUBLIC PARK                B        0.70      0.42     0.850    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.843
  SUBAREA AREA(ACRES) =    5.10      SUBAREA RUNOFF(CFS) =    9.62
  EFFECTIVE AREA(ACRES) =      5.70   AREA-AVERAGED Fm(INCH/HR) =  0.35
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.82
  TOTAL AREA(ACRES) =        5.7       PEAK FLOW RATE(CFS) =      10.80
```

```
****************************************************************************
  FLOW PROCESS FROM NODE  12030.00 TO NODE  12030.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   19.52
  RAINFALL INTENSITY(INCH/HR) =   2.45
  AREA-AVERAGED Fm(INCH/HR) =  0.35
  AREA-AVERAGED Fp(INCH/HR) =  0.42
  AREA-AVERAGED Ap =  0.82
  EFFECTIVE STREAM AREA(ACRES) =       5.70
  TOTAL STREAM AREA(ACRES) =       5.70
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      10.80

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       13.88   22.79    2.235  0.42( 0.33) 0.78       8.1   12000.00
      2       10.80   19.52    2.452  0.42( 0.35) 0.82       5.7   12030.00

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

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       24.05   19.52    2.452  0.42( 0.34) 0.80      12.6   12030.00
      2       23.57   22.79    2.235  0.42( 0.34) 0.80      13.8   12000.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      24.05    Tc(MIN.) =    19.52
  EFFECTIVE AREA(ACRES) =      12.64   AREA-AVERAGED Fm(INCH/HR) =  0.34
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.80
  TOTAL AREA(ACRES) =       13.8
  LONGEST FLOWPATH FROM NODE  12030.00 TO NODE  12030.00 =    1140.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  12020.00 TO NODE  12020.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   19.52
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.452
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        0.20      0.42     0.600    76
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        0.30      0.42     0.600    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  SUBAREA AREA(ACRES) =    0.50      SUBAREA RUNOFF(CFS) =    0.99
  EFFECTIVE AREA(ACRES) =     13.14   AREA-AVERAGED Fm(INCH/HR) =  0.33
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.79
  TOTAL AREA(ACRES) =       14.3       PEAK FLOW RATE(CFS) =      25.04

****************************************************************************
  FLOW PROCESS FROM NODE  12030.00 TO NODE  12030.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   19.52
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.452
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
```

```
 "3-4 DWELLINGS/ACRE"       B        0.20      0.42     0.600    76
 RESIDENTIAL
 "3-4 DWELLINGS/ACRE"       B        0.30      0.42     0.600    76
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
 SUBAREA AREA(ACRES) =    0.50      SUBAREA RUNOFF(CFS) =    0.99
 EFFECTIVE AREA(ACRES) =     13.64   AREA-AVERAGED Fm(INCH/HR) =  0.33
 AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.78
 TOTAL AREA(ACRES) =       14.8       PEAK FLOW RATE(CFS) =      26.03
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)     =       14.8  TC(MIN.) =     19.52
 EFFECTIVE AREA(ACRES) =     13.64  AREA-AVERAGED Fm(INCH/HR)=  0.33
 AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap = 0.783
 PEAK FLOW RATE(CFS)   =      26.03

 ** PEAK FLOW RATE TABLE **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
     1       26.03   19.52    2.452  0.42( 0.33) 0.78      13.6   12030.00
     2       25.35   22.79    2.235  0.42( 0.33) 0.78      14.8   12000.00
============================================================================
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
         (c) Copyright 1983-2008 Advanced Engineering Software (aes)
             Ver. 15.0  Release Date: 04/01/2008  License ID 1555

                           Analysis prepared by:




 ************************** DESCRIPTION OF STUDY **************************
* REDLANDS PASSENGER RAIL PROJECT                                          *
* EXISTING 100 YEAR ANALYSIS                                               *
* DRAINAGE AREA 12100                                                      *
 **************************************************************************

  FILE NAME: C:\RPRP\12100.DAT
  TIME/DATE OF STUDY: 12:28 11/12/2012
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2500

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  2   20.0     15.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0170

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.20 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE  12100.00 TO NODE  12110.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   660.00
  ELEVATION DATA: UPSTREAM(FEET) =   1009.00  DOWNSTREAM(FEET) =   1007.30

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   18.219
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.556
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        0.40      0.42     0.600    76   18.22
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
```

```
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  SUBAREA RUNOFF(CFS) =      0.83
  TOTAL AREA(ACRES) =      0.40   PEAK FLOW RATE(CFS) =      0.83
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        0.4  TC(MIN.) =     18.22
  EFFECTIVE AREA(ACRES) =      0.40  AREA-AVERAGED Fm(INCH/HR)=  0.25
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap = 0.600
  PEAK FLOW RATE(CFS)   =       0.83
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
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                           Analysis prepared by:




 ************************** DESCRIPTION OF STUDY **************************
* REDLANDS PASSENGER RAIL PROJECT                                          *
* EXISTING 100 YEAR ANALYSIS                                               *
* DRAINAGE AREA 12200                                                      *
 **************************************************************************

  FILE NAME: C:\RPRP\12200.DAT
  TIME/DATE OF STUDY: 12:32 11/12/2012
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2500

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  2   20.0     15.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0170

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.20 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE  12200.00 TO NODE  12210.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   760.00
  ELEVATION DATA: UPSTREAM(FEET) =   1011.00  DOWNSTREAM(FEET) =   1008.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   17.700
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.600
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        0.40      0.42     0.600    76   17.70
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
```

```
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  SUBAREA RUNOFF(CFS) =      0.84
  TOTAL AREA(ACRES) =      0.40   PEAK FLOW RATE(CFS) =      0.84
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        0.4  TC(MIN.) =     17.70
  EFFECTIVE AREA(ACRES) =      0.40  AREA-AVERAGED Fm(INCH/HR)=  0.25
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap = 0.600
  PEAK FLOW RATE(CFS)   =       0.84
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
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                            Analysis prepared by:




 ************************** DESCRIPTION OF STUDY **************************
* REDLANDS PASSENGER RAIL PROJECT                                          *
* EXISTING 100 YEAR ANALYSIS                                               *
* DRAINAGE AREA 14000                                                      *
 **************************************************************************

  FILE NAME: C:\RPRP\14000.DAT
  TIME/DATE OF STUDY: 16:19 05/23/2012
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2500

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.  (FT)     (FT)     SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======   ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  2   20.0     15.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0170

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.20 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE  14000.00 TO NODE  14010.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   700.00
  ELEVATION DATA: UPSTREAM(FEET) =   1015.00  DOWNSTREAM(FEET) =   1011.20

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   16.069
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.756
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        0.50      0.42     0.600    76   16.07
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
```

```
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  SUBAREA RUNOFF(CFS) =      1.13
  TOTAL AREA(ACRES) =      0.50   PEAK FLOW RATE(CFS) =      1.13

****************************************************************************
  FLOW PROCESS FROM NODE  14010.00 TO NODE  14010.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   16.07
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.756
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B       2.30      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    2.30      SUBAREA RUNOFF(CFS) =    5.62
  EFFECTIVE AREA(ACRES) =      2.80   AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.19
  TOTAL AREA(ACRES) =        2.8       PEAK FLOW RATE(CFS) =       6.74

****************************************************************************
  FLOW PROCESS FROM NODE  14010.00 TO NODE  14010.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   16.07
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.756
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B       1.40      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    1.40      SUBAREA RUNOFF(CFS) =    3.42
  EFFECTIVE AREA(ACRES) =      4.20   AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.16
  TOTAL AREA(ACRES) =        4.2       PEAK FLOW RATE(CFS) =      10.16
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        4.2  TC(MIN.) =     16.07
  EFFECTIVE AREA(ACRES) =      4.20  AREA-AVERAGED Fm(INCH/HR)=  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap = 0.160
  PEAK FLOW RATE(CFS)   =      10.16
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

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****************************************************************************
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                           Analysis prepared by:




 ************************** DESCRIPTION OF STUDY **************************
* REDLANDS PASSENGER RAIL PROJECT                                          *
* EXISTING 100 YEAR ANALYSIS                                               *
* DRAINAGE AREA 16500                                                      *
 **************************************************************************

  FILE NAME: C:\RPRP\16500.DAT
  TIME/DATE OF STUDY: 06:42 05/24/2012
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2500

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  2   20.0     15.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0170

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.20 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE  16500.00 TO NODE  16510.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =  1060.00
  ELEVATION DATA: UPSTREAM(FEET) =   1026.30  DOWNSTREAM(FEET) =   1017.80

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   17.547
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.614
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        0.60      0.42     0.600    76   17.55
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
```

```
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  SUBAREA RUNOFF(CFS) =      1.27
  TOTAL AREA(ACRES) =      0.60   PEAK FLOW RATE(CFS) =      1.27

****************************************************************************
  FLOW PROCESS FROM NODE  16510.00 TO NODE  16520.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1017.80  DOWNSTREAM(FEET) =   1014.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   850.00   CHANNEL SLOPE =  0.0045
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  1.902
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        0.50      0.42     0.600    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.65
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.16
  AVERAGE FLOW DEPTH(FEET) =   0.24   TRAVEL TIME(MIN.) =  12.26
  Tc(MIN.) =   29.81
  SUBAREA AREA(ACRES) =     0.50       SUBAREA RUNOFF(CFS) =    0.74
  EFFECTIVE AREA(ACRES) =      1.10     AREA-AVERAGED Fm(INCH/HR) =   0.25
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.60
  TOTAL AREA(ACRES) =        1.1         PEAK FLOW RATE(CFS) =       1.63

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.24   FLOW VELOCITY(FEET/SEC.) =   1.14
  LONGEST FLOWPATH FROM NODE  16500.00 TO NODE  16520.00 =    1910.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  16520.00 TO NODE  16520.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   29.81
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  1.902
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        0.70      0.42     0.600    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  SUBAREA AREA(ACRES) =    0.70      SUBAREA RUNOFF(CFS) =    1.04
  EFFECTIVE AREA(ACRES) =      1.80   AREA-AVERAGED Fm(INCH/HR) =  0.25
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.60
  TOTAL AREA(ACRES) =        1.8       PEAK FLOW RATE(CFS) =       2.67
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        1.8  TC(MIN.) =     29.81
  EFFECTIVE AREA(ACRES) =      1.80  AREA-AVERAGED Fm(INCH/HR)=  0.25
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap = 0.600
  PEAK FLOW RATE(CFS)   =       2.67
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

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****************************************************************************
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                            Analysis prepared by:




 ************************** DESCRIPTION OF STUDY **************************
 * REDLANDS PASSENGER RAIL PROOJECT                                        *
 * EXISTING 100 YEAR ANALYSIS                                              *
 * DRAINAGE AREA 16600                                                     *
 **************************************************************************

  FILE NAME: C:\RPRP\16600.DAT
  TIME/DATE OF STUDY: 06:54 05/24/2012
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2500

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  2   20.0     15.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0170

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.20 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE  16600.00 TO NODE  16610.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   641.00
  ELEVATION DATA: UPSTREAM(FEET) =   1024.00  DOWNSTREAM(FEET) =   1021.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   16.574
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.705
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        0.70      0.42     0.600    76   16.57
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
```

```
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  SUBAREA RUNOFF(CFS) =      1.54
  TOTAL AREA(ACRES) =      0.70   PEAK FLOW RATE(CFS) =      1.54

****************************************************************************
  FLOW PROCESS FROM NODE  16610.00 TO NODE  16620.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1021.50  DOWNSTREAM(FEET) =   1013.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  1250.00   CHANNEL SLOPE =  0.0068
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  1.852
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        0.70      0.42     0.600    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.06
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.43
  AVERAGE FLOW DEPTH(FEET) =   0.24   TRAVEL TIME(MIN.) =  14.59
  Tc(MIN.) =   31.16
  SUBAREA AREA(ACRES) =     0.70       SUBAREA RUNOFF(CFS) =    1.01
  EFFECTIVE AREA(ACRES) =      1.40     AREA-AVERAGED Fm(INCH/HR) =   0.25
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.60
  TOTAL AREA(ACRES) =        1.4         PEAK FLOW RATE(CFS) =       2.01

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.24   FLOW VELOCITY(FEET/SEC.) =   1.41
  LONGEST FLOWPATH FROM NODE  16600.00 TO NODE  16620.00 =    1891.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        1.4  TC(MIN.) =     31.16
  EFFECTIVE AREA(ACRES) =      1.40  AREA-AVERAGED Fm(INCH/HR)=  0.25
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap = 0.600
  PEAK FLOW RATE(CFS)   =       2.01
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
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                           Analysis prepared by:






 ************************** DESCRIPTION OF STUDY **************************
* REDLANDS PASSENGER RAIL PROJECT                                          *
* EXISTING 100 YEAR ANALYSIS                                               *
* DRAINAGE AREA 18000                                                      *
 **************************************************************************

  FILE NAME: C:\RPRP\18000.DAT
  TIME/DATE OF STUDY: 07:12 05/24/2012
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2500

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======   ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  2   13.0      8.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  3   25.0     15.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  4   35.0     25.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  5   20.0     15.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.20 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE  18000.00 TO NODE  18010.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   773.00
  ELEVATION DATA: UPSTREAM(FEET) =   1060.00  DOWNSTREAM(FEET) =   1054.20

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   15.672
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.797
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
```

```
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        0.90      0.42     0.600    76   15.67
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  SUBAREA RUNOFF(CFS) =      2.06
  TOTAL AREA(ACRES) =      0.90   PEAK FLOW RATE(CFS) =      2.06

****************************************************************************
  FLOW PROCESS FROM NODE  18010.00 TO NODE  18020.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1054.20  DOWNSTREAM(FEET) =   1046.90
  CHANNEL LENGTH THRU SUBAREA(FEET) =   697.00   CHANNEL SLOPE =  0.0105
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.374
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        0.90      0.42     0.600    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.92
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.36
  AVERAGE FLOW DEPTH(FEET) =   0.43   TRAVEL TIME(MIN.) =   4.92
  Tc(MIN.) =   20.59
  SUBAREA AREA(ACRES) =     0.90       SUBAREA RUNOFF(CFS) =    1.72
  EFFECTIVE AREA(ACRES) =      1.80     AREA-AVERAGED Fm(INCH/HR) =   0.25
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.60
  TOTAL AREA(ACRES) =        1.8         PEAK FLOW RATE(CFS) =       3.44

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.48   FLOW VELOCITY(FEET/SEC.) =   2.45
  LONGEST FLOWPATH FROM NODE  18000.00 TO NODE  18020.00 =    1470.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  18020.00 TO NODE  18030.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1046.00  DOWNSTREAM(FEET) =  1045.10
  FLOW LENGTH(FEET) =   120.00   MANNING'S N =  0.017
  DEPTH OF FLOW IN  36.0 INCH PIPE IS   7.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.58
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.44
  PIPE TRAVEL TIME(MIN.) =   0.56    Tc(MIN.) =   21.15
  LONGEST FLOWPATH FROM NODE  18000.00 TO NODE  18030.00 =    1590.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  18030.00 TO NODE  18040.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1045.10  DOWNSTREAM(FEET) =   1044.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   180.00   CHANNEL SLOPE =  0.0061
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.235
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        0.30      0.42     0.600    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
```

```
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.70
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.85
  AVERAGE FLOW DEPTH(FEET) =   0.50   TRAVEL TIME(MIN.) =   1.62
  Tc(MIN.) =   22.78
  SUBAREA AREA(ACRES) =     0.30       SUBAREA RUNOFF(CFS) =    0.53
  EFFECTIVE AREA(ACRES) =      2.10     AREA-AVERAGED Fm(INCH/HR) =   0.25
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.60
  TOTAL AREA(ACRES) =        2.1         PEAK FLOW RATE(CFS) =       3.74

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.51   FLOW VELOCITY(FEET/SEC.) =   1.84
  LONGEST FLOWPATH FROM NODE  18000.00 TO NODE  18040.00 =    1770.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  18040.00 TO NODE  18040.00 IS CODE =  82
----------------------------------------------------------------------------
  >>>>>ADD SUBAREA RUNOFF TO MAINLINE, AT MAINLINE Tc,<<<<<
  >>>>>(AND COMPUTE INITIAL SUBAREA RUNOFF)<<<<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =  1580.00
  ELEVATION DATA: UPSTREAM(FEET) =   1062.00  DOWNSTREAM(FEET) =   1046.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   19.646
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.443
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        1.30      0.42     0.600    76   19.65
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  SUBAREA AREA(ACRES) =    1.30   INITIAL SUBAREA RUNOFF(CFS) =    2.56

  ** ADD SUBAREA RUNOFF TO MAINLINE AT MAINLINE Tc:
  MAINLINE Tc(MIN.) =   22.78
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.235
  SUBAREA AREA(ACRES) =    1.30      SUBAREA RUNOFF(CFS) =    2.32
  EFFECTIVE AREA(ACRES) =      3.40   AREA-AVERAGED Fm(INCH/HR) =  0.25
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.60
  TOTAL AREA(ACRES) =        3.4       PEAK FLOW RATE(CFS) =       6.06

****************************************************************************
  FLOW PROCESS FROM NODE  18040.00 TO NODE  18050.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1044.00  DOWNSTREAM(FEET) =   1030.60
  CHANNEL LENGTH THRU SUBAREA(FEET) =  1650.00   CHANNEL SLOPE =  0.0081
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  1.754
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        1.60      0.42     0.600    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       7.15
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.43
  AVERAGE FLOW DEPTH(FEET) =   0.64   TRAVEL TIME(MIN.) =  11.33
  Tc(MIN.) =   34.11
  SUBAREA AREA(ACRES) =     1.60       SUBAREA RUNOFF(CFS) =    2.16
  EFFECTIVE AREA(ACRES) =      5.00     AREA-AVERAGED Fm(INCH/HR) =   0.25
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.60
  TOTAL AREA(ACRES) =        5.0         PEAK FLOW RATE(CFS) =       6.75

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.63   FLOW VELOCITY(FEET/SEC.) =   2.38
```

```
  LONGEST FLOWPATH FROM NODE  18000.00 TO NODE  18050.00 =    3420.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        5.0  TC(MIN.) =     34.11
  EFFECTIVE AREA(ACRES) =       5.00  AREA-AVERAGED Fm(INCH/HR)=  0.25
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap = 0.600
  PEAK FLOW RATE(CFS)   =       6.75
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
____________________________________________________________________________
****************************************************************************
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                           Analysis prepared by:







 ************************* DESCRIPTION OF STUDY *************************
* REDLANDS PASSENGER RAIL                                                *
* EXISTING HYDROLOGY 100 YEAR STORM                                      *
* BASIN 21000                                                            *
 ************************************************************************

  FILE NAME: C:\RPRP\EPRP\21000.DAT
  TIME/DATE OF STUDY: 14:31 02/16/2012
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                   --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2500

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   13.0      8.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  3   25.0     15.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  4   35.0     25.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  5   20.0     15.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.20 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE  21000.00 TO NODE  21010.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   505.00
  ELEVATION DATA: UPSTREAM(FEET) =   1107.50  DOWNSTREAM(FEET) =   1098.60

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   13.063
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.120
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
```

```
 PUBLIC PARK                B        0.50      0.42     0.850    76   13.06
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
 SUBAREA RUNOFF(CFS) =      1.24
 TOTAL AREA(ACRES) =      0.50   PEAK FLOW RATE(CFS) =      1.24

****************************************************************************
 FLOW PROCESS FROM NODE  21010.00 TO NODE  21010.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =   13.06
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.120
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 RESIDENTIAL
 "2 DWELLINGS/ACRE"         B        2.40      0.42     0.700    76
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.700
 SUBAREA AREA(ACRES) =    2.40      SUBAREA RUNOFF(CFS) =    6.10
 EFFECTIVE AREA(ACRES) =      2.90   AREA-AVERAGED Fm(INCH/HR) =  0.31
 AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.73
 TOTAL AREA(ACRES) =        2.9       PEAK FLOW RATE(CFS) =      7.34

****************************************************************************
 FLOW PROCESS FROM NODE  21010.00 TO NODE  21020.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   1098.60  DOWNSTREAM(FEET) =   1097.80
 CHANNEL LENGTH THRU SUBAREA(FEET) =    523.00   CHANNEL SLOPE =  0.0015
 CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   2.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00

        ==>>WARNING: FLOW IN CHANNEL EXCEEDS CHANNEL
            CAPACITY( NORMAL DEPTH EQUAL TO SPECIFIED MAXIMUM
            ALLOWABLE DEPTH).
            AS AN APPROXIMATION, FLOWDEPTH IS SET AT MAXIMUM
            ALLOWABLE DEPTH AND IS USED FOR TRAVELTIME CALCULATIONS.

 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.623
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 PUBLIC PARK                B        0.60      0.42     0.850    76
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       7.96
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.99
 AVERAGE FLOW DEPTH(FEET) =   1.00   TRAVEL TIME(MIN.) =   4.38
 Tc(MIN.) =   17.45
 SUBAREA AREA(ACRES) =     0.60       SUBAREA RUNOFF(CFS) =    1.22
 EFFECTIVE AREA(ACRES) =      3.50     AREA-AVERAGED Fm(INCH/HR) =   0.32
 AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.75
 TOTAL AREA(ACRES) =        3.5         PEAK FLOW RATE(CFS) =       7.34
 NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

        ==>>WARNING: FLOW IN CHANNEL EXCEEDS CHANNEL
            CAPACITY( NORMAL DEPTH EQUAL TO SPECIFIED MAXIMUM
            ALLOWABLE DEPTH).
            AS AN APPROXIMATION, FLOWDEPTH IS SET AT MAXIMUM
            ALLOWABLE DEPTH AND IS USED FOR TRAVELTIME CALCULATIONS.


 END OF SUBAREA CHANNEL FLOW HYDRAULICS:
 DEPTH(FEET) =  1.00   FLOW VELOCITY(FEET/SEC.) =   1.84

 ==>FLOWDEPTH EXCEEDS MAXIMUM ALLOWABLE DEPTH
```

```
  LONGEST FLOWPATH FROM NODE  21000.00 TO NODE  21020.00 =    1028.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  21020.00 TO NODE  21020.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   17.45
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.623
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "2 DWELLINGS/ACRE"         B       11.60      0.42     0.700    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.700
  SUBAREA AREA(ACRES) =   11.60      SUBAREA RUNOFF(CFS) =   24.29
  EFFECTIVE AREA(ACRES) =     15.10   AREA-AVERAGED Fm(INCH/HR) =  0.30
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.71
  TOTAL AREA(ACRES) =       15.1       PEAK FLOW RATE(CFS) =      31.56

****************************************************************************
  FLOW PROCESS FROM NODE  21020.00 TO NODE  21030.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1097.80  DOWNSTREAM(FEET) =   1092.90
  CHANNEL LENGTH THRU SUBAREA(FEET) =   315.00   CHANNEL SLOPE =  0.0156
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00

         ==>>WARNING: FLOW IN CHANNEL EXCEEDS CHANNEL
             CAPACITY( NORMAL DEPTH EQUAL TO SPECIFIED MAXIMUM
             ALLOWABLE DEPTH).
             AS AN APPROXIMATION, FLOWDEPTH IS SET AT MAXIMUM
             ALLOWABLE DEPTH AND IS USED FOR TRAVELTIME CALCULATIONS.

  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.565
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                B        0.40      0.42     0.850    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      31.96
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   7.99
  AVERAGE FLOW DEPTH(FEET) =   1.00   TRAVEL TIME(MIN.) =   0.66
  Tc(MIN.) =   18.10
  SUBAREA AREA(ACRES) =     0.40       SUBAREA RUNOFF(CFS) =    0.79
  EFFECTIVE AREA(ACRES) =     15.50     AREA-AVERAGED Fm(INCH/HR) =   0.30
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.71
  TOTAL AREA(ACRES) =       15.5         PEAK FLOW RATE(CFS) =      31.57

         ==>>WARNING: FLOW IN CHANNEL EXCEEDS CHANNEL
             CAPACITY( NORMAL DEPTH EQUAL TO SPECIFIED MAXIMUM
             ALLOWABLE DEPTH).
             AS AN APPROXIMATION, FLOWDEPTH IS SET AT MAXIMUM
             ALLOWABLE DEPTH AND IS USED FOR TRAVELTIME CALCULATIONS.


  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  1.00   FLOW VELOCITY(FEET/SEC.) =   7.89

  ==>FLOWDEPTH EXCEEDS MAXIMUM ALLOWABLE DEPTH

  LONGEST FLOWPATH FROM NODE  21000.00 TO NODE  21030.00 =    1343.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  21030.00 TO NODE  21030.00 IS CODE =  81
----------------------------------------------------------------------------
```

```
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =   18.10
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.565
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp        Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 RESIDENTIAL
 "1 DWELLING/ACRE"          B        2.90      0.42     0.800    76
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.800
 SUBAREA AREA(ACRES) =    2.90      SUBAREA RUNOFF(CFS) =    5.81
 EFFECTIVE AREA(ACRES) =     18.40   AREA-AVERAGED Fm(INCH/HR) =  0.31
 AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.73
 TOTAL AREA(ACRES) =       18.4       PEAK FLOW RATE(CFS) =      37.38

****************************************************************************
 FLOW PROCESS FROM NODE  21030.00 TO NODE  21040.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   1092.90  DOWNSTREAM(FEET) =   1084.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =   884.00   CHANNEL SLOPE =  0.0101
 CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   2.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00

        ==>>WARNING: FLOW IN CHANNEL EXCEEDS CHANNEL
            CAPACITY( NORMAL DEPTH EQUAL TO SPECIFIED MAXIMUM
            ALLOWABLE DEPTH).
            AS AN APPROXIMATION, FLOWDEPTH IS SET AT MAXIMUM
            ALLOWABLE DEPTH AND IS USED FOR TRAVELTIME CALCULATIONS.

 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.443
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp        Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 PUBLIC PARK                B        1.00      0.42     0.850    76
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      38.32
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   9.58
 AVERAGE FLOW DEPTH(FEET) =   1.00   TRAVEL TIME(MIN.) =   1.54
 Tc(MIN.) =   19.64
 SUBAREA AREA(ACRES) =     1.00       SUBAREA RUNOFF(CFS) =    1.88
 EFFECTIVE AREA(ACRES) =     19.40     AREA-AVERAGED Fm(INCH/HR) =   0.31
 AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.73
 TOTAL AREA(ACRES) =       19.4         PEAK FLOW RATE(CFS) =      37.38
 NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

        ==>>WARNING: FLOW IN CHANNEL EXCEEDS CHANNEL
            CAPACITY( NORMAL DEPTH EQUAL TO SPECIFIED MAXIMUM
            ALLOWABLE DEPTH).
            AS AN APPROXIMATION, FLOWDEPTH IS SET AT MAXIMUM
            ALLOWABLE DEPTH AND IS USED FOR TRAVELTIME CALCULATIONS.


 END OF SUBAREA CHANNEL FLOW HYDRAULICS:
 DEPTH(FEET) =  1.00   FLOW VELOCITY(FEET/SEC.) =   9.35

 ==>FLOWDEPTH EXCEEDS MAXIMUM ALLOWABLE DEPTH

 LONGEST FLOWPATH FROM NODE  21000.00 TO NODE  21040.00 =    2227.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE  21040.00 TO NODE  21040.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =   19.64
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.443
```

```
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "2 DWELLINGS/ACRE"         B        5.30      0.42     0.700    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.700
  SUBAREA AREA(ACRES) =     5.30      SUBAREA RUNOFF(CFS) =   10.24
  EFFECTIVE AREA(ACRES) =     24.70   AREA-AVERAGED Fm(INCH/HR) =  0.31
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.73
  TOTAL AREA(ACRES) =       24.7       PEAK FLOW RATE(CFS) =      47.47

****************************************************************************
  FLOW PROCESS FROM NODE  21040.00 TO NODE  21050.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1084.00  DOWNSTREAM(FEET) =   1080.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =   288.00   CHANNEL SLOPE =  0.0122
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00

        ==>>WARNING: FLOW IN CHANNEL EXCEEDS CHANNEL
            CAPACITY( NORMAL DEPTH EQUAL TO SPECIFIED MAXIMUM
            ALLOWABLE DEPTH).
            AS AN APPROXIMATION, FLOWDEPTH IS SET AT MAXIMUM
            ALLOWABLE DEPTH AND IS USED FOR TRAVELTIME CALCULATIONS.

  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.413
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                B        0.30      0.42     0.850    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      47.75
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =  11.94
  AVERAGE FLOW DEPTH(FEET) =   1.00   TRAVEL TIME(MIN.) =   0.40
  Tc(MIN.) =   20.04
  SUBAREA AREA(ACRES) =     0.30       SUBAREA RUNOFF(CFS) =    0.55
  EFFECTIVE AREA(ACRES) =     25.00     AREA-AVERAGED Fm(INCH/HR) =   0.31
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.73
  TOTAL AREA(ACRES) =       25.0         PEAK FLOW RATE(CFS) =      47.47
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

        ==>>WARNING: FLOW IN CHANNEL EXCEEDS CHANNEL
            CAPACITY( NORMAL DEPTH EQUAL TO SPECIFIED MAXIMUM
            ALLOWABLE DEPTH).
            AS AN APPROXIMATION, FLOWDEPTH IS SET AT MAXIMUM
            ALLOWABLE DEPTH AND IS USED FOR TRAVELTIME CALCULATIONS.


  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  1.00   FLOW VELOCITY(FEET/SEC.) =  11.87

  ==>FLOWDEPTH EXCEEDS MAXIMUM ALLOWABLE DEPTH

  LONGEST FLOWPATH FROM NODE  21000.00 TO NODE  21050.00 =    2515.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  21050.00 TO NODE  21050.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   20.04
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.413
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
```

```
  "2 DWELLINGS/ACRE"         B        1.50      0.42     0.700    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.700
  SUBAREA AREA(ACRES) =    1.50      SUBAREA RUNOFF(CFS) =    2.86
  EFFECTIVE AREA(ACRES) =     26.50   AREA-AVERAGED Fm(INCH/HR) =  0.31
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.73
  TOTAL AREA(ACRES) =       26.5       PEAK FLOW RATE(CFS) =      50.23

****************************************************************************
  FLOW PROCESS FROM NODE  21050.00 TO NODE  21060.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1080.50  DOWNSTREAM(FEET) =   1079.30
  CHANNEL LENGTH THRU SUBAREA(FEET) =   246.00   CHANNEL SLOPE =  0.0049
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00

         ==>>WARNING: FLOW IN CHANNEL EXCEEDS CHANNEL
             CAPACITY( NORMAL DEPTH EQUAL TO SPECIFIED MAXIMUM
             ALLOWABLE DEPTH).
             AS AN APPROXIMATION, FLOWDEPTH IS SET AT MAXIMUM
             ALLOWABLE DEPTH AND IS USED FOR TRAVELTIME CALCULATIONS.

  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.390
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                B        0.30      0.42     0.850    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      50.50
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =  12.63
  AVERAGE FLOW DEPTH(FEET) =   1.00   TRAVEL TIME(MIN.) =   0.32
  Tc(MIN.) =   20.37
  SUBAREA AREA(ACRES) =     0.30       SUBAREA RUNOFF(CFS) =    0.55
  EFFECTIVE AREA(ACRES) =     26.80     AREA-AVERAGED Fm(INCH/HR) =   0.31
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.73
  TOTAL AREA(ACRES) =       26.8         PEAK FLOW RATE(CFS) =      50.23
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

         ==>>WARNING: FLOW IN CHANNEL EXCEEDS CHANNEL
             CAPACITY( NORMAL DEPTH EQUAL TO SPECIFIED MAXIMUM
             ALLOWABLE DEPTH).
             AS AN APPROXIMATION, FLOWDEPTH IS SET AT MAXIMUM
             ALLOWABLE DEPTH AND IS USED FOR TRAVELTIME CALCULATIONS.


  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  1.00   FLOW VELOCITY(FEET/SEC.) =  12.56

  ==>FLOWDEPTH EXCEEDS MAXIMUM ALLOWABLE DEPTH

  LONGEST FLOWPATH FROM NODE  21000.00 TO NODE  21060.00 =    2761.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  21060.00 TO NODE  21060.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   20.37
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.390
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "2 DWELLINGS/ACRE"         B        1.30      0.42     0.700    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.700
  SUBAREA AREA(ACRES) =    1.30      SUBAREA RUNOFF(CFS) =    2.45
```

```
 EFFECTIVE AREA(ACRES) =     28.10   AREA-AVERAGED Fm(INCH/HR) =  0.31
 AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.73
 TOTAL AREA(ACRES) =       28.1       PEAK FLOW RATE(CFS) =      52.67

****************************************************************************
 FLOW PROCESS FROM NODE  21060.00 TO NODE  21070.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   1079.40  DOWNSTREAM(FEET) =   1079.20
 CHANNEL LENGTH THRU SUBAREA(FEET) =    82.00   CHANNEL SLOPE =  0.0024
 CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   2.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00

        ==>>WARNING: FLOW IN CHANNEL EXCEEDS CHANNEL
            CAPACITY( NORMAL DEPTH EQUAL TO SPECIFIED MAXIMUM
            ALLOWABLE DEPTH).
            AS AN APPROXIMATION, FLOWDEPTH IS SET AT MAXIMUM
            ALLOWABLE DEPTH AND IS USED FOR TRAVELTIME CALCULATIONS.

 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.383
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 PUBLIC PARK               B       0.10      0.42     0.850    76
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      52.76
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =  13.19
 AVERAGE FLOW DEPTH(FEET) =   1.00   TRAVEL TIME(MIN.) =   0.10
 Tc(MIN.) =   20.47
 SUBAREA AREA(ACRES) =      0.10       SUBAREA RUNOFF(CFS) =    0.18
 EFFECTIVE AREA(ACRES) =     28.20     AREA-AVERAGED Fm(INCH/HR) =   0.31
 AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.73
 TOTAL AREA(ACRES) =       28.2        PEAK FLOW RATE(CFS) =      52.67
 NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

        ==>>WARNING: FLOW IN CHANNEL EXCEEDS CHANNEL
            CAPACITY( NORMAL DEPTH EQUAL TO SPECIFIED MAXIMUM
            ALLOWABLE DEPTH).
            AS AN APPROXIMATION, FLOWDEPTH IS SET AT MAXIMUM
            ALLOWABLE DEPTH AND IS USED FOR TRAVELTIME CALCULATIONS.


 END OF SUBAREA CHANNEL FLOW HYDRAULICS:
 DEPTH(FEET) =  1.00   FLOW VELOCITY(FEET/SEC.) =  13.17

 ==>FLOWDEPTH EXCEEDS MAXIMUM ALLOWABLE DEPTH

 LONGEST FLOWPATH FROM NODE  21000.00 TO NODE  21070.00 =    2843.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE  21070.00 TO NODE  21080.00 IS CODE =  62
----------------------------------------------------------------------------
 >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>(STREET TABLE SECTION #  5 USED)<<<<<
============================================================================
 UPSTREAM ELEVATION(FEET) = 1079.20  DOWNSTREAM ELEVATION(FEET) = 1079.00
 STREET LENGTH(FEET) =    66.00   CURB HEIGHT(INCHES) =  8.0
 STREET HALFWIDTH(FEET) = 20.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  15.00
 INSIDE STREET CROSSFALL(DECIMAL) =  0.018
 OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

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

```
  **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      53.04
  ***STREET FLOWING FULL***
  STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
  STREET FLOW DEPTH(FEET) =  0.76
  HALFSTREET FLOOD WIDTH(FEET) =   24.89
  AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.99
  PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    2.28
STREET FLOW TRAVEL TIME(MIN.) =   0.37   Tc(MIN.) =   20.84
* 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.358
SUBAREA LOSS RATE DATA(AMC III):
 DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
     LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
RESIDENTIAL
"1 DWELLING/ACRE"          B        0.40      0.42     0.800    76
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.800
SUBAREA AREA(ACRES) =    0.40      SUBAREA RUNOFF(CFS) =    0.73
EFFECTIVE AREA(ACRES) =     28.60    AREA-AVERAGED Fm(INCH/HR) =  0.31
AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.73
TOTAL AREA(ACRES) =       28.6        PEAK FLOW RATE(CFS) =      52.75

END OF SUBAREA STREET FLOW HYDRAULICS:
DEPTH(FEET) = 0.76   HALFSTREET FLOOD WIDTH(FEET) =  24.83
FLOW VELOCITY(FEET/SEC.) =  2.98   DEPTH*VELOCITY(FT*FT/SEC.) =   2.28
LONGEST FLOWPATH FROM NODE  21000.00 TO NODE  21080.00 =    2909.00 FEET.
============================================================================
END OF STUDY SUMMARY:
TOTAL AREA(ACRES)     =       28.6  TC(MIN.) =     20.84
EFFECTIVE AREA(ACRES) =     28.60  AREA-AVERAGED Fm(INCH/HR)=  0.31
AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap = 0.728
PEAK FLOW RATE(CFS)   =      52.75
============================================================================
============================================================================
END OF RATIONAL METHOD ANALYSIS
```

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____________________________________________________________________________
****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
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                           Analysis prepared by:






 ************************* DESCRIPTION OF STUDY *************************
* REDLANDS PASSENGER RAIL                                                  *
* EXISTING HYDROLOGY 100 YEAR STORM                                        *
* BASIN 22000                                                              *
 **************************************************************************

  FILE NAME: C:\RPRP\EPRP\22000.DAT
  TIME/DATE OF STUDY: 14:36 02/16/2012
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                   --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2500

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   13.0      8.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  3   25.0     15.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  4   35.0     25.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  5   20.0     15.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.20 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE  22000.00 TO NODE  22010.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   980.00
  ELEVATION DATA: UPSTREAM(FEET) =   1088.90  DOWNSTREAM(FEET) =   1079.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   19.233
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.474
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
```

```
  PUBLIC PARK                 B        0.60      0.42     0.850    76   19.23
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA RUNOFF(CFS) =      1.14
  TOTAL AREA(ACRES) =      0.60   PEAK FLOW RATE(CFS) =      1.14
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        0.6  TC(MIN.) =     19.23
  EFFECTIVE AREA(ACRES) =      0.60  AREA-AVERAGED Fm(INCH/HR)=  0.36
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap = 0.850
  PEAK FLOW RATE(CFS)   =       1.14
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
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           (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
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              Ver. 15.0  Release Date: 04/01/2008  License ID 1555

                            Analysis prepared by:
```

```
 ************************** DESCRIPTION OF STUDY **************************
* REDLANDS PASSENGER RAIL                                                  *
* EXISTING HYDROLOGY 100 YEAR STORM                                        *
* BASIN 23000                                                              *
 **************************************************************************

  FILE NAME: C:\RPRP\EPRP\23000.DAT
  TIME/DATE OF STUDY: 14:38 02/16/2012
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2500

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
```

NO.	HALF- WIDTH (FT)	CROWN TO CROSSFALL (FT)	STREET-CROSSFALL: IN- / OUT-/PARK- SIDE / SIDE/ WAY	CURB HEIGHT (FT)	GUTTER-GEOMETRIES: WIDTH (FT)	LIP (FT)	HIKE (FT)	MANNING FACTOR (n)
1	30.0	20.0	0.018/0.018/0.020	0.67	2.00	0.0312	0.167	0.0150
2	13.0	8.0	0.018/0.018/0.020	0.67	2.00	0.0312	0.167	0.0150
3	25.0	15.0	0.018/0.018/0.020	0.67	2.00	0.0312	0.167	0.0150
4	35.0	25.0	0.018/0.018/0.020	0.67	2.00	0.0312	0.167	0.0150
5	20.0	15.0	0.018/0.018/0.020	0.67	2.00	0.0312	0.167	0.0150

```
  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.20 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE  23000.00 TO NODE  23010.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   348.00
  ELEVATION DATA: UPSTREAM(FEET) =   1111.70  DOWNSTREAM(FEET) =   1107.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   11.871
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.305
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
```

```
  PUBLIC PARK                 B        0.60      0.42     0.850    76   11.87
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA RUNOFF(CFS) =      1.59
  TOTAL AREA(ACRES) =      0.60   PEAK FLOW RATE(CFS) =      1.59
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        0.6  TC(MIN.) =     11.87
  EFFECTIVE AREA(ACRES) =      0.60  AREA-AVERAGED Fm(INCH/HR)=  0.36
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap = 0.850
  PEAK FLOW RATE(CFS)   =       1.59
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
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             Ver. 15.0  Release Date: 04/01/2008  License ID 1555

                            Analysis prepared by:




 ************************** DESCRIPTION OF STUDY **************************
* REDLANDS PASSENGER RAIL PROJECT                                          *
* EXISTING 100 YEAR ANALYSIS                                               *
* DRAINAGE AREA 24000                                                      *
 **************************************************************************

  FILE NAME: C:\RPRP\24000.DAT
  TIME/DATE OF STUDY: 11:40 06/18/2012
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2500

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======   ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  2   13.0      8.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  3   25.0     15.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  4   35.0     25.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  5   20.0     15.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.20 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE  24000.00 TO NODE  24005.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   973.00
  ELEVATION DATA: UPSTREAM(FEET) =   1279.00  DOWNSTREAM(FEET) =   1261.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   10.585
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.540
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
```

```
 COMMERCIAL                  B        0.90      0.42     0.100    76   10.58
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA RUNOFF(CFS) =      2.83
 TOTAL AREA(ACRES) =      0.90   PEAK FLOW RATE(CFS) =      2.83

****************************************************************************
 FLOW PROCESS FROM NODE  24005.00 TO NODE  24005.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =   10.58
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.540
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                  B        4.50      0.42     0.100    76
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA AREA(ACRES) =    4.50      SUBAREA RUNOFF(CFS) =   14.17
 EFFECTIVE AREA(ACRES) =      5.40   AREA-AVERAGED Fm(INCH/HR) =  0.04
 AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =        5.4       PEAK FLOW RATE(CFS) =      17.00

****************************************************************************
 FLOW PROCESS FROM NODE  24005.00 TO NODE  24010.00 IS CODE =  62
----------------------------------------------------------------------------
 >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>(STREET TABLE SECTION #  4 USED)<<<<<
============================================================================
 UPSTREAM ELEVATION(FEET) = 1261.00  DOWNSTREAM ELEVATION(FEET) = 1256.00
 STREET LENGTH(FEET) =   273.00   CURB HEIGHT(INCHES) =  8.0
 STREET HALFWIDTH(FEET) = 35.00

 DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  25.00
 INSIDE STREET CROSSFALL(DECIMAL) =  0.018
 OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

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

   **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      17.44
   STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
   STREET FLOW DEPTH(FEET) =  0.53
   HALFSTREET FLOOD WIDTH(FEET) =   20.50
   AVERAGE FLOW VELOCITY(FEET/SEC.) =    4.39
   PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    2.33
 STREET FLOW TRAVEL TIME(MIN.) =   1.04   Tc(MIN.) =   11.62
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.347
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                  B        0.30      0.42     0.100    76
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA AREA(ACRES) =    0.30      SUBAREA RUNOFF(CFS) =    0.89
 EFFECTIVE AREA(ACRES) =      5.70    AREA-AVERAGED Fm(INCH/HR) =  0.04
 AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =        5.7        PEAK FLOW RATE(CFS) =      17.00
 NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

 END OF SUBAREA STREET FLOW HYDRAULICS:
 DEPTH(FEET) = 0.53   HALFSTREET FLOOD WIDTH(FEET) =  20.21
 FLOW VELOCITY(FEET/SEC.) =  4.39   DEPTH*VELOCITY(FT*FT/SEC.) =   2.31
 LONGEST FLOWPATH FROM NODE  24000.00 TO NODE  24010.00 =    1246.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE  24010.00 TO NODE  24010.00 IS CODE =  81
----------------------------------------------------------------------------
```

```
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
==============================================================================
  MAINLINE Tc(MIN.) =   11.62
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.347
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        7.70      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    7.70      SUBAREA RUNOFF(CFS) =   22.90
  EFFECTIVE AREA(ACRES) =     13.40   AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =       13.4       PEAK FLOW RATE(CFS) =      39.85

****************************************************************************
  FLOW PROCESS FROM NODE  24010.00 TO NODE  24015.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  4 USED)<<<<<
==============================================================================
  UPSTREAM ELEVATION(FEET) = 1256.00  DOWNSTREAM ELEVATION(FEET) = 1248.00
  STREET LENGTH(FEET) =   490.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 35.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  25.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

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

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      40.68
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.69
    HALFSTREET FLOOD WIDTH(FEET) =   30.24
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    5.17
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    3.55
  STREET FLOW TRAVEL TIME(MIN.) =   1.58   Tc(MIN.) =   13.20
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.100
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.60      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.60      SUBAREA RUNOFF(CFS) =    1.65
  EFFECTIVE AREA(ACRES) =     14.00    AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =       14.0        PEAK FLOW RATE(CFS) =      39.85
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.68   HALFSTREET FLOOD WIDTH(FEET) =  29.68
  FLOW VELOCITY(FEET/SEC.) =  5.17   DEPTH*VELOCITY(FT*FT/SEC.) =   3.53
  LONGEST FLOWPATH FROM NODE  24000.00 TO NODE  24015.00 =    1736.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  24015.00 TO NODE  24015.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
==============================================================================
  MAINLINE Tc(MIN.) =   13.20
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.100
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B       10.30      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
```

```
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =   10.30      SUBAREA RUNOFF(CFS) =   28.35
  EFFECTIVE AREA(ACRES) =     24.30   AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =       24.3       PEAK FLOW RATE(CFS) =      66.88

****************************************************************************
  FLOW PROCESS FROM NODE  24015.00 TO NODE  24020.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  4 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1248.00  DOWNSTREAM ELEVATION(FEET) = 1245.00
  STREET LENGTH(FEET) =   180.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 35.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  25.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

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

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      67.15
    ***STREET FLOW SPLITS OVER STREET-CROWN***
    FULL DEPTH(FEET) =    0.79   FLOOD WIDTH(FEET) =   41.28
    FULL HALF-STREET VELOCITY(FEET/SEC.) =    5.78
    SPLIT DEPTH(FEET) =    0.20   SPLIT FLOOD WIDTH(FEET) =    2.03
    SPLIT FLOW(CFS) =    0.05   SPLIT VELOCITY(FEET/SEC.) =    0.20
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.79
    HALFSTREET FLOOD WIDTH(FEET) =   41.28
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    5.78
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    4.58
  STREET FLOW TRAVEL TIME(MIN.) =   0.52   Tc(MIN.) =   13.72
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.029
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.20      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.20      SUBAREA RUNOFF(CFS) =    0.54
  EFFECTIVE AREA(ACRES) =     24.50    AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =       24.5        PEAK FLOW RATE(CFS) =      66.88
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.79   HALFSTREET FLOOD WIDTH(FEET) =  41.19
  FLOW VELOCITY(FEET/SEC.) =  5.78   DEPTH*VELOCITY(FT*FT/SEC.) =   4.57
  LONGEST FLOWPATH FROM NODE  24000.00 TO NODE  24020.00 =    1916.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  24020.00 TO NODE  24020.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   13.72
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.029
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        3.80      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    3.80      SUBAREA RUNOFF(CFS) =   10.22
  EFFECTIVE AREA(ACRES) =     28.30   AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
```

```
  TOTAL AREA(ACRES) =       28.3       PEAK FLOW RATE(CFS) =      76.08

****************************************************************************
  FLOW PROCESS FROM NODE  24020.00 TO NODE  24025.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  4 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1245.00  DOWNSTREAM ELEVATION(FEET) = 1236.00
  STREET LENGTH(FEET) =   600.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 35.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  25.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

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

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      77.33
    ***STREET FLOW SPLITS OVER STREET-CROWN***
    FULL DEPTH(FEET) =    0.79   FLOOD WIDTH(FEET) =   41.28
    FULL HALF-STREET VELOCITY(FEET/SEC.) =    5.48
    SPLIT DEPTH(FEET) =    0.51   SPLIT FLOOD WIDTH(FEET) =   19.33
    SPLIT FLOW(CFS) =   13.67   SPLIT VELOCITY(FEET/SEC.) =    3.85
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.79
    HALFSTREET FLOOD WIDTH(FEET) =   41.28
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    5.48
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    4.34
  STREET FLOW TRAVEL TIME(MIN.) =   1.82   Tc(MIN.) =   15.55
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.811
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B       1.00      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    1.00      SUBAREA RUNOFF(CFS) =    2.49
  EFFECTIVE AREA(ACRES) =     29.30    AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =       29.3        PEAK FLOW RATE(CFS) =      76.08
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.79   HALFSTREET FLOOD WIDTH(FEET) =  41.28
  FLOW VELOCITY(FEET/SEC.) =  5.48   DEPTH*VELOCITY(FT*FT/SEC.) =   4.34
  LONGEST FLOWPATH FROM NODE  24000.00 TO NODE  24025.00 =    2516.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  24025.00 TO NODE  24025.00 IS CODE =  82
----------------------------------------------------------------------------
  >>>>>ADD SUBAREA RUNOFF TO MAINLINE, AT MAINLINE Tc,<<<<<
  >>>>>(AND COMPUTE INITIAL SUBAREA RUNOFF)<<<<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =  2520.00
  ELEVATION DATA: UPSTREAM(FEET) =   1279.00  DOWNSTREAM(FEET) =   1236.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   15.741
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.790
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 B      10.10      0.42     0.100    76   15.74
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =   10.10   INITIAL SUBAREA RUNOFF(CFS) =   24.98
```

```
 ** ADD SUBAREA RUNOFF TO MAINLINE AT MAINLINE Tc:
 MAINLINE Tc(MIN.) =   15.55
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.811
 SUBAREA AREA(ACRES) =   10.10      SUBAREA RUNOFF(CFS) =   25.17
 EFFECTIVE AREA(ACRES) =     39.40   AREA-AVERAGED Fm(INCH/HR) =  0.04
 AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
 TOTAL AREA(ACRES) =       39.4       PEAK FLOW RATE(CFS) =      98.17

****************************************************************************
 FLOW PROCESS FROM NODE  24025.00 TO NODE  24025.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
 TIME OF CONCENTRATION(MIN.) =   15.55
 RAINFALL INTENSITY(INCH/HR) =   2.81
 AREA-AVERAGED Fm(INCH/HR) =  0.04
 AREA-AVERAGED Fp(INCH/HR) =  0.42
 AREA-AVERAGED Ap =  0.10
 EFFECTIVE STREAM AREA(ACRES) =      39.40
 TOTAL STREAM AREA(ACRES) =      39.40
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      98.17

****************************************************************************
 FLOW PROCESS FROM NODE  24030.00 TO NODE  24035.00 IS CODE =  21
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
 INITIAL SUBAREA FLOW-LENGTH(FEET) =   920.00
 ELEVATION DATA: UPSTREAM(FEET) =   1310.00  DOWNSTREAM(FEET) =   1287.00

 Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
 SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   14.041
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.988
 SUBAREA Tc AND LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
 RESIDENTIAL
 "2 DWELLINGS/ACRE"         B        2.20      0.42     0.700    76   14.04
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.700
 SUBAREA RUNOFF(CFS) =      5.33
 TOTAL AREA(ACRES) =      2.20   PEAK FLOW RATE(CFS) =      5.33

****************************************************************************
 FLOW PROCESS FROM NODE  24035.00 TO NODE  24040.00 IS CODE =  41
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =  1287.00  DOWNSTREAM(FEET) =  1269.00
 FLOW LENGTH(FEET) =   450.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  24.0 INCH PIPE IS   5.7 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =   9.30
 GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =       5.33
 PIPE TRAVEL TIME(MIN.) =   0.81    Tc(MIN.) =   14.85
 LONGEST FLOWPATH FROM NODE  24030.00 TO NODE  24040.00 =    1370.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE  24040.00 TO NODE  24040.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =   14.85
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.889
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
```

```
  RESIDENTIAL
  "2 DWELLINGS/ACRE"         B       12.60      0.42     0.700    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.700
  SUBAREA AREA(ACRES) =   12.60      SUBAREA RUNOFF(CFS) =   29.41
  EFFECTIVE AREA(ACRES) =     14.80   AREA-AVERAGED Fm(INCH/HR) =  0.30
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.70
  TOTAL AREA(ACRES) =       14.8       PEAK FLOW RATE(CFS) =      34.54

****************************************************************************
  FLOW PROCESS FROM NODE  24040.00 TO NODE  24045.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1269.00  DOWNSTREAM(FEET) =  1253.00
  FLOW LENGTH(FEET) =   940.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  30.0 INCH PIPE IS  18.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  11.12
  GIVEN PIPE DIAMETER(INCH) =  30.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      34.54
  PIPE TRAVEL TIME(MIN.) =   1.41    Tc(MIN.) =   16.26
  LONGEST FLOWPATH FROM NODE  24030.00 TO NODE  24045.00 =    2310.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  24045.00 TO NODE  24045.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   16.26
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.736
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "2 DWELLINGS/ACRE"         B       10.60      0.42     0.700    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.700
  SUBAREA AREA(ACRES) =   10.60      SUBAREA RUNOFF(CFS) =   23.28
  EFFECTIVE AREA(ACRES) =     25.40   AREA-AVERAGED Fm(INCH/HR) =  0.30
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.70
  TOTAL AREA(ACRES) =       25.4       PEAK FLOW RATE(CFS) =      55.79

****************************************************************************
  FLOW PROCESS FROM NODE  24045.00 TO NODE  24050.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1253.00  DOWNSTREAM(FEET) =  1242.00
  FLOW LENGTH(FEET) =   500.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  30.0 INCH PIPE IS  23.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  13.39
  GIVEN PIPE DIAMETER(INCH) =  30.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      55.79
  PIPE TRAVEL TIME(MIN.) =   0.62    Tc(MIN.) =   16.88
  LONGEST FLOWPATH FROM NODE  24030.00 TO NODE  24050.00 =    2810.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  24050.00 TO NODE  24050.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   16.88
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.675
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "2 DWELLINGS/ACRE"         B        7.10      0.42     0.700    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
```

```
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.700
  SUBAREA AREA(ACRES) =    7.10      SUBAREA RUNOFF(CFS) =   15.20
  EFFECTIVE AREA(ACRES) =     32.50   AREA-AVERAGED Fm(INCH/HR) =  0.30
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.70
  TOTAL AREA(ACRES) =       32.5       PEAK FLOW RATE(CFS) =      69.60

****************************************************************************
  FLOW PROCESS FROM NODE  24050.00 TO NODE  24025.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  4 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1242.00  DOWNSTREAM ELEVATION(FEET) = 1236.00
  STREET LENGTH(FEET) =  1307.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 35.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  25.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

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

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      80.96
    ***STREET FLOWING FULL***
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.82
    HALFSTREET FLOOD WIDTH(FEET) =   42.59
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.18
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    2.61
  STREET FLOW TRAVEL TIME(MIN.) =   6.84   Tc(MIN.) =   23.72
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.181
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B      11.80      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =   11.80      SUBAREA RUNOFF(CFS) =   22.72
  EFFECTIVE AREA(ACRES) =     44.30    AREA-AVERAGED Fm(INCH/HR) =  0.23
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.54
  TOTAL AREA(ACRES) =       44.3        PEAK FLOW RATE(CFS) =      77.86

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.81   HALFSTREET FLOOD WIDTH(FEET) =  42.23
  FLOW VELOCITY(FEET/SEC.) =  3.14   DEPTH*VELOCITY(FT*FT/SEC.) =   2.55
  *NOTE: INITIAL SUBAREA NOMOGRAPH WITH SUBAREA PARAMETERS,
         AND L = 1307.0 FT WITH ELEVATION-DROP =   6.0 FT, IS   29.2 CFS,
         WHICH EXCEEDS THE TOP-OF-CURB STREET CAPACITY AT NODE  24025.00
  LONGEST FLOWPATH FROM NODE  24030.00 TO NODE  24025.00 =    4117.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  24025.00 TO NODE  24025.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   23.72
  RAINFALL INTENSITY(INCH/HR) =   2.18
  AREA-AVERAGED Fm(INCH/HR) =  0.23
  AREA-AVERAGED Fp(INCH/HR) =  0.42
  AREA-AVERAGED Ap =  0.54
  EFFECTIVE STREAM AREA(ACRES) =      44.30
  TOTAL STREAM AREA(ACRES) =      44.30
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      77.86

  ** CONFLUENCE DATA **
```

```
 STREAM      Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
 NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
    1       98.17   15.55    2.811  0.42( 0.04) 0.10      39.4   24000.00
    2       77.86   23.72    2.181  0.42( 0.23) 0.54      44.3   24030.00

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

** PEAK FLOW RATE TABLE **
 STREAM      Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
 NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
    1      165.65   15.55    2.811  0.42( 0.12) 0.29      68.4   24000.00
    2      153.72   23.72    2.181  0.42( 0.14) 0.33      83.7   24030.00

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
PEAK FLOW RATE(CFS) =     165.65    Tc(MIN.) =    15.55
EFFECTIVE AREA(ACRES) =      68.43   AREA-AVERAGED Fm(INCH/HR) =  0.12
AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.29
TOTAL AREA(ACRES) =       83.7
LONGEST FLOWPATH FROM NODE  24030.00 TO NODE  24025.00 =    4117.00 FEET.

****************************************************************************
FLOW PROCESS FROM NODE  24025.00 TO NODE  24055.00 IS CODE =  41
----------------------------------------------------------------------------
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
ELEVATION DATA: UPSTREAM(FEET) =  1230.00  DOWNSTREAM(FEET) =  1205.00
FLOW LENGTH(FEET) =  1650.00   MANNING'S N =  0.013
DEPTH OF FLOW IN  48.0 INCH PIPE IS  38.8 INCHES
PIPE-FLOW VELOCITY(FEET/SEC.) =  15.22
GIVEN PIPE DIAMETER(INCH) =  48.00    NUMBER OF PIPES =   1
PIPE-FLOW(CFS) =     165.65
PIPE TRAVEL TIME(MIN.) =   1.81    Tc(MIN.) =   17.35
LONGEST FLOWPATH FROM NODE  24030.00 TO NODE  24055.00 =    5767.00 FEET.

****************************************************************************
FLOW PROCESS FROM NODE  24055.00 TO NODE  24055.00 IS CODE =  81
----------------------------------------------------------------------------
>>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
MAINLINE Tc(MIN.) =   17.35
* 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.631
SUBAREA LOSS RATE DATA(AMC III):
 DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
     LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
PUBLIC PARK                B       29.10      0.42     0.850    76
SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
SUBAREA AREA(ACRES) =   29.10      SUBAREA RUNOFF(CFS) =   59.50
EFFECTIVE AREA(ACRES) =     97.53   AREA-AVERAGED Fm(INCH/HR) =  0.19
AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.45
TOTAL AREA(ACRES) =      112.8       PEAK FLOW RATE(CFS) =     214.09

****************************************************************************
FLOW PROCESS FROM NODE  24055.00 TO NODE  24060.00 IS CODE =  41
----------------------------------------------------------------------------
>>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
ELEVATION DATA: UPSTREAM(FEET) =  1205.00  DOWNSTREAM(FEET) =  1190.00
FLOW LENGTH(FEET) =  1090.00   MANNING'S N =  0.013
ASSUME FULL-FLOWING PIPELINE
PIPE-FLOW VELOCITY(FEET/SEC.) =  14.52
PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
GIVEN PIPE DIAMETER(INCH) =  52.00    NUMBER OF PIPES =   1
PIPE-FLOW(CFS) =     214.09
PIPE TRAVEL TIME(MIN.) =   1.25    Tc(MIN.) =   18.60
LONGEST FLOWPATH FROM NODE  24030.00 TO NODE  24060.00 =    6857.00 FEET.

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

```
  FLOW PROCESS FROM NODE  24060.00 TO NODE  24060.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   18.60
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.524
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS               B       11.00      0.42     0.350    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA AREA(ACRES) =   11.00      SUBAREA RUNOFF(CFS) =   23.52
  EFFECTIVE AREA(ACRES) =    108.53   AREA-AVERAGED Fm(INCH/HR) =  0.19
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.44
  TOTAL AREA(ACRES) =      123.8       PEAK FLOW RATE(CFS) =     228.16

****************************************************************************
  FLOW PROCESS FROM NODE  24060.00 TO NODE  24065.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1190.00  DOWNSTREAM(FEET) =  1155.00
  FLOW LENGTH(FEET) =  2675.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  15.47
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  52.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     228.16
  PIPE TRAVEL TIME(MIN.) =   2.88    Tc(MIN.) =   21.49
  LONGEST FLOWPATH FROM NODE  24030.00 TO NODE  24065.00 =    9532.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  24065.00 TO NODE  24065.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   21.49
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.315
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS               B      209.60      0.42     0.350    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA AREA(ACRES) =  209.60      SUBAREA RUNOFF(CFS) =  408.73
  EFFECTIVE AREA(ACRES) =    318.13   AREA-AVERAGED Fm(INCH/HR) =  0.16
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.38
  TOTAL AREA(ACRES) =      333.4       PEAK FLOW RATE(CFS) =     616.48

****************************************************************************
  FLOW PROCESS FROM NODE  24065.00 TO NODE  24070.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1155.00  DOWNSTREAM(FEET) =  1104.00
  FLOW LENGTH(FEET) =  4780.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  21.80
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  72.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     616.48
  PIPE TRAVEL TIME(MIN.) =   3.65    Tc(MIN.) =   25.14
  LONGEST FLOWPATH FROM NODE  24030.00 TO NODE  24070.00 =   14312.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  24070.00 TO NODE  24070.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
```

```
============================================================================
  MAINLINE Tc(MIN.) =   25.14
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.107
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS               B       48.70      0.42     0.350    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA AREA(ACRES) =   48.70      SUBAREA RUNOFF(CFS) =   85.84
  EFFECTIVE AREA(ACRES) =    366.83   AREA-AVERAGED Fm(INCH/HR) =  0.16
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.38
  TOTAL AREA(ACRES) =      382.1       PEAK FLOW RATE(CFS) =     642.73
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =      382.1  TC(MIN.) =     25.14
  EFFECTIVE AREA(ACRES) =    366.83  AREA-AVERAGED Fm(INCH/HR)=  0.16
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap = 0.378
  PEAK FLOW RATE(CFS)   =     642.73

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1      642.73   25.14    2.107  0.42( 0.16) 0.38     366.8   24000.00
      2      545.66   34.27    1.749  0.42( 0.16) 0.38     382.1   24030.00
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
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                           Analysis prepared by:




 ************************** DESCRIPTION OF STUDY **************************
* REDLANDS PASSENGER RAIL PROJECT                                          *
* EXISTING 100 YEAR ANALYSIS                                               *
* DRAINAGE AREA 24100                                                      *
 **************************************************************************

  FILE NAME: C:\RPRP\24100.DAT
  TIME/DATE OF STUDY: 11:01 06/18/2012
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2500

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======   ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  2   13.0      8.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  3   25.0     15.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  4   35.0     25.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  5   20.0     15.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.20 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE  24100.00 TO NODE  24105.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   930.00
  ELEVATION DATA: UPSTREAM(FEET) =   1146.00  DOWNSTREAM(FEET) =   1135.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   11.368
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.391
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
```

```
  COMMERCIAL                 B        1.60      0.42     0.100    76   11.37
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      4.82
  TOTAL AREA(ACRES) =      1.60   PEAK FLOW RATE(CFS) =      4.82

****************************************************************************
  FLOW PROCESS FROM NODE  24105.00 TO NODE  24110.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  4 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1135.00  DOWNSTREAM ELEVATION(FEET) = 1121.00
  STREET LENGTH(FEET) =  1370.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 35.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  25.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

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

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      11.73
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.52
    HALFSTREET FLOOD WIDTH(FEET) =   19.62
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.21
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.65
  STREET FLOW TRAVEL TIME(MIN.) =   7.12   Tc(MIN.) =   18.49
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.533
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        6.10      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    6.10      SUBAREA RUNOFF(CFS) =   13.67
  EFFECTIVE AREA(ACRES) =      7.70    AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        7.7        PEAK FLOW RATE(CFS) =      17.26

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.57   HALFSTREET FLOOD WIDTH(FEET) =  22.84
  FLOW VELOCITY(FEET/SEC.) =  3.53   DEPTH*VELOCITY(FT*FT/SEC.) =   2.02
  LONGEST FLOWPATH FROM NODE  24100.00 TO NODE  24110.00 =    2300.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  24110.00 TO NODE  24070.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  4 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1121.00  DOWNSTREAM ELEVATION(FEET) = 1111.00
  STREET LENGTH(FEET) =   800.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 35.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  25.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

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

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      18.98
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.57
```

```
    HALFSTREET FLOOD WIDTH(FEET) =   22.84
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.88
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    2.23
  STREET FLOW TRAVEL TIME(MIN.) =   3.44   Tc(MIN.) =   21.93
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.287
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        1.70      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    1.70      SUBAREA RUNOFF(CFS) =    3.43
  EFFECTIVE AREA(ACRES) =      9.40    AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        9.4        PEAK FLOW RATE(CFS) =      18.99

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.57   HALFSTREET FLOOD WIDTH(FEET) =  22.84
  FLOW VELOCITY(FEET/SEC.) =  3.88   DEPTH*VELOCITY(FT*FT/SEC.) =   2.23
  LONGEST FLOWPATH FROM NODE  24100.00 TO NODE  24070.00 =    3100.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  24070.00 TO NODE  24070.00 IS CODE =  82
----------------------------------------------------------------------------
  >>>>>ADD SUBAREA RUNOFF TO MAINLINE, AT MAINLINE Tc,<<<<<
  >>>>>(AND COMPUTE INITIAL SUBAREA RUNOFF)<<<<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =  1912.00
  ELEVATION DATA: UPSTREAM(FEET) =   1127.40  DOWNSTREAM(FEET) =   1111.70

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   16.315
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.731
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 B       15.40      0.42     0.100    76   16.31
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =   15.40   INITIAL SUBAREA RUNOFF(CFS) =   37.26

  ** ADD SUBAREA RUNOFF TO MAINLINE AT MAINLINE Tc:
  MAINLINE Tc(MIN.) =   21.93
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.287
  SUBAREA AREA(ACRES) =   15.40      SUBAREA RUNOFF(CFS) =   31.11
  EFFECTIVE AREA(ACRES) =     24.80   AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =       24.8       PEAK FLOW RATE(CFS) =      50.10
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)      =       24.8  TC(MIN.) =     21.93
  EFFECTIVE AREA(ACRES) =     24.80  AREA-AVERAGED Fm(INCH/HR)=  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap = 0.100
  PEAK FLOW RATE(CFS)   =      50.10
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

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____________________________________________________________________________
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                           Analysis prepared by:







 ************************* DESCRIPTION OF STUDY ************************
* REDLANDS PASSENGER RAIL                                                *
* EXISTING HYDROLOGY 100 YEAR STORM                                      *
* BASIN 26000                                                            *
 **************************************************************************

  FILE NAME: C:\RPRP\EPRP\26000.DAT
  TIME/DATE OF STUDY: 14:54 02/16/2012
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2500

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   13.0      8.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  3   25.0     15.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  4   35.0     25.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  5   20.0     15.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.20 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE  26000.00 TO NODE  26010.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   750.00
  ELEVATION DATA: UPSTREAM(FEET) =   1126.60  DOWNSTREAM(FEET) =   1120.70

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   17.981
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.576
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
```

```
 PUBLIC PARK                B       0.60      0.42     0.850    76   17.98
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
 SUBAREA RUNOFF(CFS) =      1.20
 TOTAL AREA(ACRES) =      0.60   PEAK FLOW RATE(CFS) =      1.20

****************************************************************************
 FLOW PROCESS FROM NODE  26010.00 TO NODE  26020.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   1120.70  DOWNSTREAM(FEET) =   1112.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =   822.00   CHANNEL SLOPE =  0.0106
 CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   2.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.122
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 PUBLIC PARK                B       0.60      0.42     0.850    76
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.67
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.00
 AVERAGE FLOW DEPTH(FEET) =   0.32   TRAVEL TIME(MIN.) =   6.85
 Tc(MIN.) =   24.83
 SUBAREA AREA(ACRES) =     0.60       SUBAREA RUNOFF(CFS) =    0.95
 EFFECTIVE AREA(ACRES) =      1.20     AREA-AVERAGED Fm(INCH/HR) =   0.36
 AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.85
 TOTAL AREA(ACRES) =        1.2         PEAK FLOW RATE(CFS) =       1.90

 END OF SUBAREA CHANNEL FLOW HYDRAULICS:
 DEPTH(FEET) =  0.34   FLOW VELOCITY(FEET/SEC.) =   2.09
 LONGEST FLOWPATH FROM NODE  26000.00 TO NODE  26020.00 =    1572.00 FEET.
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)     =        1.2  TC(MIN.) =     24.83
 EFFECTIVE AREA(ACRES) =      1.20  AREA-AVERAGED Fm(INCH/HR)=  0.36
 AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap = 0.850
 PEAK FLOW RATE(CFS)   =      1.90
============================================================================
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

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****************************************************************************
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                          Analysis prepared by:






 ************************** DESCRIPTION OF STUDY **************************
* REDLANDS PASSENGER RAIL PROJECT                                          *
* EXISTING 100 YEAR ANALYSIS                                               *
* DRAINAGE AREA 27000                                                      *
 **************************************************************************

  FILE NAME: C:\RPRP\27000.DAT
  TIME/DATE OF STUDY: 15:57 11/12/2012
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2500

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======   ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  2   13.0      8.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  3   25.0     15.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  4   35.0     25.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  5   20.0     15.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.20 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE  27000.00 TO NODE  27010.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   960.00
  ELEVATION DATA: UPSTREAM(FEET) =   1165.00  DOWNSTREAM(FEET) =   1148.30

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   14.445
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.937
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
```

```
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        0.60      0.42     0.600    76   14.44
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  SUBAREA RUNOFF(CFS) =      1.45
  TOTAL AREA(ACRES) =      0.60   PEAK FLOW RATE(CFS) =      1.45

****************************************************************************
  FLOW PROCESS FROM NODE  27010.00 TO NODE  27020.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1149.30  DOWNSTREAM(FEET) =   1135.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  1680.00   CHANNEL SLOPE =  0.0085
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  1.983
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        1.30      0.42     0.600    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       2.48
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.10
  AVERAGE FLOW DEPTH(FEET) =   0.42   TRAVEL TIME(MIN.) =  13.35
  Tc(MIN.) =   27.80
  SUBAREA AREA(ACRES) =     1.30       SUBAREA RUNOFF(CFS) =    2.02
  EFFECTIVE AREA(ACRES) =      1.90     AREA-AVERAGED Fm(INCH/HR) =   0.25
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.60
  TOTAL AREA(ACRES) =       1.9         PEAK FLOW RATE(CFS) =       2.96

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.46   FLOW VELOCITY(FEET/SEC.) =   2.19
  LONGEST FLOWPATH FROM NODE  27000.00 TO NODE  27020.00 =    2640.00 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        1.9  TC(MIN.) =     27.80
  EFFECTIVE AREA(ACRES) =      1.90  AREA-AVERAGED Fm(INCH/HR)=  0.25
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap = 0.600
  PEAK FLOW RATE(CFS)   =       2.96
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
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             Ver. 15.0  Release Date: 04/01/2008  License ID 1555

                           Analysis prepared by:





 ************************** DESCRIPTION OF STUDY **************************
* REDLANDS PASSENGER RAIL PROJECT                                           *
* EXISTING 100 YEAR ANALYSIS                                                *
* DRAINAGE AREA 28000                                                       *
 **************************************************************************

  FILE NAME: C:\RPRP\28000.DAT
  TIME/DATE OF STUDY: 13:50 06/18/2012
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2500

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======   ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  2   13.0      8.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  3   25.0     15.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  4   35.0     25.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  5   20.0     15.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.20 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE  28000.00 TO NODE  28010.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   990.00
  ELEVATION DATA: UPSTREAM(FEET) =   1156.00  DOWNSTREAM(FEET) =   1142.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   17.869
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.585
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
```

```
 PUBLIC PARK                B        1.30      0.42     0.850    76   17.87
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
 SUBAREA RUNOFF(CFS) =      2.60
 TOTAL AREA(ACRES) =      1.30   PEAK FLOW RATE(CFS) =      2.60

****************************************************************************
 FLOW PROCESS FROM NODE  28010.00 TO NODE  28010.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =   17.87
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.585
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                 B        7.70      0.42     0.100    76
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA AREA(ACRES) =    7.70      SUBAREA RUNOFF(CFS) =   17.62
 EFFECTIVE AREA(ACRES) =      9.00   AREA-AVERAGED Fm(INCH/HR) =  0.09
 AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.21
 TOTAL AREA(ACRES) =        9.0      PEAK FLOW RATE(CFS) =      20.23

****************************************************************************
 FLOW PROCESS FROM NODE  28010.00 TO NODE  28020.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =  1142.00  DOWNSTREAM(FEET) =   1128.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =   990.00   CHANNEL SLOPE =  0.0141
 CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   2.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00

        ==>>WARNING: FLOW IN CHANNEL EXCEEDS CHANNEL
            CAPACITY( NORMAL DEPTH EQUAL TO SPECIFIED MAXIMUM
            ALLOWABLE DEPTH).
            AS AN APPROXIMATION, FLOWDEPTH IS SET AT MAXIMUM
            ALLOWABLE DEPTH AND IS USED FOR TRAVELTIME CALCULATIONS.

 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.354
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 PUBLIC PARK                B        1.80      0.42     0.850    76
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      21.85
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   5.46
 AVERAGE FLOW DEPTH(FEET) =   1.00   TRAVEL TIME(MIN.) =   3.02
 Tc(MIN.) =   20.89
 SUBAREA AREA(ACRES) =     1.80       SUBAREA RUNOFF(CFS) =    3.23
 EFFECTIVE AREA(ACRES) =     10.80     AREA-AVERAGED Fm(INCH/HR) =   0.13
 AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.32
 TOTAL AREA(ACRES) =       10.8         PEAK FLOW RATE(CFS) =      21.59

        ==>>WARNING: FLOW IN CHANNEL EXCEEDS CHANNEL
            CAPACITY( NORMAL DEPTH EQUAL TO SPECIFIED MAXIMUM
            ALLOWABLE DEPTH).
            AS AN APPROXIMATION, FLOWDEPTH IS SET AT MAXIMUM
            ALLOWABLE DEPTH AND IS USED FOR TRAVELTIME CALCULATIONS.


 END OF SUBAREA CHANNEL FLOW HYDRAULICS:
 DEPTH(FEET) =  1.00   FLOW VELOCITY(FEET/SEC.) =   5.40

 ==>FLOWDEPTH EXCEEDS MAXIMUM ALLOWABLE DEPTH

 LONGEST FLOWPATH FROM NODE  28000.00 TO NODE  28020.00 =    1980.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE  28020.00 TO NODE  28020.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   20.89
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.354
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        3.80      0.42     0.100    76
  PUBLIC PARK                B       18.10      0.42     0.850    76
  PUBLIC PARK                B       20.40      0.42     0.850    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.783
  SUBAREA AREA(ACRES) =   42.30      SUBAREA RUNOFF(CFS) =   77.02
  EFFECTIVE AREA(ACRES) =     53.10   AREA-AVERAGED Fm(INCH/HR) =  0.29
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.69
  TOTAL AREA(ACRES) =       53.1       PEAK FLOW RATE(CFS) =      98.61

****************************************************************************
  FLOW PROCESS FROM NODE  28020.00 TO NODE  28030.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1120.70  DOWNSTREAM(FEET) =  1115.40
  FLOW LENGTH(FEET) =   520.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  10.25
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  42.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      98.61
  PIPE TRAVEL TIME(MIN.) =   0.85    Tc(MIN.) =   21.74
  LONGEST FLOWPATH FROM NODE  28000.00 TO NODE  28030.00 =    2500.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  28030.00 TO NODE  28030.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   21.74
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.299
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        6.20      0.42     0.100    76
  COMMERCIAL                 B        2.70      0.42     0.100    76
  COMMERCIAL                 B        5.80      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =   14.70      SUBAREA RUNOFF(CFS) =   29.85
  EFFECTIVE AREA(ACRES) =     67.80   AREA-AVERAGED Fm(INCH/HR) =  0.24
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.56
  TOTAL AREA(ACRES) =       67.8       PEAK FLOW RATE(CFS) =     125.81

****************************************************************************
  FLOW PROCESS FROM NODE  28030.00 TO NODE  28040.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1115.40  DOWNSTREAM(FEET) =  1107.20
  FLOW LENGTH(FEET) =   390.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  48.0 INCH PIPE IS  27.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  16.66
  GIVEN PIPE DIAMETER(INCH) =  48.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     125.81
  PIPE TRAVEL TIME(MIN.) =   0.39    Tc(MIN.) =   22.13
  LONGEST FLOWPATH FROM NODE  28000.00 TO NODE  28040.00 =    2890.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE  28040.00 TO NODE  28040.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   22.13
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.274
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B       6.60      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    6.60      SUBAREA RUNOFF(CFS) =   13.26
  EFFECTIVE AREA(ACRES) =     74.40   AREA-AVERAGED Fm(INCH/HR) =  0.22
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.52
  TOTAL AREA(ACRES) =       74.4       PEAK FLOW RATE(CFS) =     137.58
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       74.4  TC(MIN.) =     22.13
  EFFECTIVE AREA(ACRES) =     74.40  AREA-AVERAGED Fm(INCH/HR)=  0.22
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap = 0.519
  PEAK FLOW RATE(CFS)   =     137.58
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
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             Ver. 15.0  Release Date: 04/01/2008  License ID 1555

                           Analysis prepared by:





 ************************** DESCRIPTION OF STUDY **************************
* REDLANDS PASSENGER RAIL PROJECT                                          *
* EXISTING 100 YEAR ANALYSIS                                               *
* DRAINAGE AREA 50000                                                      *
 **************************************************************************

  FILE NAME: C:\RPRP\51000.DAT
  TIME/DATE OF STUDY: 12:56 06/05/2012
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2500

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======   ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  2   20.0     15.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0170

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.20 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE  50000.00 TO NODE  50001.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   840.00
  ELEVATION DATA: UPSTREAM(FEET) =   1320.00  DOWNSTREAM(FEET) =   1294.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.004
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.901
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 B        2.80      0.42      0.100    76    9.00
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
```

```
  SUBAREA RUNOFF(CFS) =      9.72
  TOTAL AREA(ACRES) =      2.80   PEAK FLOW RATE(CFS) =      9.72

****************************************************************************
  FLOW PROCESS FROM NODE  50001.00 TO NODE  50002.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1290.00  DOWNSTREAM(FEET) =  1286.00
  FLOW LENGTH(FEET) =    55.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   7.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  13.98
  GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       9.72
  PIPE TRAVEL TIME(MIN.) =   0.07    Tc(MIN.) =    9.07
  LONGEST FLOWPATH FROM NODE  50000.00 TO NODE  50002.00 =     895.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  50002.00 TO NODE  50003.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1286.00  DOWNSTREAM(FEET) =   1282.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   300.00   CHANNEL SLOPE =  0.0133
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.704
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        3.20      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      15.00
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   6.72
  AVERAGE FLOW DEPTH(FEET) =   0.67   TRAVEL TIME(MIN.) =   0.74
  Tc(MIN.) =    9.81
  SUBAREA AREA(ACRES) =     3.20       SUBAREA RUNOFF(CFS) =   10.55
  EFFECTIVE AREA(ACRES) =      6.00     AREA-AVERAGED Fm(INCH/HR) =   0.04
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =        6.0         PEAK FLOW RATE(CFS) =      19.77

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.77   FLOW VELOCITY(FEET/SEC.) =   7.21
  LONGEST FLOWPATH FROM NODE  50000.00 TO NODE  50003.00 =    1195.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  50003.00 TO NODE  50004.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1282.00  DOWNSTREAM(FEET) =  1277.00
  FLOW LENGTH(FEET) =   100.00   MANNING'S N =  0.024
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  11.19
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      19.77
  PIPE TRAVEL TIME(MIN.) =   0.15    Tc(MIN.) =    9.96
  LONGEST FLOWPATH FROM NODE  50000.00 TO NODE  50004.00 =    1295.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  50004.00 TO NODE  50005.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1277.00  DOWNSTREAM(FEET) =   1247.00
```

```
  CHANNEL LENGTH THRU SUBAREA(FEET) =  2350.00   CHANNEL SLOPE =  0.0128
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   2.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.845
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B       14.90      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      38.72
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   7.43
  AVERAGE FLOW DEPTH(FEET) =   0.92   TRAVEL TIME(MIN.) =   5.27
  Tc(MIN.) =   15.23
  SUBAREA AREA(ACRES) =    14.90       SUBAREA RUNOFF(CFS) =   37.59
  EFFECTIVE AREA(ACRES) =     20.90     AREA-AVERAGED Fm(INCH/HR) =   0.04
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =       20.9         PEAK FLOW RATE(CFS) =      52.72

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  1.05   FLOW VELOCITY(FEET/SEC.) =   8.10
  LONGEST FLOWPATH FROM NODE  50000.00 TO NODE  50005.00 =    3645.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  50005.00 TO NODE  50006.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1247.00  DOWNSTREAM(FEET) =  1241.00
  FLOW LENGTH(FEET) =   450.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  36.0 INCH PIPE IS  22.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  11.25
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      52.72
  PIPE TRAVEL TIME(MIN.) =   0.67    Tc(MIN.) =   15.90
  LONGEST FLOWPATH FROM NODE  50000.00 TO NODE  50006.00 =    4095.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  50006.00 TO NODE  50006.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   15.90
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.773
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B       10.00      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =   10.00      SUBAREA RUNOFF(CFS) =   24.58
  EFFECTIVE AREA(ACRES) =     30.90   AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =       30.9       PEAK FLOW RATE(CFS) =      75.94

****************************************************************************
  FLOW PROCESS FROM NODE  50006.00 TO NODE  50007.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1241.00  DOWNSTREAM(FEET) =  1218.00
  FLOW LENGTH(FEET) =  1330.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  36.0 INCH PIPE IS  27.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  13.34
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      75.94
  PIPE TRAVEL TIME(MIN.) =   1.66    Tc(MIN.) =   17.56
  LONGEST FLOWPATH FROM NODE  50000.00 TO NODE  50007.00 =    5425.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE  50007.00 TO NODE  50007.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   17.56
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.613
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        9.30      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    9.30      SUBAREA RUNOFF(CFS) =   21.51
  EFFECTIVE AREA(ACRES) =     40.20   AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =       40.2       PEAK FLOW RATE(CFS) =      92.99

****************************************************************************
  FLOW PROCESS FROM NODE  50007.00 TO NODE  50008.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1218.00  DOWNSTREAM(FEET) =   1192.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  1316.00   CHANNEL SLOPE =  0.0198
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   3.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.451
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        5.90      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      99.39
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =  11.15
  AVERAGE FLOW DEPTH(FEET) =   1.26   TRAVEL TIME(MIN.) =   1.97
  Tc(MIN.) =   19.53
  SUBAREA AREA(ACRES) =     5.90       SUBAREA RUNOFF(CFS) =   12.79
  EFFECTIVE AREA(ACRES) =     46.10     AREA-AVERAGED Fm(INCH/HR) =   0.04
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =       46.1         PEAK FLOW RATE(CFS) =      99.95

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  1.26   FLOW VELOCITY(FEET/SEC.) =  11.21
  LONGEST FLOWPATH FROM NODE  50000.00 TO NODE  50008.00 =    6741.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  50008.00 TO NODE  50008.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   19.53
  RAINFALL INTENSITY(INCH/HR) =   2.45
  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =      46.10
  TOTAL STREAM AREA(ACRES) =      46.10
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      99.95

****************************************************************************
  FLOW PROCESS FROM NODE  52000.00 TO NODE  52005.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   480.00
```

```
  ELEVATION DATA: UPSTREAM(FEET) =   1240.00  DOWNSTREAM(FEET) =   1237.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.913
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.682
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 B        1.50      0.42     0.100    76    9.91
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      4.91
  TOTAL AREA(ACRES) =      1.50   PEAK FLOW RATE(CFS) =      4.91

****************************************************************************
  FLOW PROCESS FROM NODE  52005.00 TO NODE  52010.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1237.00  DOWNSTREAM(FEET) =   1228.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   635.00   CHANNEL SLOPE =  0.0142
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.030
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        0.40      0.42     0.600    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.41
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.78
  AVERAGE FLOW DEPTH(FEET) =   0.49   TRAVEL TIME(MIN.) =   3.81
  Tc(MIN.) =   13.72
  SUBAREA AREA(ACRES) =     0.40       SUBAREA RUNOFF(CFS) =    1.00
  EFFECTIVE AREA(ACRES) =      1.90     AREA-AVERAGED Fm(INCH/HR) =   0.09
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.21
  TOTAL AREA(ACRES) =        1.9         PEAK FLOW RATE(CFS) =       5.03

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.48   FLOW VELOCITY(FEET/SEC.) =   2.71
  LONGEST FLOWPATH FROM NODE  52000.00 TO NODE  52010.00 =    1115.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  52010.00 TO NODE  52010.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   13.72
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.030
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        2.90      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    2.90      SUBAREA RUNOFF(CFS) =    7.80
  EFFECTIVE AREA(ACRES) =      4.80   AREA-AVERAGED Fm(INCH/HR) =  0.06
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.14
  TOTAL AREA(ACRES) =        4.8       PEAK FLOW RATE(CFS) =      12.83

****************************************************************************
  FLOW PROCESS FROM NODE  52010.00 TO NODE  52015.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1228.00  DOWNSTREAM(FEET) =   1218.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   520.00   CHANNEL SLOPE =  0.0192
```

```
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.770
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        0.30      0.42     0.600    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      13.17
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.93
  AVERAGE FLOW DEPTH(FEET) =   0.70   TRAVEL TIME(MIN.) =   2.21
  Tc(MIN.) =   15.93
  SUBAREA AREA(ACRES) =     0.30       SUBAREA RUNOFF(CFS) =    0.68
  EFFECTIVE AREA(ACRES) =      5.10     AREA-AVERAGED Fm(INCH/HR) =   0.07
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.17
  TOTAL AREA(ACRES) =        5.1         PEAK FLOW RATE(CFS) =      12.83
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.69   FLOW VELOCITY(FEET/SEC.) =   3.89
  LONGEST FLOWPATH FROM NODE  52000.00 TO NODE  52015.00 =    1635.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  52015.00 TO NODE  52015.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   15.93
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.770
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        4.10      0.42     0.600    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  SUBAREA AREA(ACRES) =    4.10      SUBAREA RUNOFF(CFS) =    9.29
  EFFECTIVE AREA(ACRES) =      9.20   AREA-AVERAGED Fm(INCH/HR) =  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.36
  TOTAL AREA(ACRES) =        9.2       PEAK FLOW RATE(CFS) =      21.67

****************************************************************************
  FLOW PROCESS FROM NODE  52015.00 TO NODE  52025.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1218.00  DOWNSTREAM(FEET) =   1209.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   610.00   CHANNEL SLOPE =  0.0148
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.538
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        0.40      0.42     0.600    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      22.09
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   4.07
  AVERAGE FLOW DEPTH(FEET) =   0.94   TRAVEL TIME(MIN.) =   2.50
  Tc(MIN.) =   18.42
  SUBAREA AREA(ACRES) =     0.40       SUBAREA RUNOFF(CFS) =    0.82
  EFFECTIVE AREA(ACRES) =      9.60     AREA-AVERAGED Fm(INCH/HR) =   0.16
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.37
  TOTAL AREA(ACRES) =        9.6         PEAK FLOW RATE(CFS) =      21.67
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE
```

```
  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.93   FLOW VELOCITY(FEET/SEC.) =   4.05
  LONGEST FLOWPATH FROM NODE  52000.00 TO NODE  52025.00 =    2245.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  52025.00 TO NODE  52035.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1209.00  DOWNSTREAM(FEET) =   1199.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   938.00   CHANNEL SLOPE =  0.0107
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   2.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.236
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B        0.40      0.42     0.600    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      22.03
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.60
  AVERAGE FLOW DEPTH(FEET) =   1.01   TRAVEL TIME(MIN.) =   4.34
  Tc(MIN.) =   22.77
  SUBAREA AREA(ACRES) =     0.40       SUBAREA RUNOFF(CFS) =    0.71
  EFFECTIVE AREA(ACRES) =     10.00     AREA-AVERAGED Fm(INCH/HR) =   0.16
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.38
  TOTAL AREA(ACRES) =       10.0         PEAK FLOW RATE(CFS) =      21.67
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  1.00   FLOW VELOCITY(FEET/SEC.) =   3.59
  LONGEST FLOWPATH FROM NODE  52000.00 TO NODE  52035.00 =    3183.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  52035.00 TO NODE  52040.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1199.00  DOWNSTREAM ELEVATION(FEET) = 1198.00
  STREET LENGTH(FEET) =   180.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

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

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      21.77
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.67
    HALFSTREET FLOOD WIDTH(FEET) =   28.40
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.96
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.98
  STREET FLOW TRAVEL TIME(MIN.) =   1.01   Tc(MIN.) =   23.78
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.178
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.10      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.10      SUBAREA RUNOFF(CFS) =    0.19
  EFFECTIVE AREA(ACRES) =     10.10    AREA-AVERAGED Fm(INCH/HR) =  0.16
```

```
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.38
  TOTAL AREA(ACRES) =       10.1        PEAK FLOW RATE(CFS) =      21.67
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.67   HALFSTREET FLOOD WIDTH(FEET) =  28.40
  FLOW VELOCITY(FEET/SEC.) =  2.95   DEPTH*VELOCITY(FT*FT/SEC.) =   1.97
  LONGEST FLOWPATH FROM NODE  52000.00 TO NODE  52040.00 =    3363.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  52040.00 TO NODE  52040.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   23.78
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.178
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        4.60      0.42     0.100    76
  COMMERCIAL                 B       12.30      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =   16.90      SUBAREA RUNOFF(CFS) =   32.49
  EFFECTIVE AREA(ACRES) =     27.00   AREA-AVERAGED Fm(INCH/HR) =  0.09
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =       27.0       PEAK FLOW RATE(CFS) =      50.83

****************************************************************************
  FLOW PROCESS FROM NODE  52040.00 TO NODE  50008.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1198.00  DOWNSTREAM(FEET) =  1192.00
  FLOW LENGTH(FEET) =    45.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS  14.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  26.54
  GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      50.83
  PIPE TRAVEL TIME(MIN.) =   0.03    Tc(MIN.) =   23.81
  LONGEST FLOWPATH FROM NODE  52000.00 TO NODE  50008.00 =    3408.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  50008.00 TO NODE  50008.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   23.81
  RAINFALL INTENSITY(INCH/HR) =   2.18
  AREA-AVERAGED Fm(INCH/HR) =  0.09
  AREA-AVERAGED Fp(INCH/HR) =  0.42
  AREA-AVERAGED Ap =  0.20
  EFFECTIVE STREAM AREA(ACRES) =      27.00
  TOTAL STREAM AREA(ACRES) =      27.00
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      50.83

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       99.95   19.53    2.451  0.42( 0.04) 0.10      46.1   50000.00
      2       50.83   23.81    2.177  0.42( 0.09) 0.20      27.0   52000.00

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

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
```

```
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1      147.13   19.53    2.451  0.42( 0.06) 0.13      68.2   50000.00
      2      139.39   23.81    2.177  0.42( 0.06) 0.14      73.1   52000.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =     147.13    Tc(MIN.) =    19.53
  EFFECTIVE AREA(ACRES) =      68.25   AREA-AVERAGED Fm(INCH/HR) =  0.06
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.13
  TOTAL AREA(ACRES) =       73.1
  LONGEST FLOWPATH FROM NODE  50000.00 TO NODE  50008.00 =    6741.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  50008.00 TO NODE  50035.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1192.00  DOWNSTREAM(FEET) =  1190.60
  FLOW LENGTH(FEET) =   140.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  11.71
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  48.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     147.13
  PIPE TRAVEL TIME(MIN.) =   0.20    Tc(MIN.) =   19.73
  LONGEST FLOWPATH FROM NODE  50000.00 TO NODE  50035.00 =    6881.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  50035.00 TO NODE  50035.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   19.73
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.436
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B      69.30      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =   69.30      SUBAREA RUNOFF(CFS) =  149.32
  EFFECTIVE AREA(ACRES) =    137.55   AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.12
  TOTAL AREA(ACRES) =      142.4       PEAK FLOW RATE(CFS) =     295.51

****************************************************************************
  FLOW PROCESS FROM NODE  50035.00 TO NODE  50015.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1190.60  DOWNSTREAM(FEET) =   1162.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  2460.00   CHANNEL SLOPE =  0.0116
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   4.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.241
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B      10.00      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =     305.40
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =  13.93
  AVERAGE FLOW DEPTH(FEET) =   2.85   TRAVEL TIME(MIN.) =   2.94
  Tc(MIN.) =   22.67
  SUBAREA AREA(ACRES) =    10.00       SUBAREA RUNOFF(CFS) =   19.79
  EFFECTIVE AREA(ACRES) =    147.55     AREA-AVERAGED Fm(INCH/HR) =   0.05
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.12
  TOTAL AREA(ACRES) =      152.4         PEAK FLOW RATE(CFS) =     295.51
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE
```

```
  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  2.81   FLOW VELOCITY(FEET/SEC.) =  13.80
  LONGEST FLOWPATH FROM NODE  50000.00 TO NODE  50015.00 =    9341.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  50015.00 TO NODE  50015.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   22.67
  RAINFALL INTENSITY(INCH/HR) =   2.24
  AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.42
  AREA-AVERAGED Ap =  0.12
  EFFECTIVE STREAM AREA(ACRES) =     147.55
  TOTAL STREAM AREA(ACRES) =     152.40
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     295.51

****************************************************************************
  FLOW PROCESS FROM NODE  50005.00 TO NODE  50010.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   418.80
  ELEVATION DATA: UPSTREAM(FEET) =   1188.00  DOWNSTREAM(FEET) =   1183.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   13.103
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.114
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK                B        1.10      0.42     0.850    76   13.10
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA RUNOFF(CFS) =      2.73
  TOTAL AREA(ACRES) =      1.10   PEAK FLOW RATE(CFS) =      2.73

****************************************************************************
  FLOW PROCESS FROM NODE  50010.00 TO NODE  50015.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1183.00  DOWNSTREAM(FEET) =   1162.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  1592.70   CHANNEL SLOPE =  0.0132
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.153
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                B        2.90      0.42     0.850    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.12
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.38
  AVERAGE FLOW DEPTH(FEET) =   0.34   TRAVEL TIME(MIN.) =  11.14
  Tc(MIN.) =   24.25
  SUBAREA AREA(ACRES) =     2.90       SUBAREA RUNOFF(CFS) =    4.68
  EFFECTIVE AREA(ACRES) =      4.00     AREA-AVERAGED Fm(INCH/HR) =   0.36
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.85
  TOTAL AREA(ACRES) =        4.0         PEAK FLOW RATE(CFS) =       6.46

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.38   FLOW VELOCITY(FEET/SEC.) =   2.57
  LONGEST FLOWPATH FROM NODE  50005.00 TO NODE  50015.00 =    2011.50 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE  50015.00 TO NODE  50015.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   24.25
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.153
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                B        3.80      0.42     0.850    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA AREA(ACRES) =    3.80      SUBAREA RUNOFF(CFS) =    6.13
  EFFECTIVE AREA(ACRES) =      7.80   AREA-AVERAGED Fm(INCH/HR) =  0.36
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.85
  TOTAL AREA(ACRES) =        7.8       PEAK FLOW RATE(CFS) =      12.59

****************************************************************************
  FLOW PROCESS FROM NODE  50015.00 TO NODE  50015.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   24.25
  RAINFALL INTENSITY(INCH/HR) =   2.15
  AREA-AVERAGED Fm(INCH/HR) =  0.36
  AREA-AVERAGED Fp(INCH/HR) =  0.42
  AREA-AVERAGED Ap =  0.85
  EFFECTIVE STREAM AREA(ACRES) =       7.80
  TOTAL STREAM AREA(ACRES) =       7.80
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      12.59

****************************************************************************
  FLOW PROCESS FROM NODE  50020.00 TO NODE  50025.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   544.10
  ELEVATION DATA: UPSTREAM(FEET) =   1198.00  DOWNSTREAM(FEET) =   1190.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   13.955
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.999
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK                B        0.40      0.42     0.850    76   13.96
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA RUNOFF(CFS) =      0.95
  TOTAL AREA(ACRES) =      0.40   PEAK FLOW RATE(CFS) =      0.95

****************************************************************************
  FLOW PROCESS FROM NODE  50025.00 TO NODE  50015.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1190.00  DOWNSTREAM(FEET) =   1162.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  2131.40   CHANNEL SLOPE =  0.0131
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  1.739
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                B        1.40      0.42     0.850    76
```

```
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.86
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.72
  AVERAGE FLOW DEPTH(FEET) =   0.19   TRAVEL TIME(MIN.) =  20.65
  Tc(MIN.) =   34.61
  SUBAREA AREA(ACRES) =     1.40       SUBAREA RUNOFF(CFS) =    1.74
  EFFECTIVE AREA(ACRES) =      1.80     AREA-AVERAGED Fm(INCH/HR) =   0.36
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.85
  TOTAL AREA(ACRES) =        1.8         PEAK FLOW RATE(CFS) =       2.23

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.21   FLOW VELOCITY(FEET/SEC.) =   1.81
  LONGEST FLOWPATH FROM NODE  50020.00 TO NODE  50015.00 =    2675.50 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  50015.00 TO NODE  50015.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  3
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  3 ARE:
  TIME OF CONCENTRATION(MIN.) =   34.61
  RAINFALL INTENSITY(INCH/HR) =   1.74
  AREA-AVERAGED Fm(INCH/HR) =  0.36
  AREA-AVERAGED Fp(INCH/HR) =  0.42
  AREA-AVERAGED Ap =  0.85
  EFFECTIVE STREAM AREA(ACRES) =       1.80
  TOTAL STREAM AREA(ACRES) =       1.80
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       2.23

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1      295.51   22.67    2.241  0.42( 0.05) 0.12     147.5   50000.00
      1      270.99   27.03    2.017  0.42( 0.05) 0.12     152.4   52000.00
      2       12.59   24.25    2.153  0.42( 0.36) 0.85       7.8   50005.00
      3        2.23   34.61    1.739  0.42( 0.36) 0.85       1.8   50020.00

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

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1      309.85   22.67    2.241  0.42( 0.07) 0.16     156.0   50000.00
      2      301.26   24.25    2.153  0.42( 0.07) 0.16     158.4   50005.00
      3      284.73   27.03    2.017  0.42( 0.07) 0.16     161.6   52000.00
      4      244.60   34.61    1.739  0.42( 0.07) 0.16     162.0   50020.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =     309.85    Tc(MIN.) =    22.67
  EFFECTIVE AREA(ACRES) =     156.02   AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.16
  TOTAL AREA(ACRES) =      162.0
  LONGEST FLOWPATH FROM NODE  50000.00 TO NODE  50015.00 =    9341.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  50015.00 TO NODE  50020.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1162.00  DOWNSTREAM(FEET) =  1160.00
  FLOW LENGTH(FEET) =   140.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  43.84
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     309.85
```

```
  PIPE TRAVEL TIME(MIN.) =   0.05    Tc(MIN.) =   22.72
  LONGEST FLOWPATH FROM NODE  50000.00 TO NODE  50020.00 =    9481.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  50020.00 TO NODE  50020.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   22.72
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.238
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B       10.70      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =   10.70      SUBAREA RUNOFF(CFS) =   21.15
  EFFECTIVE AREA(ACRES) =    166.72   AREA-AVERAGED Fm(INCH/HR) =  0.06
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.15
  TOTAL AREA(ACRES) =      172.7       PEAK FLOW RATE(CFS) =     326.20

****************************************************************************
  FLOW PROCESS FROM NODE  50020.00 TO NODE  50025.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1160.00  DOWNSTREAM(FEET) =   1128.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  2940.00   CHANNEL SLOPE =  0.0109
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   2.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   4.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.053
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B       12.40      0.42     0.600    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =     336.24
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =  13.92
  AVERAGE FLOW DEPTH(FEET) =   3.01   TRAVEL TIME(MIN.) =   3.52
  Tc(MIN.) =   26.24
  SUBAREA AREA(ACRES) =    12.40       SUBAREA RUNOFF(CFS) =   20.08
  EFFECTIVE AREA(ACRES) =    179.12     AREA-AVERAGED Fm(INCH/HR) =   0.08
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.18
  TOTAL AREA(ACRES) =      185.1         PEAK FLOW RATE(CFS) =     326.20
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  2.97   FLOW VELOCITY(FEET/SEC.) =  13.81
  LONGEST FLOWPATH FROM NODE  50000.00 TO NODE  50025.00 =   12421.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  50025.00 TO NODE  50025.00 IS CODE =  82
----------------------------------------------------------------------------
  >>>>>ADD SUBAREA RUNOFF TO MAINLINE, AT MAINLINE Tc,<<<<<
  >>>>>(AND COMPUTE INITIAL SUBAREA RUNOFF)<<<<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =  2970.00
  ELEVATION DATA: UPSTREAM(FEET) =   1165.00  DOWNSTREAM(FEET) =   1129.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   28.598
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  1.950
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK                B        8.70      0.42     0.850    76   28.60
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
```

```
 SUBAREA AREA(ACRES) =    8.70   INITIAL SUBAREA RUNOFF(CFS) =   12.45

 ** ADD SUBAREA RUNOFF TO MAINLINE AT MAINLINE Tc:
 MAINLINE Tc(MIN.) =   26.24
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.053
 SUBAREA AREA(ACRES) =    8.70      SUBAREA RUNOFF(CFS) =   13.26
 EFFECTIVE AREA(ACRES) =    187.82   AREA-AVERAGED Fm(INCH/HR) =  0.09
 AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.21
 TOTAL AREA(ACRES) =      193.8       PEAK FLOW RATE(CFS) =     331.74
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)     =      193.8  TC(MIN.) =     26.24
 EFFECTIVE AREA(ACRES) =    187.82  AREA-AVERAGED Fm(INCH/HR)=  0.09
 AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap = 0.214
 PEAK FLOW RATE(CFS)   =     331.74

 ** PEAK FLOW RATE TABLE **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
     1      331.74   26.24    2.053  0.42( 0.09) 0.21     187.8   50000.00
     2      323.50   27.84    1.981  0.42( 0.09) 0.22     190.2   50005.00
     3      309.53   30.67    1.870  0.42( 0.09) 0.22     193.4   52000.00
     4      268.92   38.40    1.634  0.42( 0.09) 0.22     193.8   50020.00
============================================================================
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
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             Ver. 15.0  Release Date: 04/01/2008  License ID 1555

                           Analysis prepared by:




 ************************** DESCRIPTION OF STUDY **************************
* REDLANDS PASSENGER RAIL PROJECT                                          *
* EXISTING 100 YEAR ANALYSIS                                               *
* DRAINAGE AREA 55000                                                      *
 **************************************************************************

  FILE NAME: C:\RPRP\55000.DAT
  TIME/DATE OF STUDY: 15:38 11/08/2012
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2500

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  2   20.0     15.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0170

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.20 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE  55000.00 TO NODE  55005.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   330.00
  ELEVATION DATA: UPSTREAM(FEET) =   1275.00  DOWNSTREAM(FEET) =   1270.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.148
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.480
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 B        1.20      0.42     0.100    76    7.15
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
```

```
  SUBAREA RUNOFF(CFS) =      4.79
  TOTAL AREA(ACRES) =      1.20   PEAK FLOW RATE(CFS) =      4.79

****************************************************************************
  FLOW PROCESS FROM NODE  55005.00 TO NODE  55010.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1270.00  DOWNSTREAM ELEVATION(FEET) = 1261.00
  STREET LENGTH(FEET) =   580.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

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

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      11.95
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.49
    HALFSTREET FLOOD WIDTH(FEET) =   18.24
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.78
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.84
  STREET FLOW TRAVEL TIME(MIN.) =   2.56   Tc(MIN.) =    9.71
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.728
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B       4.30      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    4.30      SUBAREA RUNOFF(CFS) =   14.27
  EFFECTIVE AREA(ACRES) =      5.50    AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        5.5        PEAK FLOW RATE(CFS) =      18.25

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.55   HALFSTREET FLOOD WIDTH(FEET) =  21.60
  FLOW VELOCITY(FEET/SEC.) =  4.18   DEPTH*VELOCITY(FT*FT/SEC.) =   2.29
  LONGEST FLOWPATH FROM NODE  55000.00 TO NODE  55010.00 =     910.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  55010.00 TO NODE  55015.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  2 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1261.00  DOWNSTREAM ELEVATION(FEET) = 1252.00
  STREET LENGTH(FEET) =   511.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  15.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0170
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0170

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      28.82
    ***STREET FLOW SPLITS OVER STREET-CROWN***
    FULL DEPTH(FEET) =    0.53   FLOOD WIDTH(FEET) =   21.31
    FULL HALF-STREET VELOCITY(FEET/SEC.) =    3.96
    SPLIT DEPTH(FEET) =    0.49   SPLIT FLOOD WIDTH(FEET) =   17.98
    SPLIT FLOW(CFS) =   12.45   SPLIT VELOCITY(FEET/SEC.) =    3.71
```

```
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.53
    HALFSTREET FLOOD WIDTH(FEET) =   21.31
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.96
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    2.08
  STREET FLOW TRAVEL TIME(MIN.) =   2.15   Tc(MIN.) =   11.86
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.307
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        7.20      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    7.20      SUBAREA RUNOFF(CFS) =   21.15
  EFFECTIVE AREA(ACRES) =     12.70    AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =       12.7        PEAK FLOW RATE(CFS) =      37.31

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.54   HALFSTREET FLOOD WIDTH(FEET) =  22.14
  FLOW VELOCITY(FEET/SEC.) =  4.15   DEPTH*VELOCITY(FT*FT/SEC.) =   2.25
  *NOTE: INITIAL SUBAREA NOMOGRAPH WITH SUBAREA PARAMETERS,
        AND L =  511.0 FT WITH ELEVATION-DROP =   9.0 FT, IS   26.3 CFS,
        WHICH EXCEEDS THE TOP-OF-CURB STREET CAPACITY AT NODE  55015.00
  LONGEST FLOWPATH FROM NODE  55000.00 TO NODE  55015.00 =    1421.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  55015.00 TO NODE  55020.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  2 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1252.00  DOWNSTREAM ELEVATION(FEET) = 1239.00
  STREET LENGTH(FEET) =   980.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 20.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  15.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.020
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.020

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0170
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0170

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      50.81
    ***STREET FLOWING FULL***
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.61
    HALFSTREET FLOOD WIDTH(FEET) =   25.43
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    4.19
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    2.55
  STREET FLOW TRAVEL TIME(MIN.) =   3.90   Tc(MIN.) =   15.76
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.788
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B       10.90      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =   10.90      SUBAREA RUNOFF(CFS) =   26.94
  EFFECTIVE AREA(ACRES) =     23.60    AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =       23.6        PEAK FLOW RATE(CFS) =      58.33

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.63   HALFSTREET FLOOD WIDTH(FEET) =  26.65
  FLOW VELOCITY(FEET/SEC.) =  4.35   DEPTH*VELOCITY(FT*FT/SEC.) =   2.76
  *NOTE: INITIAL SUBAREA NOMOGRAPH WITH SUBAREA PARAMETERS,
        AND L =  980.0 FT WITH ELEVATION-DROP =  13.0 FT, IS   32.9 CFS,
        WHICH EXCEEDS THE TOP-OF-CURB STREET CAPACITY AT NODE  55020.00
```

```
 LONGEST FLOWPATH FROM NODE  55000.00 TO NODE  55020.00 =    2401.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  55020.00 TO NODE  55020.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   15.76
  RAINFALL INTENSITY(INCH/HR) =   2.79
  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =      23.60
  TOTAL STREAM AREA(ACRES) =      23.60
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      58.33

****************************************************************************
  FLOW PROCESS FROM NODE  55025.00 TO NODE  55030.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   230.00
  ELEVATION DATA: UPSTREAM(FEET) =   1273.00  DOWNSTREAM(FEET) =   1270.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.375
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.799
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 B       0.50      0.42     0.100    76    6.38
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      2.14
  TOTAL AREA(ACRES) =      0.50   PEAK FLOW RATE(CFS) =      2.14

****************************************************************************
  FLOW PROCESS FROM NODE  55030.00 TO NODE  55035.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1270.00  DOWNSTREAM ELEVATION(FEET) = 1251.00
  STREET LENGTH(FEET) =  1140.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

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

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      12.33
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.49
    HALFSTREET FLOOD WIDTH(FEET) =   18.24
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.90
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.90
  STREET FLOW TRAVEL TIME(MIN.) =   4.88   Tc(MIN.) =   11.25
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.412
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B       6.60      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
```

```
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    6.60      SUBAREA RUNOFF(CFS) =   20.02
  EFFECTIVE AREA(ACRES) =      7.10    AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        7.1        PEAK FLOW RATE(CFS) =      21.54

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.57   HALFSTREET FLOOD WIDTH(FEET) =  22.77
  FLOW VELOCITY(FEET/SEC.) =  4.46   DEPTH*VELOCITY(FT*FT/SEC.) =   2.54
  LONGEST FLOWPATH FROM NODE  55025.00 TO NODE  55035.00 =    1370.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  55035.00 TO NODE  55040.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1251.00  DOWNSTREAM ELEVATION(FEET) = 1242.50
  STREET LENGTH(FEET) =   590.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

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

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      29.31
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.63
    HALFSTREET FLOOD WIDTH(FEET) =   26.45
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    4.55
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    2.89
  STREET FLOW TRAVEL TIME(MIN.) =   2.16   Tc(MIN.) =   13.41
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.071
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                  B        5.70      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    5.70      SUBAREA RUNOFF(CFS) =   15.54
  EFFECTIVE AREA(ACRES) =     12.80    AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =       12.8        PEAK FLOW RATE(CFS) =      34.89

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.67   HALFSTREET FLOOD WIDTH(FEET) =  28.26
  FLOW VELOCITY(FEET/SEC.) =  4.77   DEPTH*VELOCITY(FT*FT/SEC.) =   3.18
  LONGEST FLOWPATH FROM NODE  55025.00 TO NODE  55040.00 =    1960.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  55040.00 TO NODE  55020.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1242.50  DOWNSTREAM ELEVATION(FEET) = 1239.00
  STREET LENGTH(FEET) =   330.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

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

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      36.82
    ***STREET FLOW SPLITS OVER STREET-CROWN***
    FULL DEPTH(FEET) =    0.70   FLOOD WIDTH(FEET) =   31.58
    FULL HALF-STREET VELOCITY(FEET/SEC.) =    4.23
    SPLIT DEPTH(FEET) =    0.32   SPLIT FLOOD WIDTH(FEET) =    8.78
    SPLIT FLOW(CFS) =    1.91   SPLIT VELOCITY(FEET/SEC.) =    2.16
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.70
    HALFSTREET FLOOD WIDTH(FEET) =   31.58
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    4.23
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    2.95
  STREET FLOW TRAVEL TIME(MIN.) =   1.30   Tc(MIN.) =   14.71
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.905
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        1.50      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    1.50      SUBAREA RUNOFF(CFS) =    3.86
  EFFECTIVE AREA(ACRES) =     14.30    AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =       14.3        PEAK FLOW RATE(CFS) =      36.85

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.70   HALFSTREET FLOOD WIDTH(FEET) =  31.58
  FLOW VELOCITY(FEET/SEC.) =  4.23   DEPTH*VELOCITY(FT*FT/SEC.) =   2.95
  LONGEST FLOWPATH FROM NODE  55025.00 TO NODE  55020.00 =    2290.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  55020.00 TO NODE  55020.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   14.71
  RAINFALL INTENSITY(INCH/HR) =   2.91
  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =      14.30
  TOTAL STREAM AREA(ACRES) =      14.30
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      36.85

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       58.33   15.76    2.788  0.42( 0.04) 0.10      23.6   55000.00
      2       36.85   14.71    2.905  0.42( 0.04) 0.10      14.3   55025.00

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

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       93.63   14.71    2.905  0.42( 0.04) 0.10      36.3   55025.00
      2       93.67   15.76    2.788  0.42( 0.04) 0.10      37.9   55000.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      93.67    Tc(MIN.) =    15.76
  EFFECTIVE AREA(ACRES) =      37.90   AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =       37.9
  LONGEST FLOWPATH FROM NODE  55000.00 TO NODE  55020.00 =    2401.00 FEET.

****************************************************************************
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```
  FLOW PROCESS FROM NODE  55020.00 TO NODE  55025.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1226.00  DOWNSTREAM(FEET) =  1224.80
  FLOW LENGTH(FEET) =   301.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  11.29
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  39.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      93.67
  PIPE TRAVEL TIME(MIN.) =   0.44    Tc(MIN.) =   16.20
  LONGEST FLOWPATH FROM NODE  55000.00 TO NODE  55025.00 =    2702.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  55025.00 TO NODE  55025.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   16.20
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.742
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B       3.40      0.42     0.100    76
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       B       0.30      0.42     0.600    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.141
  SUBAREA AREA(ACRES) =    3.70      SUBAREA RUNOFF(CFS) =    8.93
  EFFECTIVE AREA(ACRES) =     41.60   AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =       41.6       PEAK FLOW RATE(CFS) =     101.03

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1      101.26   15.16    2.854  0.42( 0.04) 0.10      40.0   55025.00
      2      101.03   16.20    2.742  0.42( 0.04) 0.10      41.6   55000.00
  NEW PEAK FLOW DATA ARE:
  PEAK FLOW RATE(CFS) =     101.26  Tc(MIN.) =   15.16
  AREA-AVERAGED Fm(INCH/HR) =  0.04  AREA-AVERAGED Fp(INCH/HR) =  0.42
  AREA-AVERAGED Ap =  0.10  EFFECTIVE AREA(ACRES) =      40.04
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       41.6  TC(MIN.) =     15.16
  EFFECTIVE AREA(ACRES) =     40.04  AREA-AVERAGED Fm(INCH/HR)=  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap = 0.104
  PEAK FLOW RATE(CFS)   =     101.26

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1      101.26   15.16    2.854  0.42( 0.04) 0.10      40.0   55025.00
      2      101.03   16.20    2.742  0.42( 0.04) 0.10      41.6   55000.00
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
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             Ver. 15.0  Release Date: 04/01/2008  License ID 1555

                           Analysis prepared by:




 ************************** DESCRIPTION OF STUDY **************************
* REDLANDS PASSENGER RAIL                                                  *
* EXISTING HYDROLOGY 100 YEAR EVENT                                        *
* BASIN 60000                                                              *
 **************************************************************************

  FILE NAME: C:\RPRP\60000.DAT
  TIME/DATE OF STUDY: 14:16 11/09/2012
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2500

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======   ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  2   20.0     15.0    0.020/0.020/0.020   0.50    1.50 0.0313 0.125 0.0170
  3  100.0     40.0    0.020/0.050/0.050   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.20 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE  60000.00 TO NODE  60005.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   337.00
  ELEVATION DATA: UPSTREAM(FEET) =   1321.00  DOWNSTREAM(FEET) =   1315.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    6.979
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.545
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 B       1.30      0.42     0.100    76    6.98
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
```

```
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      5.27
  TOTAL AREA(ACRES) =      1.30   PEAK FLOW RATE(CFS) =      5.27

****************************************************************************
  FLOW PROCESS FROM NODE  60005.00 TO NODE  60010.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1315.00  DOWNSTREAM(FEET) =   1298.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   680.00   CHANNEL SLOPE =  0.0250
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   4.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.673
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                B        3.70      0.42     0.850    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      10.83
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   3.81
  AVERAGE FLOW DEPTH(FEET) =   0.42   TRAVEL TIME(MIN.) =   2.97
  Tc(MIN.) =    9.95
  SUBAREA AREA(ACRES) =     3.70       SUBAREA RUNOFF(CFS) =   11.03
  EFFECTIVE AREA(ACRES) =      5.00     AREA-AVERAGED Fm(INCH/HR) =   0.28
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.66
  TOTAL AREA(ACRES) =        5.0         PEAK FLOW RATE(CFS) =      15.28

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.51   FLOW VELOCITY(FEET/SEC.) =   4.21
  LONGEST FLOWPATH FROM NODE  60000.00 TO NODE  60010.00 =    1017.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  60010.00 TO NODE  60010.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    9.95
  RAINFALL INTENSITY(INCH/HR) =   3.67
  AREA-AVERAGED Fm(INCH/HR) =  0.28
  AREA-AVERAGED Fp(INCH/HR) =  0.42
  AREA-AVERAGED Ap =  0.66
  EFFECTIVE STREAM AREA(ACRES) =       5.00
  TOTAL STREAM AREA(ACRES) =       5.00
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      15.28

****************************************************************************
  FLOW PROCESS FROM NODE  60015.00 TO NODE  60020.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =  1000.00
  ELEVATION DATA: UPSTREAM(FEET) =   1326.00  DOWNSTREAM(FEET) =   1307.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   10.644
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.528
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 B        1.20      0.42     0.100    76   10.64
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      3.76
  TOTAL AREA(ACRES) =      1.20   PEAK FLOW RATE(CFS) =      3.76
```

```
****************************************************************************
  FLOW PROCESS FROM NODE  60020.00 TO NODE  60020.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   10.64
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.528
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B       5.19      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    5.19      SUBAREA RUNOFF(CFS) =   16.28
  EFFECTIVE AREA(ACRES) =      6.39   AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        6.4       PEAK FLOW RATE(CFS) =      20.05

****************************************************************************
  FLOW PROCESS FROM NODE  60020.00 TO NODE  60025.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1307.00  DOWNSTREAM ELEVATION(FEET) = 1301.00
  STREET LENGTH(FEET) =   450.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

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

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      20.06
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.58
    HALFSTREET FLOOD WIDTH(FEET) =   23.16
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    4.02
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    2.32
  STREET FLOW TRAVEL TIME(MIN.) =   1.86   Tc(MIN.) =   12.51
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.202
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  MOBILE HOME PARK           B       0.01      0.42     0.250    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.250
  SUBAREA AREA(ACRES) =    0.01      SUBAREA RUNOFF(CFS) =    0.03
  EFFECTIVE AREA(ACRES) =      6.40    AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        6.4        PEAK FLOW RATE(CFS) =      20.05
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.58   HALFSTREET FLOOD WIDTH(FEET) =  23.16
  FLOW VELOCITY(FEET/SEC.) =  4.02   DEPTH*VELOCITY(FT*FT/SEC.) =   2.32
  LONGEST FLOWPATH FROM NODE  60015.00 TO NODE  60025.00 =    1450.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  60025.00 TO NODE  60010.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1301.00  DOWNSTREAM ELEVATION(FEET) = 1298.00
  STREET LENGTH(FEET) =   520.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00
```

```
  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  2
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      27.48
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.58
    HALFSTREET FLOOD WIDTH(FEET) =   23.48
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.69
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.56
  STREET FLOW TRAVEL TIME(MIN.) =   3.23   Tc(MIN.) =   15.74
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.790
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        6.00      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    6.00      SUBAREA RUNOFF(CFS) =   14.84
  EFFECTIVE AREA(ACRES) =     12.40    AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =       12.4        PEAK FLOW RATE(CFS) =      30.67

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.60   HALFSTREET FLOOD WIDTH(FEET) =  24.57
  FLOW VELOCITY(FEET/SEC.) =  2.75   DEPTH*VELOCITY(FT*FT/SEC.) =   1.65
  LONGEST FLOWPATH FROM NODE  60015.00 TO NODE  60010.00 =    1970.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  60010.00 TO NODE  60010.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   15.74
  RAINFALL INTENSITY(INCH/HR) =   2.79
  AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.42
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =      12.40
  TOTAL STREAM AREA(ACRES) =      12.40
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      30.67

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       15.28    9.95    3.673  0.42( 0.28) 0.66       5.0   60000.00
      2       30.67   15.74    2.790  0.42( 0.04) 0.10      12.4   60015.00

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

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       40.91    9.95    3.673  0.42( 0.13) 0.32      12.8   60000.00
      2       41.98   15.74    2.790  0.42( 0.11) 0.26      17.4   60015.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      41.98    Tc(MIN.) =    15.74
  EFFECTIVE AREA(ACRES) =      17.40   AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.26
  TOTAL AREA(ACRES) =       17.4
```

```
  LONGEST FLOWPATH FROM NODE  60015.00 TO NODE  60010.00 =    1970.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  60010.00 TO NODE  60030.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1298.00  DOWNSTREAM ELEVATION(FEET) = 1297.00
  STREET LENGTH(FEET) =   225.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  2
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

   **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      42.10
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.68
    HALFSTREET FLOOD WIDTH(FEET) =   30.03
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.70
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.84
  STREET FLOW TRAVEL TIME(MIN.) =   1.39   Tc(MIN.) =   17.13
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.652
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.10      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.10      SUBAREA RUNOFF(CFS) =    0.23
  EFFECTIVE AREA(ACRES) =     17.50    AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.26
  TOTAL AREA(ACRES) =       17.5        PEAK FLOW RATE(CFS) =      41.98
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.68   HALFSTREET FLOOD WIDTH(FEET) =  30.03
  FLOW VELOCITY(FEET/SEC.) =  2.69   DEPTH*VELOCITY(FT*FT/SEC.) =   1.84
  LONGEST FLOWPATH FROM NODE  60015.00 TO NODE  60030.00 =    2195.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  60030.00 TO NODE  60030.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   17.13
  RAINFALL INTENSITY(INCH/HR) =   2.65
  AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.42
  AREA-AVERAGED Ap =  0.26
  EFFECTIVE STREAM AREA(ACRES) =      17.50
  TOTAL STREAM AREA(ACRES) =      17.50
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      41.98

****************************************************************************
  FLOW PROCESS FROM NODE  60100.00 TO NODE  60105.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   230.00
  ELEVATION DATA: UPSTREAM(FEET) =   1320.00  DOWNSTREAM(FEET) =   1317.00
```

```
  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.640
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.998
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  SCHOOL                    B        0.60      0.42     0.600    76    8.64
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  SUBAREA RUNOFF(CFS) =      2.02
  TOTAL AREA(ACRES) =      0.60   PEAK FLOW RATE(CFS) =      2.02

****************************************************************************
  FLOW PROCESS FROM NODE  60105.00 TO NODE  60110.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1317.00  DOWNSTREAM(FEET) =   1306.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   590.00   CHANNEL SLOPE =  0.0186
  CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   0.50
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.276
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  SCHOOL                    B        6.00      0.42     0.600    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      10.28
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.89
  AVERAGE FLOW DEPTH(FEET) =   0.32   TRAVEL TIME(MIN.) =   3.40
  Tc(MIN.) =   12.04
  SUBAREA AREA(ACRES) =     6.00       SUBAREA RUNOFF(CFS) =   16.32
  EFFECTIVE AREA(ACRES) =      6.60     AREA-AVERAGED Fm(INCH/HR) =   0.25
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.60
  TOTAL AREA(ACRES) =        6.6         PEAK FLOW RATE(CFS) =      17.95

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.43   FLOW VELOCITY(FEET/SEC.) =   3.54
  LONGEST FLOWPATH FROM NODE  60100.00 TO NODE  60110.00 =     820.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  60110.00 TO NODE  60030.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1306.00  DOWNSTREAM ELEVATION(FEET) = 1297.00
  STREET LENGTH(FEET) =   750.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  2
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      24.21
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.51
    HALFSTREET FLOOD WIDTH(FEET) =   19.34
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.43
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.74
  STREET FLOW TRAVEL TIME(MIN.) =   3.65   Tc(MIN.) =   15.69
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.795
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
```

```
     LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                 B        0.70      0.42     0.100    76
 PUBLIC PARK                B        4.90      0.42     0.850    76
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.756
 SUBAREA AREA(ACRES) =    5.60      SUBAREA RUNOFF(CFS) =   12.48
 EFFECTIVE AREA(ACRES) =     12.20    AREA-AVERAGED Fm(INCH/HR) =  0.28
 AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.67
 TOTAL AREA(ACRES) =       12.2        PEAK FLOW RATE(CFS) =      27.57

 END OF SUBAREA STREET FLOW HYDRAULICS:
 DEPTH(FEET) = 0.53   HALFSTREET FLOOD WIDTH(FEET) =  20.35
 FLOW VELOCITY(FEET/SEC.) =  3.54   DEPTH*VELOCITY(FT*FT/SEC.) =   1.86
 LONGEST FLOWPATH FROM NODE  60100.00 TO NODE  60030.00 =    1570.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE  60030.00 TO NODE  60030.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =   15.69
 RAINFALL INTENSITY(INCH/HR) =   2.80
 AREA-AVERAGED Fm(INCH/HR) =  0.28
 AREA-AVERAGED Fp(INCH/HR) =  0.42
 AREA-AVERAGED Ap =  0.67
 EFFECTIVE STREAM AREA(ACRES) =      12.20
 TOTAL STREAM AREA(ACRES) =      12.20
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      27.57

 ** CONFLUENCE DATA **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
     1       40.91   11.36    3.393  0.42( 0.13) 0.31      12.9   60000.00
     1       41.98   17.13    2.652  0.42( 0.11) 0.26      17.5   60015.00
     2       27.57   15.69    2.795  0.42( 0.28) 0.67      12.2   60100.00

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

 ** PEAK FLOW RATE TABLE **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
     1       65.62   11.36    3.393  0.42( 0.19) 0.46      21.8   60000.00
     2       69.29   15.69    2.795  0.42( 0.19) 0.44      28.6   60100.00
     3       67.98   17.13    2.652  0.42( 0.18) 0.43      29.7   60015.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      69.29    Tc(MIN.) =    15.69
 EFFECTIVE AREA(ACRES) =      28.57   AREA-AVERAGED Fm(INCH/HR) =  0.19
 AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.44
 TOTAL AREA(ACRES) =       29.7
 LONGEST FLOWPATH FROM NODE  60015.00 TO NODE  60030.00 =    2195.00 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE  60030.00 TO NODE  60040.00 IS CODE =  41
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =  1297.00  DOWNSTREAM(FEET) =  1296.00
 FLOW LENGTH(FEET) =    40.00   MANNING'S N =  0.010
 DEPTH OF FLOW IN  36.0 INCH PIPE IS  18.7 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  18.69
 GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      69.29
 PIPE TRAVEL TIME(MIN.) =   0.04    Tc(MIN.) =   15.73
 LONGEST FLOWPATH FROM NODE  60015.00 TO NODE  60040.00 =    2235.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE  60040.00 TO NODE  60040.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   15.73
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.791
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        1.00      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    1.00      SUBAREA RUNOFF(CFS) =    2.47
  EFFECTIVE AREA(ACRES) =     29.57   AREA-AVERAGED Fm(INCH/HR) =  0.18
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.43
  TOTAL AREA(ACRES) =       30.7       PEAK FLOW RATE(CFS) =      69.42

****************************************************************************
  FLOW PROCESS FROM NODE  60040.00 TO NODE  60045.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1297.00  DOWNSTREAM(FEET) =  1293.00
  FLOW LENGTH(FEET) =   158.80   MANNING'S N =  0.013
  DEPTH OF FLOW IN  36.0 INCH PIPE IS  22.0 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  15.33
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      69.42
  PIPE TRAVEL TIME(MIN.) =   0.17    Tc(MIN.) =   15.90
  LONGEST FLOWPATH FROM NODE  60015.00 TO NODE  60045.00 =    2393.80 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  60045.00 TO NODE  60045.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   15.90
  RAINFALL INTENSITY(INCH/HR) =   2.77
  AREA-AVERAGED Fm(INCH/HR) =  0.18
  AREA-AVERAGED Fp(INCH/HR) =  0.42
  AREA-AVERAGED Ap =  0.43
  EFFECTIVE STREAM AREA(ACRES) =      29.57
  TOTAL STREAM AREA(ACRES) =      30.70
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      69.42

****************************************************************************
  FLOW PROCESS FROM NODE  60200.00 TO NODE  60205.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   230.00
  ELEVATION DATA: UPSTREAM(FEET) =   1315.00  DOWNSTREAM(FEET) =   1312.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   10.129
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.635
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK                B        0.70      0.42     0.850    76   10.13
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA RUNOFF(CFS) =      2.06
  TOTAL AREA(ACRES) =      0.70   PEAK FLOW RATE(CFS) =      2.06

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

```
  FLOW PROCESS FROM NODE  60205.00 TO NODE  60210.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1312.00  DOWNSTREAM(FEET) =   1301.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   692.00   CHANNEL SLOPE =  0.0159
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.854
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                B        1.50      0.42     0.850    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.77
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.30
  AVERAGE FLOW DEPTH(FEET) =   0.27   TRAVEL TIME(MIN.) =   5.02
  Tc(MIN.) =   15.15
  SUBAREA AREA(ACRES) =     1.50       SUBAREA RUNOFF(CFS) =    3.37
  EFFECTIVE AREA(ACRES) =      2.20     AREA-AVERAGED Fm(INCH/HR) =   0.36
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.85
  TOTAL AREA(ACRES) =        2.2         PEAK FLOW RATE(CFS) =       4.94

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.31   FLOW VELOCITY(FEET/SEC.) =   2.55
  LONGEST FLOWPATH FROM NODE  60200.00 TO NODE  60210.00 =     922.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  60210.00 TO NODE  60215.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1301.00  DOWNSTREAM(FEET) =  1300.00
  FLOW LENGTH(FEET) =    59.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  24.0 INCH PIPE IS   6.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   6.70
  GIVEN PIPE DIAMETER(INCH) =  24.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       4.94
  PIPE TRAVEL TIME(MIN.) =   0.15    Tc(MIN.) =   15.30
  LONGEST FLOWPATH FROM NODE  60200.00 TO NODE  60215.00 =     981.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  60215.00 TO NODE  60220.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1301.00  DOWNSTREAM(FEET) =   1297.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   322.00   CHANNEL SLOPE =  0.0124
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.617
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                B        0.60      0.42     0.850    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.55
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.43
  AVERAGE FLOW DEPTH(FEET) =   0.36   TRAVEL TIME(MIN.) =   2.21
  Tc(MIN.) =   17.51
  SUBAREA AREA(ACRES) =     0.60       SUBAREA RUNOFF(CFS) =    1.22
  EFFECTIVE AREA(ACRES) =      2.80     AREA-AVERAGED Fm(INCH/HR) =   0.36
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.85
  TOTAL AREA(ACRES) =        2.8         PEAK FLOW RATE(CFS) =       5.69

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
```

```
  DEPTH(FEET) =  0.36   FLOW VELOCITY(FEET/SEC.) =   2.43
  LONGEST FLOWPATH FROM NODE  60200.00 TO NODE  60220.00 =    1303.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  60020.00 TO NODE  60045.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1297.00  DOWNSTREAM(FEET) =  1293.00
  FLOW LENGTH(FEET) =    41.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  36.0 INCH PIPE IS   4.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  12.36
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       5.69
  PIPE TRAVEL TIME(MIN.) =   0.06    Tc(MIN.) =   17.56
  LONGEST FLOWPATH FROM NODE  60200.00 TO NODE  60045.00 =    1344.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  60045.00 TO NODE  60045.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   17.56
  RAINFALL INTENSITY(INCH/HR) =   2.61
  AREA-AVERAGED Fm(INCH/HR) =  0.36
  AREA-AVERAGED Fp(INCH/HR) =  0.42
  AREA-AVERAGED Ap =  0.85
  EFFECTIVE STREAM AREA(ACRES) =       2.80
  TOTAL STREAM AREA(ACRES) =       2.80
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       5.69

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       65.62   11.57    3.356  0.42( 0.19) 0.44      22.8   60000.00
      1       69.42   15.90    2.773  0.42( 0.18) 0.43      29.6   60100.00
      1       68.31   17.33    2.633  0.42( 0.18) 0.42      30.7   60015.00
      2        5.69   17.56    2.612  0.42( 0.36) 0.85       2.8   60200.00

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

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       70.61   11.57    3.356  0.42( 0.20) 0.47      24.6   60000.00
      2       74.94   15.90    2.773  0.42( 0.20) 0.46      32.1   60100.00
      3       73.97   17.33    2.633  0.42( 0.19) 0.45      33.5   60015.00
      4       73.42   17.56    2.612  0.42( 0.19) 0.45      33.5   60200.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      74.94    Tc(MIN.) =    15.90
  EFFECTIVE AREA(ACRES) =      32.10   AREA-AVERAGED Fm(INCH/HR) =  0.20
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.46
  TOTAL AREA(ACRES) =       33.5
  LONGEST FLOWPATH FROM NODE  60015.00 TO NODE  60045.00 =    2393.80 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  60045.00 TO NODE  60050.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1293.00  DOWNSTREAM(FEET) =   1287.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   625.30   CHANNEL SLOPE =  0.0096
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   4.00
```

```
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.568
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                B        9.80      0.42     0.850    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      84.69
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   4.80
  AVERAGE FLOW DEPTH(FEET) =   1.57   TRAVEL TIME(MIN.) =   2.17
  Tc(MIN.) =   18.07
  SUBAREA AREA(ACRES) =     9.80       SUBAREA RUNOFF(CFS) =   19.48
  EFFECTIVE AREA(ACRES) =     41.90     AREA-AVERAGED Fm(INCH/HR) =   0.23
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.55
  TOTAL AREA(ACRES) =       43.3         PEAK FLOW RATE(CFS) =      88.00

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  1.59   FLOW VELOCITY(FEET/SEC.) =   4.86
  LONGEST FLOWPATH FROM NODE  60015.00 TO NODE  60050.00 =    3019.10 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  60050.00 TO NODE  60055.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1287.00  DOWNSTREAM(FEET) =   1283.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =    96.50   CHANNEL SLOPE =  0.0415
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   4.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.552
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                B        1.80      0.42     0.850    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      89.77
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   8.32
  AVERAGE FLOW DEPTH(FEET) =   1.13   TRAVEL TIME(MIN.) =   0.19
  Tc(MIN.) =   18.26
  SUBAREA AREA(ACRES) =     1.80       SUBAREA RUNOFF(CFS) =    3.55
  EFFECTIVE AREA(ACRES) =     43.70     AREA-AVERAGED Fm(INCH/HR) =   0.24
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.57
  TOTAL AREA(ACRES) =       45.1         PEAK FLOW RATE(CFS) =      90.93

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  1.14   FLOW VELOCITY(FEET/SEC.) =   8.35
  LONGEST FLOWPATH FROM NODE  60015.00 TO NODE  60055.00 =    3115.60 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  60055.00 TO NODE  60055.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   18.26
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.552
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        1.10      0.42     0.100    76
  PUBLIC PARK                B        1.30      0.42     0.850    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.506
  SUBAREA AREA(ACRES) =    2.40      SUBAREA RUNOFF(CFS) =    5.05
  EFFECTIVE AREA(ACRES) =     46.10   AREA-AVERAGED Fm(INCH/HR) =  0.24
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.56
  TOTAL AREA(ACRES) =       47.5       PEAK FLOW RATE(CFS) =      95.98

****************************************************************************
  FLOW PROCESS FROM NODE  60055.00 TO NODE  60060.00 IS CODE =  61
```

```
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STANDARD CURB SECTION USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1283.00  DOWNSTREAM ELEVATION(FEET) = 1247.00
  STREET LENGTH(FEET) =  2626.47   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =   2.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.100
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.100

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.005
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0130
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      98.36
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.95
    HALFSTREET FLOOD WIDTH(FEET) =   98.64
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    4.04
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    3.82
  STREET FLOW TRAVEL TIME(MIN.) =  10.84   Tc(MIN.) =   29.10
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  1.929
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B       2.80      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    2.80      SUBAREA RUNOFF(CFS) =    4.76
  EFFECTIVE AREA(ACRES) =     48.90    AREA-AVERAGED Fm(INCH/HR) =  0.23
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.54
  TOTAL AREA(ACRES) =       50.3        PEAK FLOW RATE(CFS) =      95.98
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.94   HALFSTREET FLOOD WIDTH(FEET) =  97.55
  FLOW VELOCITY(FEET/SEC.) =  4.02   DEPTH*VELOCITY(FT*FT/SEC.) =   3.79
  *NOTE: INITIAL SUBAREA NOMOGRAPH WITH SUBAREA PARAMETERS,
         AND L = 2626.5 FT WITH ELEVATION-DROP =  36.0 FT, IS    6.7 CFS,
         WHICH EXCEEDS THE TOP-OF-CURB STREET CAPACITY AT NODE  60060.00
  LONGEST FLOWPATH FROM NODE  60015.00 TO NODE  60060.00 =    5742.07 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  60060.00 TO NODE  60060.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   29.10
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  1.929
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                B       2.50      0.42     0.850    76
  PUBLIC PARK                B       0.60      0.42     0.850    76
  PUBLIC PARK                B       0.40      0.42     0.850    76
  COMMERCIAL                 B      16.40      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.232
  SUBAREA AREA(ACRES) =   19.90      SUBAREA RUNOFF(CFS) =   32.80
  EFFECTIVE AREA(ACRES) =     68.80   AREA-AVERAGED Fm(INCH/HR) =  0.19
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.45
  TOTAL AREA(ACRES) =       70.2       PEAK FLOW RATE(CFS) =     107.72

****************************************************************************
  FLOW PROCESS FROM NODE  60060.00 TO NODE  60060.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
```

```
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   29.10
  RAINFALL INTENSITY(INCH/HR) =   1.93
  AREA-AVERAGED Fm(INCH/HR) =  0.19
  AREA-AVERAGED Fp(INCH/HR) =  0.42
  AREA-AVERAGED Ap =  0.45
  EFFECTIVE STREAM AREA(ACRES) =      68.80
  TOTAL STREAM AREA(ACRES) =      70.20
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     107.72

****************************************************************************
  FLOW PROCESS FROM NODE  60300.00 TO NODE  60305.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =  1346.00
  ELEVATION DATA: UPSTREAM(FEET) =   1266.00  DOWNSTREAM(FEET) =   1248.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   20.432
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.386
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK                B        1.50      0.42     0.850    76   20.43
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA RUNOFF(CFS) =      2.74
  TOTAL AREA(ACRES) =      1.50   PEAK FLOW RATE(CFS) =      2.74

****************************************************************************
  FLOW PROCESS FROM NODE  60305.00 TO NODE  60305.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   20.43
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.386
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B       11.60      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =   11.60      SUBAREA RUNOFF(CFS) =   24.46
  EFFECTIVE AREA(ACRES) =     13.10   AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.19
  TOTAL AREA(ACRES) =       13.1       PEAK FLOW RATE(CFS) =      27.20

****************************************************************************
  FLOW PROCESS FROM NODE  60305.00 TO NODE  60310.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1248.00  DOWNSTREAM(FEET) =  1247.00
  FLOW LENGTH(FEET) =    20.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  15.39
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      27.20
  PIPE TRAVEL TIME(MIN.) =   0.02    Tc(MIN.) =   20.45
  LONGEST FLOWPATH FROM NODE  60300.00 TO NODE  60310.00 =    1366.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  60310.00 TO NODE  60060.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
```

```
==============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1247.00  DOWNSTREAM(FEET) =   1245.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   116.40   CHANNEL SLOPE =  0.0172
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.354
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                B        0.10      0.42     0.850    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      27.29
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   4.36
  AVERAGE FLOW DEPTH(FEET) =   0.77   TRAVEL TIME(MIN.) =   0.45
  Tc(MIN.) =   20.90
  SUBAREA AREA(ACRES) =     0.10       SUBAREA RUNOFF(CFS) =    0.18
  EFFECTIVE AREA(ACRES) =     13.20     AREA-AVERAGED Fm(INCH/HR) =   0.08
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.19
  TOTAL AREA(ACRES) =       13.2         PEAK FLOW RATE(CFS) =      27.20
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.77   FLOW VELOCITY(FEET/SEC.) =   4.35
  LONGEST FLOWPATH FROM NODE  60300.00 TO NODE  60060.00 =    1482.40 FEET.

******************************************************************************
  FLOW PROCESS FROM NODE  60060.00 TO NODE  60060.00 IS CODE =   1
------------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
==============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   20.90
  RAINFALL INTENSITY(INCH/HR) =   2.35
  AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.42
  AREA-AVERAGED Ap =  0.19
  EFFECTIVE STREAM AREA(ACRES) =      13.20
  TOTAL STREAM AREA(ACRES) =      13.20
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      27.20

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1      106.68   24.80    2.124  0.42( 0.19) 0.45      61.3   60000.00
      1      107.72   29.10    1.929  0.42( 0.19) 0.45      68.8   60100.00
      1      106.39   30.59    1.873  0.42( 0.19) 0.44      70.2   60015.00
      1      105.87   30.84    1.864  0.42( 0.19) 0.44      70.2   60200.00
      2       27.20   20.90    2.354  0.42( 0.08) 0.19      13.2   60300.00

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

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1      127.78   20.90    2.354  0.42( 0.17) 0.40      64.9   60300.00
      2      131.13   24.80    2.124  0.42( 0.17) 0.40      74.5   60000.00
      3      129.84   29.10    1.929  0.42( 0.17) 0.41      82.0   60100.00
      4      127.84   30.59    1.873  0.42( 0.17) 0.40      83.4   60015.00
      5      127.21   30.84    1.864  0.42( 0.17) 0.40      83.4   60200.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =     131.13    Tc(MIN.) =    24.80
  EFFECTIVE AREA(ACRES) =      74.52   AREA-AVERAGED Fm(INCH/HR) =  0.17
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.40
  TOTAL AREA(ACRES) =       83.4
  LONGEST FLOWPATH FROM NODE  60015.00 TO NODE  60060.00 =    5742.07 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE  60060.00 TO NODE  60065.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =  1245.00  DOWNSTREAM(FEET) =  1244.00
  FLOW LENGTH(FEET) =   124.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  93.92
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  16.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     131.13
  PIPE TRAVEL TIME(MIN.) =   0.02    Tc(MIN.) =   24.82
  LONGEST FLOWPATH FROM NODE  60015.00 TO NODE  60065.00 =    5866.07 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  60065.00 TO NODE  60065.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   24.82
  RAINFALL INTENSITY(INCH/HR) =   2.12
  AREA-AVERAGED Fm(INCH/HR) =  0.17
  AREA-AVERAGED Fp(INCH/HR) =  0.42
  AREA-AVERAGED Ap =  0.40
  EFFECTIVE STREAM AREA(ACRES) =      74.52
  TOTAL STREAM AREA(ACRES) =      83.40
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     131.13

****************************************************************************
  FLOW PROCESS FROM NODE  60400.00 TO NODE  60405.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   652.70
  ELEVATION DATA: UPSTREAM(FEET) =   1300.00  DOWNSTREAM(FEET) =   1288.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.034
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.893
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 B       0.70      0.42     0.100    76    9.03
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      2.43
  TOTAL AREA(ACRES) =      0.70   PEAK FLOW RATE(CFS) =      2.43

****************************************************************************
  FLOW PROCESS FROM NODE  60405.00 TO NODE  60410.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1288.00  DOWNSTREAM(FEET) =   1245.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  2654.10   CHANNEL SLOPE =  0.0162
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.017   MAXIMUM DEPTH(FEET) =   1.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.686
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B      13.20      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      18.51
```

TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) = 5.72
AVERAGE FLOW DEPTH(FEET) = 0.47 TRAVEL TIME(MIN.) = 7.73
Tc(MIN.) = 16.76
SUBAREA AREA(ACRES) = 13.20 SUBAREA RUNOFF(CFS) = 31.41
EFFECTIVE AREA(ACRES) = 13.90 AREA-AVERAGED Fm(INCH/HR) = 0.04
AREA-AVERAGED Fp(INCH/HR) = 0.42 AREA-AVERAGED Ap = 0.10
TOTAL AREA(ACRES) = 13.9 PEAK FLOW RATE(CFS) = 33.08

END OF SUBAREA CHANNEL FLOW HYDRAULICS:
DEPTH(FEET) = 0.65 FLOW VELOCITY(FEET/SEC.) = 6.76
LONGEST FLOWPATH FROM NODE 60400.00 TO NODE 60410.00 = 3306.80 FEET.

****
FLOW PROCESS FROM NODE 60410.00 TO NODE 60065.00 IS CODE = 46

>>>>>COMPUTE BOX-FLOW TRAVEL TIME THRU SUBAREA<<<<<
>>>>>USING USER-SPECIFIED BOX SIZE (EXISTING ELEMENT)<<<<<
==
ELEVATION DATA: UPSTREAM(FEET) = 1245.00 DOWNSTREAM(FEET) = 1244.00
FLOW LENGTH(FEET) = 68.00 MANNING'S N = 0.030
GIVEN BOX BASEWIDTH(FEET) = 24.00 GIVEN BOX HEIGHT(FEET) = 18.00
FLOWDEPTH IN BOX IS 0.42 FEET BOX-FLOW VELOCITY(FEET/SEC.) = 3.31
BOX-FLOW(CFS) = 33.08
BOX-FLOW TRAVEL TIME(MIN.) = 0.34 Tc(MIN.) = 17.11
LONGEST FLOWPATH FROM NODE 60400.00 TO NODE 60065.00 = 3374.80 FEET.

****
FLOW PROCESS FROM NODE 60065.00 TO NODE 60065.00 IS CODE = 1

>>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
>>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
==
TOTAL NUMBER OF STREAMS = 2
CONFLUENCE VALUES USED FOR INDEPENDENT STREAM 2 ARE:
TIME OF CONCENTRATION(MIN.) = 17.11
RAINFALL INTENSITY(INCH/HR) = 2.65
AREA-AVERAGED Fm(INCH/HR) = 0.04
AREA-AVERAGED Fp(INCH/HR) = 0.42
AREA-AVERAGED Ap = 0.10
EFFECTIVE STREAM AREA(ACRES) = 13.90
TOTAL STREAM AREA(ACRES) = 13.90
PEAK FLOW RATE(CFS) AT CONFLUENCE = 33.08

** CONFLUENCE DATA **

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	127.78	20.92	2.352	0.42(0.17)	0.40	64.9	60300.00
1	131.13	24.82	2.123	0.42(0.17)	0.40	74.5	60000.00
1	129.84	29.13	1.929	0.42(0.17)	0.41	82.0	60100.00
1	127.84	30.61	1.872	0.42(0.17)	0.40	83.4	60015.00
1	127.21	30.86	1.863	0.42(0.17)	0.40	83.4	60200.00
2	33.08	17.11	2.654	0.42(0.04)	0.10	13.9	60400.00

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

** PEAK FLOW RATE TABLE **

STREAM NUMBER	Q (CFS)	Tc (MIN.)	Intensity (INCH/HR)	Fp(Fm) (INCH/HR)	Ap	Ae (ACRES)	HEADWATER NODE
1	152.00	17.11	2.654	0.42(0.14)	0.34	66.9	60400.00
2	157.03	20.92	2.352	0.42(0.15)	0.35	78.8	60300.00
3	157.48	24.82	2.123	0.42(0.15)	0.36	88.4	60000.00
4	153.73	29.13	1.929	0.42(0.15)	0.36	95.9	60100.00
5	151.01	30.61	1.872	0.42(0.15)	0.36	97.3	60015.00
6	150.27	30.86	1.863	0.42(0.15)	0.36	97.3	60200.00

COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
PEAK FLOW RATE(CFS) = 157.48 Tc(MIN.) = 24.82
EFFECTIVE AREA(ACRES) = 88.42 AREA-AVERAGED Fm(INCH/HR) = 0.15
AREA-AVERAGED Fp(INCH/HR) = 0.42 AREA-AVERAGED Ap = 0.36
TOTAL AREA(ACRES) = 97.3

```
  LONGEST FLOWPATH FROM NODE  60015.00 TO NODE  60065.00 =    5866.07 FEET.
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       97.3  TC(MIN.) =     24.82
  EFFECTIVE AREA(ACRES) =     88.42  AREA-AVERAGED Fm(INCH/HR)=  0.15
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap = 0.357
  PEAK FLOW RATE(CFS)   =     157.48

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1      152.00   17.11    2.654  0.42( 0.14) 0.34      66.9   60400.00
      2      157.03   20.92    2.352  0.42( 0.15) 0.35      78.8   60300.00
      3      157.48   24.82    2.123  0.42( 0.15) 0.36      88.4   60000.00
      4      153.73   29.13    1.929  0.42( 0.15) 0.36      95.9   60100.00
      5      151.01   30.61    1.872  0.42( 0.15) 0.36      97.3   60015.00
      6      150.27   30.86    1.863  0.42( 0.15) 0.36      97.3   60200.00
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
____________________________________________________________________________
****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
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             Ver. 15.0  Release Date: 04/01/2008  License ID 1555

                           Analysis prepared by:






 ************************* DESCRIPTION OF STUDY *************************
* REDLANDS PASSENGER RAIL                                                 *
* EXISTING HYDROLOGY 100 YEAR EVENT                                       *
* BASIN 70000                                                             *
 **************************************************************************

  FILE NAME: C:\RPRP\70000.DAT
  TIME/DATE OF STUDY: 16:14 11/09/2012
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2500

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======   ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  2   13.0      8.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  3   25.0     15.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  4   35.0     25.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150
  5   20.0     15.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.20 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE  70005.00 TO NODE  70010.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   752.00
  ELEVATION DATA: UPSTREAM(FEET) =   1416.00  DOWNSTREAM(FEET) =   1406.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   10.200
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.619
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp        Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
```

```
  COMMERCIAL                 B        1.10      0.42     0.100    76   10.20
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      3.54
  TOTAL AREA(ACRES) =      1.10   PEAK FLOW RATE(CFS) =      3.54

****************************************************************************
  FLOW PROCESS FROM NODE  70010.00 TO NODE  70015.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1406.00  DOWNSTREAM(FEET) =   1372.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  1477.00   CHANNEL SLOPE =  0.0230
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   3.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.921
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        1.20      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      5.10
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   5.62
  AVERAGE FLOW DEPTH(FEET) =   0.31   TRAVEL TIME(MIN.) =   4.38
  Tc(MIN.) =   14.58
  SUBAREA AREA(ACRES) =     1.20       SUBAREA RUNOFF(CFS) =    3.11
  EFFECTIVE AREA(ACRES) =      2.30     AREA-AVERAGED Fm(INCH/HR) =   0.04
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =        2.3         PEAK FLOW RATE(CFS) =       5.96

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.34   FLOW VELOCITY(FEET/SEC.) =   5.84
  LONGEST FLOWPATH FROM NODE  70005.00 TO NODE  70015.00 =    2229.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  70015.00 TO NODE  70015.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   14.58
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.921
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        1.10      0.42     0.100    76
  CONDOMINIUMS               B        1.90      0.42     0.350    76
  PUBLIC PARK                B        1.00      0.42     0.850    76
  COMMERCIAL                 B        3.90      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.255
  SUBAREA AREA(ACRES) =    7.90      SUBAREA RUNOFF(CFS) =   20.00
  EFFECTIVE AREA(ACRES) =     10.20   AREA-AVERAGED Fm(INCH/HR) =  0.09
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.22
  TOTAL AREA(ACRES) =       10.2       PEAK FLOW RATE(CFS) =      25.96

****************************************************************************
  FLOW PROCESS FROM NODE  70015.00 TO NODE  70020.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   100.00  DOWNSTREAM(FEET) =    99.40
  FLOW LENGTH(FEET) =    60.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  36.0 INCH PIPE IS  16.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.51
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      25.96
  PIPE TRAVEL TIME(MIN.) =   0.12    Tc(MIN.) =   14.70
  LONGEST FLOWPATH FROM NODE  70005.00 TO NODE  70020.00 =    2289.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE  70020.00 TO NODE  70020.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   14.70
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.907
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.40      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.40      SUBAREA RUNOFF(CFS) =    1.03
  EFFECTIVE AREA(ACRES) =     10.60   AREA-AVERAGED Fm(INCH/HR) =  0.09
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.22
  TOTAL AREA(ACRES) =       10.6       PEAK FLOW RATE(CFS) =      26.86

****************************************************************************
  FLOW PROCESS FROM NODE  70020.00 TO NODE  70025.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   100.00  DOWNSTREAM(FEET) =    99.50
  FLOW LENGTH(FEET) =    50.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  36.0 INCH PIPE IS  16.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   8.58
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      26.86
  PIPE TRAVEL TIME(MIN.) =   0.10    Tc(MIN.) =   14.80
  LONGEST FLOWPATH FROM NODE  70005.00 TO NODE  70025.00 =    2339.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  70025.00 TO NODE  70025.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   14.80
  RAINFALL INTENSITY(INCH/HR) =   2.90
  AREA-AVERAGED Fm(INCH/HR) =  0.09
  AREA-AVERAGED Fp(INCH/HR) =  0.42
  AREA-AVERAGED Ap =  0.22
  EFFECTIVE STREAM AREA(ACRES) =      10.60
  TOTAL STREAM AREA(ACRES) =      10.60
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      26.86

****************************************************************************
  FLOW PROCESS FROM NODE  71005.00 TO NODE  71010.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   290.00
  ELEVATION DATA: UPSTREAM(FEET) =   1420.00  DOWNSTREAM(FEET) =   1407.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    5.464
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  5.264
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 B        0.70      0.42     0.100    76    5.46
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      3.29
  TOTAL AREA(ACRES) =      0.70   PEAK FLOW RATE(CFS) =      3.29
```

```
****************************************************************************
  FLOW PROCESS FROM NODE  71010.00 TO NODE  71015.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1407.00  DOWNSTREAM(FEET) =   1387.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   977.00   CHANNEL SLOPE =  0.0205
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   3.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.989
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                B       0.60      0.42     0.850    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.28
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   5.07
  AVERAGE FLOW DEPTH(FEET) =   0.29   TRAVEL TIME(MIN.) =   3.21
  Tc(MIN.) =    8.67
  SUBAREA AREA(ACRES) =     0.60       SUBAREA RUNOFF(CFS) =    1.96
  EFFECTIVE AREA(ACRES) =      1.30     AREA-AVERAGED Fm(INCH/HR) =   0.19
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.45
  TOTAL AREA(ACRES) =        1.3         PEAK FLOW RATE(CFS) =       4.45

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.29   FLOW VELOCITY(FEET/SEC.) =   5.23
  LONGEST FLOWPATH FROM NODE  71005.00 TO NODE  71015.00 =    1267.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  71015.00 TO NODE  71020.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1387.00  DOWNSTREAM(FEET) =   1385.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   193.10   CHANNEL SLOPE =  0.0104
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   3.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.790
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B       0.20      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.78
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   4.17
  AVERAGE FLOW DEPTH(FEET) =   0.37   TRAVEL TIME(MIN.) =   0.77
  Tc(MIN.) =    9.44
  SUBAREA AREA(ACRES) =     0.20       SUBAREA RUNOFF(CFS) =    0.67
  EFFECTIVE AREA(ACRES) =      1.50     AREA-AVERAGED Fm(INCH/HR) =   0.17
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.40
  TOTAL AREA(ACRES) =        1.5         PEAK FLOW RATE(CFS) =       4.89

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.38   FLOW VELOCITY(FEET/SEC.) =   4.15
  LONGEST FLOWPATH FROM NODE  71005.00 TO NODE  71020.00 =    1460.10 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  71020.00 TO NODE  71020.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    9.44
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.790
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B       9.70      0.42     0.100    76
```

```
  COMMERCIAL                  B        2.20      0.42     0.100    76
  COMMERCIAL                  B        3.10      0.42     0.100    76
  COMMERCIAL                  B        0.20      0.42     0.100    76
  COMMERCIAL                  B        1.10      0.42     0.100    76
  COMMERCIAL                  B        0.20      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =   16.50      SUBAREA RUNOFF(CFS) =   55.66
  EFFECTIVE AREA(ACRES) =     18.00   AREA-AVERAGED Fm(INCH/HR) =  0.05
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.12
  TOTAL AREA(ACRES) =       18.0       PEAK FLOW RATE(CFS) =      60.55

****************************************************************************
  FLOW PROCESS FROM NODE  71020.00 TO NODE  71020.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    9.44
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.790
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                 B        0.50      0.42     0.850    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA AREA(ACRES) =    0.50      SUBAREA RUNOFF(CFS) =    1.54
  EFFECTIVE AREA(ACRES) =     18.50   AREA-AVERAGED Fm(INCH/HR) =  0.06
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.14
  TOTAL AREA(ACRES) =       18.5       PEAK FLOW RATE(CFS) =      62.09

****************************************************************************
  FLOW PROCESS FROM NODE  71020.00 TO NODE  71025.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1385.00  DOWNSTREAM(FEET) =   1366.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  1265.00   CHANNEL SLOPE =  0.0150
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   3.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   2.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.342
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                  B        1.50      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      64.32
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   9.56
  AVERAGE FLOW DEPTH(FEET) =   1.20   TRAVEL TIME(MIN.) =   2.20
  Tc(MIN.) =   11.65
  SUBAREA AREA(ACRES) =     1.50       SUBAREA RUNOFF(CFS) =    4.45
  EFFECTIVE AREA(ACRES) =     20.00     AREA-AVERAGED Fm(INCH/HR) =   0.06
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.14
  TOTAL AREA(ACRES) =       20.0         PEAK FLOW RATE(CFS) =      62.09
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  1.18   FLOW VELOCITY(FEET/SEC.) =   9.50
  LONGEST FLOWPATH FROM NODE  71005.00 TO NODE  71025.00 =    2725.10 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  71025.00 TO NODE  70025.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   100.00  DOWNSTREAM(FEET) =    97.00
  FLOW LENGTH(FEET) =   300.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  36.0 INCH PIPE IS  28.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =  10.20
```

```
 GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      62.09
 PIPE TRAVEL TIME(MIN.) =   0.49    Tc(MIN.) =   12.14
 LONGEST FLOWPATH FROM NODE  71005.00 TO NODE  70025.00 =    3025.10 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE  70025.00 TO NODE  70025.00 IS CODE =   1
----------------------------------------------------------------------------
 >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
 >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
 TOTAL NUMBER OF STREAMS =  2
 CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
 TIME OF CONCENTRATION(MIN.) =   12.14
 RAINFALL INTENSITY(INCH/HR) =   3.26
 AREA-AVERAGED Fm(INCH/HR) =  0.06
 AREA-AVERAGED Fp(INCH/HR) =  0.42
 AREA-AVERAGED Ap =  0.14
 EFFECTIVE STREAM AREA(ACRES) =      20.00
 TOTAL STREAM AREA(ACRES) =      20.00
 PEAK FLOW RATE(CFS) AT CONFLUENCE =      62.09

 ** CONFLUENCE DATA **
  STREAM      Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
     1       26.86   14.80    2.895  0.42( 0.09) 0.22      10.6   70005.00
     2       62.09   12.14    3.260  0.42( 0.06) 0.14      20.0   71005.00

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

 ** PEAK FLOW RATE TABLE **
  STREAM      Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
     1       87.00   12.14    3.260  0.42( 0.07) 0.16      28.7   71005.00
     2       81.87   14.80    2.895  0.42( 0.07) 0.17      30.6   70005.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =      87.00    Tc(MIN.) =    12.14
 EFFECTIVE AREA(ACRES) =      28.70   AREA-AVERAGED Fm(INCH/HR) =  0.07
 AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.16
 TOTAL AREA(ACRES) =       30.6
 LONGEST FLOWPATH FROM NODE  71005.00 TO NODE  70025.00 =    3025.10 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE  70025.00 TO NODE  70025.00 IS CODE =  81
----------------------------------------------------------------------------
 >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
 MAINLINE Tc(MIN.) =   12.14
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.260
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                 B        2.40      0.42     0.100    76
 COMMERCIAL                 B        3.70      0.42     0.100    76
 RESIDENTIAL
 "5-7 DWELLINGS/ACRE"       B        2.00      0.42     0.500    76
 COMMERCIAL                 B        9.40      0.42     0.100    76
 CONDOMINIUMS               B        9.60      0.42     0.350    76
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.218
 SUBAREA AREA(ACRES) =   27.10      SUBAREA RUNOFF(CFS) =   77.27
 EFFECTIVE AREA(ACRES) =     55.80   AREA-AVERAGED Fm(INCH/HR) =  0.08
 AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.19
 TOTAL AREA(ACRES) =       57.7       PEAK FLOW RATE(CFS) =     159.69

****************************************************************************
 FLOW PROCESS FROM NODE  70025.00 TO NODE  70030.00 IS CODE =  41
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
```

```
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
==============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   100.00  DOWNSTREAM(FEET) =    95.00
  FLOW LENGTH(FEET) =   530.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  22.59
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     159.69
  PIPE TRAVEL TIME(MIN.) =   0.39    Tc(MIN.) =   12.53
  LONGEST FLOWPATH FROM NODE  71005.00 TO NODE  70030.00 =    3555.10 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  70030.00 TO NODE  70030.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
==============================================================================
  MAINLINE Tc(MIN.) =   12.53
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.199
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.90      0.42     0.100    76
  COMMERCIAL                 B        2.40      0.42     0.100    76
  COMMERCIAL                 B        8.80      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =   12.10      SUBAREA RUNOFF(CFS) =   34.38
  EFFECTIVE AREA(ACRES) =     67.90   AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.17
  TOTAL AREA(ACRES) =       69.8       PEAK FLOW RATE(CFS) =     190.98

****************************************************************************
  FLOW PROCESS FROM NODE  70030.00 TO NODE  70035.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
==============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   100.00  DOWNSTREAM(FEET) =    99.60
  FLOW LENGTH(FEET) =   135.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  27.02
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     190.98
  PIPE TRAVEL TIME(MIN.) =   0.08    Tc(MIN.) =   12.61
  LONGEST FLOWPATH FROM NODE  71005.00 TO NODE  70035.00 =    3690.10 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  70035.00 TO NODE  70035.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
==============================================================================
  MAINLINE Tc(MIN.) =   12.61
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.186
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        3.00      0.42     0.100    76
  COMMERCIAL                 B        0.60      0.42     0.100    76
  COMMERCIAL                 B        1.30      0.42     0.100    76
  COMMERCIAL                 B        0.80      0.42     0.100    76
  COMMERCIAL                 B        0.60      0.42     0.100    76
  COMMERCIAL                 B        1.20      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    7.50      SUBAREA RUNOFF(CFS) =   21.22
  EFFECTIVE AREA(ACRES) =     75.40   AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.17
  TOTAL AREA(ACRES) =       77.3       PEAK FLOW RATE(CFS) =     211.43
```

```
****************************************************************************
  FLOW PROCESS FROM NODE  70035.00 TO NODE  70040.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   100.00  DOWNSTREAM(FEET) =    97.00
  FLOW LENGTH(FEET) =   310.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  29.91
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     211.43
  PIPE TRAVEL TIME(MIN.) =   0.17    Tc(MIN.) =   12.79
  LONGEST FLOWPATH FROM NODE  71005.00 TO NODE  70040.00 =    4000.10 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  70040.00 TO NODE  70040.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   12.79
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.160
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        3.10      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    3.10      SUBAREA RUNOFF(CFS) =    8.70
  EFFECTIVE AREA(ACRES) =     78.50   AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.16
  TOTAL AREA(ACRES) =       80.4       PEAK FLOW RATE(CFS) =     218.37

****************************************************************************
  FLOW PROCESS FROM NODE  70040.00 TO NODE  70045.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   100.00  DOWNSTREAM(FEET) =    98.00
  FLOW LENGTH(FEET) =   200.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  30.89
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     218.37
  PIPE TRAVEL TIME(MIN.) =   0.11    Tc(MIN.) =   12.89
  LONGEST FLOWPATH FROM NODE  71005.00 TO NODE  70045.00 =    4200.10 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  70045.00 TO NODE  70045.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   12.89
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.145
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "1 DWELLING/ACRE"          B        1.00      0.42     0.800    76
  COMMERCIAL                 B        2.60      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.294
  SUBAREA AREA(ACRES) =    3.60      SUBAREA RUNOFF(CFS) =    9.78
  EFFECTIVE AREA(ACRES) =     82.10   AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.17
  TOTAL AREA(ACRES) =       84.0       PEAK FLOW RATE(CFS) =     227.03

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

```
  FLOW PROCESS FROM NODE  70045.00 TO NODE  70050.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   100.00  DOWNSTREAM(FEET) =    98.70
  FLOW LENGTH(FEET) =   125.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  32.12
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     227.03
  PIPE TRAVEL TIME(MIN.) =   0.06    Tc(MIN.) =   12.96
  LONGEST FLOWPATH FROM NODE  71005.00 TO NODE  70050.00 =    4325.10 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  70050.00 TO NODE  70050.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   12.96
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.135
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        2.70      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    2.70      SUBAREA RUNOFF(CFS) =    7.52
  EFFECTIVE AREA(ACRES) =     84.80   AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.17
  TOTAL AREA(ACRES) =       86.7       PEAK FLOW RATE(CFS) =     233.85

****************************************************************************
  FLOW PROCESS FROM NODE  70050.00 TO NODE  70055.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   100.00  DOWNSTREAM(FEET) =    98.00
  FLOW LENGTH(FEET) =   210.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  33.08
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     233.85
  PIPE TRAVEL TIME(MIN.) =   0.11    Tc(MIN.) =   13.07
  LONGEST FLOWPATH FROM NODE  71005.00 TO NODE  70055.00 =    4535.10 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  70055.00 TO NODE  70055.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   13.07
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.120
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "5-7 DWELLINGS/ACRE"       B        1.40      0.42     0.500    76
  COMMERCIAL                 B        2.20      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.256
  SUBAREA AREA(ACRES) =    3.60      SUBAREA RUNOFF(CFS) =    9.76
  EFFECTIVE AREA(ACRES) =     88.40   AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.17
  TOTAL AREA(ACRES) =       90.3       PEAK FLOW RATE(CFS) =     242.44

****************************************************************************
  FLOW PROCESS FROM NODE  70055.00 TO NODE  70060.00 IS CODE =  41
```

```
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   100.00  DOWNSTREAM(FEET) =    98.60
  FLOW LENGTH(FEET) =   140.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  34.30
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     242.44
  PIPE TRAVEL TIME(MIN.) =   0.07    Tc(MIN.) =   13.13
  LONGEST FLOWPATH FROM NODE  71005.00 TO NODE  70060.00 =    4675.10 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  70060.00 TO NODE  70060.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   13.13
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.110
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        2.00      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    2.00      SUBAREA RUNOFF(CFS) =    5.52
  EFFECTIVE AREA(ACRES) =     90.40   AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.17
  TOTAL AREA(ACRES) =       92.3       PEAK FLOW RATE(CFS) =     247.19

****************************************************************************
  FLOW PROCESS FROM NODE  70060.00 TO NODE  70065.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   100.00  DOWNSTREAM(FEET) =    99.80
  FLOW LENGTH(FEET) =   120.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  34.97
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     247.19
  PIPE TRAVEL TIME(MIN.) =   0.06    Tc(MIN.) =   13.19
  LONGEST FLOWPATH FROM NODE  71005.00 TO NODE  70065.00 =    4795.10 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  70065.00 TO NODE  70065.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   13.19
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.102
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.60      0.42     0.100    76
  COMMERCIAL                 B        9.10      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    9.70      SUBAREA RUNOFF(CFS) =   26.71
  EFFECTIVE AREA(ACRES) =    100.10   AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.16
  TOTAL AREA(ACRES) =      102.0       PEAK FLOW RATE(CFS) =     273.25

****************************************************************************
  FLOW PROCESS FROM NODE  70065.00 TO NODE  70070.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
```

```
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   100.00  DOWNSTREAM(FEET) =    98.10
  FLOW LENGTH(FEET) =   190.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  38.66
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     273.25
  PIPE TRAVEL TIME(MIN.) =   0.08    Tc(MIN.) =   13.27
  LONGEST FLOWPATH FROM NODE  71005.00 TO NODE  70070.00 =    4985.10 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  70070.00 TO NODE  70070.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   13.27
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.091
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B       0.60      0.42     0.100    76
  COMMERCIAL                 B       1.70      0.42     0.100    76
  RESIDENTIAL
  "5-7 DWELLINGS/ACRE"       B       1.00      0.42     0.500    76
  PUBLIC PARK                B       1.20      0.42     0.850    76
  COMMERCIAL                 B       1.00      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.336
  SUBAREA AREA(ACRES) =    5.50      SUBAREA RUNOFF(CFS) =   14.59
  EFFECTIVE AREA(ACRES) =    105.60   AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.17
  TOTAL AREA(ACRES) =      107.5       PEAK FLOW RATE(CFS) =     286.80

****************************************************************************
  FLOW PROCESS FROM NODE  70070.00 TO NODE  72005.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   100.00  DOWNSTREAM(FEET) =    95.70
  FLOW LENGTH(FEET) =   430.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  40.57
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     286.80
  PIPE TRAVEL TIME(MIN.) =   0.18    Tc(MIN.) =   13.45
  LONGEST FLOWPATH FROM NODE  71005.00 TO NODE  72005.00 =    5415.10 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  72005.00 TO NODE  72005.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   13.45
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.066
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B       0.80      0.42     0.100    76
  COMMERCIAL                 B       2.40      0.42     0.100    76
  PUBLIC PARK                B       3.00      0.42     0.850    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.463
  SUBAREA AREA(ACRES) =    6.20      SUBAREA RUNOFF(CFS) =   16.02
  EFFECTIVE AREA(ACRES) =    111.80   AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.19
  TOTAL AREA(ACRES) =      113.7       PEAK FLOW RATE(CFS) =     300.50
```

```
****************************************************************************
  FLOW PROCESS FROM NODE  72005.00 TO NODE  72010.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   100.00  DOWNSTREAM(FEET) =    85.20
  FLOW LENGTH(FEET) =  1420.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  42.51
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     300.50
  PIPE TRAVEL TIME(MIN.) =   0.56    Tc(MIN.) =   14.01
  LONGEST FLOWPATH FROM NODE  71005.00 TO NODE  72010.00 =    6835.10 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  72010.00 TO NODE  72010.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   14.01
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.992
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        7.50      0.42     0.100    76
  PUBLIC PARK                B        9.30      0.42     0.850    76
  COMMERCIAL                 B        1.70      0.42     0.100    76
  COMMERCIAL                 B       11.00      0.42     0.100    76
  COMMERCIAL                 B        4.60      0.42     0.100    76
  COMMERCIAL                 B        5.60      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.276
  SUBAREA AREA(ACRES) =   39.70      SUBAREA RUNOFF(CFS) =  102.75
  EFFECTIVE AREA(ACRES) =    151.50   AREA-AVERAGED Fm(INCH/HR) =  0.09
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.21
  TOTAL AREA(ACRES) =      153.4       PEAK FLOW RATE(CFS) =     395.83

****************************************************************************
  FLOW PROCESS FROM NODE  72010.00 TO NODE  72010.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   14.01
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.992
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        1.80      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    1.80      SUBAREA RUNOFF(CFS) =    4.78
  EFFECTIVE AREA(ACRES) =    153.30   AREA-AVERAGED Fm(INCH/HR) =  0.09
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.21
  TOTAL AREA(ACRES) =      155.2       PEAK FLOW RATE(CFS) =     400.61

****************************************************************************
  FLOW PROCESS FROM NODE  72010.00 TO NODE  72015.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   100.00  DOWNSTREAM(FEET) =    98.80
  FLOW LENGTH(FEET) =   120.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  41.64
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  42.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     400.61
  PIPE TRAVEL TIME(MIN.) =   0.05    Tc(MIN.) =   14.05
```

```
  LONGEST FLOWPATH FROM NODE  71005.00 TO NODE  72015.00 =    6955.10 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  72015.00 TO NODE  72015.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   14.05
  RAINFALL INTENSITY(INCH/HR) =   2.99
  AREA-AVERAGED Fm(INCH/HR) =  0.09
  AREA-AVERAGED Fp(INCH/HR) =  0.42
  AREA-AVERAGED Ap =  0.21
  EFFECTIVE STREAM AREA(ACRES) =     153.30
  TOTAL STREAM AREA(ACRES) =     155.20
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     400.61

****************************************************************************
  FLOW PROCESS FROM NODE  73000.00 TO NODE  73005.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   330.00
  ELEVATION DATA: UPSTREAM(FEET) =   1337.00  DOWNSTREAM(FEET) =   1332.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   11.357
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.393
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK                B       0.90      0.42     0.850    76   11.36
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA RUNOFF(CFS) =      2.46
  TOTAL AREA(ACRES) =      0.90   PEAK FLOW RATE(CFS) =      2.46

****************************************************************************
  FLOW PROCESS FROM NODE  73005.00 TO NODE  73010.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1332.00  DOWNSTREAM(FEET) =   1327.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   240.00   CHANNEL SLOPE =  0.0208
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   3.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.257
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B       0.90      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      3.76
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   4.96
  AVERAGE FLOW DEPTH(FEET) =   0.27   TRAVEL TIME(MIN.) =   0.81
  Tc(MIN.) =   12.16
  SUBAREA AREA(ACRES) =     0.90       SUBAREA RUNOFF(CFS) =    2.60
  EFFECTIVE AREA(ACRES) =      1.80     AREA-AVERAGED Fm(INCH/HR) =   0.20
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.47
  TOTAL AREA(ACRES) =        1.8         PEAK FLOW RATE(CFS) =       4.95

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.32   FLOW VELOCITY(FEET/SEC.) =   5.32
  LONGEST FLOWPATH FROM NODE  73000.00 TO NODE  73010.00 =     570.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  73010.00 TO NODE  73015.00 IS CODE =  51
```

```
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1327.00  DOWNSTREAM(FEET) =   1318.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   477.00   CHANNEL SLOPE =  0.0189
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   3.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.054
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                B        1.90      0.42     0.850    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       7.26
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   5.79
  AVERAGE FLOW DEPTH(FEET) =   0.39   TRAVEL TIME(MIN.) =   1.37
  Tc(MIN.) =   13.54
  SUBAREA AREA(ACRES) =     1.90       SUBAREA RUNOFF(CFS) =    4.61
  EFFECTIVE AREA(ACRES) =      3.70     AREA-AVERAGED Fm(INCH/HR) =   0.28
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.67
  TOTAL AREA(ACRES) =        3.7         PEAK FLOW RATE(CFS) =       9.23

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.45   FLOW VELOCITY(FEET/SEC.) =   6.21
  LONGEST FLOWPATH FROM NODE  73000.00 TO NODE  73015.00 =    1047.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  73015.00 TO NODE  72015.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1318.00  DOWNSTREAM(FEET) =   1315.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   410.00   CHANNEL SLOPE =  0.0073
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   3.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   2.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.872
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        1.70      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      11.39
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   4.67
  AVERAGE FLOW DEPTH(FEET) =   0.63   TRAVEL TIME(MIN.) =   1.46
  Tc(MIN.) =   15.00
  SUBAREA AREA(ACRES) =     1.70       SUBAREA RUNOFF(CFS) =    4.33
  EFFECTIVE AREA(ACRES) =      5.40     AREA-AVERAGED Fm(INCH/HR) =   0.21
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.49
  TOTAL AREA(ACRES) =        5.4         PEAK FLOW RATE(CFS) =      12.95

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.67   FLOW VELOCITY(FEET/SEC.) =   4.84
  LONGEST FLOWPATH FROM NODE  73000.00 TO NODE  72015.00 =    1457.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  72015.00 TO NODE  72015.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   15.00
  RAINFALL INTENSITY(INCH/HR) =   2.87
  AREA-AVERAGED Fm(INCH/HR) =  0.21
  AREA-AVERAGED Fp(INCH/HR) =  0.42
  AREA-AVERAGED Ap =  0.49
```

```
  EFFECTIVE STREAM AREA(ACRES) =       5.40
  TOTAL STREAM AREA(ACRES) =       5.40
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      12.95

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1      400.61   14.05    2.986  0.42( 0.09) 0.21     153.3   71005.00
      1      361.68   16.90    2.673  0.42( 0.09) 0.21     155.2   70005.00
      2       12.95   15.00    2.872  0.42( 0.21) 0.49       5.4   73000.00

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

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1      413.27   14.05    2.986  0.42( 0.09) 0.22     158.4   71005.00
      2      400.62   15.00    2.872  0.42( 0.09) 0.22     159.3   73000.00
      3      373.67   16.90    2.673  0.42( 0.09) 0.22     160.6   70005.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =     413.27    Tc(MIN.) =    14.05
  EFFECTIVE AREA(ACRES) =     158.35   AREA-AVERAGED Fm(INCH/HR) =  0.09
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.22
  TOTAL AREA(ACRES) =      160.6
  LONGEST FLOWPATH FROM NODE  71005.00 TO NODE  72015.00 =    6955.10 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  72015.00 TO NODE  72020.00 IS CODE =  41
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   100.00  DOWNSTREAM(FEET) =    97.90
  FLOW LENGTH(FEET) =   210.00   MANNING'S N =  0.013
  ASSUME FULL-FLOWING PIPELINE
  PIPE-FLOW VELOCITY(FEET/SEC.) =  42.95
  PIPE FLOW VELOCITY = (TOTAL FLOW)/(PIPE CROSS SECTION AREA)
  GIVEN PIPE DIAMETER(INCH) =  42.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =     413.27
  PIPE TRAVEL TIME(MIN.) =   0.08    Tc(MIN.) =   14.14
  LONGEST FLOWPATH FROM NODE  71005.00 TO NODE  72020.00 =    7165.10 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  72020.00 TO NODE  72020.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   14.14
  RAINFALL INTENSITY(INCH/HR) =   2.98
  AREA-AVERAGED Fm(INCH/HR) =  0.09
  AREA-AVERAGED Fp(INCH/HR) =  0.42
  AREA-AVERAGED Ap =  0.22
  EFFECTIVE STREAM AREA(ACRES) =     158.35
  TOTAL STREAM AREA(ACRES) =     160.60
  PEAK FLOW RATE(CFS) AT CONFLUENCE =     413.27

****************************************************************************
  FLOW PROCESS FROM NODE  74005.00 TO NODE  74010.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =  1000.00
  ELEVATION DATA: UPSTREAM(FEET) =   1338.00  DOWNSTREAM(FEET) =   1320.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   17.096
```

```
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.655
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK                 B       2.50      0.42     0.850    76   17.10
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA RUNOFF(CFS) =      5.16
  TOTAL AREA(ACRES) =      2.50   PEAK FLOW RATE(CFS) =      5.16

****************************************************************************
  FLOW PROCESS FROM NODE  74010.00 TO NODE  72020.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1320.00  DOWNSTREAM(FEET) =   1314.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   570.00   CHANNEL SLOPE =  0.0105
  CHANNEL BASE(FEET) =    2.00   "Z" FACTOR =   3.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   2.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.488
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                  B       2.70      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       8.14
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   4.85
  AVERAGE FLOW DEPTH(FEET) =   0.49   TRAVEL TIME(MIN.) =   1.96
  Tc(MIN.) =   19.05
  SUBAREA AREA(ACRES) =     2.70       SUBAREA RUNOFF(CFS) =    5.94
  EFFECTIVE AREA(ACRES) =      5.20     AREA-AVERAGED Fm(INCH/HR) =   0.19
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.46
  TOTAL AREA(ACRES) =       5.2         PEAK FLOW RATE(CFS) =      10.73

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.56   FLOW VELOCITY(FEET/SEC.) =   5.21
  LONGEST FLOWPATH FROM NODE  74005.00 TO NODE  72020.00 =    1570.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  72020.00 TO NODE  72020.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   19.05
  RAINFALL INTENSITY(INCH/HR) =   2.49
  AREA-AVERAGED Fm(INCH/HR) =  0.19
  AREA-AVERAGED Fp(INCH/HR) =  0.42
  AREA-AVERAGED Ap =  0.46
  EFFECTIVE STREAM AREA(ACRES) =       5.20
  TOTAL STREAM AREA(ACRES) =       5.20
  PEAK FLOW RATE(CFS) AT CONFLUENCE =      10.73

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1      413.27   14.14    2.976  0.42( 0.09) 0.22     158.4   71005.00
      1      400.62   15.09    2.862  0.42( 0.09) 0.22     159.3   73000.00
      1      373.67   16.99    2.665  0.42( 0.09) 0.22     160.6   70005.00
      2       10.73   19.05    2.488  0.42( 0.19) 0.46       5.2   74005.00

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

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
```

```
    1      422.92   14.14    2.976  0.42( 0.09) 0.22     162.2   71005.00
    2      410.51   15.09    2.862  0.42( 0.10) 0.23     163.4   73000.00
    3      383.98   16.99    2.665  0.42( 0.10) 0.23     165.2   70005.00
    4      358.71   19.05    2.488  0.42( 0.10) 0.23     165.8   74005.00

 COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
 PEAK FLOW RATE(CFS) =     422.92    Tc(MIN.) =    14.14
 EFFECTIVE AREA(ACRES) =     162.21   AREA-AVERAGED Fm(INCH/HR) =  0.09
 AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.22
 TOTAL AREA(ACRES) =      165.8
 LONGEST FLOWPATH FROM NODE  71005.00 TO NODE  72020.00 =    7165.10 FEET.
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)     =      165.8  TC(MIN.) =     14.14
 EFFECTIVE AREA(ACRES) =    162.21  AREA-AVERAGED Fm(INCH/HR)=  0.09
 AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap = 0.224
 PEAK FLOW RATE(CFS)   =     422.92

 ** PEAK FLOW RATE TABLE **
  STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
  NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
    1      422.92   14.14    2.976  0.42( 0.09) 0.22     162.2   71005.00
    2      410.51   15.09    2.862  0.42( 0.10) 0.23     163.4   73000.00
    3      383.98   16.99    2.665  0.42( 0.10) 0.23     165.2   70005.00
    4      358.71   19.05    2.488  0.42( 0.10) 0.23     165.8   74005.00
============================================================================
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

```
____________________________________________________________________________
****************************************************************************
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             Ver. 15.0  Release Date: 04/01/2008  License ID 1555

                           Analysis prepared by:






 ************************** DESCRIPTION OF STUDY **************************
* REDLANDS PASSENGER RAIL                                                  *
* EXISTING HYDROLOGY 100 YEAR EVENT                                        *
* BASIN 80000                                                              *
 **************************************************************************

  FILE NAME: C:\RPRP\EPRP\80000.DAT
  TIME/DATE OF STUDY: 13:14 02/13/2012
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2500

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   20.0     15.0    0.020/0.020/0.020   0.50    1.50 0.0312 0.125 0.0170

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.20 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE  80005.00 TO NODE  80010.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   605.60
  ELEVATION DATA: UPSTREAM(FEET) =   1370.00  DOWNSTREAM(FEET) =   1358.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   13.722
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.029
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  PUBLIC PARK                B        0.30      0.42      0.850    76   13.72
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
```

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  SUBAREA RUNOFF(CFS) =      0.72
  TOTAL AREA(ACRES) =      0.30   PEAK FLOW RATE(CFS) =      0.72

****************************************************************************
  FLOW PROCESS FROM NODE  80010.00 TO NODE  80015.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1358.00  DOWNSTREAM(FEET) =   1357.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   116.80   CHANNEL SLOPE =  0.0086
  CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =   4.000
  MANNING'S FACTOR = 0.017   MAXIMUM DEPTH(FEET) =   1.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.896
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.30      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      1.11
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.82
  AVERAGE FLOW DEPTH(FEET) =   0.11   TRAVEL TIME(MIN.) =   1.07
  Tc(MIN.) =   14.79
  SUBAREA AREA(ACRES) =     0.30       SUBAREA RUNOFF(CFS) =    0.77
  EFFECTIVE AREA(ACRES) =      0.60     AREA-AVERAGED Fm(INCH/HR) =   0.20
  AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.48
  TOTAL AREA(ACRES) =        0.6        PEAK FLOW RATE(CFS) =       1.46

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.13   FLOW VELOCITY(FEET/SEC.) =   1.99
  LONGEST FLOWPATH FROM NODE  80005.00 TO NODE  80015.00 =     722.40 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  80015.00 TO NODE  80015.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   14.79
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.896
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        3.10      0.42     0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    3.10      SUBAREA RUNOFF(CFS) =    7.96
  EFFECTIVE AREA(ACRES) =      3.70   AREA-AVERAGED Fm(INCH/HR) =  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.16
  TOTAL AREA(ACRES) =        3.7       PEAK FLOW RATE(CFS) =       9.42
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        3.7  TC(MIN.) =     14.79
  EFFECTIVE AREA(ACRES) =      3.70  AREA-AVERAGED Fm(INCH/HR)=  0.07
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap = 0.161
  PEAK FLOW RATE(CFS)   =       9.42
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

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____________________________________________________________________________
****************************************************************************
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                           Analysis prepared by:







 ************************* DESCRIPTION OF STUDY *************************
* REDLANDS PASSENGER RAIL                                                 *
* EXISTING HYDROLOGY 100 YEAR EVENT                                       *
* BASIN 90000                                                             *
 **************************************************************************

  FILE NAME: C:\RPRP\EPRP\90000.DAT
  TIME/DATE OF STUDY: 13:43 10/17/2012
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  12.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 1.2500

  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 0.0150
  2   20.0     15.0    0.020/0.020/0.020   0.50    1.50 0.0312 0.125 0.0170

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.20 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint = 10.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE  90000.00 TO NODE  90005.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   238.50
  ELEVATION DATA: UPSTREAM(FEET) =   1500.00  DOWNSTREAM(FEET) =   1498.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.810
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.248
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  MOBILE HOME PARK           B        0.50      0.42      0.250    76    7.81
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.250
```
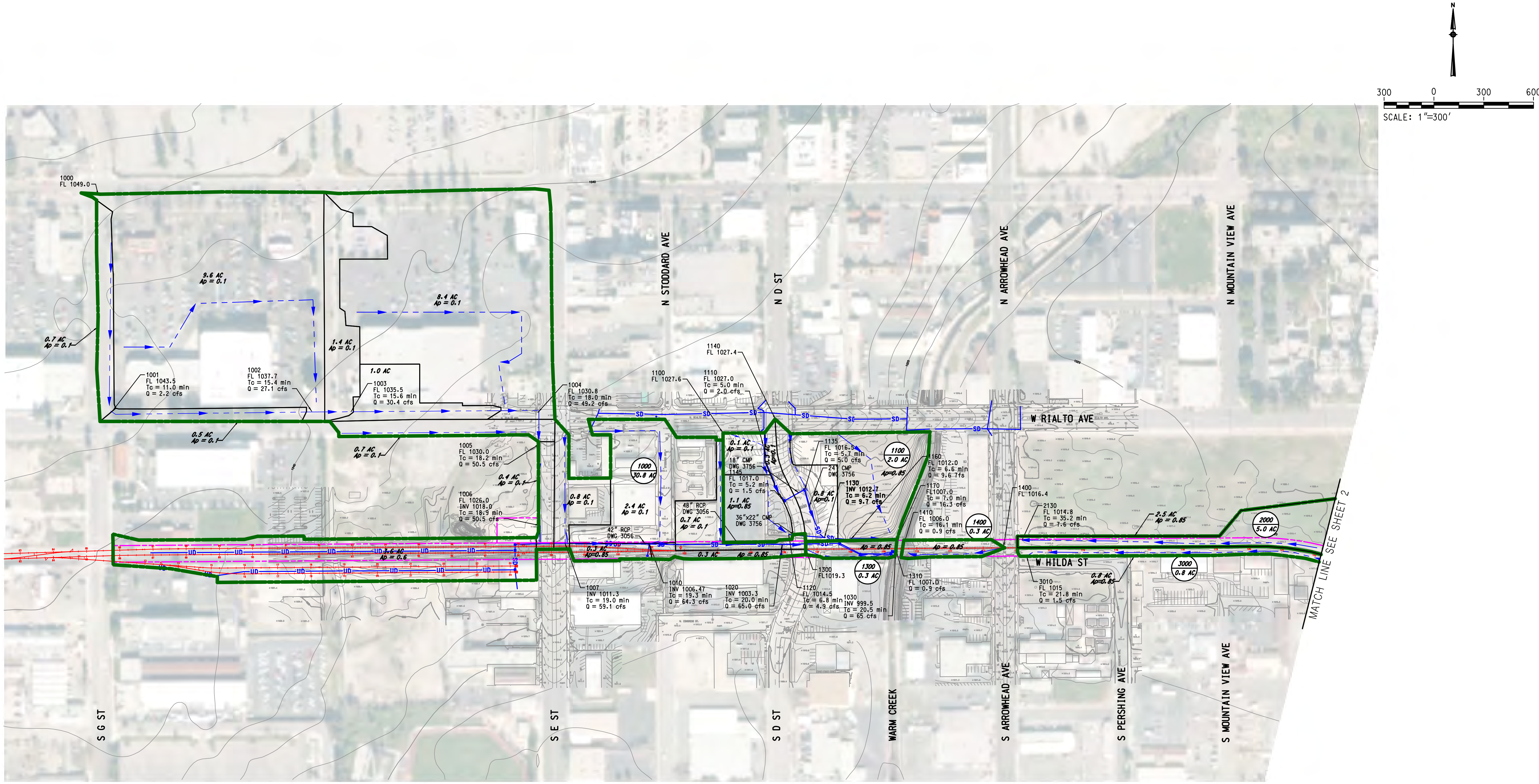

```
  SUBAREA RUNOFF(CFS) =      1.86
  TOTAL AREA(ACRES) =      0.50   PEAK FLOW RATE(CFS) =      1.86

****************************************************************************
  FLOW PROCESS FROM NODE  90005.00 TO NODE  90010.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) = 1498.00  DOWNSTREAM ELEVATION(FEET) = 1485.00
  STREET LENGTH(FEET) =   677.80   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

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

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       8.78
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.44
    HALFSTREET FLOOD WIDTH(FEET) =   15.43
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    3.78
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    1.66
  STREET FLOW TRAVEL TIME(MIN.) =   2.99   Tc(MIN.) =   10.79
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.498
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  MOBILE HOME PARK           B       4.50      0.42     0.250    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.250
  SUBAREA AREA(ACRES) =    4.50      SUBAREA RUNOFF(CFS) =   13.74
  EFFECTIVE AREA(ACRES) =      5.00    AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.25
  TOTAL AREA(ACRES) =        5.0        PEAK FLOW RATE(CFS) =      15.27

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.51   HALFSTREET FLOOD WIDTH(FEET) =  19.34
  FLOW VELOCITY(FEET/SEC.) =  4.32   DEPTH*VELOCITY(FT*FT/SEC.) =   2.19
  LONGEST FLOWPATH FROM NODE  90000.00 TO NODE  90010.00 =     916.30 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE  90010.00 TO NODE  90010.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   10.79
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.498
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  MOBILE HOME PARK           B       1.50      0.42     0.250    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.250
  SUBAREA AREA(ACRES) =    1.50      SUBAREA RUNOFF(CFS) =    4.58
  EFFECTIVE AREA(ACRES) =      6.50   AREA-AVERAGED Fm(INCH/HR) =  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap =  0.25
  TOTAL AREA(ACRES) =        6.5       PEAK FLOW RATE(CFS) =      19.85

****************************************************************************
  FLOW PROCESS FROM NODE  90010.00 TO NODE  90015.00 IS CODE =  51
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   1485.00  DOWNSTREAM(FEET) =   1464.00
```

```
 CHANNEL LENGTH THRU SUBAREA(FEET) =  1265.00   CHANNEL SLOPE =  0.0166
 CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =   4.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   4.00
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.787
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp        Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 PUBLIC PARK                B        5.20      0.42     0.850    76
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      25.55
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   4.24
 AVERAGE FLOW DEPTH(FEET) =   0.75   TRAVEL TIME(MIN.) =   4.97
 Tc(MIN.) =   15.77
 SUBAREA AREA(ACRES) =     5.20       SUBAREA RUNOFF(CFS) =   11.36
 EFFECTIVE AREA(ACRES) =     11.70     AREA-AVERAGED Fm(INCH/HR) =   0.22
 AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.52
 TOTAL AREA(ACRES) =       11.7         PEAK FLOW RATE(CFS) =      27.05

 END OF SUBAREA CHANNEL FLOW HYDRAULICS:
 DEPTH(FEET) =  0.78   FLOW VELOCITY(FEET/SEC.) =   4.31
 LONGEST FLOWPATH FROM NODE  90000.00 TO NODE  90015.00 =    2181.30 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE  90015.00 TO NODE  90020.00 IS CODE =  41
----------------------------------------------------------------------------
 >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
 >>>>>USING USER-SPECIFIED PIPESIZE (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =  1465.00  DOWNSTREAM(FEET) =  1464.00
 FLOW LENGTH(FEET) =    39.00   MANNING'S N =  0.013
 DEPTH OF FLOW IN  36.0 INCH PIPE IS  12.7 INCHES
 PIPE-FLOW VELOCITY(FEET/SEC.) =  12.13
 GIVEN PIPE DIAMETER(INCH) =  36.00    NUMBER OF PIPES =   1
 PIPE-FLOW(CFS) =      27.05
 PIPE TRAVEL TIME(MIN.) =   0.05    Tc(MIN.) =   15.82
 LONGEST FLOWPATH FROM NODE  90000.00 TO NODE  90020.00 =    2220.30 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE  90020.00 TO NODE  90025.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   1464.00  DOWNSTREAM(FEET) =   1455.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =   548.00   CHANNEL SLOPE =  0.0164
 CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =   1.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   4.00
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.612
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp        Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 PUBLIC PARK                B        3.00      0.42     0.850    76
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      30.09
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   5.22
 AVERAGE FLOW DEPTH(FEET) =   0.97   TRAVEL TIME(MIN.) =   1.75
 Tc(MIN.) =   17.57
 SUBAREA AREA(ACRES) =     3.00       SUBAREA RUNOFF(CFS) =    6.08
 EFFECTIVE AREA(ACRES) =     14.70     AREA-AVERAGED Fm(INCH/HR) =   0.25
 AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.58
 TOTAL AREA(ACRES) =       14.7         PEAK FLOW RATE(CFS) =      31.28

 END OF SUBAREA CHANNEL FLOW HYDRAULICS:
 DEPTH(FEET) =  0.99   FLOW VELOCITY(FEET/SEC.) =   5.28
 LONGEST FLOWPATH FROM NODE  90000.00 TO NODE  90025.00 =    2768.30 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE  90025.00 TO NODE  90030.00 IS CODE =  51
----------------------------------------------------------------------------
```

```
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
==============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   1455.00  DOWNSTREAM(FEET) =   1446.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =   592.00   CHANNEL SLOPE =  0.0152
 CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =   1.000
 MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   4.00
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.511
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                 B       1.00      0.42     0.100    76
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      32.39
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   8.33
 AVERAGE FLOW DEPTH(FEET) =   0.68   TRAVEL TIME(MIN.) =   1.18
 Tc(MIN.) =   18.76
 SUBAREA AREA(ACRES) =     1.00       SUBAREA RUNOFF(CFS) =    2.22
 EFFECTIVE AREA(ACRES) =     15.70     AREA-AVERAGED Fm(INCH/HR) =   0.23
 AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.55
 TOTAL AREA(ACRES) =       15.7         PEAK FLOW RATE(CFS) =      32.18

 END OF SUBAREA CHANNEL FLOW HYDRAULICS:
 DEPTH(FEET) =  0.68   FLOW VELOCITY(FEET/SEC.) =   8.31
 LONGEST FLOWPATH FROM NODE  90000.00 TO NODE  90030.00 =    3360.30 FEET.

****************************************************************************
 FLOW PROCESS FROM NODE  90030.00 TO NODE  90035.00 IS CODE =  51
----------------------------------------------------------------------------
 >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
 >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
==============================================================================
 ELEVATION DATA: UPSTREAM(FEET) =   1446.00  DOWNSTREAM(FEET) =   1412.00
 CHANNEL LENGTH THRU SUBAREA(FEET) =  1406.73   CHANNEL SLOPE =  0.0242
 CHANNEL BASE(FEET) =    5.00   "Z" FACTOR =   2.000
 MANNING'S FACTOR = 0.030   MAXIMUM DEPTH(FEET) =   1.00
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  2.234
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 PUBLIC PARK                B       1.60      0.42     0.850    76
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.42
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
 TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      33.53
 TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   5.81
 AVERAGE FLOW DEPTH(FEET) =   0.86   TRAVEL TIME(MIN.) =   4.04
 Tc(MIN.) =   22.79
 SUBAREA AREA(ACRES) =     1.60       SUBAREA RUNOFF(CFS) =    2.70
 EFFECTIVE AREA(ACRES) =     17.30     AREA-AVERAGED Fm(INCH/HR) =   0.25
 AREA-AVERAGED Fp(INCH/HR) =   0.42  AREA-AVERAGED Ap =   0.58
 TOTAL AREA(ACRES) =       17.3         PEAK FLOW RATE(CFS) =      32.18
 NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

 END OF SUBAREA CHANNEL FLOW HYDRAULICS:
 DEPTH(FEET) =  0.84   FLOW VELOCITY(FEET/SEC.) =   5.72
 LONGEST FLOWPATH FROM NODE  90000.00 TO NODE  90035.00 =    4767.03 FEET.
==============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)      =       17.3  TC(MIN.) =     22.79
 EFFECTIVE AREA(ACRES) =     17.30  AREA-AVERAGED Fm(INCH/HR)=  0.25
 AREA-AVERAGED Fp(INCH/HR) =  0.42  AREA-AVERAGED Ap = 0.581
 PEAK FLOW RATE(CFS)    =      32.18
==============================================================================
==============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

Appendix B

Existing Conditions Hydrology Maps



LEGEND

- RAIL TRACK
- MAJOR DRAINAGE AREA
- DRAINAGE SUB AREA
- NODE LOCATION
- FLOW PATH
- UD — UNDER DRAIN
- SD — STORM DRAIN
- CONTOURS
- 2300 / 1.6 AC — BASIN NAME / BASIN ACREAGE

ASSUMPTIONS

1. THE GENERAL SITE IS DRAINING SOUTHEAST, BASED OFF USGS AND AVAILABLE TOPO.
2. FOR PROPERTIES WHERE SURVEY OR TOPO IS NOT AVAILABLE, IT IS ASSUMED THE SITE DRAINS TOWARDS THE SOUTHEAST.
3. FOR PROPERTIES NEAR PUBLIC R/W AND NO AVAILABLE TOPO OR SURVEY, IT IS ASSUMED THE PROPERTY DRAINS TOWARDS THE NEAREST PUBLIC ROAD.
4. ALL Q VALUES SHOWN ARE FOR THE 100 YEAR EVENT, UNLESS OTHERWISE NOTED.

ACRONYMS AND ABBREVIATIONS

- Ap – PERVIOUS AREA
- CB – CATCHBASIN
- CFS – CUBIC FEET PER SECOND
- CMP – CORRUGATED METAL PIPE
- DI – DRAIN INLET
- DWG – DRAWING AREA
- FL – ELEVATION AT SURFACE
- INV – PIPE FLOWLINE ELEVATION
- MIN – MINUTES
- Q – SUBAREA FLOW RATE IN CFS
- RCP – REINFORCED CONCRETE PIPE
- SQ – TOTAL FLOW RATE IN CFS
- Tc – TIME OF CONCENTRATION
- X.X AC – SUBAREA ACREAGE

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HDR Engineering, Inc.

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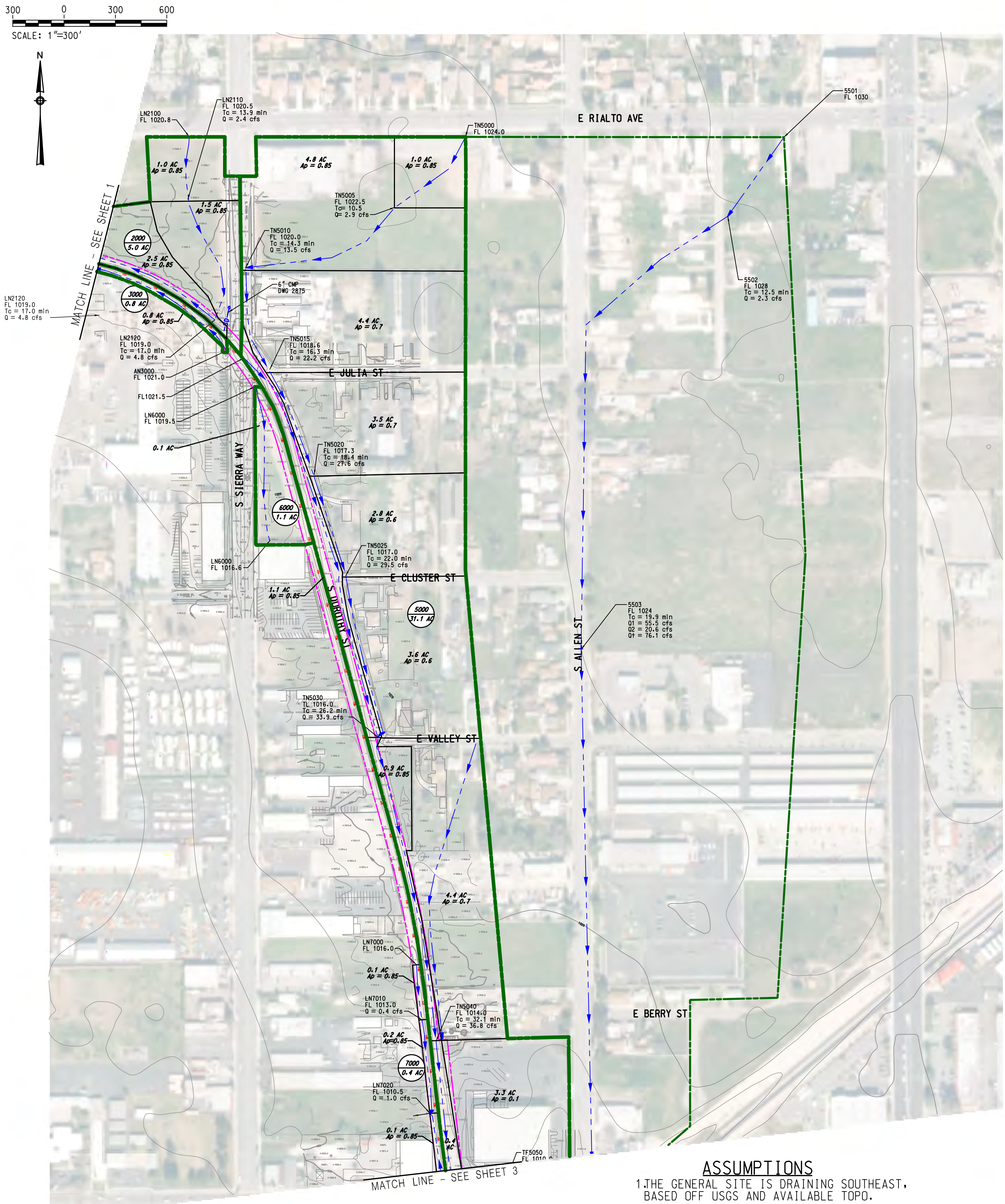
SAN BERNARDINO ASSOCIATED GOVERNMENTS
REDLANDS PASSENGER RAIL PROJECT
EXISTING HYDROLOGY MAP
SHEET 1 OF 14

SCALE: 1"=300'
DATE: 07-09-2012



ASSUMPTIONS

1. THE GENERAL SITE IS DRAINING SOUTHEAST, BASED OFF USGS AND AVAILABLE TOPO.
2. FOR PROPERTIES WHERE SURVEY OR TOPO IS NOT AVAILABLE, IT IS ASSUMED THE SITE DRAINS TOWARDS THE SOUTHEAST.
3. FOR PROPERTIES NEAR PUBLIC R/W AND NO AVAILABLE TOPO OR SURVEY, IT IS ASSUMED THE PROPERTY DRAINS TOWARDS THE NEAREST PUBLIC ROAD.
4. ALL Q VALUES SHOWN ARE FOR THE 100 YEAR EVENT, UNLESS OTHERWISE NOTED.

LEGEND

- RAIL TRACK
- MAJOR DRAINAGE AREA
- DRAINAGE SUB AREA
- NODE LOCATION
- FLOW PATH
- UD — UNDER DRAIN
- SD — STORM DRAIN
- CONTOURS
- 2300 / 1.6 AC — BASIN NAME / BASIN ACREAGE

ACRONYMS AND ABBREVIATIONS

Ap - PERVIOUS AREA	DWG - DRAWING AREA	RCP - REINFORCED CONCRETE PIPE
CB - CATCHBASIN	FL - ELEVATION AT SURFACE	SQ - TOTAL FLOW RATE IN CFS
CFS - CUBIC FEET PER SECOND	INV - PIPE FLOWLINE ELEVATION	Tc - TIME OF CONCENTRATION
CMP - CORRUGATED METAL PIPE	MIN - MINUTES	X.X AC - SUBAREA ACREAGE
DI - DRAIN INLET	Q - SUBAREA FLOW RATE IN CFS	

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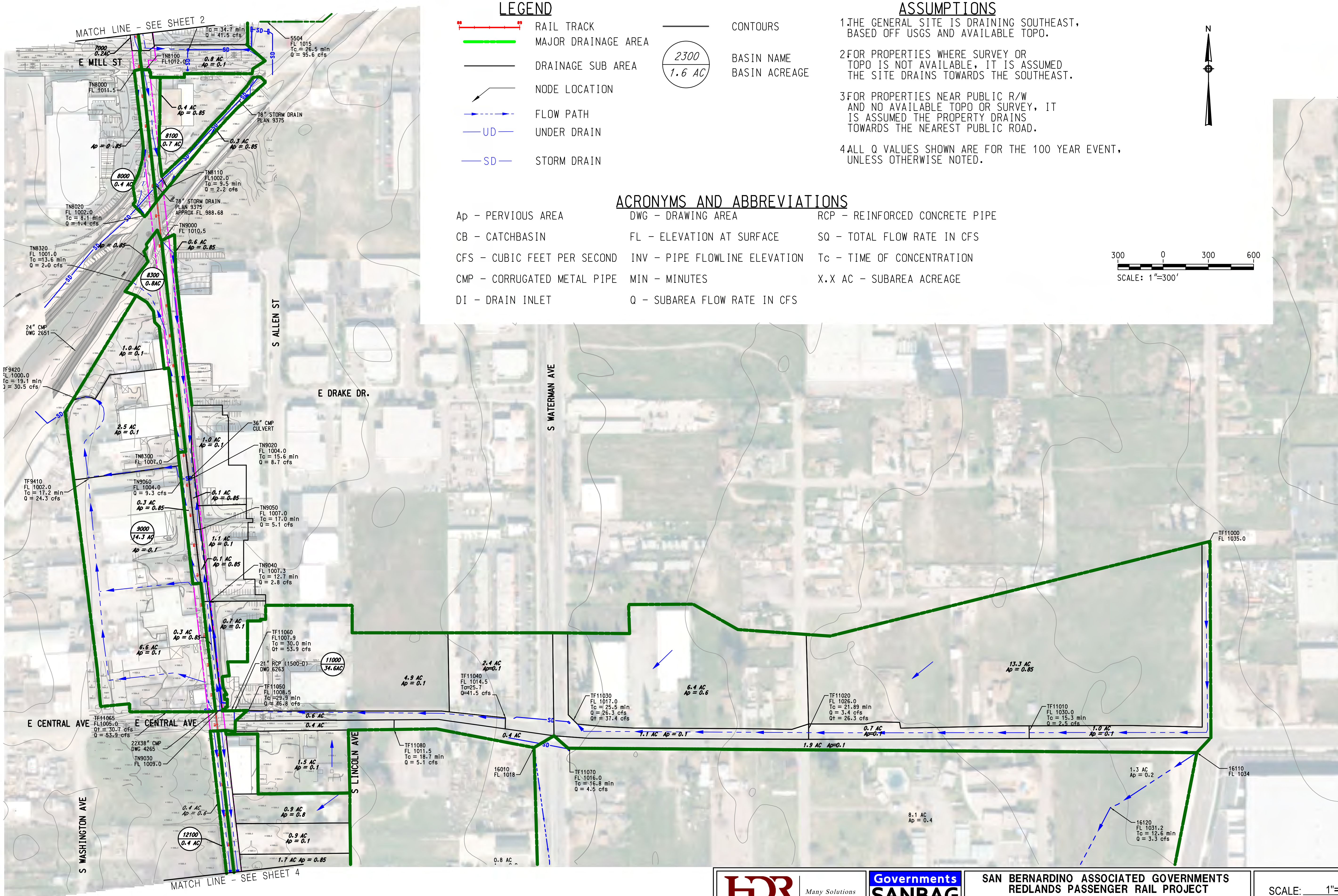
SAN BERNARDINO ASSOCIATED GOVERNMENTS
REDLANDS PASSENGER RAIL PROJECT
EXISTING HYDROLOGY MAP
SHEET 2 OF 14

SCALE: 1"=300'
DATE: 07-09-2012



LEGEND

- RAIL TRACK
- MAJOR DRAINAGE AREA
- DRAINAGE SUB AREA
- NODE LOCATION
- FLOW PATH
- UD — UNDER DRAIN
- SD — STORM DRAIN
- CONTOURS
- 2300 / 1.6 AC — BASIN NAME / BASIN ACREAGE

ASSUMPTIONS

1. THE GENERAL SITE IS DRAINING SOUTHEAST, BASED OFF USGS AND AVAILABLE TOPO.
2. FOR PROPERTIES WHERE SURVEY OR TOPO IS NOT AVAILABLE, IT IS ASSUMED THE SITE DRAINS TOWARDS THE SOUTHEAST.
3. FOR PROPERTIES NEAR PUBLIC R/W AND NO AVAILABLE TOPO OR SURVEY, IT IS ASSUMED THE PROPERTY DRAINS TOWARDS THE NEAREST PUBLIC ROAD.
4. ALL Q VALUES SHOWN ARE FOR THE 100 YEAR EVENT, UNLESS OTHERWISE NOTED.

N

300 0 300 600

SCALE: 1"=300'

ACRONYMS AND ABBREVIATIONS

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- X.X AC - SUBAREA ACREAGE

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REDLANDS PASSENGER RAIL PROJECT
EXISTING HYDROLOGY MAP
SHEET 3 OF 14

SCALE: 1"=300'
DATE: 07-09-2012

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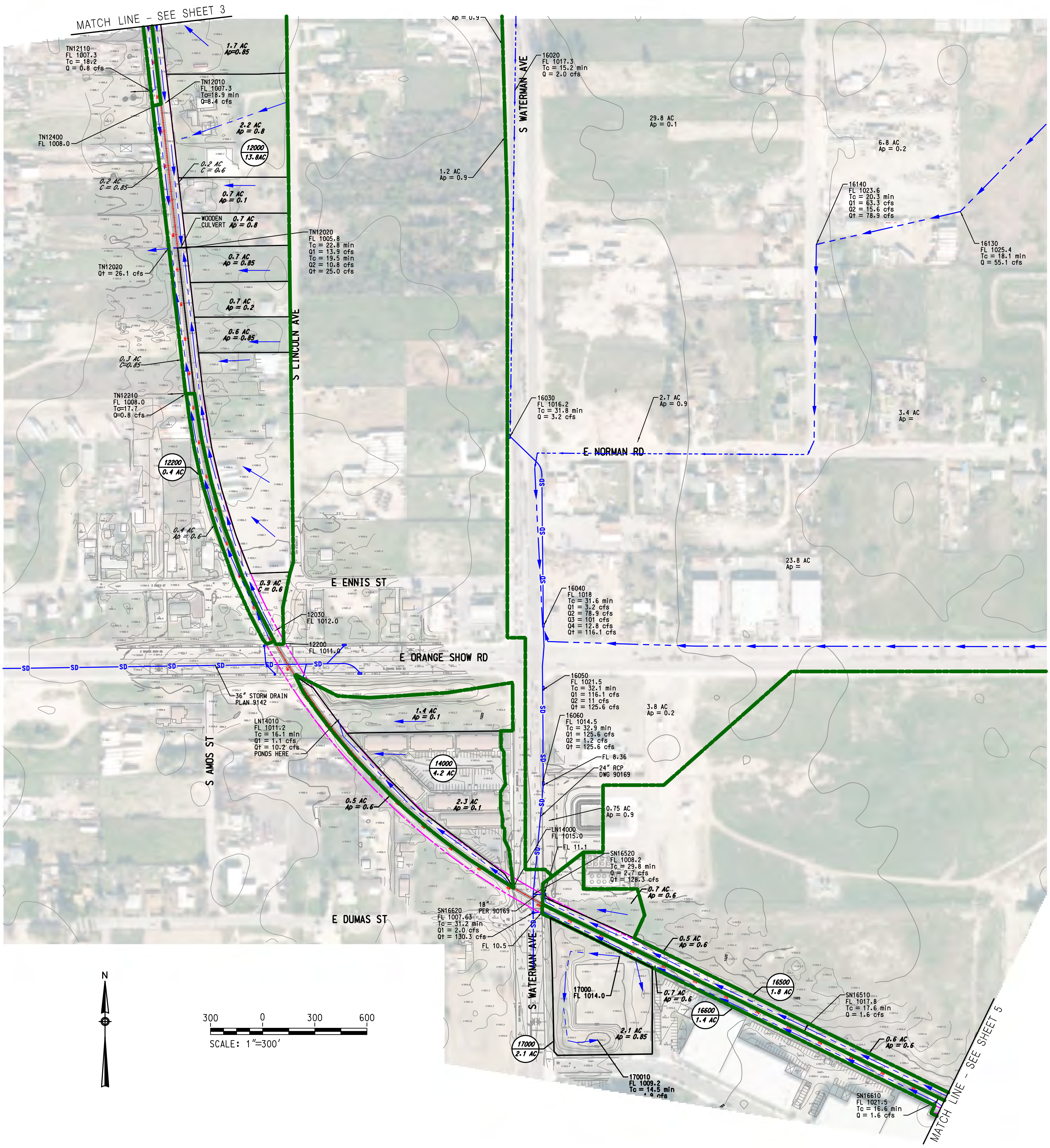

LEGEND

- RAIL TRACK
- MAJOR DRAINAGE AREA
- DRAINAGE SUB AREA
- NODE LOCATION
- FLOW PATH
- UD — UNDER DRAIN
- SD — STORM DRAIN
- CONTOURS
- 2300 / 1.6 AC — BASIN NAME / BASIN ACREAGE

ASSUMPTIONS

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3. FOR PROPERTIES NEAR PUBLIC R/W AND NO AVAILABLE TOPO OR SURVEY, IT IS ASSUMED THE PROPERTY DRAINS TOWARDS THE NEAREST PUBLIC ROAD.
4. ALL Q VALUES SHOWN ARE FOR THE 100 YEAR EVENT, UNLESS OTHERWISE NOTED.

ACRONYMS AND ABBREVIATIONS

Ap - PERVIOUS AREA	DWG - DRAWING AREA	RCP - REINFORCED CONCRETE PIPE
CB - CATCHBASIN	FL - ELEVATION AT SURFACE	SQ - TOTAL FLOW RATE IN CFS
CFS - CUBIC FEET PER SECOND	INV - PIPE FLOWLINE ELEVATION	Tc - TIME OF CONCENTRATION
CMP - CORRUGATED METAL PIPE	MIN - MINUTES	X.X AC - SUBAREA ACREAGE
DI - DRAIN INLET	Q - SUBAREA FLOW RATE IN CFS	

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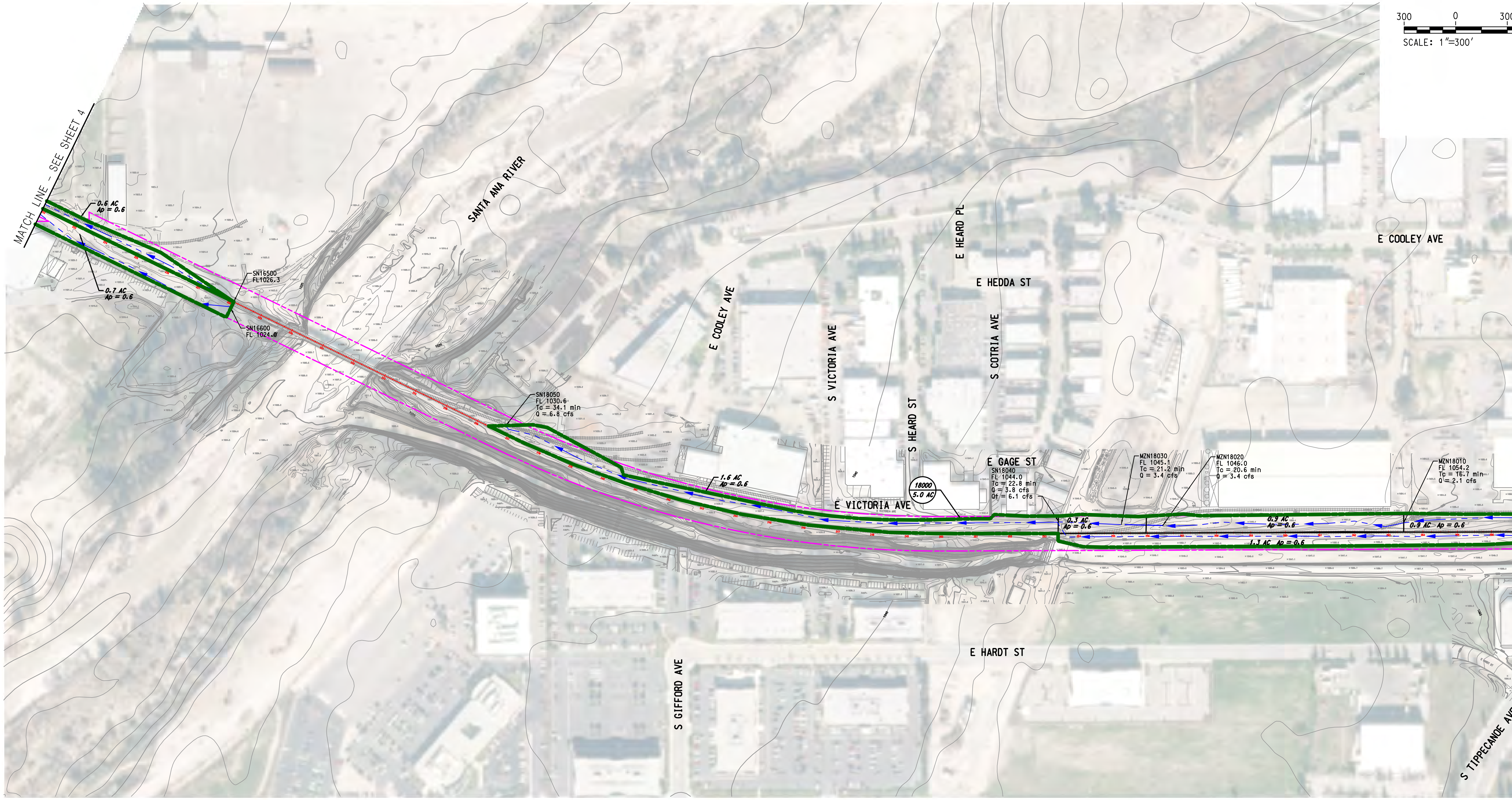
SAN BERNARDINO ASSOCIATED GOVERNMENTS
REDLANDS PASSENGER RAIL PROJECT
EXISTING HYDROLOGY MAP
SHEET 4 OF 14

SCALE: 1"=300'
DATE: 07-09-2012



LEGEND

- RAIL TRACK
- MAJOR DRAINAGE AREA
- DRAINAGE SUB AREA
- NODE LOCATION
- FLOW PATH
- UD — UNDER DRAIN
- SD — STORM DRAIN
- CONTOURS
- 2300 / 1.6 AC — BASIN NAME / BASIN ACREAGE

ASSUMPTIONS

1. THE GENERAL SITE IS DRAINING SOUTHEAST, BASED OFF USGS AND AVAILABLE TOPO.
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3. FOR PROPERTIES NEAR PUBLIC R/W AND NO AVAILABLE TOPO OR SURVEY, IT IS ASSUMED THE PROPERTY DRAINS TOWARDS THE NEAREST PUBLIC ROAD.
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- SQ - TOTAL FLOW RATE IN CFS
- Tc - TIME OF CONCENTRATION
- X.X AC - SUBAREA ACREAGE

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SAN BERNARDINO ASSOCIATED GOVERNMENTS
REDLANDS PASSENGER RAIL PROJECT
EXISTING HYDROLOGY MAP
SHEET 5 OF 14

SCALE: 1"=300'
DATE: 07-09-2012

LEGEND

- RAIL TRACK
- MAJOR DRAINAGE AREA
- DRAINAGE SUB AREA
- NODE LOCATION
- FLOW PATH
- UD — UNDER DRAIN
- SD — STORM DRAIN
- CONTOURS
- 2300 / 1.6 AC — BASIN NAME / BASIN ACREAGE

ASSUMPTIONS

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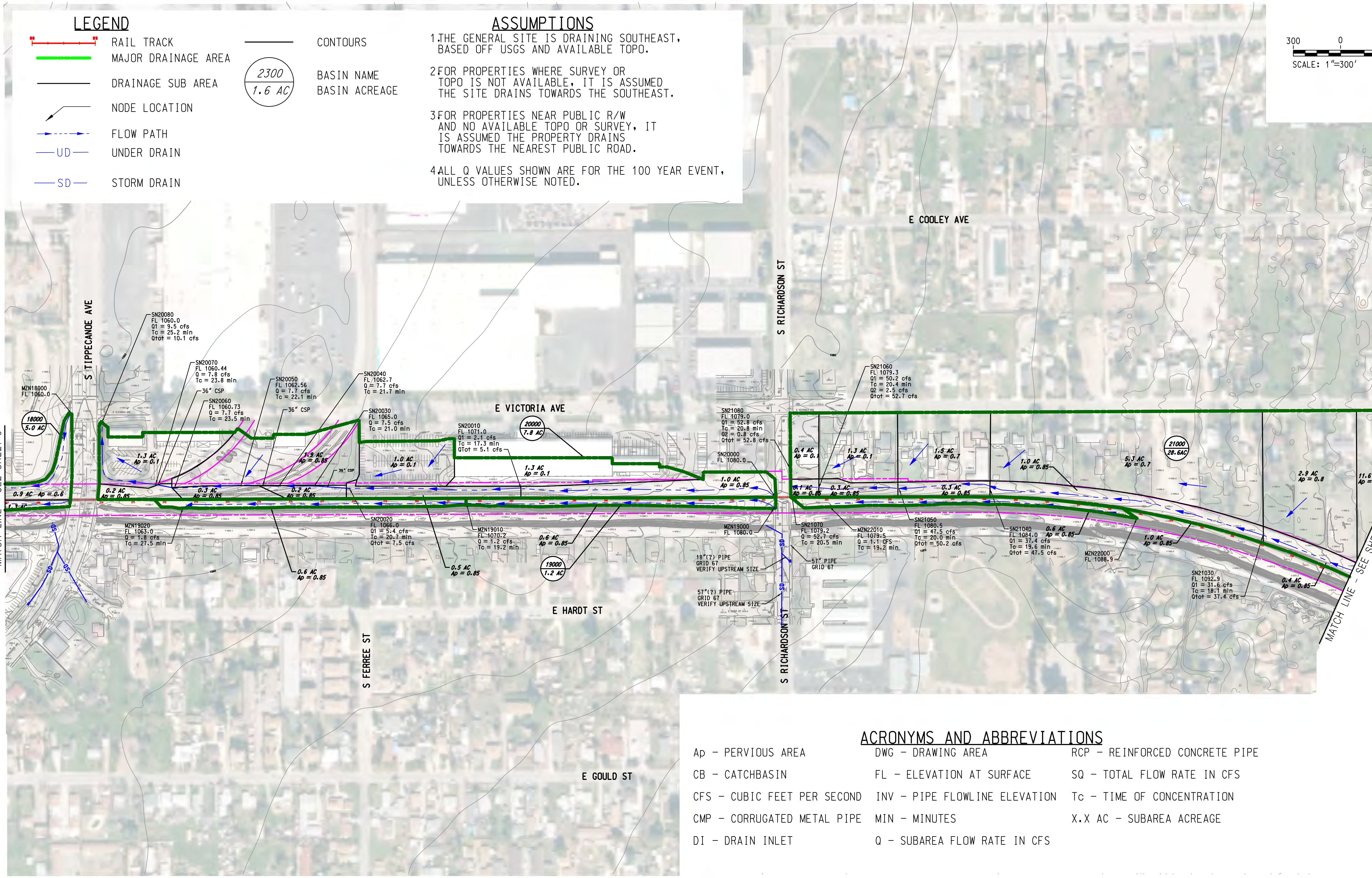

ACRONYMS AND ABBREVIATIONS

Ap - PERVIOUS AREA	DWG - DRAWING AREA	RCP - REINFORCED CONCRETE PIPE
CB - CATCHBASIN	FL - ELEVATION AT SURFACE	SQ - TOTAL FLOW RATE IN CFS
CFS - CUBIC FEET PER SECOND	INV - PIPE FLOWLINE ELEVATION	Tc - TIME OF CONCENTRATION
CMP - CORRUGATED METAL PIPE	MIN - MINUTES	X.X AC - SUBAREA ACREAGE
DI - DRAIN INLET	Q - SUBAREA FLOW RATE IN CFS	

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REDLANDS PASSENGER RAIL PROJECT
EXISTING HYDROLOGY MAP
SHEET 6 OF 14

SCALE: 1"=300'
DATE: 07-09-2012

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X.X AC - SUBAREA ACREAGE

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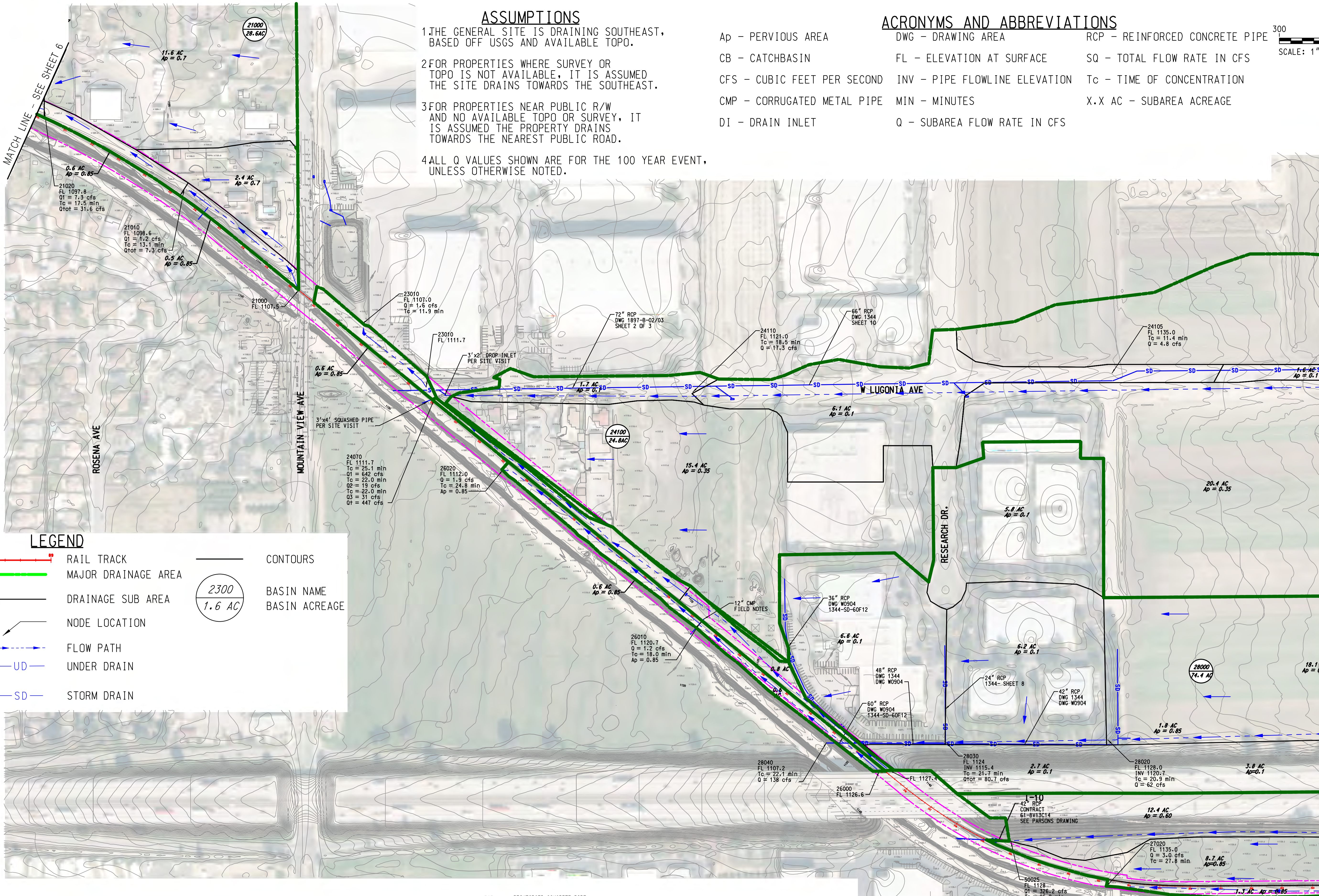
SCALE: 1"=300'



LEGEND

RAIL TRACK
MAJOR DRAINAGE AREA
DRAINAGE SUB AREA
NODE LOCATION
FLOW PATH
UD UNDER DRAIN
SD STORM DRAIN
CONTOURS
2300 / 1.6 AC — BASIN NAME / BASIN ACREAGE

CONTOURS

RCP - REINFORCED CONCRETE PIPE
SQ - TOTAL FLOW RATE IN CFS
Tc - TIME OF CONCENTRATION
X.X AC - SUBAREA ACREAGE

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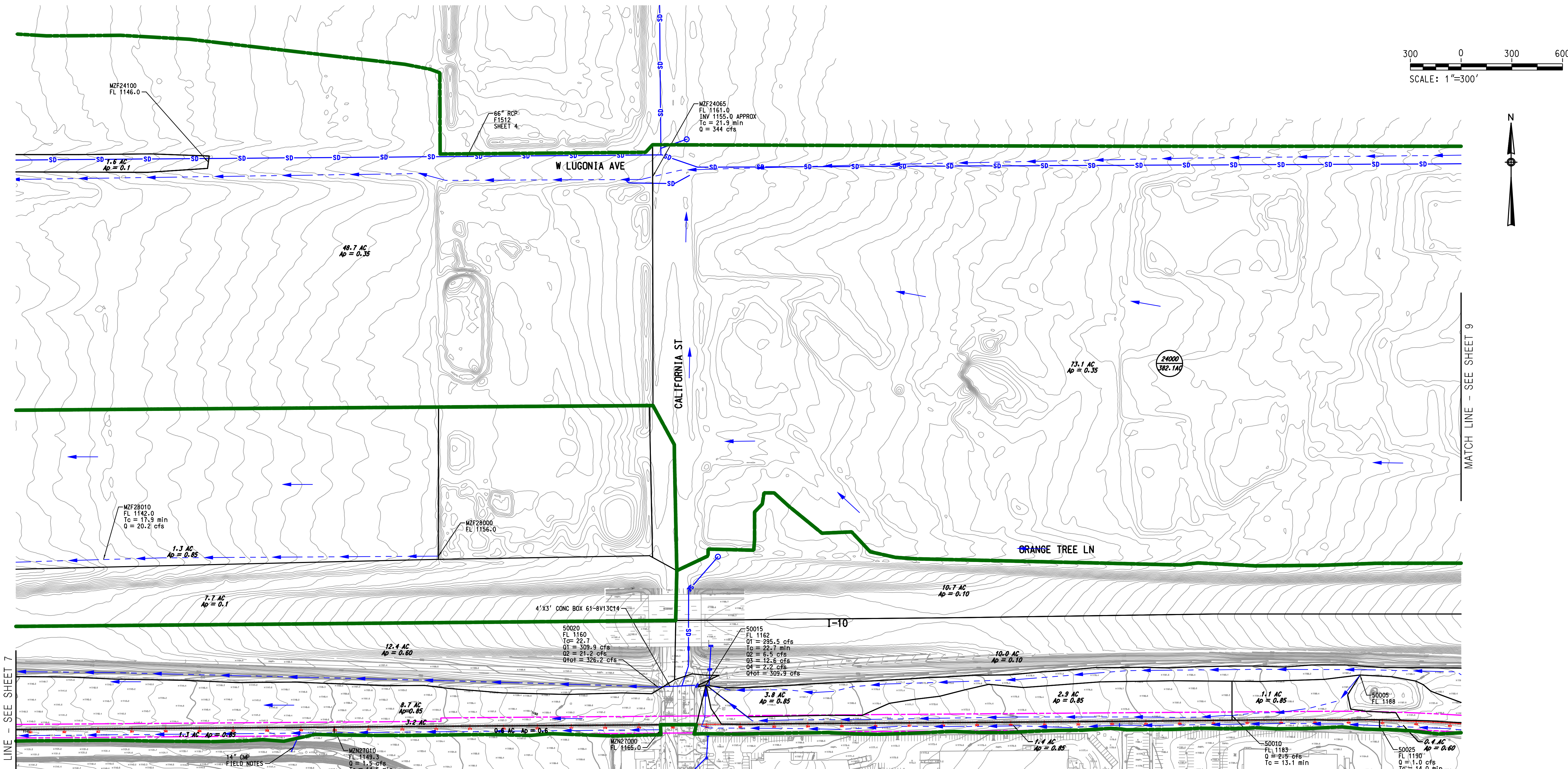
REDLANDS PASSENGER RAIL PROJECT
EXISTING HYDROLOGY MAP
SHEET 7 OF 14

SCALE: 1"=300'
DATE: 07-09-2012



LEGEND

	RAIL TRACK		CONTOURS
	MAJOR DRAINAGE AREA	2300 / 1.6 AC	BASIN NAME / BASIN ACREAGE
	DRAINAGE SUB AREA		
	NODE LOCATION		
	FLOW PATH		
UD	UNDER DRAIN		
SD	STORM DRAIN		

CALIFORNIA ST

24" RCP
F 1395-2

30" RCP
F 1395-2

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REDLANDS PASSENGER RAIL PROJECT
EXISTING HYDROLOGY MAP
SHEET 8 OF 14

SCALE: 1"=300'

DATE: 07-09-2012

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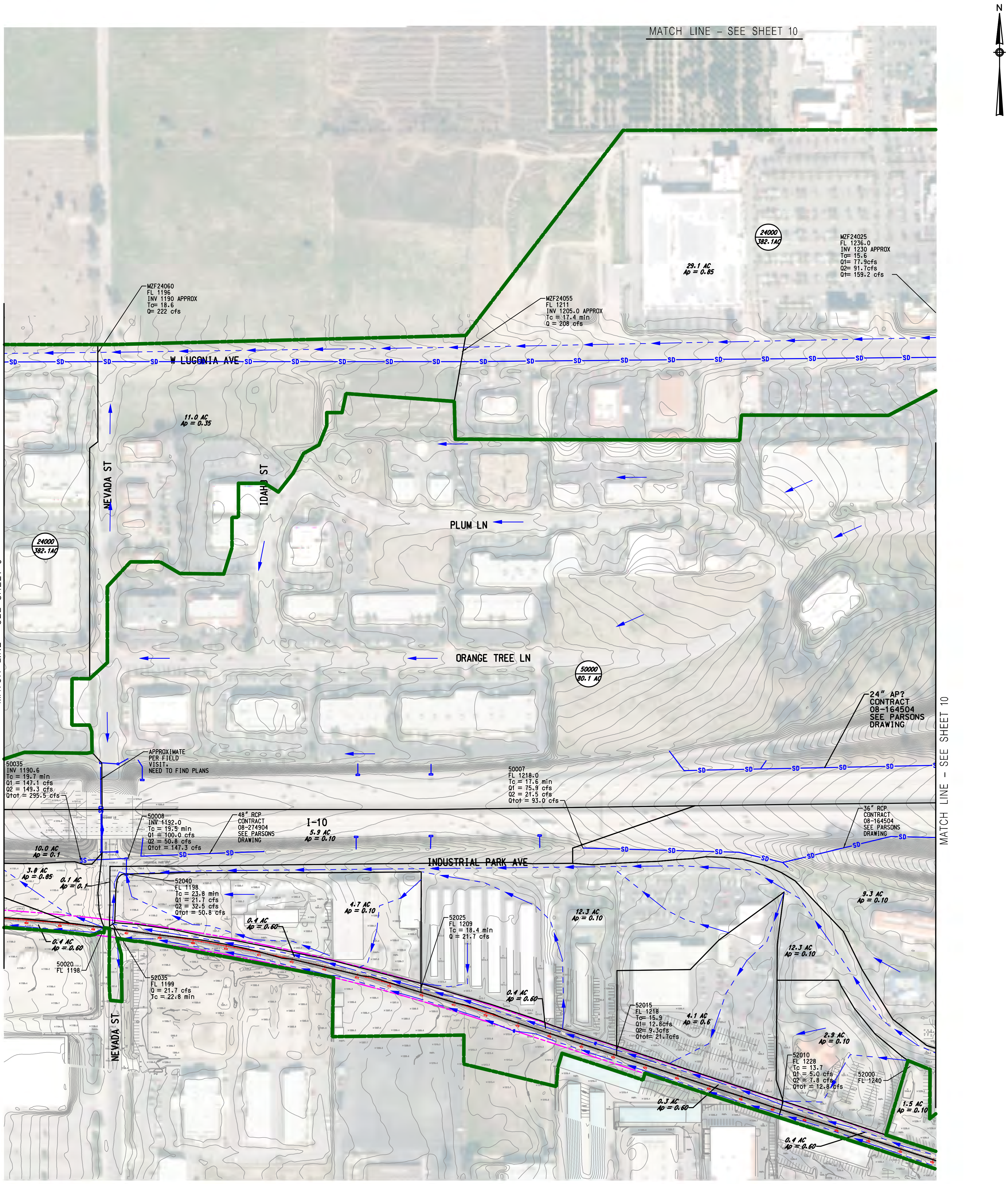

LEGEND

RAIL TRACK	
MAJOR DRAINAGE AREA	
DRAINAGE SUB AREA	
NODE LOCATION	
FLOW PATH	
—UD—	UNDER DRAIN
—SD—	STORM DRAIN
CONTOURS	
2300 / 1.6 AC	BASIN NAME / BASIN ACREAGE

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300 0 300 600
SCALE: 1"=300'

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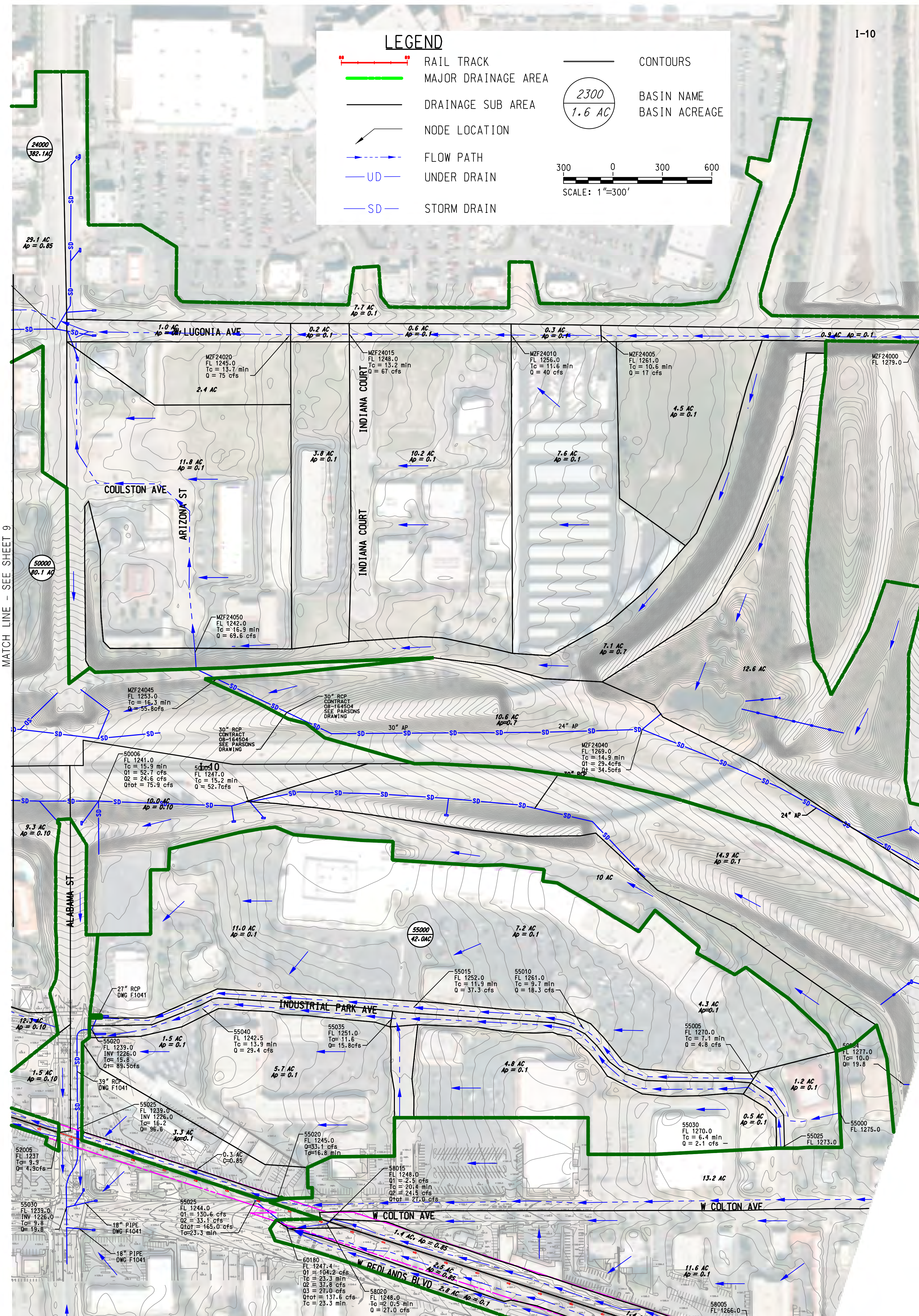
REDLANDS PASSENGER RAIL PROJECT
EXISTING HYDROLOGY MAP
SHEET 9 OF 14

SCALE: 1"=300'
DATE: 07-09-2012



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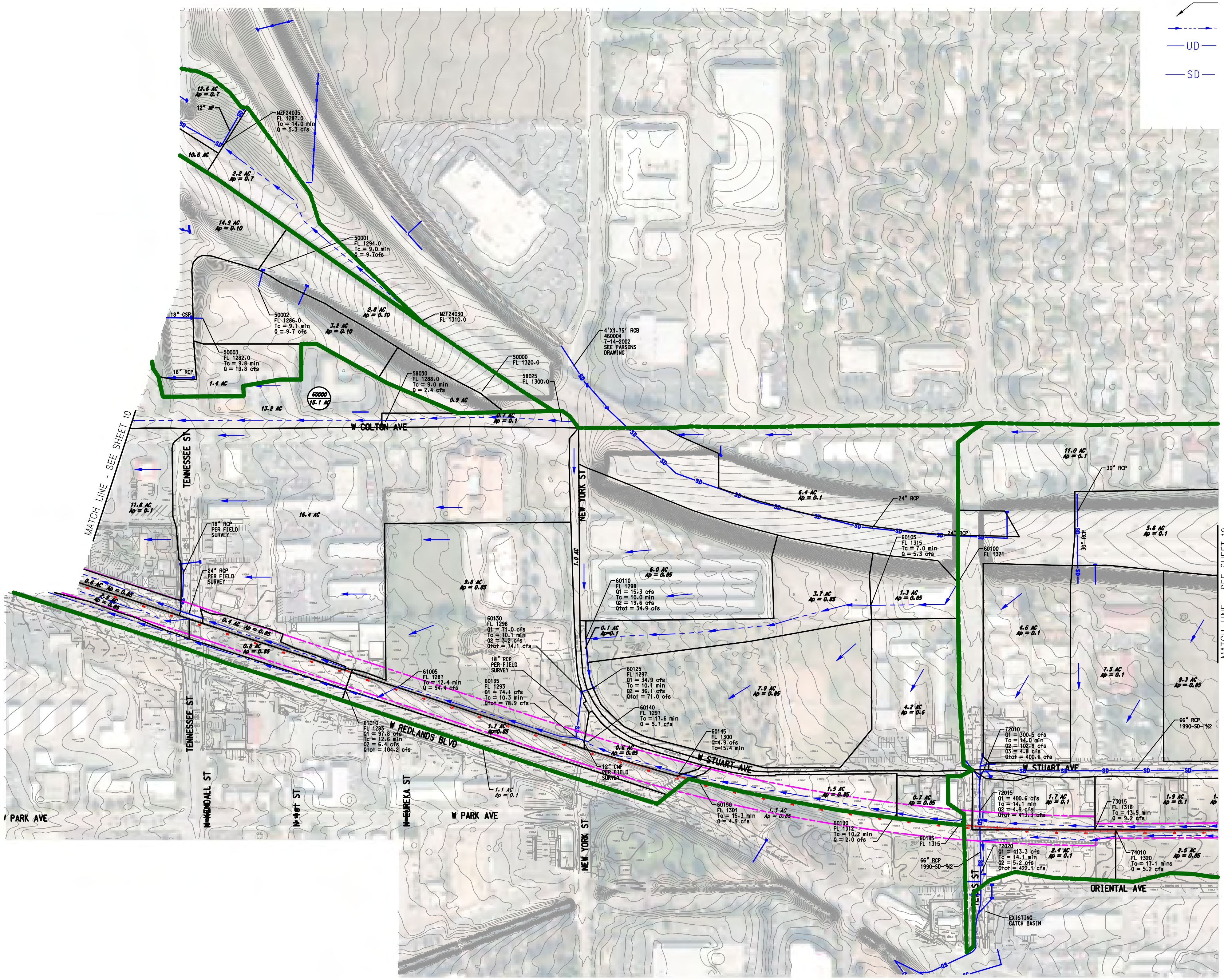
REDLANDS PASSENGER RAIL PROJECT
EXISTING HYDROLOGY MAP
SHEET 10 OF 14

SCALE: 1"=300'
DATE: 07-09-2012



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LEGEND

- RAIL TRACK
- MAJOR DRAINAGE AREA
- DRAINAGE SUB AREA
- NODE LOCATION
- FLOW PATH
- UD — UNDER DRAIN
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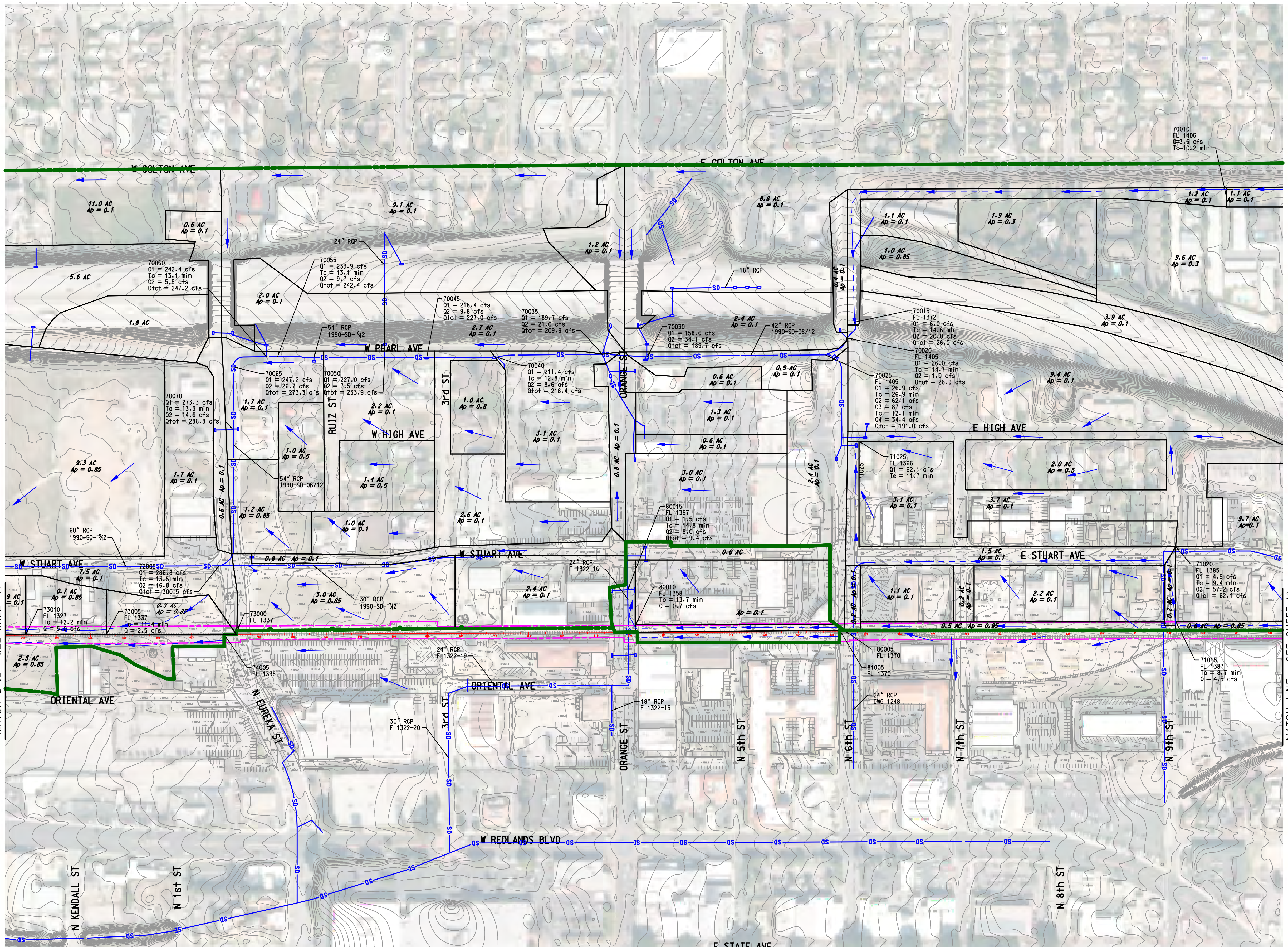
REDLANDS PASSENGER RAIL PROJECT
EXISTING HYDROLOGY MAP
SHEET 11 OF 14

SCALE: 1"=400'
DATE: 07-09-2012



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300 0 300 600

SCALE: 1"=300'

LEGEND

- RAIL TRACK
- MAJOR DRAINAGE AREA
- DRAINAGE SUB AREA
- NODE LOCATION
- FLOW PATH
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REDLANDS PASSENGER RAIL PROJECT
EXISTING HYDROLOGY MAP
SHEET 12 OF 14

SCALE: 1"=300'
DATE: 07-09-2012

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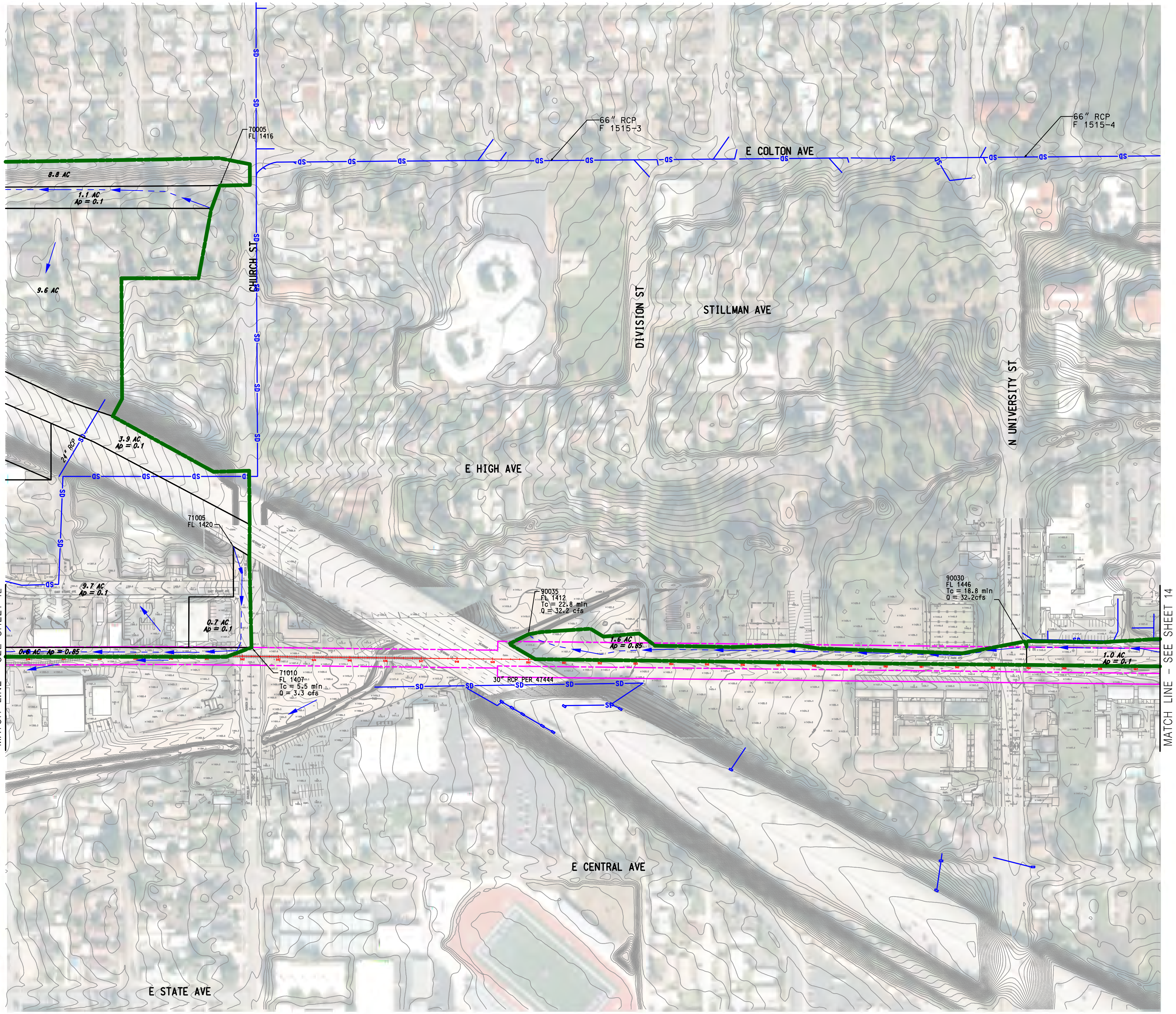

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SCALE: 1"=300'

LEGEND

RAIL TRACK
MAJOR DRAINAGE AREA
DRAINAGE SUB AREA
NODE LOCATION
FLOW PATH
UD — UNDER DRAIN
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REDLANDS PASSENGER RAIL PROJECT
EXISTING HYDROLOGY MAP
SHEET 13 OF 14

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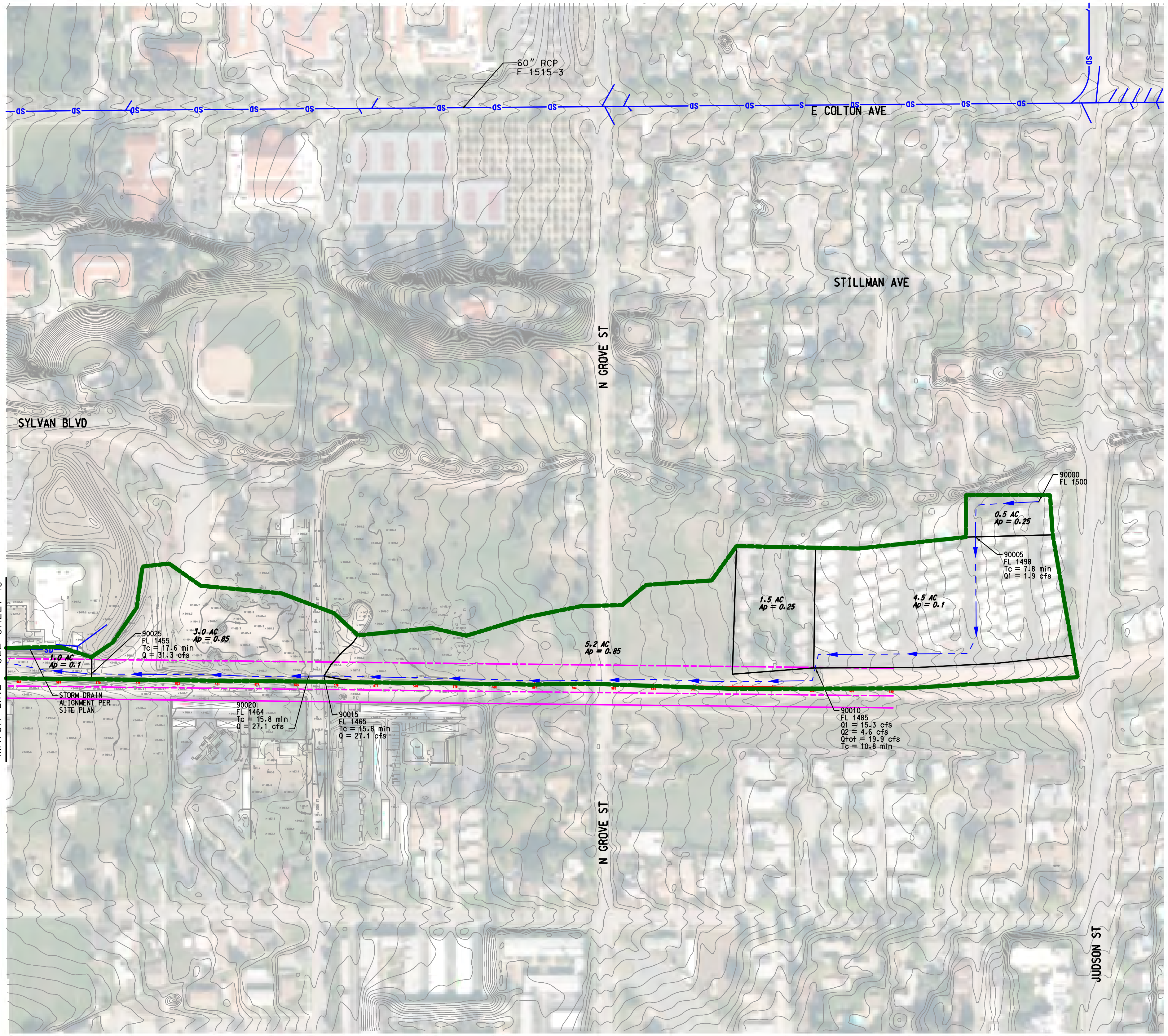

N

300 0 300 600

SCALE: 1"=300'

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REDLANDS PASSENGER RAIL PROJECT
EXISTING HYDROLOGY MAP
SHEET 14 OF 14

SCALE: 1"=300'
DATE: 07-09-2012

Appendix C

Historical Flood Photos

Aug 11, 1965 Intersection, Orange & State

Aug 11, 1965 State St. btwn 6th and 7th
View: east

Aug 11, 1965 Orange & State

Aug 11, 1965 State & Orange

State St. between 6th & 7th

View: east

Aug. 11, 1965

c
57.7
14471

Aug. 11, 1965

Intersection - orange & state

c
57.7
14275

Aug. 11, 1965

State & orange

c
57.7
14276

Aug. 11, 1965

orange & state

c
57.7
14274

FRIDAY SEPT. 24 1976

AT BRIDGE

LOOKING N.E. INTO GLORY HOLE ON N.Y. ST.

FRIDAY SEPT 24 1976

LOOKING NORTH ON TEXAS & REDLANDS

FRIDAY SEPT 24 1976

AT TEXAS

LOOKING EAST ON REDLANDS BLVD

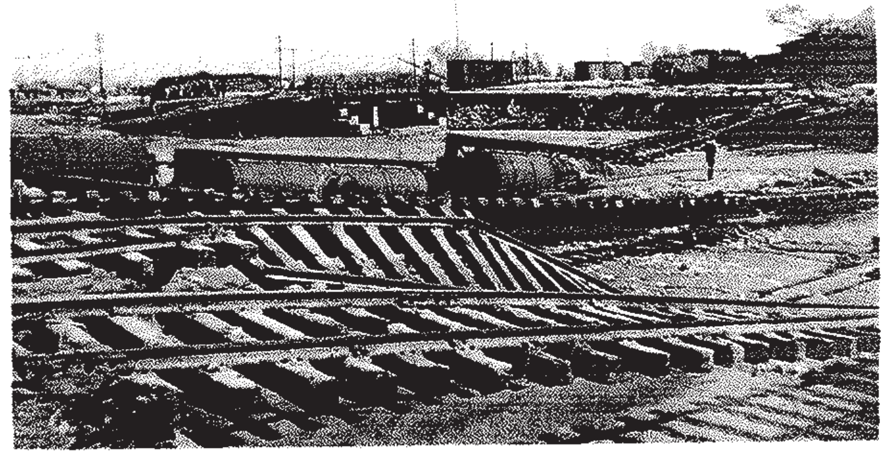
FRIDAY SEPT 24 1976

FROM NEW YORK ST.

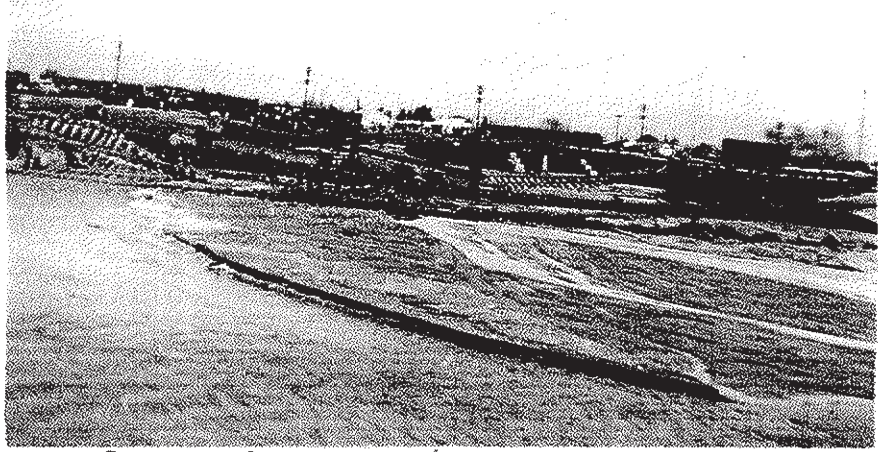
LOOKING IN TO ENTRANCE OF GLORY HOLE

FRIDAY SEPT 24 1976

LOOKING WEST CITRUS & EUREKA



1938 Flood Santa Ana River



1938 Flood Santa Ana River

Santa Ana River
1938 Flood

C
57.4
12604

Friday, September 24
1976

C
57.4
12207b

Santa Ana River
1938 Flood

C
57.4
12605

Page 2

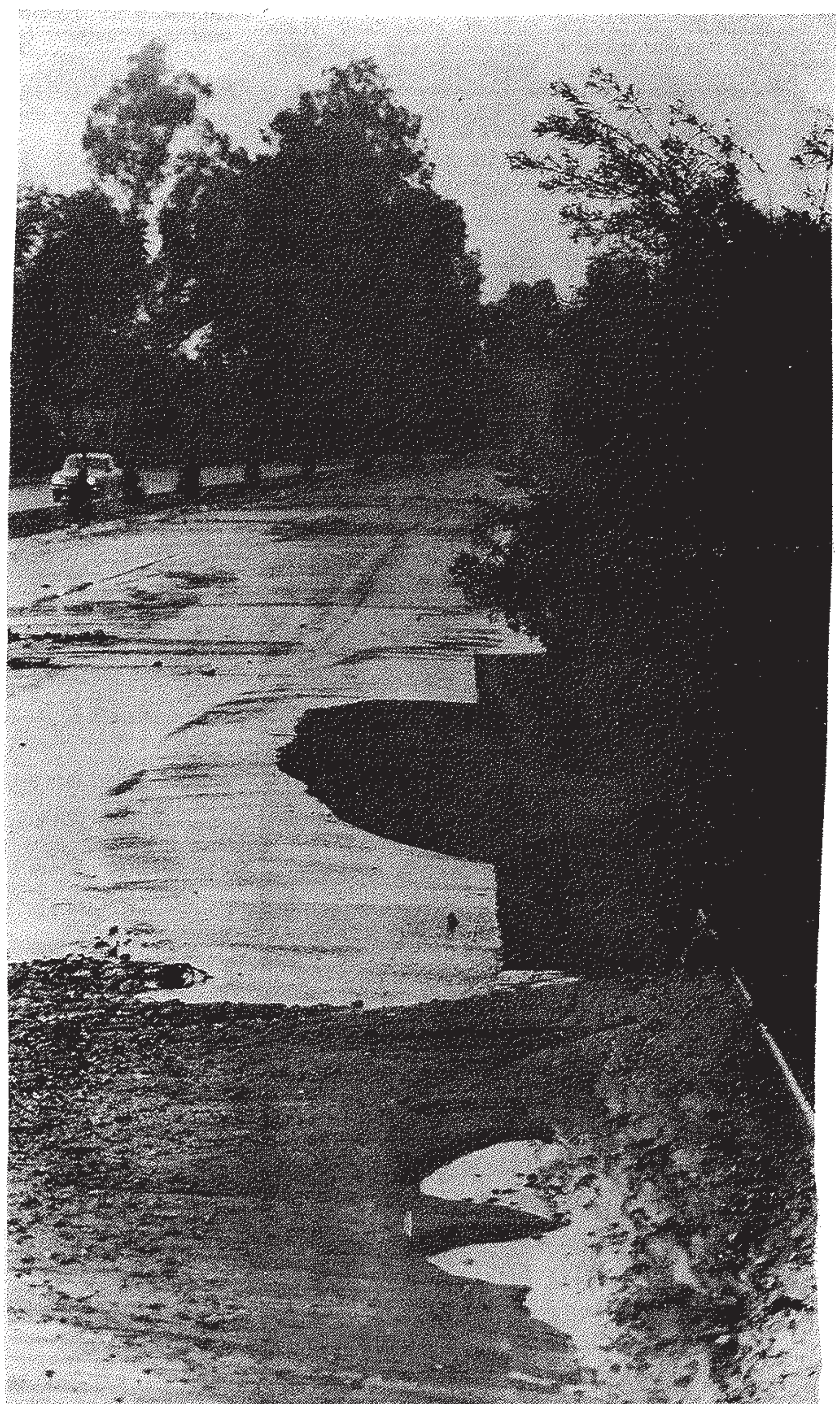
WATER TALK—A number of residents of Sylvan Mobile Estates cluster together and talk—as everyone did yesterday afternoon—about the deluge. The grounds took some flooding from the railroad right-of-way at Judson but due to good drainage there was no major tr Wall is on property line by the railroad.

(Art Miller

JENNIE DAVIS LAKE—A trash barrel (center left) floats atop a swift river of water as it swirls through Jennie Davis park. Water and debris swept through the park during yesterday's flash flood, flattening grass, ripping off pieces of shrubs, and leaving an oozing layer of muck on picnic tables and park benches. Much of the park was submerged beneath several inches of water yesterday.

(Photo by Dick Wiley)

over



BOULEVARD COLLAPSED—Severe flooding undermined and collapsed this portion of Redlands boulevard in the eastbound lanes between New York and Tennessee streets. Motorists who were able to travel the road after nearly two feet of water drained off found they had to dodge rocks and other debris, as well as thick, slick deposits of mud. (Photo by Dick Wiley)

Page 4

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River on State street

Flash flood damages business district

By FRANK MOORE

A flash flood turned Redlands boulevard and State street into rivers yesterday afternoon.

Occupants of buildings along the way blocked the spaces under front doors as best they could, but some had the most trouble at their alley entrances.

Here is a partial inventory of places and damage:

Water against front doors of Harris' was effectively blocked. Water in alley invaded the warehouse stockroom, soaking bottom boxes of merchandise. This water also got into shoe basement, damaging bottom rows of stock. Alley damage was heightened when a 3 by 4 steel grating clogged and drainage was blocked.

Harris Bookstore had water on Fifth 18 inches deep against the front. Water on the floor was about eight to 10 inches, damaging lowest stock which could not be removed quickly enough.

Manager Steve Mathews said that when Harris' closed about 5 o'clock (instead of 9 p.m.) many employes could not get across the Redlands boulevard river to where their cars were parked.

At Bank of America, water rose about six inches against closed, east doors, but penetrated into about one third of the lobby.

Charlene Cooke and Pat Johnston said that three girls grabbed money bags—"empty bags", they emphasized with a laugh—and used them as a barrier. Doug Dixon, formerly of this branch, happened by and joined the sweep and mopping brigade. Fortunately there is a janitor's room, which has a floor drain, into which water could be coaxed. Manager Dean Cullop's office was partially wetted by water coming under the State street window.

Adding insult to injury, the roof leaked.

United California Bank, like the Bank of America, is new. Water came at it in flood on Redlands boulevard leaving mud marks about 30 inches high along the font glass on Orange street. Water passed over the carpet in a wide swath, going about 30 feet to the stand-up patrons counter in the center of the lobby space.

Adjoining the bank on the Redlands boulevard side is a large, new, unoccupied store or office space and it was well wetted inside.

Bob Hatfield said water flowing down Redlands boulevard was not invading the Buick agency at Eighth street. However, the Zanja comes down to the edge of his used car lot in a stone ditch, about 15 feet wide and six feet deep and goes underground, the cover being about four feet high.

Hatfield said that logs and debris floating on the tide partially jammed the entrance to the tunnel. The water then came over the used car lot, flooded the new-car show room and deposited about three inches of mud over two-thirds of the garage floor.

Hatfield said it was almost an exact replay of the flood of August 11, 1965 which was largely caused by the then-new drainage ditch along Redlands boulevard from Ford street to Fern simply pouring out onto the boulevard.

As a result of the 1965 flood a 30-inch pipe was installed in the bottom of the ditch about 100 yards above Fern avenue, carrying the water over to a ditch that runs between MacDonald's and the YMCA.

While the pipe took much of the water, the overflow again went down Redlands boulevard. But it also broke over onto Church street at the point where it makes an S turn to Redlands boulevard at the high school. This caused flooding on Clark between Redlands and Church.

The Reservoir Canyon Storm drain was a major contributor to flooding on Redlands boulevard, State and Citrus according to Horace P. Hinckley, chairman of the local county flood control district.

Directors have not been unmindful of the problem but have not been able to finance the necessary improvement for lack of sufficient funds, he said today. The major allocation in recent years has been for acquisition of rights-of-way to deepen and widen the Zanja, east of town.

As a result of the August 1965 flood, he explained, a 30 inch pipe was installed in the ditch by Redlands boulevard just above Fern. But this was inadequate Friday and a culvert with direct flow to the Zanja is needed. The current budget includes $20,000 for engineering this connection.

In the 1965 storm the Gold Banner Packing House on Redlands boulevard at Eighth—just west of Hatfield Buick—was badly flooded, with deep water in the basement. The common wisdom around town late yesterday was that the building would surely have suffered the same fate—but it didn't.

Now called The Packing House, it is the home of various small shops, selling specialties and old things. John Cortinger, one of the owners, said that the basement windows—two panes above ground level—held. If they had popped, water would have poured in. Many people worked like the little Dutch Boy putting his finger in the dike to keep the water out, he said.

The Robert Conreras family lives at 409 Central and faces the open Zanja, just at the portal to the tunnel. They thought they would be flooded indoors but they protected their home. Their water pipe across the ditch, however, was washed out.

Many places of business were inundated but the damage was quite variable. Many establishments have composition tile floors with no valuable merchandise resting on it. Hence the water was merely a nuisance, to be kept out as much as possible, and if not, then there was much sweeping and mopping.

But where there were vulnerable stocks to be water-damaged, the trouble was grievous. For example, Arthur Commercial Press on Fifth street between State and Redlands boulevard. Here the water came from three directions—State, the alley and Redlands boulevard.

Harvey Sawyer, the proprietor, said that much of his paper, at the back of his shop, was wetted. Where cartons of stock were standing on the floor, the bottom one in each pile was wetted. He said he was particularly hurt by the ruination of printing work that had been finished and was ready for delivery.

Places that could be swept out and mopped were soon back in business, such as Taco Blanco at Redlands and Seventh.

The Tartan Restaurant at Fifth and Redlands was very flood vunerable and took some water at the front door on Fifth [illegible]

RAINFALL TABLE

	Storm	Season	Last Year
Redlands	.66	3.83	tr
Yucaipa	.90	4.98	.32
Calimesa	.92	5.72	.11
Mill Creek	.56	5.58	tr
Camp Angelus	.15	12.26	2.09

bar was flooded it was back in operation by early evening. Dinners, however, were not served.

Because Bank of America and United California were inundated there was confused, but erroneous talk of damage at other banks. The brand new Bank of Redlands at Citrus and Sixth was not harmed nor was the long established Security Bank on State at Seventh.

State, the main shopping street of the town, carried a flood which threatened every place of business along it. However, the results were variable. At Pacific Finance the water only reached the first desk whereas at Postal Finance, just a few doors up, the water went through on the composition tile floor.

Nearly everyone struggled to keep the water from coming under and around closed store or office doors. At Lois Lauer's new real estate office the water covered the front portion of the rug. At [illegible] was only a small wetting. But the store did catch some water from the alley, Ed Grace said.

Nelson-Hales Furniture, like many State street neighbors, was not inundated at the front door. But the flow against the show windows at the Sixth street corner leaked around the glass, wetting the carpet and causing the owners to remove the show furniture.

At Gairs a beautiful, block wooden floor has been recently installed. Fortunately, it was not damaged. However, some water did come in the back door. Also on this alley the water went into the back of Wattenbarger's Office Supply.

McEwens Furniture Galleries on West Redlands boulevard is one of the finest stores in town and fortunately stands high enough above the surrounding ground to have escaped flooding.

There was much flooding at Citrus and Redlands boulevard and the nearby YMCA, facing Citrus had troubles. Bret Cox said that there was a little water in the lobby, which did not damage the furniture, and some came in the back door. About five volunteers pushed the water with brooms and mops into the basement to a depth of about nine inches. The roof leaked. The gym floor was not harmed.

Water pouring down State street, upon reaching Orange, poured across the ground where the Mall now stands as exterior walls, roof, but hollow interior. Some water went into the broad east opening, but left about three-fourths of the floor area dry.

However the La Posada hotel has just been razed, exposing the basement. This filled with water creating a muddy lake about 40 feet wide and 90 feet long.

A large pond also formed in the vacant lot at State and Fifth, formerly the site of the Chandler building, and used during the summer of 1976 as an outdoor Crafton College Theater.

While various specific reports are included in this article, they are but samples of numerous cases that could be [illegible]

WET RESCUE—Redlands firemen pull an unidentified woman from the wreckage of her car after it was struck by a truck on the westbound lanes of Interstate 10 near University avenue yesterday afternoon. The woman was reportedly in a parked car on the side of the freeway when she was hit by a van that went out of control just moments after a truck-trailer rig flipped over in the center divider. No details of the accident were available this morning, but California Highway Patrol officers said traffic was tied up nearly three hours. (Facts photos by Kenison)

RAINY MISHAP—The driver of this tractor-trailer rig receives first aid for cuts and bruises (left), sheltered from yesterday's torrential downpour by the bed of the trailer. The driver, whose name was not available this morning, apparently lost control of the rig when he tried to slow down and flipped the rig on its side in the center divider on Interstate 10 near the University avenue off-ramp about 4:30 p.m. yesterday.

River on

Fla
bus

By FRANK

A flash flood turned R
and State street into
afternoon.
Occupants of buildin
blocked the spaces und
best they could, but so
trouble at their alley e
Here is a partial inven
damage:
Water against front do
effectively blocked. W
vaded the warehouse st
bottom boxes of mercha
also got into shoe bas
bottom rows of stock. A
heightened when a 3 b
clogged and drainage w

Harris Bookstore had
inches deep against the f
floor was about eigh
damaging lowest stock
removed quickly enoug
Manager Steve Mathe
Harris' closed about 5 o'
p.m.) many employes c
the Redlands boulevar
their cars were parked.
At Bank of America,
six inches against close
penetrated into about
lobby.

Charlene Cooke and F
that three girls grabbe
"empty bags", they en
laugh—and used them a
Dixon, formerly of this
by and joined the swe
brigade. Fortunately th
room, which has a floor
water could be coaxed
Cullop's office was pa
water coming under
window.
Adding insult to injury

United California Bank
America, is new. Water
on Redlands boulevar
marks about 30 inches h
glass on Orange street. V
the carpet in a wide swa
feet to the stand-up patr
center of the lobby spac
Adjoining the bank
boulevard side is a large
store or office space and
inside.

Bob Hatfield said wa
Redlands boulevard was
Buick agency at Eighth
the Zanja comes down
used car lot in a stone d
wide and six feet de
derground, the cover bei
high.
Hatfield said that
floating on the tide part
entrance to the tunnel.
came over the used ca
new-car show room an
three inches of mud ove
garage floor.

Hatfield said it was
replay of the flood of Au
was largely caused
drainage ditch along R
from Ford street to Fe
out onto the boulevard.
As a result of the 19
pipe was installed in t
ditch about 100 yards a
carrying the water ove

[Sept. 1976]

ZANJA OVERFLOWS—The ancient Zanja was filled to overflowing during the flash flood during the sudden storm last Friday. At University street and Sylvan boulevard the water floods across the street into Sylvan park where it caused heavy damage, filled the municipal swimming pool with mud and debris. Water ran over the stone footbridges in Sylvan park.

(Photo by U.R. student Gary Trippeer)

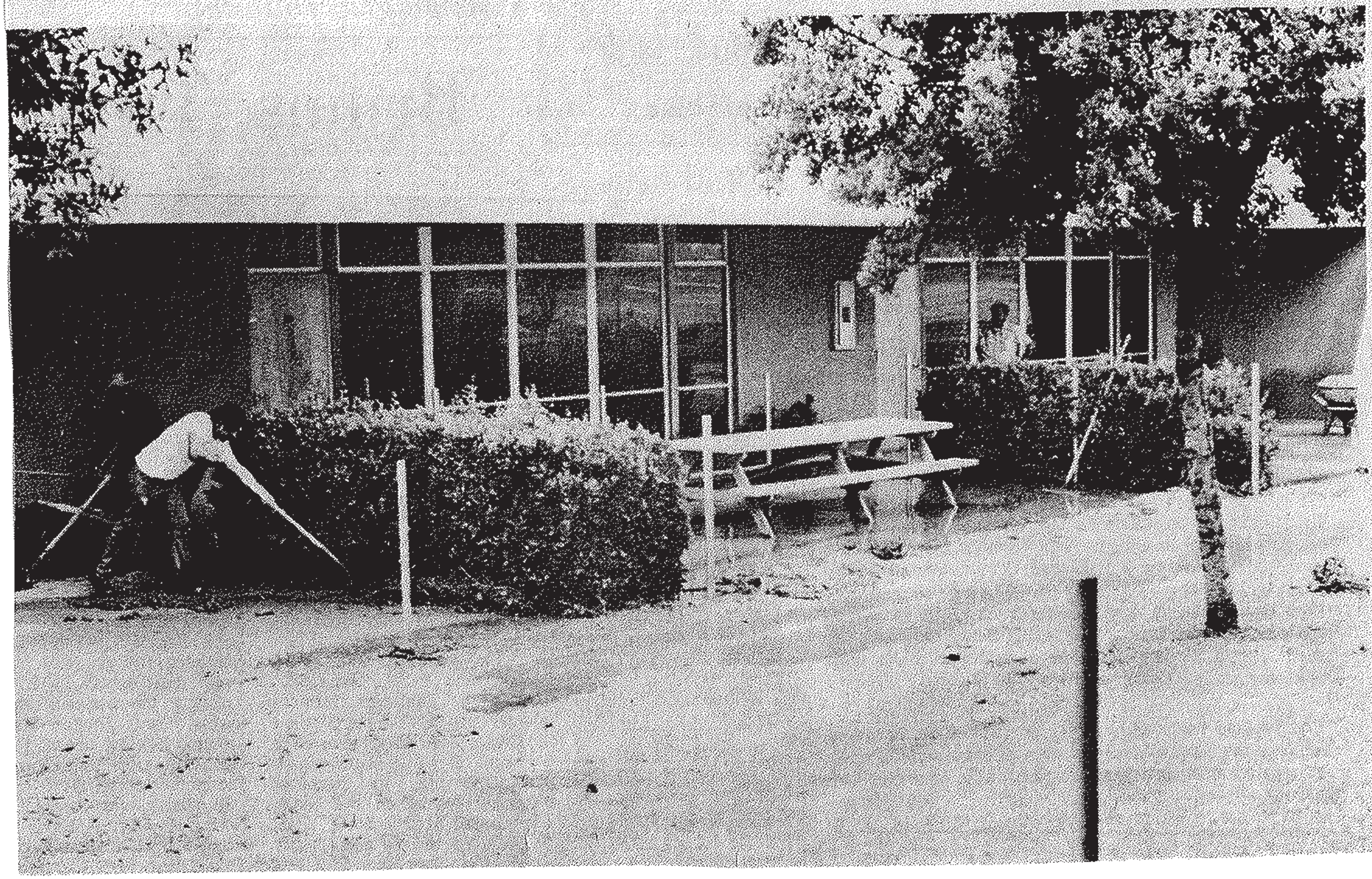
Monday, Sept. 27, 1976

Daily Facts, Redlands, [illegible], Sept [illegible], 1976

IN THE PARK—As a brook, Zanja flows under the stone-ornamented bridge (foreground) in Sylvan park. Approaching the park, however, much of the water (see other photo) could not find the Zanja and as shown here is flowing over the lawn between the bridge and the bowling greens and continuing to the right to fill Sylvan Plunge with water and mud.
(Photo by Gary Trippeer.)

Sept 29, 1976

ZANJA OVERFLOW—Taken by Gary Trippeer, UR student, during flash flood Friday this photo looks up Sylvan boulevard, above University street, bordering the campus. Zanja ditch is concealed by trees at left. This shows the large volume of water that the ditch would not accommodate. Reaching University street it spread out flowing into Sylvan park as a broad sheet.



CRAFTON SCHOOL DAMAGED—Costly cleanup and repairs were started at Crafton elementary school, which was exposed Friday to the full fury of the Mill Creek Zanja's flood waters. Bringing oil and overturned orchard heaters and other debris from upstream groves that the torrent invaded, the water swept through these classrooms, which school employes were trying to dry out Saturday. The school is on Wabash avenue, the eastern city limit line, and the Zanja is a close neighbor to the south, extending from east to west.
(Facts photo by Bettye Wells)

August 1965
Flash Flood
Downtown Redlands
Photo # 1

August 1965
Flash Flood
Downtown Redlands
Photo # 2

September 1976
Mission Zanja Creek
Flooding
Photo # 3

September 1976
Brookside St. & Eureka St
Photo # 4

September 1976
Flooding near
University St.
Photo # 5

September 1976
Redlands Furniture Store
Photo # 6

/CONTRIBUTED IMAGE

Redlands has been recommended to recieve a $5 million grant for a flood control project city officials hope will prevent a repeat of downtown flooding like this, which occurred at Citrus Avenue and Eureka Street in 1976.

Appendix D

Drainage-Related Project Photos

MP 2.25, 36-inch CMP (no. 1)

MP 2.25, 36-inch CMP (no. 2)

MP 2.4, 22-inch x 13-inch CMP

MP 2.6, 4-foot x 3-foot wood box buried (no. 1)

MP 2.6, 4-foot x 3-foot wood box buried (no. 2)

MP 2.6, 4-foot x 3-foot wood box buried (no. 3)

MP 3.9, culvert (no. 1)

MP 3.9, culvert (no. 2)

MP 3.9, culvert (no. 3)

MP 3.9, culvert (no. 4)

MP 4.2, 36-inch culvert (no. 1)

MP 4.2, 36-inch culvert (no. 2)

MP 4.2, culvert (no. 3)

MP 4.2, culvert (no. 4)

MP 4.2, culvert (no. 5)

MP 5.1, buried culvert (no. 1)

MP 5.1, buried culvert (no. 2)

MP 5.1, buried culvert (no. 3)

MP 5.2, 24-inch RCP (no. 1)

MP 5.2, 24-inch RCP (no. 2)

MP 5.2, 24-inch RCP (no. 3)

MP 5.2, 24-inch RCP (no. 4)

MP 5.2, 24-inch RCP (no. 5)

MP 5.7, culvert

MP 6.05, 14-inch CMP

MP 7.4, 24-inch x 18-inch box culverts (no. 1)

MP 7.4, 24-inch x 18-inch box culverts (no. 2)

MP 7.4, 24-inch x 18-inch box culverts (no. 3)

MP 7.4, 24-inch x 18-inch box culverts (no. 4)

MP 7.4, culvert (no. 5)

MP 7.4, culvert (no. 6)

MP 7.8, 24-inch, 18-inch culverts (no. 1)

MP 7.8, 24-inch culvert (no. 2)

MP 7.8, 24-inch culvert (no. 3)

MP 7.8, 6-inch culvert (no. 4)

MP 8.2, 12-inch CMP (no. 1)

MP 8.2, 12-inch CMP (no. 2)

Appendix E

Miscellaneous Exhibits from Referenced Document

REVIEW OF KEY DOCUMENTS

Many documents were reviewed for the tributary drainage systems, and policies and programs that may be impacted by the project. Of these documents, only the following key documents are summarized below. Applicable exhibits and figures from these documents are included in this Appendix.

City of Redlands Local Hazards Mitigation Plan

The Disaster Mitigation Act of 2000 requires that local governments, as a condition of receiving federal disaster mitigation funds, have a mitigation plan that describes the process for identifying hazards, risks and vulnerabilities, identify and prioritize mitigation actions, encourage the development of local mitigation and provide technical support for those efforts. This mitigation plan serves to meet those requirements, including as it relates to flood hazards and drainage risks.

The 2005 Plan identifies the SAR/Mill Creek and Zanja Creek as part of the City's flood history. Historic flood waters from these systems are responsible for extensive damage to the City. Since the watershed for the Mill Creek Zanja includes portions of City and County, a regional solution to flooding along the Creek has been a top priority for the City. Several attempts have been made to set assessments or development impact fees to fund improvements along the Mill Creek Zanja. Due to the extremely high cost of improvements, such efforts have failed. The USACE is currently involved in coordinating a full federal project to provide channel improvements and storm protection for the City of Redlands.

A number of local storm drain systems run through the City of Redlands. Several of these have experienced local flooding during recent storm events. Several drains are proposed in areas with the greatest potential for local flooding. Of these, the one that has the closest nexus to the project is "Lugonia Avenue from Alabama Street to the Mission Channel."

The Plan goes on to mention that approximately 25 percent of the community's critical facilities are vulnerable to flooding hazard; none of those facilities are located next to the Project. However, 75 percent of the City's non-critical facilities are vulnerable to this hazard and include the entire downtown commercial district, downtown industrial businesses, and the University of Redlands

Some of the related flood hazard mitigation projects are:

1. Flood Mitigation No. 3: Mission Storm Drain Bypass – approximately 7,500 feet in length in the reserved storm drain easement area parallel to and north of Redlands Boulevard through downtown Redlands to handle a minimum of a 100-year storm. Said storm drain system shall include all appurtenant structures to mitigate street and local flooding;
2. Flood Mitigation No. 9: Lugonia Avenue Storm Drain - 11,000 feet from Alabama Street to Mission Zanja Creek to handle a minimum of a 50-year storm. Said storm drain system shall include all appurtenant structures to mitigate street and local flooding.

Based on research, HDR is not aware that Flood Mitigation No. 9 has been constructed or implemented.

City of Redlands Redevelopment Plan

The City Council of the City of Redlands approved and adopted a Redevelopment Plan in September 1972 (City Ordinance 1575). The Redevelopment Plan cannot be fully implemented without provision for flood control which impacts local drainage. Current ordinance and commitments to the National Flood Insurance Program prescribe that the flood problem be resolved before redevelopment can be realized.

Hydrology Study, Mill Creek Zanja Storm Drain

Performed by BSI, the purpose this Study is to propose storm drain upgrades to address deficiencies to the existing Mission Storm Drain (along Redlands Boulevard) and the major tributary storm drain line -

Reservoir Canyon Drain. The existing Mission Storm Drain (Reinforced Concrete Box (RCB) under Redlands Boulevard) is of inadequate capacity to carry runoff during a major storm event (it only has current capacity for 25 year storm). In order to mitigate the flooding problem in the downtown area, this study proposes storm drain improvements consistent with those recommended in the Mission Zanja Creek Channel Improvement Study (Metcalf & Eddy (M&E), 1987). The M&E study was based on a preliminary hydrology study of the Mission Zanja watershed prepared by SBCFCD. It incorporated a proposed approximate 870 acre-foot detention basin located south and next to Mill Creek Zanja, east of Opal Avenue, west of Walnut Street, and north of Citrus Avenue, as recommended in the City of Redlands Mill Creek Zanja Detention Basin Study. From this point forward, this basin will be referred to as Opal Detention Basin.

The storm drain improvements projects proposed in the study to mitigate flooding in the downtown area of the City will consist of the Mission Storm Drain Bypass, a parallel relief system north of Redlands Boulevard (in a drainage easement) from the Mill Creek Zanja east of 9th Street to just west of Texas Street (back to Mission Zanja Creek). The other proposed storm drains will be Redlands High School Bypass Storm Drain and Reservoir Canyon Diversion Drain.

Flows in Mill Creek Zanja will be controlled by the proposed Opal Detention Basin which is designed with an outlet discharge of 600 cfs (storm event discharge associated with a 100 year frequency recurrence interval (Q100)). The existing Reservoir Canyon Drain has a peak Q100 runoff flow of 3,975 cfs while the capacity of the existing Mission Storm Drain is 2,400 cfs. The flow in the Reservoir Canyon Drain is thus split, with 2,400 cfs flowing to the existing Mission Storm Drain and 1,575 cfs flowing to the Mill Creek Zanja, upstream from the proposed Mission Storm Drain Bypass. The proposed Mission Storm Drain Bypass will divert all of the design storm flow in Mill Creek Zanja upstream from the entrance to the Mission Storm Drain.

HDR is not aware that any of these alternatives have been constructed or implemented.

EIR, Long-Term Maintenance of Flood Control and Transportation Facilities Located Throughout San Bernardino County

The County of San Bernardino Department of Public Works (DPW) is currently preparing environmental documents in accordance with the CEQA and NEPA.

The project involves maintenance of up to 1,100 flood control channels, basins, earthen streams and dams, approximately 140 bridges, and thousands of road culvert and Arizona crossings throughout San Bernardino County for the purposes of flood protection and road safety. Maintenance occurs year-round, with some facilities requiring maintenance several times a year and others on an as-needed basis in preparation or following large storm events. Maintenance is described as activities performed to allow a facility or structure to function at its current/designed capacity, including minor alterations to update a facility or structure to meet current standards or to maintain structural integrity. Maintenance does not include alterations for the purpose of expanding its original design capacity. Maintenance activities include, but are not limited to, the removal of excess sediment, debris and vegetation, stockpiling excess material and debris following removal, maintaining sufficient flowpaths, grooming/repairing of earthen and improved channel slopes and bottoms and maintaining culverts and bridges to ensure proper drainage and structural integrity. Many of the DPW-maintained facilities either traverse or contain a protected natural resource. As a result, some maintenance activities require the DPW to obtain complex permits, agreements and/or certifications from several regulatory agencies. Having to obtain multiple approvals for routine work to existing facilities and structures year after year, and sometimes multiple times a year, is a time-consuming approach and an inefficient method of performing maintenance and meeting DPW's mission of protecting life and property. Therefore, the intent of this environmental review process is to obtain long-term regulatory approvals to more effectively and efficiently maintain DPW-owned facilities and structures throughout the County.

The primary objective of the EIR is to provide the basis for acquisition of long-term maintenance permits from USACE for Section 404 permits, California Department of Fish and Game (CDFG) for Section 1602 Streambed Alteration Agreements, RWQCB for Section 401 Water Quality Certifications, and U.S. Fish and Wildlife Service (USFWS) consultations. The project proponents are SBCFCD and San Bernardino County Department of Public Works – Transportation.

Mission Zanja Creek, Channel Improvement Study

The purpose of the study was to conduct a study and cost effectiveness analysis for channel improvement alternatives for Mission Zanja Creek from Garnet Street to SAR for protection against flooding during the 100-year storm events. The results of the study are to serve as the basis for developing a financing program for implementation of the recommended improvements.

The Mission Zanja Creek is inadequate to carry the future 100-year storm flows in the majority of the reach evaluated. Various feasible open channel and closed conduit alternatives were evaluated for Mission Zanja Creek and Morey Arroyo for flood protection during the 100-year storm. The trapezoidal reinforced concrete lined channel section was found to be the most cost effective alternative although it has its disadvantages.

To date, HDR is not aware that any of that any of these alternatives have been constructed or implemented.

Mission Zanja Creek, Detailed Project Report and Environmental Assessment

This report was conducted by the Los Angeles District of the USACE to evaluate alternative improvements along the Mission Zanja Creek to mitigate the flooding problem in downtown Redlands, under the Small Flood Control Project Authority. (Note: this report refers to the Mission Storm Drain and Mill Creek Zanja inclusively as Mission Zanja Creek).

As shown in Appendix J, the recommended plan provides for a 13.5-foot high by 14-foot wide RCB from inlet structure no. 1, located along Mission Zanja Creek downstream from Division Street, to an outlet channel and an energy dissipating structure located upstream of New York Street, a distance of 1.4 miles. The RCB conduit, designed for a capacity of 5,500 cfs, would follow an abandoned railroad (SPRR) alignment running parallel to and north of Redlands Boulevard (between Redlands Boulevard and Oriental Avenue). Another set of inlet structures (no. 2), located in the vicinity of University Avenue north of I-10, would intercept the Oriental Drain and University Avenue flows and convey them to inlet structure no. 1, via a 9-foot diameter reinforced concrete pipe (RCP) designed for a capacity of 1,000 cfs. The total project cost was estimated at $10,195,000, based on May 1986 prices.

This report was conducted under the authority of Section 205 of the federal Flood Control Act of 1948, as amended. Also, the project received authorization for construction by the Water Resources Development Act of 1986, Title IV – Flood Control, Section 401(d) which states:

“Subject to section 903(a) of this Act, a project for flood control works along Mission Zanja Creek within the City of Redlands, California, in accordance with the plan developed by the District Engineer based on studies pursuant to section 205 of the Flood Control Act of 1948, at a total cost of $10,400,000, with an estimated first Federal cost of $4,500,000 and an estimated first non-Federal cost of $5,900,000.”

Due to the federal limitation under the Small Project Authority, the federal share towards study and construction costs cannot exceed $5,000,000. This amount includes construction, study costs, preparing Plans, Specifications, and Estimates (PS&Es), administering contract for construction, conduct cultural resource investigations, and conduct periodic inspections to determine adherence to maintenance requirements. Additionally, the City of Redlands, as the local sponsor, will be required to pay the amount above the federal share and will responsible for providing all necessary lands, easements, and rights-of-way; bear the expense of all relocations excluding railroad bridges and local drainage; and maintain and operate the project.

The draft report was prepared and presented to the Redlands City Council on July 15, 1986. The City Council fully supported the project and subsequently prepared a letter of support indicating their commitment to their cost sharing responsibilities.

Based on research by HDR, none of these alternatives have been constructed or implemented.

Reconnaissance Report for Mission Zanja Creek

This report was prepared under Section 205 of the Flood Control Act of 1948 and was completed in February 1984. The Reconnaissance Report identified alternatives for flood control through the downtown area of the City of Redlands that appeared to be economically justified. The Reconnaissance Report was approved by the USACE and led to the initiation of the Mission Zanja Creek, Detailed Project Report and Environmental Assessment (refer to pertinent summary in this Section).

Reconnaissance Study for Mission Zanja Creek

The study, initiated at the request of SBCFCD, identifies the flooding problems throughout the entire Zanja watershed, to formulate and evaluate potential solutions to the identified problems, and to determine whether federal planning efforts should continue into a more detailed feasibility phase. The results of the study, presented in 1994, indicate that in the reach of Mission Zanja Creek from Opal Avenue to Iowa Street, estimated future flood damages will amount to over $1.3 million on an average annual basis. Approximately $830,000 or about 62 percent of the total estimated damages will accrue in the downtown Redlands area from the East I-10 Overpass to Texas Street to the west.

Several flood control measures were considered the most likely to be feasible including upstream detention, channelization and expanding an inlet. The results of the study also indicate that providing a higher level of flood control would not be economically justified and would not warrant further federal efforts to reduce or eliminate as of the date of the study (1994).

Most of the future flood damage that is expected to occur is the result of flooding from two separate sub-watersheds that meet in the eastern or upstream portion of the downtown area: the mainstem of the Zanja and Reservoir Canyon tributary. Elimination of all or most of the flooding in the downtown Redlands area would require complete channelization of the Zanja through Redlands, detention of flood flows on the Zanja through Redlands, detention of flood flows on the Zanja east of the downtown area combined with channelization through Redlands, or detention of flood flows on the Zanja and in Reservoir Canyon plus channelization through Redlands.

Complete channelization through Redlands would not be economically justified under 1994 conditions. Although channelization was found to be economically justified in prior studies in Redlands, conditions in the area with respect to redevelopment have changed and the benefits of flood control in this area are now limited to reduction of flood damages to existing development. The study also demonstrated that detention alone would do little in reducing flooding in Redlands due to the residual flooding that would be caused by the other source (Reservoir Canyon). Detention in Reservoir Canyon and on the upper reach of Mission Zanja Creek, as well as combining detention with expanding the inlet near 9th Street, was not justified as the benefit-cost ratio was unfavorable.

The only feasible flood control plan is expanding the existing inlet to the covered section of Mission Zanja Creek near 9th Street in Redlands which will reduce the frequency of flooding in the downtown Redlands area. A project that would raise the flow-carrying capacity of the inlet from the current 300 cfs to 2,400 cfs, the capacity of the covered channel under Redlands Boulevard, appears to be economically feasible and may be implemented under the USACE Continuing Authorities Program (CAP). (The CAP establishes a process by which the USACE can respond to a variety of water resource problems without the need to obtain specific congressional authorization for each project. This decreases the amount of time required to budget, develop, and approve a potential project for construction. Under the CAP, the USACE is authorized to construct small projects within specific federal funding limits and includes sharing of the total cost the federal government and a non-federal sponsor[s]). The Study recommended that based on a preliminary appraisal of the federal interest, costs, benefits, and environmental impacts of the identified potential solutions, planning should proceed further, into a feasibility phase under the CAP, for a plan to expand the capacity of the existing inlet to the covered channel of the creek near 9th Street in Redlands.

Based on research, HDR has determined that the expanded inlet project was constructed in 2005. See related project under Section 2.7 below (Mill Creek Zanja Expanded Inlet).

Mill Creek Zanja Detention Basin Study

This study, prepared for City of Redlands, investigated the feasibility of regional detention basins along Mission Zanja Creek upstream of downtown Redlands. The most cost-effective detention basin alternative evaluated provides for a 870 acre-foot basin to be constructed east of Opal Avenue. The study also recommended an investigation of a parallel system of the Mill Creek Zanja to relieve flooding in the vicinity of the University of Redlands.

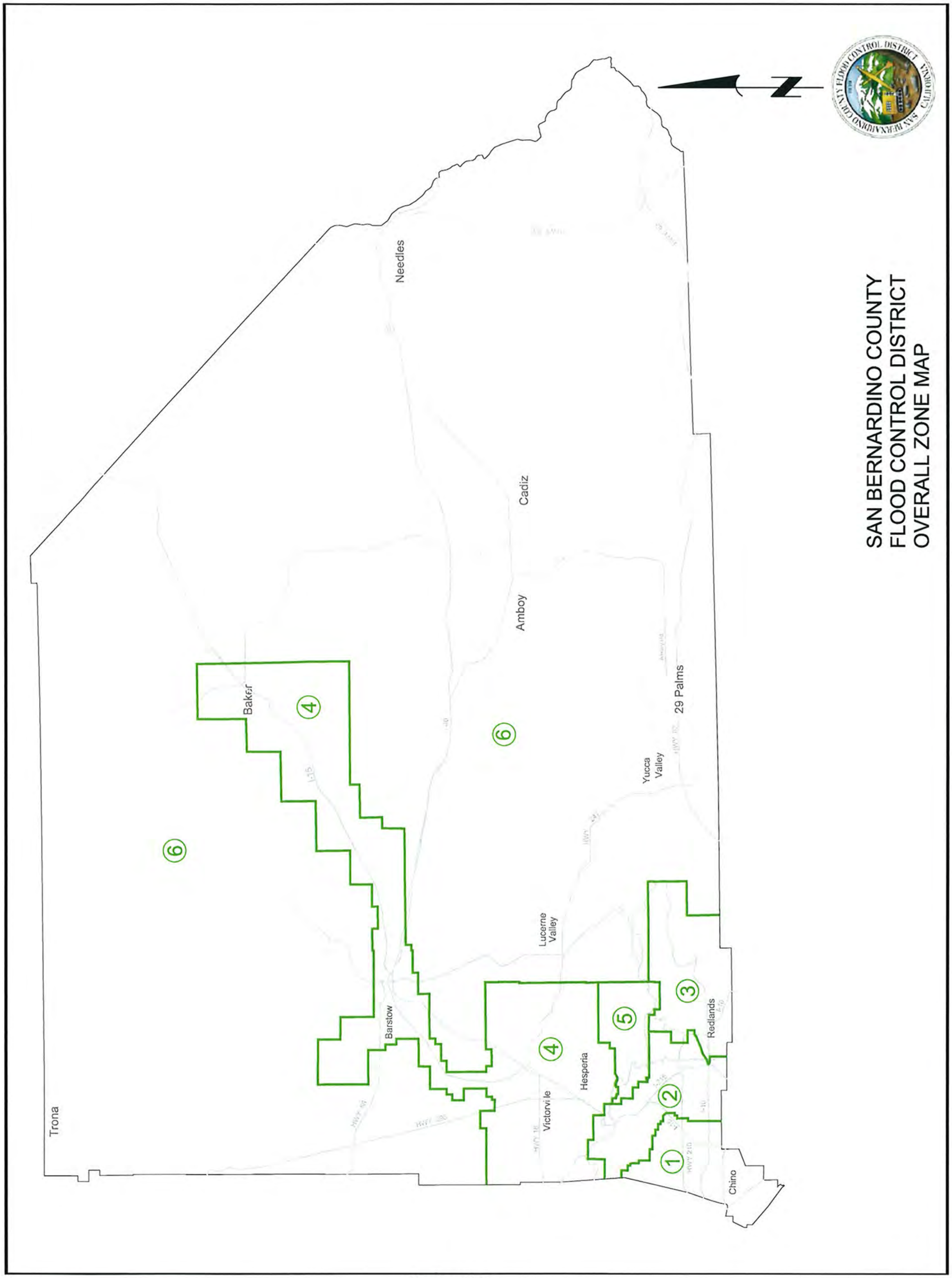
To date, none of these alternatives have been constructed and implemented.

SAN BERNARDINO COUNTY

FLOOD CONTROL DISTRICT

GENERAL INFORMATION

JANUARY 2010


SAN BERNARDINO COUNTY
FLOOD CONTROL DISTRICT
OVERALL ZONE MAP
Trona
Baker
Barstow
Needles
Cadiz
Amboy
29 Palms
Yucca Valley
Lucerne Valley
Victorville
Hesperia
Redlands
Chino
1
2
3
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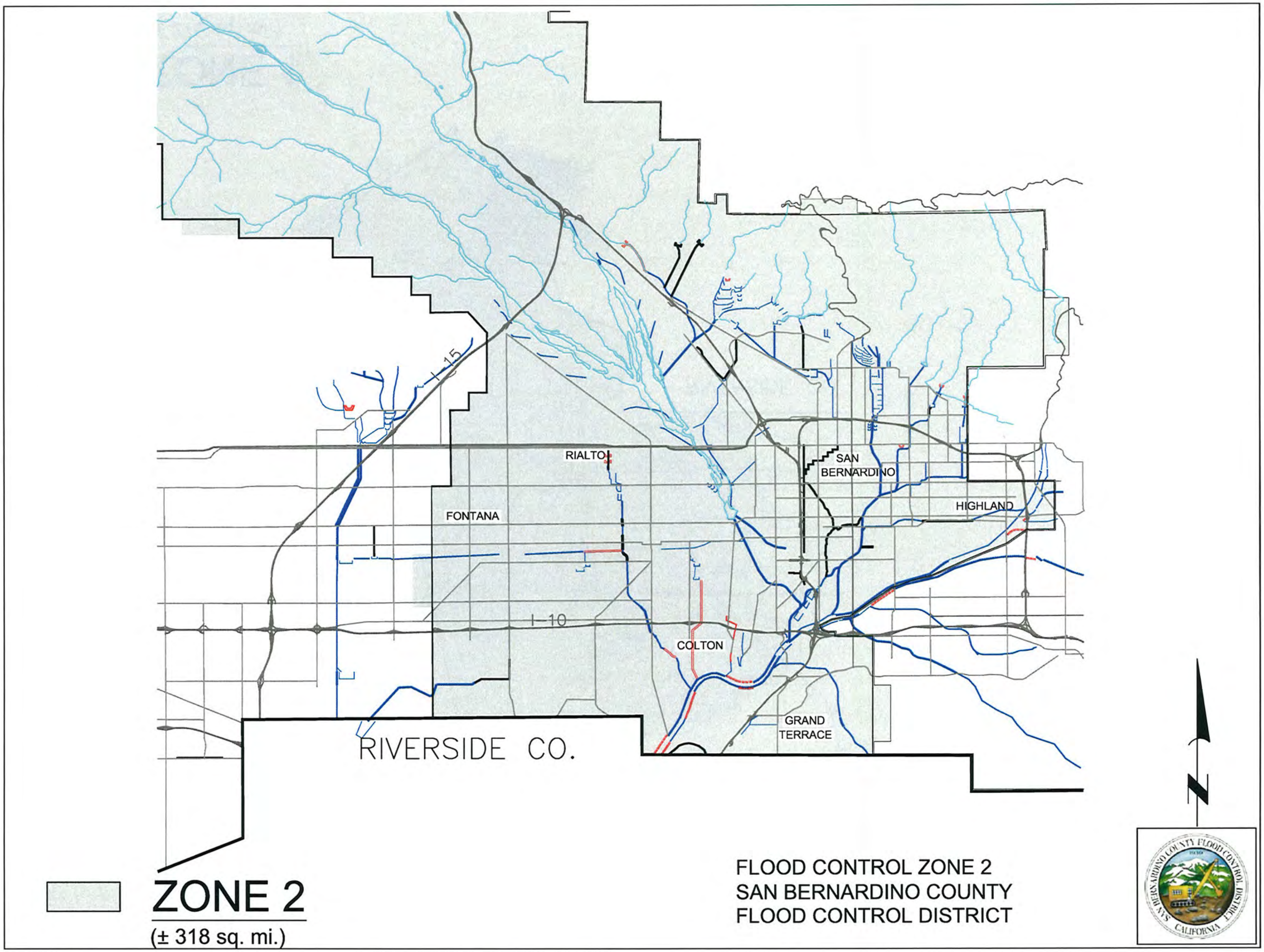
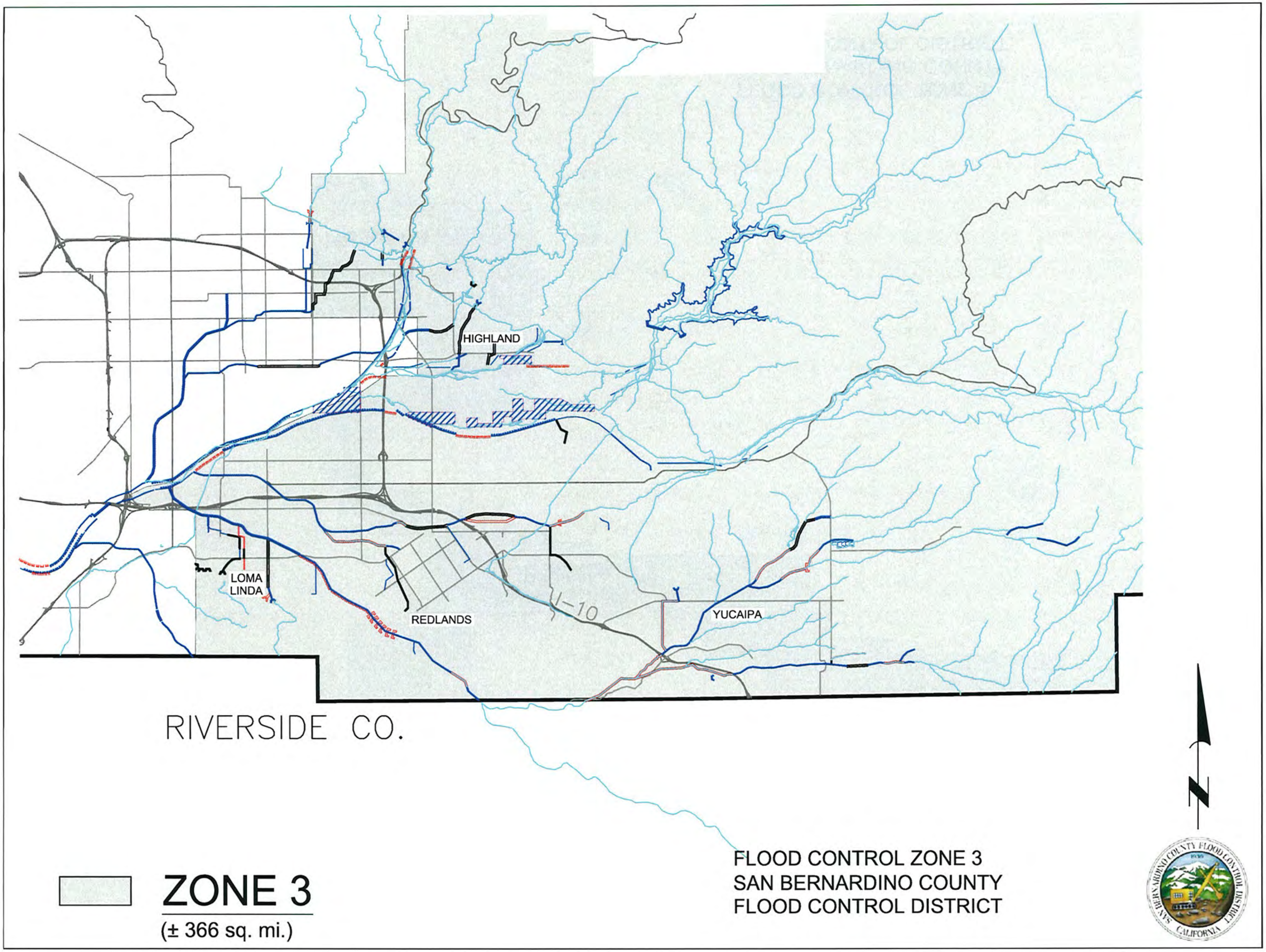

I-15
RIALTO
SAN BERNARDINO
HIGHLAND
FONTANA
I-10
COLTON
GRAND TERRACE
RIVERSIDE CO.
N
ZONE 2
(± 318 sq. mi.)
FLOOD CONTROL ZONE 2
SAN BERNARDINO COUNTY
FLOOD CONTROL DISTRICT


HIGHLAND
LOMA
LINDA
REDLANDS
I-10
YUCAIPA
RIVERSIDE CO.
ZONE 3
(± 366 sq. mi.)
FLOOD CONTROL ZONE 3
SAN BERNARDINO COUNTY
FLOOD CONTROL DISTRICT

FEDERAL FLOOD CONTROL PROJECTS

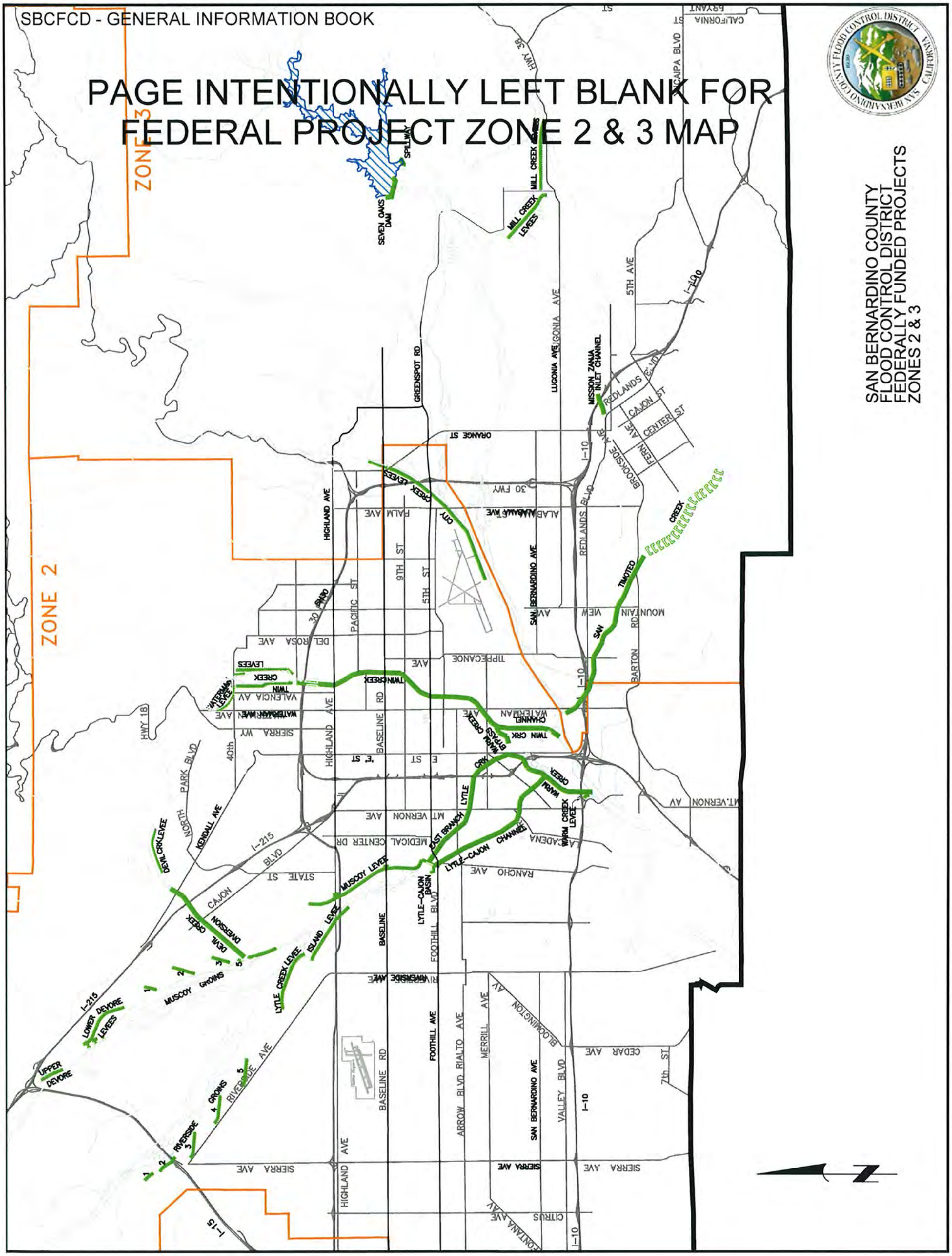
The following projects are US Army Corps of Engineers:

Projects	Project Status	Total Cost $
City Creek Levee	Completed 1942	470,000
Lytle Cajon Creeks	Completed 1948	8,400,000
San Antonio Dam & Reservoir	Completed 1956	7,600,000
Lytle Creek Levee	Completed 1956	300,000
Devil Creek Diversion	Completed Nov. 1957	1,600,000
City Creek Levee	Completed Nov. 1959	900,000
San Antonio & Chino Creeks	Completed Oct. 1960	11,500,000
Mill Creek Levees	Completed Nov. 1960	700,000
Quail Wash Levee	Completed Oct. 1961	200,000
Twin & Warm Creek	Completed Nov. 1961	8,000,000
Oro Grande Wash	Completed Feb. 1969	18,300,000
Mojave River Forks Dam	Completed June 1973	2,000,000
Needles "S" Street Channel	Completed June 1973	2,000,000
Lytle - Warm Creek	Completed June 1977	39,000,000
Cucamonga Creek	Completed Oct. 1983	121,000,000
Mission Zanja Inlet Channel	Completed June 2005	1,100,000
S.A.R. Mainstem Projects:		
Seven Oaks Dam	Completed Oct. 2001	450,000,000
Mill Creek Levee (Rebuilt)	Completed Jan. 1993	4,500,000
San Timoteo Creek:		
Phase 1	Completed Sept. 1996	Approximately 92,000,000 (Phase 1 through Phase 3B Landscaping)
Waterman Ave Bridge	Completed Sept. 1996	
Phase 2	Completed Dec. 1997	
Redlands Blvd. Bridge	Completed Mar. 1998	
Phase 3A	Completed Apr. 1998	
Phase 3B (Const)	Completed Apr. 2006	
Phase 3B (Landscaping- 5 Yr. Maintenance)	In Progress - Complete in Mar. 2013	
Beaumont Ave. Bridge	Completed Mar. 2007	2,000,000

The following Projects are US Bureau of Reclamation:

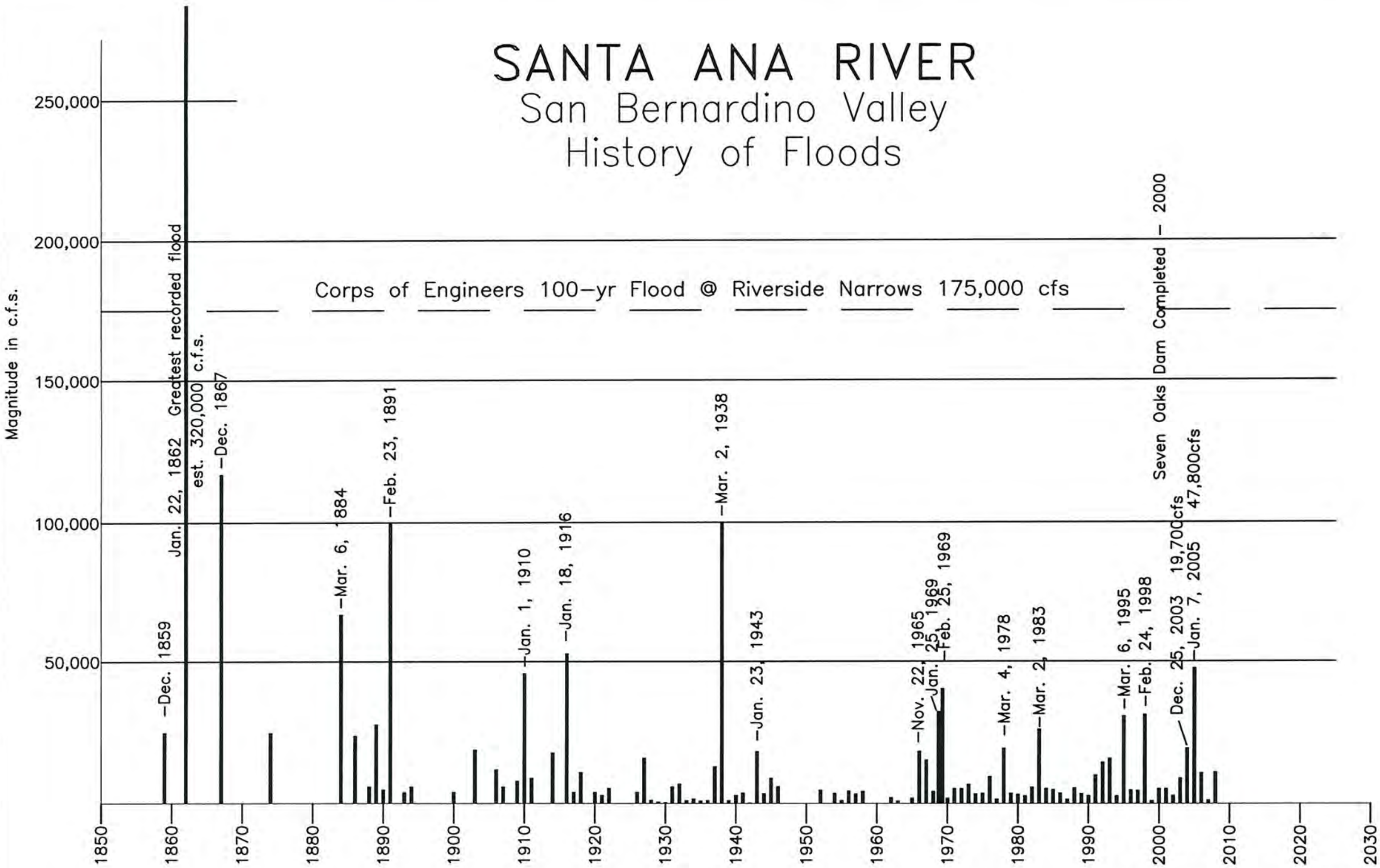
Projects	Project Status	Total Cost $
Day Creek(Loan)	Completed 1993	App. 50,000,000
Etiwanda/San Sevaine	Completed Mar. 2009	App. 130,000,000

PAGE INTENTIONALLY LEFT BLANK FOR FEDERAL PROJECT ZONE 2 & 3 MAP



SANTA ANA RIVER

San Bernardino Valley
History of Floods



U.S.G.S. Gauge #11066460
Santa Ana River at MWD Crossing
near Arlington, California

SAN BERNARDINO COUNTY FLOOD CONTROL DISTRICT			
SANTA ANA RIVER FLOODS Discharge near Riverside Narrows			
DATE: DEC. 2009	SYS. NO: 3-103	ACAD FILE: SARFLOOD	S.B.C.F.C.D. FILE: BM-D1-11/a

STORM HISTORY

1769 to 1859

Flood history in the Santa Ana River Basin is traceable since the entry of the Spanish Mission Fathers into the Los Angeles and San Bernardino areas between 1769 and 1776. Based upon a wide variety of diaries, special reports, court records and writings of residents, the period from 1769 to 1859 experienced what would be referred to as eight small floods, seven large ones, and one great flood.

The great flood occurred in the 1824-25 season, which was described as "probably the greatest of earlier recorded floods". The event has been compared as having been almost as large as the greatest flood of record in 1862, and is generally recognized as equal to or greater than the 1938 flood. The flood of 1825 is known to have altered the course of the Santa Ana River, causing it to enter the Pacific Ocean several miles from its prior entry point.

The history of floods since 1859 is portrayed in the attached charts giving a comparative magnitude for events occurring in both the Santa Ana and Mojave River Basins.

Additional flood charts for various streams are also included at the end of this section.

1860 to 1929

Of particular interest are the large floods during this period, occurring in 1862, 1867 and 1891, which may generally be compared as approximately equal to or greater than the disastrous event of the year 1938. In the San Bernardino Valley, the flood of 1884 approaches this category as does the flood of 1910 in the Mojave River Valley.

The 1862 flood is by far the greatest of record and has been referred to as the Noachian deluge of California floods, during which the Santa Ana River is said to have rivaled the "Father of Waters". Rainfall started on Christmas Day 1862, and continued until the 18th day of January 1862, when a 24-hour downpour commenced. At that time, flood peaks rolled through the valley conservatively estimated as over twice the amounts of the 1938 flood. It has been stated that the area from Loma Linda to the hill at Third Street and Arrowhead Avenue in San Bernardino was under water and extended for miles up and down the Santa Ana River. At Agua Mansa below Colton, it is recorded: "There were billows 50 feet high. The waters from the vast drainage area found themselves forced abruptly into a narrow channel, and just above Agua Mansa the river filled the valley from bluff to bluff, reaching the little church. Father Borgatta, then the pastor, heard the roar in the distance, rang the bell frantically and the people fled to high ground. Some of the last ones had to swim."

In quick succession, six years later, came the 1867 flood which is reported to have approached the 1862 event in magnitude but it was written that: "Since the first flood had cleaned the channels, the damage done by the second storm appeared to be less." The flood of 1867 is accepted as substantially greater than that of 1938.

The season of 1883-84 is known as the wettest year of record with San Bernardino reporting 36.5 inches of rainfall. The flood produced on March 6, 1884, though somewhat less than the 1938 event, ranks with the major floods and is referred to as "the Great Flood of Later Times". Great damage was inflicted to newly-installed railroads, and once again, the course of the Santa Ana River was altered.

1891 STORM

In rapid succession came the flood of February 23, 1891, of magnitude equal to the flood of 1938, and large, though lesser, floods in 1910 and in 1916. Typical reports on these read: "East section of city (San Bernardino) under water and in west end houses float." "Millions of storm damage in southland – The entire Mexican section of East Highlands was swept away by Plunge Creek, 20 families – The Santa Ana River is now two miles wide and twenty feet deep – Disastrous flood sweeps across west end."

1916 STORM

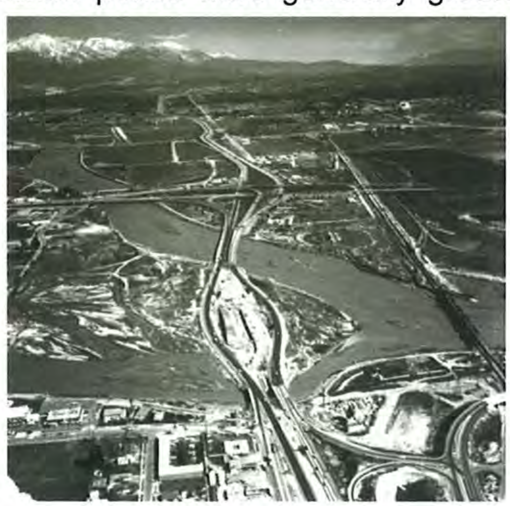
1930 to 1968

On March 2-3, 1938, the County was again swept by a large flood and the most damaging to that date due to the state of physical property improvements. There were 14 known deaths in the County with damages estimated at $12 million. Practically no part of the San Bernardino Valley or Mojave River Valley escaped the wrath of this storm. Almost every community was isolated with roads and bridges destroyed. Hundreds were homeless. During the 31 years between 1938 and 1969 there were no floods of note in the Santa Ana River Basin except for a moderate one occurring in 1943 with damage primarily to Lytle Creek and the Mojave River Valley. Moderate floods also occurred in 1952, 1956, 1965 and 1966.

1938 STORM

1969

Eclipsing, in many respects, the flood of 1938 were the floods of January and February 1969, occurring a month apart. Rainfall intensities and amounts were greater and, except for the Mojave River and its tributaries, runoff peaks were generally greater during the two 1969 floods. Although Flood Control facilities functioned well during the January flood period, there was insufficient time to perform necessary repairs and maintenance before the late February storm struck which caused nearly twice as much damage. Pecuniary losses in San Bernardino County alone from the January storm amounted to over $23 million and from the February storm over $31 million. This is, however, only a portion of the losses which would have been sustained had no flood control protection been provided. During the severe flooding throughout Southern California, 115 lives were lost; and there were



1969 STORM

costly damages exceeding $213 million in tangible property losses. San Bernardino and six neighboring counties were declared national disaster areas.

An overflow map of the 1969 floods is included at the end of this section.

1970 to 1979

The flood history of San Bernardino County remained relatively stable from 1969 until the 1978 flood which approached the magnitude of the 1943 and 1965 storms. The existing flood control facilities functioned well in 1978, but did sustain substantial damage from erosion and debris deposition. Total property damage from the 1978 storm is listed at $11.4 million dollars.

1978 STORM

There were no breakouts of flood flows; however, the earth levees of Cucamonga Channel downstream of Foothill Boulevard were critically eroded and evacuation of a portion of the City of Rancho Cucamonga was initiated. Construction of the Cucamonga Creek Corps of Engineers Channel was completed to Foothill Boulevard the following year. The entire project, including tributaries Deer Creek, Demens Creek and San Antonio Heights Intercept, currently provides flood protection for west end cities. In addition to the 1978 storm, the County was hit with numerous localized high-intensity storms, particularly the 1976 storms in the East Desert (Morongo, Yucca and Twentynine Palms) and the City of Redlands. In September 1976, a thunderstorm above the Crafton Hills dropped rainfall approaching four inches, with 75 to 100% occurring within a 30-minute time span. In Redlands, water flows of up to three feet deep caused flooding of the downtown business area and more than 200 homes. There was an estimated $1,750,000 worth of damage; $1 million to public and private property and $750,000 to Flood Control District Facilities.

1980 to 1989

The San Bernardino Mountains were subjected to concentrated high-intensity rainfall in January and February of 1980. District gauges recorded short duration rainfall in excess of one-inch per hour, which fell on the denuded watershed, burned by the Daley and Shadow fires of September 1979. Many debris basins above the City of San Bernardino were filled with mud and debris, particularly Harrison Basin which overflowed into the neighborhood below on four occasions totally destroying 25 to 30 homes and severely damaging 25 more. The February storm caused Small Canyon Basin to overflow pouring mud, water and debris into houses along Small Canyon Outlet Channel and the residential areas south of Highland Avenue and west of SH 330. Between January and March, more than 30 inches of rain fell causing $18 million in damages in San Bernardino County, $8 million of this occurring to Flood Control District Facilities.

The fall of 1980 brought with it heavy Santa Ana winds and devastating watershed burns. The Panorama Fire destroyed or damaged 333 homes and 23,800 acres; combined with the Baldy and other fires, more than 41,000 acres of mountain watershed was burned. Fortunately, 1981 and 1982 were mild weather years. That, combined with an extensive $5 million federally financed District basin over-excavation program, allowed the San Bernardino Valley to survive nature's wrath with minimal damage.

1980 STORM

1990 to 1999

An unexpected and unusual storm event struck in the early morning hours of October 7, 1997, over the Sand Creek and Little Sand Creek watersheds causing flash flooding through portions of the cities of San Bernardino, Highland and San Bernardino County Service Area 38. The major cause of the flooding was the vast amounts of floatable (organic) debris and mud produced from the burned watersheds of the Hemlock Fire, which had occurred earlier in July. This debris plugged the box culverts at Lynwood Drive and Foothill Drive causing the flows to break over the channel walls

1997 STORM

and down the adjacent roadways affecting homes as far as two miles away. Both Lynwood Drive and Foothill Drive were closed to traffic because of the storm. February of 1998 was the most productive rainfall month during the 1997/98 winter. 14.59 inches of rain were recorded for the month at the Gilbert Street gauge in San Bernardino. The major storm event occurred in the Valley on February 23rd. The rain gauge at Gilbert Street recorded 3-10 inches for the day. Prior to February 23rd, a series of storms starting on February 14th occurred almost back-to-back. The storms brought light to moderate rainfall, except for February 22, which recorded 2.18 inches of rain. The already saturated soil contributed greatly to the impact of the February 23rd storm.

2000 to PRESENT

In October of 2003, the San Bernardino Valley experienced two large fires (the Grand Prix Fire and the Old Fire) which charred most of the foothill watershed. Shortly after the fires, a Pacific storm system moved through Southern California on December 25th and 26th, 2003. Heavy rain fell over much of the mountains and foothills causing flash flooding and debris to wash across several highways and roads. In a few locations, including Lytle Creek, rainfall rates of up to an inch per hour were recorded. Just south of Crestline, rainfall rates increased from 0.20 to 0.70 inches within a five-and-a-half hour span, causing debris slides. The debris flowed down into Waterman Canyon moving through Saint Sofia Camp where 14 people were killed. Farther down Waterman Canyon, the flow demolished two bridges and finally fanned out filling the basins just north of San Bernardino. A flash flood/mud slide moved through Cable Canyon and the KOA Campground, killing 2 people, a bear, and a horse and destroying 32 travel trailers, multiple vehicles, and roads. In all, 33 of the 34 debris basins along the foothills in the San Bernardino Mountains were filled with rocks, trees, and mud.

2003 STORM

The first major storm of 2004 occurred October 19-20. The storm was expected to have significant rainfall intensities and large runoff due to recent watershed burns. Fortunately, the flows from the burn areas were relatively "clean", thus allowing the Regional Flood Control System to handle the storm runoff. Any flooding experienced within cities or developed areas was a result of debris blocking inlets and overtaxed local drainage systems. The only noteworthy damage was the washout of the small wood railroad bridge crossing the undeveloped portion of the San Sevaine Channel, southerly of Whittram Avenue. There was also a derailment of a chlorine car and boxcar and two utility lines (16" jet fuel line and 20" gas line) were exposed, caused by storm flows collapsing the north set of tracks. The 2004/05 rainy season was significant, with three prior storms (two in October and one at the end of December). The ground was already saturated prior to the January 7th – 11th event which was only the first of a series of additional storms to hit San Bernardino County. The January 7th storm was more dominant than the storms of February 22nd thru 24th or the March 23rd storm. On January 5, 2005, light flows were reported in most of the channels. Basins were holding water and draining. Some basins experienced debris flows and had to be excavated. Some minor erosion was experienced on levees and in water courses. There were varying levels of damage to the Mojave River.

2004 STORM

2005 STORM

FLOOD CONTROL
SYTEM NUMBER INDEX
and
GENERAL FILE CODES

SAN BERNARDINO COUNTY
FLOOD CONTROL DISTRICT

(Updated: January, 2010)

This San Bernardino County Flood Control District System Numbers Index Book is now revised to reflect all numbers currently being used within the Flood Control District. These numbers are used for facility identification, operation charge codes, correspondence, and map file numbers. Because of this multipurpose usage, there are listings not only for existing Flood Control District facilities but proposed facilities, overall systems and facilities constructed, operated or maintained by others. Wherever possible, we have noted these differences. Additionally, whenever reasonably possible, facilities that only exist through correspondence and not on the ground have been included. However, certain facilities that do not exist on the ground have not been shown on maps to increase clarity. As needed, these facilities will be added into the maps for more accurate locations.

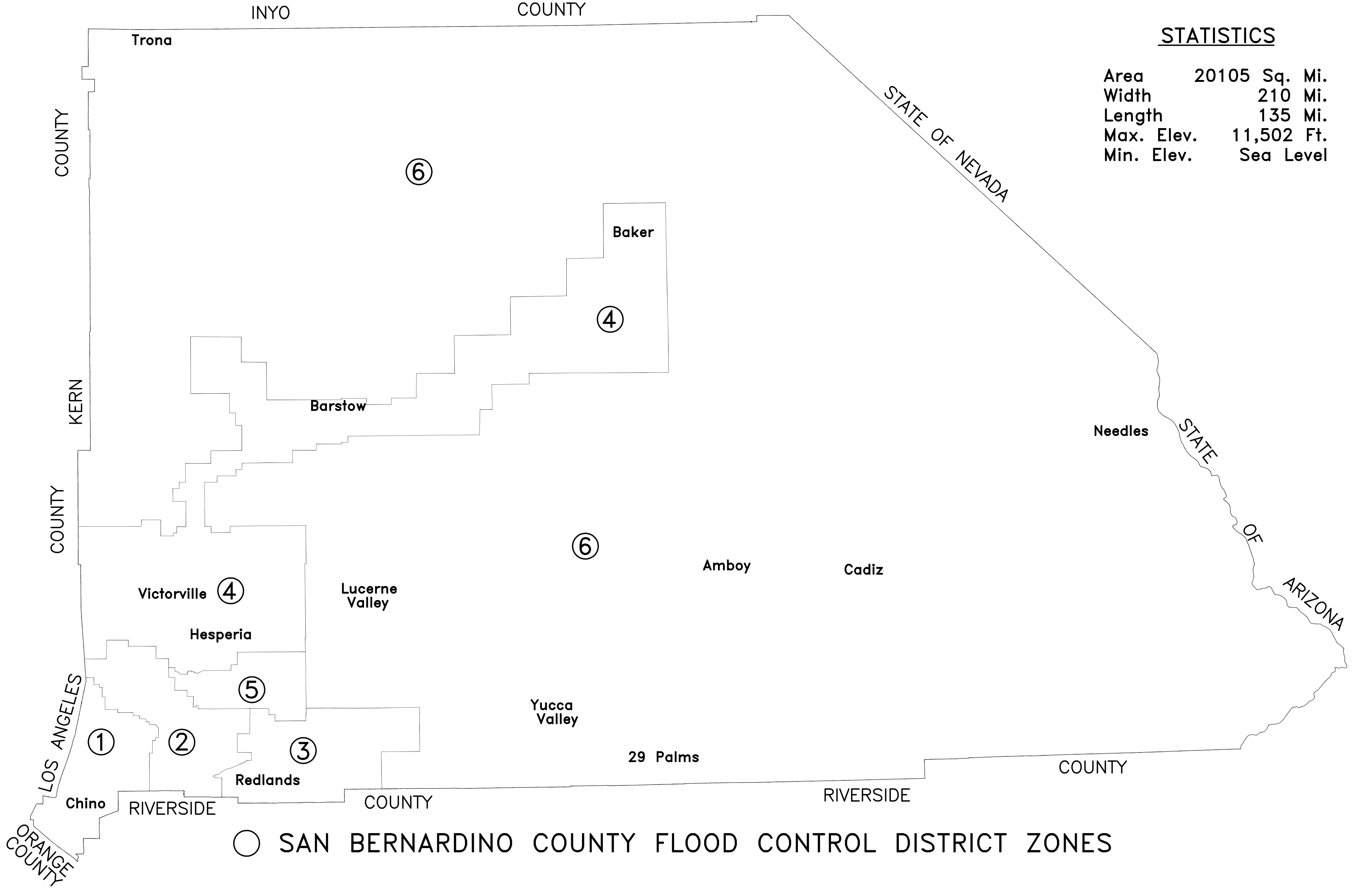
This listing is maintained by the Planning Division of the Food Control District, which has been designated to coordinate future revisions and updates. **Anyone requiring verification, explanation, or revision of an existing number should contact the Planning Division** at (909) 387-8120.

ALL CHANGES AND ADDITIONS WILL BE MADE BY THE PLANNING DIVISION.

Please note that requests for new numbers should meet the following criteria:

a) A facility is being taken over by the District for maintenance.
b) A property is purchased in fee or easement for future construction of a facility.
c) The design of a facility has commenced and is proposed to be constructed in the near future.

As the Red Book gets updated periodically, revised pages will be dated accordingly and made public on a regular basis. Please note that the Planning Division will no longer issue any new Red Book 3-ring binders.



San Bernardino County
FLOOD CONTROL DISTRICT

TYPICAL PROJECT NUMBERS

DESCRIPTION OF COMPONENT PARTS

2 – 206 – 5A C.E

ZONE……………………………….**2**

STREAM SYSTEM #...................**(2)**00

INDIVIDUAL PROJECT #............**06**

TYPE OF FACILITY……………….**5**

FACILITY REACH…………………**A**

CORPS OF ENGINEERS PROJECT……**C.E.**

NUMBER DESIGNATING TYPE OF FACILITY

1 **Channel, Stream, Watercourse** (main channels)

2 **Spreading Grounds** (not including basins, dams, crosswalls)

3 **Dams** (under State Division of Safety of Dams, incl. reservoirs)

4 **Basins** (excluding dams)

5 **Levee** (reception levees, groins etc. but excluding channels)

6 **Storm Drain** (excluding channels)

7 Fire Trails and Breaks

8 **Check Dams** (major crosswalls only)

9 **Projects** (examples) i.e.

Studies

Aerial Topo

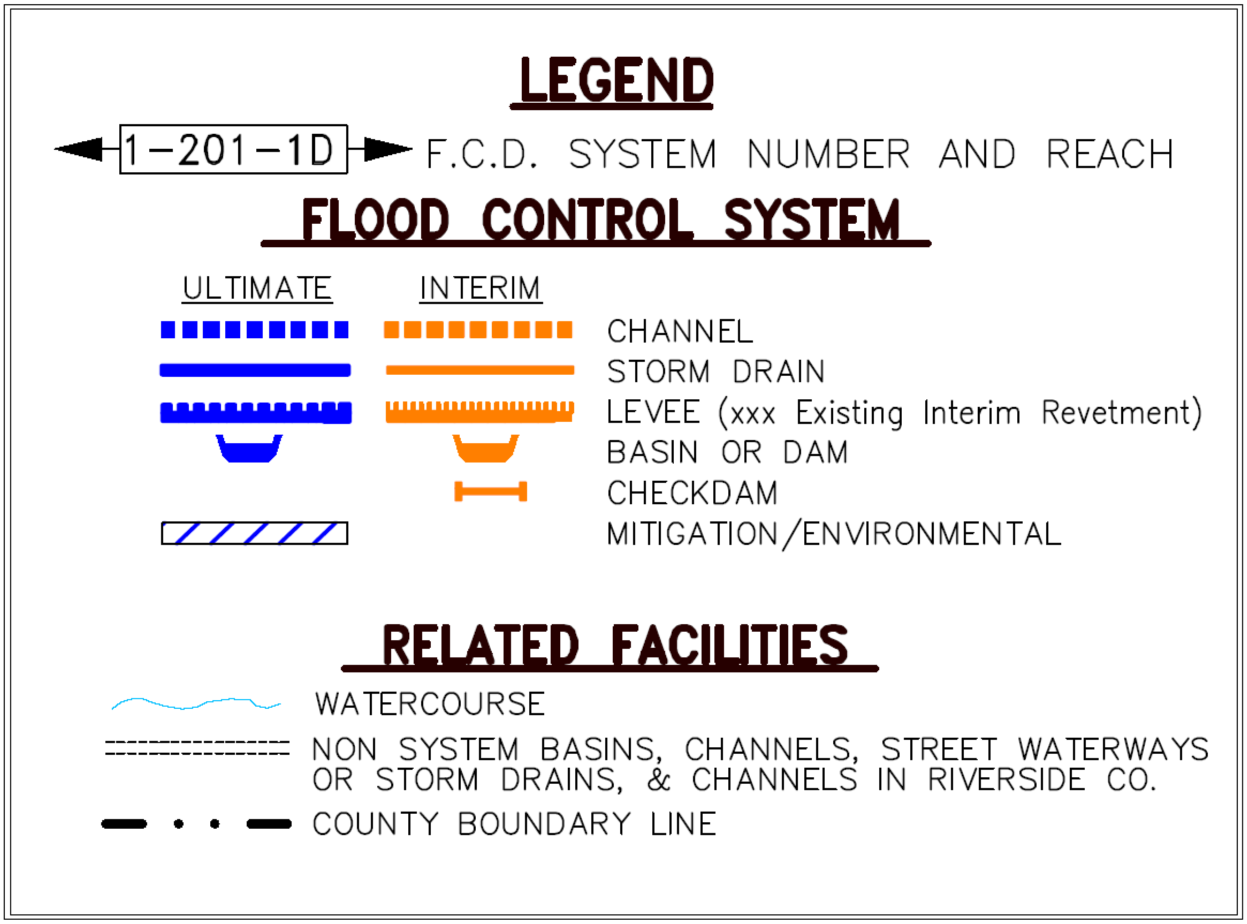
R/W Monumentation

Taxes

Obligations

Future Projects

Etc.



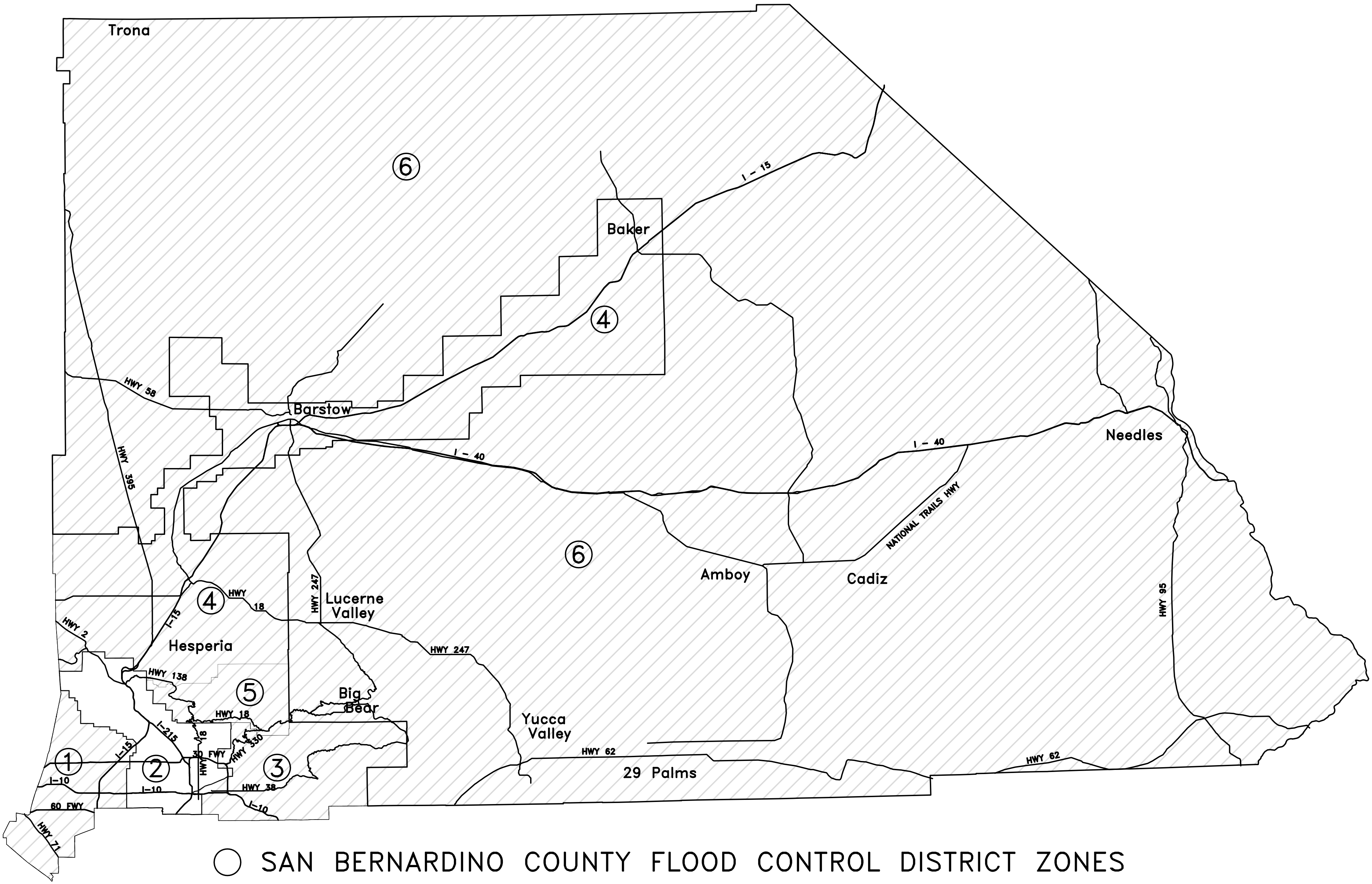
The legend above indicates the symbology used on all facility maps in this book.

POSTSCRIPT NOTATION

The following is a guide to using the postscript notations:

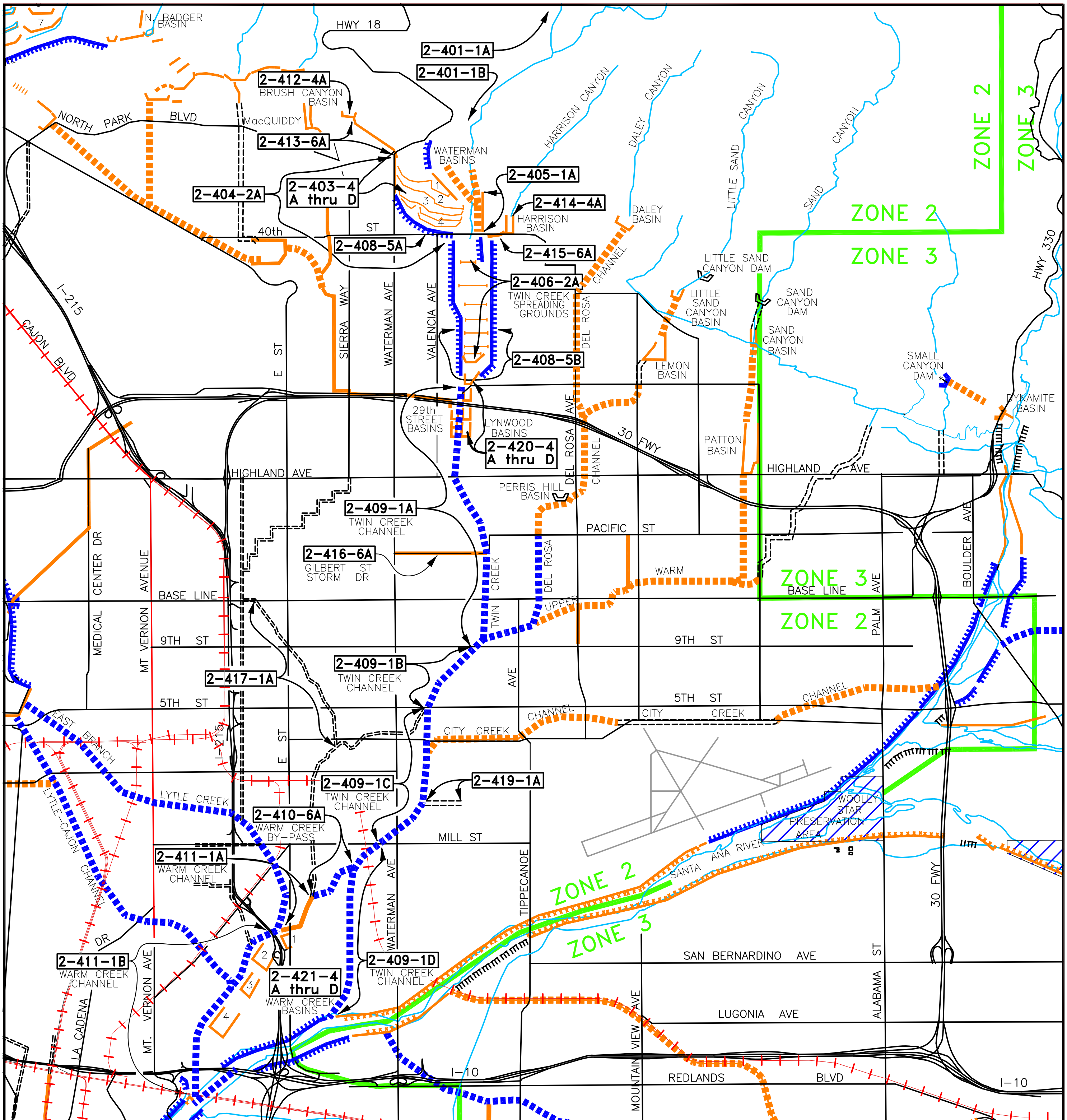
"	Facility that is owned by SBCFCD in fee title or by easement but the District does not maintain the facility.
*	Operational or semi-operational facility owned and typically maintained by agency other than SBCFCD.
^	Facility that is either general in scope, in the planning stages (i.e. not developed) or is an inter-agency correspondence number.

Revised 1/2010



San Bernardino County
FLOOD CONTROL DISTRICT
Zone 2

ZONE 2



LEGEND

◄[1-201-1D]► F.C.D. SYSTEM NUMBER AND REACH

FLOOD CONTROL SYSTEM

ULTIMATE	INTERIM	
		CHANNEL
		STORM DRAIN
		LEVEE (xxx Existing Interim Revetment)
		BASIN OR DAM
		CHECKDAM
		MITIGATION/ENVIRONMENTAL

RELATED FACILITIES

- WATERCOURSE
- NON SYSTEM BASINS, CHANNELS, STREET WATERWAYS OR STORM DRAINS, & CHANNELS IN RIVERSIDE CO.
- COUNTY BOUNDARY LINE

S.B.C.F.C.D. SYSTEM INDEX

TWIN & WARM CREEK SYSTEMS

2-400-00

REV. DATE:	ACAD NO:	S.B.C.F.C.D. FILE NO.:
01-2010	SI2400	RM-D4-8

FLOOD CONTROL DISTRICT FACILITIES

ZONE - 2

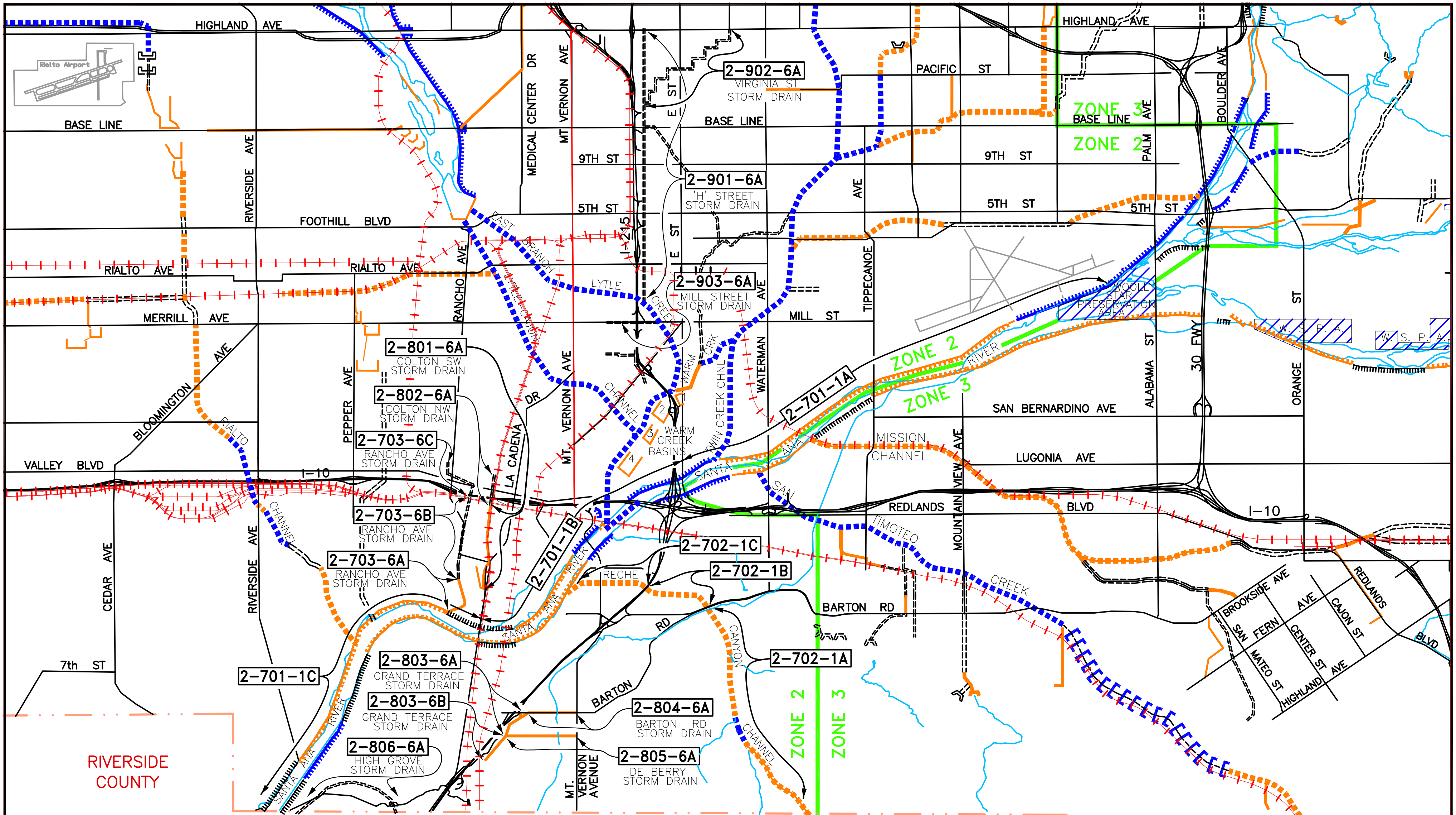
SYSTEM #	FACILITY NAME	REACH LIMITS
2-400-00	**TWIN & WARM CREEKS SYSTEM^**	**General**
2-401-1A	Waterman Creek^	Above Canyon mouth (NDC)
2-401-1B	Waterman Creek	Diversion Structure to Spreading Grounds
2-403-4A	Waterman Basin #1	In Waterman Spreading Grounds
2-403-4B	Waterman Basin #2	In Waterman Spreading Grounds
2-403-4C	Waterman Basin #3	In Waterman Spreading Grounds
2-403-4D	Waterman Basin #4	In Waterman Spreading Grounds
2-404-2A	Waterman Sprdg Grnds	40th St to Canyon mouth
2-405-1A	Twin Creek	Twin Creek North of 40th St
2-406-2A	Twin Creek Sprdg Grnds	Marshall Blvd to 40th St
2-408-5A	Waterman Levee, COE	N/O of 40th St (Twin Creek Sprd Grds to Waterman Ave)
2-408-5B	Twin Creek Levees, COE	North of Marshall Blvd to 40th St
2-409-1A	Twin Creek Channel Improved, COE	Marshall Blvd to 9th St
2-409-1B	Twin Creek Channel Improved, COE	9th St to 5th St
2-409-1C	Twin Creek Channel Improved, COE	5th St to Mill St
2-409-1D	Twin Creek Channel Improved, COE	Mill St to Santa Ana River
2-410-6A	Warm Creek By-Pass, COE	Twin Creek Channel Improvement to Warm Creek Chnl
2-411-1A	Warm Creek Channel	Warm Creek Bypass to "E" St
2-411-1B	Warm Creek, COE	"E" St to Santa Ana River
2-412-4A	Brush Canyon Basin	North of Sierra Ave & 54th St
2-413-6A	Brush Canyon Storm Drain	Brush Basin to Waterman Spreading Grounds
2-414-4A	Harrison Basin	North of Hampshire Ave & 40th St
2-415-6A	Harrison Storm Drain	Harrison Basin to Twin Creek Spreading Grounds
2-416-6A	Gilbert Street Storm Drain"	Waterman Ave to Twin Creek Channel
2-417-1A	Town Creek*	Baseline & "H" St to Historic Warm Creek (City of San Bernardino)
2-419-1A	Timber Creek*	Norton Drainage to Twin Creek Channel Imp. (City of San Bernardino)
2-420-4A	Lynwood Basin #1	South of Twin Creek Sprdg Grnds, East of Twin Creek
2-420-4B	Lynwood Basin #2	North of I-210 Fwy, East of Twin Creek
2-420-4C	Lynwood Basin #3	South of I-210 Fwy, East of Twin Creek
2-420-4D	Lynwood Basin #4	South of Lynwood Basin #3, East of Twin Creek
2-421-4A	Warm Creek Conservation Basin #1^	North-east of I-215 Fwy (No Longer Exists)
2-421-4B	Warm Creek Conservation Basin #2	South-west of I-215 Fwy
2-421-4C	Warm Creek Conservation Basin #3	South-west of Basin #2
2-421-4D	Warm Creek Conservation Basin #4	South-west of Basin #3

All facilities, unless denoted otherwise, are operated and maintained by the Flood Control District.

" owned (via r/w or easement) by FCD but not maintained * owned by others ^ not owned, use as correspondence file number only

** used only during Federal Project coordination

Revised 1/2010



LEGEND

1-201-1D — F.C.D. SYSTEM NUMBER AND REACH

FLOOD CONTROL SYSTEM

ULTIMATE / INTERIM
- CHANNEL
- STORM DRAIN
- LEVEE (xxx Existing Interim Revetment)
- BASIN OR DAM
- CHECKDAM
- MITIGATION/ENVIRONMENTAL

RELATED FACILITIES

- WATERCOURSE
- NON SYSTEM CHANNELS, STREET WATERWAYS OR STORM DRAINS, & CHANNELS IN RIVERSIDE CO.
- COUNTY BOUNDARY LINE

S.B.C.F.C.D. SYSTEM INDEX

SANTA ANA RIVER SYSTEM
COLTON DRAINAGE
SAN BERNARDINO DRAINAGE

2-700-00 thru 2-995-00

REV. DATE:	ACAD NO:	S.B.C.F.C.D. FILE NO.:
01-2010	SI2700	RM-D4-8

FLOOD CONTROL DISTRICT FACILITIES

ZONE - 2

SYSTEM #	FACILITY NAME	REACH LIMITS
2-700-00	**SANTA ANA RIVER SYSTEM^**	**General / Santa Ana River Basin Survey**
2-701-1A	Santa Ana River (Incl. COE)	Plunge Creek to South "E" St
2-701-1B	Santa Ana River (Incl. COE)	South "E" St to La Cadena Ave
2-701-1C	Santa Ana River	La Cadena Ave to Riverside County Line
2-701-9D	Santa Ana River	Mitigation Lands
2-702-1A	Reche Canyon Creek	County Line to Barton Rd
2-702-1B	Reche Canyon Creek	Barton Rd to I-215 Fwy
2-702-1C	Reche Canyon Creek	I-215 Fwy to Santa Ana River
2-703-6A	Rancho Avenue Storm Drain	Santa Ana River to North of Agua Mansa Rd
2-703-6B	Rancho Avenue Storm Drain*	North of Agua Mansa Rd to BNSF RR (City of Colton)
2-703-6C	Rancho Avenue Storm Drain*	BNSF RR to upstream (City of Colton)
2-800-00	**COLTON DRAINAGE^**	**General**
2-801-6A	Colton Southwest Storm Drain"	Intersection of J and Fifth St to east of La Cadena. Includes westerly segment from 750' s/o Rancho Ave. to La Cadena
2-802-6A	Colton Northwest Storm Drain*	North of BNSF RR (City of Colton)
2-803-6A	Grand Terrace Storm Drain	South of Barton Rd to BNSF RR
2-803-6B	Grand Terrace Storm Drain	BNSF RR to I-215 Fwy
2-804-6A	Barton Storm Drain	Mt. Vernon to Grand Terrace SD
2-805-6A	De Berry Storm Drain	Mt. Vernon to Grand Terrace SD
2-806-6A	Highgrove Storm Drain*	(City of Riverside)
2-900-00	**SAN BERNARDINO DRAINAGE^**	**General**
2-901-6A	"H" Street Storm Drain*	(City of San Bernardino)
2-902-6A	Virginia Street Storm Drain*	(City of San Bernardino)
2-903-6A	Mill Street Storm Drain*	(City of San Bernardino)
2-995-00	**COMPREHENSIVE STORM DRAIN PLAN^**	**General**
2-995-6A	**COMPREHENSIVE STORM DRAIN PLAN^**	**CSDP #2**
2-995-6B	**COMPREHENSIVE STORM DRAIN PLAN^**	**CSDP #3**
2-995-6C	**COMPREHENSIVE STORM DRAIN PLAN^**	**CSDP #6**
2-995-6D	**COMPREHENSIVE STORM DRAIN PLAN^**	**CSDP #7**

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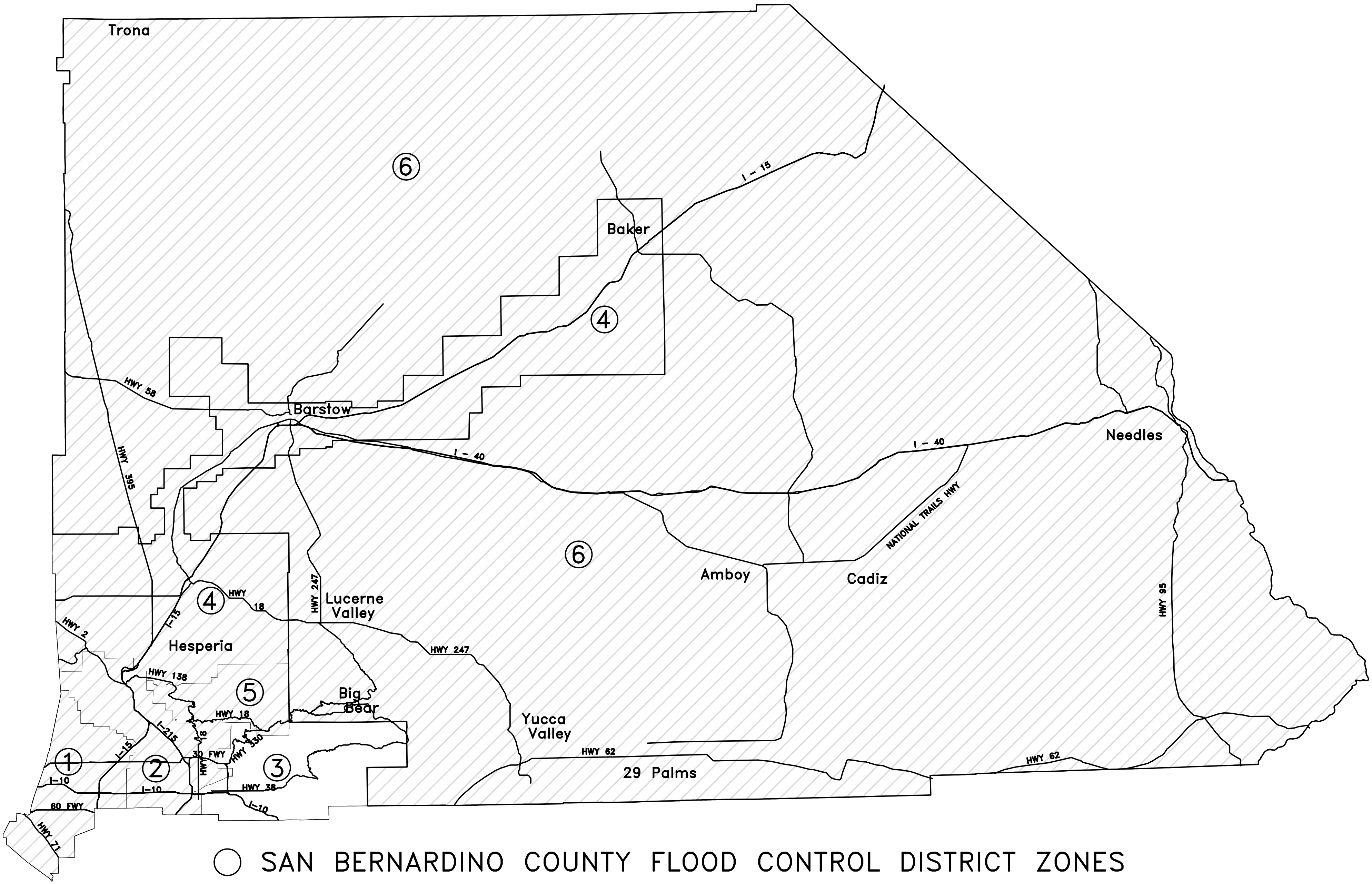
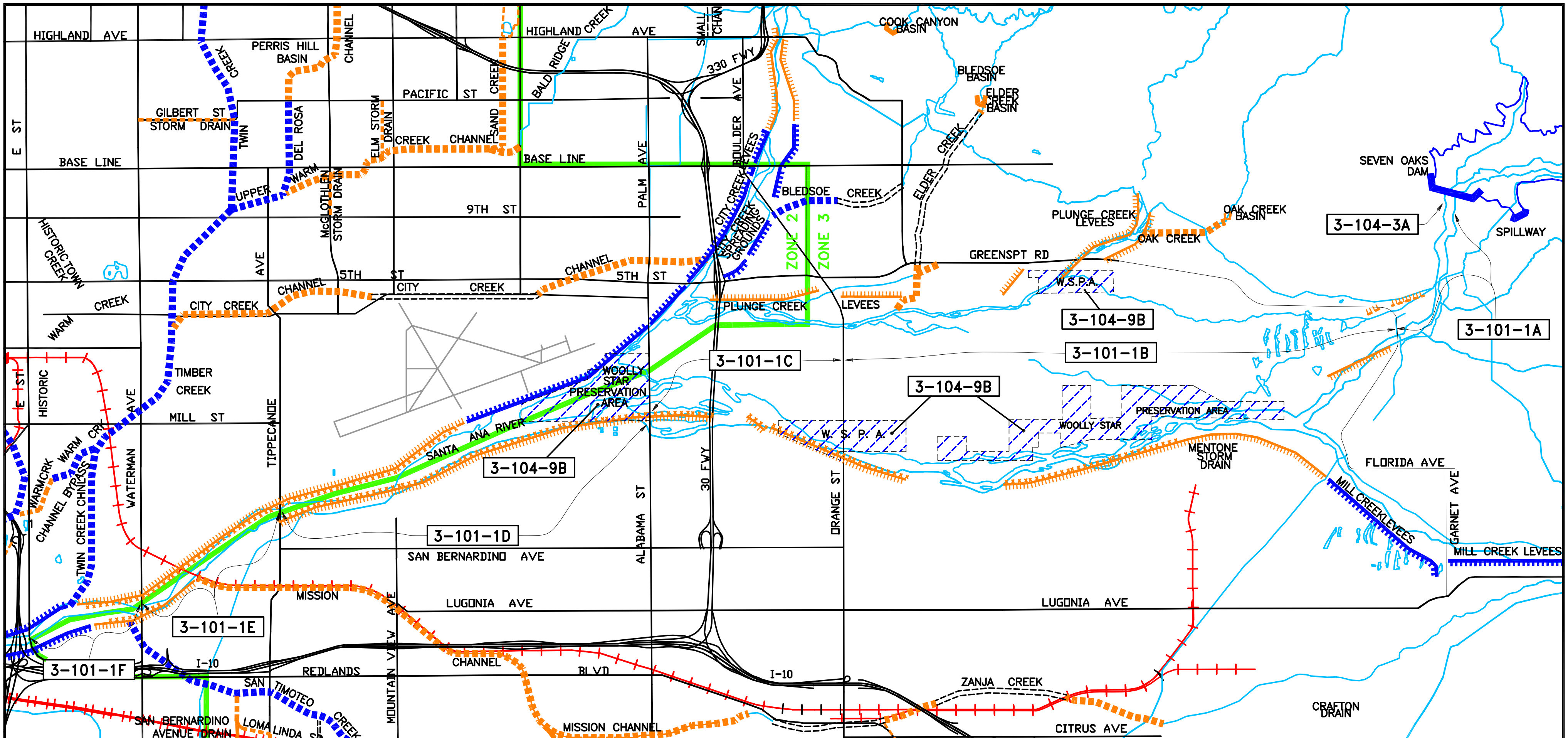
** used only during Federal Project coordination   Revised 1/2010



○ SAN BERNARDINO COUNTY FLOOD CONTROL DISTRICT ZONES

San Bernardino County
FLOOD CONTROL DISTRICT
Zone 3

ZONE 3



LEGEND

1-201-1D F.C.D. SYSTEM NUMBER AND REACH

FLOOD CONTROL SYSTEM

ULTIMATE	INTERIM	
		CHANNEL
		STORM DRAIN
		LEVEE (xxx Existing Interim Revetment)
		BASIN OR DAM
		CHECKDAM
		MITIGATION/ENVIRONMENTAL

RELATED FACILITIES

WATERCOURSE
NON SYSTEM CHANNELS, STREET WATERWAYS OR STORM DRAINS, & CHANNELS IN RIVERSIDE CO.
COUNTY BOUNDARY LINE

S.B.C.F.C.D. SYSTEM INDEX

SANTA ANA RIVER SYSTEM

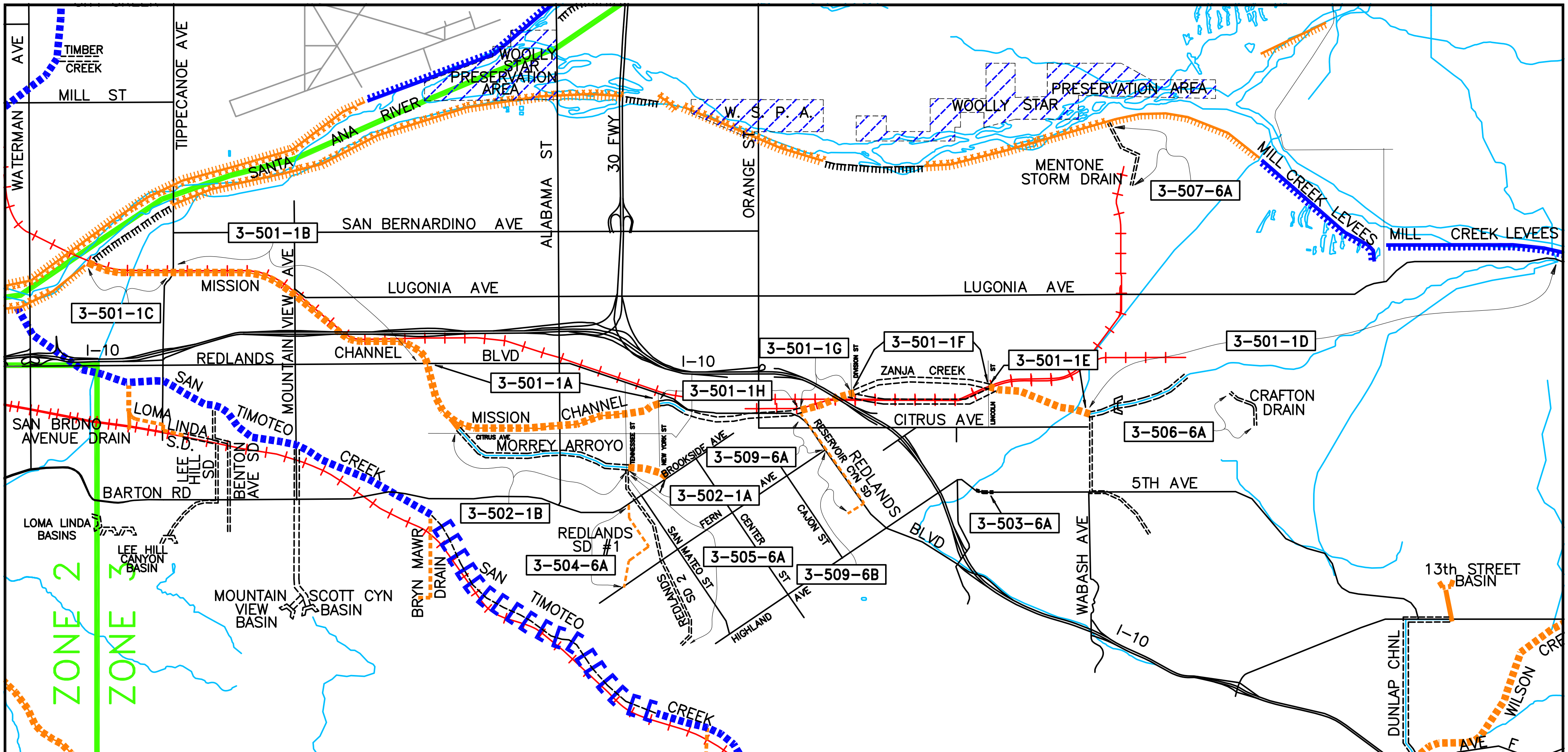
3-100-00

REV. DATE:	ACAD NO:	S.B.C.F.C.D. FILE NO.:
01-2010	SI3100	RM-D4-8

FLOOD CONTROL DISTRICT FACILITIES

ZONE - 3

SYSTEM #	FACILITY NAME	REACH LIMITS
3-000-00	**ZONE 3^**	**General**
3-100-00	**SANTA ANA RIVER SYSTEM^**	**General / Santa Ana River Basin Survey**
3-101-1A	Santa Ana River	Above Greenspot Rd.
3-101-1B	Santa Ana River"	Greenspot Rd. to Orange St.
3-101-1C	Santa Ana River	Orange St. to Alabama St.
3-101-1D	Santa Ana River	Alabama St. to Tippecanoe Ave.
3-101-1E	Santa Ana River	Tippecanoe to Waterman Ave.
3-101-1F	Santa Ana River (Incl. COE)	Waterman Ave. to South "E" St.
3-102-4A	Mentone Dam, COE^	Santa Ana River south of E. Highlands; (no longer exists; see 3-104-3A)
3-103-00	**Santa Ana River, COE^**	**SAR - All Zones Including Orange & Riverside Co.;**
		See 1-000, 2-700 & 3-100 Prior to September 1984
3-104-3A	Seven Oaks Dam, COE [DSOD]	Seven Oaks Dam
3-104-9A	Seven Oaks Dam, COE^	Water Conservation Feasibility Study
3-104-9B	Seven Oaks Dam, COE	Mitigation Lands



LEGEND

[1-201-1D] F.C.D. SYSTEM NUMBER AND REACH

FLOOD CONTROL SYSTEM

ULTIMATE	INTERIM	
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		STORM DRAIN
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RELATED FACILITIES

- WATERCOURSE
- NON SYSTEM CHANNELS, STREET WATERWAYS OR STORM DRAINS, & CHANNELS IN RIVERSIDE CO.
- COUNTY BOUNDARY LINE

S.B.C.F.C.D. SYSTEM INDEX

MISSION-ZANJA CREEK SYSTEM

3-500-00

REV. DATE:	ACAD NO:	S.B.C.F.C.D. FILE NO.:
01-2010	SI3500	RM-D4-8

FLOOD CONTROL DISTRICT FACILITIES

ZONE - 3

SYSTEM #	FACILITY NAME	REACH LIMITS
3-500-00	**MISSION-ZANJA CREEK SYSTEM^**	**General**
3-501-1A	Mission Channel	New York Ave. to Redlands Blvd.
3-501-1B	Mission Channel	Redlands Blvd. to Tippecanoe Ave.
3-501-1C	Mission Channel	Tippecanoe Ave. to Santa Ana River
3-501-1D	Zanja Creek*	Mill Creek to Opal St. (Historical; Partial R/W only)
3-501-1E	Zanja Creek	Opal St. to Lincoln
3-501-1F	Zanja Creek*	Lincoln St. to Division St.
3-501-1G	Zanja Creek	Division to 275' west of 9th St.
3-501-1H	Zanja Creek*	275' west of 9th to New York Ave. (Redlands)
3-502-1A	Morrey Arroyo	Brookside Ave. to Tennessee
3-502-1B	Morrey Arroyo*	Tennessee to Citrus (Redlands)
3-503-6A	5th Avenue SD*	Marion Rd. to Fairview Rd. (Redlands)
3-504-6A	Redlands SD #1"	Laurel Ave. to Brookside Ave. (Redlands) (R/W only)
3-505-6A	Redlands SD #2A*	Cedar to Crescent (Redlands)
3-506-00	**CRAFTON DRAINAGE^**	**General**
3-506-6A	Crafton Drain^	Citrus to Third Ave. (NDC)
3-507-6A	Mentone SD"	Carlsbad to Santa Ana River (NDC) (R/W only)
3-508-1A	Zanja By-Pass^	Dearborn to Santa Ana River (NDC)
3-509-6A	Reservoir Canyon SD^	Zanja to Fern
3-509-6B	Reservoir Canyon SD*	Fern to upstream (Redlands)
3-550-00	**REDLANDS DRAINAGE SYSTEM^**	**General**
3-551-6A	Reservoir Canyon SD^	(Does not exist - pertained to Participation Project)

All facilities, unless denoted otherwise, are operated and maintained by the Flood Control District.

" owned (via r/w or easement) by FCD but not maintained * owned by others ^ not owned, use as correspondence file number only

** used only during Federal Project coordination

Revised 1/2010

CITY OF REDLANDS

PUBLIC WORKS DEPARTMENT

HYDROLOGY STUDY

MILL CREEK ZANJA STORM DRAIN

Prepared by:

BSI Consultants, Inc.

CITY OF REDLANDS
30 CAJON STREET - CITY HALL
REDLANDS, CALIFORNIA 92373

HYDROLOGY STUDY

MILL CREEK ZANJA STORM DRAIN

PREPARED BY:

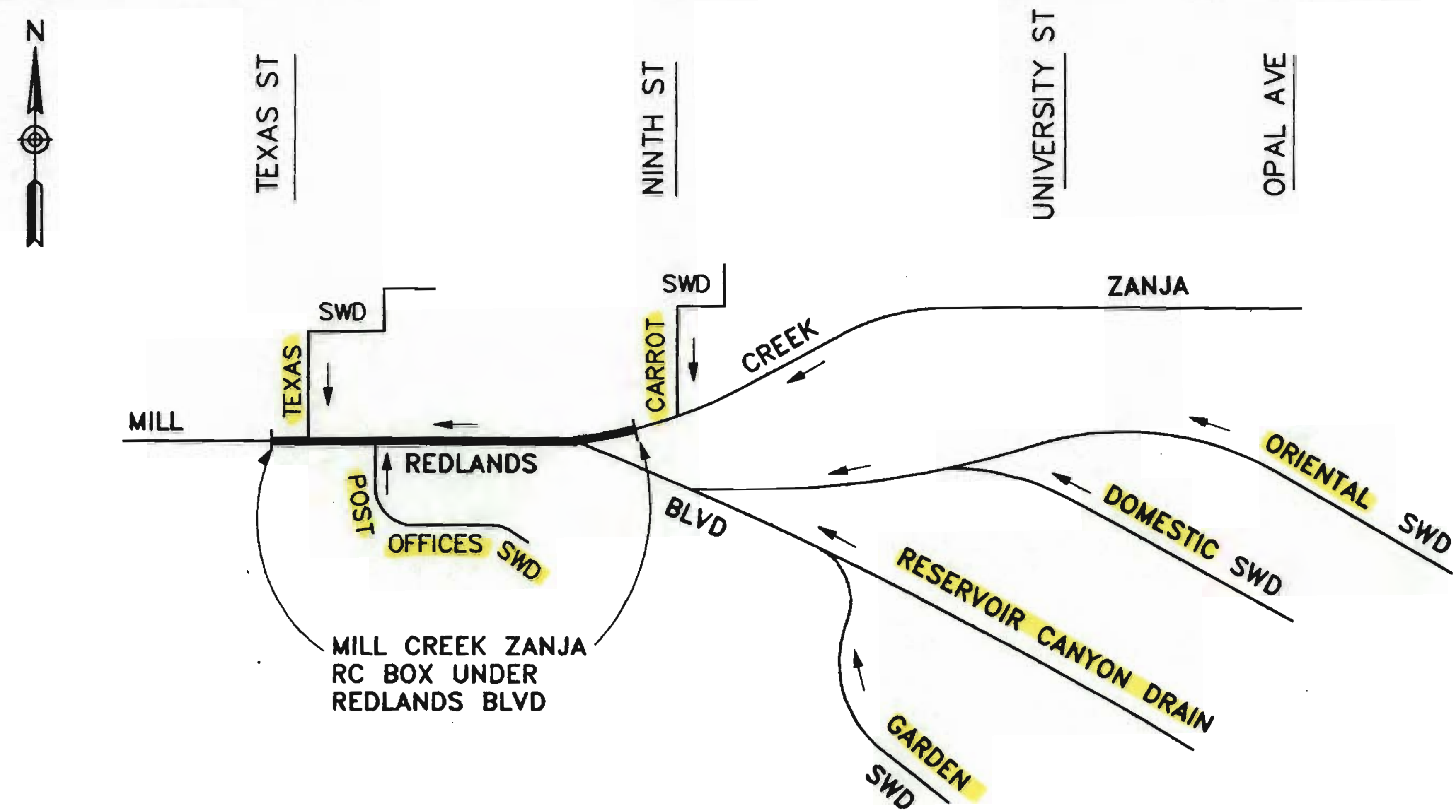
BSI CONSULTANTS, INC.
2001 EAST FIRST STREET
SANTA ANA, CALIFORNIA 92701
(714) 568-7300

Under the Supervision of:

REGISTERED PROFESSIONAL ENGINEER
MOHAMMED NAJIEB KHAN ROWTHER
37127
CIVIL
STATE OF CALIFORNIA

SIGNATURE *Mohammed Rowther* DATE 6/17/89

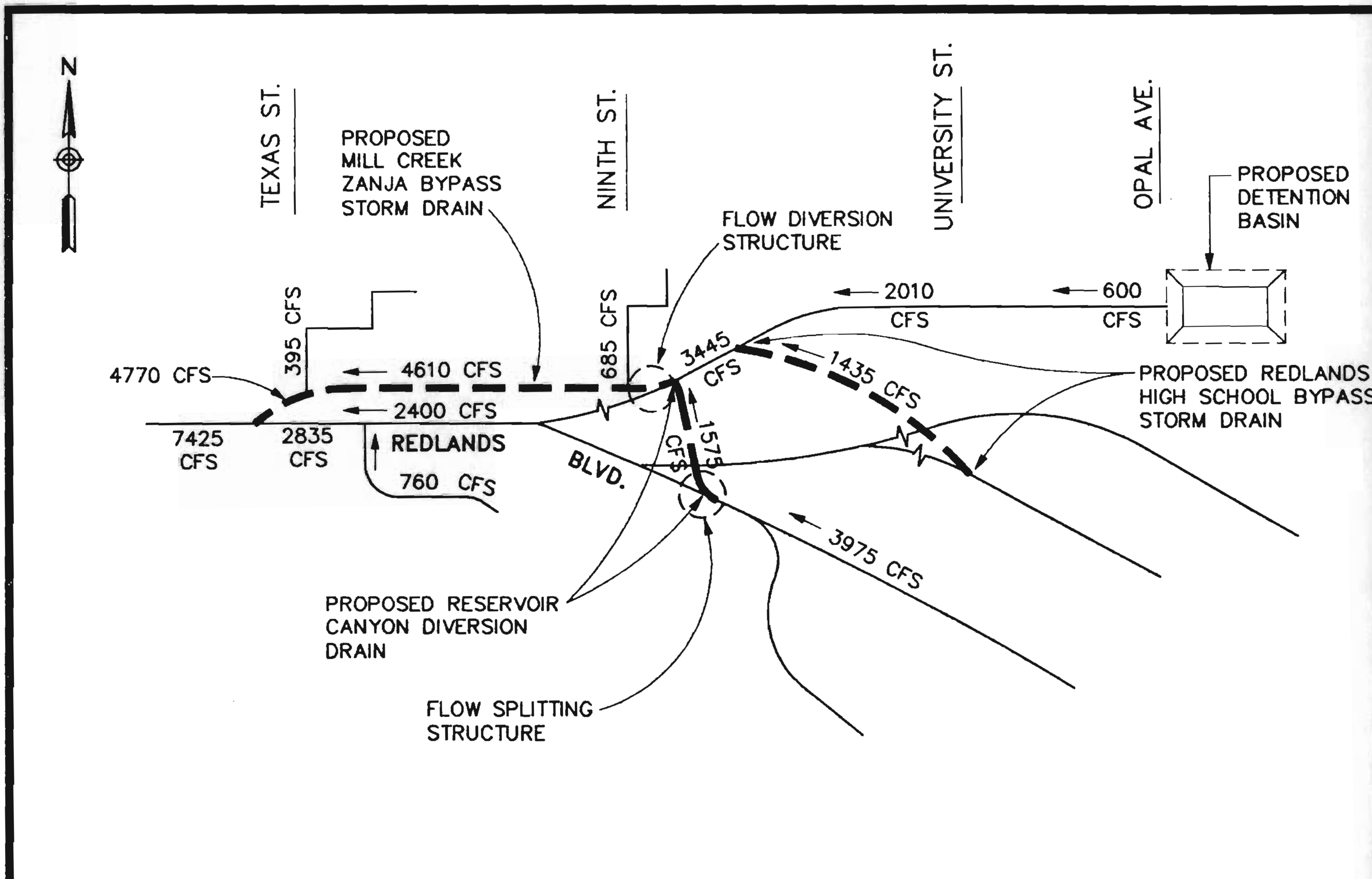
Mohammed N.K. Rowther, P.E.



BSI CONSULTANTS, INC.
2001 E. First Street
Santa Ana CA 91406
(714)568-7300
(714)836-5906 Fax

MILL CREEK & REDLANDS
HIGH SCHOOL BYPASS S.D.

EXISTING STORM DRAINS
Figure 1



BSI CONSULTANTS, INC.
2001 E. First Street
Santa Ana CA 91406
(714)568-7300
(714)836-5906 Fax

MILL CREEK & REDLANDS
HIGH SCHOOL BYPASS S.D.

100-YEAR PEAK FLOWS
Figure 2

F01060.17

MISSION ZANJA CREEK

CHANNEL IMPROVEMENT STUDY

FINAL

OCTOBER 1987

Prepared for:
SAN BERNARDINO COUNTY FLOOD CONTROL DISTRICT

Metcalf & Eddy

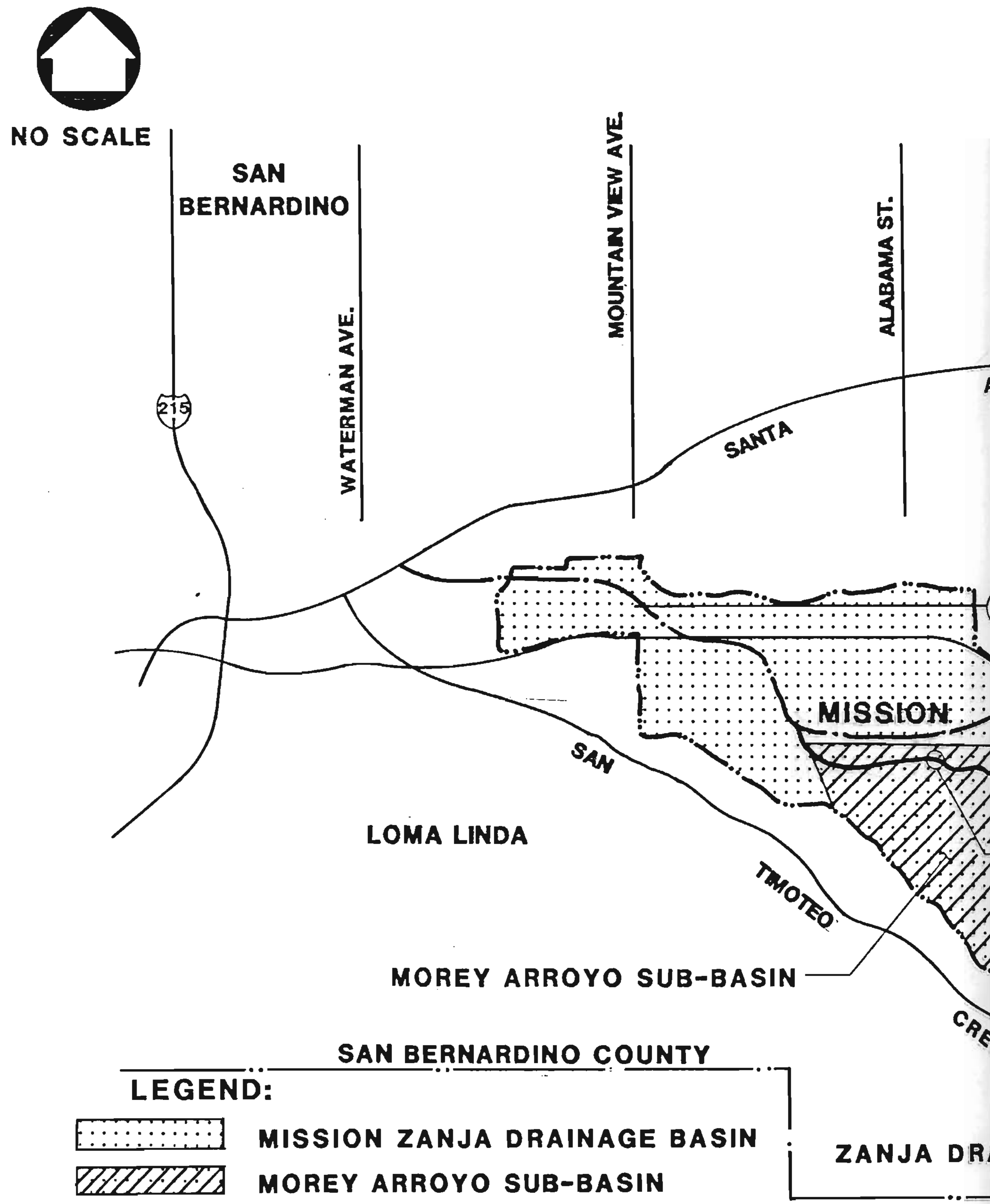
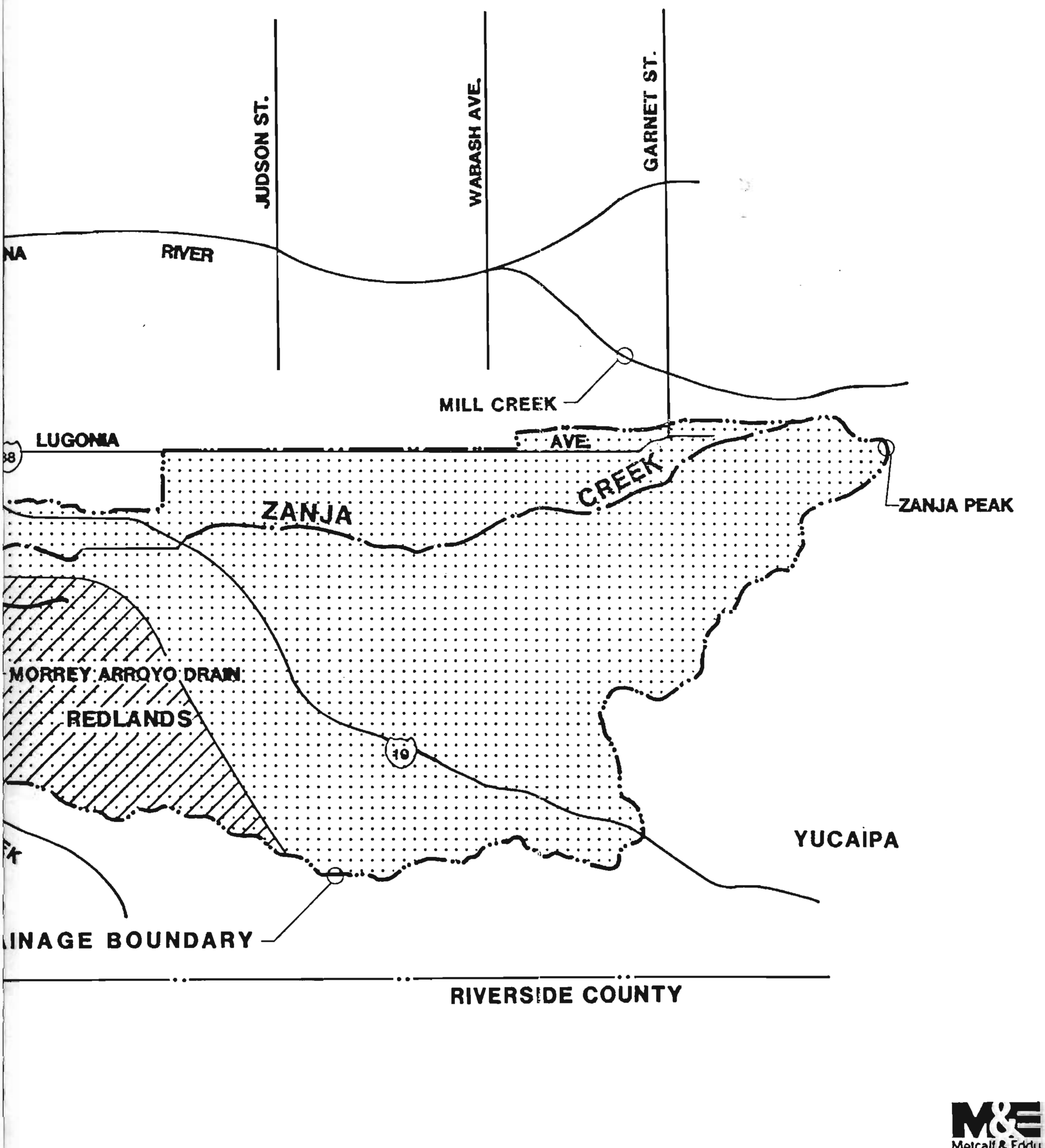
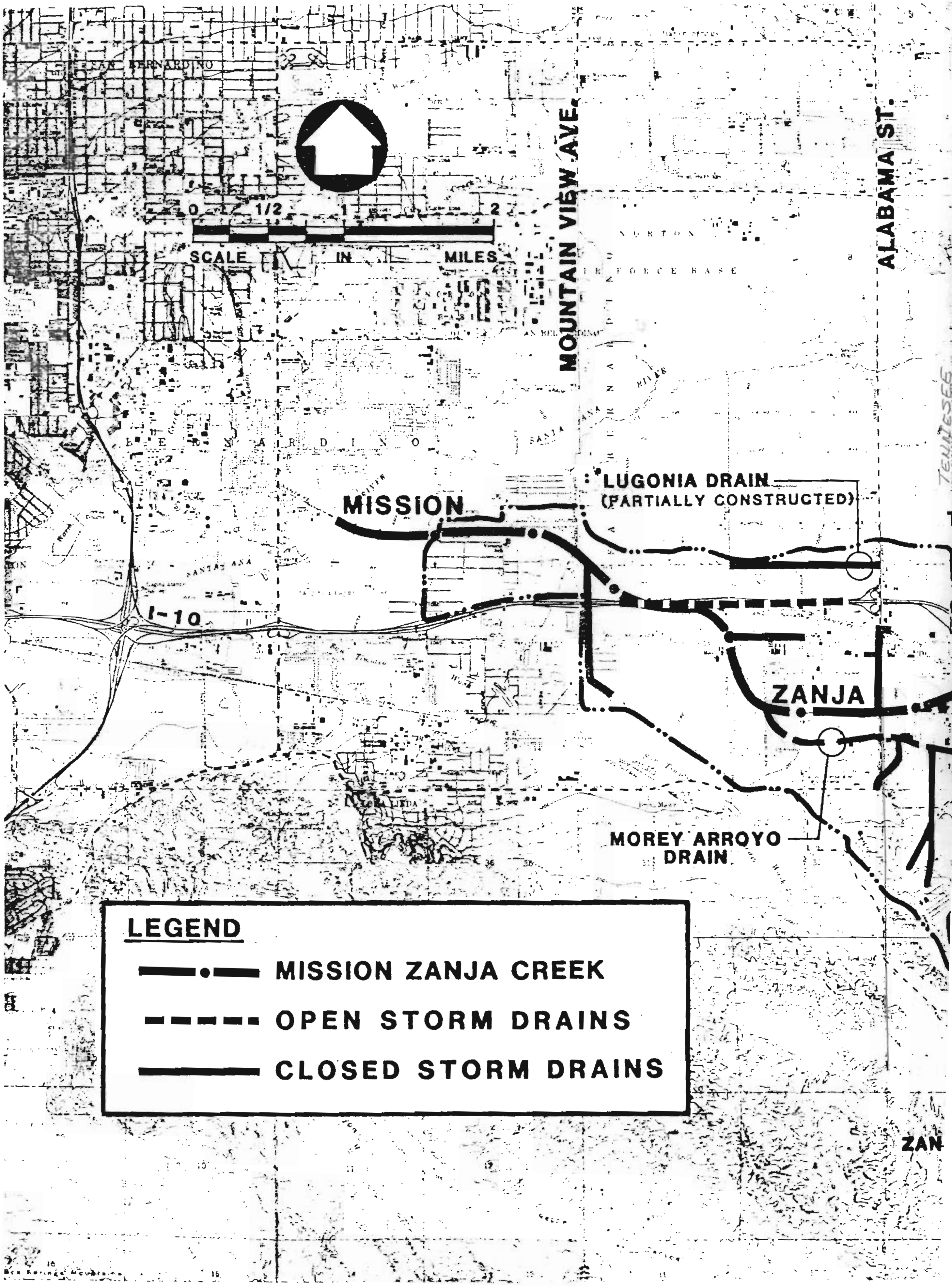

NO SCALE
SAN BERNARDINO
WATERMAN AVE.
MOUNTAIN VIEW AVE.
ALABAMA ST.
215
SANTA
MISSION
SAN
TIMOTEO
LOMA LINDA
MOREY ARROYO SUB-BASIN
SAN BERNARDINO COUNTY
LEGEND:
MISSION ZANJA DRAINAGE BASIN
MOREY ARROYO SUB-BASIN

FIGURE 3-1
MISSION ZANJA-STUDY AREA
LOCATION MAP




SAN BERNARDINO
0 1/2 1 2
SCALE IN MILES
MOUNTAIN VIEW AVE.
ALABAMA ST.
NORTON
AIR FORCE BASE
TENNESSEE
MISSION
LUGONIA DRAIN
(PARTIALLY CONSTRUCTED)
I-10
ZANJA
MOREY ARROYO
DRAIN
ZAN
LEGEND
MISSION ZANJA CREEK
OPEN STORM DRAINS
CLOSED STORM DRAINS

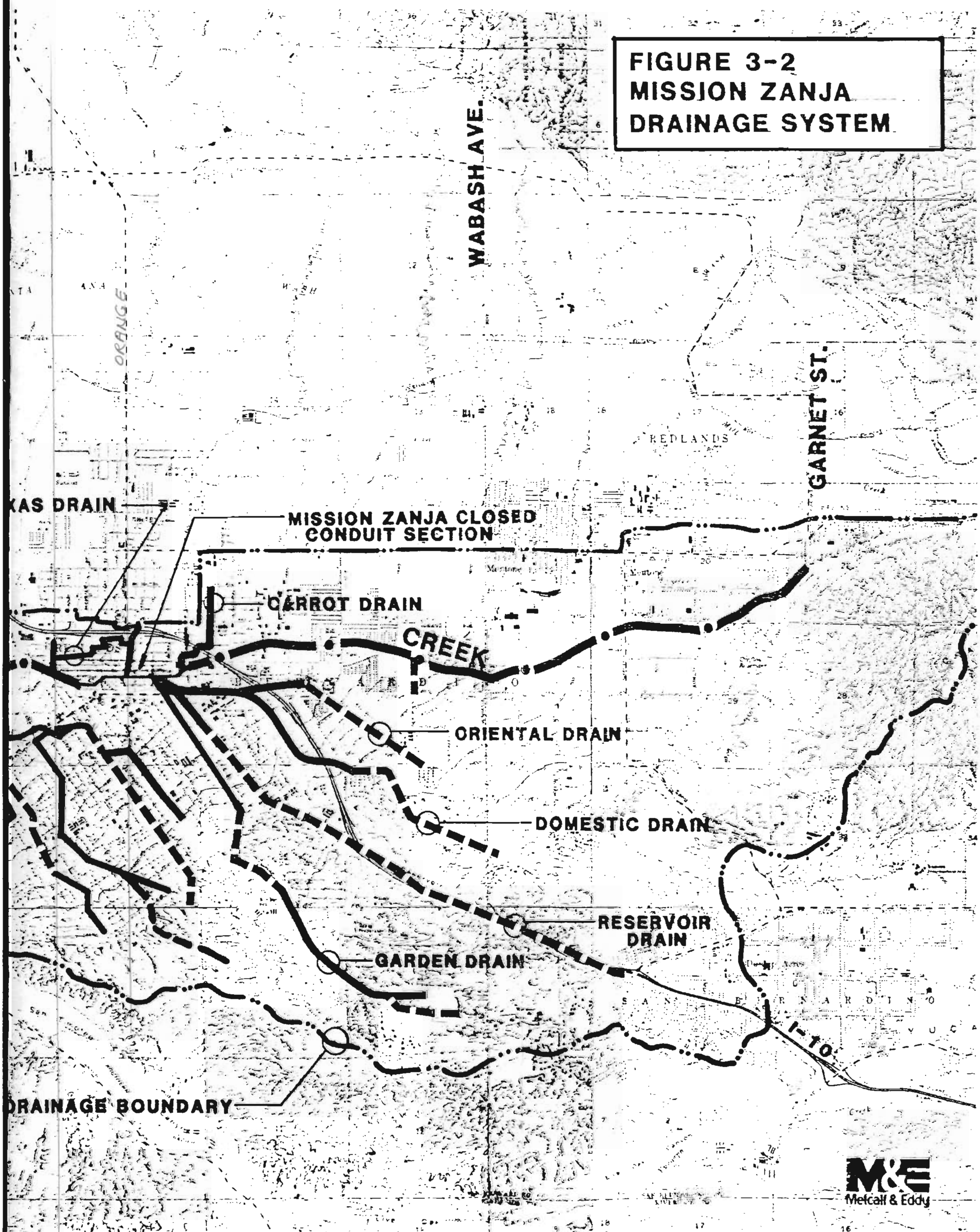


FIGURE 3-2
MISSION ZANJA
DRAINAGE SYSTEM
WABASH AVE.
GARNET ST.
ORANGE
REDLANDS
KAS DRAIN
MISSION ZANJA CLOSED
CONDUIT SECTION
CARROT DRAIN
CREEK
ORIENTAL DRAIN
DOMESTIC DRAIN
RESERVOIR
DRAIN
GARDEN DRAIN
DRAINAGE BOUNDARY
I-10
M&E
Metcalf & Eddy

MILL CREEK ZANJA DETENTION BASIN STUDY

ESPECIALLY PREPARED FOR

CITY OF REDLANDS

AND

SAN BERNARDINO COUNTY FLOOD CONTROL DISTRICT

OUR JOB NO. 85219.10

R21

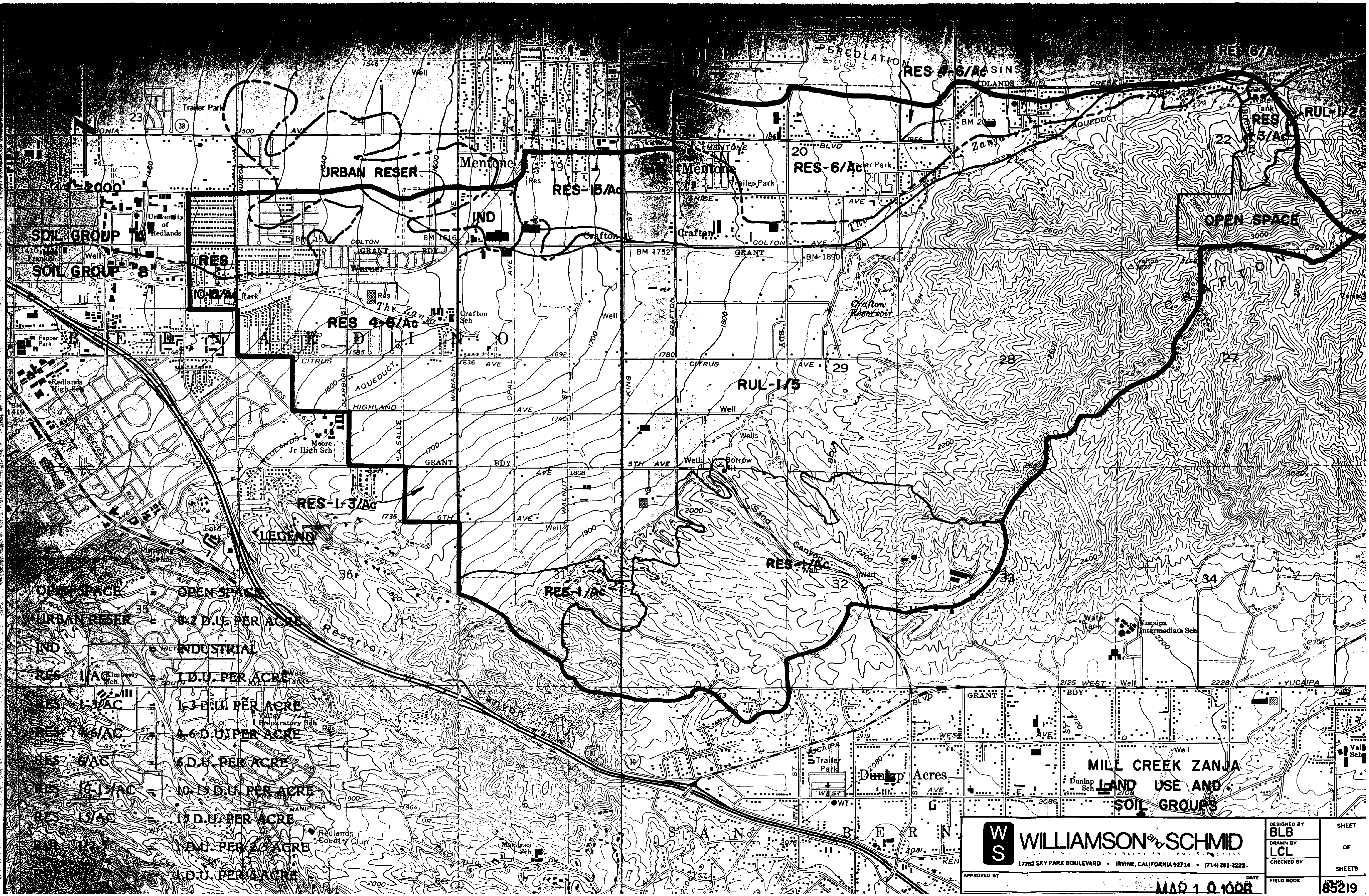
MARCH 18, 1986

WS

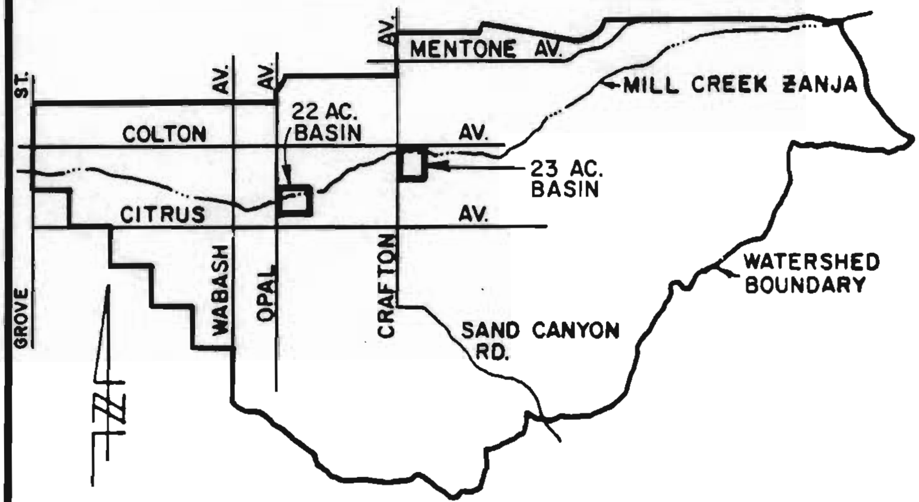
WILLIAMSON and SCHMID

CONSULTING CIVIL ENGINEERS AND LAND SURVEYORS

Corporate Office • 17782 Sky Park Blvd. • Irvine, California 92714 • 714/261-2222

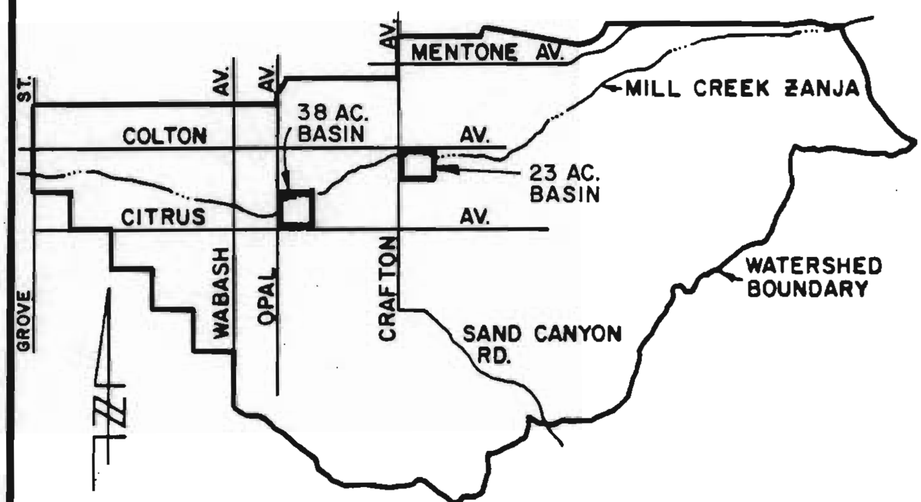


LEGEND
OPEN SPACE = OPEN SPACE
URBAN RESER = 0-2 D.U. PER ACRE
IND = INDUSTRIAL
RES 1/AC = 1 D.U. PER ACRE
RES 1-3/AC = 1-3 D.U. PER ACRE
RES 4-6/AC = 4-6 D.U. PER ACRE
RES 6/AC = 6 D.U. PER ACRE
RES 10-15/AC = 10-15 D.U. PER ACRE
RES 15/AC = 15 D.U. PER ACRE
= 1 D.U. PER 2.5 ACRE
= 1 D.U. PER 5 ACRE
SOIL GROUP "A"
SOIL GROUP "B"
URBAN RESER
RES-15/Ac
RES-6/Ac
RES 4-6/Ac
RES 4-6/Ac
RES 6/Ac
RES 10-15/Ac
RES 3/Ac
RUL-1/2.5
IND
OPEN SPACE
RUL-1/5
RES-1-3/Ac
RES-1/Ac
RES-1/Ac
Mentone
Crafton
Redlands High Sch
University of Redlands
Moore Jr High Sch
Crafton Reservoir
Dunlap Acres
Yucaipa Intermediate Sch
Redlands Country Club
MILL CREEK ZANJA
LAND USE AND
SOIL GROUPS
WILLIAMSON and SCHMID
17782 SKY PARK BOULEVARD • IRVINE, CALIFORNIA 92714 • (714) 261-2222
APPROVED BY
DATE
DESIGNED BY BLB
DRAWN BY LCL
CHECKED BY
FIELD BOOK
SHEET OF SHEETS
JOB NO. 85219



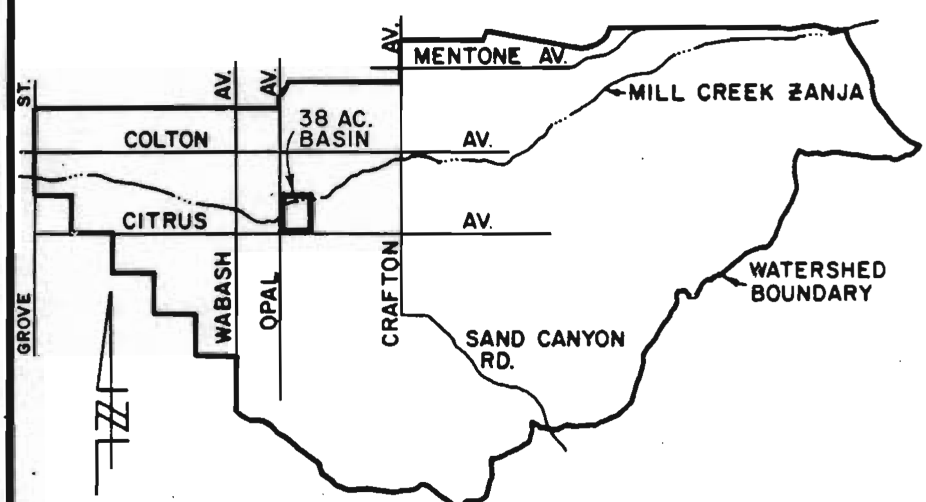
SCHEME A

2000 CFS AT GROVE STREET
CONSTRUCTION COSTS
= $4,400,000



SCHEME B

1670 CFS AT GROVE STREET
CONSTRUCTION COSTS
= $7,300,000



SCHEME C

1940 CFS AT GROVE STREET
CONSTRUCTION COSTS
= $4,200,000

WS WILLIAMSON and SCHMID
CONSULTING CIVIL ENGINEERS AND LAND SURVEYORS
17782 SKY PARK BOULEVARD
IRVINE, CALIFORNIA 92714

APPROVED BY

FIGURE 2

WATERSHED SCHEMATICS

SCALE	NO SCALE
DRAWN BY	WVB
SURVEYED BY	
CHECKED BY	
FIELD BOOK	
DATE	11-20-85
JOB NO.	85219.1

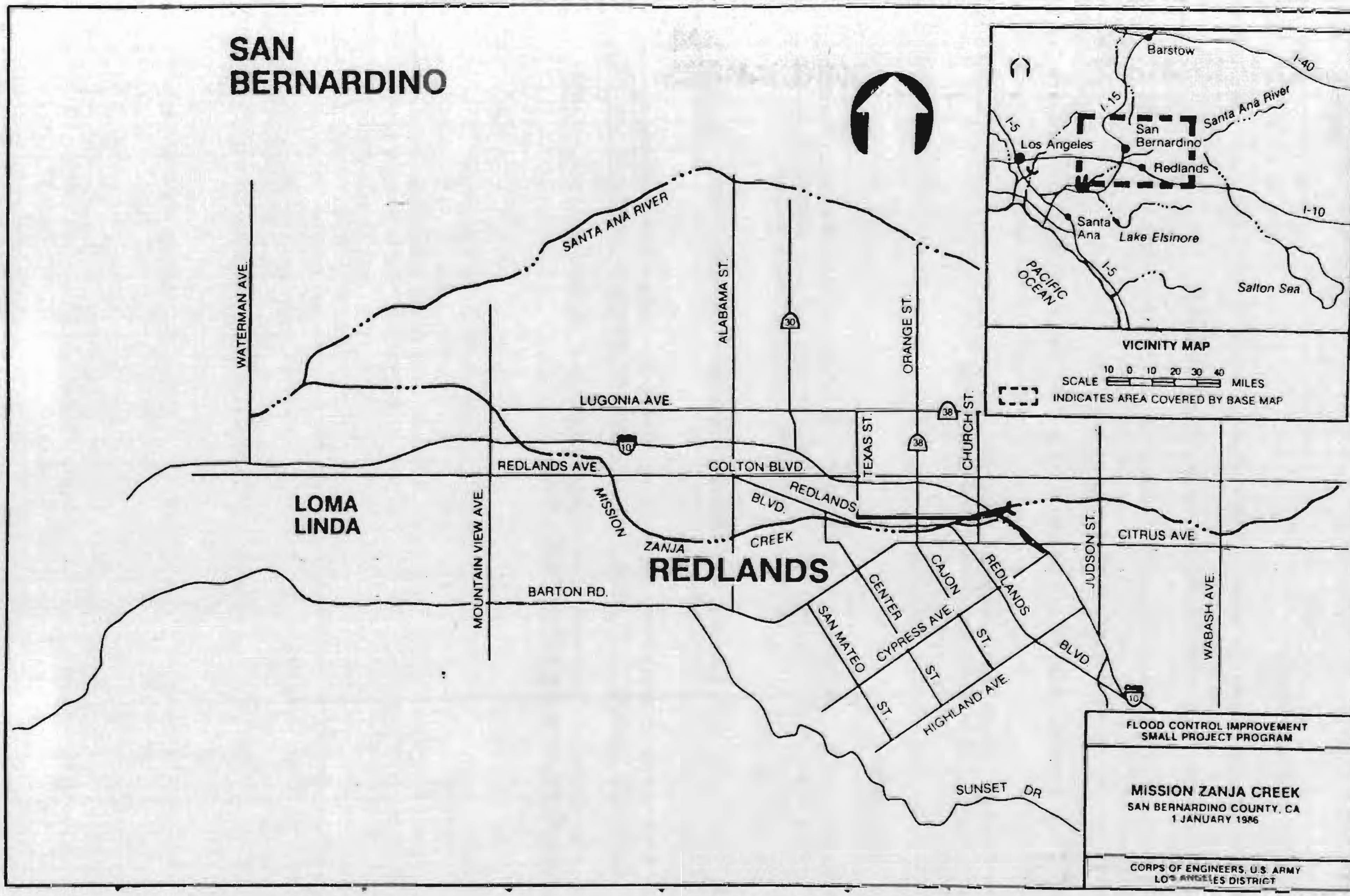
US Army Corps
of Engineers
Los Angeles District

Small Flood Control Project Authority
Detailed Project Report and
Environmental Assessment

MISSION ZANJA CREEK

City of Redlands,
San Bernardino County, California

FINAL



MISSION ZANJA CREEK VICINITY MAP

FIGURE 1

MISSION ZANJA CREEK PROJECT LOCATION
32' WIDTH OPEN CHANNEL
13' x 14-1/2' REINFORCED CONCRETE BOX
9' DIAMETER PIPE
SYLVAN PARK
JENNIE DAVIS PARK
DISSIPATOR END OF PROJECT
INLET 1
INLET 2
R.C. SPLITTER STRUCTURE
RESERVOIR CANYON DRAIN (BY OTHERS)
MISSION ZANJA CREEK
COLTON AVE
INTERSTATE 10
STUART AVE
AT & SF RR
SP RR
CENTRAL AVE
STATE ST
CITRUS AVE
REDLANDS BLVD
BROOKSIDE AVE
OLIVE AVE
CENTER ST
EUREKA ST
CAJON ST
TENNESSEE ST
NEW YORK ST
TEXAS ST
ORANGE ST
6TH ST
7TH ST
9TH ST
CHURCH ST
DIVISION ST
SYLVAN ST
UNIVERSITY ST
RCP
N
LEGEND
MISSION ZANJA CREEK
EXIST CHANNEL
CULVERT
RESERVOIR CANYON
OPEN CHANNEL
CULVERT
600 0 600 1200 1800
SCALE IN FEET
MISSION ZANJA CREEK
REDLANDS, CALIFORNIA
RECOMMENDED PLAN
US ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

FIGURE 2

BASIC FEATURES OF MAIN INLET

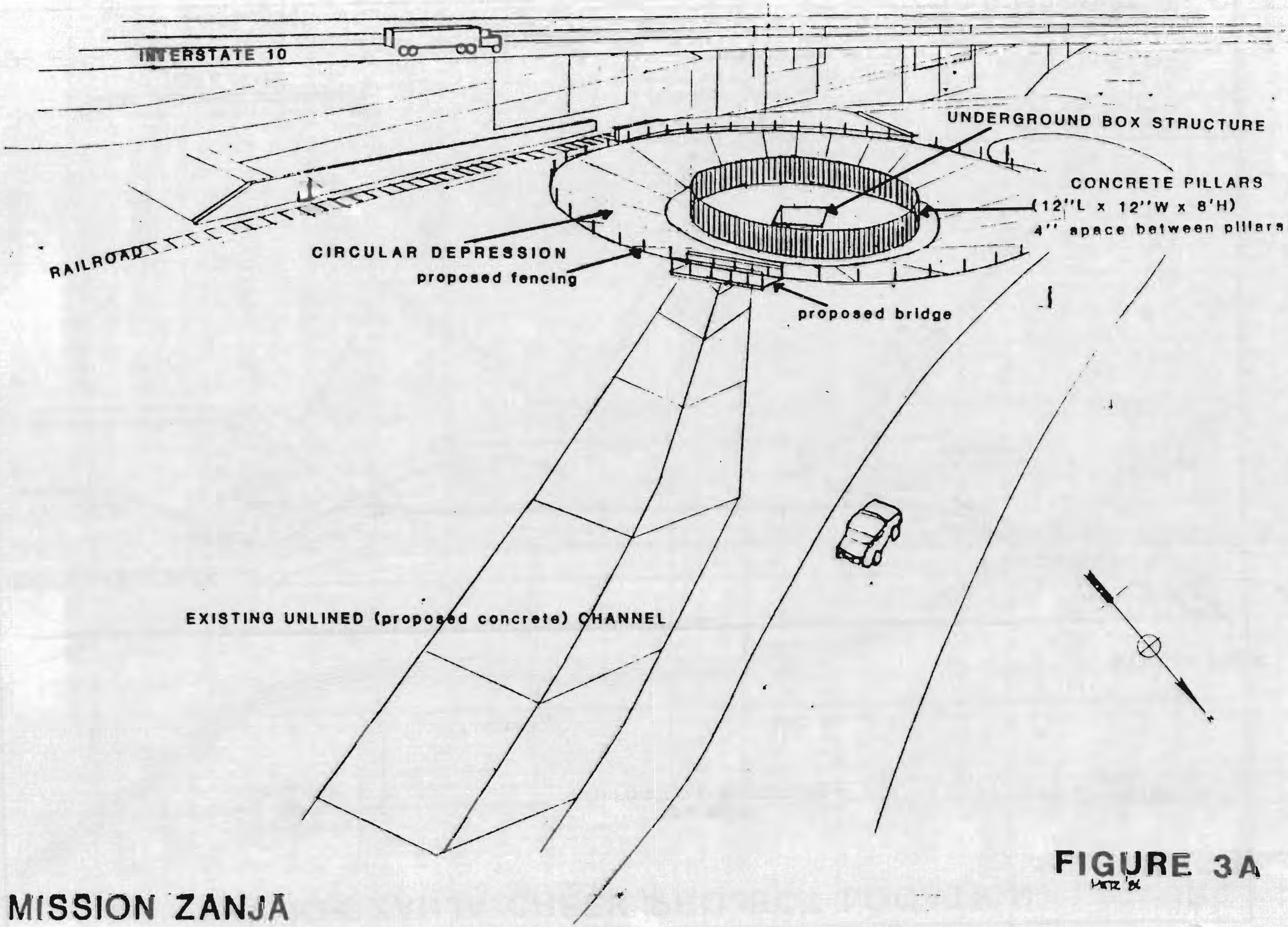


FIGURE 3A

MISSION ZANJA

POSSIBLE ESTHETIC ENHANCEMENT OF MAIN INLET STRUCTURE

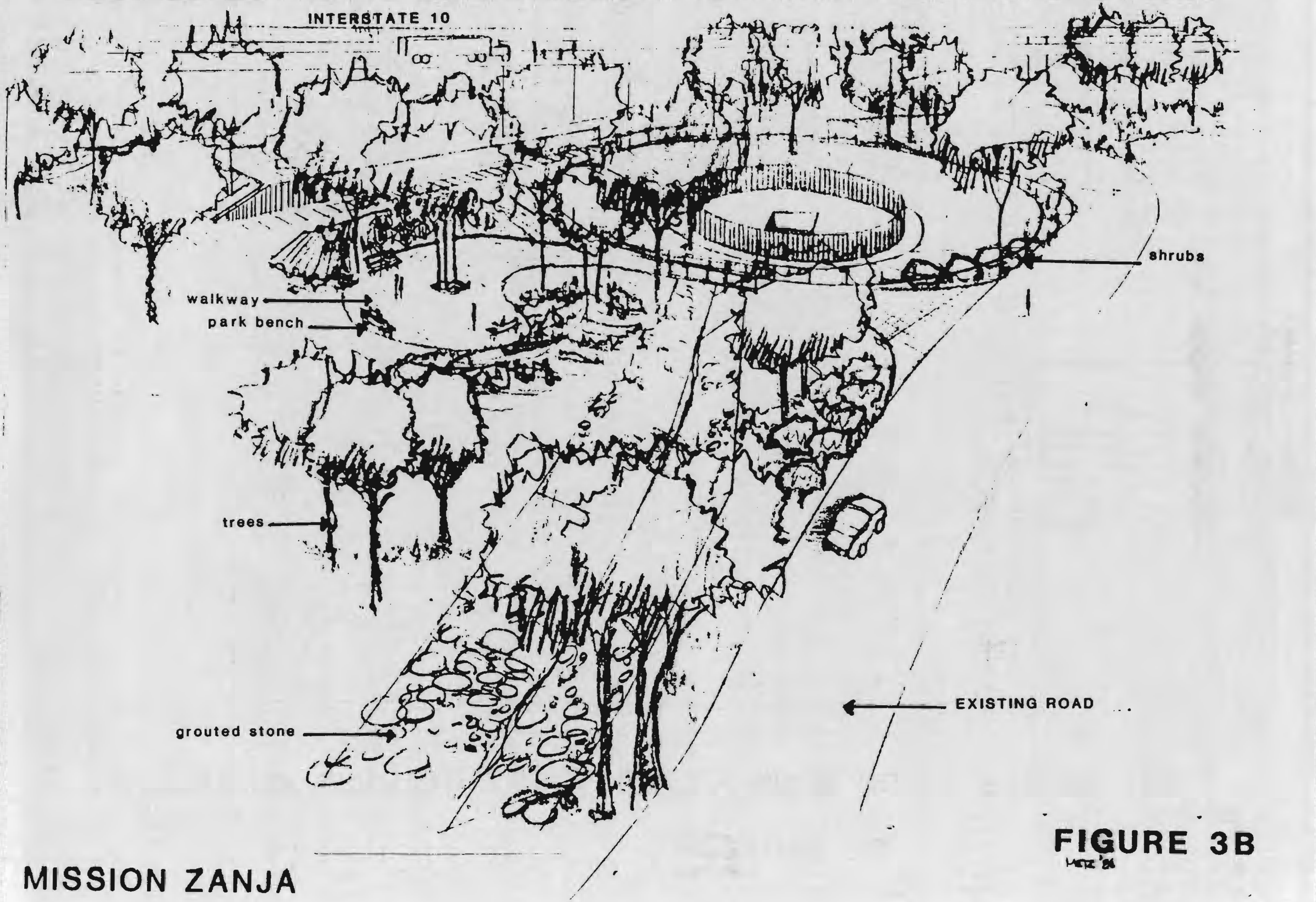
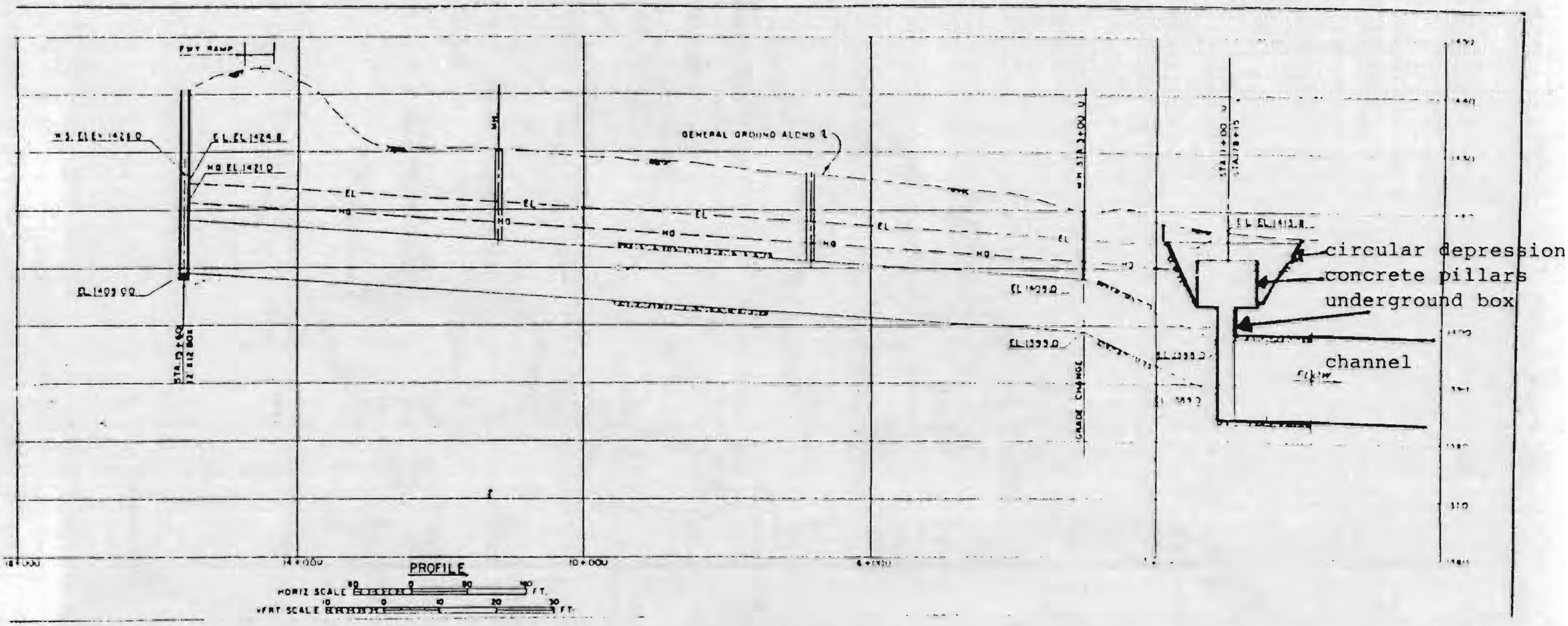


FIGURE 3B

MISSION ZANJA

PROFILE OF MISSION ZANJA CREEK MAIN INLET STRUCTURE



NOTE: The main inlet structure will be located in and adjacent to the existing channel (see Figure 3A) and will collect flows from the secondary inlet structure, overland flow in the area emanating from Mission Zanja Creek and flows from the Mission Zanja Creek existing channel. The main inlet will be a circular depression, 180 feet in diameter. Vertical concrete pillars within the depression will control the entrance of the water into the structure and prevent large debris from entering the structure.

FIGURE 3C

MISSION ZANJA CREEK SECONDARY INLET STRUCTURE

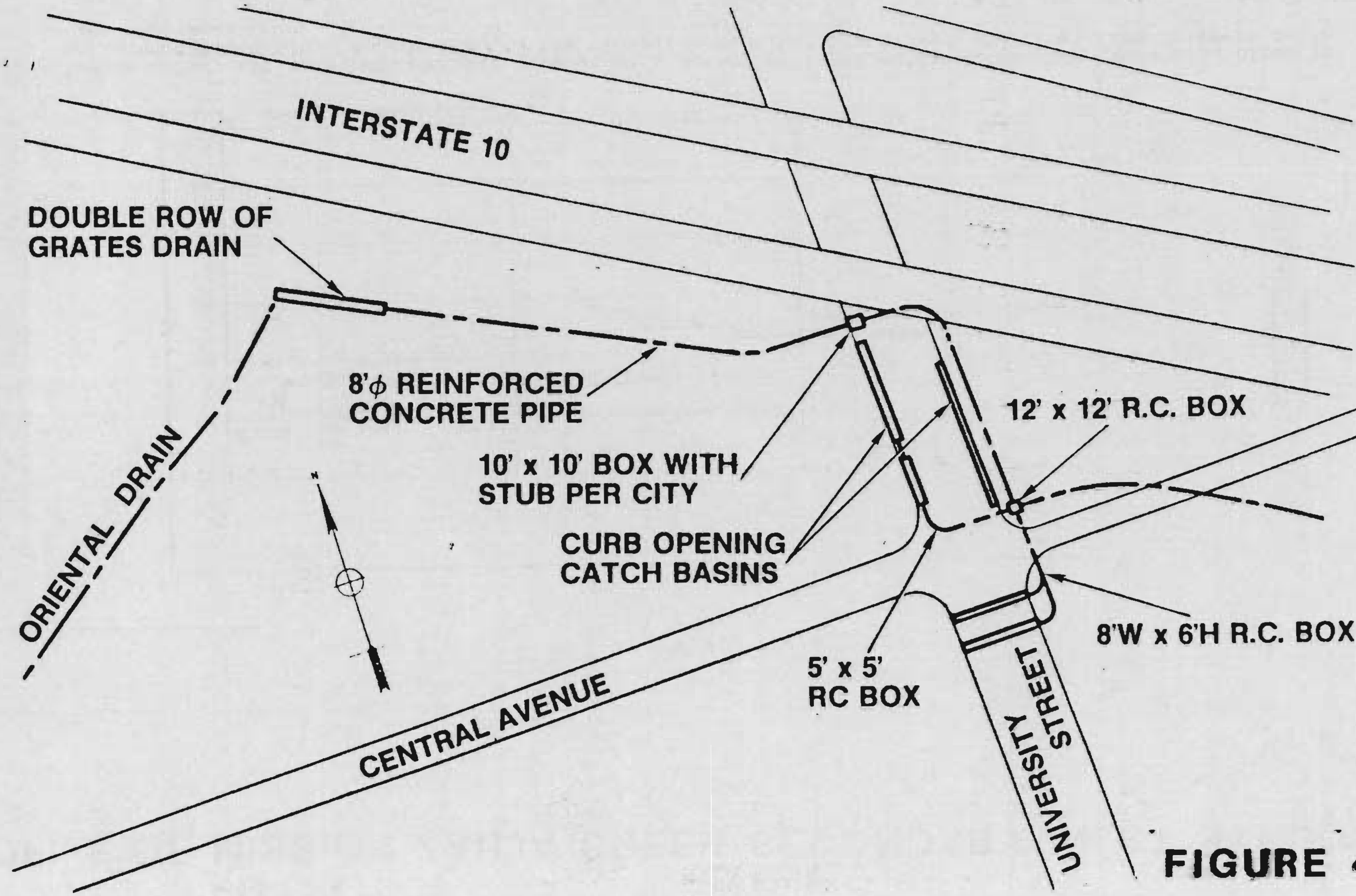
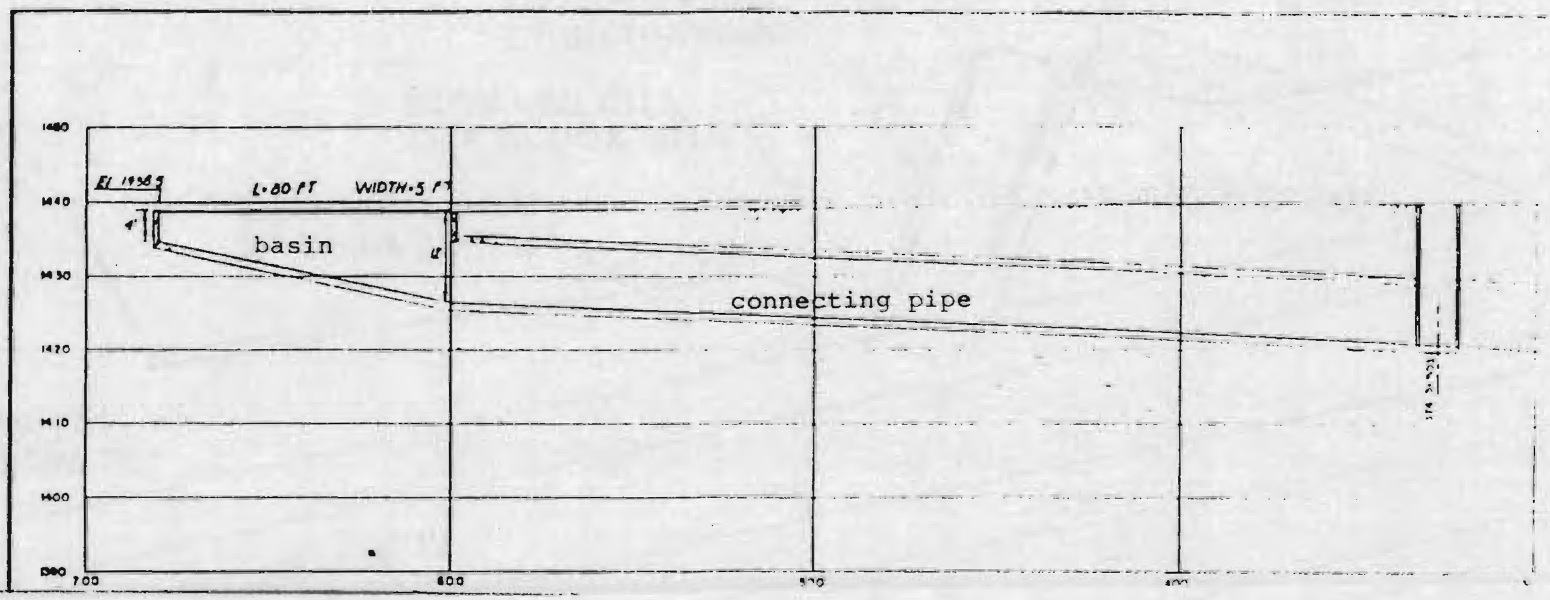


FIGURE 4A

PROFILE OF MISSION ZANJA CREEK SECONDARY INLET STRUCTURE

(typical)



NOTE: The secondary outlet structure will consist of a series of small catch basins and connecting pipes to collect overland flow, street flow in the vicinity of University Street and flows from Oriental Drain (see Figure 4A).

FIGURE 4B

MISSION ZANJA CREEK OUTLET (dissipator) STRUCTURE

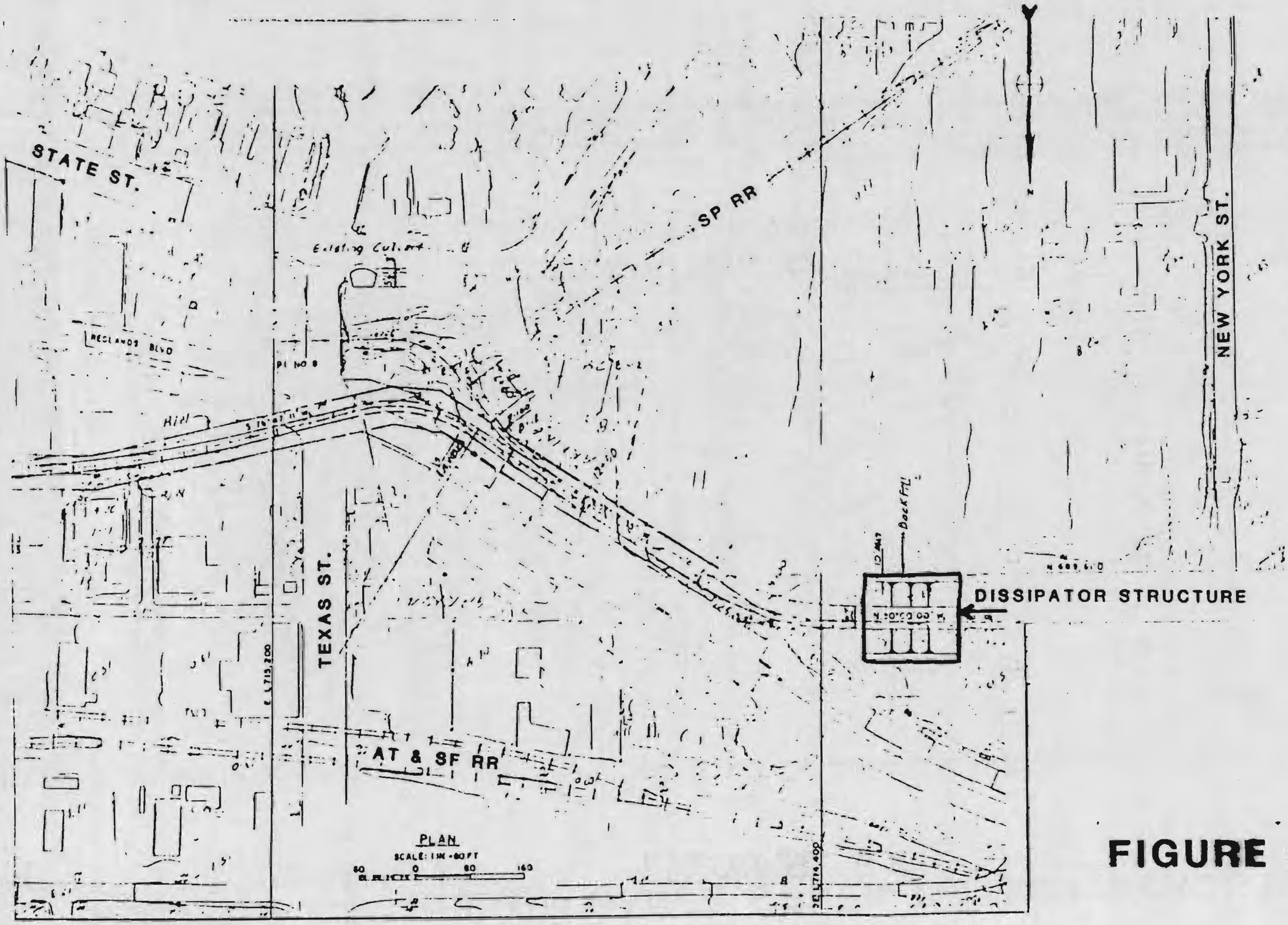
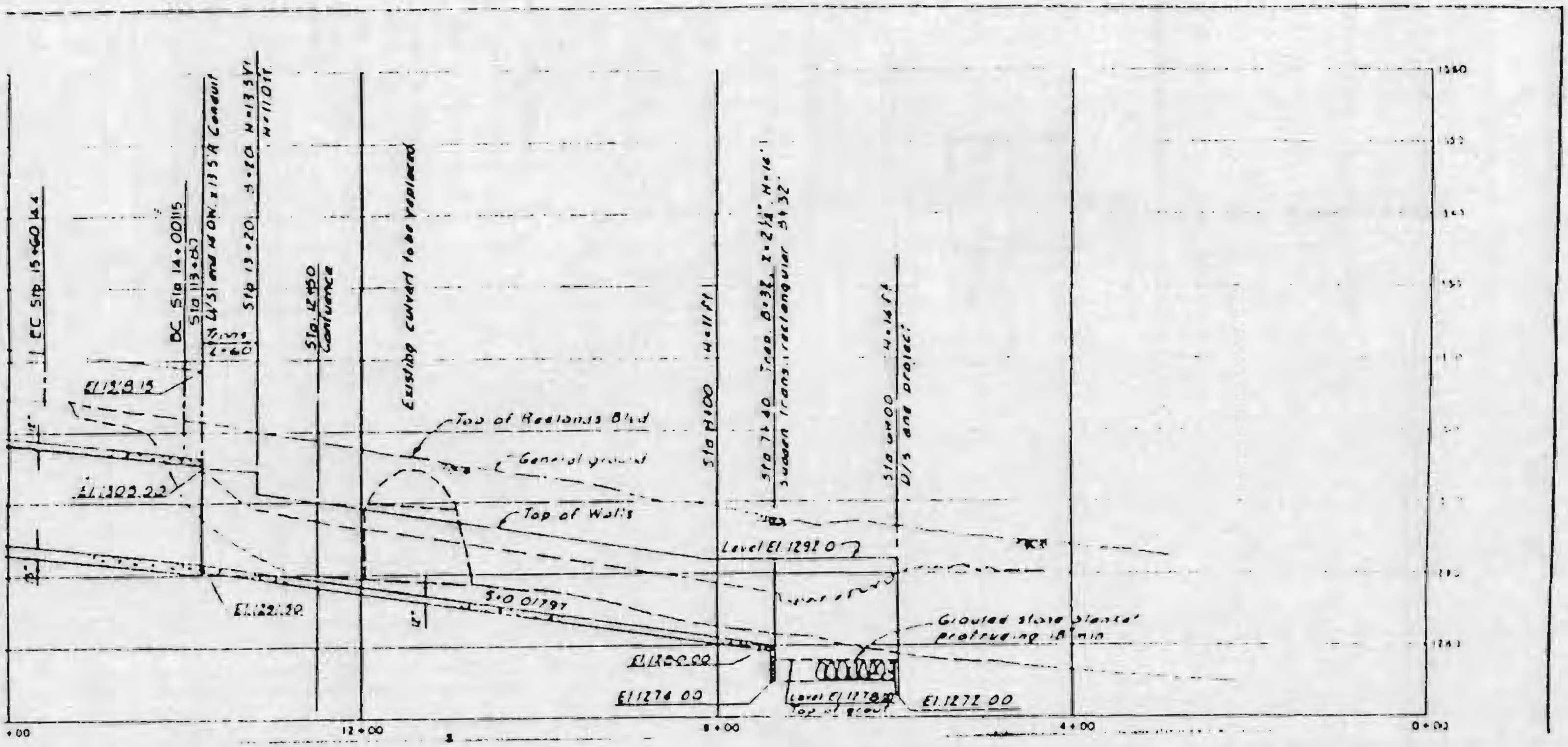


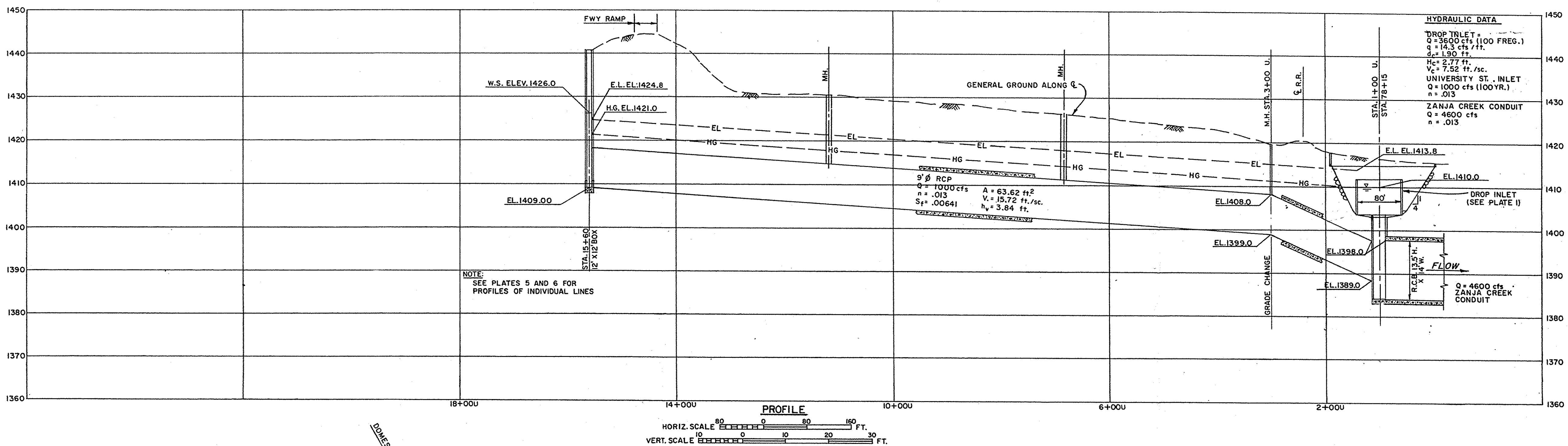
FIGURE 5A

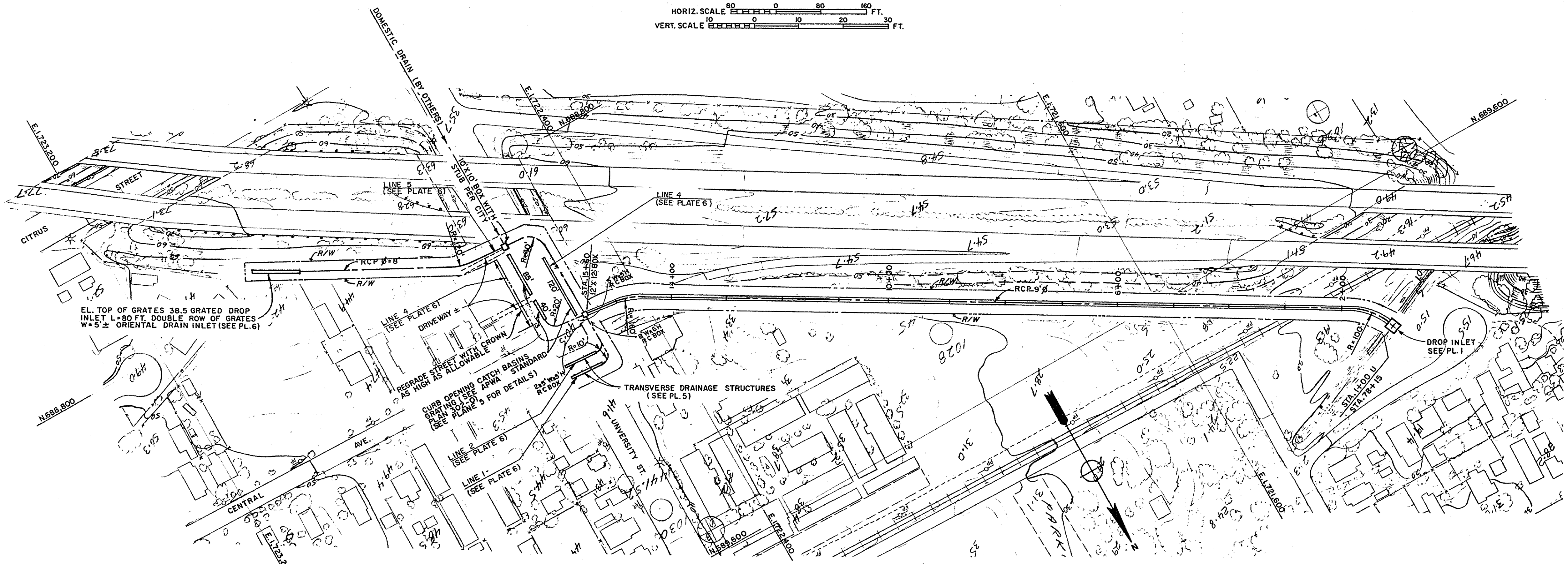
PROFILE OF MISSION ZANJA CREEK OUTLET STRUCTURE
(dissipator)



NOTE: The existing open channel downstream of Texas Street will be expanded to accept the required discharge. This new channel would have a concrete lined rectangular section with a base width of 12 feet and a wall height of 10 feet. This channel will convey flows a distance of 1200 feet downstream to a dissipator structure. The dissipator structure (outlet) will be a trapezoidal-shaped section of channel, 140 feet long and 120 feet wide at the top, with a grouted stone rough finish.

FIGURE 5B





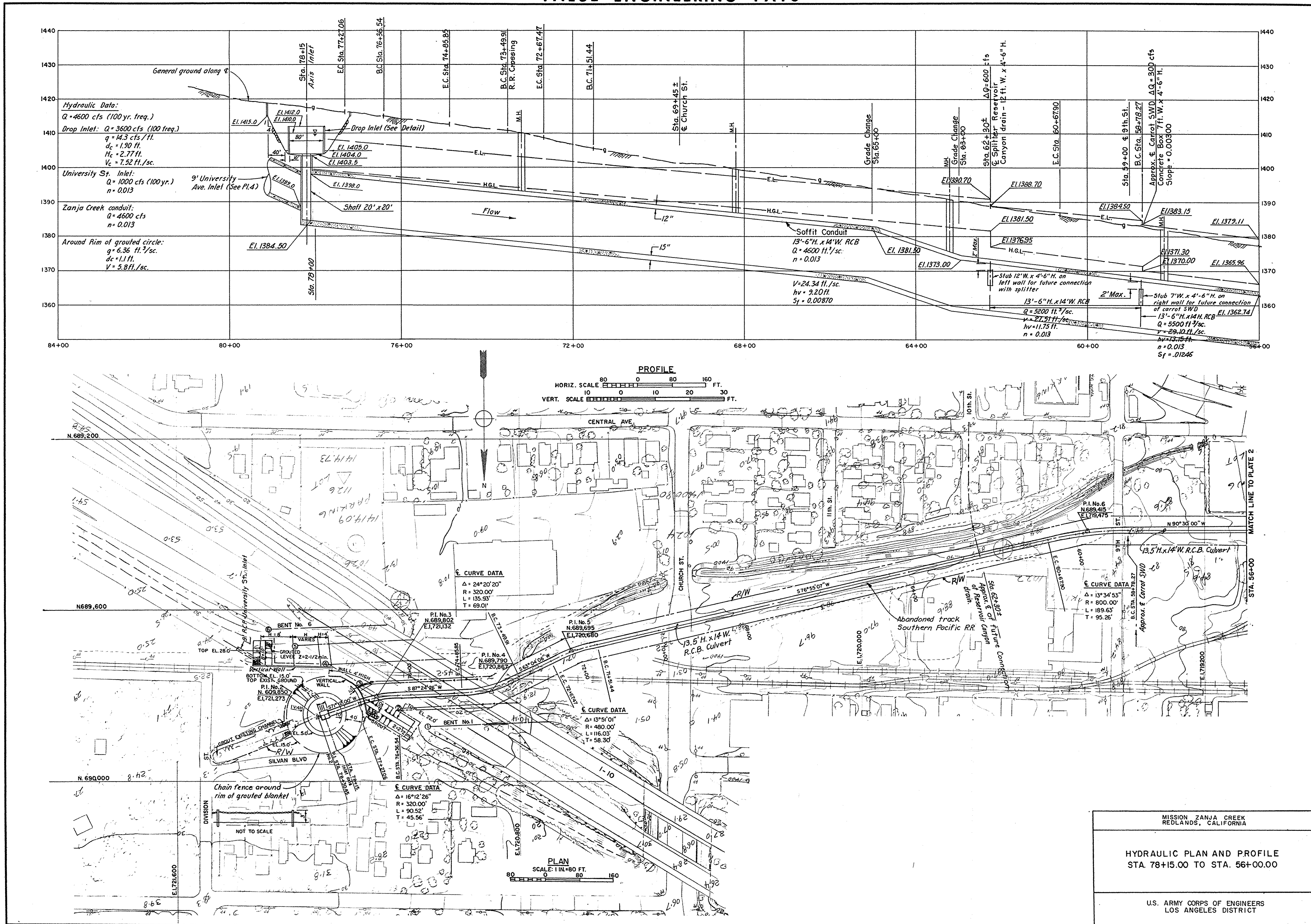
PLAN

SCALE: 1 IN. = 80 FT.

MISSION ZANJA CREEK
REDLANDS, CA

UNIVERSITY STREET
SECONDARY CHANNELS
HYDRAULIC PLAN AND PROFILE
STA. 15+60U TO STA. 1+00U

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT


Hydraulic Data:
Q = 4600 cfs (100 yr. freq.)
Drop Inlet: Q = 3600 cfs (100 freq.)
q = 14.3 cfs / ft.
dc = 1.90 ft.
Hc = 2.77 ft.
Vc = 7.52 ft./sc.
University St. Inlet:
Q = 1000 cfs (100 yr.)
n = 0.013
Zanja Creek conduit:
Q = 4600 cfs
n = 0.013
Around Rim of grouted circle:
q = 6.36 ft.³/sc.
dc = 1.1 ft.
V = 5.8 ft./sc.
General ground along ℄
Drop Inlet (See Detail)
9' University Ave. Inlet (See Pl. 4)
Shaft 20' x 20'
Flow
Soffit Conduit
13'-6"H. x 14'W. RCB
Q = 4600 ft.³/sc.
n = 0.013
V = 24.34 ft./sc.
hv = 9.20 ft.
Sf = 0.00870
Sta. 78+15 Axis Inlet
Sta. 69+45 ± ℄ Church St.
Grade Change Sta. 65+00
Grade Change Sta. 63+00
Sta. 62+30 ± ℄ Splitter Reservoir Canyon drain - 12 ft. W. x 4'-6" H.
E.C. Sta. 60+67.90
Sta. 59+00 ℄ 9th St.
Approx. ℄ Carrot SWD ΔQ = 300 cfs Concrete Box 7 ft. W. x 4'-6" H. Slope = 0.00300
Stub 12' W. x 4'-6" H. on left wall for future connection with splitter
Stub 7' W. x 4'-6" H. on right wall for future connection of carrot SWD
13'-6" H. x 14' W. RCB
Q = 5200 ft.³/sc.
13'-6" H. x 14 H. RCB
Q = 5500 ft.³/sc.
n = 0.013
Sf = .01246
PROFILE
HORIZ. SCALE
VERT. SCALE
CENTRAL AVE.
CHURCH ST.
11th St.
10th St.
9TH ST.
SILVAN BLVD
I-10
13.5' H. x 14' W. R.C.B. Culvert
Abandoned track Southern Pacific R.R.
℄ CURVE DATA
Chain fence around rim of grouted blanket
NOT TO SCALE
PLAN
SCALE: 1 IN. = 80 FT.
MATCH LINE TO PLATE 2
STA. 56+00
MISSION ZANJA CREEK
REDLANDS, CALIFORNIA
HYDRAULIC PLAN AND PROFILE
STA. 78+15.00 TO STA. 56+00.00
U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT

PLATE

General Investigations

US Army Corps
of Engineers
Los Angeles District

FEDERAL PROJECTS

Reconnaissance Study

Flood Control and Related Purposes

MISSION ZANJA CREEK
San Bernardino County, California

February 1994

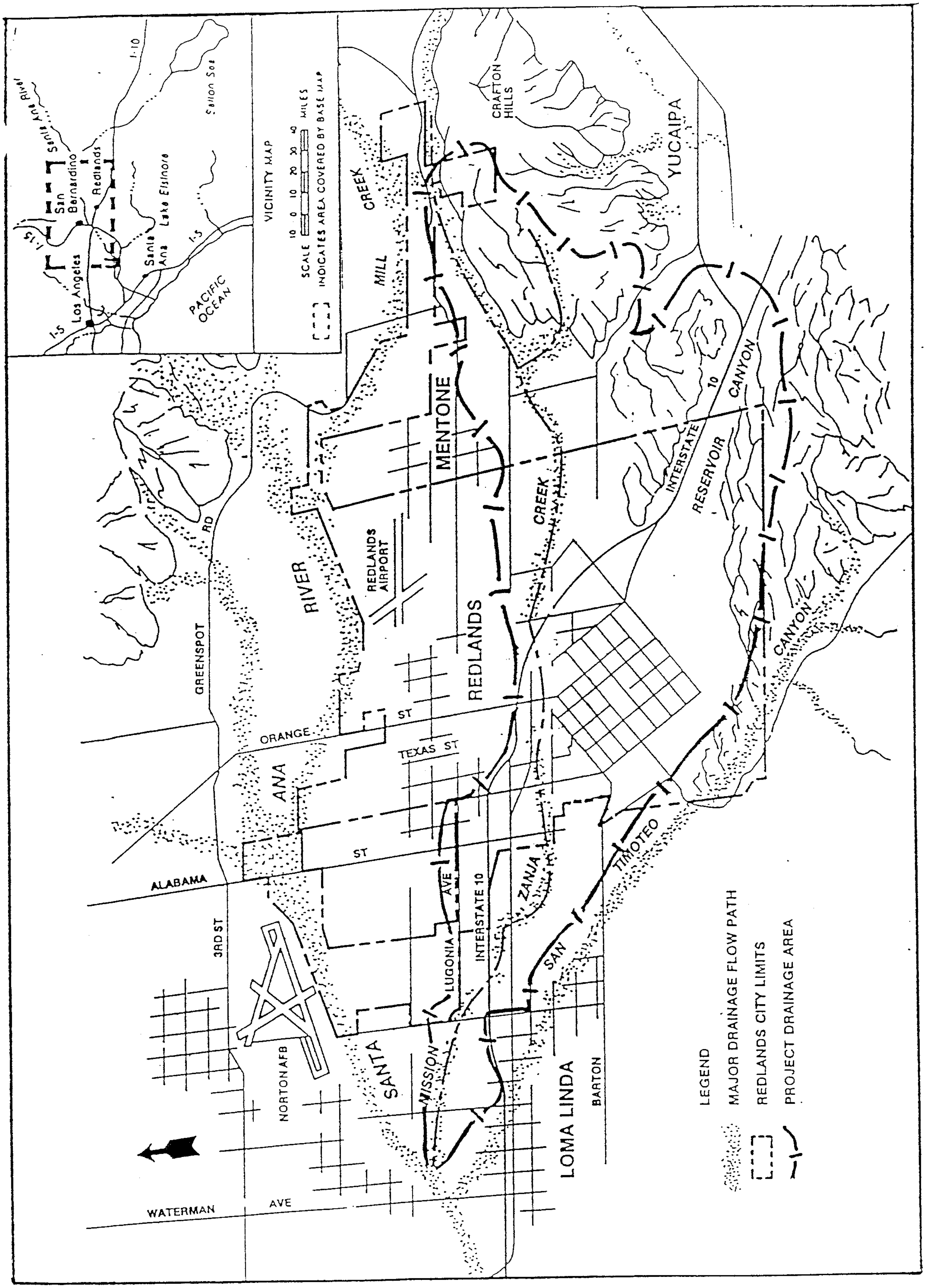


Figure 2. Study Area

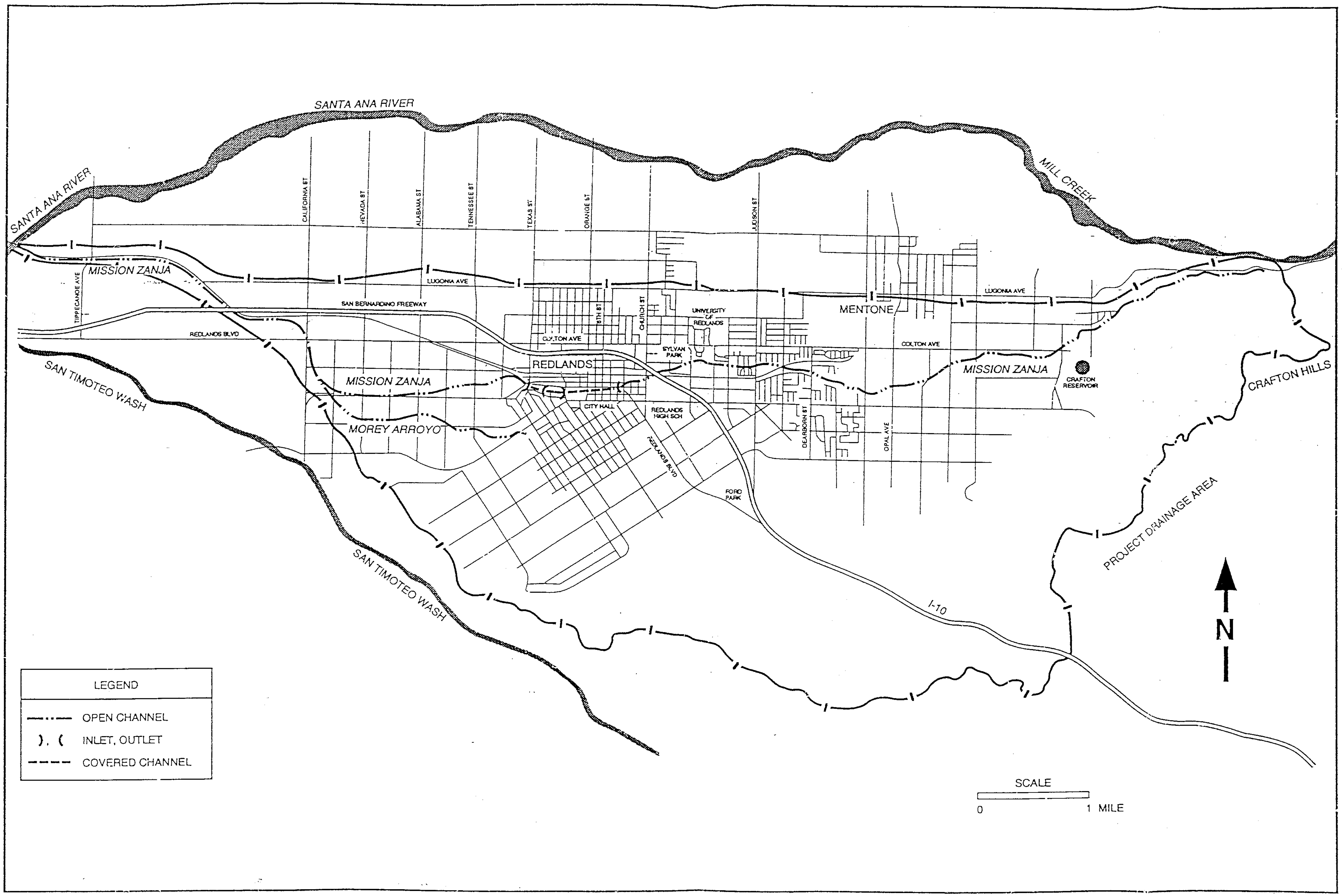


Figure 3. Mission Zanja Creek Drainage

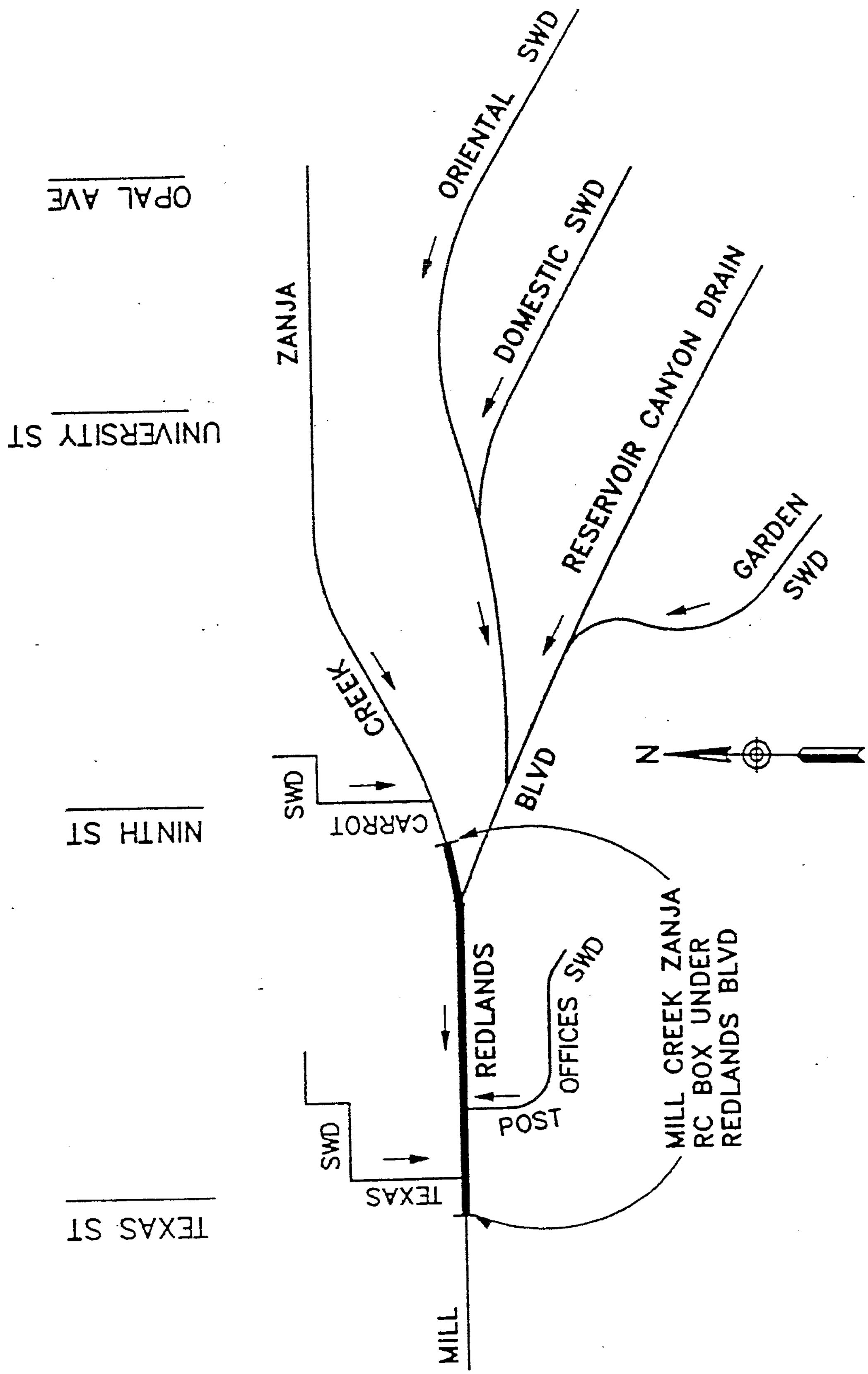


Figure 4. Mission Zanja Creek Stormwater Drains

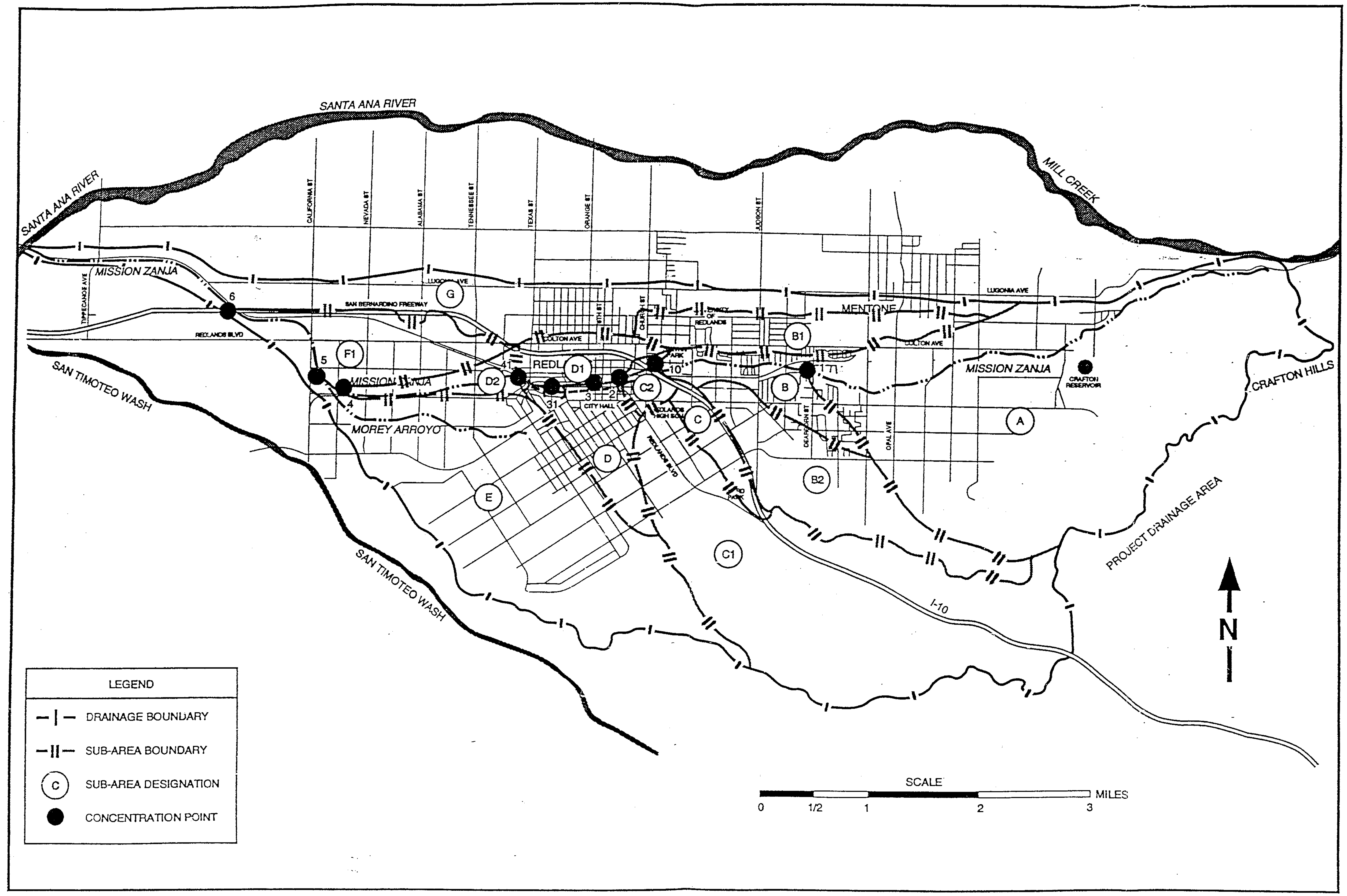


Figure 11. Drainage Boundaries and Concentration Points

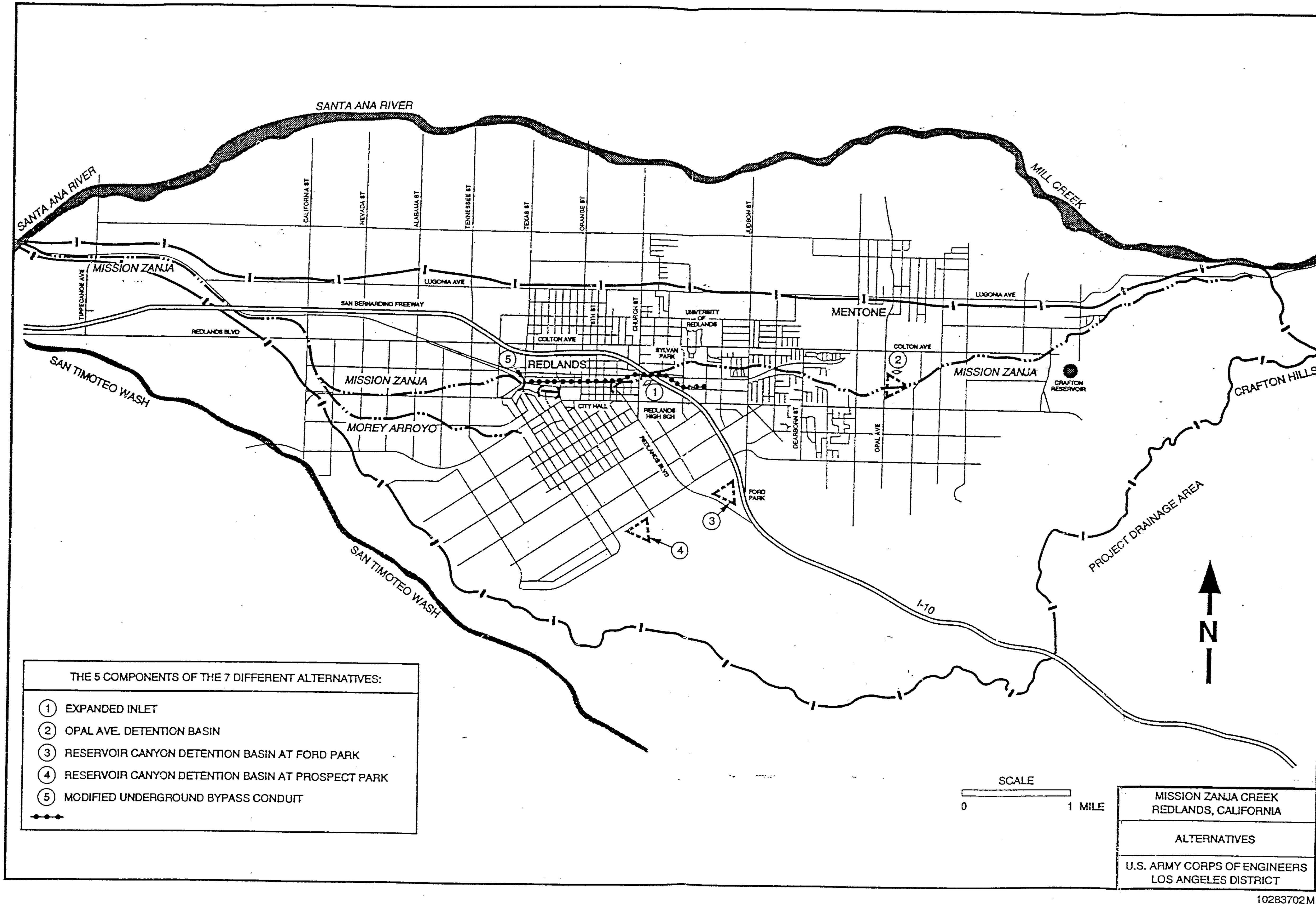


Figure 13. Flood Control Measures Considered

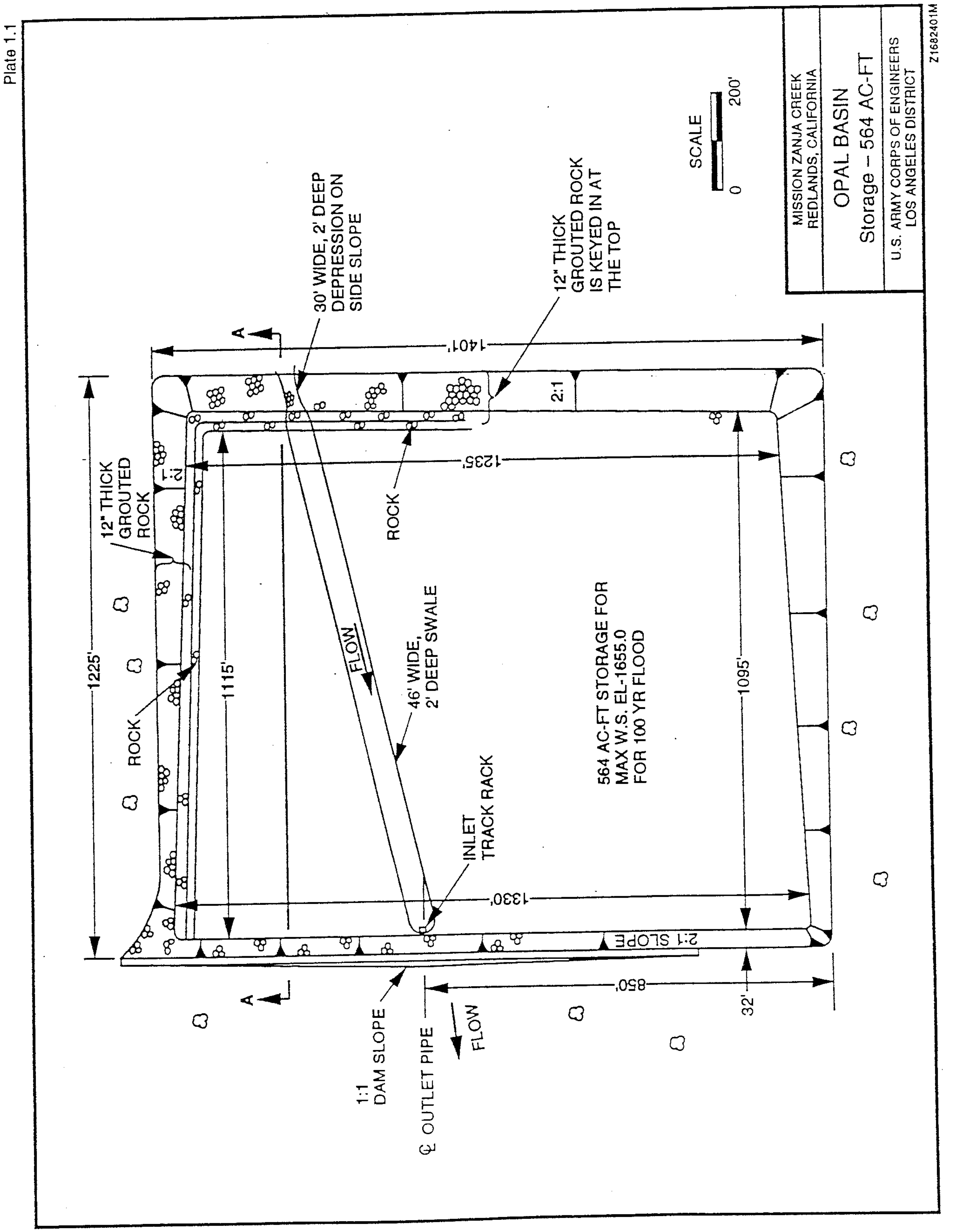


Figure 14. Mission Zanja Creek Detention Basin at Opal Ave.

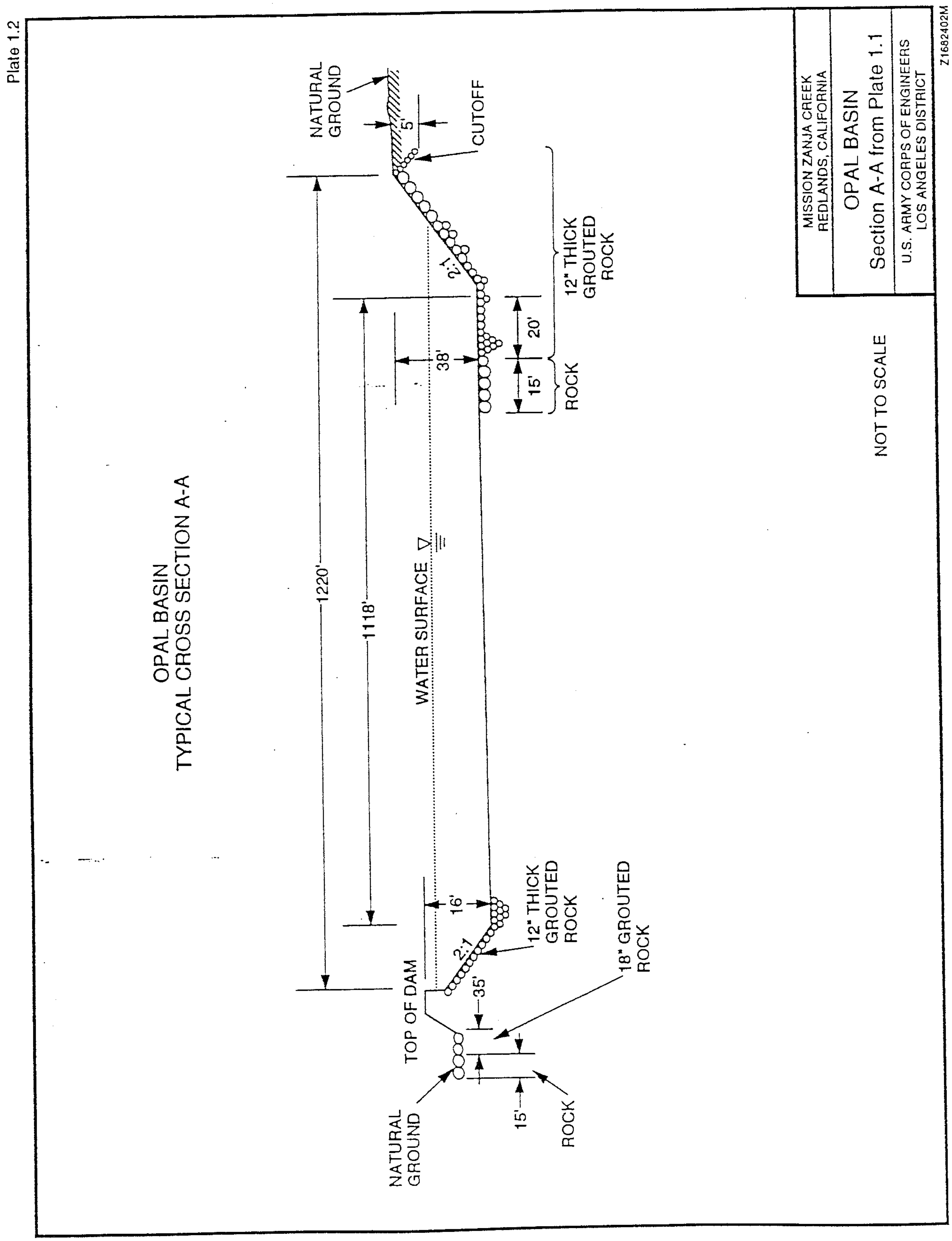


Figure 15. Mission Zanja Creek Detention Basin at Opal Ave.

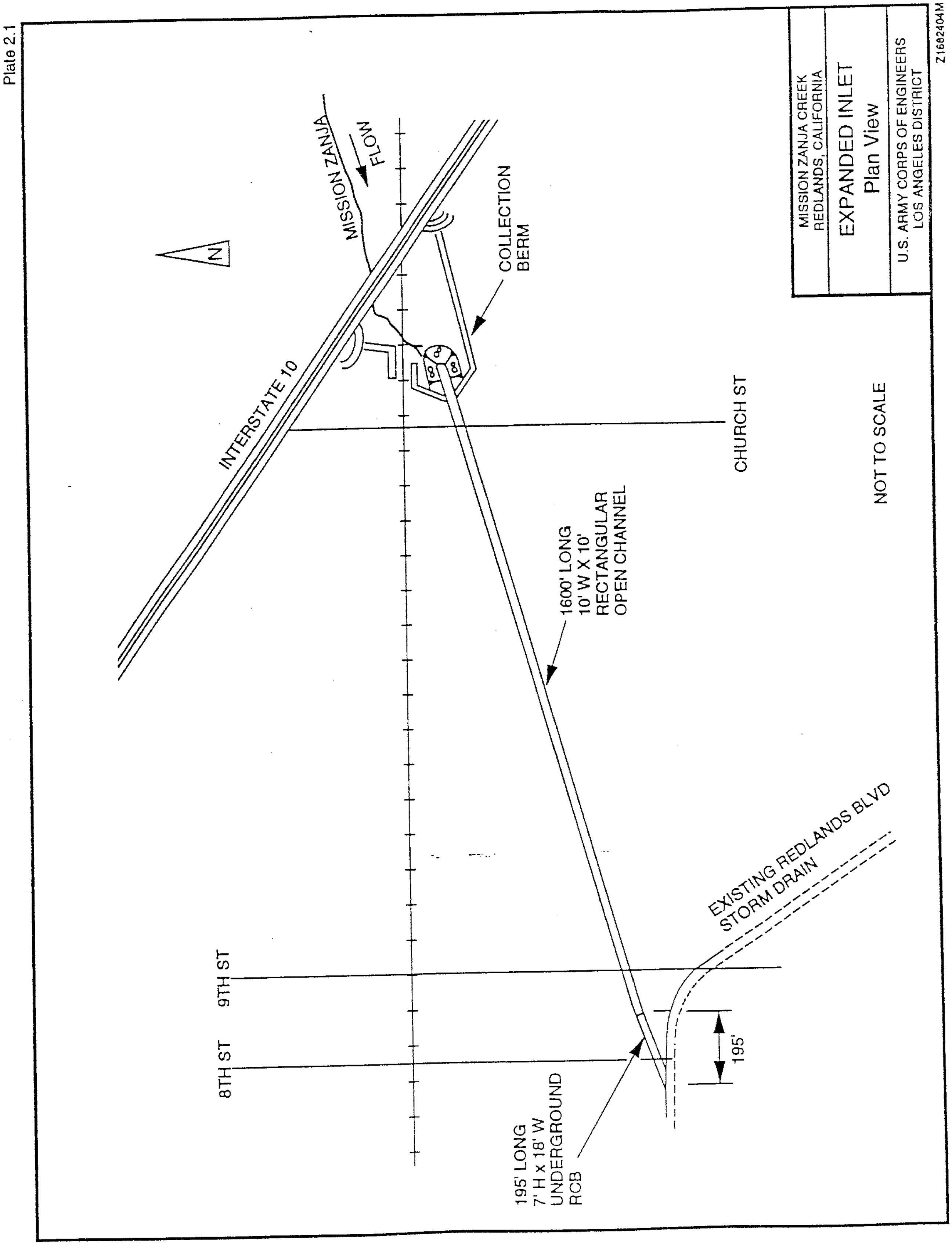


Figure 16. Mission Zanja Creek Inlet Expansion

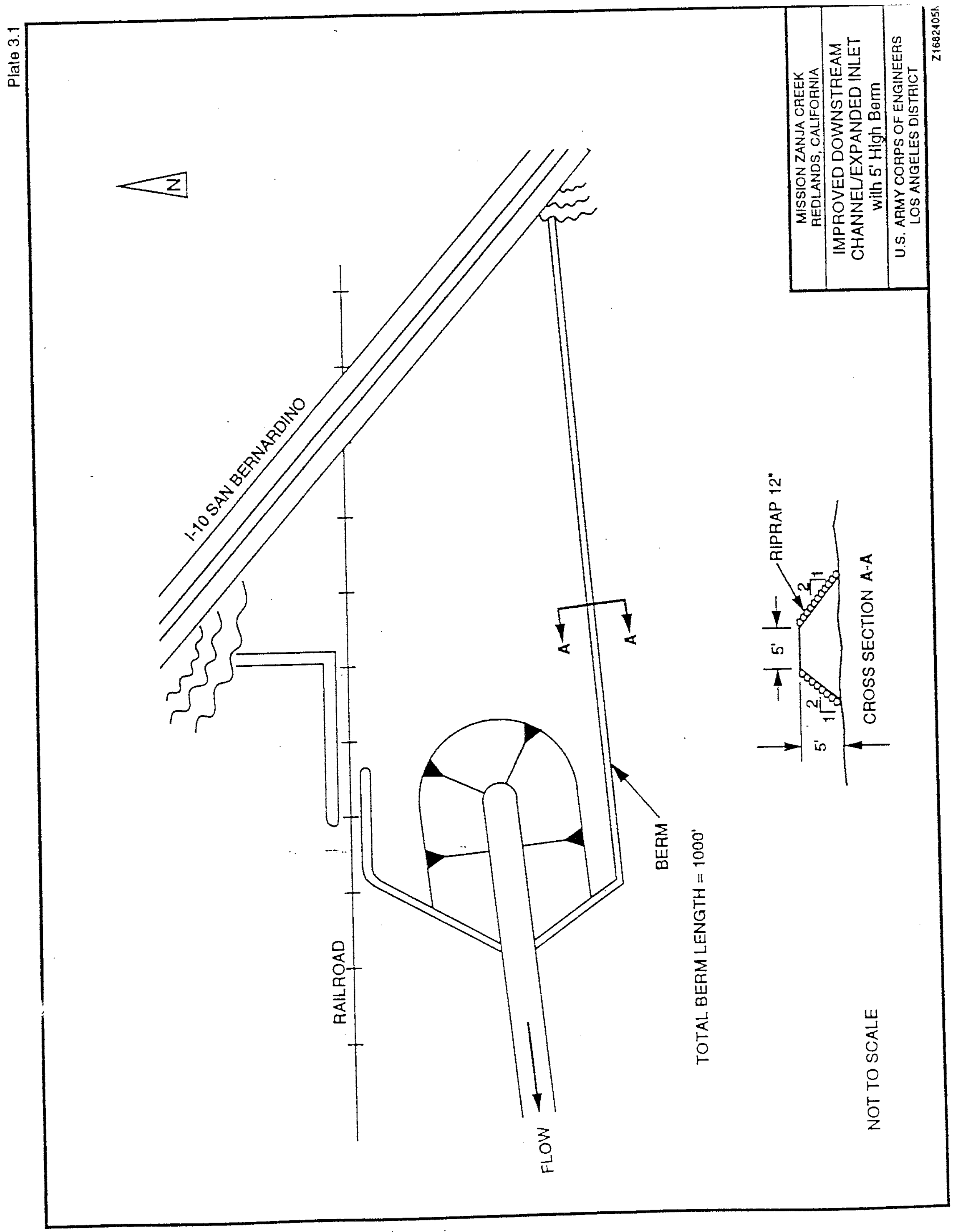


Figure 17. Mission Zanja Creek Inlet Expansion

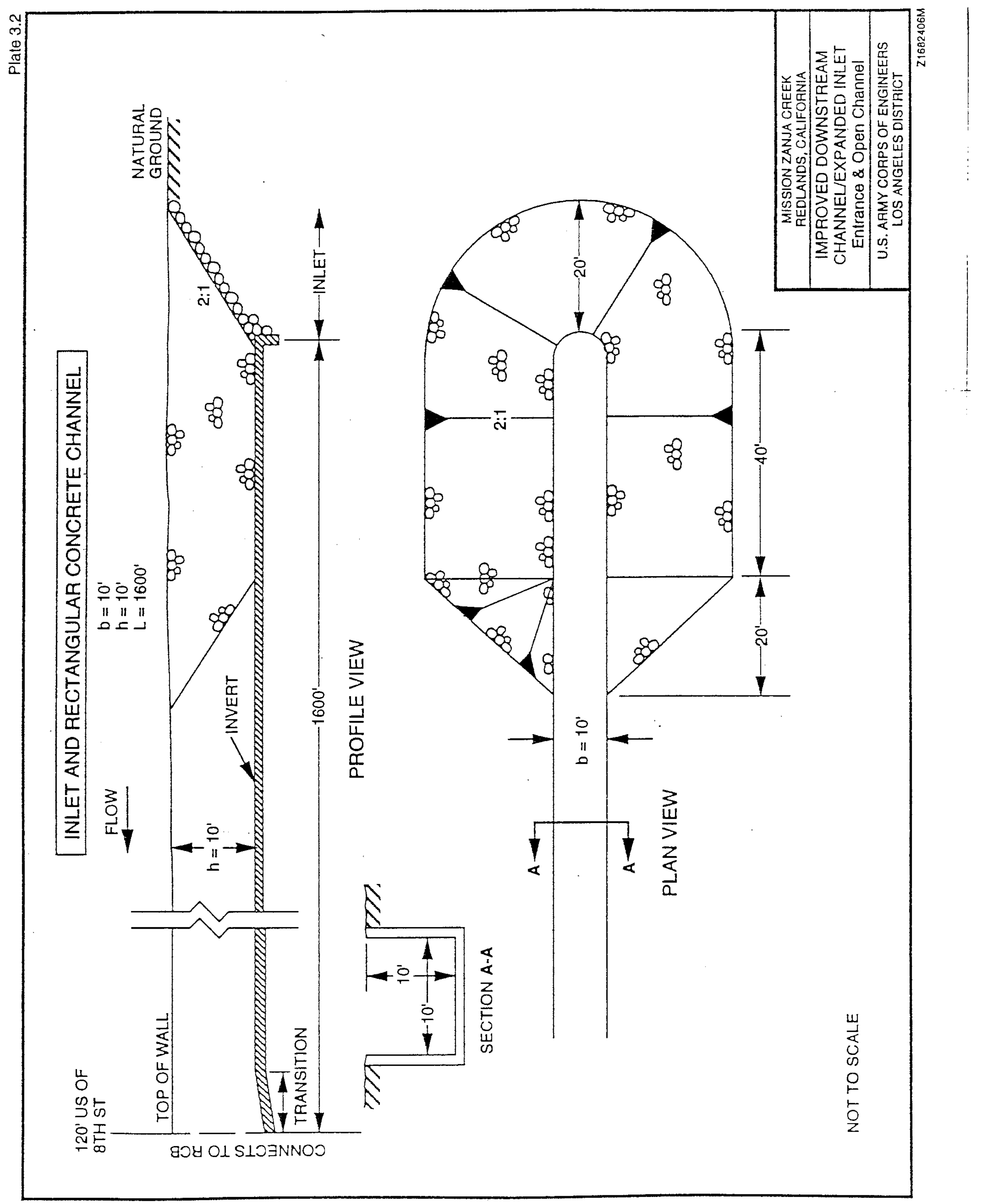


Figure 18. Mission Zanja Creek Inlet Expansion

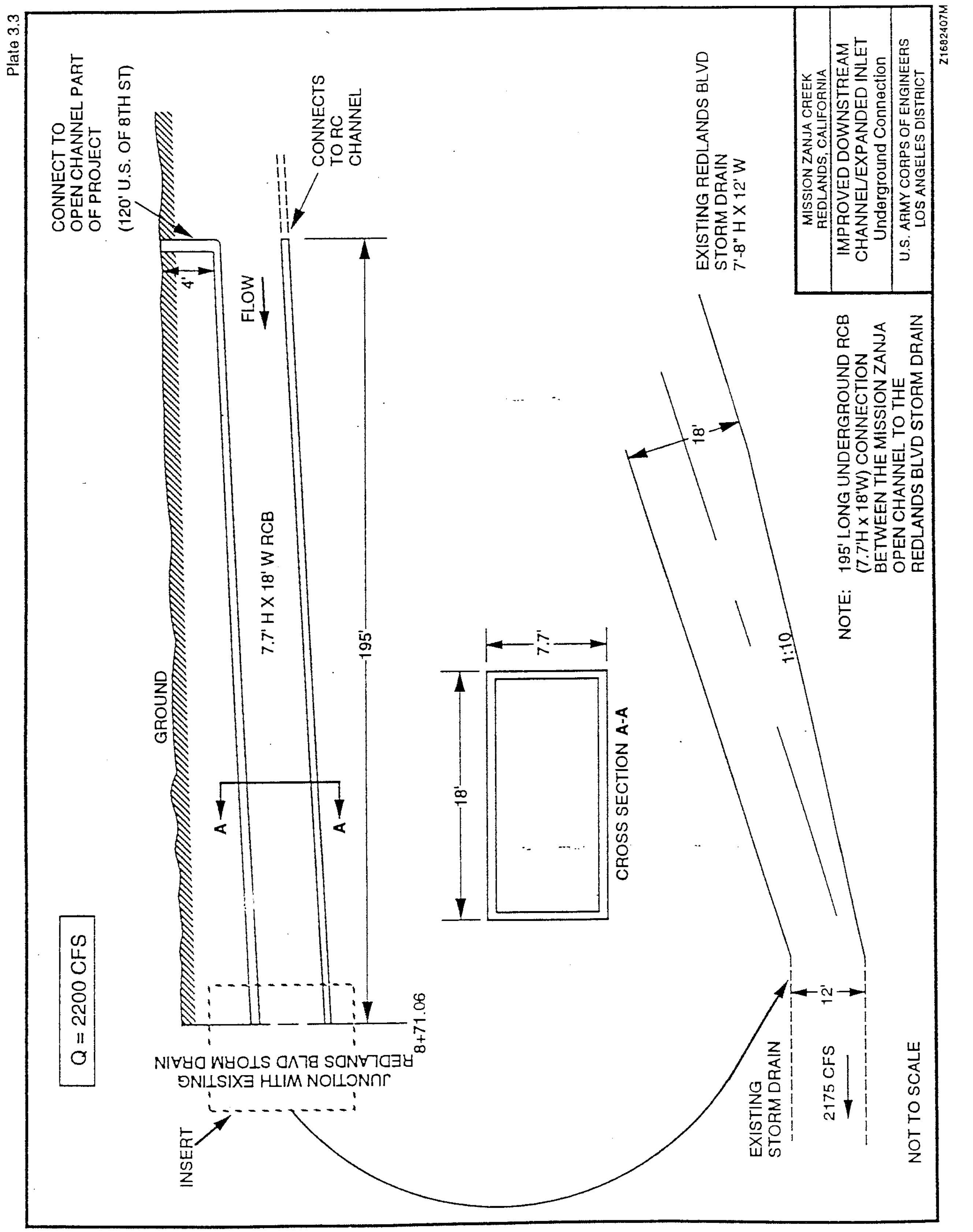


Figure 19. Mission Zanja Creek Inlet Expansion

Plate 2.3

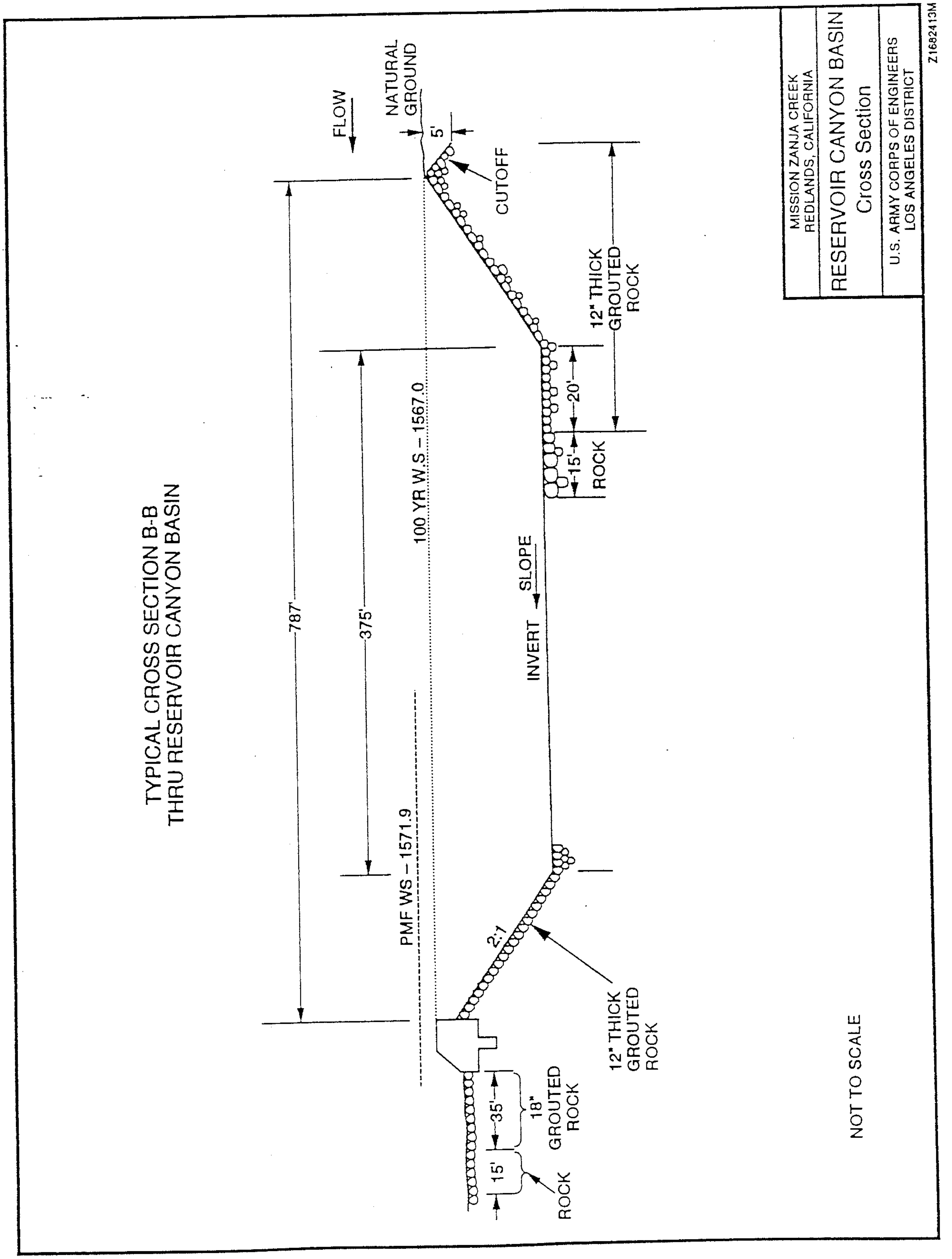


Figure 20. Reservoir Canyon Detention Basin Plan

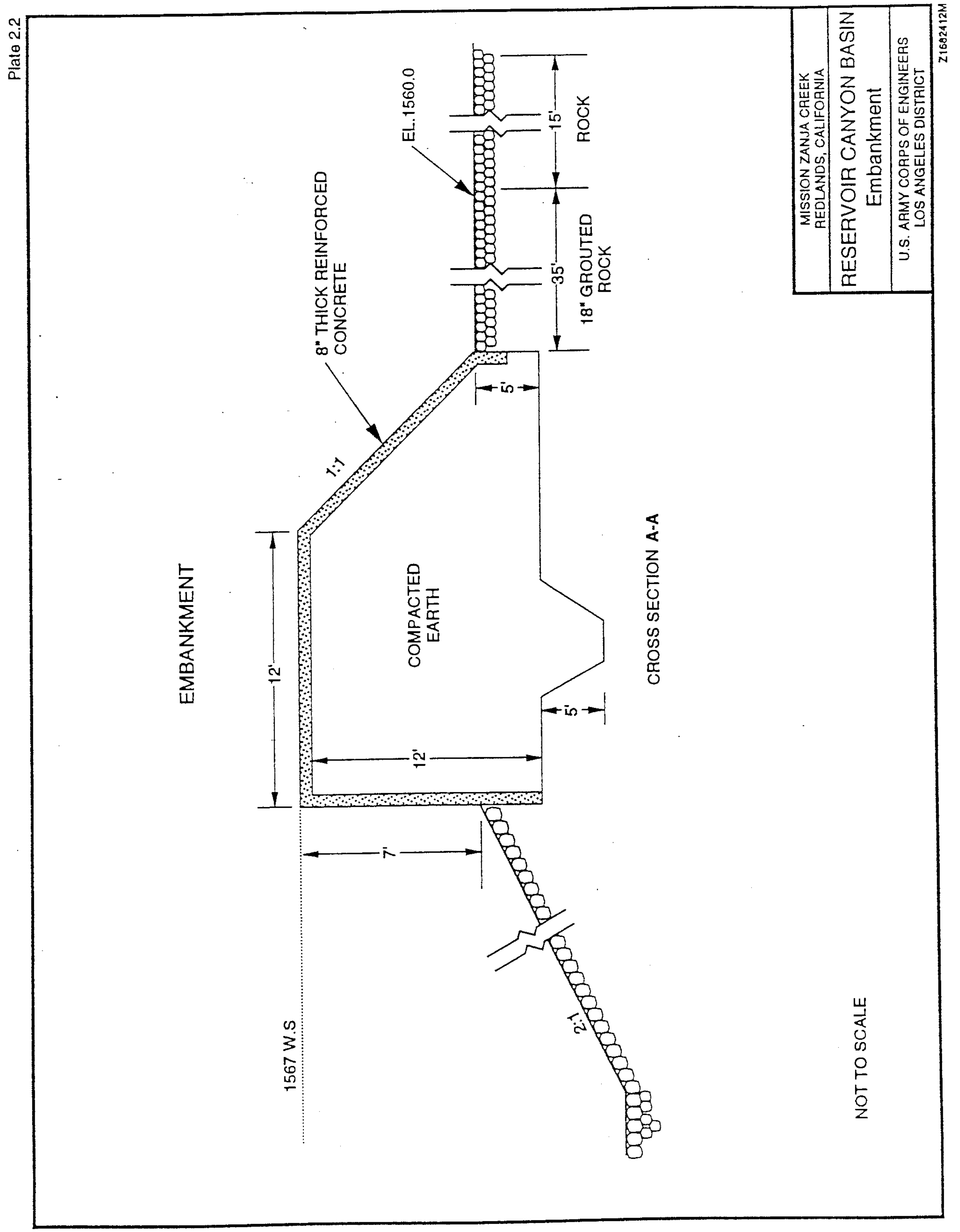


Figure 21. Reservoir Canyon Detention Basin Plan

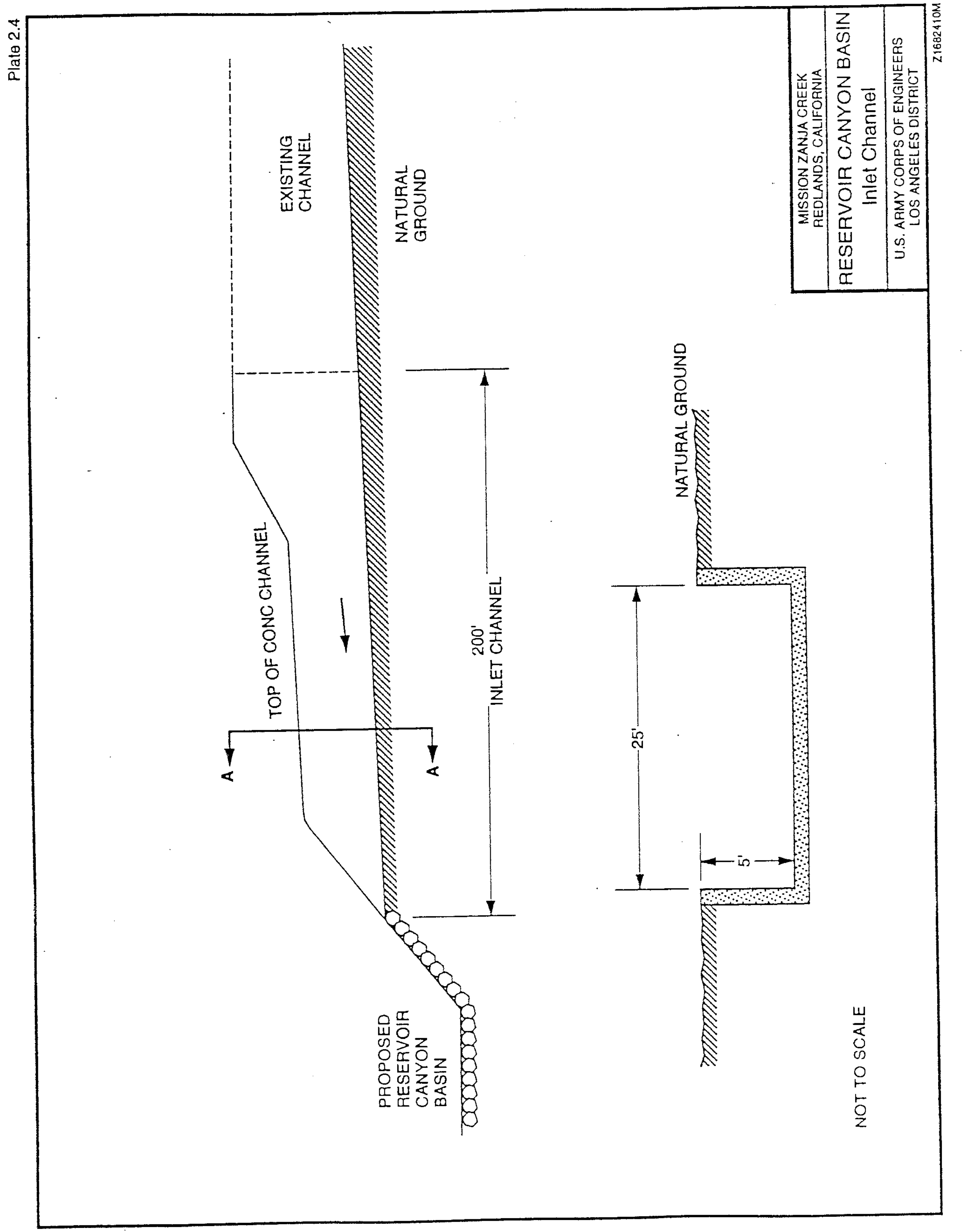


Figure 22. Reservoir Canyon Detention Basin Plan

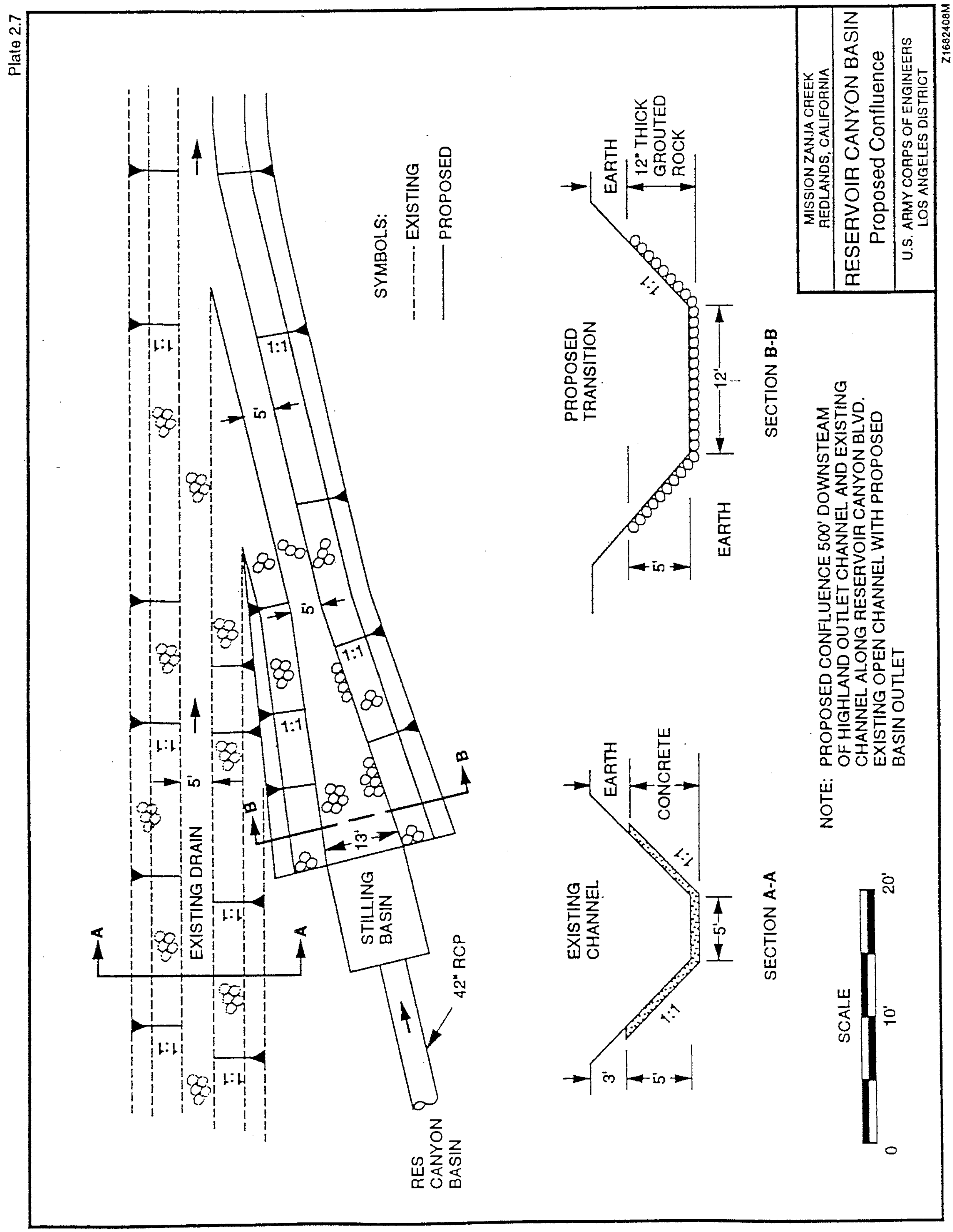


Figure 23. Reservoir Canyon Detention Basin Plan

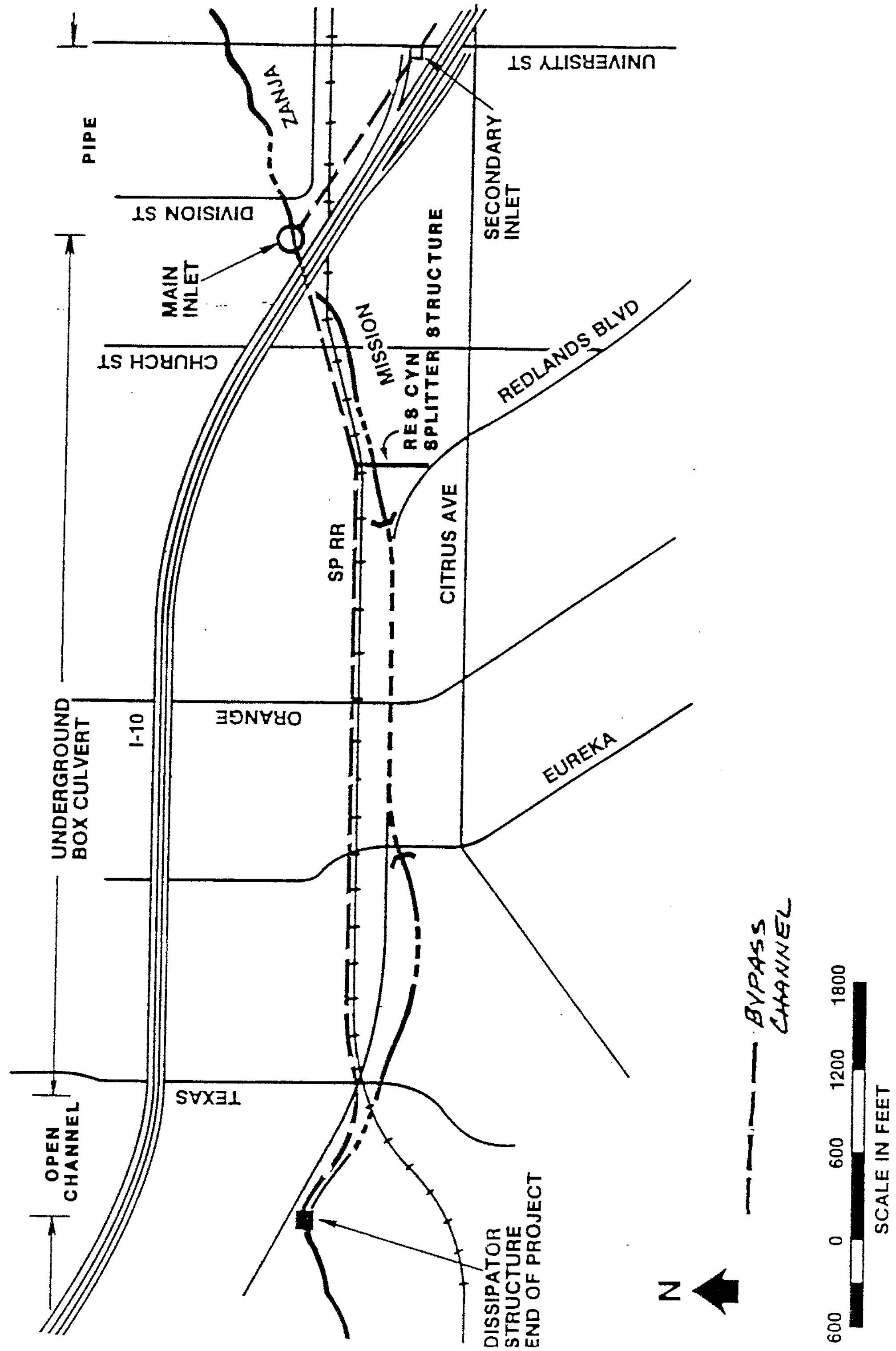


Figure 24. Redlands Bypass Channel Plan