BMP
Retrofit
Pilot Program

BASIS OF DESIGN REPORT DRAINAGE DESIGN, DISTRICT 11 PROCUREMENT

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ACRONYMS

AC	Asphalt Concrete
ac	Acre
acft	Acre feet
BMP	Best Management Practice
Caltrans	California Department of Transportation
cfs	cubic feet per second
GMP	Caltrans Inlet TYPE
NRDC	National Resources Defense Council

1.0 Introduction

1.1 General

Pursuant to the District 11 Consent Decree, a BMP Retrofit Pilot Program is required to investigate the constituent removal efficiency, technical feasibility and costs of retrofitting Caltrans facilities with selected Best Management Practices (BMPs). This report documents the design parameters associated with the implementation of Best Management Practices for storm water discharges for the seven Caltrans District 11 Procurement projects. Siting information for each of these pilot projects is provided in the report entitled, "BMP Retrofit Pilot Program, Composite Siting Study, District 11" dated May 26, 1998, by Robert Bein, William Frost & Associates. The BMP Pilot Projects in District 11 are being constructed using two administrative methods. The PS&E projects will be bid and constructed through a conventional Caltrans design-bid-build process. The procurement pilot projects, which are the subject of this report, will be constructed through the Caltrans encroachment permit process. The procurement projects discussed in this report are three sand media filters, one compost media filter, one infiltration trench, one biofiltration strip, and two biofiltration swales.

1.2 Objectives

The purpose of this study is to provide design criteria and background information relative to design opportunities and constraints in support of the construction drawings of the seven BMP Retrofit Pilot Program projects. Specifically, the objectives of this report are as follows:

- Define hydrologic criteria for the design of the BMPs.
- Develop discharges for the design conditions above.
- Define hydraulic criteria for the design of the BMPs.
- Define design parameters for each BMP.
- Provide technical calculations supporting the drainage facility designs shown on the construction drawings.

1.3 Project Locations

Project and site reference numbers are as indicated in the program *Scoping Study*, dated May 22, 1998 and *Status Report #1,* dated March 30, 1998.

1.3.1 Project 2, Site 4: I-5 North of Palomar Airport Road Interchange

This BMP Retrofit Pilot Project is a Biofilter Swale located along the Route 5 shoulder approximately 300 feet (100 m) northerly of the Palomar Airport Drive off-ramp in the city of Carlsbad. The proposed BMP area is parallel to the existing Interstate 5 freeway and is bounded by Interstate 5 to the east and commercial uses to the west. The existing shoulder consists of a 30-foot (9.1 m) wide graded shoulder, which drains freeway runoff via sheetflow to an adjacent frontage road. The site is currently impacted by a widening and landscaping project, which began construction in May 1998, but will conclude construction by August 1998.

1.3.2 Project 2, Sites 1 and 2: Carlsbad Maintenance Station

This BMP Retrofit Pilot Project is an infiltration trench and biofilter strip BMP located in the Carlsbad Maintenance Station. The Carlsbad Maintenance Station is located at 6050 Paseo Del Norte in the city of Carlsbad. The site is bounded by Paseo Del Norte to the west and commercial/industrial uses to the south, east and north. The proposed BMP is within an existing 20-foot (6.1m) wide by 170-foot (52m) long AC paved parking area in the southwesterly area of the maintenance station near the station entrance road.

1.3.3 Project 2, Site 3: SR-78 West of Melrose Avenue Interchange

This BMP Retrofit Pilot Project is a biofilter swale located along the eastbound shoulder area of SR78 and Melrose Drive off-ramp in the city of Vista. The existing roadway and off-ramp are approximately 3 feet (1m) to 10 feet (3m) above the shoulder at the right-of-way line. The shoulder area varies in total width from 20 feet (6m) to 60 feet (28m) and consists of tall grasses on an embankment slope and a low laying area having an approximate cross slope of 2 percent. Immediately beyond the Caltrans right-of-way is an existing frontage road and Buena Vista Creek.

1.3.4 Project 5, Site 1: Escondido Maintenance Station

This BMP Retrofit Pilot Project is a Delaware type Sand Filter located in the Escondido Maintenance Station on West Mission Avenue in the city of Escondido (just off the SR78 and Nordahl Road Interchange). The maintenance station is bounded by West Mission Avenue, SR78, and an industrial land use areas to the east and west. The proposed sand filter BMP is along the westerly property boundary near an existing maintenance station building.

1.3.5 Project 5, Site 2: 1-5/SR-78 Park and Ride

This BMP Retrofit Pilot Project is an Austin type Sand Filter located in the Interstate 5 / SR 78 Park and Ride facility in the city of Carlsbad. The park and ride facility is within a residential area with the access from Moreno Street. The proposed BMP is located at the southeast corner of the project in a landscaped area. The site is currently impacted by a park and ride expansion project, which began construction in May 1998. Construction of this expansion is scheduled to be completed by August 1998.

1.3.6 Project 5, Site 3: La Costa Park and Ride

This BMP Retrofit Pilot Project is an Austin type Sand Filter located in the La Costa Park and Ride facility adjacent to the Interstate 5 / La Costa Avenue Interchange in the City of Carlsbad. The proposed BMP is located in the northeast corner of the site immediately adjacent to the Bataquitos Lagoon.

1.3.7 Project 5, Site 4: Kearny Mesa Maintenance Station

This BMP Retrofit Pilot Project is a Compost Filter located within the Kearny Mesa Maintenance Station adjacent to Interstate 805 freeway at 7179 Opportunity Road in the city of San Diego. The proposed BMP is located in the southwesterly area of the maintenance station. The area is used for mainly heavy equipment, paint storage and equipment wash down.

1.4 Construction Cost

The Engineer's Estimate to construct the BMP facilities totals $1,618,737.19. Appendix F contains

an itemized cost estimate for each pilot project site.

2.0 HYDROLOGIC CHARACTERISICS

2.1 Rainfall Characteristics

San Diego County has a Mediterranean-type climate characterized by long, dry summers and mild winters. The average annual precipitation is about 12 inches and increases to about 18 inches in elevations above 2000 feet. Most of the precipitation occurs from November through March, with little or no rainfall from May through October. The average rainfall depth for a 1-year, 24-hour storm is 1.3 inches, which is calculated using the rainfall obtained from the averaged mass rainfall plotting sheets (See Appendix A).

2.2 Soil Types and Infiltration

Based on the U.S. Soil Conservation Services criteria, soils are classified into four hydrological soil groups: A, B, C, and D, where A is the most pervious with low runoff potential (such as sand or gravel) and D is the least pervious with high runoff potential (such as clay soils).

2.3 Methodology and Procedure

a. The County of San Diego Department of Public Works, Flood Control Division Hydrology Manual, dated January 5, 1985 was the primary reference used for hydrologic computations.
b. Hydrologic calculations were performed using the Civilcadd/Civildesign Rational Method and Small Area Unit Hydrograph computer programs for the 1-year and 25-year design storms.
c. Rainfall intensities were obtained from the isohyetals provided in the "San Diego Department of Public Works" hydrology manual. The 1-year 24-hour storm was extrapolated from the 2-year, 24-hour and 6-hour isohyetals. (See Appendix A)
d. User specified rainfall-intensity data was determined by plotting the 6 and 24-hour storm data on a mass rainfall plotting sheet. The data pairs were then selected and input into the hydrology modeling computer program.
e. The unit hydrograph procedure was used to compute stormwater runoff volumes.

2.4 Summary of Results

The hydrology maps for all sites are located in Appendix A. The hydrology maps show the tributary areas for drainage to the BMP Retrofit sites. Each BMP site captures runoff from the most feasible area. Additional runoff could potentially be directed to some BMPs, but due to high construction costs for redirecting flow and downstream hydraulic restrictions at some locations, these options were not pursued. Appendix A contains the result of the Civilcadd/CivilDesign computer program hydrologic calculations for the sites identified in this report. Hand calculations performed to verify the computer results for Sites 5 and 6 are contained in Appendix E.

3.0 WATER QUALITY DESIGN CRITERIA AND ASSUMPTIONS

3.1 Project 2, Site 4: I-5/ North of Palomar Airport Road Interchange

The pilot project is a biofilter swale with a tributary area that consists of the southbound lanes of Interstate 5. A proposed concrete trapezoidal swale will collect the sheet flow originating from the freeway and direct it through a monitoring flume and into the swale. A proposed concrete rectangular channel will direct the 'filtered' water through a second monitoring flume and into an existing drainage inlet. The existing storm drain discharges into an underground concrete box culvert that crosses Interstate 5. The proposed inlet swale has been sized to capture and convey the calculated 1-year storm runoff of 3.2 c.f.s. Runoff in excess of the design storm will exceed the swale capacity and will sheetflow away from the shoulder following the existing drainage pattern. The initial sizing of the concrete swales and biofilter swale were based on normal depth calculations. The proposed cutthroat flumes will create a backwater condition in the upstream portion of the swale. Therefore, a water surface profile calculation was performed using the Los Angeles County Water Surface Pressure Gradient (WSPG) computer program to determine the actual water depth and subsequent final swale dimensions. The ponded depth at the existing downstream drainage inlet was used as the downstream control in the hydraulic model.

The residence time within the biofilter swale was calculated to be approximately 9.3 minutes using the WSPG velocity of 0.56 and 0.70 feet per second for the biofilter swale with the base width of 9.84 feet and 6.56 feet, respectively. The storm water runoff velocity entering the BMP is less than 1 feet per second. A Mannings "N" of 0.150 was used due to the low depth of flow (0.54') compared to the height of the grass (2" to 6"). A maximum Manning's "n" value of 0.200 was agreed upon by the authorized agencies participating in this Pilot Study.

A hydroseed mix will be applied to the areas disturbed during the construction of the biofilter swale, in order to stabilize and reduce the potential of erosion. The hydroseeding mix will be applied as indicated in the project specifications and Design Directive No. 6, page 3 of the planning recommendation written by Martha Blane and Associates dated May 12, 1998 (see Appendix C for mix design). Two monitoring locations will be located along the biofilter swale, in order to monitor the flow using autosampler equipment.

A maintenance pullout will be constructed along the earthen shoulder of Interstate 5. The pullout will be used by maintenance and monitoring crews. The location of the pullout allows for the crews to park near the site and eliminates the necessity of using the emergency shoulder to service the biofilter site.

3.1.1 Tributary Drainage Area

The site tributary area totals approximately 4.60 acres and is located on the southbound side of the Interstate 5 freeway mainline. The tributary runoff from Interstate 5 freeway mainline sheet flows over the existing earthen shoulder and into an adjacent frontage road storm drain. Approximately 90% of the area tributary to the existing storm drain inlet, that originates from Caltran's property, will be treated by the biofilter swale. The computed peak design storm flow for the 1-year storm event is approximately 3.2 c.f.s. The site is tributary to Encinas Creek, which discharges directly into the Pacific Ocean. This existing flow path is not altered with the construction of the biofilter. Interception of significantly more drainage area at this location would result in drainage area diversions.

3.1.2 Site Constraints

Since the proposed BMP site is located adjacent to Interstate 5, design of the biofilter swale was performed in such a manner that it will not pose any significant hazard to motorists. The BMP interception swale is a concrete trapezoidal swale with a side-slope of 6:1 adjacent to the edge of shoulder and a side slope of 4:1 along the earthen shoulder. The BMP swale was designed as a trapezoidal channel with 2:1 side slopes. The width and depth of the facilities are also constrained by the distance between the edge of shoulder and existing trees at the right-of-way line.

A new auxiliary lane is currently under construction by Caltrans along southbound I-5 between Cannon Road and Palomar Airport Road, and should be completed during the Fall of 1998. The auxiliary lane extends the existing edge of pavement about 12 feet into the existing shoulder. The new lane constrains the potential northerly extent of the biofilter swale since the right-of-way narrows approaching the Cannon Road onramp. The swale has been extended the maximum length practical given these constraints.

It is anticipated that the contractor constructing the auxiliary lane will also construct the biofilter swale improvements as a part of the project. This should result in reduced construction time and cost, since the contractor is currently mobilized and prepared to complete the work. This project illustrates the advantage of incorporating BMP retrofit into an existing Caltrans improvement project. The schedule and cost savings will be quantified as a part of the pilot program documentation. The biofilter swale will be bid as an independent project to estimate the cost savings of having the pilot project costructed as a part of the auxiliary lane.

3.2 Project 2, Site 1: Carlsbad Maintenance Station

The proposed BMP is an in-line system comprised of an infiltration trench and a biofilter strip. The infiltration trench BMP also contains a separate biofilter strip that serves as a pre-treatment device. The tributary areas for the infiltration trench/biofilter combination and the biofilter strip are 1.7 acres and 0.7 acres, respectively. The design storm peak runoff of approximately 1.4 c.f.s. tributary to the infiltration trench, is conveyed by a proposed concrete swale and routed through a Parshall flume. The flume transitions into a concrete gutter with a varying cross slope that will allow a side weir condition. The concrete gutter will spread the flow over the entire length of the biofilter strip. The infiltration trench BMP is sized to contain the total design storm volume of 2,943ft^3 (83.3 m^3) as defined in the Caltrans Storn Water Quality Handbook. The design storm volume was calculated using the Caltrans Storm Water Quality Handbook, Planning and Design Staff Guide dated May 10, 1996. The inlet swale and flume are sized to accommodate a 25-year storm. Runoff exceeding the BMP capacity will flow into a proposed overflow channel and will be returned to its current flow path.

The storm runoff tributary to the biofilter strip sheet flows directly onto the BMP and flows to the proposed concrete lined collection swale outlet. The computed 1-year storm flow tributary to the biofilter strip is approximately 0.60 c.f.s. A concrete-lined swale and trapezoidal flume, sized to accommodate a 25-year storm, will convey flow from the BMP. Flow will be measured and tested only on the discharge side of the biofilter. Since the biofilter strip does not have an inflow monitor, it will be assumed that the inflow is equal to the outflow. Water quality of the inflow will be assumed to be consistent with the infiltration trench/biofilter combination inflow which is being measured and tested.

Storm water monitoring and sampling will be performed using automated equipment at the inflow point of the infiltration trench/biofilter combination BMP and the outlet point of the biofilter strip. An observation well and ground water monitoring well are proposed near the west end of the infiltration trench for water quality sampling.

Access to the BMP site is through the maintenance station.

The site chosen for this BMP is currently used for parking. As a result, a new parking area was designed northwest of the BMP site.

3.2.1 Tributary Drainage Area

The tributary area for the proposed BMPs is composed of 2.4 acres of asphalt surface. No upstream berms or other devices are proposed to direct runoff to the strip/trench site. The BMP is located near the downstream end of the maintenance station where a majority of the runoff from the station is concentrated. The BMP sites are not impacted by any off-site areas (area beyond the maintenance station). The tributary area is composed of three subareas. Two of the subareas drain into the infiltration trench/biofilter combination. The third subarea drains through the biofilter strip. Approximately 70% of the maintenance station will be treated by the biofilter strip and/or trench, which includes all the possible constituent contributing areas without undertaking substantial regrading of the site. The design storm peak runoff for the two systems are 1.4 c.f.s. and 0.6 c.f.s. for the infiltration trench/biofilter combination and biofilter strip, respectively. The storm runoff tributary to the biofilter strip will sheetflow from the adjacent AC paved maintenance yard area. The storm runoff tributary to infiltration trench is conveyed through a concrete swale. The site is tributary to Encinas Creek, which drains directly into the Pacific Ocean. The intercepted area includes about 95% of the active use area within the maintenance yard.

3.2.2 Site Constraints

The BMP is located within the perimeter of an existing parking area that is located adjacent to the maintenance station main entrance. Planters containing sprinkler systems, mature trees, utilities, and street lighting surround the parking area. In order to maintain access to the maintenance station and minimize the relocation of the existing facilities, the BMP pilot project will be built within the perimeter of the parking area. This will reduce the possibility of heavy equipment driving over the BMP.

3.3 Project 2, Site 3: SR 78 West of Melrose Avenue Interchange

The proposed BMP consists of a biofilter swale that runs adjacent to the eastbound side of the SR 78 freeway and Melrose Avenue offramp. The BMP lies in a low area between the roadway embankment and an existing improved channel. Runoff is currently conveyed from the roadway and into the channel through a series of cross culverts. BMP design flows will be collected via two proposed overside drains located on each side of an existing grated inlet. The proposed overside drains are sized to intercept the computed 1-year storm runoff. Storm runoff exceeding the overside drain capacity will flow into the existing grated inlet. BMP flows will be routed back into the same channel by way of an additional existing cross culvert located immediately downstream of the outflow monitoring flume.

The biofilter swale BMP is a trapezoidal-shaped channel with 2:1 side slopes. The methodology used to size the system is consistent with Project 1, Site 3. The design criteria indicates a minimum residence time of five minutes and a maximum velocity of 1 foot/second, in order to effectively treat the storm water runoff. As a result, the biofilter swale design utilizes a width of 19.7 feet and a longitudinal slope of 0.08% to achieve the recommended criteria. The calculated velocities at the BMP inlet and outlet areas are less than 1 foot per second. The areas disturbed during the construction of the biofilter swale will be stabilized by applying a hydroseeding mix. The hydroseeding mix will be applied as indicated in the project specifications and Design Directive No. 6 in page 3 of the planning recommendation written by Martha Blane and Associates dated May

12, 1998 (see Appendix C for mix design). The design storm flows will be sampled and monitored using automated equipment in conjunction with two trapezoidal flumes.

Access to the BMP site is provided at Hacienda Drive (existing frontage road).

3.3.1 Tributary Drainage Area

The tributary area, which totals 2.4 acres, is comprised of the eastbound side of the SR 78 freeway mainline. The site boundaries are SR 78, a frontage road, and a freeway off ramp. The tributary storm runoff sheet flows from the freeway and is directed into a low point with an AC dike. About 100% of the existing drain inlet tributary area is treated by the biofilter swale. The design storm runoff for a 1-year storm event is approximately 3.7 c.f.s. The site is tributary to Buena Vista Creek, which ultimately discharges into the Buena Vista Lagoon.

3.3.2 Site Constraints

The preliminary siting study proposed a redirection of the cross culvert flows through modification of the existing drainage facility at the sump inlet. This existing drainage facility crosses SR 78 and collects runoff from approximately 29 acres, most of which are offsite areas north of SR 78. This tributary area results in a 1-year storm runoff of approximately 30 c.f.s. It is beyond the scope of this project to accommodate significant offsite areas. Therefore, the proposed watershed area for the BMP was restricted to the eastbound side of State Route 78.

The described site topography and existing drainage systems are the chief design constraints. The existing improved Buena Vista Creek channel passes underneath the freeway by way of a large cross culvert. The proposed biofilter swale length is restricted due to the proximity of the cross culvert to the BMP pick-up point. The grades and elevations within the BMP are restricted due to the existing downstream drainage system elevation, which serves to return the 'treated' runoff to its original flow pattern.

3.4 Project 5, Site 1: Escondido Maintenance Station

The proposed BMP consists of a sand filter located within the Escondido maintenance station. The tributary 1-year storm runoff will be intercepted using a grated inlet and conveyed to the BMP structure. The grated inlet was sized using the HEC-12 computer program developed by the Federal Highway Administration. The existing drainage pattern for flows exceeding the 1-year storm will be maintained. Flows in excess of the 1-year discharge exceed the inlet capacity and will flow into an existing 36" (900mm) culvert, which crosses the site. The BMP will discharge into this same culvert by way of a new piping system. The design storm flow will be monitored and sampled using automated equipment at both the inflow and outflow points of the proposed BMP system. The inlet pipe has been sized to prevent flows exceeding the 1-year storm to enter the sand filter BMP.

The filter volume and surface area were sized in accordance with the Delaware Sand Filter design procedures and standard drawings prepared by State of Delaware Department of Natural Resources and Environmental Control. The design guidelines require a total surface area within the filter structure to be equal to 720 square feet per acre of tributary area. Additionally, the design guidelines require that the first chamber volume be set to 540 cubic feet per acre of tributary area with the sediment chamber and filter chamber equal in volume and area. An 8" (200mm) PVC bypass line and gate valve was added to the sediment chamber for maintenance

purposes.

The design storm flow will be monitored and sampled using automated equipment at both the inflow and outflow points of the proposed BMP system.

Access to the BMP site is through the maintenance station.

3.4.1 Tributary Drainage Area

The BMP structure and BMP inlet are protected from tributary offsite flow. Approximately 0.8 acres of fully paved storage area and building rooftop are tributary to the BMP inlet. No berms or other devices are proposed to direct flow to the filter location, rather existing drainage patterns are used to intercept flow at the entrance to an existing storm drain. The computed 1-year storm, which totals 2.2 c.f.s., sheet flows across the maintenance station yard and then flows along an existing AC dike. The onsite runoff confluences with offsite flow at the outlet of the previously mentioned 36" (900mm) onsite system. The ons ite system discharges into a municipal storm drain system, which discharges into Escondido Creek. Escondido Creek then discharges into the San Elijo Lagoon. The sand filter will intercept flow from the majority of the working portion of the maintenance station. The northerly portion of the station is tributary to a separate drainage facility adjacent to SR 78. Diversion of flow from this part of the station would require significant regrading of the facility. The remaining portion of the station not intercepted by the sand filter, consist largely of office area and area where equipment is not stored or parked.

3.4.2 Site Constraints

The major constraint for the filter system is the available hydraulic head between the BMP inlet and discharge points. A minimum of 1.5 feet of hydraulic head is recommended for the sand filter, in order to compensate for the sand filter head loss. This value was achieved but flows exceeding the 1-year storm in the downstream drainage system will force a backwater condition for the filter. This backwater will reduce the flow rate through the filter for storms exceeding the 1-year storm design frequency.

3.5 Project 5, Site 2: I-5/ SR 78 Park and Ride

The proposed BMP is an Austin type sand filter structure located in the Interstate-5 / SR 78 Park and Ride facility. The proposed BMP site is a heavily used park and ride facility, therefore, intrusion into the parking area by the project was kept to a minimum. The filter structure has been placed adjacent to the existing paved area and within an embankment slope that is part of an expansion area that is currently being constructed. The BMP inflow will originate from the existing park and ride area only. The calculated 1-year storm flow will be rerouted from the two existing sump areas at the easterly edge of the paved area. The existing drainage inlets will be reconstructed such that flows exceeding the 1-year storm will be conveyed through the existing drainage system and will not flow through the sand filter BMP.

The sand filter was designed and sized in accordance with the city of Austin design guidelines. The sediment chamber was designed to contain the entire 1-year, 24-hour design storm volume. The sand filter chamber was sized to drain the sediment chamber storm volume in a 24 hour period using a percolation rate of 0.5 gallons per minute per square foot. Storm water samples will be taken using automated equipment at both the inflow and outflow points of the BMP system in conjunction with two proposed Palmer Bowlus flumes.

Access to the BMP site is through the park and ride facility and the proposed Caltrans standard maintenance

pullout on Vista Way exit ramp.

3.5.1 Tributary Drainage Area

The park and ride tributary area is approximately 0.8 acres of paved and landscaped areas. No offsite flow is tributary to the park and ride or the proposed sand filter. The total design storm flow is 1.3 c.f.s. with a 24-hour storm volume of 4,227 ft^3. The existing on-site system discharges into an underground drainage system within the Interstate 5 right-of-way. Runoff from the entire existing park and ride facility is intercepted and discharged to the proposed filter.

The park and ride lot at this location is currently undergoing an expansion, with construction to be completed during the fall of 1998. The expanded portion of the park and ride was not included as a part of the retrofit pilot program. Planning and design for this park and ride was completed prior to the development of the pilot program, and subsequent coordination between to treat the additional pavement area the two projects was not pursued. In the future, there may be a good opportunity to take advantage of Caltrans facility expansion and reconstruction activities with the incorporation of structural BMP retrofits.

3.5.2 Site Constraints

The major site constraint was the available area in which the filter could be placed. The current park and ride expansion project dramatically reduced the available open space area. As part of the landscaping 4-36" box palm trees have been planted. The palms are expensive to relocate and are deemed as an integral part of the expansion landscaping. Therefore, the filter was shaped to fit between the new trees, the new pavement area, the park and ride right-of-way, and the existing park and ride pavement area.

3.6 Project 5, Site 3: La Costa Park and Ride

The proposed BMP consists of an Austin type sand filter structure located within the La Costa Park and Ride. The filter has been placed between the existing pavement low point and the Bataquitos Lagoon fence line. In order to avoid construction within the Bataquitos Lagoon, the BMP outlet pipe and bypass channel were designed to connect to the existing drainage system within the park and ride fence line. Storm flows greater than the 1-year storm event will flow into the proposed overflow channel due to a backwater condition forced by the inflow monitoring trapezoidal flume. The parking area adjacent to the project inlet will be overlayed to reestablish a positive drainage gradient. The existing paving has developed low points with the associated pavement maintenance problems.

The sand filter design and sizing have been performed in accordance with the city of Austin design guidelines.

Access to the BMP site is through the park and ride facility.

3.6.1 Tributary Drainage Area

The La Costa Park and Ride has an area of approximately 1.7 acres of paved area and 1.1 acres of landscaped area. The watershed area is bounded by Interstate 5 northbound on-ramp to the west, La Costa Boulevard to the south, and Bataquitos Lagoon to the east and north. The total design flow for the 1-year storm event was calculated to be 2.3 c.f.s. with a 24-hour storm volume of 8,080 ft^3. The storm runoff sheet flows across the paved area and is intercepted by a curb that surrounds the parking lot perimeter. The curb

directs the runoff into a drainage system, which discharges into the Bataquitos Lagoon. Runoff from the entire park and ride facility is discharged through the proposed sand filter.

3.6.2 Site Constraints

Buildable area and available grade separation between the BMP inflow and outlet points were the major constraints for the design of the sand filter system. The system had to be constructed within the right-of-way of the park and ride. Therefore, the filter was placed between the existing maintenance road to Bataquitos Lagoon and the right-of-way fence. The required hydraulic head through the sand chamber also controlled the size of the filter. The design guidelines for the sand filter suggest a minimum hydraulic head of 3 feet be allowed. The hydraulic head is required in order to recover the head-loss through the sand filter. In order to make full use of the available grade between the BMP inflow and outlet points, an open channel with a weir into the sand filter sediment chamber was used for the BMP inflow system.

3.7 Project 5, Site 4: Kearny Mesa Maintenance Station

The proposed BMP consists of three (3) compost filter vaults and a sedimentation vault located along the south side of the Kearny Mesa maintenance station. This BMP site is currently used as a storage area for small equipment and light construction materials. Approximately 1.5 acres of asphalt surface area is tributary to the proposed BMP system. The design 1-year storm flows of 2.7 c.f.s. are conveyed through the existing concrete swale and discharged into the proposed drainage inlet. The grated inlet and the inflow monitoring flume control the total inflow into the compost filter system. This control is based on the sizing of a grated inlet and the 12" diameter inlet pipe. The HEC-12 computer program, developed for the Federal Highway Administration, was utilized to size the grated inlet. In order to analyze the backwater condition caused by the 12" inlet pipe, the Los Angeles County Water Surface Pressure Gradient (WSPG) computer program was utilized. By calculating the backwater condition caused by a 25-year storm flow and a 1–year storm flow, it was determined that the maximum flow rate the inlet system will allow is 2.86 c.f.s. These flows are routed through a system of small underground pipes, a sedimentation vault, and three compost filter vaults, discharging the flows into the existing 900mm RCP located on-site. The design storm flows will be monitored and sampled using automated equipment at both the inflow and outflow points of the BMP system.

Access to the BMP site is through the maintenance station.

The size of the proposed facility is based upon the manufacturer's design criteria of 30 compost canisters per c.f.s. of storm runoff, requiring three 2.438m (8') x 5.486m (18') vaults. The layout of the system is controlled by the required vault sizes and the minimum hydraulic head differential of 0.71m (2.3') between the inlet and outlet elevations of the compost filter structures.

3.7.1 Tributary Drainage Area

The BMP tributary area consists of approximately 1.5 acres of asphalt surface within Kearny Mesa Maintenance Station. No berms or other devices are proposed to direct the flow to the filter, rather the inlet will be located in an existing sump area. Industrial and commercial buildings, a mainline freeway, and a landscaped area surround the area. The design 1-year storm flow of 2.7 c.f.s. will be intercepted and discharged into an existing municipal underground system. This system is tributary to Tecolote Creek, which discharges into Mission Bay. Additional flow could be discharged to compost filter units at this location,

however, additional filter units would be required. The entire station includes about 17 acres. The area with the most heavy equipment activity was selected for the filter installation project.

3.7.2 Site Constraints

The primary constraints on the compost filter system were to minimize the disturbance of existing facilities and control the runoff quantity into the system. One compost filter canister can filter 0.033 c.f.s. The 1-year storm runoff tributary to the westerly portion of the maintenance station is approximately 39 c.f.s. This flow rate would require approximately 1167 canisters to treat, which is not practical. Therefore, only the south/west portion of the maintenance station was intercepted. The area tributary to the filter is utilized for storing equipment and other maintenance materials. As a result, the proposed BMP will be beneficial to this area. The reduced area contributes a 1-year peak runoff of 2.7 c.f.s, which require 81 canisters, still a substantial installation.

4.0 HYDRAULIC ANALYSIS – ALL LOCATIONS

4.1 Design Criteria

Technical references include the Caltrans Highway Design Manual (Caltrans 1997), and the Caltrans Storm Water Quality Handbook, Planning and design Staff Guide (Caltrans 1996) and the project *Scoping Study (Op. Cit.)*.

4.2 Methodology and Design Procedures

a. The Los Angeles County Flood Control District Water Surface Pressure Gradient (WSPG) computer program was used to determine the water surface profile through the proposed biofilter swales and some inlet and outlet channels of other pilot projects.
b. Normal depth calculations were used to size the proposed BMP inlet, outlet channels, and underground conduits where backwater conditions are not present.
c. The Federal Highway Administration HEC-12 computer program was used to determine proposed and existing drainage inlet sizes.

4.3 Summary of Results

Hydraulic analyses have been performed for the design storm of 1-year for each of the facilities. The 25-year storm flows will generally by-pass the proposed BMP facilities except for Project 2, Sites 1 and 2 which are in-line system. Therefore hydraulic analyses for the 25-year storm flows have not been performed. The proposed BMP designs meet or exceed the general requirements set forth in the Scoping Study, the City of Austin and State of Delaware design guidelines.

APPENDIX A HYDROLOGY CALCULATIONS and MAPS

CALTRANS DISTRICT 11 NPDES PROJECT BMP HYDROLOGY DATA

DRN SYS NO.	LOCATION	BMP	TRIBUTARY AREA			Effective "C" Coefficient	1yr Storm T_C (min)	1yr PEAK FLOW (ft^3/s)	25yr PEAK FLOW (ft^3/s)	BMP FLOW OUT (ft^3/s)	UNIT HYDROGRAPH 24 HR. STORM VOL.		DESIGN VOLUME (ft^3/s)
			AREA (acre)	LENGTH (ft)	SOIL TYPE						(acre-feet)	(ft^3/s)	
1	KEARNY MESA MAINTENANCE STATION	COMPOST MEDIA FILTER (MF)	1.46	423	D	0.90	6.64	2.7	5.8	.5 cfs +/-	-	-	N/A
2	ESCONDIDO MAINTENANCE STATION	SAND MEDIA FILTER (MF)	0.82	269	D	0.90	5.78	2.2	4.5	105 GPM	0.0970	4,227	443 ***
3	LA COSTA PARK AND RIDE	SAND MEDIA FILTER (MF)	2.78	500	D	0.60	12.10	2.3	4.9	52 GPM	0.1855	8,080	10,091
*4 (@ 1ST INLET)	SR-78/I-5 PARK AND RIDE	SAND MEDIA FILTER (MF)	0.36	298	B	0.75	5.59	0.63	1.32				
**4 (@ 2ND INLET)	SR-78/I-5 PARK AND RIDE	SAND MEDIA FILTER (MF)	0.39	SUBAREA	B	0.75	5.76	0.67	1.41				
4 (@BMP)	SR-78/I-5 PARK AND RIDE	SAND MEDIA FILTER (MF)	0.75	357	B	0.75	5.76	1.29	2.73	20 GPM	0.0857	3,734	3,734
5	MELROSE DRIVE / SR 78	BIOFILTRATION SWALE (BSw)	2.40	1500	C	0.90	13.37	3.7	6.1	3.74 cfs	-	-	N/A
6	PALOMAR AIRPORT RD	BIOFILTRATION SWALE (BSw)	2.32	1700	A	0.80	30.91	3.2	7.4	3.20	-	-	N/A
7A	CARLSBAD MAINTENANCE STATION	INFILTRATION TRENCH (IT)	1.72	477	A	0.70	15.07	1.4	2.9	0.00	0.1753	7,636	6,244****
7B	CARLSBAD MAINTENANCE STATION	BIOFILTRATION STRIP (BSt)	0.66	269	A	0.70	11.68	0.6	1.3	.60 cfs	-	-	N/A

NOTES:

* Tributary to upstream interception concrete swale. (Unit c)

** Tributary to upstream interception concrete swale and downstream interception inlet. (Unit n)

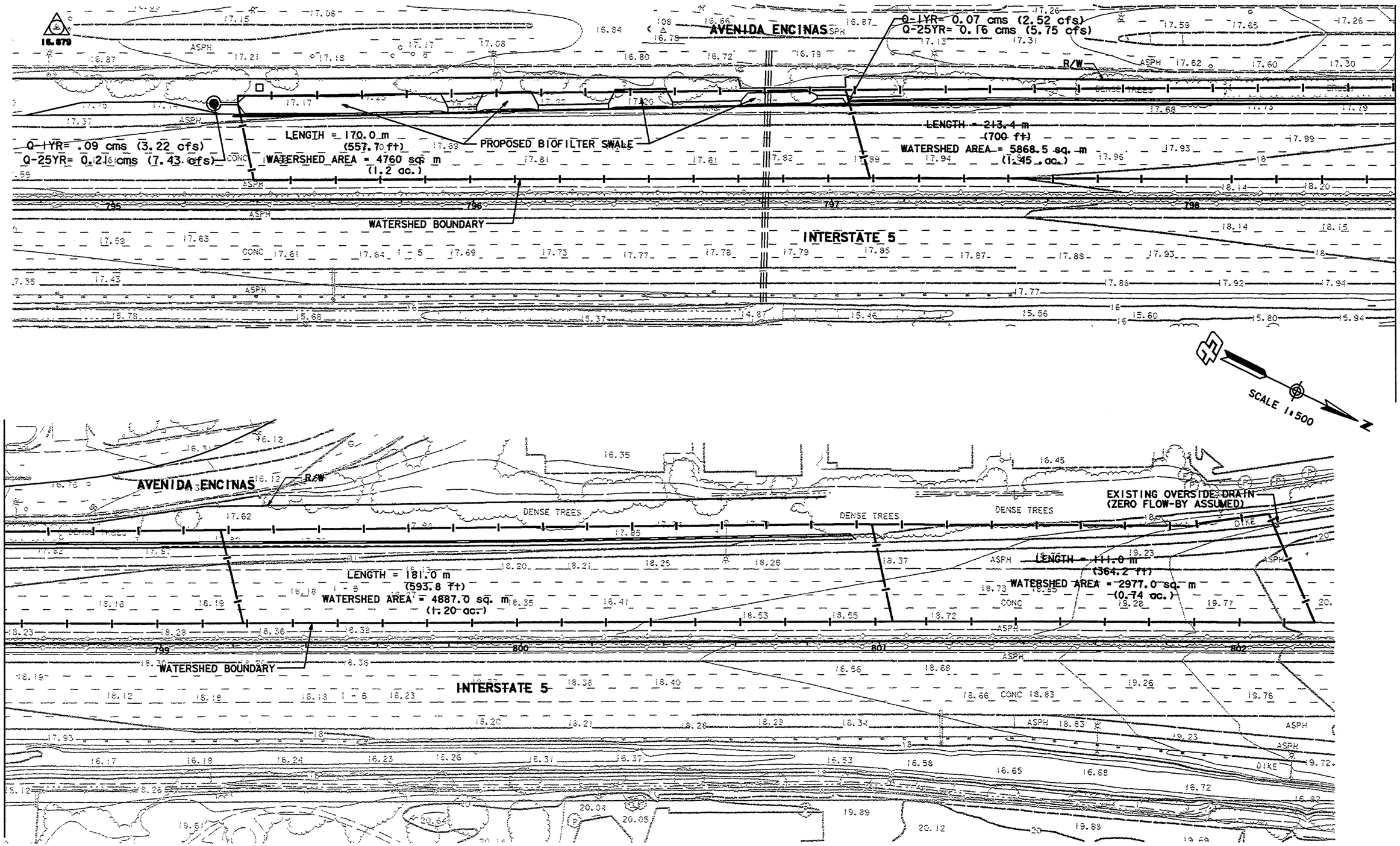
*** Design volume is based on Delaware Transportation Dept. design guidelines of 540 cubic feet per acre of tributary area

**** Design volume is based on California Transportation Dept. design guidelines of 540 cubic feet per acre of tributary area

***** Total Area is equal Subarea 2 + Subarea 3 (See Appendix A)

HYDROLOGY DATA FOR CALTRANS NPDES PILOT PROGRAM

PROJECT 2, SITE 4
RATIONAL METOHD HYDROLOGY CALCULATIONS
I-5/ PALOMAR AIRPORT ROAD



HYDROLOGY MAP

SITE 6: I-5 / PALOMAR AIRPORT ROAD BIOFILTER SWALE

FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

12 JUN 10 13:53:48 q:\57704\34358\dgn\hydrology maps\hydro6.div

SITE #6 PALOMAR AIRPORT ROAD/
I5 SOUTHBOUND OFF RAMP

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1996 Version 3.3

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 02/01/00

1-YEAR HYDROLOGY ANALYSIS FOR SITE 6
PALOMAR AIRPORT ROAD AND INTERSTATE 5 INTERCHANGE
BY: J. CASTANEDA FN: SITE6.OUT

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

AEI-CASC Engineering, Colton, California - S/N 615

Rational hydrology study storm event year is 1.0

Map data precipitation entered:
6 hour, precipitation(inches) = 0.994
24 hour precipitation(inches) = 1.338
Adjusted 6 hour precipitation (inches) = 0.870
P6/P24 = 74.3%
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++

Process from Point/Station 1.000 to Point/Station 2.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[INDUSTRIAL area type]
Initial subarea flow distance = 364.20(Ft.)
Highest elevation = 59.75(Ft.)
Lowest elevation = 57.70(Ft.)
Elevation difference = 2.05(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 12.48 min.
TC = [1.8*(1.1-C)*distance^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8000)*(364.20^.5)/(0.56^(1/3)]= 12.48
Rainfall intensity (I) = 1.270 for a 1.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.800
Subarea runoff = 0.752(CFS)
Total initial stream area = 0.740(Ac.)

++

Process from Point/Station 2.000 to Point/Station 3.000
**** IMPROVED CHANNEL TRAVEL TIME ****

```
Upstream point elevation =     57.70(Ft.)
Downstream point elevation =     56.80(Ft.)
Channel length thru subarea  =    593.80(Ft.)
Channel base width      =    2.000(Ft.)
Slope or 'Z' of left channel bank =   6.000
Slope or 'Z' of right channel bank =   6.000
Estimated mean flow rate at midpoint of channel =      1.362(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      1.362(CFS)
Depth of flow =   0.285(Ft.), Average velocity =   1.289(Ft/s)
Channel flow top width =    5.417(Ft.)
Flow Velocity =    1.29(Ft/s)
Travel time  =    7.68 min.
Time of concentration =   20.16 min.
Critical depth =      0.197(Ft.)
 Adding area flow to channel
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[INDUSTRIAL area type                        ]
Rainfall intensity =      0.932(In/Hr) for a     1.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.800
Subarea runoff =      0.895(CFS) for    1.200(Ac.)
Total runoff =      1.647(CFS)      Total area =        1.94(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station        4.000
**** IMPROVED CHANNEL TRAVEL TIME ****
------------------------------------------------------------------------------
Upstream point elevation =     56.80(Ft.)
Downstream point elevation =     55.75(Ft.)
Channel length thru subarea  =    700.00(Ft.)
Channel base width      =    2.000(Ft.)
Slope or 'Z' of left channel bank =   6.000
Slope or 'Z' of right channel bank =   6.000
Estimated mean flow rate at midpoint of channel =      2.262(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      2.262(CFS)
Depth of flow =   0.366(Ft.), Average velocity =   1.473(Ft/s)
Channel flow top width =    6.392(Ft.)
Flow Velocity =    1.47(Ft/s)
Travel time  =    7.92 min.
Time of concentration =   28.08 min.
Critical depth =      0.262(Ft.)
 Adding area flow to channel
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[INDUSTRIAL area type                        ]
Rainfall intensity =      0.753(In/Hr) for a     1.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.800
Subarea runoff =      0.873(CFS) for    1.450(Ac.)
```

```
Total runoff =      2.520(CFS)      Total area =        3.39(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        4.000 to Point/Station        5.000
**** IMPROVED CHANNEL TRAVEL TIME ****
------------------------------------------------------------------------------
Upstream point elevation =     55.75(Ft.)
Downstream point elevation =     54.91(Ft.)
Channel length thru subarea  =    557.70(Ft.)
Channel base width      =    9.840(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Estimated mean flow rate at midpoint of channel =      2.967(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      2.967(CFS)
Depth of flow =   0.326(Ft.), Average velocity =   0.867(Ft/s)
Channel flow top width =   11.145(Ft.)
Flow Velocity =    0.87(Ft/s)
Travel time  =   10.72 min.
Time of concentration =   38.80 min.
Critical depth =      0.141(Ft.)
 Adding area flow to channel
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type                        ]
Rainfall intensity =      0.611(In/Hr) for a     1.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      0.697(CFS) for    1.200(Ac.)
Total runoff =      3.217(CFS)      Total area =        4.59(Ac.)
End of computations, total study area =            4.59 (Ac.)
```

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1996 Version 3.3

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 02/01/00

25-YEAR HYDROLOGY ANALYSIS FOR SITE 6
PALOMAR AIRPORT ROAD AND INTERSTATE 5 INTERCHANGE
BY: J. CASTANEDA FN: SITE6.OUT

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

AEI-CASC Engineering, Colton, California - S/N 615

Rational hydrology study storm event year is 25.0

Map data precipitation entered:
6 hour, precipitation(inches) = 1.900
24 hour precipitation(inches) = 3.100
Adjusted 6 hour precipitation (inches) = 1.900
P6/P24 = 61.3%
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++

Process from Point/Station 1.000 to Point/Station 2.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[INDUSTRIAL area type]
Initial subarea flow distance = 364.20(Ft.)
Highest elevation = 59.75(Ft.)
Lowest elevation = 57.70(Ft.)
Elevation difference = 2.05(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 12.48 min.
TC = [1.8*(1.1-C)*distance^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8000)*(364.20^.5)/(0.56^(1/3)]= 12.48
Rainfall intensity (I) = 2.775 for a 25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.800
Subarea runoff = 1.643(CFS)
Total initial stream area = 0.740(Ac.)

++

Process from Point/Station 2.000 to Point/Station 3.000
**** IMPROVED CHANNEL TRAVEL TIME ****

```
Upstream point elevation =     57.70(Ft.)
Downstream point elevation =     56.80(Ft.)
Channel length thru subarea  =    593.80(Ft.)
Channel base width      =    2.000(Ft.)
Slope or 'Z' of left channel bank =   6.000
Slope or 'Z' of right channel bank =   6.000
Estimated mean flow rate at midpoint of channel =      2.975(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      2.975(CFS)
Depth of flow =   0.416(Ft.), Average velocity =   1.591(Ft/s)
Channel flow top width =    6.992(Ft.)
Flow Velocity =    1.59(Ft/s)
Travel time  =    6.22 min.
Time of concentration =   18.70 min.
Critical depth =      0.303(Ft.)
 Adding area flow to channel
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[INDUSTRIAL area type                    ]
Rainfall intensity =      2.138(In/Hr) for a    25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.800
Subarea runoff =      2.052(CFS) for    1.200(Ac.)
Total runoff =      3.695(CFS)      Total area =        1.94(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station        4.000
**** IMPROVED CHANNEL TRAVEL TIME ****
------------------------------------------------------------------------
Upstream point elevation =     56.80(Ft.)
Downstream point elevation =     55.75(Ft.)
Channel length thru subarea  =    700.00(Ft.)
Channel base width      =    2.000(Ft.)
Slope or 'Z' of left channel bank =   6.000
Slope or 'Z' of right channel bank =   6.000
Estimated mean flow rate at midpoint of channel =      5.076(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      5.076(CFS)
Depth of flow =   0.535(Ft.), Average velocity =   1.823(Ft/s)
Channel flow top width =    8.416(Ft.)
Flow Velocity =    1.82(Ft/s)
Travel time  =    6.40 min.
Time of concentration =   25.10 min.
Critical depth =      0.398(Ft.)
 Adding area flow to channel
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[INDUSTRIAL area type                    ]
Rainfall intensity =      1.768(In/Hr) for a    25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.800
Subarea runoff =      2.051(CFS) for    1.450(Ac.)
```

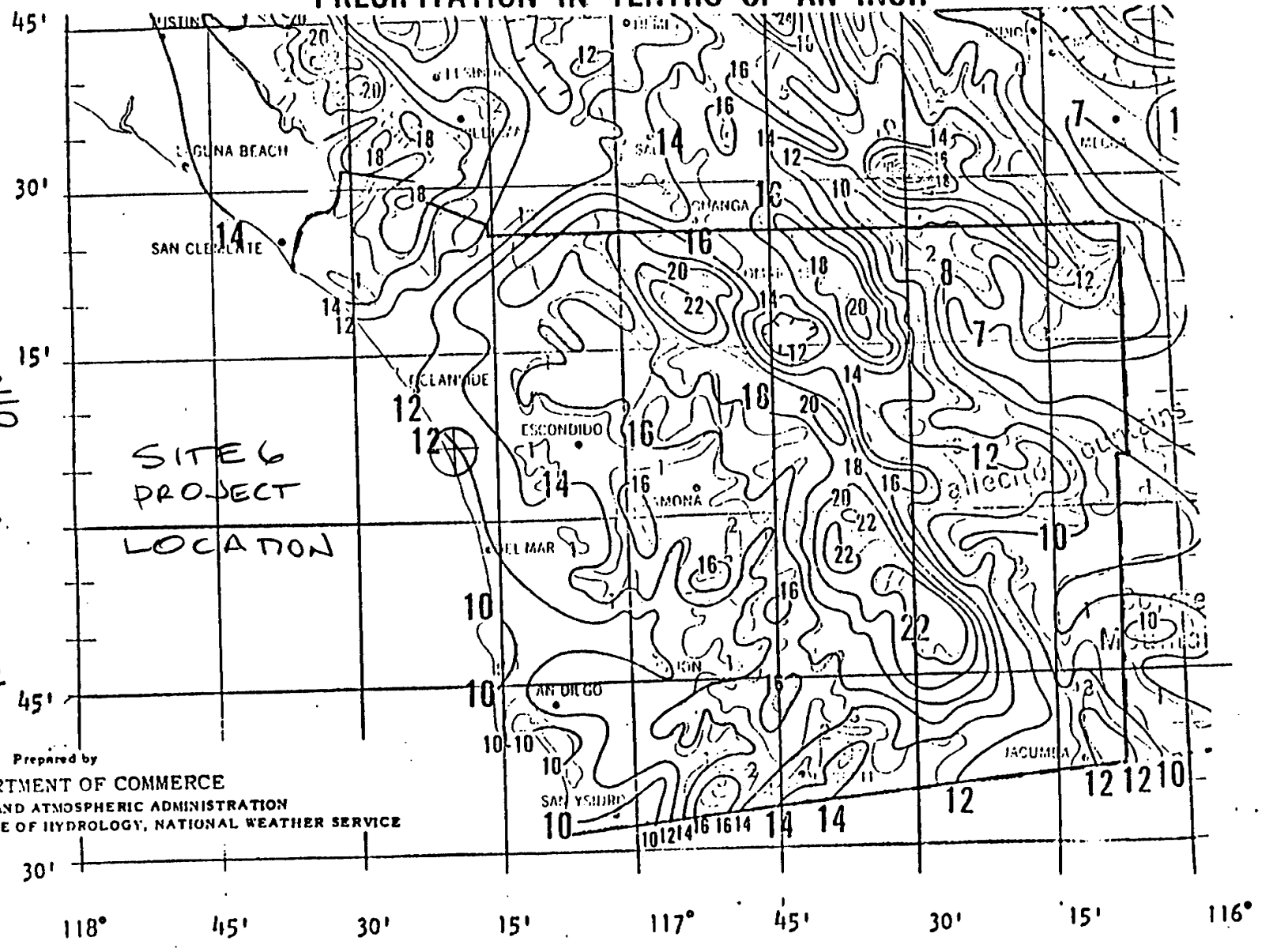
```
Total runoff =      5.746(CFS)      Total area =        3.39(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        4.000 to Point/Station        5.000
**** IMPROVED CHANNEL TRAVEL TIME ****
------------------------------------------------------------------------------
Upstream point elevation =     55.75(Ft.)
Downstream point elevation =     54.91(Ft.)
Channel length thru subarea  =    557.70(Ft.)
Channel base width      =    9.840(Ft.)
Slope or 'Z' of left channel bank =   2.000
Slope or 'Z' of right channel bank =   2.000
Estimated mean flow rate at midpoint of channel =      6.763(CFS)
Manning's 'N'    = 0.030
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      6.763(CFS)
Depth of flow =   0.531(Ft.), Average velocity =   1.168(Ft/s)
Channel flow top width =   11.964(Ft.)
Flow Velocity =    1.17(Ft/s)
Travel time  =    7.96 min.
Time of concentration =   33.06 min.
Critical depth =      0.242(Ft.)
 Adding area flow to channel
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[INDUSTRIAL area type                    ]
Rainfall intensity =      1.480(In/Hr) for a    25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.950
Subarea runoff =      1.688(CFS) for    1.200(Ac.)
Total runoff =      7.434(CFS)      Total area =        4.59(Ac.)
End of computations, total study area =            4.59 (Ac.)
```

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

2-YEAR 6-HOUR PRECIPITATION

—10— ISOPLUVIALS OF 2-YEAR 6-HOUR PRECIPITATION IN TENTHS OF AN INCH



2YR-6HR P = 12/10

1.2"

1YR/2YR RATIO = 0.78733

1YR-6HR P =

0.787 × 1.2

0.94

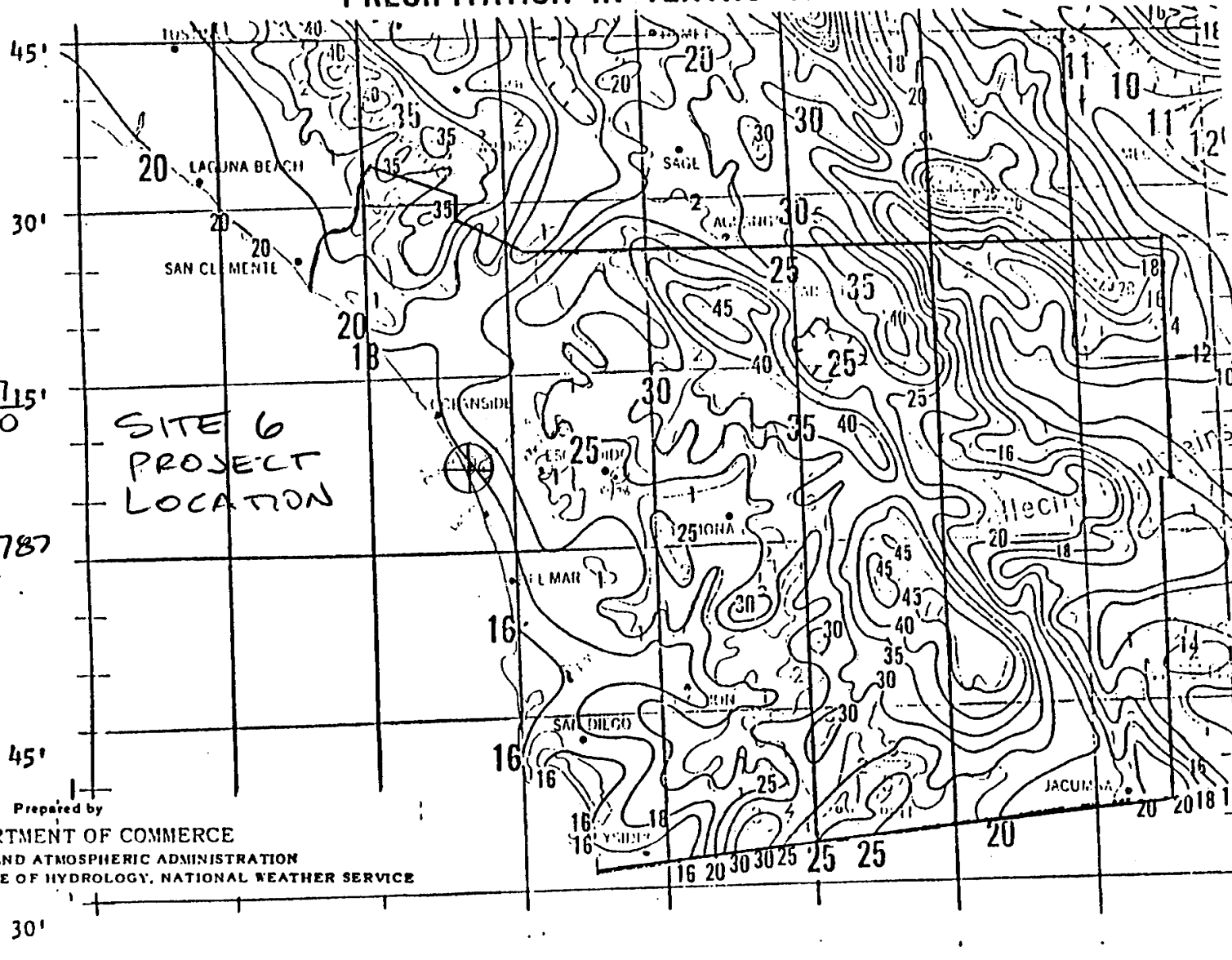
Prepared by

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
SPECIAL STUDIES BRANCH, OFFICE OF HYDROLOGY, NATIONAL WEATHER SERVICE

2-YEAR 24-HOUR PRECIPITATION

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

—10— ISOPLUVIALS OF 2-YEAR 24-HOUR PRECIPITATION IN TENTHS OF AN INCH



2YR-24HR P = 17/10
= 1.7"

SITE 6
PROJECT
LOCATION

1YR/2YR RATIO = 0.787
33°

1YR-24HR P =
= 0.787 × 1.7
= 1.34

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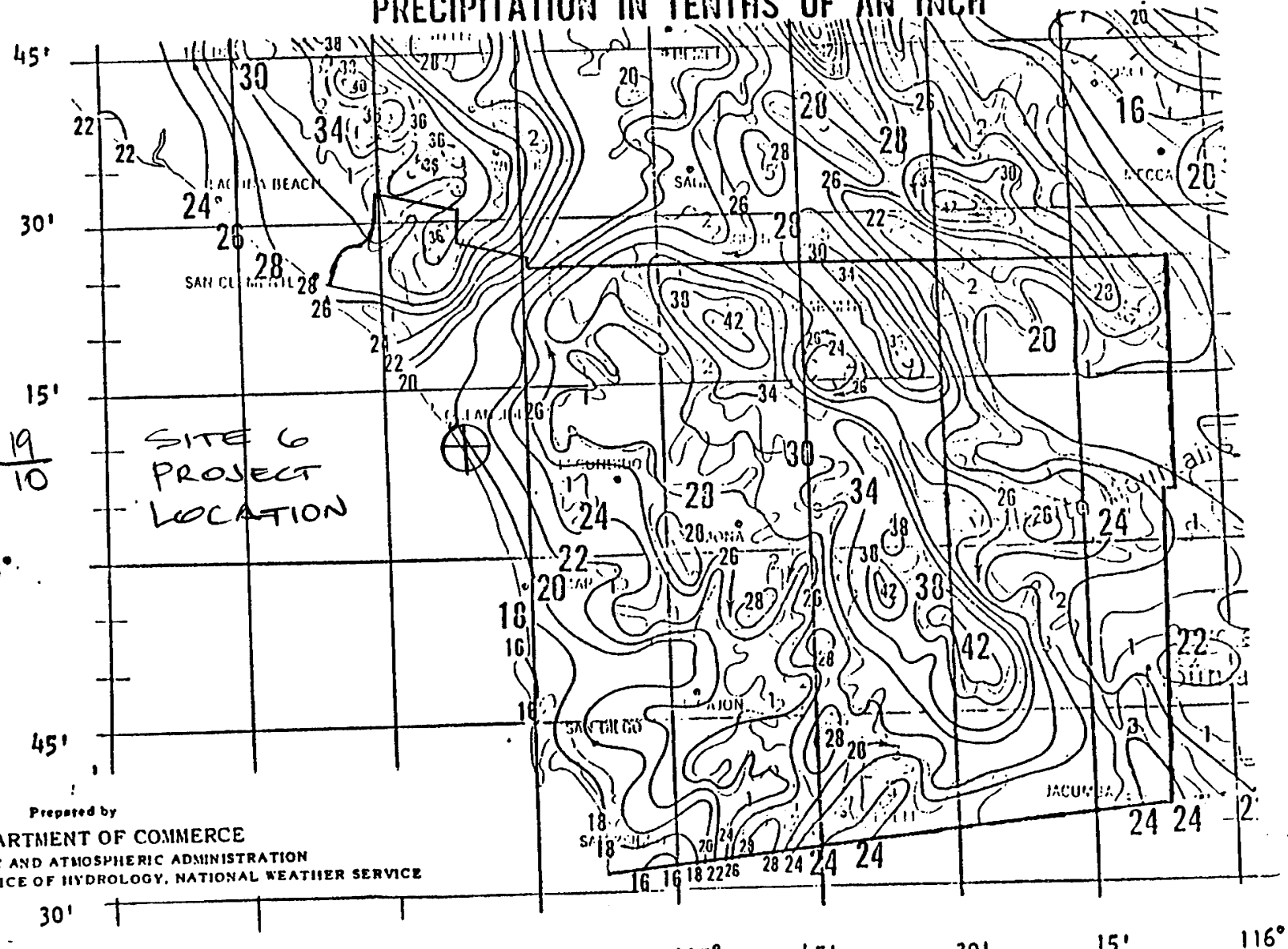
U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
SPECIAL STUDIES BRANCH, OFFICE OF HYDROLOGY, NATIONAL WEATHER SERVICE

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

25-YEAR 6-HOUR PRECIPITATION

(16) ISOPLUVIALS OF 25-YEAR 6-HOUR PRECIPITATION IN TENTHS OF AN INCH



25YR-6HR P = 19/10
1.9"

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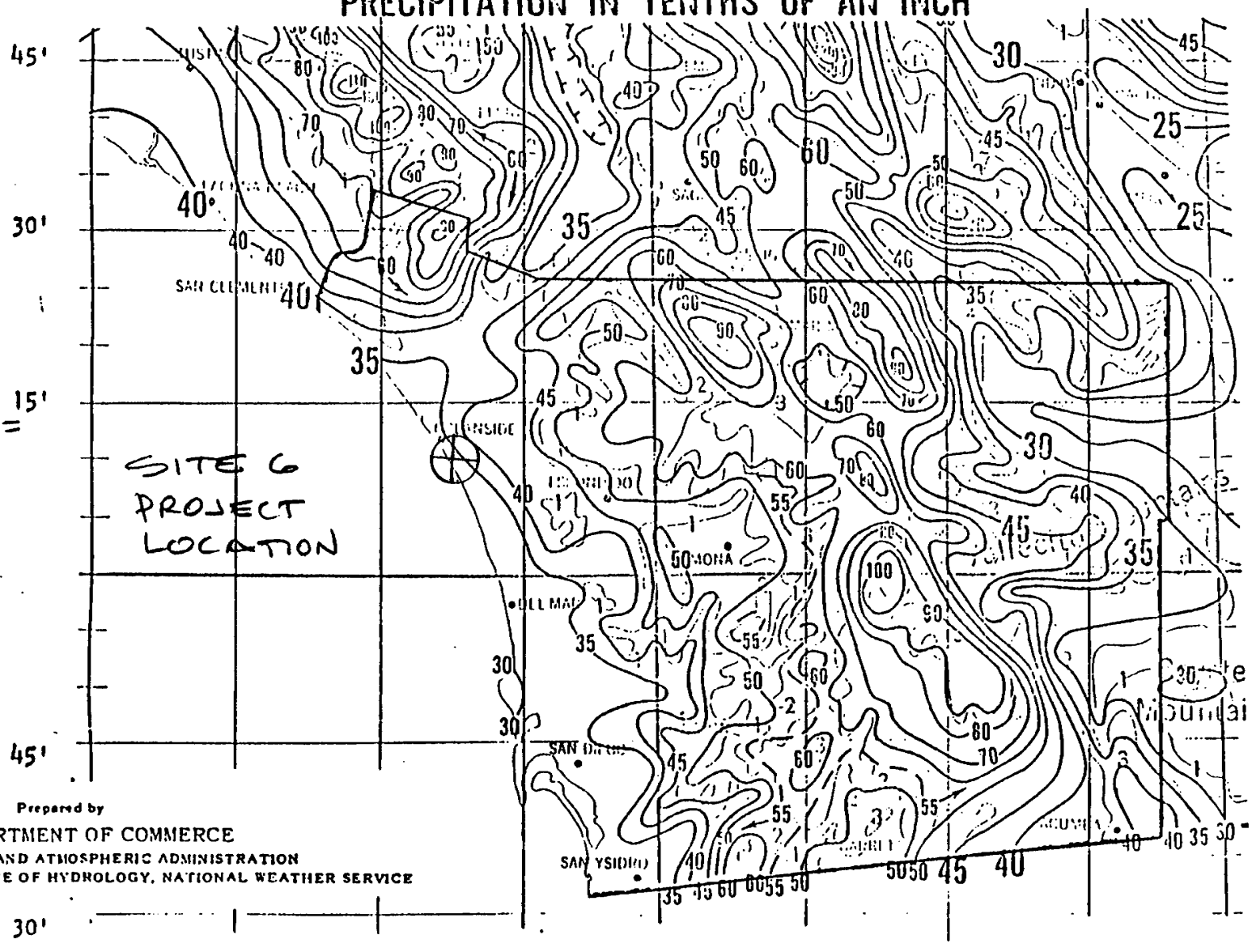
U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
SPECIAL STUDIES BRANCH, OFFICE OF HYDROLOGY, NATIONAL WEATHER SERVICE

25-YEAR 24-HOUR PRECIPITATION

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

(20) ISOPLUVIALS OF 25-YEAR 24-HOUR PRECIPITATION IN TENTHS OF AN INCH

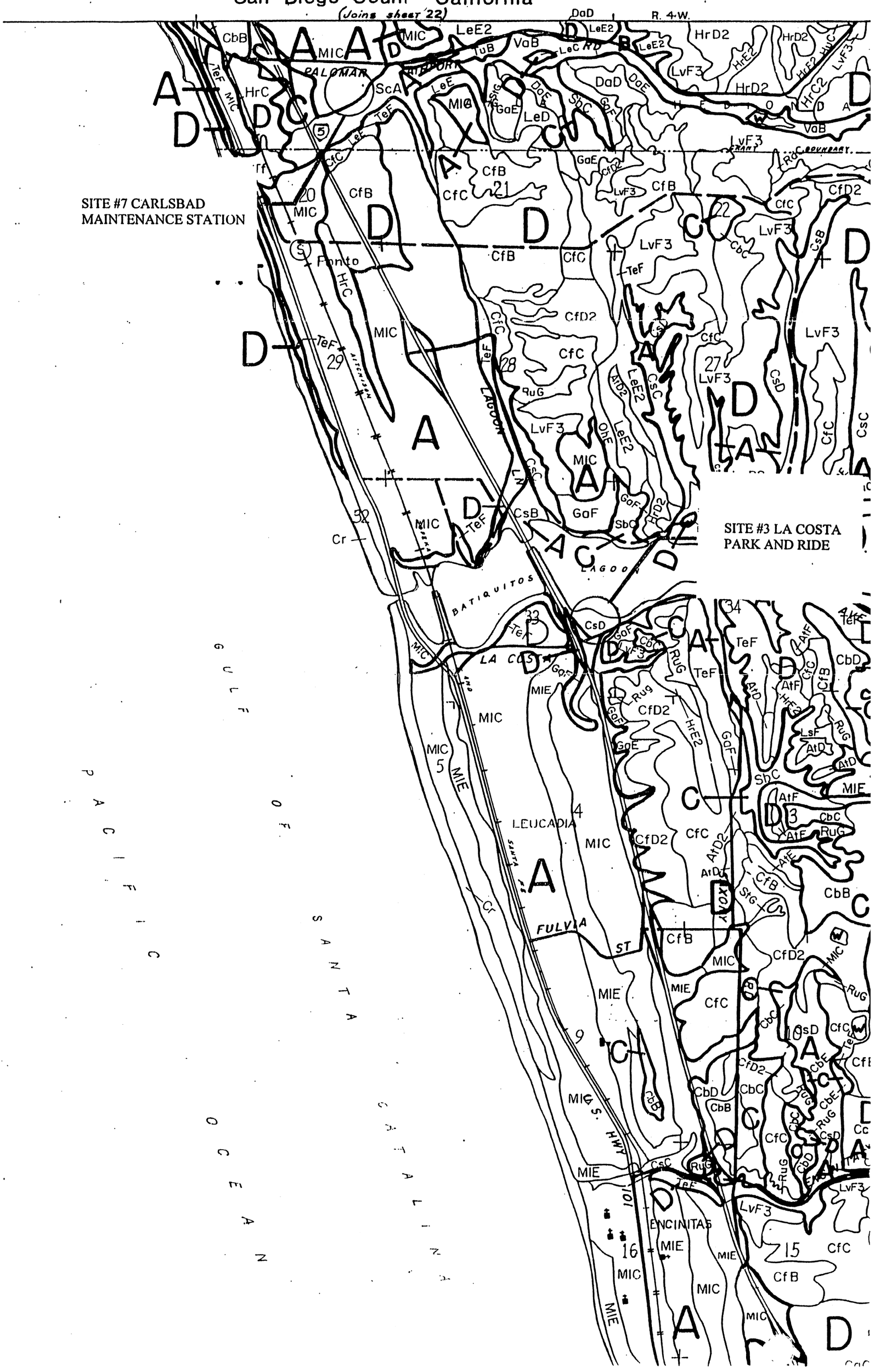


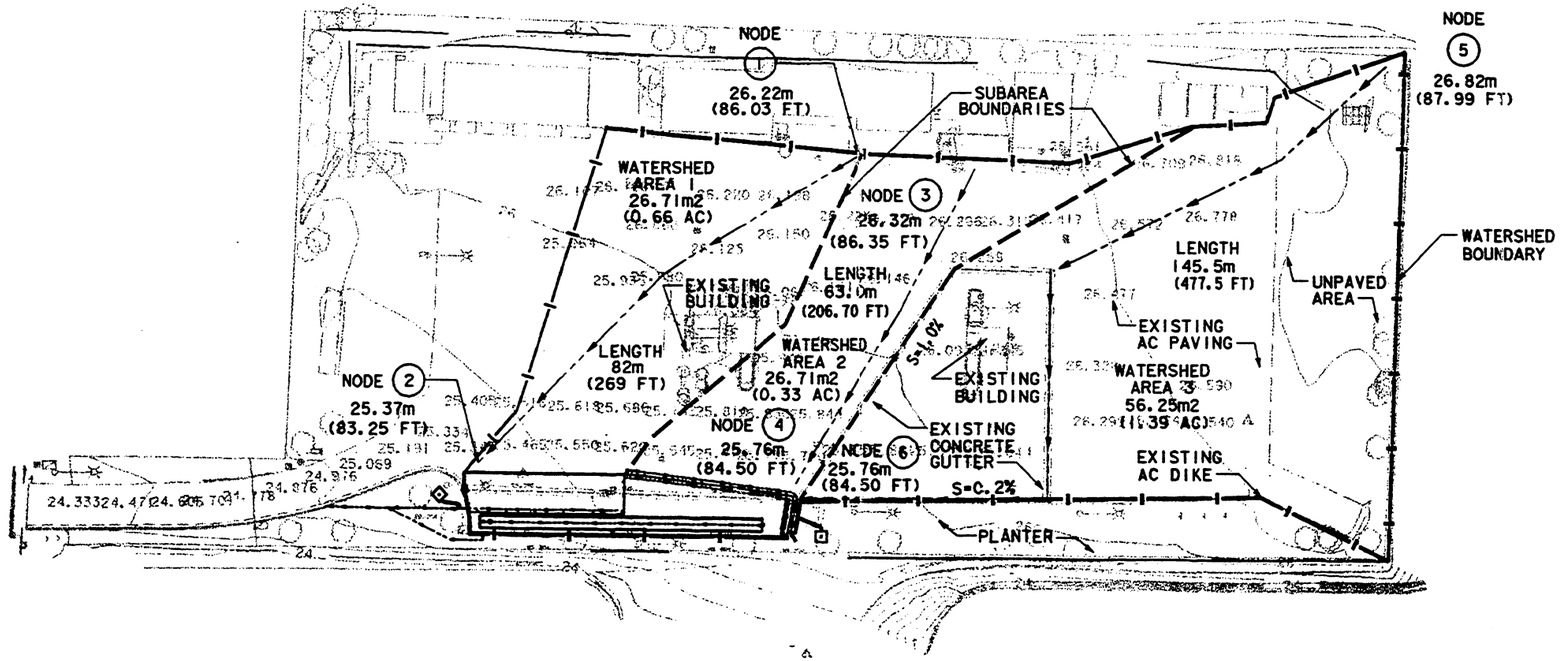
25YR-24HR P = 31/10 = 3.1"

Prepared by
U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
SPECIAL STUDIES BRANCH, OFFICE OF HYDROLOGY, NATIONAL WEATHER SERVICE

PROJECT 2, SITE 1 AND 2
RATIONAL METHOD HYDROLOGY CALCULATIONS
AND UNIT HYDROGRAPH ANALYSIS
CARLSBAD MAINTENANCE STATION

San Diego Count California





N

SCALE: 1 : 500

HYDROLOGY MAP

SITE 7 CARLSBAD MAINTENANCE STATION

FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

29 MAY 98 16 :57 q:\57704\34358\dgn\dlv\salte7.dlv

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1996 Version 3.3

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/08/98

Hydrology for 1 year Storm
File Name S7A1
AREA 1
SITE 7 CARLSBAD MAINTENANCE STATION

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

AEI-CASC Engineering, Colton, California - S/N 615

Rational hydrology study storm event year is 1.0

Map data precipitation entered:
6 hour, precipitation(inches) = 0.866
24 hour precipitation(inches) = 1.340
Adjusted 6 hour precipitation (inches) = 0.866
P6/P24 = 64.6%
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++

Process from Point/Station 1.000 to Point/Station 2.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[COMMERCIAL area type]
Initial subarea flow distance = 269.02(Ft.)
Highest elevation = 86.03(Ft.)
Lowest elevation = 83.25(Ft.)
Elevation difference = 2.78(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 11.68 min.
TC = [1.8*(1.1-C)*distance^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.7000)*(269.02^.5)/(1.03^(1/3)]= 11.68
Rainfall intensity (I) = 1.320 for a 1.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.700
Subarea runoff = 0.610(CFS)
Total initial stream area = 0.660(Ac.)
End of computations, total study area = 0.66 (Ac.)

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1996 Version 3.3

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/08/98

Hydrology 1 year strom
File Name S7A2
AREA 2
SITE 7 CARLSBAD MAINTENANCE STATION

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

AEI-CASC Engineering, Colton, California - S/N 615

Rational hydrology study storm event year is 1.0

Map data precipitation entered:
6 hour, precipitation(inches) = 0.866
24 hour precipitation(inches) = 1.340
Adjusted 6 hour precipitation (inches) = 0.866
P6/P24 = 64.6%
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++

Process from Point/Station 3.000 to Point/Station 4.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[COMMERCIAL area type]
Initial subarea flow distance = 206.70(Ft.)
Highest elevation = 86.35(Ft.)
Lowest elevation = 84.50(Ft.)
Elevation difference = 1.85(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 10.74 min.
TC = [1.8*(1.1-C)*distance^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.7000)*(206.70^.5)/(0.90^(1/3)]= 10.74
Rainfall intensity (I) = 1.394 for a 1.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.700
Subarea runoff = 0.324(CFS)
Total initial stream area = 0.332(Ac.)
End of computations, total study area = 0.33 (Ac.)

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1996 Version 3.3

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/08/98

Hydrology 1 year storm
File Name S7A3
AREA 3
SITE 7 CARLSBAD MAINTENANCE STATION

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

AEI-CASC Engineering, Colton, California - S/N 615

Rational hydrology study storm event year is 1.0

Map data precipitation entered:
6 hour, precipitation(inches) = 0.866
24 hour precipitation(inches) = 1.340
Adjusted 6 hour precipitation (inches) = 0.866
P6/P24 = 64.6%
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++

Process from Point/Station 5.000 to Point/Station 6.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[COMMERCIAL area type]
Initial subarea flow distance = 400.00(Ft.)
Highest elevation = 87.99(Ft.)
Lowest elevation = 84.50(Ft.)
Elevation difference = 3.49(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 15.07 min.
TC = [1.8*(1.1-C)*distance^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.7000)*(400.00^.5)/(0.87^(1/3)]= 15.07
Rainfall intensity (I) = 1.120 for a 1.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.700
Subarea runoff = 1.090(CFS)
Total initial stream area = 1.390(Ac.)
End of computations, total study area = 1.39 (Ac.)

San Diego County Rational Hydrology Program

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Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/08/98

Peak Flow Utilizing Rational Method for 25 Year Storm
File Name S07A1
Area 1
SITE 7 CARLSBAD MAINTENANCE STATION

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

AEI-CASC Engineering, Colton, California - S/N 615

Rational hydrology study storm event year is 25.0

Map data precipitation entered:
6 hour, precipitation(inches) = 1.900
24 hour precipitation(inches) = 3.100
Adjusted 6 hour precipitation (inches) = 1.900
P6/P24 = 61.3%
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++

Process from Point/Station 1.000 to Point/Station 2.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[COMMERCIAL area type]
Initial subarea flow distance = 269.02(Ft.)
Highest elevation = 86.03(Ft.)
Lowest elevation = 83.25(Ft.)
Elevation difference = 2.78(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 11.68 min.
TC = [1.8*(1.1-C)*distance^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.7000)*(269.02^.5)/(1.03^(1/3)]= 11.68
Rainfall intensity (I) = 2.896 for a 25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.700
Subarea runoff = 1.338(CFS)
Total initial stream area = 0.660(Ac.)
End of computations, total study area = 0.66 (Ac.)

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1996 Version 3.3

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/08/98

Peak Flow Utilizing the Rational Method for 25 Year Storm
File Name S07A2
Area 2
SITE 7 CARLSBAD MAINTENANCE STATION

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

AEI-CASC Engineering, Colton, California - S/N 615

Rational hydrology study storm event year is 25.0

Map data precipitation entered:
6 hour, precipitation(inches) = 1.900
24 hour precipitation(inches) = 3.100
Adjusted 6 hour precipitation (inches) = 1.900
P6/P24 = 61.3%
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++

Process from Point/Station 3.000 to Point/Station 4.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[COMMERCIAL area type]
Initial subarea flow distance = 206.70(Ft.)
Highest elevation = 86.35(Ft.)
Lowest elevation = 84.50(Ft.)
Elevation difference = 1.85(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 10.74 min.
TC = [1.8*(1.1-C)*distance^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.7000)*(206.70^.5)/(0.90^(1/3)]= 10.74
Rainfall intensity (I) = 3.057 for a 25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.700
Subarea runoff = 0.710(CFS)
Total initial stream area = 0.332(Ac.)
End of computations, total study area = 0.33 (Ac.)

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1996 Version 3.3

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/28/98

Peak Flow Utilizing the Rational Method for 25 Year Storm
File Name S07A3
Area 3
SITE 7 CARLSBAD MAINTENANCE STATION

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

AEI-CASC Engineering, Colton, California - S/N 615

Rational hydrology study storm event year is 25.0

Map data precipitation entered:
6 hour, precipitation(inches) = 1.900
24 hour precipitation(inches) = 3.100
Adjusted 6 hour precipitation (inches) = 1.900
P6/P24 = 61.3%
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++

Process from Point/Station 5.000 to Point/Station 6.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[COMMERCIAL area type]
Initial subarea flow distance = 477.50(Ft.)
Highest elevation = 87.99(Ft.)
Lowest elevation = 84.50(Ft.)
Elevation difference = 3.49(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 17.47 min.
TC = [1.8*(1.1-C)*distance^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.7000)*(477.50^.5)/(0.73^(1/3)]= 17.47
Rainfall intensity (I) = 2.234 for a 25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.700
Subarea runoff = 2.174(CFS)
Total initial stream area = 1.390(Ac.)
End of computations, total study area = 1.39 (Ac.)

U n i t H y d r o g r a p h A n a l y s i s

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Study date 03/09/98

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San Bernardino County Synthetic Unit Hydrology Method
Manual date - August 1986

AEI CASC Engineering, Colton, California - S/N 615

Site No. 7 - Carlsbad M.S.
1-yr, 24-hr storm runoff volume calculation

Storm Event Year = 1

Antecedent Moisture Condition = 2

Area averaged rainfall intensity isohyetal data:

Sub-Area (acres)	Duration (hours)	Intensity (inches)
Rainfall data for year 1		
1.72	1	0.46
Rainfall data for year 1		
1.72	6	0.87
Rainfall data for year 1		
1.72	24	1.34

++

******** Area-averaged max loss rate, Fm ********

SCS curve No.(AMCII)	SCS curve No.(AMC 2)	Area (Acres)	Area Fraction	Fp(Fig c6) (In/Hr)	Ap (dec.)	Fm (in/hr)
89.0	89.0	1.72	1.000	0.211	0.100	0.021

Area-averaged adjusted loss rate Fm (In/Hr)= 0.021

********* Area-Averaged low loss rate fraction, Yb **********

Area (acres)	Area fract	SCS cn (AMC2)	SCS cn (AMC2)	S	Pervious yield fr
0.17	0.100	89.0	89.0	1.24	0.383
1.55	0.900	98.0	98.0	0.20	0.960

Area-averaged catchment yield fraction, Y = 0.903
Area-averaged low loss fraction, Yb = 0.097
++
User entry of time of concentration = 0.677 (hours)
Watershed area = 1.72 acres
Catchment Lag time = 0.541 hours
Unit interval = 60.000 minutes
Unit interval percentage of lag time = 184.7200

Hydrograph baseflow = 0.00 (CFS)
Average maximum watershed loss rate(Fm) = 0.021 (In/hr)
Average low loss rate fraction (Yb) = 0.097 (decimal)
VALLEY DEVELOPED S-Graph Selected
Computed peak 5-minute rainfall = 0.190 inches
Computed peak 30-minute rainfall = 0.359 inches
Specified peak 1-hour rainfall = 0.459 inches
Computed peak 3-hour rainfall = 0.677 inches
Specified peak 6-hour rainfall = 0.866 inches
Specified peak 24-hour rainfall = 1.340 inches

Rainfall depth area reduction factors:
Using a total area of 1.72 acres (Ref: fig. E-4)

5-minute factor = 1.000 Adjusted rainfall = 0.190 inches
30-minute factor = 1.000 Adjusted rainfall = 0.359 inches
1-hour factor = 1.000 Adjusted rainfall = 0.459 inches
3-hour factor = 1.000 Adjusted rainfall = 0.677 inches
6-hour factor = 1.000 Adjusted rainfall = 0.866 inches
24-hour factor = 1.000 Adjusted rainfall = 1.340 inches

U n i t H y d r o g r a p h

Interval Number	'S' Graph Mean values	Unit Hydrograph (CFS)
1	44.530	0.772
2	100.000	0.962

Peak Unit Number	Adjusted mass rainfall (inches)	Unit rainfall (inches)
1	0.4590	0.4590
2	0.5868	0.1278
3	0.6774	0.0907
4	0.7501	0.0727
5	0.8118	0.0617
6	0.8660	0.0542
7	0.9091	0.0431
8	0.9481	0.0390
9	0.9839	0.0358
10	1.0171	0.0332
11	1.0481	0.0310
12	1.0772	0.0291
13	1.1047	0.0275
14	1.1308	0.0261
15	1.1557	0.0248
16	1.1794	0.0237
17	1.2021	0.0227
18	1.2239	0.0218
19	1.2450	0.0210
20	1.2652	0.0203
21	1.2848	0.0196
22	1.3038	0.0190
23	1.3222	0.0184
24	1.3400	0.0178

Unit Period (number)	Unit Rainfall (inches)	Unit Soil-Loss (inches)	Effective Rainfall (inches)
1	0.0179	0.0017	0.0162
2	0.0188	0.0018	0.0170
3	0.0197	0.0019	0.0178

4	0.0208	0.0020	0.0188
5	0.0220	0.0021	0.0199
6	0.0234	0.0023	0.0211
7	0.0251	0.0024	0.0226
8	0.0271	0.0026	0.0244
9	0.0295	0.0029	0.0266
10	0.0325	0.0032	0.0294
11	0.0365	0.0036	0.0329
12	0.0418	0.0041	0.0378
13	0.0557	0.0054	0.0502
14	0.0693	0.0067	0.0625
15	0.0971	0.0095	0.0876
16	0.2491	0.0211	0.2280
17	0.3313	0.0211	0.3102
18	0.0637	0.0062	0.0575
19	0.0396	0.0039	0.0358
20	0.0313	0.0030	0.0282
21	0.0263	0.0026	0.0237
22	0.0228	0.0022	0.0206
23	0.0204	0.0020	0.0184
24	0.0184	0.0018	0.0166

Total soil rain loss = 0.12 (In.)
Total effective runoff = 1.22 (In.)

Total soil-loss volume = 0.0167 (Acre-Feet)
Total storm runoff volume = 0.1753 (Acre-Feet)

++

24 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 60 Minute intervals (CFS)

Time(h+m)	Volume(AF)	Q(CFS)	0 2.5 5.0 7.5 10.0
1+ 0	0.0010	0.01	Q
2+ 0	0.0034	0.03	Q
3+ 0	0.0059	0.03	QV
4+ 0	0.0085	0.03	QV
5+ 0	0.0113	0.03	Q V
6+ 0	0.0142	0.04	Q V
7+ 0	0.0173	0.04	Q V
8+ 0	0.0207	0.04	Q V
9+ 0	0.0243	0.04	Q V
10+ 0	0.0283	0.05	Q V
11+ 0	0.0327	0.05	Q V
12+ 0	0.0378	0.06	Q V
13+ 0	0.0440	0.08	Q V
14+ 0	0.0519	0.10	Q V
15+ 0	0.0625	0.13	Q V
16+ 0	0.0840	0.26	Q V
17+ 0	0.1219	0.46	Q V
18+ 0	0.1502	0.34	Q V
19+ 0	0.1571	0.08	Q V
20+ 0	0.1617	0.06	Q V
21+ 0	0.1655	0.05	Q V
22+ 0	0.1687	0.04	Q V
23+ 0	0.1715	0.03	Q V
24+ 0	0.1740	0.03	Q V
25+ 0	0.1753	0.02	Q V

U n i t H y d r o g r a p h A n a l y s i s

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Study date 04/22/98

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San Bernardino County Synthetic Unit Hydrology Method
Manual date - August 1986

AEI CASC Engineering, Colton, California - S/N 615

Site 7 25 year storm volume calc

Storm Event Year = 25

Antecedent Moisture Condition = 2

Area averaged rainfall intensity isohyetal data:

Sub-Area (acres)	Duration (hours)	Intensity (inches)
Rainfall data for year 25		
1.72	1	1.01
Rainfall data for year 25		
1.72	6	1.90
Rainfall data for year 25		
1.72	24	3.10

++

******** Area-averaged max loss rate, Fm ********

SCS curve No.(AMCII)	SCS curve No.(AMC 2)	Area (Acres)	Area Fraction	Fp(Fig c6) (In/Hr)	Ap (dec.)	Fm (in/hr)
98.0	98.0	1.72	1.000	0.040	0.200	0.008

Area-averaged adjusted loss rate Fm (In/Hr)= 0.008

********* Area-Averaged low loss rate fraction, Yb **********

Area (acres)	Area fract	SCS cn (AMC2)	SCS cn (AMC2)	S	Pervious yield fr
0.34	0.200	98.0	98.0	0.20	0.925
1.38	0.800	98.0	98.0	0.20	0.960

Area-averaged catchment yield fraction, Y = 0.953
Area-averaged low loss fraction, Yb = 0.047
++
Direct entry of lag time by user
Watershed area = 1.72 acres
Catchment Lag time = 0.271 hours

Unit interval = 30.000 minutes
Unit interval percentage of lag time = 184.5018
Hydrograph baseflow = 0.00 (CFS)
Average maximum watershed loss rate(Fm) = 0.008 (In/hr)
Average low loss rate fraction (Yb) = 0.047 (decimal)
VALLEY DEVELOPED S-Graph Selected
Computed peak 5-minute rainfall = 0.374 inches
Computed peak 30-minute rainfall = 0.765 inches
Specified peak 1-hour rainfall = 1.010 inches
Computed peak 3-hour rainfall = 1.488 inches
Specified peak 6-hour rainfall = 1.900 inches
Specified peak 24-hour rainfall = 3.100 inches

Rainfall depth area reduction factors:
Using a total area of 1.72 acres (Ref: fig. E-4)

5-minute factor = 1.000 Adjusted rainfall = 0.374 inches
30-minute factor = 1.000 Adjusted rainfall = 0.765 inches
1-hour factor = 1.000 Adjusted rainfall = 1.010 inches
3-hour factor = 1.000 Adjusted rainfall = 1.488 inches
6-hour factor = 1.000 Adjusted rainfall = 1.900 inches
24-hour factor = 1.000 Adjusted rainfall = 3.100 inches

U n i t H y d r o g r a p h

Interval Number	'S' Graph Mean values	Unit Hydrograph (CFS)
1	44.473	1.542
2	100.000	1.925

Peak Unit Number	Adjusted mass rainfall (inches)	Unit rainfall (inches)
1	0.7654	0.7654
2	1.0099	0.2445
3	1.1652	0.1553
4	1.2896	0.1244
5	1.3953	0.1056
6	1.4879	0.0927
7	1.5711	0.0831
8	1.6468	0.0758
9	1.7167	0.0698
10	1.7817	0.0650
11	1.8426	0.0609
12	1.9000	0.0574
13	1.9545	0.0545
14	2.0063	0.0518
15	2.0558	0.0495
16	2.1032	0.0474
17	2.1487	0.0455
18	2.1925	0.0438
19	2.2347	0.0423
20	2.2756	0.0408
21	2.3151	0.0395
22	2.3535	0.0383
23	2.3907	0.0372
24	2.4269	0.0362
25	2.4622	0.0352
26	2.4965	0.0343
27	2.5300	0.0335
28	2.5627	0.0327

29	2.5947	0.0320
30	2.6259	0.0312
31	2.6565	0.0306
32	2.6864	0.0300
33	2.7158	0.0294
34	2.7446	0.0288
35	2.7728	0.0282
36	2.8005	0.0277
37	2.8278	0.0272
38	2.8545	0.0268
39	2.8808	0.0263
40	2.9067	0.0259
41	2.9321	0.0255
42	2.9572	0.0251
43	2.9819	0.0247
44	3.0062	0.0243
45	3.0301	0.0240
46	3.0538	0.0236
47	3.0770	0.0233
48	3.1000	0.0230

Unit Period (number)	Unit Rainfall (inches)	Unit Soil-Loss (inches)	Effective Rainfall (inches)
1	0.0230	0.0011	0.0219
2	0.0235	0.0011	0.0224
3	0.0240	0.0011	0.0229
4	0.0246	0.0011	0.0234
5	0.0251	0.0012	0.0240
6	0.0257	0.0012	0.0245
7	0.0264	0.0012	0.0251
8	0.0271	0.0013	0.0258
9	0.0278	0.0013	0.0265
10	0.0286	0.0013	0.0273
11	0.0295	0.0014	0.0281
12	0.0304	0.0014	0.0290
13	0.0314	0.0015	0.0299
14	0.0324	0.0015	0.0309
15	0.0336	0.0016	0.0321
16	0.0349	0.0016	0.0333
17	0.0364	0.0017	0.0347
18	0.0380	0.0018	0.0362
19	0.0398	0.0019	0.0379
20	0.0418	0.0020	0.0398
21	0.0441	0.0021	0.0420
22	0.0468	0.0022	0.0446
23	0.0499	0.0023	0.0475
24	0.0536	0.0025	0.0511
25	0.0580	0.0027	0.0553
26	0.0636	0.0030	0.0606
27	0.0708	0.0033	0.0675
28	0.0806	0.0038	0.0768
29	0.0947	0.0040	0.0907
30	0.1177	0.0040	0.1137
31	0.1722	0.0040	0.1683
32	0.4069	0.0040	0.4030
33	0.5860	0.0040	0.5821
34	0.1104	0.0040	0.1064
35	0.0774	0.0036	0.0738
36	0.0617	0.0029	0.0589
37	0.0523	0.0024	0.0499
38	0.0459	0.0021	0.0437

39	0.0411	0.0019	0.0392
40	0.0374	0.0017	0.0357
41	0.0345	0.0016	0.0329
42	0.0321	0.0015	0.0306
43	0.0301	0.0014	0.0287
44	0.0283	0.0013	0.0270
45	0.0268	0.0013	0.0256
46	0.0255	0.0012	0.0243
47	0.0244	0.0011	0.0232
48	0.0233	0.0011	0.0222

Total soil rain loss = 0.10 (In.)
Total effective runoff = 3.00 (In.)

Total soil-loss volume = 0.0142 (Acre-Feet)
Total storm runoff volume = 0.4299 (Acre-Feet)

++

24 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 30 Minute intervals (CFS)

Time(h+m)	Volume(AF)	Q(CFS)	0 2.5 5.0 7.5 10.0
0+30	0.0014	0.03	Q
1+ 0	0.0046	0.08	Q
1+30	0.0078	0.08	Q
2+ 0	0.0111	0.08	QV
2+30	0.0145	0.08	QV
3+ 0	0.0180	0.08	QV
3+30	0.0215	0.09	Q V
4+ 0	0.0252	0.09	Q V
4+30	0.0289	0.09	Q V
5+ 0	0.0328	0.09	Q V
5+30	0.0367	0.10	Q V
6+ 0	0.0408	0.10	Q V
6+30	0.0450	0.10	Q V
7+ 0	0.0494	0.11	Q V
7+30	0.0539	0.11	Q V
8+ 0	0.0585	0.11	Q V
8+30	0.0634	0.12	Q V
9+ 0	0.0685	0.12	Q V
9+30	0.0737	0.13	Q V
10+ 0	0.0793	0.13	Q V
10+30	0.0851	0.14	Q V
11+ 0	0.0913	0.15	Q V
11+30	0.0979	0.16	Q V
12+ 0	0.1049	0.17	Q V
12+30	0.1125	0.18	Q V
13+ 0	0.1208	0.20	Q V
13+30	0.1299	0.22	Q V
14+ 0	0.1402	0.25	Q V
14+30	0.1521	0.29	Q V
15+ 0	0.1665	0.35	Q V
15+30	0.1863	0.48	Q V
16+ 0	0.2253	0.95	Q V
16+30	0.2945	1.67	Q V
17+ 0	0.3476	1.28	Q V
17+30	0.3607	0.32	Q V
18+ 0	0.3703	0.23	Q V

18+30	0.3782	0.19	Q				V
19+ 0	0.3850	0.16	Q				V
19+30	0.3909	0.14	Q				V
20+ 0	0.3963	0.13	Q				V
20+30	0.4013	0.12	Q				V
21+ 0	0.4058	0.11	Q				V
21+30	0.4101	0.10	Q				V
22+ 0	0.4141	0.10	Q				V
22+30	0.4179	0.09	Q				V
23+ 0	0.4214	0.09	Q				V
23+30	0.4249	0.08	Q				V
24+ 0	0.4281	0.08	Q				V
24+30	0.4299	0.04	Q				V

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1996 Version 3.3

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 04/22/98

Site 7 - 25 year 1 hour intensity calc

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

AEI-CASC Engineering, Colton, California - S/N 615

Rational hydrology study storm event year is 25.0

Map data precipitation entered:
6 hour, precipitation(inches) = 1.900
24 hour precipitation(inches) = 3.100
Adjusted 6 hour precipitation (inches) = 1.900
P6/P24 = 61.3%
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++

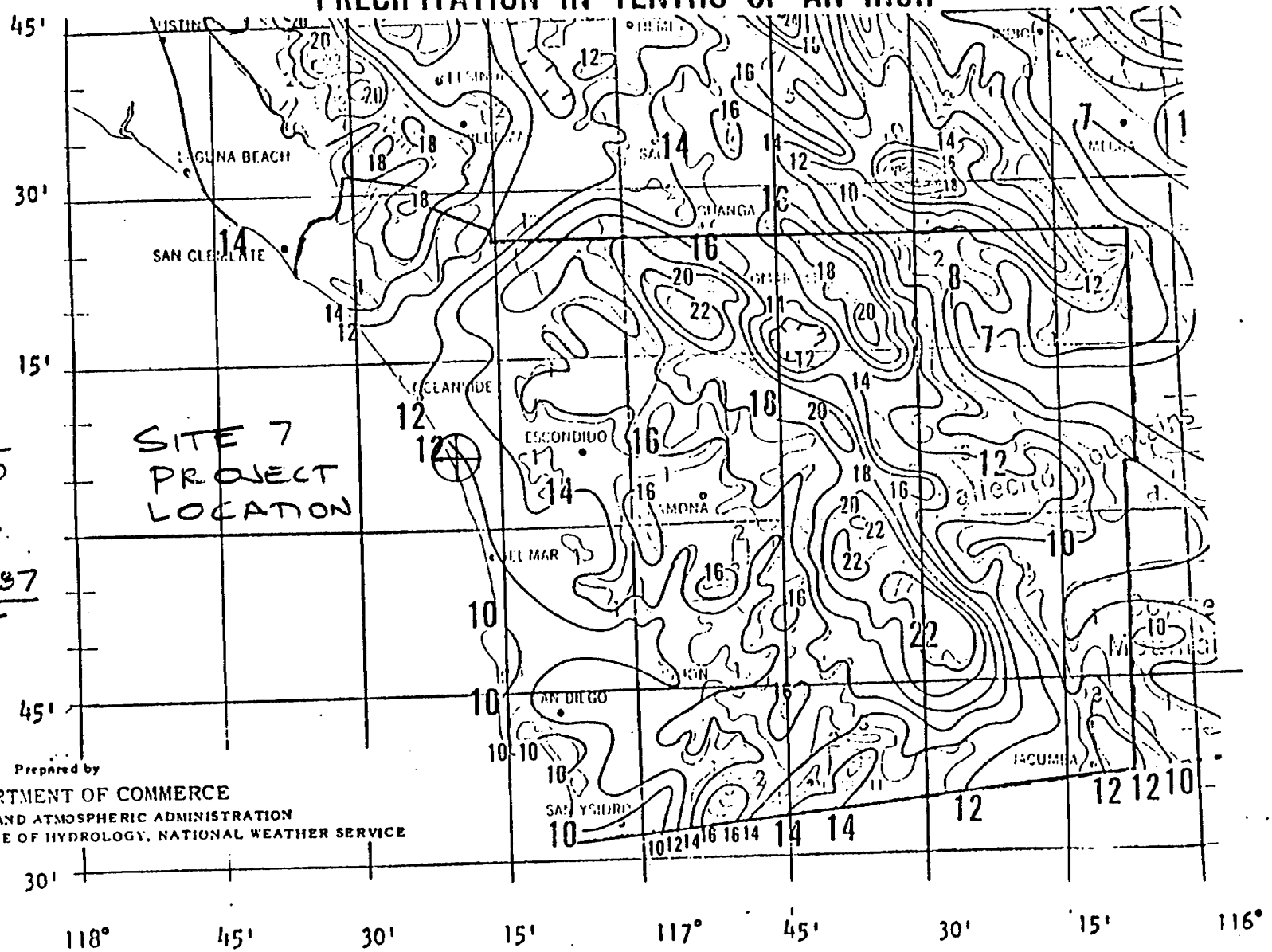
Process from Point/Station 1.000 to Point/Station 2.000
**** USER DEFINED FLOW INFORMATION AT A POINT ****

Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[COMMERCIAL area type]
Rainfall intensity (I) = 1.008 for a 25.0 year storm
User specified values are as follows:
TC = 60.00 min. Rain intensity = 1.01(In/Hr)
Total area = 1.72(Ac.) Total runoff = 7.00(CFS)
End of computations, total study area = 1.72 (Ac.)

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

2-YEAR 6-HOUR PRECIPITATION

—10— ISOPLUVIALS OF 2-YEAR 6-HOUR PRECIPITATION IN TENTHS OF AN INCH



2YR-6HR P = 11/10

1.1"

1YR/2YR RATIO = 0.787

1YR-6HR P =

1.1 × 0.787

0.87"

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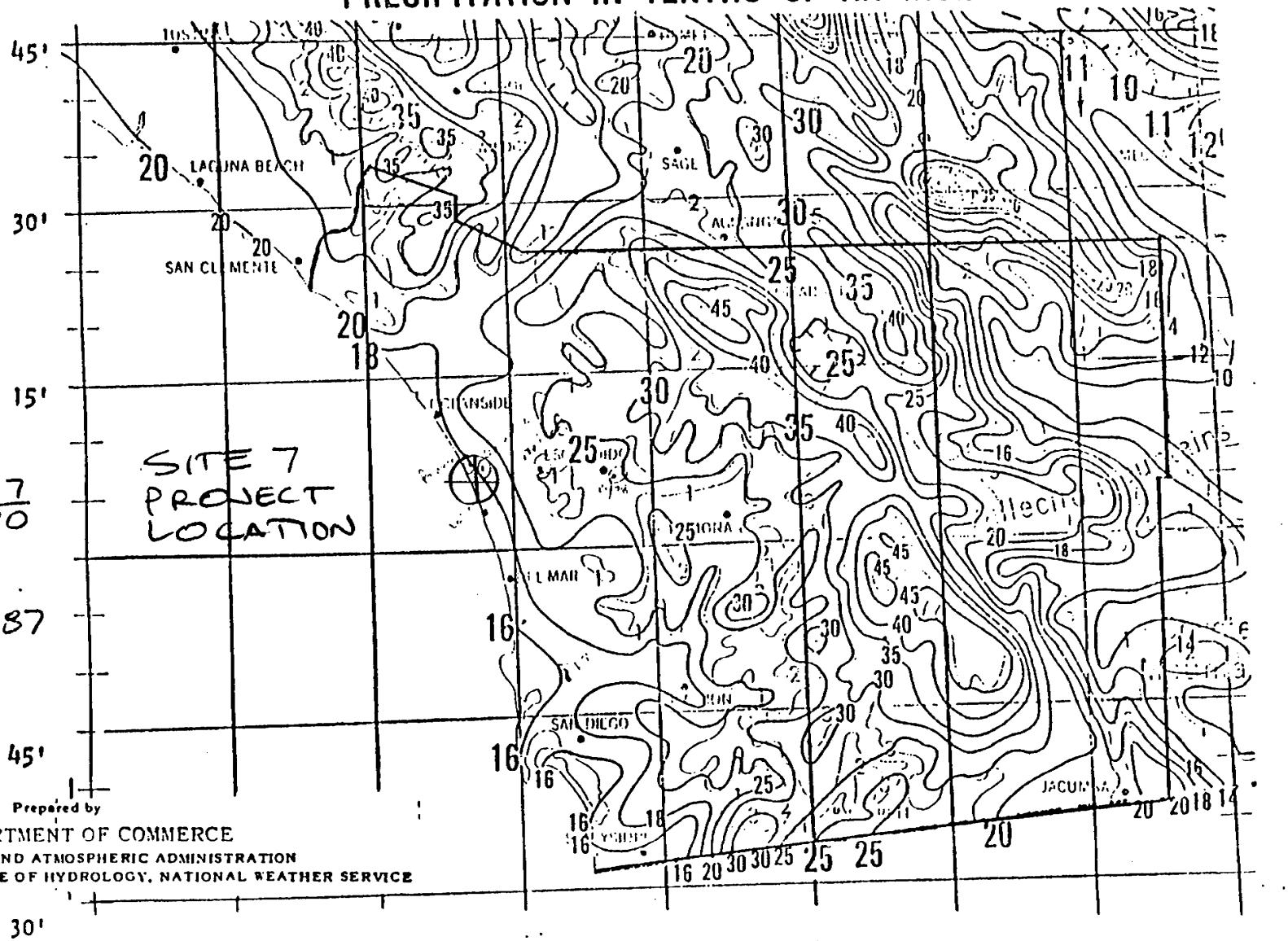
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
SPECIAL STUDIES BRANCH, OFFICE OF HYDROLOGY, NATIONAL WEATHER SERVICE

2-YEAR 24-HOUR PRECIPITATION

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

—10— ISOPLUVIALS OF 2-YEAR 24-HOUR PRECIPITATION IN TENTHS OF AN INCH



SITE 7
PROJECT
LOCATION

2YR-24HR P = 17/10
1.7"

1YR/2YR RATIO = 0.787

1YR-24HR P
0.787 x 1.7
1.34

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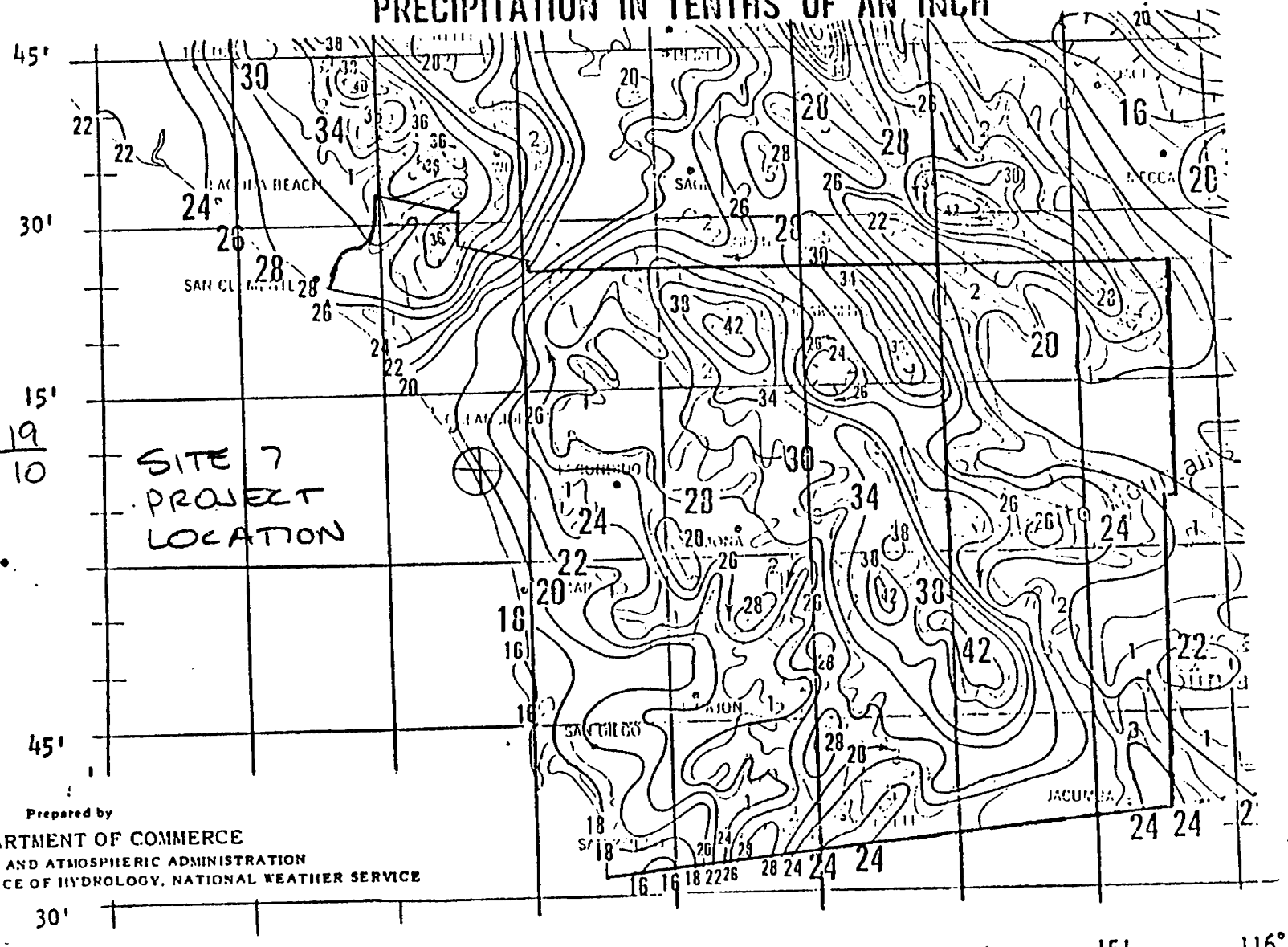
COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

25-YEAR 6-HOUR PRECIPITATION

~16~ ISOPLUVIALS OF 25-YEAR 6-HOUR PRECIPITATION IN TENTHS OF AN INCH



25YR-6HR P = 19/10
1.9"

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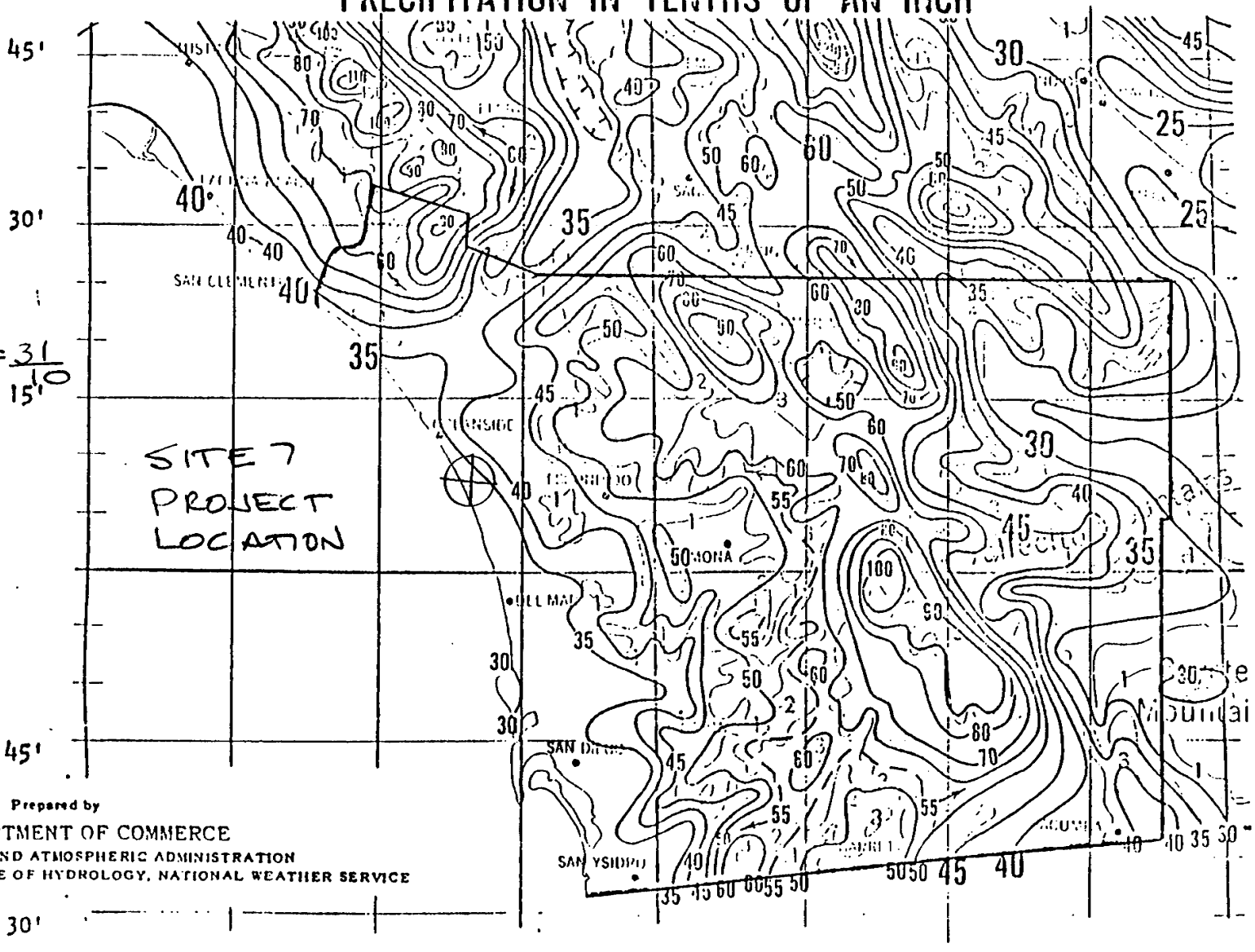
25-YEAR 24-HOUR PRECIPITATION

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

-20- ISOPLUVIALS OF 25-YEAR 24-HOUR PRECIPITATION IN TENTHS OF AN INCH



25YR - 24HR P = 31/10
3.1"

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SPECIAL STUDIES BRANCH, OFFICE OF HYDROLOGY, NATIONAL WEATHER SERVICE

RUNOFF CURVE NUMBERS FOR HYDROLOGIC SOIL-COVER COMPLEXES (CN)

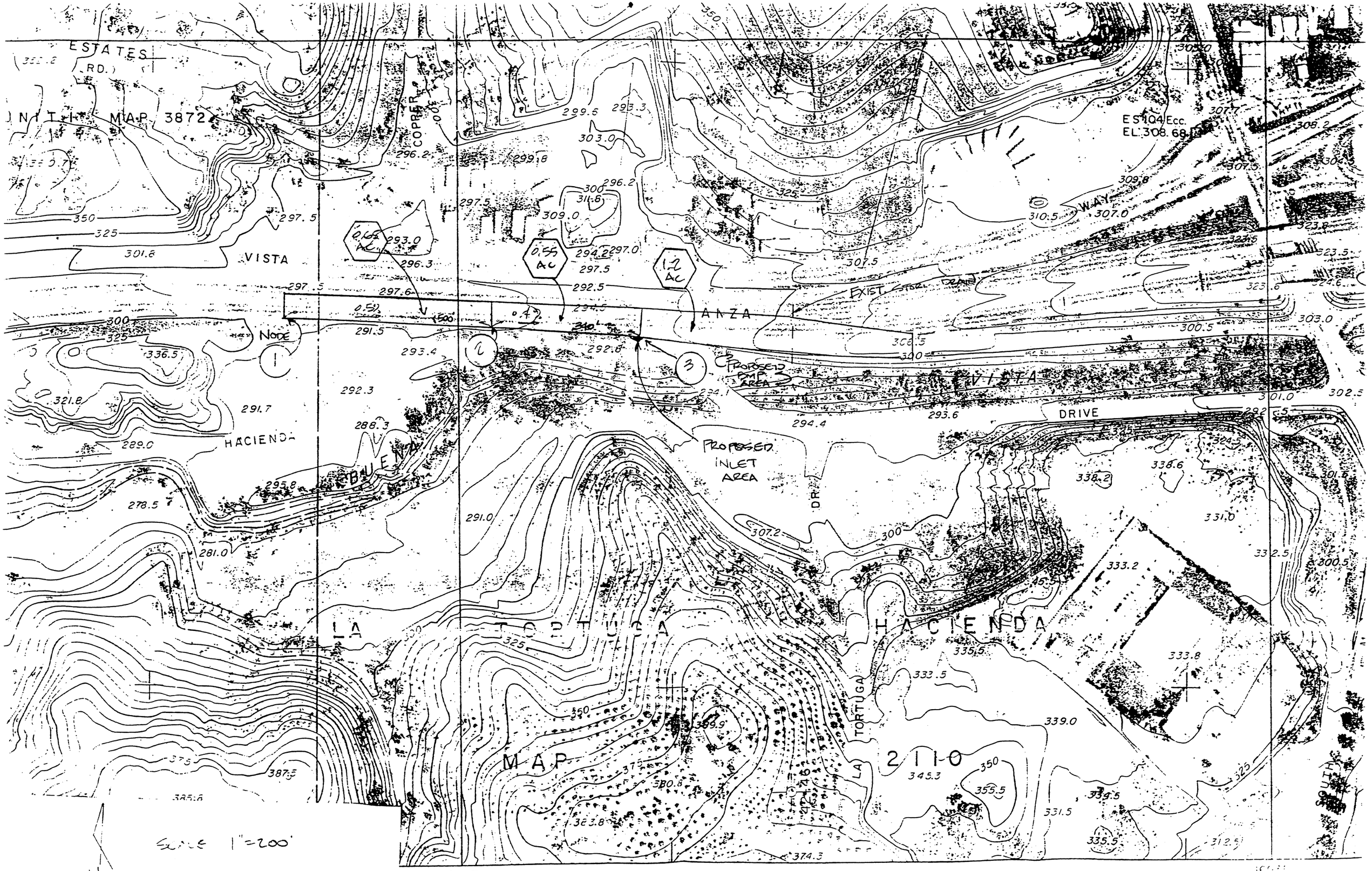
TABLE I-A-1

AMC 2

Ia = 0.2S

Land Use	Cover: Treatment or Practice[3]	Cover: Hydrologic Condition[4]	Hydrologic Soil Groups: A	B	C	D
Water Surfaces (during floods)			97	98	99	99
Urban						
Commercial-industrial			89	90	91	92
High density residential			75	82	88	90
Medium density residential			73	80	86	88
Low density residential			70	78	84	87
Barren			78	86	91	93
Fallow	Straight row		76	85	90	92
Vineyards	(see accompanying land-use description)					
	disked		76	85	90	92
	annual grass or legume cover	Poor	65	78	85	89
		Fair	50	69	79	84
		Good	38	61	74	80
Roads[5] (hard surface)			74	84	90	92
(dirt)			72	82	87	89
Row crops	Straight row	Poor	72	81	88	91
		Good	67	78	85	89
	Contoured	Poor	70	79	84	88
		Good	65	75	82	86
Narrowleaf chaparral		Poor	71	82	88	91
		Fair	55	72	81	86

PROJECT 2, SITE 3
RATIONAL METOHD HYDROLOGY CALCULATIONS
SR-78/ MELROSE AVENUE


ESTATES
RD.
MAP 3872
COPPER
VISTA
ANZA
WAY
ES 104 Ecc.
EL. 308.68
EXIST. STORM DRAIN
NODE
PROPOSED PMP AREA
PROPOSED INLET AREA
VISTA
DRIVE
HACIENDA
BUENA
LA TORTUGA
HACIENDA
MAP 2110
LA TORTUGA
DR.
SOUTH
0.65 AC
0.55 AC
1.2 AC
SCALE 1"=200'

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1996 Version 3.3

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/27/98

Site 5 - Rational Method Hydrology Calculation
1yr storm

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

AEI-CASC Engineering, Colton, California - S/N 615

Rational hydrology study storm event year is 1.0

Map data precipitation entered:
6 hour, precipitation(inches) = 1.180
24 hour precipitation(inches) = 1.810
Adjusted 6 hour precipitation (inches) = 1.177
P6/P24 = 65.2%
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++
Process from Point/Station 1.000 to Point/Station 2.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[INDUSTRIAL area type]
Initial subarea flow distance = 500.00(Ft.)
Highest elevation = 297.50(Ft.)
Lowest elevation = 295.00(Ft.)
Elevation difference = 2.50(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 10.14 min.
TC = [1.8*(1.1-C)*distance^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.9000)*(500.00^.5)/(0.50^(1/3)]= 10.14
Rainfall intensity (I) = 1.964 for a 1.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.900
Subarea runoff = 1.149(CFS)
Total initial stream area = 0.650(Ac.)

++
Process from Point/Station 2.000 to Point/Station 3.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

```
Top of street segment elevation =    295.000(Ft.)
End of street segment elevation =    293.600(Ft.)
Length of street segment  =   340.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  10.000(Ft.)
Distance from crown to crossfall grade break  =   9.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.050
Slope from grade break to crown (v/hz)  =   0.050
Street flow is on [1] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.000
Gutter width =   0.000(Ft.)
Gutter hike from flowline =  0.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      1.635(CFS)
Depth of flow =   0.305(Ft.), Average velocity =   1.756(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   6.104(Ft.)
Flow velocity =   1.76(Ft/s)
Travel time =    3.23 min.     TC =   13.37  min.
 Adding area flow to street
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[INDUSTRIAL area type                        ]
Rainfall intensity =      1.644(In/Hr) for a     1.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.900
Subarea runoff =      0.814(CFS) for    0.550(Ac.)
Total runoff =      1.963(CFS)      Total area =        1.20(Ac.)
Street flow at end of street =      1.963(CFS)
Half street flow at end of street =      1.963(CFS)
Depth of flow =   0.327(Ft.), Average velocity =   1.838(Ft/s)
Flow width (from curb towards crown)=   6.536(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station        3.000
**** SUBAREA FLOW ADDITION ****
```

```
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[INDUSTRIAL area type                        ]
Time of concentration =    13.37 min.
Rainfall intensity =      1.644(In/Hr) for a     1.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.900
Subarea runoff =      1.775(CFS) for    1.200(Ac.)
Total runoff =      3.738(CFS)      Total area =        2.40(Ac.)
End of computations, total study area =           2.40 (Ac.)
```

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1996 Version 3.3

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/28/98

Site 5 - Rational Method Hydrology Calculation
25 Year Storm

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

AEI-CASC Engineering, Colton, California - S/N 615

Rational hydrology study storm event year is 25.0

Map data precipitation entered:
6 hour, precipitation(inches) = 1.900
24 hour precipitation(inches) = 3.100
Adjusted 6 hour precipitation (inches) = 1.900
P6/P24 = 61.3%
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++

Process from Point/Station 1.000 to Point/Station 2.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[INDUSTRIAL area type]
Initial subarea flow distance = 500.00(Ft.)
Highest elevation = 297.50(Ft.)
Lowest elevation = 295.00(Ft.)
Elevation difference = 2.50(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 10.14 min.
TC = [1.8*(1.1-C)*distance^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.9000)*(500.00^.5)/(0.50^(1/3)]= 10.14
Rainfall intensity (I) = 3.172 for a 25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.900
Subarea runoff = 1.856(CFS)
Total initial stream area = 0.650(Ac.)

++

Process from Point/Station 2.000 to Point/Station 3.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

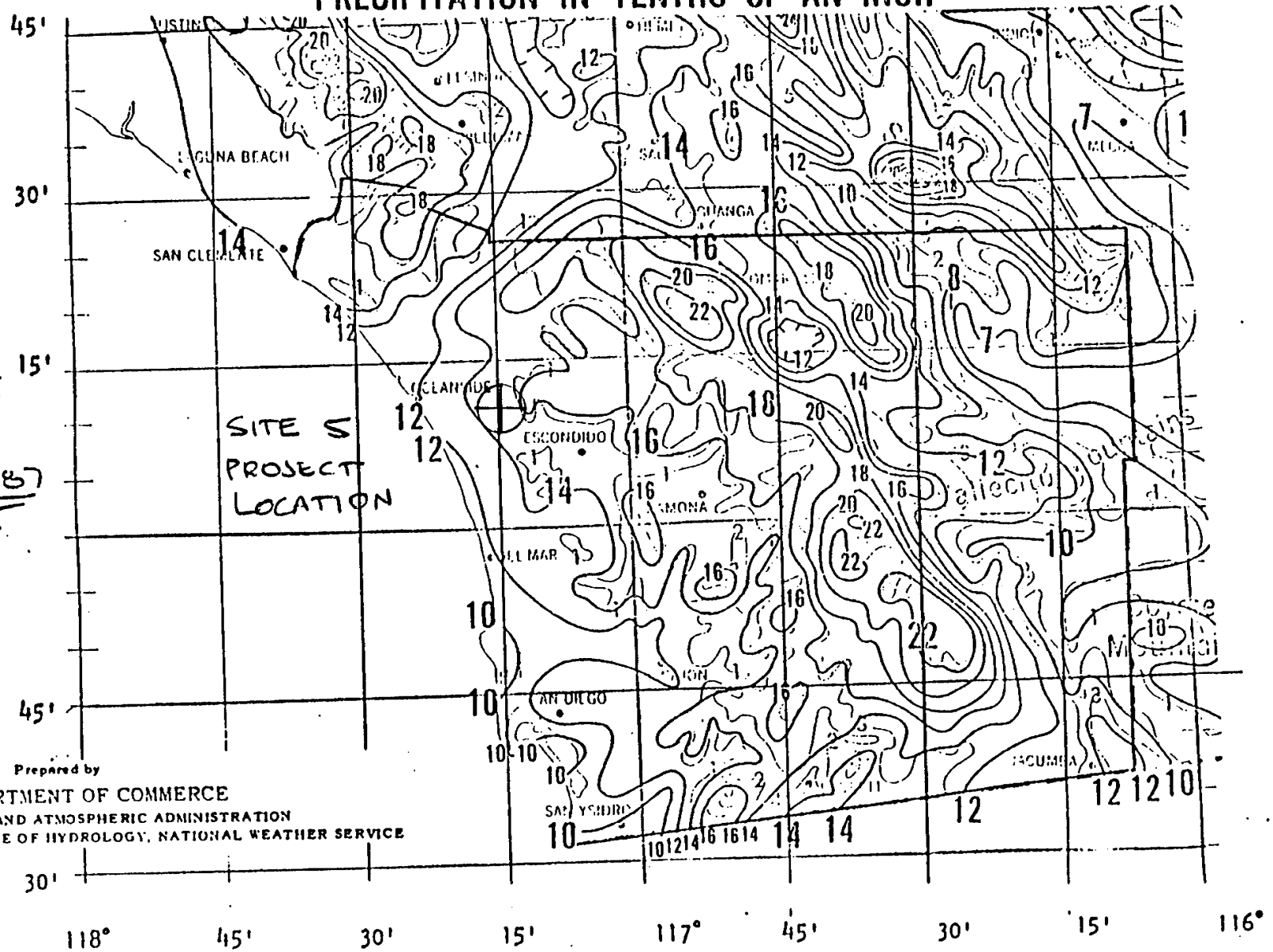
```
Top of street segment elevation =    295.000(Ft.)
End of street segment elevation =    293.600(Ft.)
Length of street segment  =   340.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  10.000(Ft.)
Distance from crown to crossfall grade break  =   9.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.050
Slope from grade break to crown (v/hz)  =   0.050
Street flow is on [1] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.000
Gutter width =   0.000(Ft.)
Gutter hike from flowline =  0.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      2.641(CFS)
Depth of flow =   0.365(Ft.), Average velocity =   1.979(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   7.305(Ft.)
Flow velocity =   1.98(Ft/s)
Travel time =    2.86 min.     TC =   13.01  min.
 Adding area flow to street
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[INDUSTRIAL area type                        ]
Rainfall intensity =      2.702(In/Hr) for a    25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.900
Subarea runoff =      1.338(CFS) for    0.550(Ac.)
Total runoff =      3.193(CFS)      Total area =        1.20(Ac.)
Street flow at end of street =      3.193(CFS)
Half street flow at end of street =      3.193(CFS)
Depth of flow =   0.392(Ft.), Average velocity =   2.076(Ft/s)
Flow width (from curb towards crown)=   7.845(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station        3.000
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[INDUSTRIAL area type                        ]
Time of concentration =    13.01 min.
Rainfall intensity =      2.702(In/Hr) for a    25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.900
Subarea runoff =      2.918(CFS) for    1.200(Ac.)
Total runoff =      6.112(CFS)      Total area =        2.40(Ac.)
End of computations, total study area =           2.40 (Ac.)
```

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

2-YEAR 6-HOUR PRECIPITATION

—10— ISOPLUVIALS OF 2-YEAR 6-HOUR PRECIPITATION IN TENTHS OF AN INCH



2YR 6HR P = 15/10
= 1.5

1YR/2YR RATIO = 0.787/33°

1YR 6HR P =
0.787 × 1.5
= 1.18

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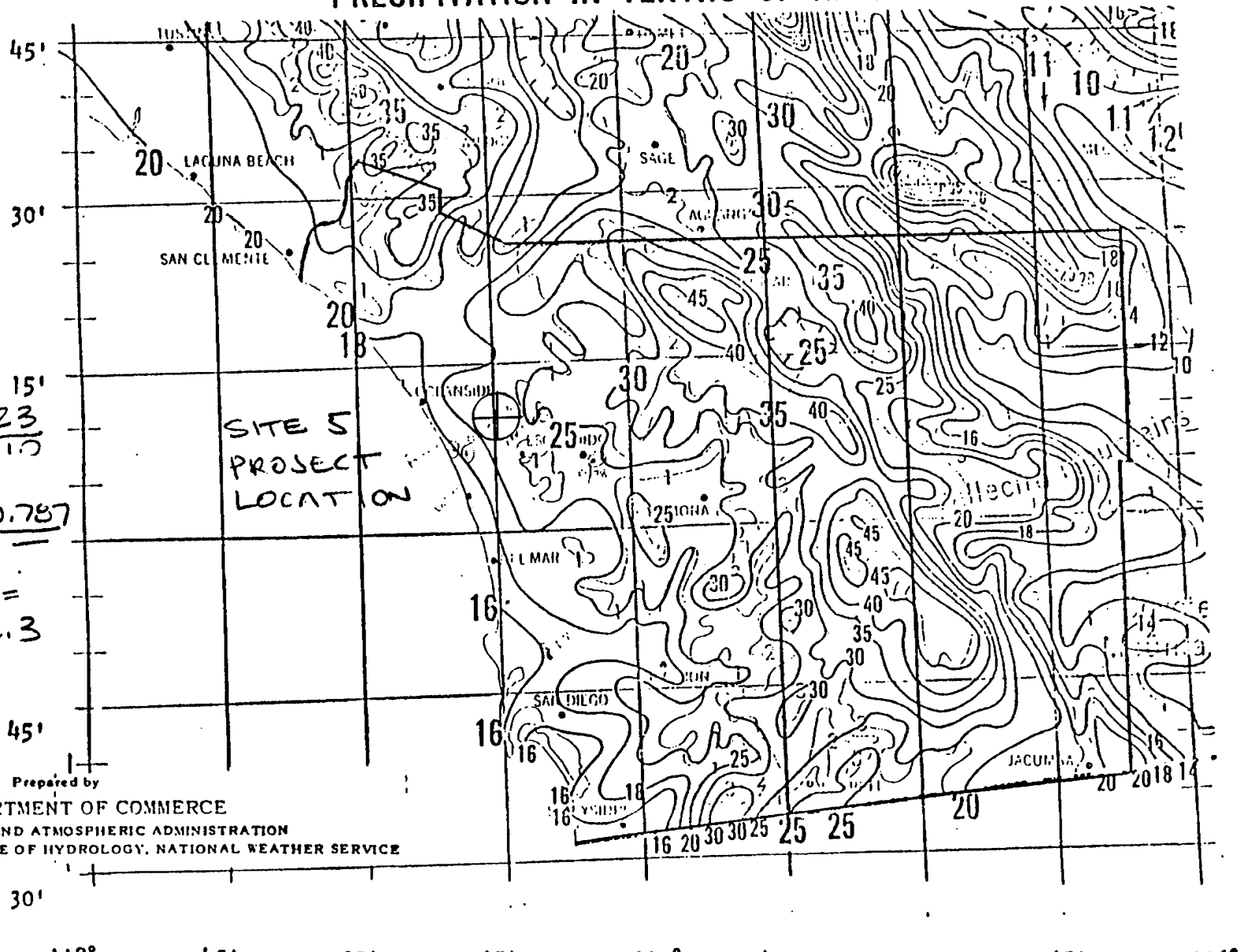
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
SPECIAL STUDIES BRANCH, OFFICE OF HYDROLOGY, NATIONAL WEATHER SERVICE

2-YEAR 24-HOUR PRECIPITATION

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

—10— ISOPLUVIALS OF 2-YEAR 24-HOUR PRECIPITATION IN TENTHS OF AN INCH



SITE 5
PROJECT
LOCATION

2YR 24HR P = $\frac{23}{10}$

$= 2.3$

$\frac{1YR}{2YR}$ RATIO $= 0.787$

1YR - 24HR P =

0.787×2.3

$= 1.81$

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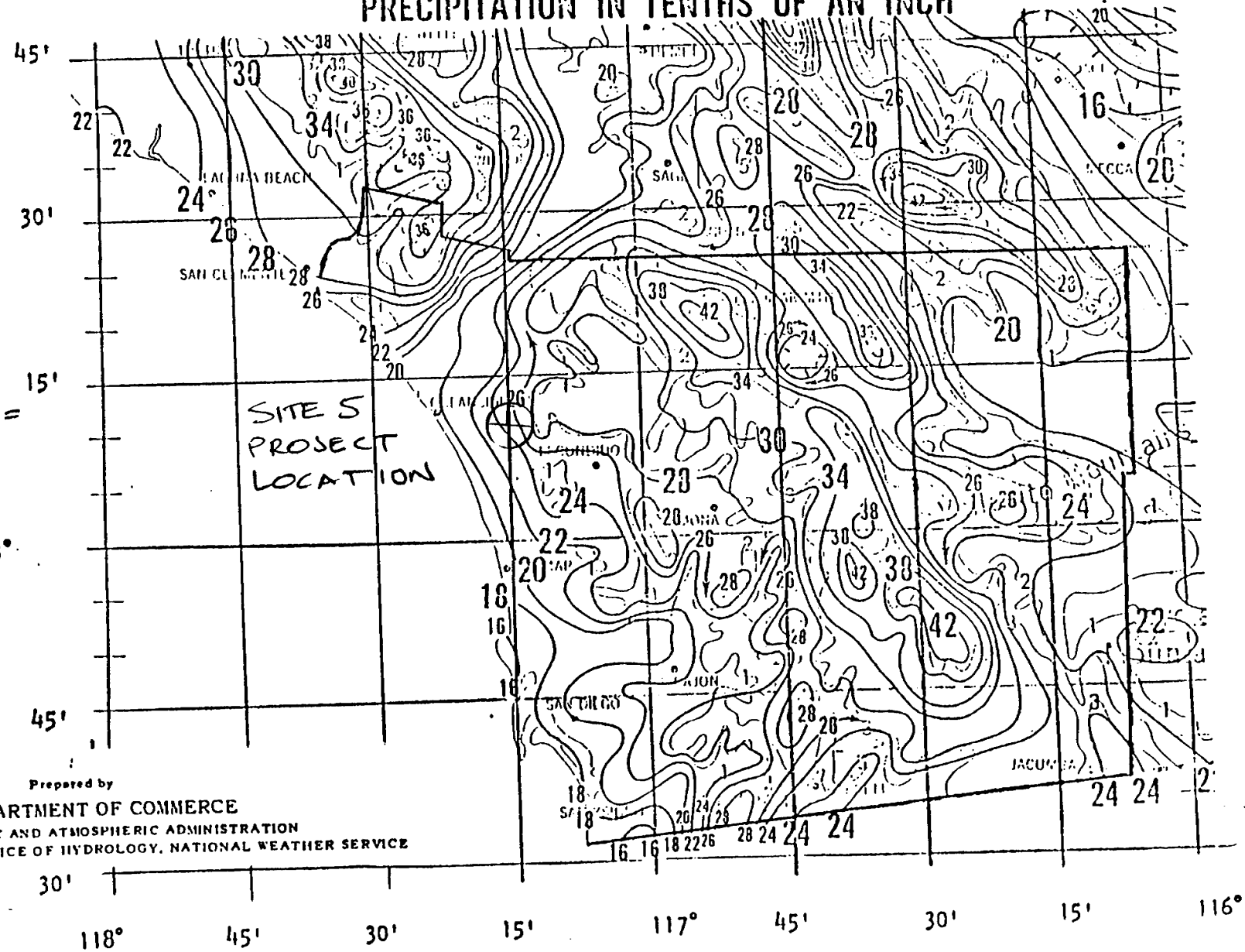
SPECIAL STUDIES BRANCH, OFFICE OF HYDROLOGY, NATIONAL WEATHER SERVICE

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

25-YEAR 6-HOUR PRECIPITATION

(16) ISOPLUVIALS OF 25-YEAR 6-HOUR PRECIPITATION IN TENTHS OF AN INCH



25YR 6HR P=
= 25/10
= 2.5

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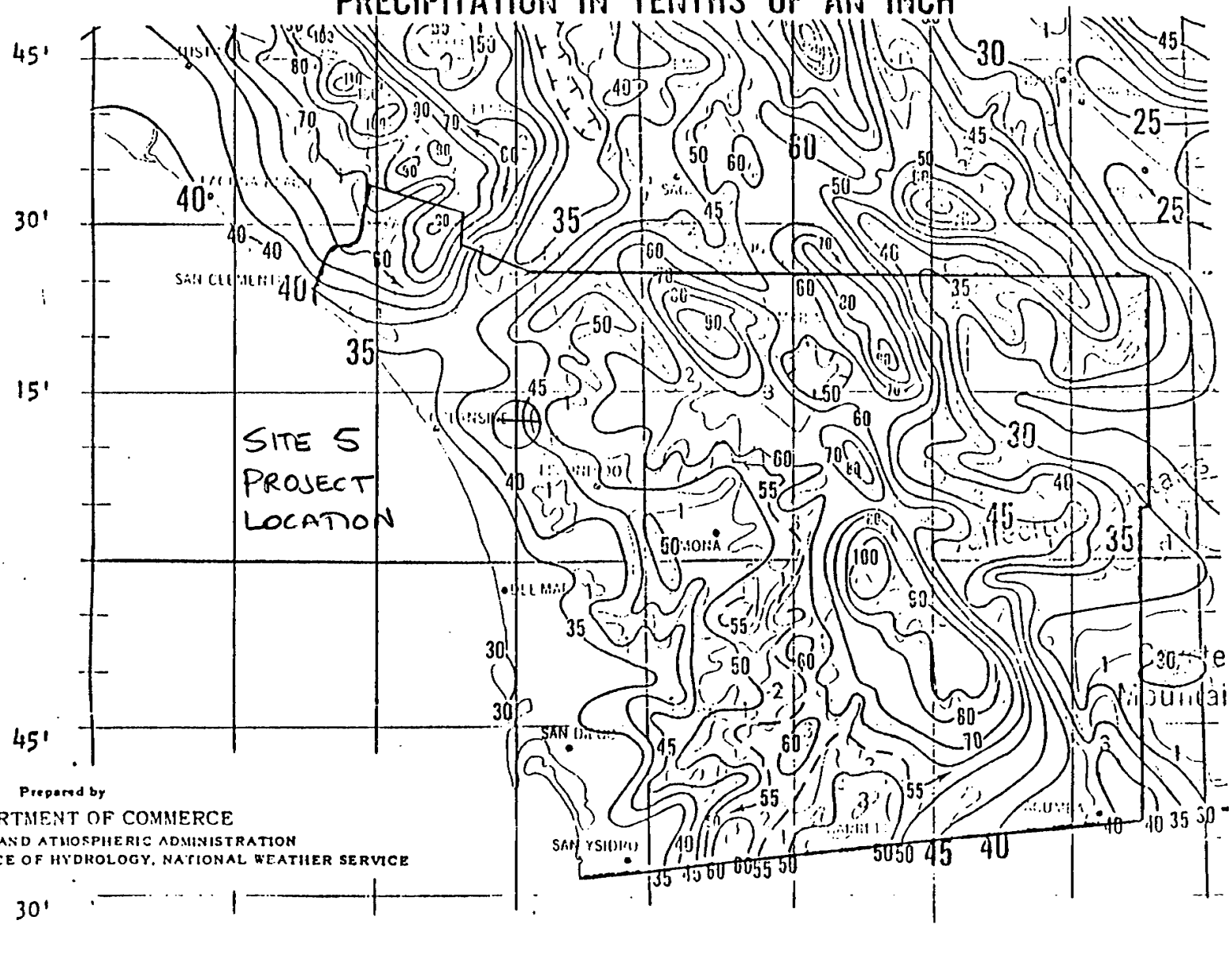
25-YEAR 24-HOUR PRECIPITATION

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

(20) ISOPLUVIALS OF 25-YEAR 24-HOUR
PRECIPITATION IN TENTHS OF AN INCH



25 YR - 24 HR P = 44/10 = 4.4"

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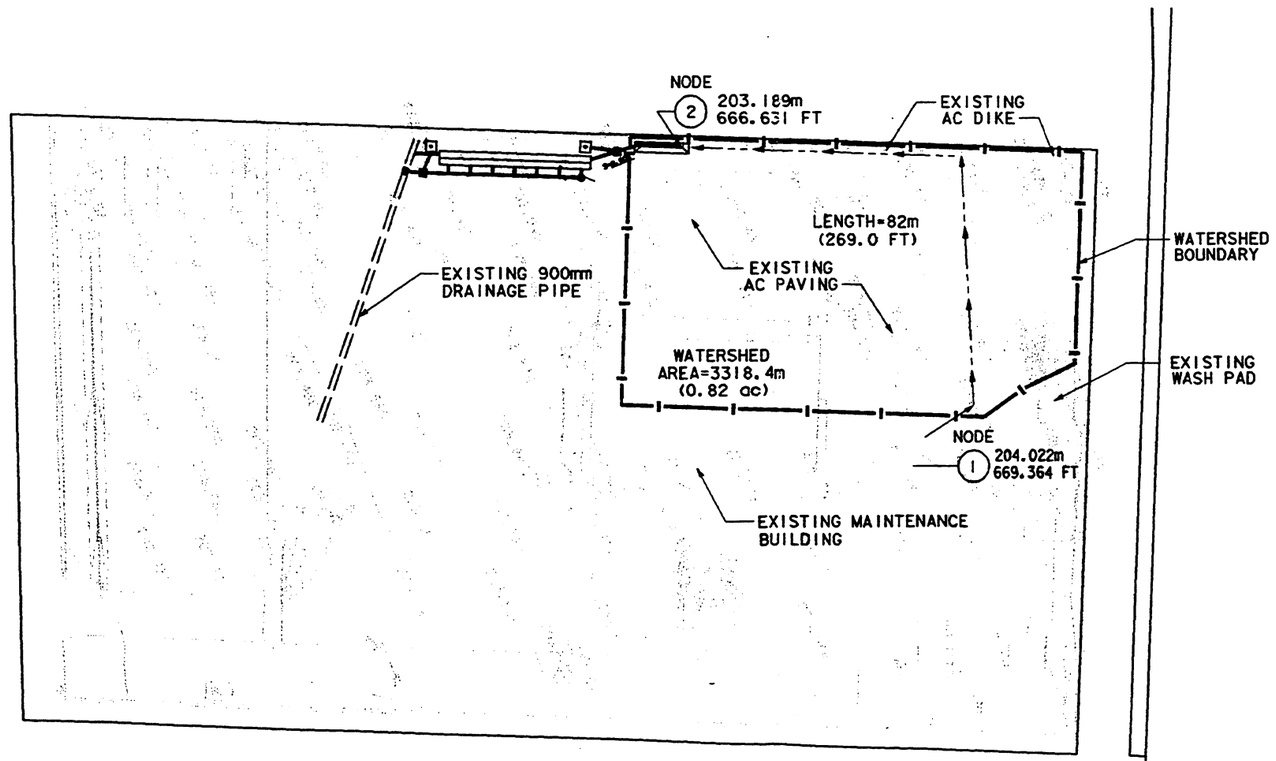
SPECIAL STUDIES BRANCH, OFFICE OF HYDROLOGY, NATIONAL WEATHER SERVICE

PROJECT 5, SITE 1
RATIONAL METHOD HYDROLOGY CALCULATIONS
AND UNIT HYDROGRAPH ANALYSIS
ESCONDIDO MAINTENANCE STATION

SITE #2 ESCONDIDO
MAINTENANCE STATION



N

SCALE: 1 = 500

HYDROLOGY MAP

SITE 2 ESCONDIDO MAINTENANCE STATION

FOR REDUCED PLANS ORIGINAL 0 20 40 60 80

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1996 Version 3.3

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/07/98

Site No. 2 - Escondido M.S.
1-yr storm peak flow calculation
FILENAME SITE2

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

AEI-CASC Engineering, Colton, California - S/N 615

Rational hydrology study storm event year is 1.0

Map data precipitation entered:
6 hour, precipitation(inches) = 1.220
24 hour precipitation(inches) = 1.890
Adjusted 6 hour precipitation (inches) = 1.220
P6/P24 = 64.6%
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++

Process from Point/Station 1.000 to Point/Station 2.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type]
Note: user entry of impervious value, Ap = 0.850
Initial subarea flow distance = 269.00(Ft.)
Highest elevation = 669.36(Ft.)
Lowest elevation = 666.63(Ft.)
Elevation difference = 2.73(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.78 min.
TC = [1.8*(1.1-C)*distance^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.9031)*(269.00^.5)/(1.01^(1/3)]= 5.78
Rainfall intensity (I) = 2.926 for a 1.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.903
Subarea runoff = 2.167(CFS)
Total initial stream area = 0.820(Ac.)
End of computations, total study area = 0.82 (Ac.)

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1996 Version 3.3

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/07/98

ESCONDIDO MS SITE#2
25 YEAR PEAK FLOW
FILENAME EMS 25

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

AEI-CASC Engineering, Colton, California - S/N 615

Rational hydrology study storm event year is 25.0

Map data precipitation entered:
6 hour, precipitation(inches) = 2.550
24 hour precipitation(inches) = 4.650
Adjusted 6 hour precipitation (inches) = 2.550
P6/P24 = 54.8%
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++
Process from Point/Station 1.000 to Point/Station 2.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type]
Note: user entry of impervious value, Ap = 0.850
Initial subarea flow distance = 269.00(Ft.)
Highest elevation = 669.36(Ft.)
Lowest elevation = 666.63(Ft.)
Elevation difference = 2.73(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.78 min.
TC = [1.8*(1.1-C)*distance^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.9031)*(269.00^.5)/(1.01^(1/3)]= 5.78
Rainfall intensity (I) = 6.116 for a 25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.903
Subarea runoff = 4.530(CFS)
Total initial stream area = 0.820(Ac.)
End of computations, total study area = 0.82 (Ac.)

U n i t H y d r o g r a p h A n a l y s i s

Copyright (c) CIVILCADD/CIVILDESIGN, 1996, Version 3.0

Study date 04/05/98

++

San Bernardino County Synthetic Unit Hydrology Method
Manual date - August 1986

AEI CASC Engineering, Colton, California - S/N 615

---
24 hour inflow hydrograph for Site 2 Detention pipe

Storm Event Year = 25

Antecedent Moisture Condition = 2

Area averaged rainfall intensity isohyetal data:

Sub-Area (acres)	Duration (hours)	Intensity (inches)
Rainfall data for year 25		
1.00	1	1.35
Rainfall data for year 25		
1.00	6	2.55
Rainfall data for year 25		
1.00	24	4.65

++

******** Area-averaged max loss rate, Fm ********

SCS curve No.(AMCII)	SCS curve No.(AMC 2)	Area (Acres)	Area Fraction	Fp(Fig c6) (In/Hr)	Ap (dec.)	Fm (in/hr)
92.0	92.0	1.00	1.000	0.155	0.100	0.016

Area-averaged adjusted loss rate Fm (In/Hr)= 0.016

********* Area-Averaged low loss rate fraction, Yb **********

Area (acres)	Area fract	SCS cn (AMC2)	SCS cn (AMC2)	S	Pervious yield fr
0.10	0.100	92.0	92.0	0.87	0.806
0.90	0.900	98.0	98.0	0.20	0.960

Area-averaged catchment yield fraction, Y = 0.945
Area-averaged low loss fraction, Yb = 0.055
++
User entry of time of concentration = 6.000 (hours)
Watershed area = 1.00 acres
Catchment Lag time = 4.800 hours

Unit interval = 5.000 minutes
Unit interval percentage of lag time = 1.7361
Hydrograph baseflow = 0.00 (CFS)
Average maximum watershed loss rate(Fm) = 0.016 (In/hr)
Average low loss rate fraction (Yb) = 0.055 (decimal)
VALLEY DEVELOPED S-Graph Selected
Computed peak 5-minute rainfall = 0.501 inches
Computed peak 30-minute rainfall = 1.025 inches
Specified peak 1-hour rainfall = 1.353 inches
Computed peak 3-hour rainfall = 1.996 inches
Specified peak 6-hour rainfall = 2.550 inches
Specified peak 24-hour rainfall = 4.650 inches

Rainfall depth area reduction factors:
Using a total area of 1.00 acres (Ref: fig. E-4)

5-minute factor = 1.000 Adjusted rainfall = 0.501 inches
30-minute factor = 1.000 Adjusted rainfall = 1.025 inches
1-hour factor = 1.000 Adjusted rainfall = 1.353 inches
3-hour factor = 1.000 Adjusted rainfall = 1.996 inches
6-hour factor = 1.000 Adjusted rainfall = 2.550 inches
24-hour factor = 1.000 Adjusted rainfall = 4.650 inches

U n i t H y d r o g r a p h

Interval Number	'S' Graph Mean values	Unit Hydrograph (CFS)
1	0.094	0.011
2	0.281	0.023
3	0.468	0.023
4	0.666	0.024
5	0.884	0.026
6	1.103	0.026
7	1.321	0.026
8	1.540	0.026
9	1.759	0.026
10	1.984	0.027
11	2.267	0.034
12	2.564	0.036
13	2.860	0.036
14	3.157	0.036
15	3.454	0.036
16	3.751	0.036
17	4.188	0.053
18	4.767	0.070
19	5.345	0.070
20	5.923	0.070
21	6.501	0.070
22	7.079	0.070
23	7.714	0.077
24	8.579	0.105
25	9.470	0.108
26	10.361	0.108
27	11.251	0.108
28	12.142	0.108
29	13.035	0.108
30	14.011	0.118
31	15.027	0.123
32	16.042	0.123
33	17.058	0.123

34	18.074	0.123
35	19.090	0.123
36	20.140	0.127
37	21.263	0.136
38	22.388	0.136
39	23.514	0.136
40	24.639	0.136
41	25.764	0.136
42	26.899	0.137
43	28.127	0.148
44	29.377	0.151
45	30.627	0.151
46	31.877	0.151
47	33.127	0.151
48	34.377	0.151
49	35.722	0.163
50	37.159	0.174
51	38.597	0.174
52	40.035	0.174
53	41.472	0.174
54	42.910	0.174
55	44.415	0.182
56	46.197	0.215
57	48.008	0.219
58	49.774	0.214
59	51.124	0.163
60	52.373	0.151
61	53.631	0.152
62	55.199	0.190
63	56.918	0.208
64	58.637	0.208
65	60.356	0.208
66	62.075	0.208
67	63.793	0.208
68	65.363	0.190
69	66.623	0.152
70	67.873	0.151
71	69.123	0.151
72	70.373	0.151
73	71.623	0.151
74	72.829	0.146
75	73.618	0.095
76	74.306	0.083
77	74.993	0.083
78	75.681	0.083
79	76.368	0.083
80	77.056	0.083
81	77.790	0.089
82	78.571	0.094
83	79.353	0.094
84	80.134	0.094
85	80.915	0.094
86	81.697	0.094
87	82.487	0.096
88	83.311	0.100
89	84.139	0.100
90	84.967	0.100
91	85.796	0.100
92	86.624	0.100
93	87.441	0.099
94	87.908	0.056
95	88.205	0.036
96	88.502	0.036

97	88.799	0.036
98	89.096	0.036
99	89.393	0.036
100	89.715	0.039
101	90.088	0.045
102	90.463	0.045
103	90.838	0.045
104	91.213	0.045
105	91.588	0.045
106	91.958	0.045
107	92.282	0.039
108	92.594	0.038
109	92.907	0.038
110	93.219	0.038
111	93.532	0.038
112	93.845	0.038
113	94.118	0.033
114	94.352	0.028
115	94.586	0.028
116	94.820	0.028
117	95.054	0.028
118	95.289	0.028
119	95.512	0.027
120	95.689	0.021
121	95.861	0.021
122	96.032	0.021
123	96.204	0.021
124	96.376	0.021
125	96.547	0.021
126	96.687	0.017
127	96.812	0.015
128	96.937	0.015
129	97.062	0.015
130	97.187	0.015
131	97.312	0.015
132	97.432	0.015
133	97.542	0.013
134	97.651	0.013
135	97.761	0.013
136	97.870	0.013
137	97.980	0.013
138	98.083	0.012
139	98.128	0.005
140	98.159	0.004
141	98.191	0.004
142	98.222	0.004
143	98.253	0.004
144	98.284	0.004
145	98.316	0.004
146	98.347	0.004
147	98.378	0.004
148	98.409	0.004
149	98.441	0.004
150	98.472	0.004
151	98.503	0.004
152	98.534	0.004
153	98.566	0.004
154	98.597	0.004
155	98.628	0.004
156	98.659	0.004
157	98.691	0.004
158	98.722	0.004
159	98.753	0.004

160	98.784	0.004
161	98.816	0.004
162	98.847	0.004
163	98.878	0.004
164	98.909	0.004
165	98.941	0.004
166	98.972	0.004
167	99.003	0.004
168	99.034	0.004
169	99.066	0.004
170	99.097	0.004
171	99.128	0.004
172	99.159	0.004
173	99.191	0.004
174	99.222	0.004
175	99.253	0.004
176	99.284	0.004
177	99.316	0.004
178	99.347	0.004
179	99.378	0.004
180	99.409	0.004
181	99.441	0.004
182	99.472	0.004
183	99.503	0.004
184	99.534	0.004
185	99.566	0.004
186	99.597	0.004
187	99.628	0.004
188	99.659	0.004
189	99.691	0.004
190	99.722	0.004
191	99.753	0.004
192	99.784	0.004
193	99.816	0.004
194	99.847	0.004
195	99.878	0.004
196	99.904	0.003
197	99.920	0.002
198	99.936	0.002
199	99.952	0.002
200	99.967	0.002
201	99.983	0.002
202	100.000	0.002

Peak Unit Number	Adjusted mass rainfall (inches)	Unit rainfall (inches)
1	0.5007	0.5007
2	0.6607	0.1600
3	0.7771	0.1163
4	0.8718	0.0948
5	0.9532	0.0814
6	1.0253	0.0721
7	1.0905	0.0652
8	1.1504	0.0598
9	1.2059	0.0555
10	1.2578	0.0519
11	1.3067	0.0489
12	1.3529	0.0463
13	1.3918	0.0389
14	1.4288	0.0370
15	1.4641	0.0353
16	1.4979	0.0338
17	1.5303	0.0325

18	1.5616	0.0313
19	1.5918	0.0302
20	1.6209	0.0291
21	1.6491	0.0282
22	1.6765	0.0274
23	1.7031	0.0266
24	1.7289	0.0258
25	1.7540	0.0251
26	1.7785	0.0245
27	1.8024	0.0239
28	1.8258	0.0233
29	1.8486	0.0228
30	1.8709	0.0223
31	1.8927	0.0218
32	1.9141	0.0214
33	1.9350	0.0209
34	1.9556	0.0205
35	1.9757	0.0202
36	1.9955	0.0198
37	2.0150	0.0194
38	2.0341	0.0191
39	2.0528	0.0188
40	2.0713	0.0185
41	2.0895	0.0182
42	2.1074	0.0179
43	2.1250	0.0176
44	2.1423	0.0174
45	2.1594	0.0171
46	2.1763	0.0169
47	2.1929	0.0166
48	2.2093	0.0164
49	2.2255	0.0162
50	2.2414	0.0160
51	2.2572	0.0158
52	2.2727	0.0156
53	2.2881	0.0154
54	2.3033	0.0152
55	2.3183	0.0150
56	2.3331	0.0148
57	2.3477	0.0147
58	2.3622	0.0145
59	2.3766	0.0143
60	2.3907	0.0142
61	2.4048	0.0140
62	2.4186	0.0139
63	2.4324	0.0137
64	2.4459	0.0136
65	2.4594	0.0135
66	2.4727	0.0133
67	2.4859	0.0132
68	2.4990	0.0131
69	2.5119	0.0129
70	2.5247	0.0128
71	2.5374	0.0127
72	2.5500	0.0126
73	2.5653	0.0153
74	2.5805	0.0152
75	2.5955	0.0151
76	2.6104	0.0149
77	2.6253	0.0148
78	2.6400	0.0147
79	2.6546	0.0146
80	2.6691	0.0145

81	2.6835	0.0144
82	2.6978	0.0143
83	2.7120	0.0142
84	2.7262	0.0141
85	2.7402	0.0140
86	2.7541	0.0139
87	2.7679	0.0138
88	2.7817	0.0137
89	2.7953	0.0137
90	2.8089	0.0136
91	2.8224	0.0135
92	2.8358	0.0134
93	2.8491	0.0133
94	2.8623	0.0132
95	2.8755	0.0132
96	2.8886	0.0131
97	2.9016	0.0130
98	2.9145	0.0129
99	2.9274	0.0129
100	2.9401	0.0128
101	2.9528	0.0127
102	2.9655	0.0126
103	2.9780	0.0126
104	2.9905	0.0125
105	3.0030	0.0124
106	3.0153	0.0124
107	3.0276	0.0123
108	3.0398	0.0122
109	3.0520	0.0122
110	3.0641	0.0121
111	3.0762	0.0120
112	3.0881	0.0120
113	3.1001	0.0119
114	3.1119	0.0119
115	3.1237	0.0118
116	3.1355	0.0117
117	3.1471	0.0117
118	3.1588	0.0116
119	3.1703	0.0116
120	3.1819	0.0115
121	3.1933	0.0115
122	3.2047	0.0114
123	3.2161	0.0114
124	3.2274	0.0113
125	3.2387	0.0113
126	3.2499	0.0112
127	3.2610	0.0112
128	3.2721	0.0111
129	3.2832	0.0111
130	3.2942	0.0110
131	3.3051	0.0110
132	3.3160	0.0109
133	3.3269	0.0109
134	3.3377	0.0108
135	3.3485	0.0108
136	3.3592	0.0107
137	3.3699	0.0107
138	3.3805	0.0106
139	3.3911	0.0106
140	3.4017	0.0106
141	3.4122	0.0105
142	3.4227	0.0105
143	3.4331	0.0104

144	3.4435	0.0104
145	3.4538	0.0103
146	3.4641	0.0103
147	3.4744	0.0103
148	3.4846	0.0102
149	3.4948	0.0102
150	3.5049	0.0101
151	3.5150	0.0101
152	3.5251	0.0101
153	3.5351	0.0100
154	3.5451	0.0100
155	3.5551	0.0100
156	3.5650	0.0099
157	3.5749	0.0099
158	3.5847	0.0099
159	3.5946	0.0098
160	3.6043	0.0098
161	3.6141	0.0097
162	3.6238	0.0097
163	3.6335	0.0097
164	3.6431	0.0096
165	3.6527	0.0096
166	3.6623	0.0096
167	3.6718	0.0095
168	3.6814	0.0095
169	3.6908	0.0095
170	3.7003	0.0094
171	3.7097	0.0094
172	3.7191	0.0094
173	3.7284	0.0094
174	3.7378	0.0093
175	3.7471	0.0093
176	3.7563	0.0093
177	3.7656	0.0092
178	3.7748	0.0092
179	3.7839	0.0092
180	3.7931	0.0091
181	3.8022	0.0091
182	3.8113	0.0091
183	3.8204	0.0091
184	3.8294	0.0090
185	3.8384	0.0090
186	3.8474	0.0090
187	3.8563	0.0090
188	3.8653	0.0089
189	3.8741	0.0089
190	3.8830	0.0089
191	3.8919	0.0088
192	3.9007	0.0088
193	3.9095	0.0088
194	3.9182	0.0088
195	3.9270	0.0087
196	3.9357	0.0087
197	3.9444	0.0087
198	3.9530	0.0087
199	3.9617	0.0086
200	3.9703	0.0086
201	3.9789	0.0086
202	3.9875	0.0086
203	3.9960	0.0085
204	4.0045	0.0085
205	4.0130	0.0085
206	4.0215	0.0085

207	4.0299	0.0084
208	4.0384	0.0084
209	4.0468	0.0084
210	4.0551	0.0084
211	4.0635	0.0084
212	4.0718	0.0083
213	4.0801	0.0083
214	4.0884	0.0083
215	4.0967	0.0083
216	4.1050	0.0082
217	4.1132	0.0082
218	4.1214	0.0082
219	4.1296	0.0082
220	4.1377	0.0082
221	4.1459	0.0081
222	4.1540	0.0081
223	4.1621	0.0081
224	4.1702	0.0081
225	4.1782	0.0081
226	4.1863	0.0080
227	4.1943	0.0080
228	4.2023	0.0080
229	4.2102	0.0080
230	4.2182	0.0080
231	4.2261	0.0079
232	4.2341	0.0079
233	4.2420	0.0079
234	4.2498	0.0079
235	4.2577	0.0079
236	4.2655	0.0078
237	4.2734	0.0078
238	4.2812	0.0078
239	4.2890	0.0078
240	4.2967	0.0078
241	4.3045	0.0077
242	4.3122	0.0077
243	4.3199	0.0077
244	4.3276	0.0077
245	4.3353	0.0077
246	4.3430	0.0077
247	4.3506	0.0076
248	4.3582	0.0076
249	4.3658	0.0076
250	4.3734	0.0076
251	4.3810	0.0076
252	4.3885	0.0076
253	4.3961	0.0075
254	4.4036	0.0075
255	4.4111	0.0075
256	4.4186	0.0075
257	4.4261	0.0075
258	4.4335	0.0075
259	4.4410	0.0074
260	4.4484	0.0074
261	4.4558	0.0074
262	4.4632	0.0074
263	4.4706	0.0074
264	4.4779	0.0074
265	4.4853	0.0073
266	4.4926	0.0073
267	4.4999	0.0073
268	4.5072	0.0073
269	4.5145	0.0073

270	4.5217	0.0073
271	4.5290	0.0073
272	4.5362	0.0072
273	4.5434	0.0072
274	4.5507	0.0072
275	4.5578	0.0072
276	4.5650	0.0072
277	4.5722	0.0072
278	4.5793	0.0071
279	4.5865	0.0071
280	4.5936	0.0071
281	4.6007	0.0071
282	4.6078	0.0071
283	4.6148	0.0071
284	4.6219	0.0071
285	4.6289	0.0070
286	4.6360	0.0070
287	4.6430	0.0070
288	4.6500	0.0070

Unit Period (number)	Unit Rainfall (inches)	Unit Soil-Loss (inches)	Effective Rainfall (inches)
1	0.0070	0.0004	0.0066
2	0.0070	0.0004	0.0066
3	0.0070	0.0004	0.0067
4	0.0071	0.0004	0.0067
5	0.0071	0.0004	0.0067
6	0.0071	0.0004	0.0067
7	0.0071	0.0004	0.0067
8	0.0071	0.0004	0.0068
9	0.0072	0.0004	0.0068
10	0.0072	0.0004	0.0068
11	0.0072	0.0004	0.0068
12	0.0072	0.0004	0.0068
13	0.0073	0.0004	0.0069
14	0.0073	0.0004	0.0069
15	0.0073	0.0004	0.0069
16	0.0073	0.0004	0.0069
17	0.0074	0.0004	0.0070
18	0.0074	0.0004	0.0070
19	0.0074	0.0004	0.0070
20	0.0074	0.0004	0.0070
21	0.0075	0.0004	0.0070
22	0.0075	0.0004	0.0071
23	0.0075	0.0004	0.0071
24	0.0075	0.0004	0.0071
25	0.0076	0.0004	0.0071
26	0.0076	0.0004	0.0072
27	0.0076	0.0004	0.0072
28	0.0076	0.0004	0.0072
29	0.0077	0.0004	0.0072
30	0.0077	0.0004	0.0073
31	0.0077	0.0004	0.0073
32	0.0077	0.0004	0.0073
33	0.0078	0.0004	0.0073
34	0.0078	0.0004	0.0074
35	0.0078	0.0004	0.0074
36	0.0078	0.0004	0.0074
37	0.0079	0.0004	0.0074
38	0.0079	0.0004	0.0075
39	0.0079	0.0004	0.0075

40	0.0080	0.0004	0.0075
41	0.0080	0.0004	0.0076
42	0.0080	0.0004	0.0076
43	0.0081	0.0004	0.0076
44	0.0081	0.0004	0.0076
45	0.0081	0.0004	0.0077
46	0.0081	0.0004	0.0077
47	0.0082	0.0005	0.0077
48	0.0082	0.0005	0.0078
49	0.0082	0.0005	0.0078
50	0.0083	0.0005	0.0078
51	0.0083	0.0005	0.0079
52	0.0083	0.0005	0.0079
53	0.0084	0.0005	0.0079
54	0.0084	0.0005	0.0079
55	0.0084	0.0005	0.0080
56	0.0085	0.0005	0.0080
57	0.0085	0.0005	0.0080
58	0.0085	0.0005	0.0081
59	0.0086	0.0005	0.0081
60	0.0086	0.0005	0.0081
61	0.0087	0.0005	0.0082
62	0.0087	0.0005	0.0082
63	0.0087	0.0005	0.0083
64	0.0088	0.0005	0.0083
65	0.0088	0.0005	0.0083
66	0.0088	0.0005	0.0084
67	0.0089	0.0005	0.0084
68	0.0089	0.0005	0.0084
69	0.0090	0.0005	0.0085
70	0.0090	0.0005	0.0085
71	0.0091	0.0005	0.0086
72	0.0091	0.0005	0.0086
73	0.0091	0.0005	0.0086
74	0.0092	0.0005	0.0087
75	0.0092	0.0005	0.0087
76	0.0093	0.0005	0.0088
77	0.0093	0.0005	0.0088
78	0.0094	0.0005	0.0088
79	0.0094	0.0005	0.0089
80	0.0094	0.0005	0.0089
81	0.0095	0.0005	0.0090
82	0.0095	0.0005	0.0090
83	0.0096	0.0005	0.0091
84	0.0096	0.0005	0.0091
85	0.0097	0.0005	0.0092
86	0.0097	0.0005	0.0092
87	0.0098	0.0005	0.0093
88	0.0099	0.0005	0.0093
89	0.0099	0.0005	0.0094
90	0.0100	0.0005	0.0094
91	0.0100	0.0006	0.0095
92	0.0101	0.0006	0.0095
93	0.0101	0.0006	0.0096
94	0.0102	0.0006	0.0096
95	0.0103	0.0006	0.0097
96	0.0103	0.0006	0.0097
97	0.0104	0.0006	0.0098
98	0.0104	0.0006	0.0099
99	0.0105	0.0006	0.0099
100	0.0106	0.0006	0.0100
101	0.0106	0.0006	0.0101
102	0.0107	0.0006	0.0101

103	0.0108	0.0006	0.0102
104	0.0108	0.0006	0.0102
105	0.0109	0.0006	0.0103
106	0.0110	0.0006	0.0104
107	0.0111	0.0006	0.0104
108	0.0111	0.0006	0.0105
109	0.0112	0.0006	0.0106
110	0.0113	0.0006	0.0106
111	0.0114	0.0006	0.0107
112	0.0114	0.0006	0.0108
113	0.0115	0.0006	0.0109
114	0.0116	0.0006	0.0109
115	0.0117	0.0006	0.0110
116	0.0117	0.0006	0.0111
117	0.0119	0.0007	0.0112
118	0.0119	0.0007	0.0113
119	0.0120	0.0007	0.0114
120	0.0121	0.0007	0.0114
121	0.0122	0.0007	0.0116
122	0.0123	0.0007	0.0116
123	0.0124	0.0007	0.0117
124	0.0125	0.0007	0.0118
125	0.0126	0.0007	0.0119
126	0.0127	0.0007	0.0120
127	0.0129	0.0007	0.0121
128	0.0129	0.0007	0.0122
129	0.0131	0.0007	0.0124
130	0.0132	0.0007	0.0124
131	0.0133	0.0007	0.0126
132	0.0134	0.0007	0.0127
133	0.0136	0.0007	0.0128
134	0.0137	0.0008	0.0129
135	0.0138	0.0008	0.0131
136	0.0139	0.0008	0.0132
137	0.0141	0.0008	0.0133
138	0.0142	0.0008	0.0134
139	0.0144	0.0008	0.0136
140	0.0145	0.0008	0.0137
141	0.0147	0.0008	0.0139
142	0.0148	0.0008	0.0140
143	0.0151	0.0008	0.0142
144	0.0152	0.0008	0.0143
145	0.0126	0.0007	0.0119
146	0.0127	0.0007	0.0120
147	0.0129	0.0007	0.0122
148	0.0131	0.0007	0.0123
149	0.0133	0.0007	0.0126
150	0.0135	0.0007	0.0127
151	0.0137	0.0008	0.0130
152	0.0139	0.0008	0.0131
153	0.0142	0.0008	0.0134
154	0.0143	0.0008	0.0135
155	0.0147	0.0008	0.0138
156	0.0148	0.0008	0.0140
157	0.0152	0.0008	0.0143
158	0.0154	0.0008	0.0145
159	0.0158	0.0009	0.0149
160	0.0160	0.0009	0.0151
161	0.0164	0.0009	0.0155
162	0.0166	0.0009	0.0157
163	0.0171	0.0009	0.0162
164	0.0174	0.0010	0.0164
165	0.0179	0.0010	0.0169

166	0.0182	0.0010	0.0172
167	0.0188	0.0010	0.0177
168	0.0191	0.0011	0.0180
169	0.0198	0.0011	0.0187
170	0.0202	0.0011	0.0190
171	0.0209	0.0012	0.0198
172	0.0214	0.0012	0.0202
173	0.0223	0.0012	0.0211
174	0.0228	0.0013	0.0215
175	0.0239	0.0013	0.0226
176	0.0245	0.0013	0.0232
177	0.0258	0.0013	0.0245
178	0.0266	0.0013	0.0253
179	0.0282	0.0013	0.0269
180	0.0291	0.0013	0.0279
181	0.0313	0.0013	0.0300
182	0.0325	0.0013	0.0312
183	0.0353	0.0013	0.0340
184	0.0370	0.0013	0.0357
185	0.0463	0.0013	0.0450
186	0.0489	0.0013	0.0476
187	0.0555	0.0013	0.0542
188	0.0598	0.0013	0.0585
189	0.0721	0.0013	0.0708
190	0.0814	0.0013	0.0801
191	0.1163	0.0013	0.1150
192	0.1600	0.0013	0.1587
193	0.5007	0.0013	0.4994
194	0.0948	0.0013	0.0935
195	0.0652	0.0013	0.0639
196	0.0519	0.0013	0.0506
197	0.0389	0.0013	0.0376
198	0.0338	0.0013	0.0325
199	0.0302	0.0013	0.0289
200	0.0274	0.0013	0.0261
201	0.0251	0.0013	0.0239
202	0.0233	0.0013	0.0221
203	0.0218	0.0012	0.0206
204	0.0205	0.0011	0.0194
205	0.0194	0.0011	0.0184
206	0.0185	0.0010	0.0174
207	0.0176	0.0010	0.0166
208	0.0169	0.0009	0.0159
209	0.0162	0.0009	0.0153
210	0.0156	0.0009	0.0147
211	0.0150	0.0008	0.0142
212	0.0145	0.0008	0.0137
213	0.0140	0.0008	0.0132
214	0.0136	0.0007	0.0128
215	0.0132	0.0007	0.0125
216	0.0128	0.0007	0.0121
217	0.0153	0.0008	0.0144
218	0.0149	0.0008	0.0141
219	0.0146	0.0008	0.0138
220	0.0143	0.0008	0.0135
221	0.0140	0.0008	0.0132
222	0.0137	0.0008	0.0130
223	0.0135	0.0007	0.0127
224	0.0132	0.0007	0.0125
225	0.0130	0.0007	0.0123
226	0.0128	0.0007	0.0121
227	0.0126	0.0007	0.0119
228	0.0124	0.0007	0.0117

229	0.0122	0.0007	0.0115
230	0.0120	0.0007	0.0113
231	0.0118	0.0007	0.0112
232	0.0116	0.0006	0.0110
233	0.0115	0.0006	0.0108
234	0.0113	0.0006	0.0107
235	0.0112	0.0006	0.0105
236	0.0110	0.0006	0.0104
237	0.0109	0.0006	0.0103
238	0.0107	0.0006	0.0101
239	0.0106	0.0006	0.0100
240	0.0105	0.0006	0.0099
241	0.0103	0.0006	0.0098
242	0.0102	0.0006	0.0097
243	0.0101	0.0006	0.0095
244	0.0100	0.0006	0.0094
245	0.0099	0.0005	0.0093
246	0.0098	0.0005	0.0092
247	0.0097	0.0005	0.0091
248	0.0096	0.0005	0.0090
249	0.0095	0.0005	0.0090
250	0.0094	0.0005	0.0089
251	0.0093	0.0005	0.0088
252	0.0092	0.0005	0.0087
253	0.0091	0.0005	0.0086
254	0.0090	0.0005	0.0085
255	0.0090	0.0005	0.0085
256	0.0089	0.0005	0.0084
257	0.0088	0.0005	0.0083
258	0.0087	0.0005	0.0082
259	0.0086	0.0005	0.0082
260	0.0086	0.0005	0.0081
261	0.0085	0.0005	0.0080
262	0.0084	0.0005	0.0080
263	0.0084	0.0005	0.0079
264	0.0083	0.0005	0.0078
265	0.0082	0.0005	0.0078
266	0.0082	0.0004	0.0077
267	0.0081	0.0004	0.0077
268	0.0080	0.0004	0.0076
269	0.0080	0.0004	0.0075
270	0.0079	0.0004	0.0075
271	0.0079	0.0004	0.0074
272	0.0078	0.0004	0.0074
273	0.0077	0.0004	0.0073
274	0.0077	0.0004	0.0073
275	0.0076	0.0004	0.0072
276	0.0076	0.0004	0.0072
277	0.0075	0.0004	0.0071
278	0.0075	0.0004	0.0071
279	0.0074	0.0004	0.0070
280	0.0074	0.0004	0.0070
281	0.0073	0.0004	0.0069
282	0.0073	0.0004	0.0069
283	0.0073	0.0004	0.0069
284	0.0072	0.0004	0.0068
285	0.0072	0.0004	0.0068
286	0.0071	0.0004	0.0067
287	0.0071	0.0004	0.0067
288	0.0070	0.0004	0.0066

Total soil rain loss = 0.19 (In.)

Total effective runoff = 4.46 (In.)

Total soil-loss volume = 0.0160 (Acre-Feet)
Total storm runoff volume = 0.3713 (Acre-Feet)

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24 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 5 Minute intervals (CFS)

Time(h+m)	Volume(AF)	Q(CFS)	0	2.5	5.0	7.5	10.0
0+ 5	0.0000	0.00	Q				
0+10	0.0000	0.00	Q				
0+15	0.0000	0.00	Q				
0+20	0.0000	0.00	Q				
0+25	0.0000	0.00	Q				
0+30	0.0000	0.00	Q				
0+35	0.0000	0.00	Q				
0+40	0.0000	0.00	Q				
0+45	0.0000	0.00	Q				
0+50	0.0001	0.00	Q				
0+55	0.0001	0.00	Q				
1+ 0	0.0001	0.00	Q				
1+ 5	0.0001	0.00	Q				
1+10	0.0001	0.00	Q				
1+15	0.0001	0.00	Q				
1+20	0.0002	0.00	Q				
1+25	0.0002	0.00	Q				
1+30	0.0002	0.00	Q				
1+35	0.0002	0.00	Q				
1+40	0.0003	0.00	Q				
1+45	0.0003	0.01	Q				
1+50	0.0003	0.01	Q				
1+55	0.0004	0.01	Q				
2+ 0	0.0004	0.01	Q				
2+ 5	0.0005	0.01	Q				
2+10	0.0006	0.01	Q				
2+15	0.0006	0.01	Q				
2+20	0.0007	0.01	Q				
2+25	0.0008	0.01	Q				
2+30	0.0008	0.01	Q				
2+35	0.0009	0.01	Q				
2+40	0.0010	0.01	Q				
2+45	0.0011	0.01	Q				
2+50	0.0012	0.01	Q				
2+55	0.0013	0.02	Q				
3+ 0	0.0014	0.02	Q				
3+ 5	0.0016	0.02	Q				
3+10	0.0017	0.02	Q				
3+15	0.0018	0.02	Q				
3+20	0.0020	0.02	Q				
3+25	0.0021	0.02	Q				
3+30	0.0023	0.02	Q				
3+35	0.0024	0.02	Q				
3+40	0.0026	0.02	Q				
3+45	0.0028	0.03	Q				
3+50	0.0030	0.03	Q				
3+55	0.0032	0.03	Q				
4+ 0	0.0034	0.03	Q				
4+ 5	0.0036	0.03	Q				

229	0.0122	0.0007	0.0115
230	0.0120	0.0007	0.0113
231	0.0118	0.0007	0.0112
232	0.0116	0.0006	0.0110
233	0.0115	0.0006	0.0108
234	0.0113	0.0006	0.0107
235	0.0112	0.0006	0.0105
236	0.0110	0.0006	0.0104
237	0.0109	0.0006	0.0103
238	0.0107	0.0006	0.0101
239	0.0106	0.0006	0.0100
240	0.0105	0.0006	0.0099
241	0.0103	0.0006	0.0098
242	0.0102	0.0006	0.0097
243	0.0101	0.0006	0.0095
244	0.0100	0.0006	0.0094
245	0.0099	0.0005	0.0093
246	0.0098	0.0005	0.0092
247	0.0097	0.0005	0.0091
248	0.0096	0.0005	0.0090
249	0.0095	0.0005	0.0090
250	0.0094	0.0005	0.0089
251	0.0093	0.0005	0.0088
252	0.0092	0.0005	0.0087
253	0.0091	0.0005	0.0086
254	0.0090	0.0005	0.0085
255	0.0090	0.0005	0.0085
256	0.0089	0.0005	0.0084
257	0.0088	0.0005	0.0083
258	0.0087	0.0005	0.0082
259	0.0086	0.0005	0.0082
260	0.0086	0.0005	0.0081
261	0.0085	0.0005	0.0080
262	0.0084	0.0005	0.0080
263	0.0084	0.0005	0.0079
264	0.0083	0.0005	0.0078
265	0.0082	0.0005	0.0078
266	0.0082	0.0004	0.0077
267	0.0081	0.0004	0.0077
268	0.0080	0.0004	0.0076
269	0.0080	0.0004	0.0075
270	0.0079	0.0004	0.0075
271	0.0079	0.0004	0.0074
272	0.0078	0.0004	0.0074
273	0.0077	0.0004	0.0073
274	0.0077	0.0004	0.0073
275	0.0076	0.0004	0.0072
276	0.0076	0.0004	0.0072
277	0.0075	0.0004	0.0071
278	0.0075	0.0004	0.0071
279	0.0074	0.0004	0.0070
280	0.0074	0.0004	0.0070
281	0.0073	0.0004	0.0069
282	0.0073	0.0004	0.0069
283	0.0073	0.0004	0.0069
284	0.0072	0.0004	0.0068
285	0.0072	0.0004	0.0068
286	0.0071	0.0004	0.0067
287	0.0071	0.0004	0.0067
288	0.0070	0.0004	0.0066

Total soil rain loss = 0.19 (In.)

Total effective runoff = 4.46 (In.)

Total soil-loss volume = 0.0160 (Acre-Feet)
Total storm runoff volume = 0.3713 (Acre-Feet)

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24 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 5 Minute intervals (CFS)

Time(h+m)	Volume(AF)	Q(CFS)	0	2.5	5.0	7.5	10.0
0+ 5	0.0000	0.00	Q				
0+10	0.0000	0.00	Q				
0+15	0.0000	0.00	Q				
0+20	0.0000	0.00	Q				
0+25	0.0000	0.00	Q				
0+30	0.0000	0.00	Q				
0+35	0.0000	0.00	Q				
0+40	0.0000	0.00	Q				
0+45	0.0000	0.00	Q				
0+50	0.0001	0.00	Q				
0+55	0.0001	0.00	Q				
1+ 0	0.0001	0.00	Q				
1+ 5	0.0001	0.00	Q				
1+10	0.0001	0.00	Q				
1+15	0.0001	0.00	Q				
1+20	0.0002	0.00	Q				
1+25	0.0002	0.00	Q				
1+30	0.0002	0.00	Q				
1+35	0.0002	0.00	Q				
1+40	0.0003	0.00	Q				
1+45	0.0003	0.01	Q				
1+50	0.0003	0.01	Q				
1+55	0.0004	0.01	Q				
2+ 0	0.0004	0.01	Q				
2+ 5	0.0005	0.01	Q				
2+10	0.0006	0.01	Q				
2+15	0.0006	0.01	Q				
2+20	0.0007	0.01	Q				
2+25	0.0008	0.01	Q				
2+30	0.0008	0.01	Q				
2+35	0.0009	0.01	Q				
2+40	0.0010	0.01	Q				
2+45	0.0011	0.01	Q				
2+50	0.0012	0.01	Q				
2+55	0.0013	0.02	Q				
3+ 0	0.0014	0.02	Q				
3+ 5	0.0016	0.02	Q				
3+10	0.0017	0.02	Q				
3+15	0.0018	0.02	Q				
3+20	0.0020	0.02	Q				
3+25	0.0021	0.02	Q				
3+30	0.0023	0.02	Q				
3+35	0.0024	0.02	Q				
3+40	0.0026	0.02	Q				
3+45	0.0028	0.03	Q				
3+50	0.0030	0.03	Q				
3+55	0.0032	0.03	Q				
4+ 0	0.0034	0.03	Q				
4+ 5	0.0036	0.03	Q				

4+10	0.0038	0.03	Q				
4+15	0.0040	0.03	Q				
4+20	0.0042	0.03	Q				
4+25	0.0045	0.04	Q				
4+30	0.0047	0.04	Q				
4+35	0.0050	0.04	Q				
4+40	0.0053	0.04	Q				
4+45	0.0055	0.04	Q				
4+50	0.0058	0.04	Q				
4+55	0.0061	0.04	Q				
5+ 0	0.0064	0.04	Q				
5+ 5	0.0068	0.05	Q				
5+10	0.0071	0.05	Q				
5+15	0.0074	0.05	Q				
5+20	0.0078	0.05	Q				
5+25	0.0081	0.05	Q				
5+30	0.0085	0.05	Q				
5+35	0.0089	0.06	Q				
5+40	0.0093	0.06	Q				
5+45	0.0097	0.06	QV				
5+50	0.0101	0.06	QV				
5+55	0.0105	0.06	QV				
6+ 0	0.0109	0.06	QV				
6+ 5	0.0113	0.06	QV				
6+10	0.0118	0.06	QV				
6+15	0.0122	0.06	QV				
6+20	0.0127	0.07	QV				
6+25	0.0131	0.07	QV				
6+30	0.0136	0.07	QV				
6+35	0.0140	0.07	QV				
6+40	0.0145	0.07	QV				
6+45	0.0150	0.07	QV				
6+50	0.0155	0.07	QV				
6+55	0.0160	0.07	QV				
7+ 0	0.0165	0.07	QV				
7+ 5	0.0170	0.07	QV				
7+10	0.0175	0.07	QV				
7+15	0.0180	0.07	QV				
7+20	0.0185	0.08	QV				
7+25	0.0190	0.08	Q V				
7+30	0.0196	0.08	Q V				
7+35	0.0201	0.08	Q V				
7+40	0.0207	0.08	Q V				
7+45	0.0212	0.08	Q V				
7+50	0.0218	0.08	Q V				
7+55	0.0223	0.08	Q V				
8+ 0	0.0229	0.08	Q V				
8+ 5	0.0235	0.08	Q V				
8+10	0.0240	0.08	Q V				
8+15	0.0246	0.08	Q V				
8+20	0.0252	0.08	Q V				
8+25	0.0258	0.09	Q V				
8+30	0.0264	0.09	Q V				
8+35	0.0270	0.09	Q V				
8+40	0.0276	0.09	Q V				
8+45	0.0282	0.09	Q V				
8+50	0.0288	0.09	Q V				
8+55	0.0294	0.09	Q V				
9+ 0	0.0300	0.09	Q V				
9+ 5	0.0306	0.09	Q V				
9+10	0.0313	0.09	Q V				
9+15	0.0319	0.09	Q V				
9+20	0.0325	0.09	Q V				

9+25	0.0332	0.09	Q	V				
9+30	0.0338	0.09	Q	V				
9+35	0.0345	0.09	Q	V				
9+40	0.0351	0.09	Q	V				
9+45	0.0358	0.10	Q	V				
9+50	0.0364	0.10	Q	V				
9+55	0.0371	0.10	Q	V				
10+ 0	0.0378	0.10	Q	V				
10+ 5	0.0384	0.10	Q	V				
10+10	0.0391	0.10	Q	V				
10+15	0.0398	0.10	Q	V				
10+20	0.0405	0.10	Q	V				
10+25	0.0412	0.10	Q	V				
10+30	0.0419	0.10	Q	V				
10+35	0.0426	0.10	Q	V				
10+40	0.0433	0.10	Q	V				
10+45	0.0440	0.10	Q	V				
10+50	0.0447	0.10	Q	V				
10+55	0.0454	0.10	Q	V				
11+ 0	0.0461	0.10	Q	V				
11+ 5	0.0468	0.11	Q	V				
11+10	0.0476	0.11	Q	V				
11+15	0.0483	0.11	Q	V				
11+20	0.0490	0.11	Q	V				
11+25	0.0498	0.11	Q	V				
11+30	0.0505	0.11	Q	V				
11+35	0.0513	0.11	Q	V				
11+40	0.0520	0.11	Q	V				
11+45	0.0528	0.11	Q	V				
11+50	0.0536	0.11	Q	V				
11+55	0.0543	0.11	Q	V				
12+ 0	0.0551	0.11	Q	V				
12+ 5	0.0559	0.11	Q	V				
12+10	0.0567	0.11	Q	V				
12+15	0.0574	0.11	Q	V				
12+20	0.0582	0.11	Q	V				
12+25	0.0590	0.12	Q	V				
12+30	0.0598	0.12	Q	V				
12+35	0.0606	0.12	Q	V				
12+40	0.0614	0.12	Q	V				
12+45	0.0623	0.12	Q	V				
12+50	0.0631	0.12	Q	V				
12+55	0.0639	0.12	Q	V				
13+ 0	0.0647	0.12	Q	V				
13+ 5	0.0656	0.12	Q	V				
13+10	0.0664	0.12	Q	V				
13+15	0.0673	0.12	Q	V				
13+20	0.0681	0.12	Q	V				
13+25	0.0690	0.12	Q	V				
13+30	0.0698	0.13	Q	V				
13+35	0.0707	0.13	Q	V				
13+40	0.0716	0.13	Q	V				
13+45	0.0724	0.13	Q	V				
13+50	0.0733	0.13	Q	V				
13+55	0.0742	0.13	Q	V				
14+ 0	0.0751	0.13	Q	V				
14+ 5	0.0760	0.13	Q	V				
14+10	0.0769	0.13	Q	V				
14+15	0.0778	0.13	Q	V				
14+20	0.0788	0.13	Q	V				
14+25	0.0797	0.13	Q	V				
14+30	0.0806	0.14	Q	V				
14+35	0.0816	0.14	Q	V				

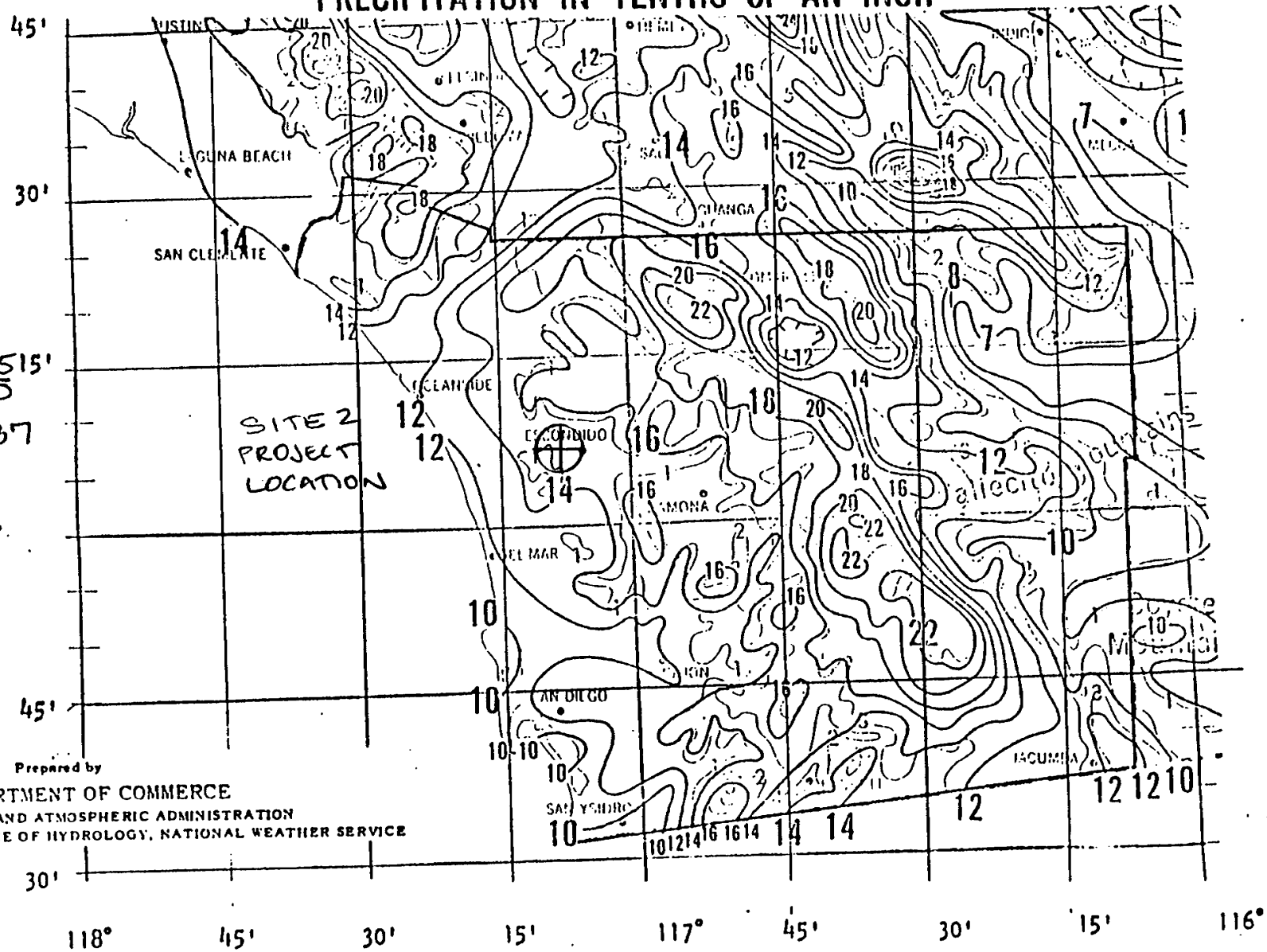
14+40	0.0825	0.14	Q	V |	|	|	|
14+45	0.0835	0.14	Q	V |	|	|	|
14+50	0.0844	0.14	Q	V|	|	|	|
14+55	0.0854	0.14	Q	V|	|	|	|
15+ 0	0.0864	0.14	Q	V|	|	|	|
15+ 5	0.0874	0.14	Q	V|	|	|	|
15+10	0.0884	0.14	Q	V|	|	|	|
15+15	0.0894	0.15	Q	V|	|	|	|
15+20	0.0904	0.15	Q	V|	|	|	|
15+25	0.0914	0.15	Q	V|	|	|	|
15+30	0.0925	0.15	Q	V|	|	|	|
15+35	0.0935	0.15	Q	V	|	|	|
15+40	0.0946	0.16	Q	V	|	|	|
15+45	0.0957	0.16	Q	V	|	|	|
15+50	0.0968	0.16	Q	V	|	|	|
15+55	0.0979	0.16	Q	V	|	|	|
16+ 0	0.0991	0.17	Q	V	|	|	|
16+ 5	0.1003	0.18	Q	V	|	|	|
16+10	0.1016	0.19	Q	V	|	|	|
16+15	0.1029	0.19	Q	|V	|	|	|
16+20	0.1042	0.19	Q	|V	|	|	|
16+25	0.1056	0.20	Q	|V	|	|	|
16+30	0.1069	0.20	Q	|V	|	|	|
16+35	0.1083	0.20	Q	|V	|	|	|
16+40	0.1097	0.20	Q	|V	|	|	|
16+45	0.1112	0.21	Q	|V	|	|	|
16+50	0.1126	0.21	Q	| V	|	|	|
16+55	0.1141	0.22	Q	| V	|	|	|
17+ 0	0.1157	0.22	Q	| V	|	|	|
17+ 5	0.1172	0.23	Q	| V	|	|	|
17+10	0.1188	0.23	Q	| V	|	|	|
17+15	0.1205	0.24	Q	| V	|	|	|
17+20	0.1221	0.24	Q	| V	|	|	|
17+25	0.1239	0.25	|Q	| V	|	|	|
17+30	0.1257	0.27	|Q	| V	|	|	|
17+35	0.1276	0.27	|Q	| V	|	|	|
17+40	0.1295	0.28	|Q	| V	|	|	|
17+45	0.1314	0.28	|Q	| V	|	|	|
17+50	0.1334	0.29	|Q	| V	|	|	|
17+55	0.1355	0.30	|Q	| V	|	|	|
18+ 0	0.1376	0.31	|Q	| V	|	|	|
18+ 5	0.1398	0.32	|Q	| V	|	|	|
18+10	0.1420	0.32	|Q	| V	|	|	|
18+15	0.1443	0.33	|Q	| V	|	|	|
18+20	0.1466	0.33	|Q	| V	|	|	|
18+25	0.1489	0.33	|Q	| V	|	|	|
18+30	0.1512	0.34	|Q	| V	|	|	|
18+35	0.1536	0.35	|Q	| V	|	|	|
18+40	0.1560	0.35	|Q	| V	|	|	|
18+45	0.1584	0.35	|Q	| V	|	|	|
18+50	0.1609	0.36	|Q	| V	|	|	|
18+55	0.1634	0.36	|Q	| V	|	|	|
19+ 0	0.1659	0.36	|Q	| V	|	|	|
19+ 5	0.1684	0.37	|Q	| V	|	|	|
19+10	0.1710	0.37	|Q	| V	|	|	|
19+15	0.1735	0.37	|Q	| V	|	|	|
19+20	0.1761	0.38	|Q	| V	|	|	|
19+25	0.1787	0.38	|Q	| V|	|	|	|
19+30	0.1814	0.38	|Q	| V|	|	|	|
19+35	0.1841	0.39	|Q	| V|	|	|	|
19+40	0.1868	0.39	|Q	| V	|	|	|
19+45	0.1895	0.39	|Q	| V	|	|	|
19+50	0.1922	0.40	|Q	| V	|	|	|

19+55	0.1950	0.40	Q		V		
20+ 0	0.1977	0.40	Q		V		
20+ 5	0.2006	0.41	Q		V		
20+10	0.2035	0.42	Q		V		
20+15	0.2064	0.42	Q		V		
20+20	0.2093	0.42	Q		V		
20+25	0.2122	0.42	Q		V		
20+30	0.2151	0.43	Q		V		
20+35	0.2181	0.43	Q		V		
20+40	0.2211	0.45	Q		V		
20+45	0.2242	0.45	Q		V		
20+50	0.2272	0.44	Q		V		
20+55	0.2301	0.41	Q		V		
21+ 0	0.2329	0.41	Q		V		
21+ 5	0.2357	0.41	Q		V		
21+10	0.2386	0.43	Q		V		
21+15	0.2416	0.43	Q		V		
21+20	0.2446	0.43	Q		V		
21+25	0.2475	0.43	Q		V		
21+30	0.2504	0.42	Q		V		
21+35	0.2533	0.41	Q		V		
21+40	0.2560	0.40	Q		V		
21+45	0.2586	0.37	Q		V		
21+50	0.2611	0.37	Q		V		
21+55	0.2636	0.36	Q		V		
22+ 0	0.2660	0.35	Q		V		
22+ 5	0.2684	0.34	Q		V		
22+10	0.2707	0.33	Q		V		
22+15	0.2728	0.30	Q		V		
22+20	0.2748	0.29	Q		V		
22+25	0.2768	0.29	Q		V		
22+30	0.2788	0.28	Q		V		
22+35	0.2807	0.28	Q		V		
22+40	0.2827	0.28	Q		V		
22+45	0.2846	0.28	Q		V		
22+50	0.2865	0.28	Q		V		
22+55	0.2885	0.28	Q		V		
23+ 0	0.2904	0.28	Q		V		
23+ 5	0.2923	0.28	Q		V		
23+10	0.2942	0.27	Q		V		
23+15	0.2961	0.27	Q		V		
23+20	0.2979	0.27	Q		V		
23+25	0.2998	0.27	Q		V		
23+30	0.3016	0.26	Q		V		
23+35	0.3034	0.26	Q		V		
23+40	0.3051	0.25	Q		V		
23+45	0.3068	0.24	Q		V		
23+50	0.3083	0.22	Q		V		
23+55	0.3097	0.20	Q		V		
24+ 0	0.3111	0.20	Q		V		

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

2-YEAR 6-HOUR PRECIPITATION

—10— ISOPLUVIALS OF 2-YEAR 6-HOUR PRECIPITATION IN TENTHS OF AN INCH



2YR 6HR P = 15.5/10 = 1.55

1YR/2YR RATIO = 0.787

1YR 6HR P = 33°

0.787 × 1.55

1.22

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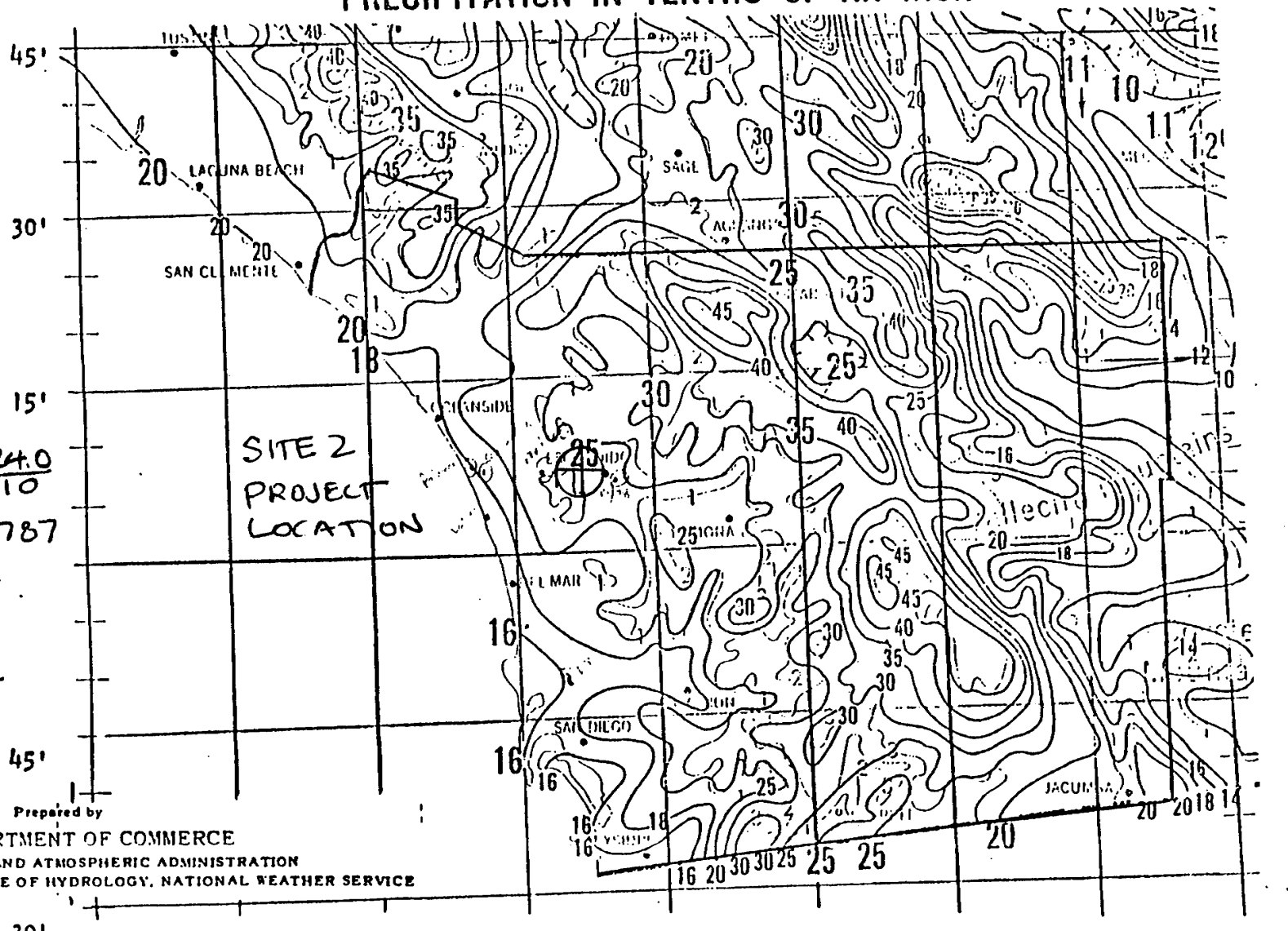
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
SPECIAL STUDIES BRANCH, OFFICE OF HYDROLOGY, NATIONAL WEATHER SERVICE

2-YEAR 24-HOUR PRECIPITATION

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

—10— ISOPLUVIALS OF 2-YEAR 24-HOUR PRECIPITATION IN TENTHS OF AN INCH



2 YR 24 HR P = $\frac{24.0}{10}$ = 2.4

$\frac{1\,YR}{2\,YR}$ RATIO = 0.787

1 YR 24HR P =
0.787 × 2.4
= 1.89

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U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
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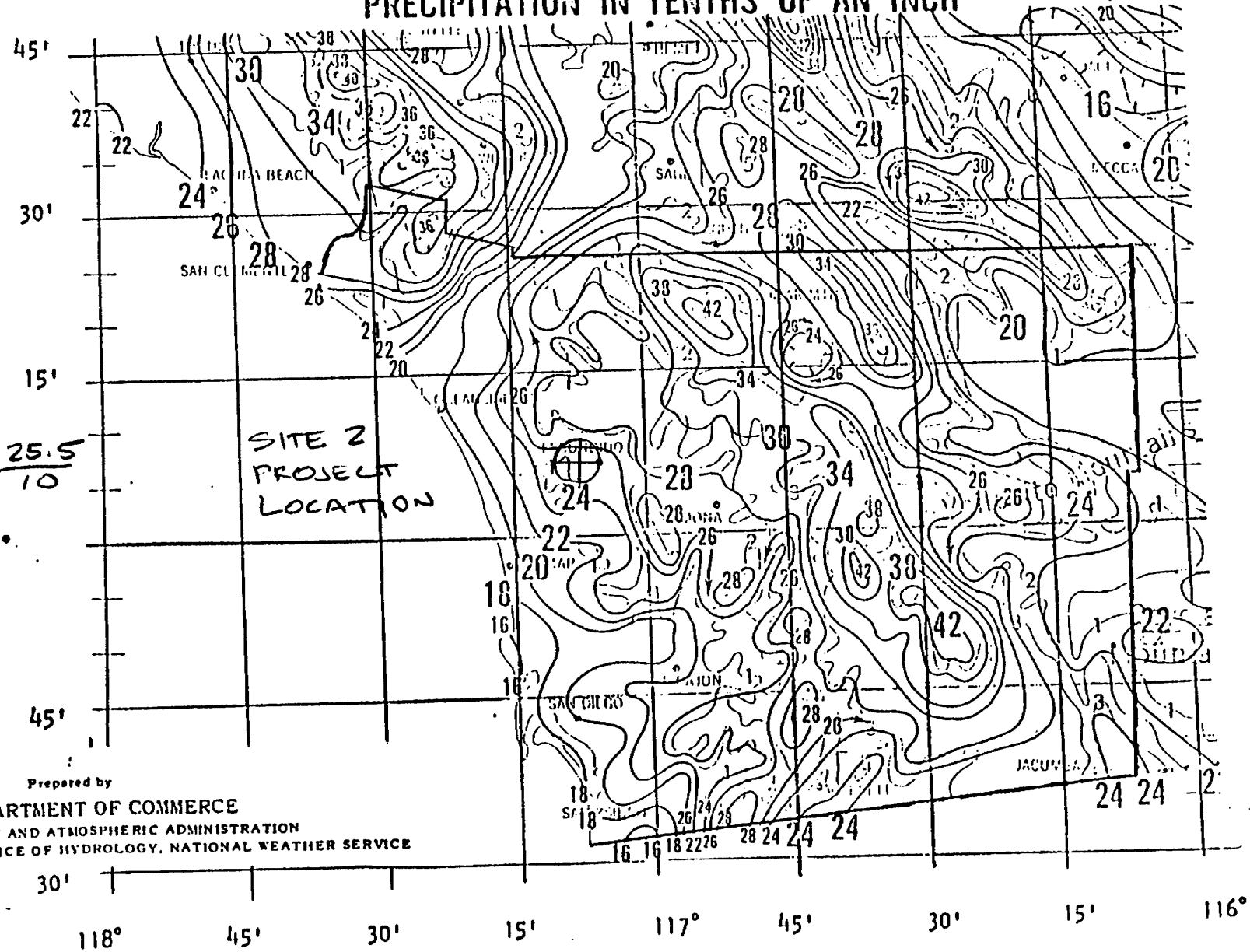
COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

25-YEAR 6-HOUR PRECIPITATION

(16) ISOPLUVIALS OF 25-YEAR 6-HOUR PRECIPITATION IN TENTHS OF AN INCH



25 YR 6HR P = 25.5/10
2.55

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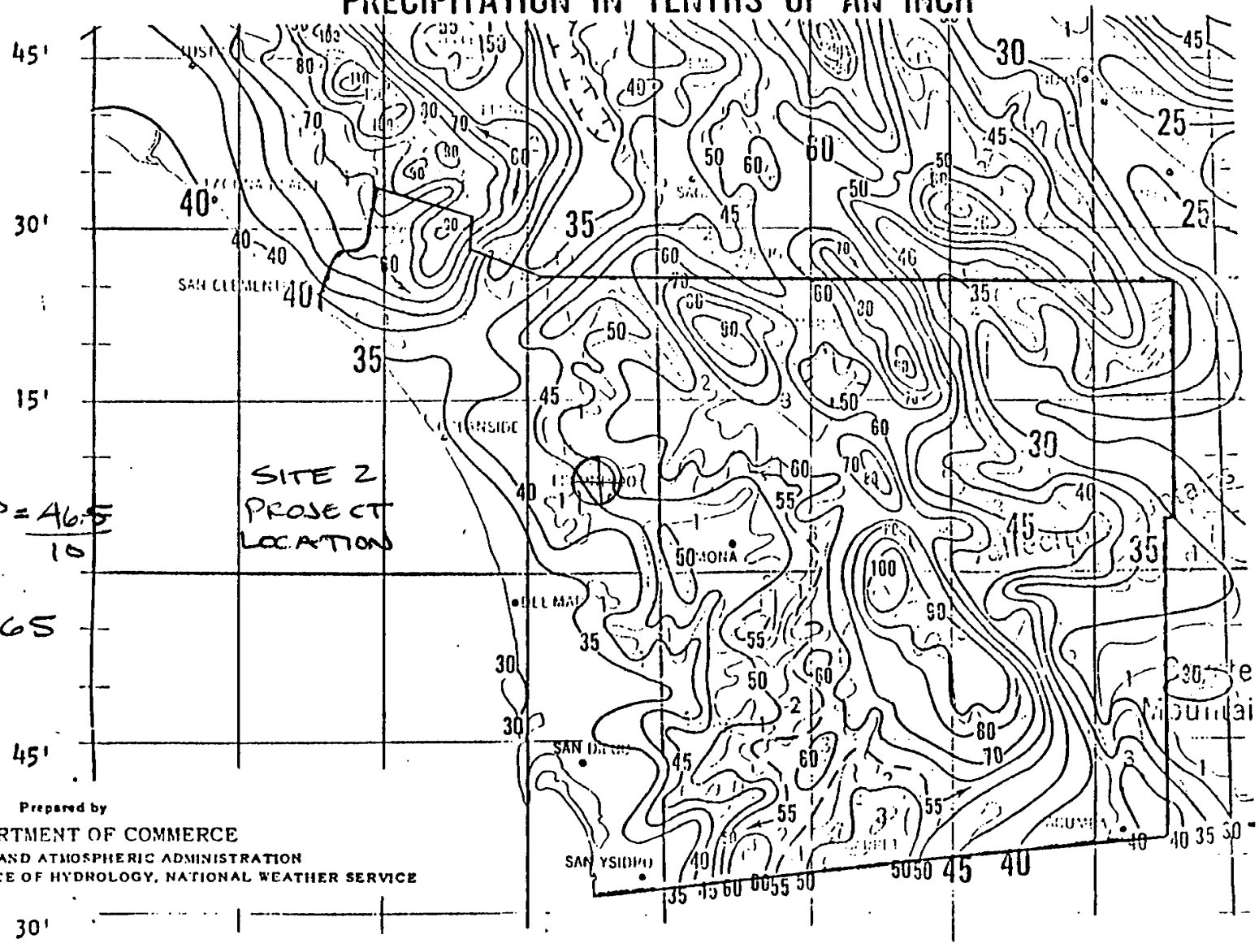
25-YEAR 24-HOUR PRECIPITATION

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

(20) ISOPLUVIALS OF 25-YEAR 24-HOUR PRECIPITATION IN TENTHS OF AN INCH



SITE 2
PROJECT
LOCATION

25 YR 24HR P = 46.5/10
= 4.65

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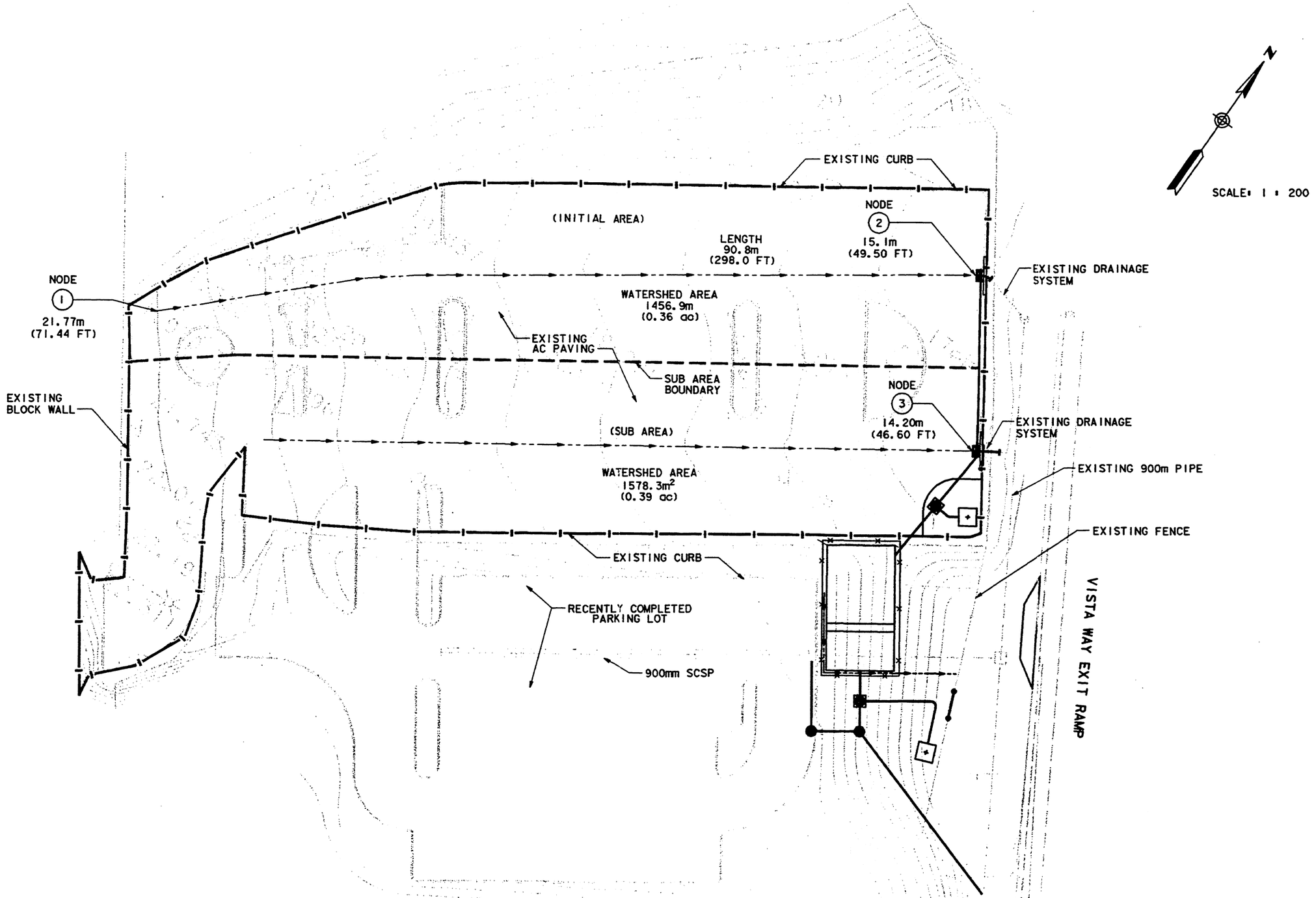
SPECIAL STUDIES BRANCH, OFFICE OF HYDROLOGY, NATIONAL WEATHER SERVICE

PROJECT 5, SITE 2
RATIONAL METHOD HYDROLOGY CALCULATIONS
AND UNIT HYDROGRAPH ANALYSIS
I5/SR78 PARK & RIDE

SITE #4 SR-78/15
PARK AND RIDE

SITE #5 MELROSE ROAD/SR-78
EASTBOUND CFF RAMP



HYDROLOGY MAP

SITE 4 15/SR78 PARK AND RIDE

FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1996 Version 3.3

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 03/03/98

Hydrology Calculation for Site 4
Filename Site4
Analysis performed for 1 Year Storm

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

AEI-CASC Engineering, Colton, California - S/N 615

Rational hydrology study storm event year is 1.0

Map data precipitation entered:
6 hour, precipitation(inches) = 0.984
24 hour precipitation(inches) = 1.456
Adjusted 6 hour precipitation (inches) = 0.946
P6/P24 = 67.6%
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++

Process from Point/Station 1.000 to Point/Station 2.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[COMMERCIAL area type]
Initial subarea flow distance = 298.00(Ft.)
Highest elevation = 71.44(Ft.)
Lowest elevation = 49.50(Ft.)
Elevation difference = 21.94(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.59 min.
TC = [1.8*(1.1-C)*distance^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.7500)*(298.00^.5)/(7.36^(1/3)]= 5.59
Rainfall intensity (I) = 2.320 for a 1.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.750
Subarea runoff = 0.626(CFS)
Total initial stream area = 0.360(Ac.)

++

Process from Point/Station 2.000 to Point/Station 3.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

Upstream point/station elevation = 49.50(Ft.)
Downstream point/station elevation = 46.60(Ft.)

```
Pipe length  =    59.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     0.626(CFS)
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =     0.626(CFS)
Normal flow depth in pipe =    2.03(In.)
Flow top width inside pipe =   11.39(In.)
Critical Depth =    3.52(In.)
Pipe flow velocity =      5.71(Ft/s)
Travel time through pipe =    0.17 min.
Time of concentration (TC) =     5.76 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station        3.000
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[COMMERCIAL area type                          ]
Time of concentration =     5.76 min.
Rainfall intensity =      2.275(In/Hr) for a     1.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.750
Subarea runoff =      0.666(CFS) for    0.390(Ac.)
Total runoff =      1.292(CFS)      Total area =        0.75(Ac.)
End of computations, total study area =            0.75 (Ac.)
```

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1996 Version 3.3

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/07/98

Hydrology Calculation & Analysis for 25 Year Storm
File Name Site04
SR78/I5 Park and Ride

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

AEI-CASC Engineering, Colton, California - S/N 615

Rational hydrology study storm event year is 25.0

Map data precipitation entered:
6 hour, precipitation(inches) = 2.000
24 hour precipitation(inches) = 3.500
Adjusted 6 hour precipitation (inches) = 2.000
P6/P24 = 57.1%
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++

Process from Point/Station 1.000 to Point/Station 2.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[COMMERCIAL area type]
Initial subarea flow distance = 298.00(Ft.)
Highest elevation = 71.44(Ft.)
Lowest elevation = 49.50(Ft.)
Elevation difference = 21.94(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 5.59 min.
TC = [1.8*(1.1-C)*distance^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.7500)*(298.00^.5)/(7.36^(1/3)]= 5.59
Rainfall intensity (I) = 4.903 for a 25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.750
Subarea runoff = 1.324(CFS)
Total initial stream area = 0.360(Ac.)

++

Process from Point/Station 2.000 to Point/Station 3.000
**** PIPEFLOW TRAVEL TIME (User specified size) ****

```
Upstream point/station elevation =    49.50(Ft.)
Downstream point/station elevation =    46.60(Ft.)
Pipe length  =    59.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.324(CFS)
Given pipe size =     18.00(In.)
Calculated individual pipe flow  =     1.324(CFS)
Normal flow depth in pipe =    2.91(In.)
Flow top width inside pipe =   13.26(In.)
Critical Depth =    5.16(In.)
Pipe flow velocity =      7.14(Ft/s)
Travel time through pipe =    0.14 min.
Time of concentration (TC) =     5.73 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station        3.000
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 1.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[COMMERCIAL area type                         ]
Time of concentration =     5.73 min.
Rainfall intensity =      4.827(In/Hr) for a    25.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.750
Subarea runoff =      1.412(CFS) for    0.390(Ac.)
Total runoff =      2.736(CFS)      Total area =        0.75(Ac.)
End of computations, total study area =            0.75 (Ac.)
```

U n i t H y d r o g r a p h A n a l y s i s

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Study date 03/11/98

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San Bernardino County Synthetic Unit Hydrology Method
Manual date - August 1986

AEI CASC Engineering, Colton, California - S/N 615

Site 4 - SR78/I5 Park and Ride
1-yr, 24-hr storm volume calculation

Storm Event Year = 1

Antecedent Moisture Condition = 1

Area averaged rainfall intensity isohyetal data:

Sub-Area (acres)	Duration (hours)	Intensity (inches)
Rainfall data for year 1		
1.00	1	0.52
Rainfall data for year 1		
1.00	6	0.99
Rainfall data for year 1		
1.00	24	1.50

++

******** Area-averaged max loss rate, Fm ********

SCS curve No.(AMCII)	SCS curve No.(AMC 1)	Area (Acres)	Area Fraction	Fp(Fig c6) (In/Hr)	Ap (dec.)	Fm (in/hr)
89.0	76.4	1.00	1.000	0.430	0.100	0.043

Area-averaged adjusted loss rate Fm (In/Hr)= 0.043

********* Area-Averaged low loss rate fraction, Yb **********

Area (acres)	Area fract	SCS cn (AMC2)	SCS cn (AMC1)	S	Pervious yield fr
0.10	0.100	89.0	76.4	3.09	0.131
0.90	0.900	98.0	98.0	0.20	0.960

Area-averaged catchment yield fraction, Y = 0.877
Area-averaged low loss fraction, Yb = 0.123
++
User entry of time of concentration = 0.109 (hours)
Watershed area = 1.00 acres
Catchment Lag time = 0.087 hours
Unit interval = 60.000 minutes
Unit interval percentage of lag time = 1143.6414
Hydrograph baseflow = 0.00 (CFS)
Average maximum watershed loss rate(Fm) = 0.043 (In/hr)
Average low loss rate fraction (Yb) = 0.123 (decimal)
VALLEY DEVELOPED S-Graph Selected
Computed peak 5-minute rainfall = 0.214 inches
Computed peak 30-minute rainfall = 0.404 inches
Specified peak 1-hour rainfall = 0.517 inches
Computed peak 3-hour rainfall = 0.768 inches
Specified peak 6-hour rainfall = 0.985 inches
Specified peak 24-hour rainfall = 1.500 inches

Rainfall depth area reduction factors:
Using a total area of 1.00 acres (Ref: fig. E-4)

5-minute factor = 1.000 Adjusted rainfall = 0.214 inches
30-minute factor = 1.000 Adjusted rainfall = 0.404 inches
1-hour factor = 1.000 Adjusted rainfall = 0.517 inches
3-hour factor = 1.000 Adjusted rainfall = 0.768 inches
6-hour factor = 1.000 Adjusted rainfall = 0.985 inches
24-hour factor = 1.000 Adjusted rainfall = 1.500 inches

U n i t H y d r o g r a p h

Interval Number	'S' Graph Mean values	Unit Hydrograph (CFS)
1	100.000	1.008

Peak Unit Number	Adjusted mass rainfall (inches)	Unit rainfall (inches)
1	0.5170	0.5170
2	0.6634	0.1464
3	0.7676	0.1042
4	0.8513	0.0837
5	0.9225	0.0712
6	0.9850	0.0625
7	1.0322	0.0472
8	1.0748	0.0427
9	1.1139	0.0391
10	1.1501	0.0362
11	1.1839	0.0337
12	1.2155	0.0317
13	1.2454	0.0299
14	1.2737	0.0283
15	1.3007	0.0269
16	1.3264	0.0257
17	1.3510	0.0246
18	1.3746	0.0236
19	1.3974	0.0227

20	1.4193	0.0219
21	1.4404	0.0212
22	1.4609	0.0205
23	1.4808	0.0198
24	1.5000	0.0192

Unit Period (number)	Unit Rainfall (inches)	Unit Soil-Loss (inches)	Effective Rainfall (inches)
1	0.0194	0.0024	0.0170
2	0.0203	0.0025	0.0178
3	0.0213	0.0026	0.0187
4	0.0225	0.0028	0.0197
5	0.0238	0.0029	0.0209
6	0.0254	0.0031	0.0223
7	0.0272	0.0033	0.0239
8	0.0294	0.0036	0.0258
9	0.0321	0.0039	0.0282
10	0.0354	0.0043	0.0311
11	0.0398	0.0049	0.0349
12	0.0458	0.0056	0.0402
13	0.0642	0.0079	0.0564
14	0.0798	0.0098	0.0700
15	0.1115	0.0137	0.0978
16	0.2814	0.0345	0.2469
17	0.3747	0.0430	0.3317
18	0.0734	0.0090	0.0644
19	0.0433	0.0053	0.0380
20	0.0341	0.0042	0.0299
21	0.0285	0.0035	0.0250
22	0.0247	0.0030	0.0217
23	0.0220	0.0027	0.0193
24	0.0199	0.0024	0.0175

Total soil rain loss = 0.18 (In.)
Total effective runoff = 1.32 (In.)

Total soil-loss volume = 0.0151 (Acre-Feet)
Total storm runoff volume = 0.1099 (Acre-Feet)

++

24 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 60 Minute intervals (CFS)

Time(h+m)	Volume(AF)	Q(CFS)	0	2.5	5.0	7.5	10.0
1+ 0	0.0014	0.02	Q				
2+ 0	0.0029	0.02	QV				
3+ 0	0.0045	0.02	QV				
4+ 0	0.0061	0.02	Q V				
5+ 0	0.0078	0.02	Q V				
6+ 0	0.0097	0.02	Q V				
7+ 0	0.0117	0.02	Q V				
8+ 0	0.0138	0.03	Q V				

9+ 0	0.0162	0.03	Q	V	|	|	|	|	|
10+ 0	0.0188	0.03	Q	V	|	|	|	|	|
11+ 0	0.0217	0.04	Q	V	|	|	|	|	|
12+ 0	0.0250	0.04	Q	V	|	|	|	|	|
13+ 0	0.0297	0.06	Q	V	|	|	|	|	|
14+ 0	0.0355	0.07	Q	V	|	|	|	|	|
15+ 0	0.0437	0.10	Q	V	|	|	|	|	|
16+ 0	0.0643	0.25	Q	V	|	|	|	|	|
17+ 0	0.0919	0.33	IQ	V	|	|	|	|	|
18+ 0	0.0972	0.06	Q	V	|	|	|	|	|
19+ 0	0.1004	0.04	Q	V	|	|	|	|	|
20+ 0	0.1029	0.03	Q	V	|	|	|	|	|
21+ 0	0.1050	0.03	Q	V	|	|	|	|	|
22+ 0	0.1068	0.02	Q	V	|	|	|	|	|
23+ 0	0.1084	0.02	Q	V	|	|	|	|	|
24+ 0	0.1099	0.02	Q	V	|	|	|	|	|

DUE TO INPUT RESTRICTIONS THE INPUT AREA = 1.0 ACRES

RECTANGULAR STORAGE AREA = 0.78 ACRES

USING DIRECT RATIO REQUIRED VOLUME = $0.1099 \times \frac{.78}{1} \times 43560$

$= 3.734 \text{ ac-ft}$

$\approx 105.74 \text{ m}^3 \rightarrow 106 \text{ m}^3$

5001

$d = 6.186 \text{ m}$

$d = 6.19 \text{ m}$

RUNOFF CURVE NUMBERS FOR HYDROLOGIC SOIL-COVER COMPLEXES (CN)

TABLE I-A-1

AMC 2

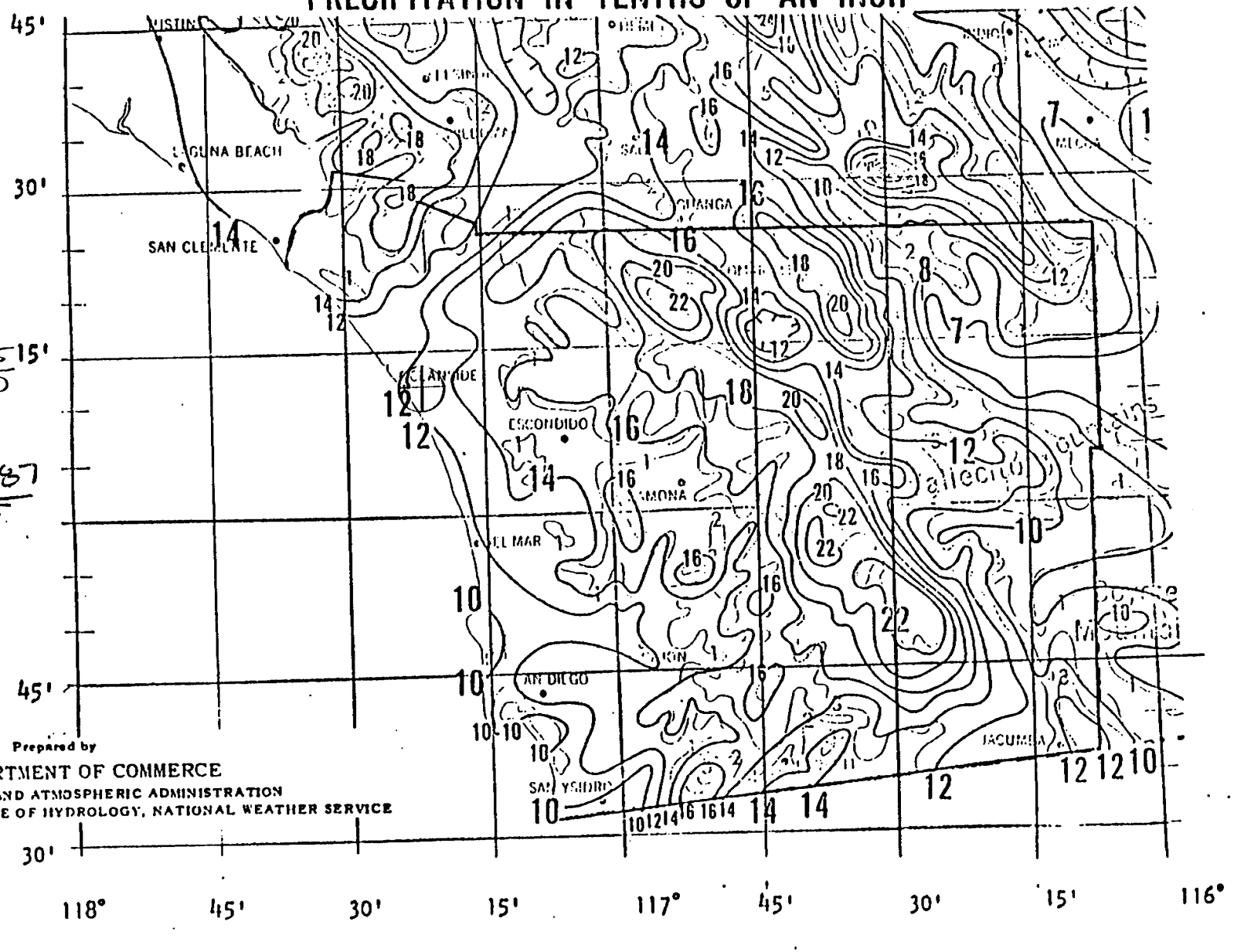
Ia = 0.2S

Land Use	Cover Treatment or Practice[3]	Hydrologic Condition[4]	Hydrologic Soil Groups A	B	C	D
Water Surfaces (during floods)			97	98	99	99
Urban						
Commercial-industrial			89	90	91	92
High density residential			75	82	88	90
Medium density residential			73	80	86	88
Low density residential			70	78	84	87
Barren			78	86	91	93
Fallow	Straight row		76	85	90	92
Vineyards	(see accompanying land-use description)					
	disked		76	85	90	92
	annual grass or legume cover	Poor	65	78	85	89
		Fair	50	69	79	84
		Good	38	61	74	80
Roads[5] (hard surface)			74	84	90	92
(dirt)			72	82	87	89
Row crops	Straight row	Poor	72	81	88	91
		Good	67	78	85	89
	Contoured	Poor	70	79	84	88
		Good	65	75	82	86
Narrowleaf chaparral		Poor	71	82	88	91
		Fair	55	72	81	86

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

2-YEAR 6-HOUR PRECIPITATION

—10— ISOPLUVIALS OF 2-YEAR 6-HOUR PRECIPITATION IN TENTHS OF AN INCH



2YR-6HR P = $\frac{12.5}{10}$ = 1.25

$\frac{1YR}{2YR}$ RATIO = $\frac{0.787}{33°}$

1YR-6HR P = 0.787 × 1.25 = 0.98

Prepared by

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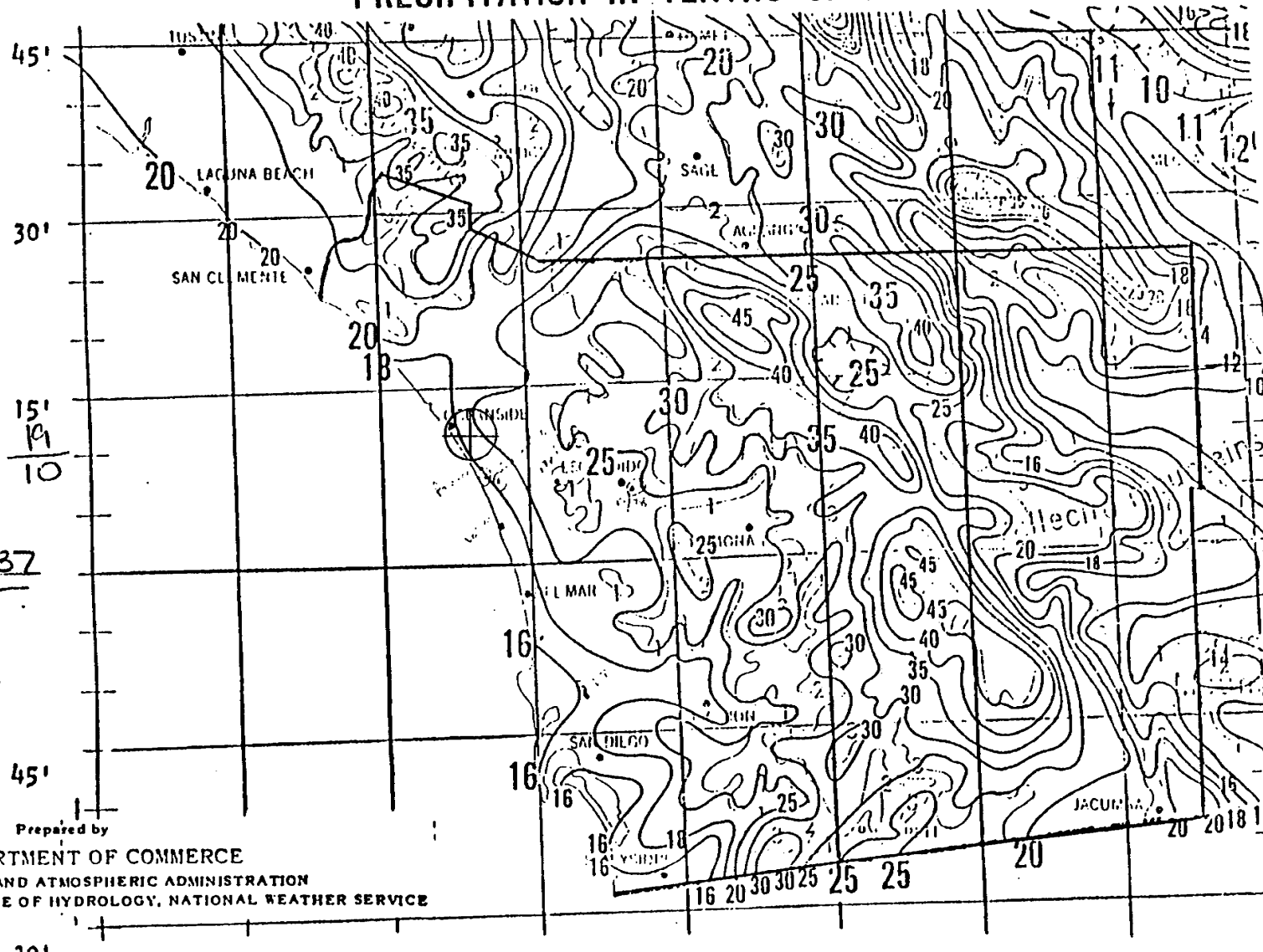
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
SPECIAL STUDIES BRANCH, OFFICE OF HYDROLOGY, NATIONAL WEATHER SERVICE

2-YEAR 24-HOUR PRECIPITATION

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

—10— ISOPLUVIALS OF 2-YEAR 24-HOUR PRECIPITATION IN TENTHS OF AN INCH



2YR - 24HR P = 19/10

= 1.9

1YR/24YR RATIO = 0.787/33*

1YR - 24HR P =

= 0.787 × 1.9

= 1.5

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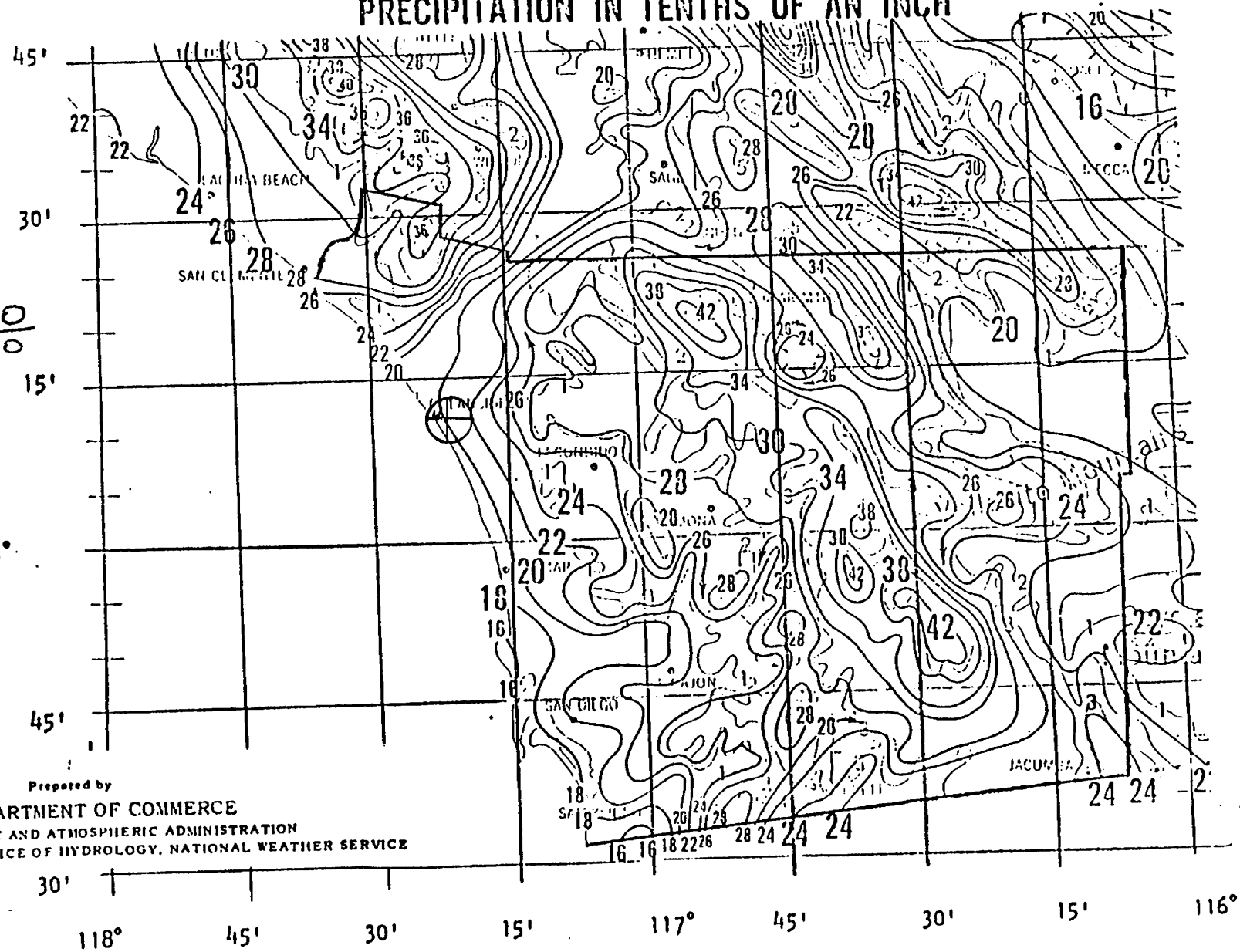
COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

25-YEAR 6-HOUR PRECIPITATION

(16) ISOPLUVIALS OF 25-YEAR 6-HOUR PRECIPITATION IN TENTHS OF AN INCH

25YR-6HR P = 20/10 = 2.0



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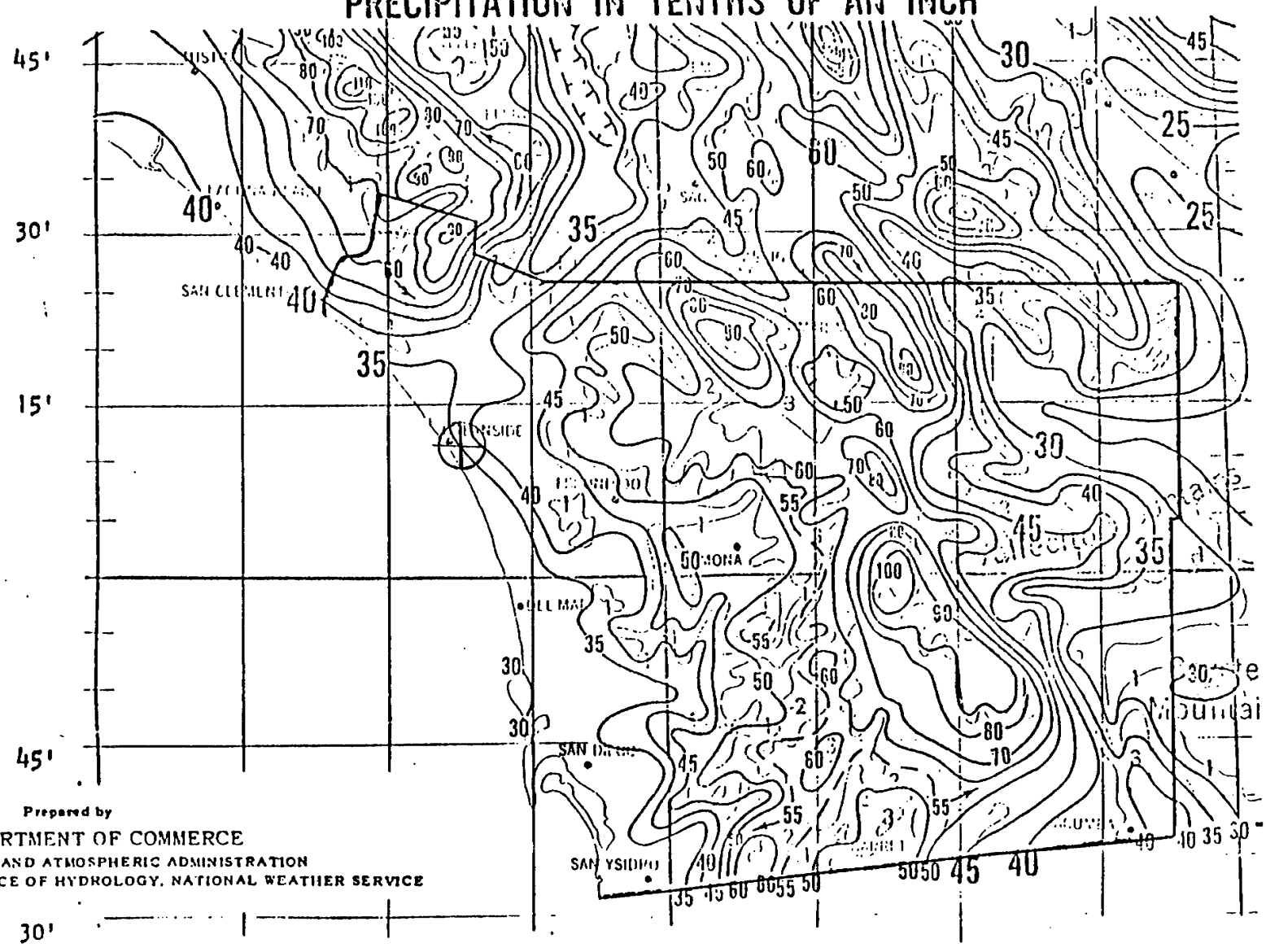
25-YEAR 24-HOUR PRECIPITATION

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

(20) ISOPLUVIALS OF 25-YEAR 24-HOUR PRECIPITATION IN TENTHS OF AN INCH



25YR-24HR P=
= 35/10
= 3.5

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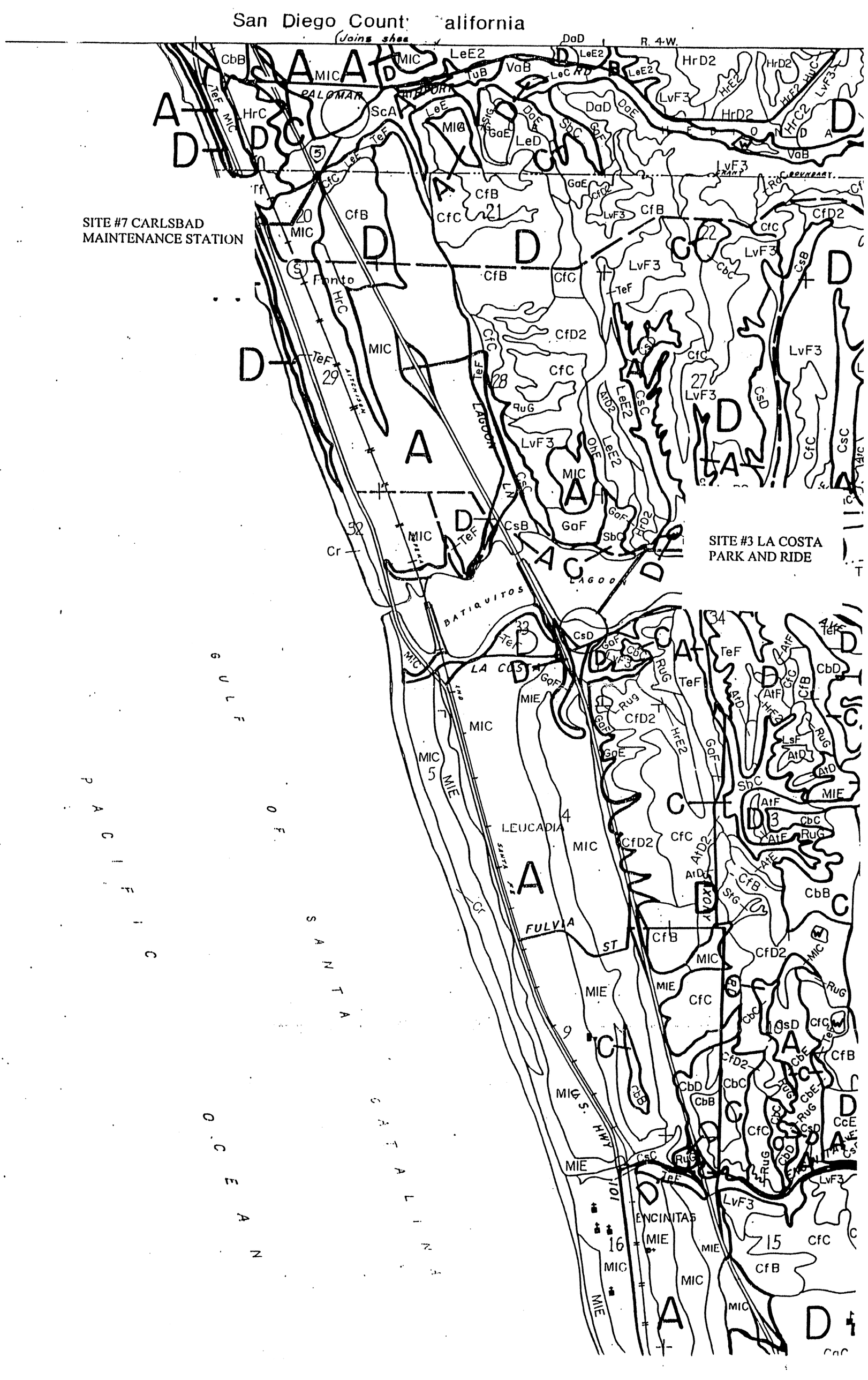
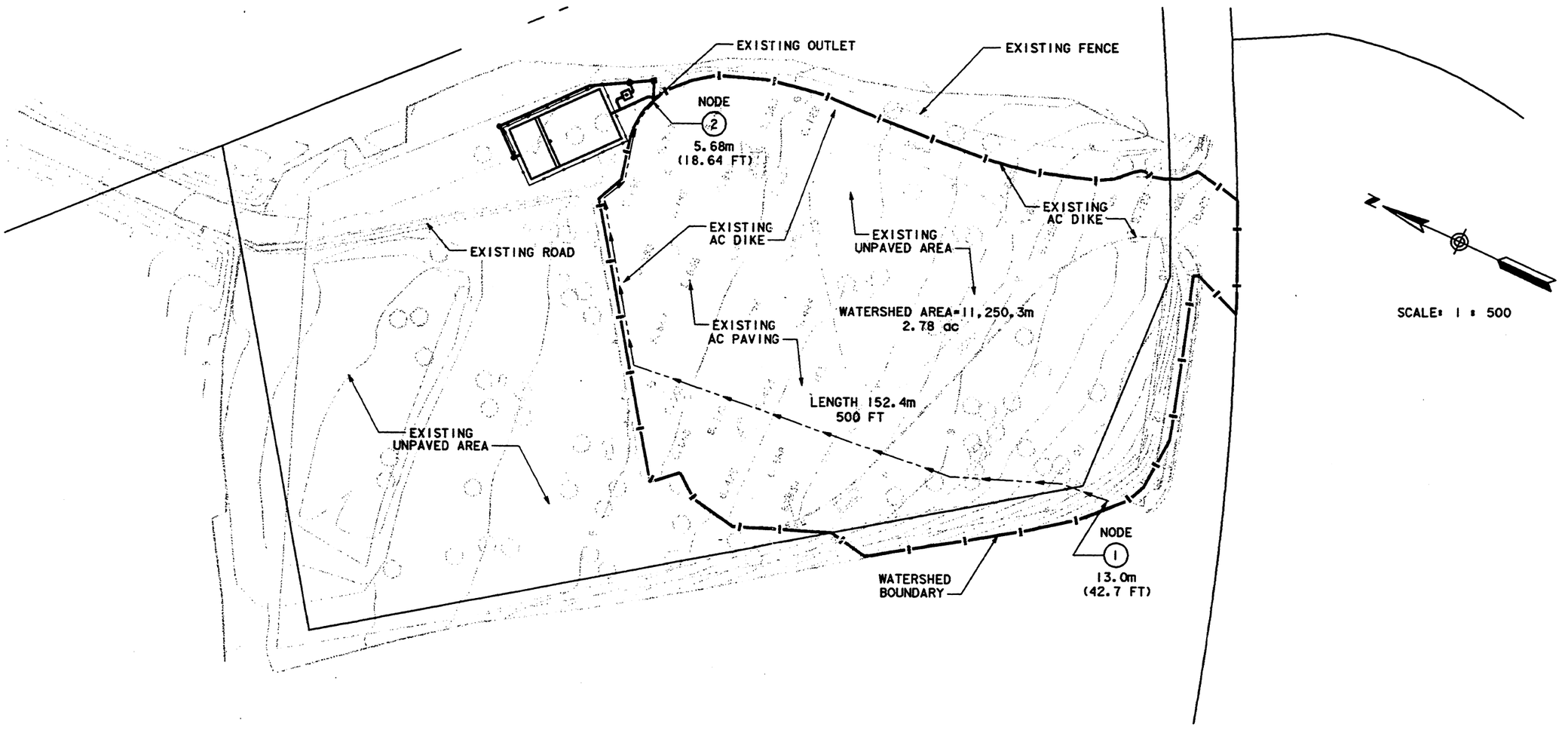
PROJECT 5, SITE 3
RATIONAL METHOD HYDROLOGY CALCULATIONS
AND UNIT HYDROGRAPH ANALYSIS
LA COSTA PARK & RIDE

San Diego County, California





a:\57704\34358\dgn\div\alte3.div

02 JUN 98 15:

HYDROLOGY MAP

SITE 3 LA COSTA PARK AND RIDE

FOR REDUCED PLANS ORIGINAL 0 20 40 60 80

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1996 Version 3.3

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 03/06/98

Hydrology Calculation & Analysis for 1 Year Storm
File Name Site3

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

AEI-CASC Engineering, Colton, California - S/N 615

Rational hydrology study storm event year is 1.0

Map data precipitation entered:
6 hour, precipitation(inches) = 0.984
24 hour precipitation(inches) = 1.420
Adjusted 6 hour precipitation (inches) = 0.923
P6/P24 = 69.3%
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++

Process from Point/Station 1.000 to Point/Station 2.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type]
Note: user entry of impervious value, Ap = 0.558
Initial subarea flow distance = 500.00(Ft.)
Highest elevation = 42.65(Ft.)
Lowest elevation = 18.64(Ft.)
Elevation difference = 24.01(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 12.10 min.
TC = [1.8*(1.1-C)*distance^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.5929)*(500.00^.5)/(4.80^(1/3)]= 12.10
Rainfall intensity (I) = 1.375 for a 1.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.593
Subarea runoff = 2.267(CFS)
Total initial stream area = 2.780(Ac.)
End of computations, total study area = 2.78 (Ac.)

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1996 Version 3.3

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/15/98

Hydrology Calculation & Analysis for 25 Year Storm
FILENAME SITE03

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

AEI-CASC Engineering, Colton, California - S/N 615

Rational hydrology study storm event year is 25.0

Map data precipitation entered:
6 hour, precipitation(inches) = 2.000
24 hour precipitation(inches) = 3.400
Adjusted 6 hour precipitation (inches) = 2.000
P6/P24 = 58.8%
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++

Process from Point/Station 1.000 to Point/Station 2.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type]
Note: user entry of impervious value, Ap = 0.558
Initial subarea flow distance = 500.00(Ft.)
Highest elevation = 42.65(Ft.)
Lowest elevation = 18.64(Ft.)
Elevation difference = 24.01(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 12.10 min.
TC = [1.8*(1.1-C)*distance^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.5929)*(500.00^.5)/(4.80^(1/3)]= 12.10
Rainfall intensity (I) = 2.980 for a 25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.593
Subarea runoff = 4.912(CFS)
Total initial stream area = 2.780(Ac.)
End of computations, total study area = 2.78 (Ac.)

U n i t H y d r o g r a p h A n a l y s i s

Copyright (c) CIVILCADD/CIVILDESIGN, 1996, Version 3.0

Study date 03/11/98

++

San Bernardino County Synthetic Unit Hydrology Method
Manual date - August 1986

AEI CASC Engineering, Colton, California - S/N 615

Site No. 3 - La Costa Avenue Park and Ride
1-yr, 24-hr storm volume calculation

Storm Event Year = 1

Antecedent Moisture Condition = 1

Area averaged rainfall intensity isohyetal data:

	Sub-Area (acres)	Duration (hours)	Intensity (inches)
Rainfall data for year 1	2.78	1	0.59
Rainfall data for year 1	2.78	6	0.98
Rainfall data for year 1	2.78	24	1.42

++

******** Area-averaged max loss rate, Fm ********

SCS curve No.(AMCII)	SCS curve No.(AMC 1)	Area (Acres)	Area Fraction	Fp(Fig c6) (In/Hr)	Ap (dec.)	Fm (in/hr)
92.0	81.6	1.46	0.525	0.342	0.200	0.068
80.0	63.0	1.32	0.475	0.637	0.700	0.446

Area-averaged adjusted loss rate Fm (In/Hr)= 0.248

********* Area-Averaged low loss rate fraction, Yb **********

Area (acres)	Area fract	SCS cn (AMC2)	SCS cn (AMC1)	S	Pervious yield fr
0.29	0.105	92.0	81.6	2.25	0.205
1.17	0.420	98.0	98.0	0.20	0.960
0.92	0.332	80.0	63.0	5.87	0.007
0.40	0.142	98.0	98.0	0.20	0.960

Area-averaged catchment yield fraction, Y = 0.564
Area-averaged low loss fraction, Yb = 0.436
++
User entry of time of concentration = 0.139 (hours)
Watershed area = 2.78 acres
Catchment Lag time = 0.111 hours
Unit interval = 60.000 minutes
Unit interval percentage of lag time = 897.9885
Hydrograph baseflow = 0.00 (CFS)
Average maximum watershed loss rate(Fm) = 0.248 (In/hr)
Average low loss rate fraction (Yb) = 0.436 (decimal)
VALLEY DEVELOPED S-Graph proportion = 0.600
VALLEY UNDEVELOPED S-Graph proportion = 0.400
FOOTHILL S-Graph proportion = 0.000
MOUNTAIN S-Graph proportion = 0.000
DESERT S-Graph proportion = 0.000

Computed peak 5-minute rainfall = 0.219 inches
Computed peak 30-minute rainfall = 0.449 inches
Specified peak 1-hour rainfall = 0.593 inches
Computed peak 3-hour rainfall = 0.809 inches
Specified peak 6-hour rainfall = 0.984 inches
Specified peak 24-hour rainfall = 1.420 inches

Rainfall depth area reduction factors:
Using a total area of 2.78 acres (Ref: fig. E-4)

5-minute factor = 1.000 Adjusted rainfall = 0.219 inches
30-minute factor = 1.000 Adjusted rainfall = 0.449 inches
1-hour factor = 1.000 Adjusted rainfall = 0.593 inches
3-hour factor = 1.000 Adjusted rainfall = 0.809 inches
6-hour factor = 1.000 Adjusted rainfall = 0.984 inches
24-hour factor = 1.000 Adjusted rainfall = 1.420 inches

U n i t H y d r o g r a p h
++

Interval Number	'S' Graph Mean values	Unit Hydrograph (CFS)
1	100.000	2.802

Peak Unit Number	Adjusted mass rainfall (inches)	Unit rainfall (inches)
1	0.5929	0.5929
2	0.7213	0.1284
3	0.8089	0.0876
4	0.8774	0.0685
5	0.9346	0.0571
6	0.9840	0.0494
7	1.0250	0.0410
8	1.0618	0.0369
9	1.0954	0.0336
10	1.1264	0.0310
11	1.1552	0.0288
12	1.1821	0.0269
13	1.2074	0.0253
14	1.2313	0.0239
15	1.2539	0.0227
16	1.2755	0.0216

17	1.2962	0.0206
18	1.3159	0.0198
19	1.3349	0.0190
20	1.3531	0.0182
21	1.3707	0.0176
22	1.3877	0.0170
23	1.4041	0.0164
24	1.4200	0.0159

Unit Period (number)	Unit Rainfall (inches)	Unit Soil-Loss (inches)	Effective Rainfall (inches)
1	0.0160	0.0070	0.0090
2	0.0168	0.0073	0.0095
3	0.0177	0.0077	0.0100
4	0.0187	0.0082	0.0106
5	0.0199	0.0087	0.0112
6	0.0213	0.0093	0.0120
7	0.0229	0.0100	0.0129
8	0.0249	0.0108	0.0140
9	0.0273	0.0119	0.0154
10	0.0303	0.0132	0.0171
11	0.0343	0.0149	0.0193
12	0.0397	0.0173	0.0224
13	0.0509	0.0222	0.0287
14	0.0649	0.0283	0.0366
15	0.0946	0.0412	0.0534
16	0.3274	0.1427	0.1847
17	0.3869	0.1686	0.2182
18	0.0592	0.0258	0.0334
19	0.0375	0.0163	0.0211
20	0.0290	0.0127	0.0164
21	0.0241	0.0105	0.0136
22	0.0207	0.0090	0.0117
23	0.0183	0.0080	0.0103
24	0.0165	0.0072	0.0093

Total soil rain loss = 0.62 (In.)
Total effective runoff = 0.80 (In.)

Total soil-loss volume = 0.1434 (Acre-Feet)
Total storm runoff volume = 0.1855 (Acre-Feet)

++

24 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 60 Minute intervals (CFS)

Time(h+m)	Volume(AF)	Q(CFS)	0	2.5	5.0	7.5	10.0
1+ 0	0.0021	0.03	Q				
2+ 0	0.0043	0.03	Q				
3+ 0	0.0066	0.03	QV				
4+ 0	0.0090	0.03	QV				
5+ 0	0.0117	0.03	Q V				
6+ 0	0.0144	0.03	Q V				
7+ 0	0.0174	0.04	Q V				

```
 8+ 0        0.0207      0.04  Q   V      |          |          |          |
 9+ 0        0.0242      0.04  Q    V     |          |          |          |
10+ 0        0.0282      0.05  Q     V    |          |          |          |
11+ 0        0.0327      0.05  Q      V   |          |          |          |
12+ 0        0.0379      0.06  Q       V  |          |          |          |
13+ 0        0.0445      0.08  Q        V |          |          |          |
14+ 0        0.0530      0.10  Q          V          |          |          |
15+ 0        0.0654      0.15  Q          |   V      |          |          |
16+ 0        0.1081      0.52  | Q        |          |  V       |          |
17+ 0        0.1587      0.61  | Q        |          |          |    V     |
18+ 0        0.1664      0.09  Q          |          |          |   V      |
19+ 0        0.1713      0.06  Q          |          |          |    V     |
20+ 0        0.1751      0.05  Q          |          |          |     V    |
21+ 0        0.1782      0.04  Q          |          |          |      V   |
22+ 0        0.1809      0.03  Q          |          |          |       V  |
23+ 0        0.1833      0.03  Q          |          |          |       V  |
24+ 0        0.1855      0.03  Q          |          |          |       V  |
-------------------------------------------------------------------------
```

RUNOFF CURVE NUMBERS FOR HYDROLOGIC SOIL-COVER COMPLEXES (CN)

TABLE I-A-1

AMC 2

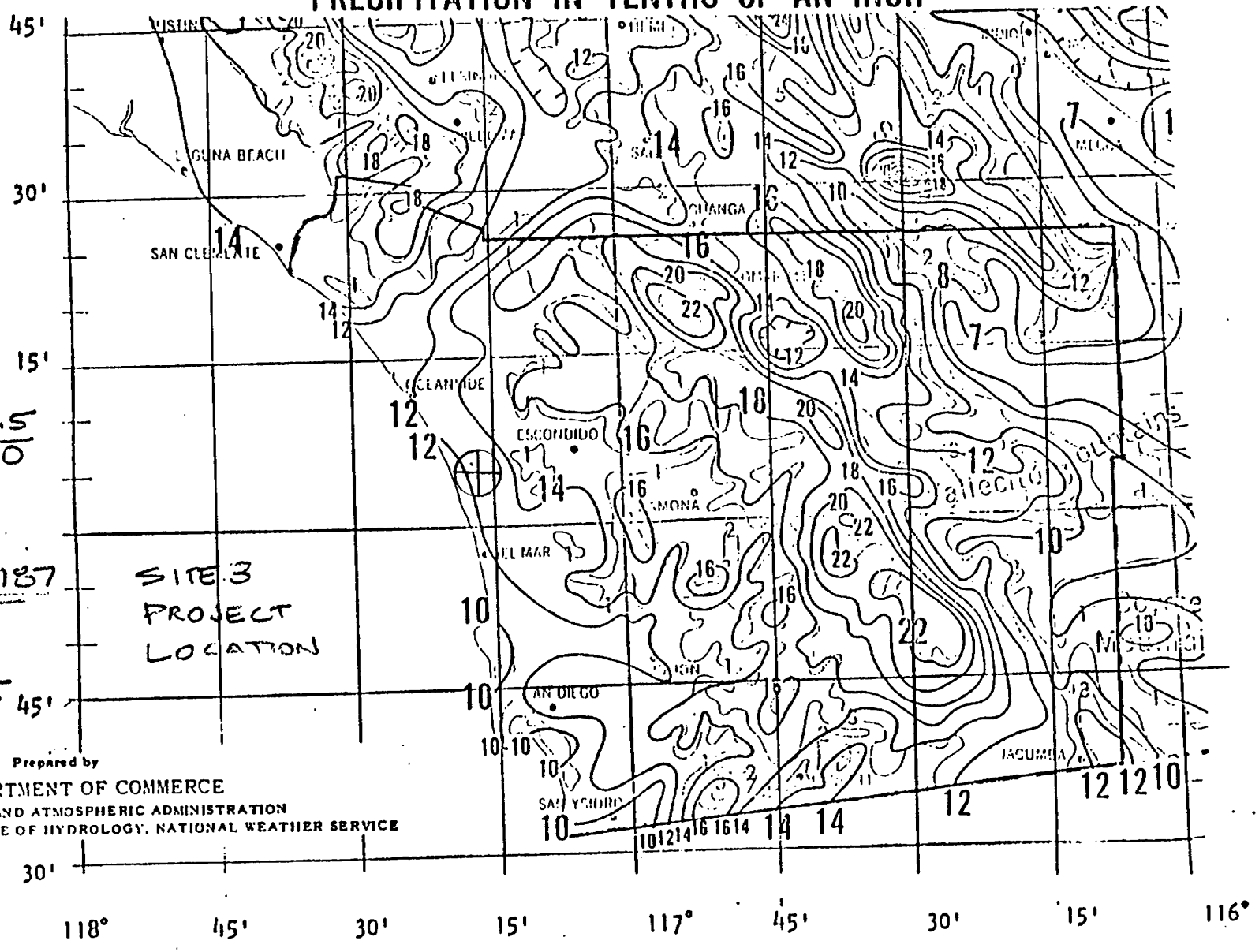
Ia = 0.2S

Land Use	Cover Treatment or Practice[3]	Hydrologic Condition[4]	Hydrologic Soil Groups A	B	C	D
Water Surfaces (during floods)			97	98	99	99
Urban						
Commercial-industrial			89	90	91	92
High density residential			75	82	88	90
Medium density residential			73	80	86	88
Low density residential			70	78	84	87
Barren			78	86	91	93
Fallow	Straight row		76	85	90	92
Vineyards	(see accompanying land-use description)					
	disked		76	85	90	92
	annual grass or legume cover	Poor	65	78	85	89
		Fair	50	69	79	84
		Good	38	61	74	80
Roads[5] (hard surface)			74	84	90	92
(dirt)			72	82	87	89
Row crops	Straight row	Poor	72	81	88	91
		Good	67	78	85	89
	Contoured	Poor	70	79	84	88
		Good	65	75	82	86
Narrowleaf chaparral		Poor	71	82	88	91
		Fair	55	72	81	86

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

2-YEAR 6-HOUR PRECIPITATION

—10— ISOPLUVIALS OF 2-YEAR 6-HOUR PRECIPITATION IN TENTHS OF AN INCH



2YR-6HR P = $\frac{12.5}{10}$

= 1.25

$\frac{1YR}{2YR}$ RATIO = 0.787

1YR-6HR P =

0.787 × 1.25

= 0.98

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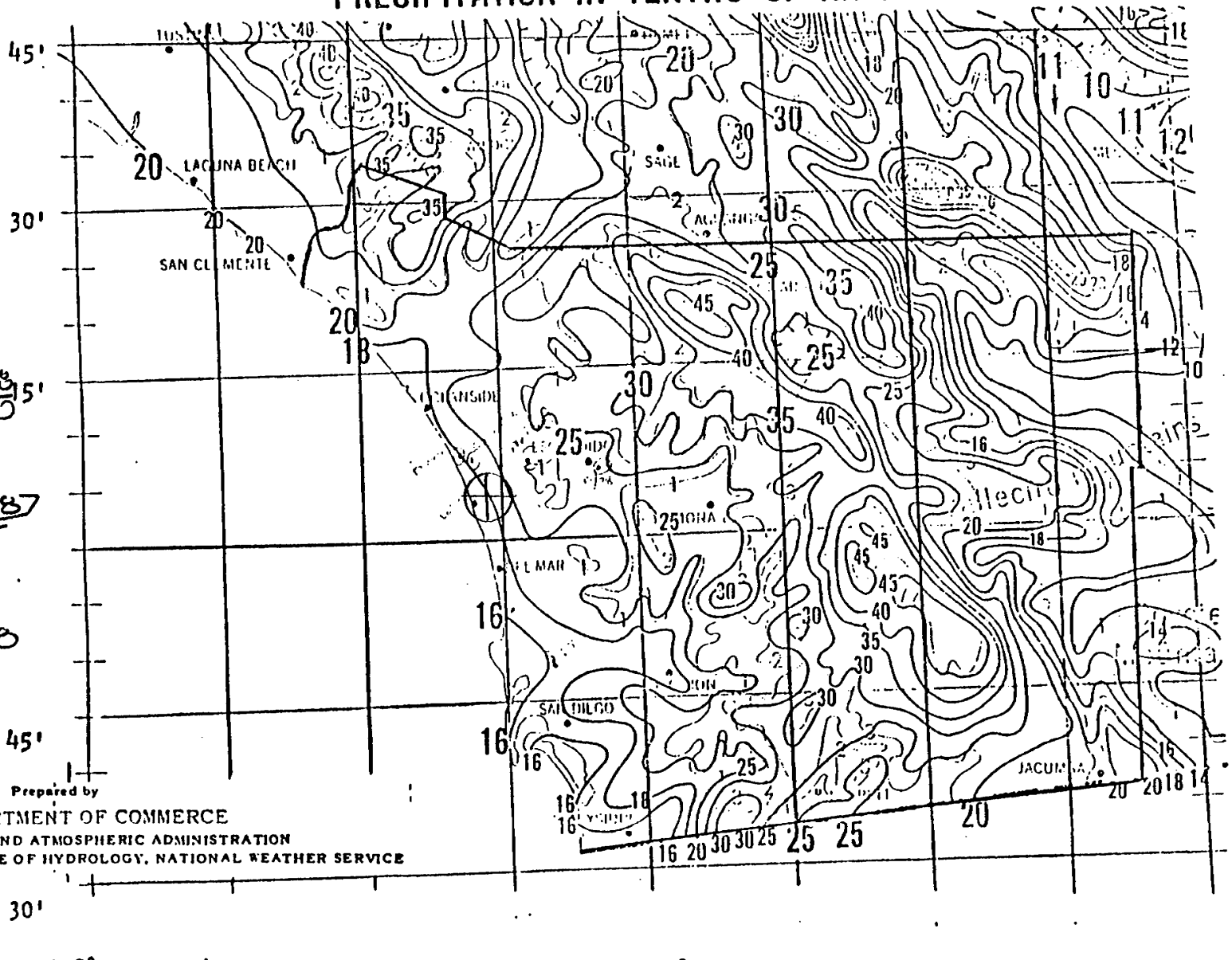
2-YEAR 24-HOUR PRECIPITATION

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

—10— ISOPLUVIALS OF 2-YEAR 24-HOUR PRECIPITATION IN TENTHS OF AN INCH



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2 YR 24 HR P = $\frac{18}{10}$

= 1.8

$\frac{1\text{YR}}{2\text{YR}}$ RATIO = 0.787

1 YR 24 HR P =

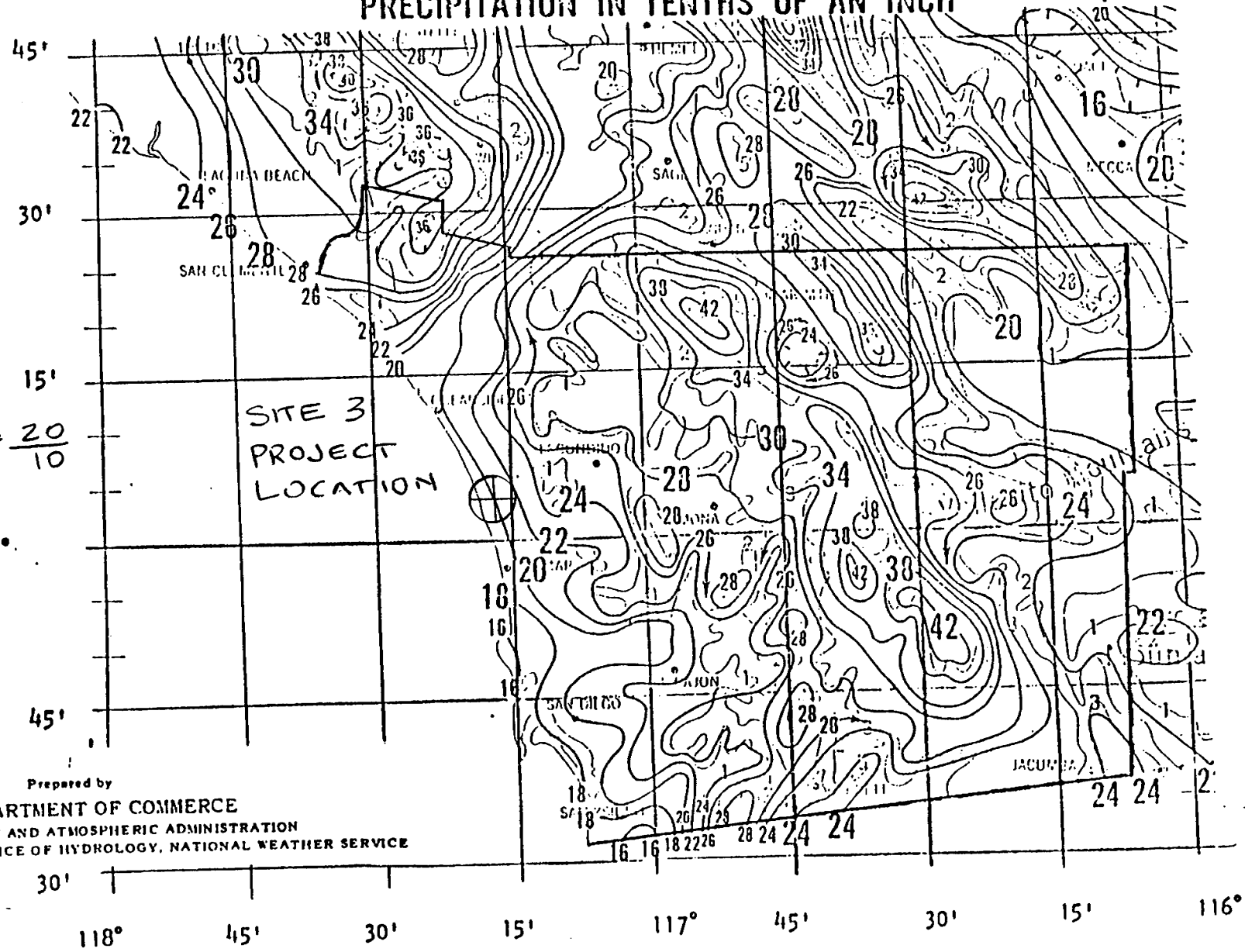
= 0.787 × 1.8

= 1.42

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

25-YEAR 6-HOUR PRECIPITATION

(16) ISOPLUVIALS OF 25-YEAR 6-HOUR PRECIPITATION IN TENTHS OF AN INCH



25YR-6HR P = 20/10
= 2.0

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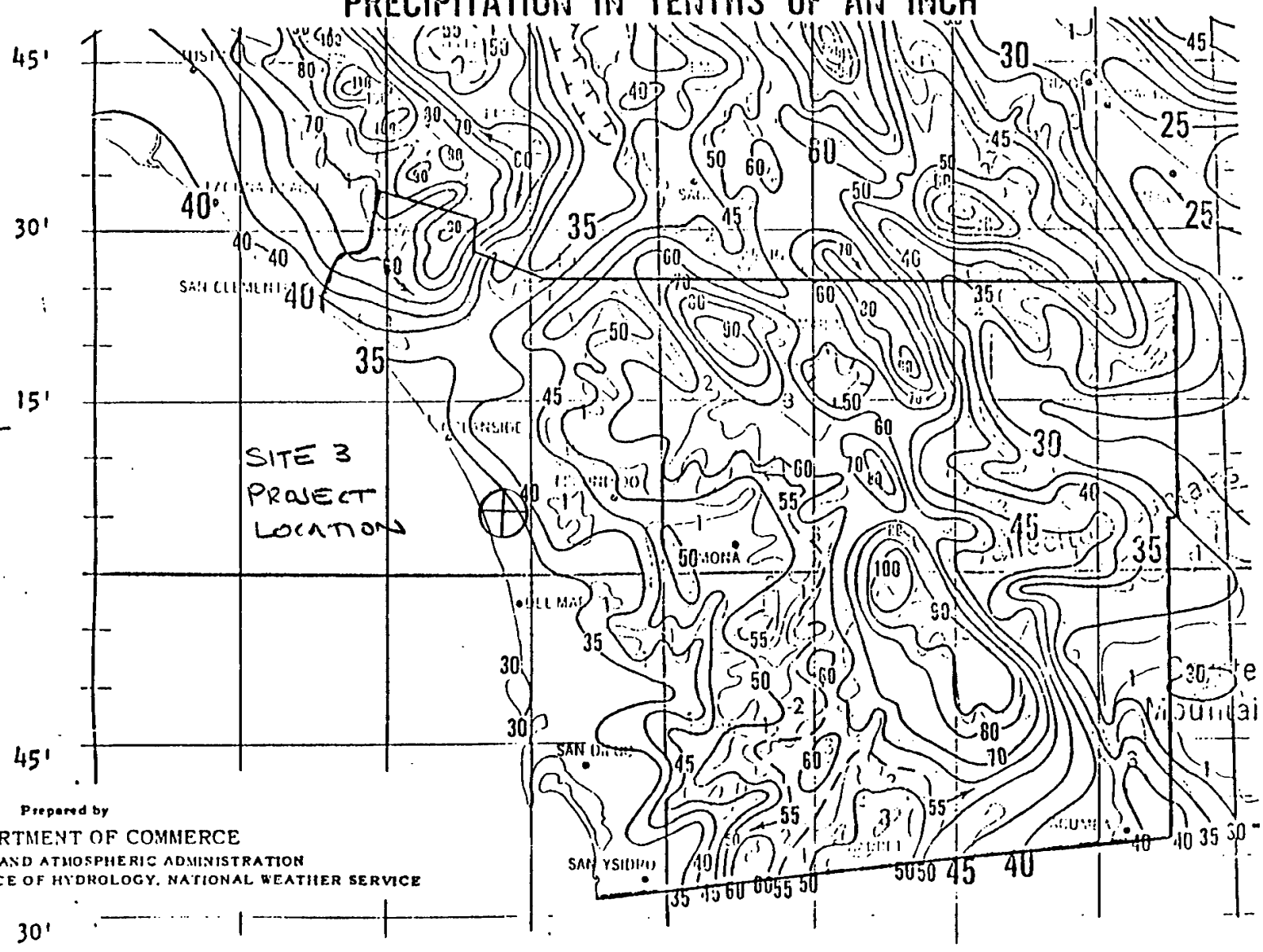
25-YEAR 24-HOUR PRECIPITATION

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

~20~ ISOPLUVIALS OF 25-YEAR 24-HOUR
PRECIPITATION IN TENTHS OF AN INCH



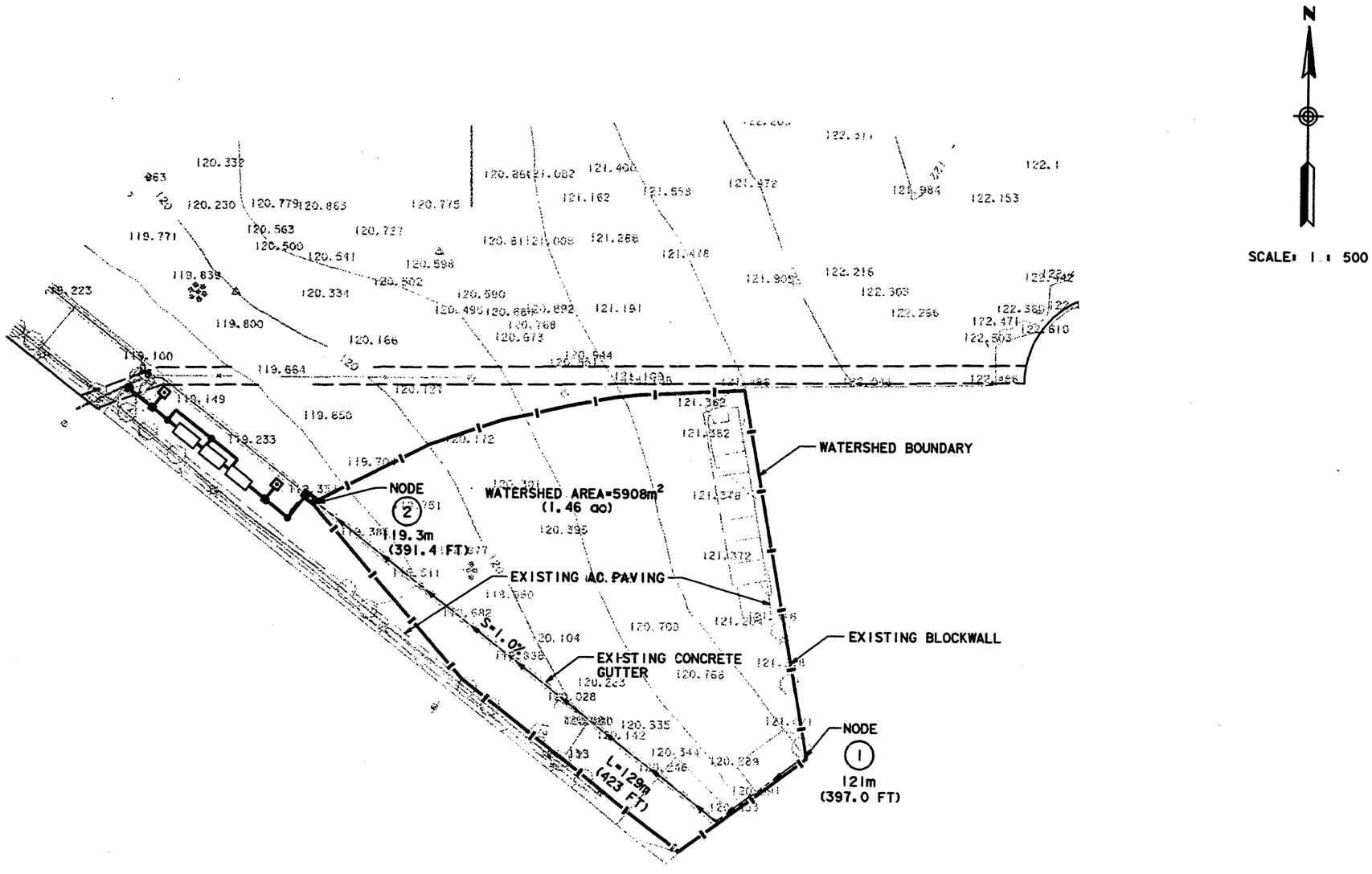
25 YR 24HR P = 34/10

= 3.4

Prepared by
U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
SPECIAL STUDIES BRANCH, OFFICE OF HYDROLOGY, NATIONAL WEATHER SERVICE

II-A-11

PROJECT 5, SITE 4
RATIONAL METHOD HYDROLOGY CALCULATIONS
AND UNIT HYDROGRAPH ANALYSIS
KEARNY MESA MAINTENANCE STATION



HYDROLOGY MAP

SITE 1 KEARNY MESA MAINTENANCE STATION

29 MAY 98 15: q:\57704\34358\dgn\div\site1.div

FOR REDUCED PLANS ORIGINAL 0 20 40 60 80

SITE #1 KEARNY MESA
MAINTENANCE STATION

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1996 Version 3.3

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/06/98

Kearny Mesa Maintenance Station Site No. 1
Peak Q Based On 1 Year Storm
File Name STKM

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

AEI-CASC Engineering, Colton, California - S/N 615

Rational hydrology study storm event year is 1.0

Map data precipitation entered:
6 hour, precipitation(inches) = 0.940
24 hour precipitation(inches) = 1.420
Adjusted 6 hour precipitation (inches) = 0.923
P6/P24 = 66.2%
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++
Process from Point/Station 1.000 to Point/Station 2.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type]
Note: user entry of impervious value, Ap = 0.850
Initial subarea flow distance = 423.00(Ft.)
Highest elevation = 397.00(Ft.)
Lowest elevation = 391.40(Ft.)
Elevation difference = 5.60(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 6.64 min.
TC = [1.8*(1.1-C)*distance^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.9031)*(423.00^.5)/(1.32^(1/3)]= 6.64
Rainfall intensity (I) = 2.026 for a 1.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.903
Subarea runoff = 2.671(CFS)
Total initial stream area = 1.460(Ac.)
End of computations, total study area = 1.46 (Ac.)

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1996 Version 3.3

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/06/98

KEARNY MESA MAINTENANCE STATION
PEAK FLOW FOR 25 YEARS
FILE NAME 25YRKM

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

AEI-CASC Engineering, Colton, California - S/N 615

Rational hydrology study storm event year is 25.0

Map data precipitation entered:
6 hour, precipitation(inches) = 2.000
24 hour precipitation(inches) = 3.500
Adjusted 6 hour precipitation (inches) = 2.000
P6/P24 = 57.1%
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++

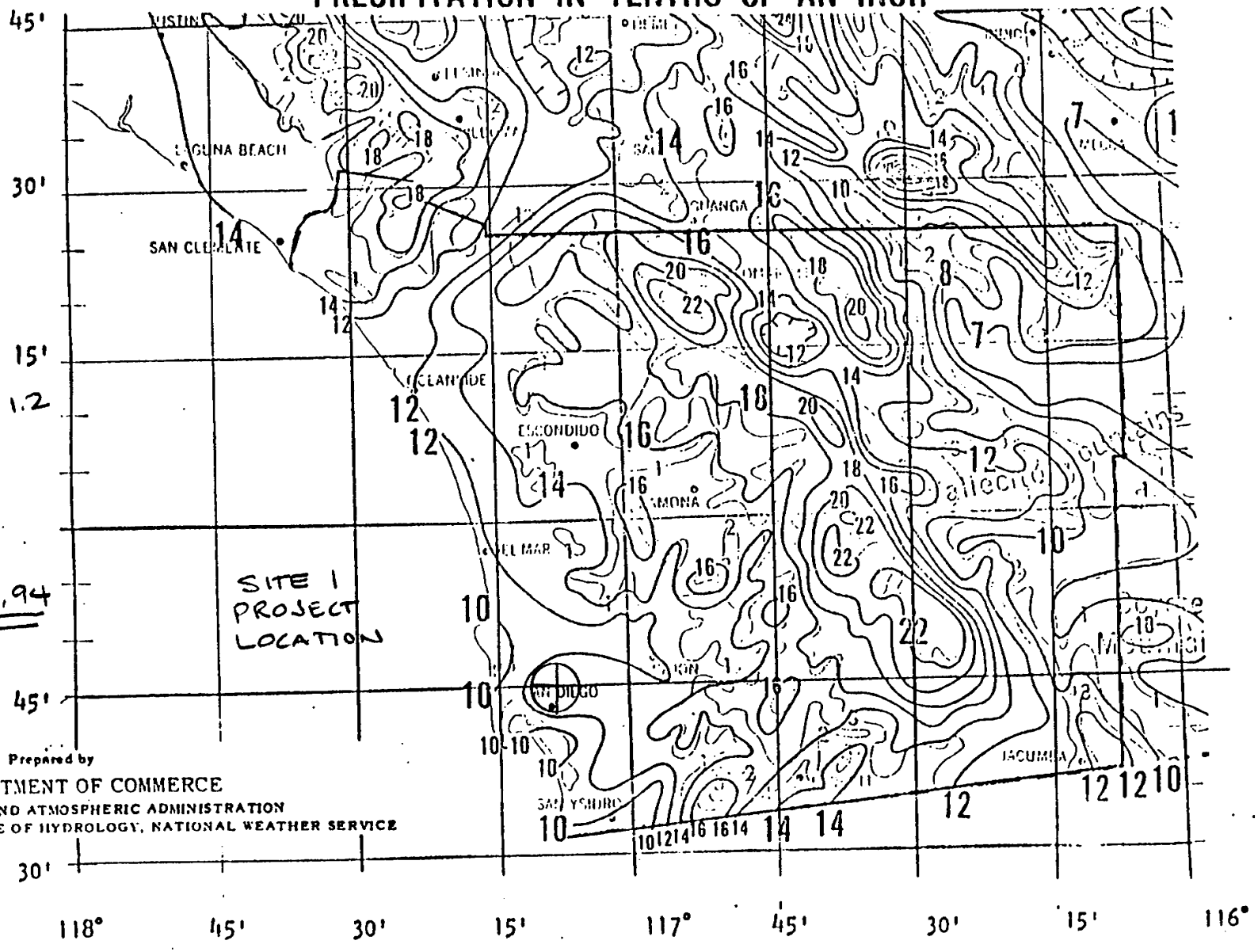
Process from Point/Station 1.000 to Point/Station 2.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 1.000
[COMMERCIAL area type]
Note: user entry of impervious value, Ap = 0.850
Initial subarea flow distance = 423.00(Ft.)
Highest elevation = 397.00(Ft.)
Lowest elevation = 391.40(Ft.)
Elevation difference = 5.60(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 6.64 min.
TC = [1.8*(1.1-C)*distance^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.9031)*(423.00^.5)/(1.32^(1/3)]= 6.64
Rainfall intensity (I) = 4.389 for a 25.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.903
Subarea runoff = 5.788(CFS)
Total initial stream area = 1.460(Ac.)
End of computations, total study area = 1.46 (Ac.)

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

2-YEAR 6-HOUR PRECIPITATION

—10— ISOPLUVIALS OF 2-YEAR 6-HOUR PRECIPITATION IN TENTHS OF AN INCH



2 YR 6HR P = $\frac{12}{10}$ = 1.2

$\frac{1\text{YR}}{2\text{YR}}$ RATIO = 0.787

1 YR 6HR P =

1.2 × 0.787 = 0.94

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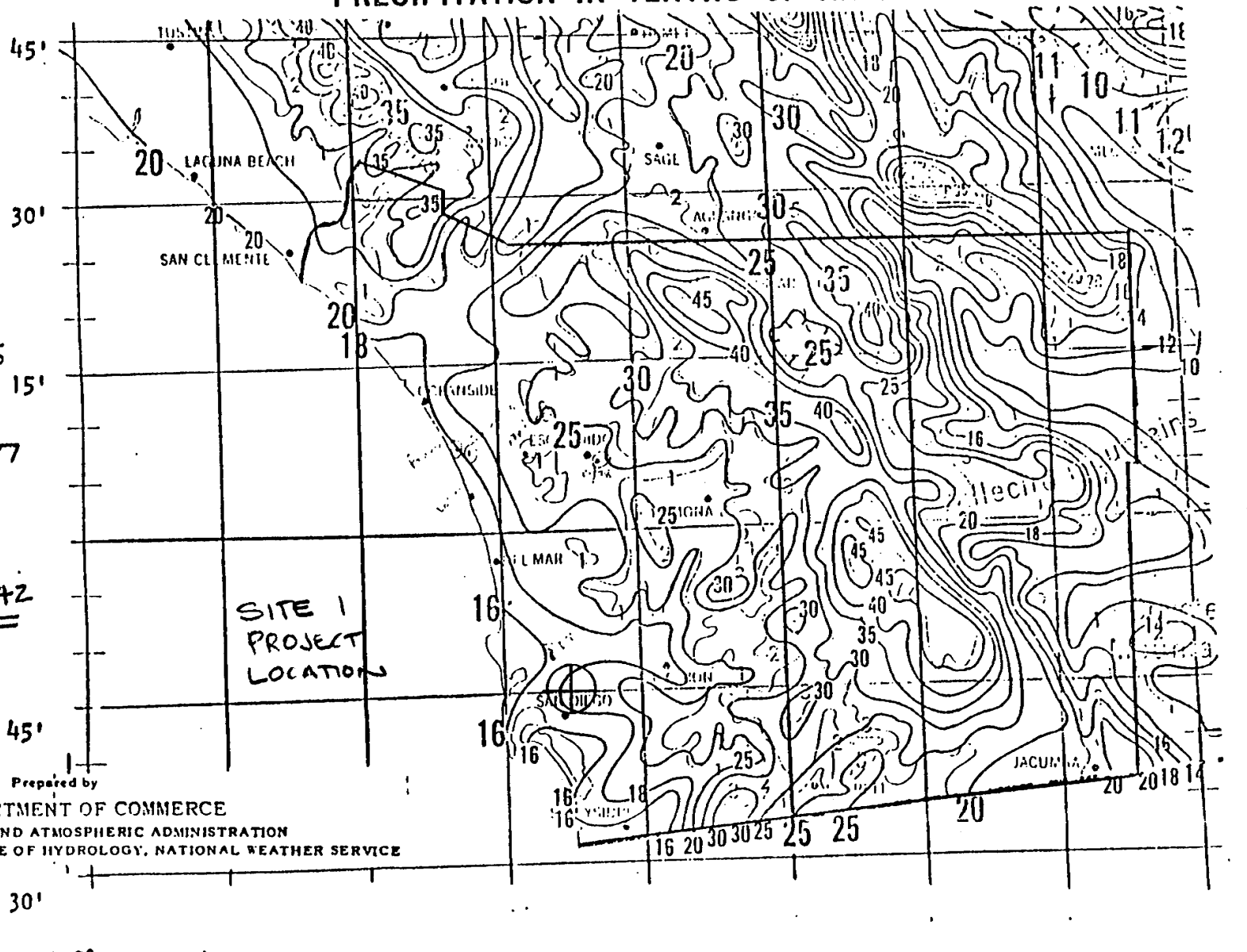
SPECIAL STUDIES BRANCH, OFFICE OF HYDROLOGY, NATIONAL WEATHER SERVICE

2-YEAR 24-HOUR PRECIPITATION

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

—10— ISOPLUVIALS OF 2-YEAR 24-HOUR PRECIPITATION IN TENTHS OF AN INCH



2 YR 24 HR P = 18/10
= 1.8

1YR/2YR RATIO = 0.787

1 YR 24 HR P = 33°
∴ 0.787 × 1.8 = 1.42

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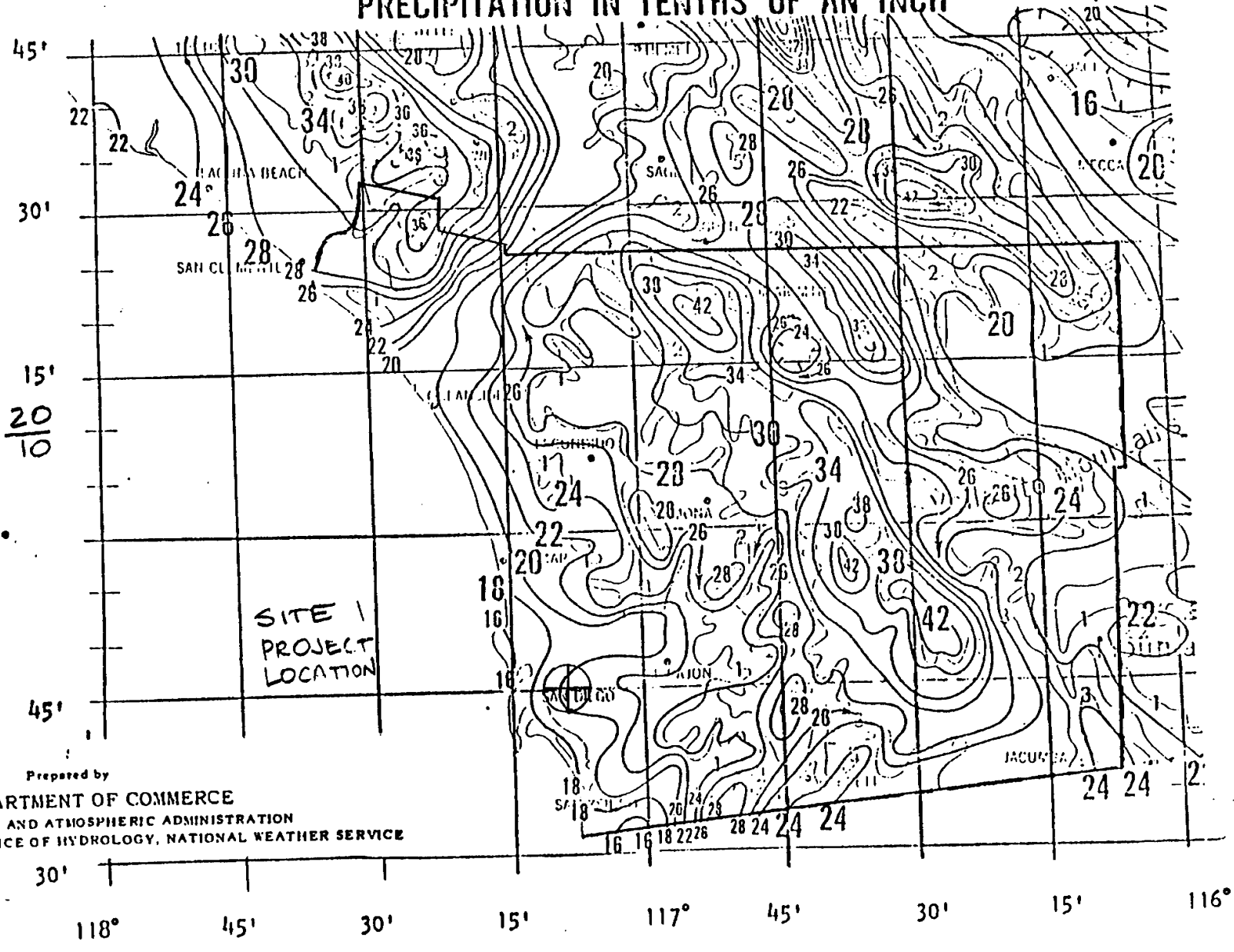
COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

25-YEAR 6-HOUR PRECIPITATION

(16) ISOPLUVIALS OF 25-YEAR 6-HOUR PRECIPITATION IN TENTHS OF AN INCH



25 YR 6 HR P = 20/10
= 2.0

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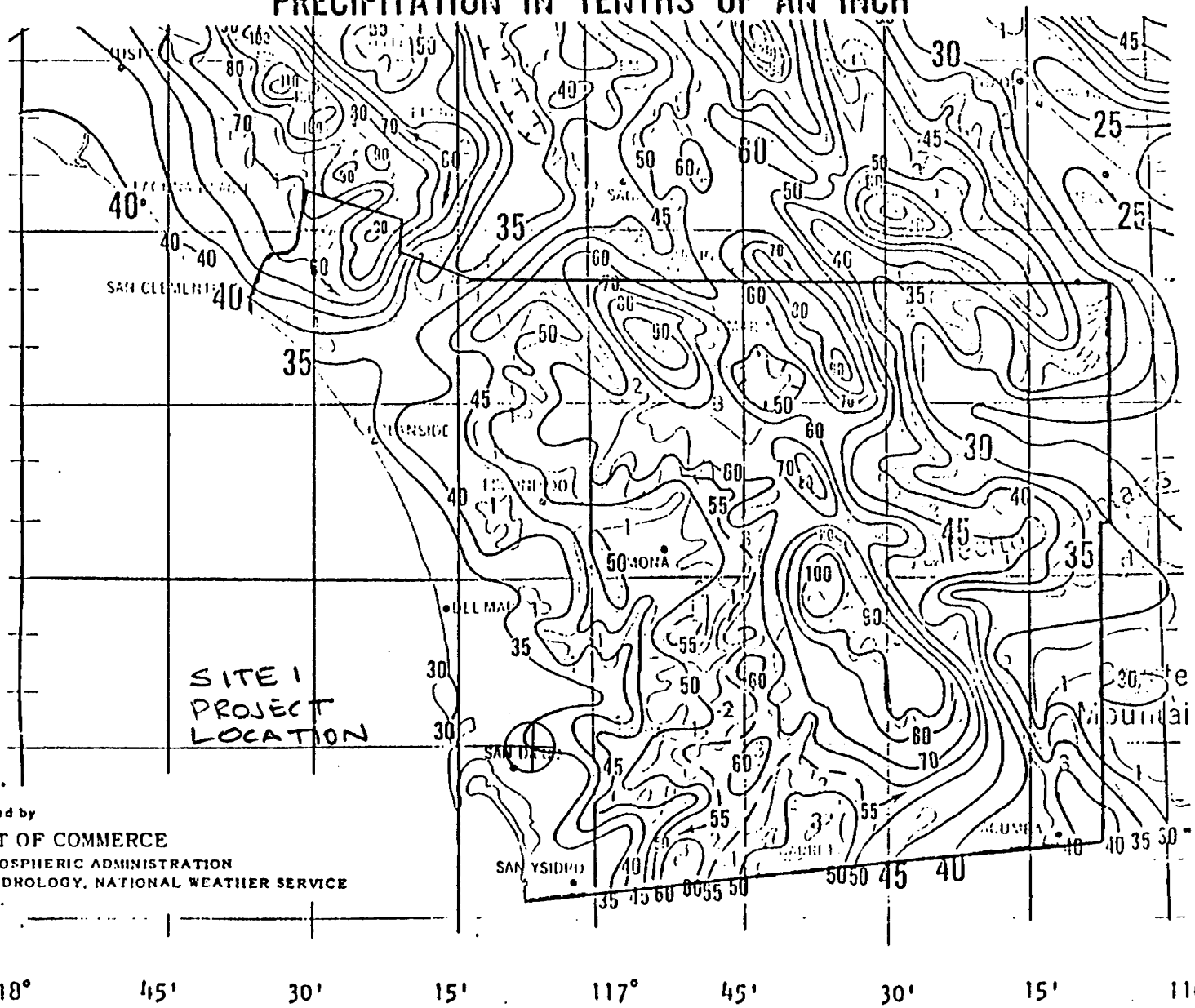
25-YEAR 24-HOUR PRECIPITATION

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

(20) ISOPLUVIALS OF 25-YEAR 24-HOUR PRECIPITATION IN TENTHS OF AN INCH



25 YR 24HR P = 35/10

∴ 3.5

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APPENDIX B HYDRAULIC CALCULATIONS

CALTRANS DISTRICT 11 NPDES PROJECT BMP HYDRAULIC SUMMARY

DRN SYS NO.	LOCATION	BMP	Longitudal Slope (ft/ft)	Tranverse Slope (ft/ft)	Flow Depth (ft)	Flow Velocity (ft/s)	Vegetation Height (in)	Residence Time (min)	Infiltration Rate (ft/s)	Inlet Type	Inlet Slope (ft/ft)	Inlet Velocity (ft/s)
1	KEARNY MESA MAINTENANCE STATION	COMPOST MEDIA FILTER (MF)	2.3 FEET OF DROP OVER ENTIRE STRUCTURE	N/A	N/A	N/A	N/A	-	N/A	10" DIA. PIPE	0.002	4.6
2	ESCONDIDO MAINTENANCE STATION	SAND MEDIA FILTER (MF)	0.0010	0.0010	N/A	N/A	N/A	-	N/A	10" DIA. PIPE	0.005	3.62
3	LA COSTA PARK AND RIDE	SAND MEDIA FILTER (MF)	N/A	0.0000	N/A	N/A	N/A	-	N/A	CONCRETE CHANNEL	0.002	2.5
4	SR-78/I-5 PARK AND RIDE	SAND MEDIA FILTER (MF)	0.0000	0.0000	N/A	N/A	N/A	-	N/A	10" DIA. PIPE	0.01	3.7
5	MELROSE DRIVE / SR-78	BIOFILTRATION SWALE (BSw)	0.0080	0.5000	0.47	1.1	2-6	15	N/A	CONCRETE CHANNEL	0.004	0.52
6	PALOMAR AIRPORT RD	BIOFILTRATION SWALE (BSw)	0.0050	0.2500	0.54	0.6	2-6	9.3	N/A	CONCRETE SWALE	0.0015	0.87
7A	CARLSBAD MAINTENANCE STATION	INFILTRATION TRENCH (IT)	0.0100	0.0000	N/A	N/A	N/A	-	$2.8x10^{-5}$	CONCRETE CHANNEL	0.002	2.1
7B	CARLSBAD MAINTENANCE STATION	BIOFILTRATION STRIP (BSt)	0.0200	0.0010	0.03 ALONG FLOWLINE	0.21 ALONG FLOWLINE	2-6	-	N/A	SHEET FLOW OFF OF AC PAVEMENT	0.01	0.6

HYDRAULIC CALCULATIONS FOR CALTRANS NPDES PILOT PROGRAM

PROJECT 2, SITE 4
HYDRAULIC CALCULATIONS
I-5/ PALOMAR AIRPORT ROAD

AEI·CASC ENGINEERING
937 South Via Lata, Suite 500
Colton, CA 92324
(909) 783-0101 • Fax (909) 783-0108

SHEET ____ OF ____

ENGINEER J. CASTANEDA DATE ____ JOB # ____ BY JC

SUBJECT PALOMAR AIRPORT ROAD / I-5 CHECKED BY ____

BIOFILTER SWALE

SITE:
I-5 / PALOMAR AIRPORT ROAD

PARAMETERS FOR BIOFILTER SWALES

1) PEAK FLOW FROM RATIONAL METHOD ANALYSIS

$Q_{1YR} = 3.22$ cfs

2) BIOFILTER SWALE SLOPE BASED UPON THE DRAINAGE SITE.
EXISTING SHOULDER SLOPES @ .15%

MAXIMUM SLOPE ATTAINABLE IS CONTROLLED BY INLET USED TO DRAIN RUNOFF.

$S = 0.5\%$

3) GEOMETRY OF BIOFILTER SWALE

SIDE SLOPE = LEFT = 2:1
RIGHT = 4:1

WIDTH = 9.84'

4) FLOW AREA

$A_{FLOW} = 8.63$ ft²

AEI·CASC ENGINEERING
937 South Via Lata, Suite 500
Colton, CA 92324
(909) 783-0101 • Fax (909) 783-0108

SHEET ____ OF ____

ENGINEER _____ DATE _____ JOB # _____ BY _____

SUBJECT _____ CHECKED BY _____

5) VELOCITY (BASED ON WSPG CALCULATIONS. MANNING "n" = 0.15)

V = 0.56 ft/s BASE WIDTH = 9.84'

V = 0.70 ft/s BASE WIDTH = 6.56'

6) TOTAL LENGTH OF BIOFILTER SWALE

BASE WIDTH	TOTAL LENGTH
9.84	267.4 ft
6.56	56.5 ft

7) RESIDENCE TIME (T_R) FOR BIOFILTER SWALE

$$\text{TOTAL } T_R = \frac{267.4\ ft}{0.56\ ft/s} + \frac{56.5\ ft}{0.70\ ft/s} = 558.2\ s$$

$$T_R = 558.2\ s = 9.3\ minutes > 4\ min.$$

```
T1 WATER PROFILE FOR PALOMAR AIRPORT ROAD AND I-5                                0
T2 1 YEAR FLOW USING RATIONAL METHOD, PREPARED BY JOE CASTANEDA
T3 FILENAME:1YR6GR
SO       .00  53.84  1                              53.84
R       6.71  53.85  1      .015                                  .000
TS      8.71  53.86  2      .015                                  .000
TS      9.71  53.86  1      .015                                  .000
R      16.27  53.87  1      .015                                  .000
TS     22.80  54.20  3      .015                                  .000
R     116.98  55.09  3      .150                                -1.442
R     200.90  55.51  3      .150                                  .000
TS    207.50  55.52  7      .035                                  .000
R     221.40  55.63  7      .015                                  .000
JX    222.40  55.64  7 2    .015      .23           56.65        45.0          .000
R     233.18  55.68  7      .015                                -42.714
TS    240.07  55.70  3      .015                                 42.714
R     283.23  55.94  3      .150                                 44.562
TS    289.75  55.98  7      .035                                -44.562
R     325.39  56.16  7      .015                                  .000
JX    326.39  56.17  7 2    .015      .23           56.65         .00          .000
R     360.02  56.34  7      .015                                  .000
TS    363.02  56.35  3      .015                                 44.272
R     407.11  56.58  3      .150                                 44.329
TS    413.68  56.62  7      .035                                -44.329
R     475.87  56.93  7      .015                                -21.695
TS    482.40  56.97  4      .015                                 21.695
R     538.64  57.25  4      .150                                  .000
TS    545.16  57.26  1      .035                                  .000
R     546.07  57.26  7      .015                                  .000
JX    547.07  57.26  7 2    .015      .23           56.65         .00          .000
R     549.07  57.27  7      .015                                  .000
TS    554.98  57.27  2      .015                                  .000
TS    555.98  57.27  1      .015                                  .000
R     562.54  57.27  1      .015                                 46.272
R     569.10  57.28  1      .015                                  .000
SH    569.10  57.28  1                              57.28
CD   1  2   0     .00   1.00    2.00  .00  .00   .0
CD   2  2   0     .00   1.00    1.00  .00  .00   .0
CD   3  1   0     .00   1.00    9.84 2.00 4.00   .0
CD   4  1   0     .00   1.00    6.56 2.00 2.00   .0
CD   5  1   0     .00   1.00    1.64 3.33 0.20   .0
CD   6  1   0     .00   1.00    9.84 2.00 4.00   .0
CD   7  2   0     .00   1.00    2.46  .00  .00   .0
Q              2.52   .0
```

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

W S P G N - CIVILDESIGN Vers 6.0
For: CASC Engineering Group, Riverside, California - S/N 615
WATER SURFACE PROFILE LISTING
Date: 2- 1-2000 Time: 2:59:16

WATER PROFILE FOR PALOMAR AIRPORT ROAD AND I-5
1 YEAR FLOW USING RATIONAL METHOD, PREPARED BY JOE CASTANEDA
FILENAME:1YR6GR

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"		ZR	Type Ch
.00	53.84	.297	54.137	3.2	5.41	.454	54.591	.00	.431	2.00	1.00	2.00	.00	0 .0
.93	.00149					.022291	.02	.30	1.749	.742	.015		.00	RECTANG
.93	53.84	.288	54.129	3.2	5.57	.482	54.612	.00	.431	2.00	1.00	2.00	.00	0 .0
1.47	.00149					.025132	.04	.29	1.830	.742	.015		.00	RECTANG
2.41	53.84	.275	54.118	3.2	5.84	.530	54.649	.00	.431	2.00	1.00	2.00	.00	0 .0
1.46	.00149					.029059	.04	.27	1.966	.742	.015		.00	RECTANG
3.87	53.85	.262	54.108	3.2	6.13	.583	54.691	.00	.431	2.00	1.00	2.00	.00	0 .0
1.44	.00149					.033616	.05	.26	2.111	.742	.015		.00	RECTANG
5.31	53.85	.250	54.098	3.2	6.43	.642	54.739	.00	.431	2.00	1.00	2.00	.00	0 .0
1.40	.00149					.038907	.05	.25	2.268	.742	.015		.00	RECTANG
6.71	53.85	.238	54.088	3.2	6.74	.706	54.794	.00	.431	2.00	1.00	2.00	.00	0 .0
TRANS STR	.00500					.026774	.05	.24	2.436		.015		.00	RECTANG
8.71	53.86	.684	54.544	3.2	4.69	.342	54.886	.00	.684	1.00	1.00	1.00	.00	0 .0
TRANS STR	.00000					.006186	.01	.68	1.000		.015		.00	RECTANG
9.71	53.86	1.025	54.885	3.2	1.57	.038	54.923	.00	.431	2.00	1.00	2.00	.00	0 .0
6.56	.00152					.000624	.00	1.03	.273	.736	.015		.00	RECTANG
16.27	53.87	1.019	54.889	3.2	1.58	.039	54.927	.00	.431	2.00	1.00	2.00	.00	0 .0
TRANS STR	.05054					.000328	.00	1.02	.275		.015		.00	RECTANG

WATER SURFACE PROFILE LISTING Date: 2- 1-2000 Time: 2:59:16

WATER PROFILE FOR PALOMAR AIRPORT ROAD AND I-5
1 YEAR FLOW USING RATIONAL METHOD, PREPARED BY JOE CASTANEDA
FILENAME:1YR6GR

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS) / SF Ave	Vel Head / HF	Energy Grd.El. / SE Dpth	Super Elev / Froude N	Critical Depth / Norm Dp	Flow Top Width / "N"	Height/ Dia.-FT / ZR	Base Wt or I.D.	ZL	No Wth Prs/Pip / Type Ch
22.80	54.20	.731	54.931	3.2	.36	.002	54.933	.00	.147	14.23	1.00	9.84	2.00	0 .0
4.35	.00945				.002841	.01	.73	.082	.507	.150			4.00	TRAP
27.15	54.24	.702	54.943	3.2	.38	.002	54.945	.00	.147	14.05	1.00	9.84	2.00	0 .0
4.49	.00945				.003274	.01	.70	.087	.507	.150			4.00	TRAP
31.64	54.28	.674	54.958	3.2	.40	.003	54.960	.00	.147	13.88	1.00	9.84	2.00	0 .0
4.71	.00945				.003775	.02	.67	.093	.507	.150			4.00	TRAP
36.34	54.33	.647	54.975	3.2	.42	.003	54.978	.00	.147	13.72	1.00	9.84	2.00	0 .0
5.05	.00945				.004355	.02	.65	.100	.507	.150			4.00	TRAP
41.39	54.38	.621	54.997	3.2	.44	.003	55.000	.00	.147	13.57	1.00	9.84	2.00	0 .0
5.60	.00945				.005025	.03	.62	.106	.507	.150			4.00	TRAP
46.99	54.43	.596	55.025	3.2	.46	.003	55.028	.00	.147	13.42	1.00	9.84	2.00	0 .0
6.53	.00945				.005801	.04	.60	.114	.507	.150			4.00	TRAP
53.52	54.49	.572	55.062	3.2	.49	.004	55.066	.00	.147	13.27	1.00	9.84	2.00	0 .0
8.33	.00945				.006699	.06	.57	.121	.507	.150			4.00	TRAP
61.86	54.57	.549	55.118	3.2	.51	.004	55.122	.00	.147	13.13	1.00	9.84	2.00	0 .0
12.88	.00945				.007738	.10	.55	.130	.507	.150			4.00	TRAP
74.74	54.69	.526	55.217	3.2	.53	.004	55.221	.00	.147	13.00	1.00	9.84	2.00	0 .0
30.40	.00945				.008833	.27	.53	.138	.507	.150			4.00	TRAP

WATER PROFILE FOR PALOMAR AIRPORT ROAD AND I-5
1 YEAR FLOW USING RATIONAL METHOD, PREPARED BY JOE CASTANEDA
FILENAME:1YR6GR

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS) / SF Ave	Vel Head / HF	Energy Grd.El. / SE Dpth	Super Elev / Froude N	Critical Depth / Norm Dp	Flow Top Width / "N"	Height/Dia.-FT / ZR	Base Wt or I.D. / ZL	No Wth Prs/Pip / Type Ch
105.14	54.98	.507	55.485	3.2	.56	.005	55.490	.00	.147	12.88	1.00	9.84	2.00 / 0 / .0
11.84	.00945					.009369	.11	.51	.147	.507	.150		4.00 / TRAP
116.98	55.09	.507	55.597	3.2	.56	.005	55.602	.00	.147	12.88	1.00	9.84	2.00 / 0 / .0
5.61	.00501					.008794	.05	.51	.147	.609	.150		4.00 / TRAP
122.59	55.12	.529	55.647	3.2	.53	.004	55.651	.00	.147	13.01	1.00	9.84	2.00 / 0 / .0
8.50	.00501					.007610	.06	.53	.137	.609	.150		4.00 / TRAP
131.10	55.16	.551	55.712	3.2	.51	.004	55.716	.00	.147	13.15	1.00	9.84	2.00 / 0 / .0
14.56	.00501					.006588	.10	.55	.129	.609	.150		4.00 / TRAP
145.65	55.23	.575	55.808	3.2	.48	.004	55.812	.00	.147	13.29	1.00	9.84	2.00 / 0 / .0
34.23	.00501					.005705	.20	.57	.120	.609	.150		4.00 / TRAP
179.88	55.40	.599	56.004	3.2	.46	.003	56.007	.00	.147	13.43	1.00	9.84	2.00 / 0 / .0
21.02	.00501					.005224	.11	.60	.113	.609	.150		4.00 / TRAP
200.90	55.51	.604	56.114	3.2	.46	.003	56.117	.00	.147	13.46	1.00	9.84	2.00 / 0 / .0
TRANS STR	.00152					.005356	.04	.60	.111		.035		4.00 / TRAP
207.50	55.52	.566	56.086	3.2	2.31	.083	56.169	.00	.375	2.46	1.00	2.46	.00 / 0 / .0
3.09	.00791					.002059	.01	.57	.540	.352	.015		.00 / RECTANG
210.59	55.54	.540	56.084	3.2	2.42	.091	56.175	.00	.375	2.46	1.00	2.46	.00 / 0 / .0
2.89	.00791					.002367	.01	.54	.580	.352	.015		.00 / RECTANG

WATER PROFILE FOR PALOMAR AIRPORT ROAD AND I-5
1 YEAR FLOW USING RATIONAL METHOD, PREPARED BY JOE CASTANEDA
FILENAME:1YR6GR

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/Dia.-FT / "N"	Base Wt or I.D. / ZR	ZL	No Wth Prs/Pip / Type Ch
213.48	55.57	.515	56.082	3.2	2.54	.100	56.182	.00	.375	2.46	1.00	2.46	.00	0 .0
2.69	.00791					.002724	.01	.51	.623	.352	.015		.00	RECTANG
216.17	55.59	.491	56.079	3.2	2.66	.110	56.189	.00	.375	2.46	1.00	2.46	.00	0 .0
2.48	.00791					.003135	.01	.49	.669	.352	.015		.00	RECTANG
218.65	55.61	.468	56.076	3.2	2.79	.121	56.197	.00	.375	2.46	1.00	2.46	.00	0 .0
2.25	.00791					.003611	.01	.47	.719	.352	.015		.00	RECTANG
220.90	55.63	.446	56.072	3.2	2.93	.133	56.205	.00	.375	2.46	1.00	2.46	.00	0 .0
.50	.00791					.003932	.00	.45	.772	.352	.015		.00	RECTANG
221.40	55.63	.441	56.071	3.2	2.96	.136	56.207	.00	.375	2.46	1.00	2.46	.00	0 .0
JUNCT STR	.01000					.003237	.00	.49	.785		.015		.00	RECTANG
222.40	55.64	.493	56.133	3.0	2.46	.094	56.227	.03	.357	2.46	1.00	2.46	.00	0 .0
10.78	.00371					.002627	.03	.52	.617	.430	.015		.00	RECTANG
233.18	55.68	.474	56.154	3.0	2.56	.101	56.255	.05	.357	2.46	1.00	2.46	.00	0 .0
TRANS STR	.00290					.001416	.01	.53	.654		.015		.00	RECTANG
240.07	55.70	.572	56.272	3.0	.45	.003	56.275	.00	.140	13.27	1.00	9.84	2.00	0 .0
43.16	.00556					.005434	.23	.57	.113	.566	.150		4.00	TRAP
283.23	55.94	.567	56.507	3.0	.46	.003	56.510	.01	.140	13.24	1.00	9.84	2.00	0 .0
TRANS STR	.00613					.006615	.04	.58	.114		.035		4.00	TRAP

WATER PROFILE FOR PALOMAR AIRPORT ROAD AND I-5
1 YEAR FLOW USING RATIONAL METHOD, PREPARED BY JOE CASTANEDA
FILENAME:1YR6GR

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/Dia.-FT / "N"	Base Wt or I.D.	ZL / ZR	No Wth Prs/Pip / Type Ch
289.75	55.98	.500	56.480	3.0	2.42	.091	56.571	.00	.357	2.46	1.00	2.46	.00	0 .0
5.67	.00505					.002555	.01	.50	.604	.388	.015		.00	RECTANG
295.42	56.01	.477	56.485	3.0	2.54	.100	56.586	.00	.357	2.46	1.00	2.46	.00	0 .0
5.76	.00505					.002942	.02	.48	.649	.388	.015		.00	RECTANG
301.18	56.04	.455	56.492	3.0	2.67	.110	56.603	.00	.357	2.46	1.00	2.46	.00	0 .0
6.09	.00505					.003390	.02	.45	.697	.388	.015		.00	RECTANG
307.28	56.07	.433	56.502	3.0	2.80	.121	56.623	.00	.357	2.46	1.00	2.46	.00	0 .0
7.03	.00505					.003908	.03	.43	.748	.388	.015		.00	RECTANG
314.31	56.10	.413	56.517	3.0	2.93	.133	56.651	.00	.357	2.46	1.00	2.46	.00	0 .0
10.84	.00505					.004508	.05	.41	.804	.388	.015		.00	RECTANG
325.16	56.16	.394	56.553	3.0	3.07	.147	56.700	.00	.357	2.46	1.00	2.46	.00	0 .0
.23	.00505					.004830	.00	.39	.863	.388	.015		.00	RECTANG
325.39	56.16	.394	56.554	3.0	3.07	.147	56.701	.00	.357	2.46	1.00	2.46	.00	0 .0
JUNCT STR	.01000					.003697	.00	.39	.863		.015		.00	RECTANG
326.39	56.17	.461	56.631	2.8	2.42	.091	56.723	.00	.339	2.46	1.00	2.46	.00	0 .0
5.39	.00506					.002759	.01	.46	.628	.368	.015		.00	RECTANG
331.78	56.20	.440	56.637	2.8	2.54	.100	56.737	.00	.339	2.46	1.00	2.46	.00	0 .0
5.58	.00506					.003180	.02	.44	.675	.368	.015		.00	RECTANG

WATER SURFACE PROFILE LISTING Date: 2- 1-2000 Time: 2:59:16

WATER PROFILE FOR PALOMAR AIRPORT ROAD AND I-5
1 YEAR FLOW USING RATIONAL METHOD, PREPARED BY JOE CASTANEDA
FILENAME:1YR6GR

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS) / SF Ave	Vel Head / HF	Energy Grd.El. / SE Dpth	Super Elev / Froude N	Critical Depth / Norm Dp	Flow Top Width / "N"	Height/ Dia.-FT / ZR	Base Wt or I.D.	ZL	No Wth Prs/Pip / Type Ch
337.35	56.23	.420	56.645	2.8	2.66	.110	56.755	.00	.339	2.46	1.00	2.46	.00	0 .0
6.13	.00506					.003668	.02	.42	.725	.368	.015		.00	RECTANG
343.48	56.26	.400	56.656	2.8	2.79	.121	56.778	.00	.339	2.46	1.00	2.46	.00	0 .0
7.90	.00506					.004233	.03	.40	.779	.368	.015		.00	RECTANG
351.38	56.30	.381	56.678	2.8	2.93	.133	56.811	.00	.339	2.46	1.00	2.46	.00	0 .0
8.64	.00506					.004730	.04	.38	.836	.368	.015		.00	RECTANG
360.02	56.34	.371	56.711	2.8	3.01	.141	56.852	.18	.339	2.46	1.00	2.46	.00	0 .0
TRANS STR	.00333					.002493	.01	.55	.871		.015		.00	RECTANG
363.02	56.35	.520	56.870	2.8	.46	.003	56.873	.00	.133	12.96	1.00	9.84	2.00	0 .0
31.39	.00522					.005915	.19	.52	.121	.550	.150		4.00	TRAP
394.41	56.51	.542	57.056	2.8	.44	.003	57.059	.00	.133	13.09	1.00	9.84	2.00	0 .0
12.70	.00522					.005434	.07	.54	.113	.550	.150		4.00	TRAP
407.11	56.58	.545	57.125	2.8	.44	.003	57.128	.01	.133	13.11	1.00	9.84	2.00	0 .0
TRANS STR	.00609					.006244	.04	.56	.112		.035		4.00	TRAP
413.68	56.62	.483	57.103	2.8	2.31	.083	57.186	.00	.339	2.46	1.00	2.46	.00	0 .0
5.50	.00499					.002410	.01	.49	.587	.370	.015		.00	RECTANG
419.18	56.65	.461	57.108	2.8	2.43	.091	57.199	.00	.339	2.46	1.00	2.46	.00	0 .0
5.56	.00499					.002776	.02	.46	.630	.370	.015		.00	RECTANG

WATER PROFILE FOR PALOMAR AIRPORT ROAD AND I-5
1 YEAR FLOW USING RATIONAL METHOD, PREPARED BY JOE CASTANEDA
FILENAME:1YR6GR

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS) / SF Ave	Vel Head / HF	Energy Grd.El. / SE Dpth	Super Elev / Froude N	Critical Depth / Norm Dp	Flow Top Width / "N"	Height/Dia.-FT / ZR	Base Wt or I.D. / ZL	No Wth Prs/Pip / Type Ch
424.74	56.68	.439	57.114	2.8	2.55	.101	57.215	.00	.339	2.46	1.00	2.46	.00	0 .0
5.81	.00499					.003201	.02	.44	.677	.370	.015		.00	RECTANG
430.55	56.70	.419	57.123	2.8	2.67	.111	57.233	.00	.339	2.46	1.00	2.46	.00	0 .0
6.50	.00499					.003692	.02	.42	.727	.370	.015		.00	RECTANG
437.05	56.74	.399	57.136	2.8	2.80	.122	57.257	.00	.339	2.46	1.00	2.46	.00	0 .0
8.83	.00499					.004260	.04	.40	.781	.370	.015		.00	RECTANG
445.88	56.78	.381	57.161	2.8	2.94	.134	57.295	.00	.339	2.46	1.00	2.46	.00	0 .0
11.88	.00499					.004748	.06	.38	.839	.370	.015		.00	RECTANG
457.77	56.84	.370	57.210	2.8	3.02	.142	57.352	.00	.339	2.46	1.00	2.46	.00	0 .0
18.10	.00499					.004931	.09	.37	.875	.370	.015		.00	RECTANG
475.87	56.93	.370	57.300	2.8	3.02	.142	57.442	.04	.339	2.46	1.00	2.46	.00	0 .0
TRANS STR	.00613					.002573	.02	.41	.875		.015		.00	RECTANG
482.40	56.97	.494	57.464	2.8	.74	.008	57.472	.00	.173	8.54	1.00	6.56	2.00	0 .0
1.83	.00498					.016168	.03	.49	.197	.708	.150		2.00	TRAP
484.23	56.98	.515	57.494	2.8	.70	.008	57.502	.00	.173	8.62	1.00	6.56	2.00	0 .0
2.37	.00498					.013995	.03	.52	.184	.708	.150		2.00	TRAP
486.59	56.99	.537	57.528	2.8	.67	.007	57.535	.00	.173	8.71	1.00	6.56	2.00	0 .0
3.11	.00498					.012119	.04	.54	.172	.708	.150		2.00	TRAP

WATER PROFILE FOR PALOMAR AIRPORT ROAD AND I-5
1 YEAR FLOW USING RATIONAL METHOD, PREPARED BY JOE CASTANEDA
FILENAME:1YR6GR

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS) / SF Ave	Vel Head / HF	Energy Grd.El. / SE Dpth	Super Elev / Froude N	Critical Depth / Norm Dp	Flow Top Width / "N"	Height/ Dia.-FT / ZR	Base Wt or I.D.	ZL	No Wth Prs/Pip / Type Ch
489.71	57.01	.560	57.566	2.8	.64 / .006	.010498	57.573 / .04	.00 / .56	.173 / .161	8.80 / .708	1.00 / .150	6.56	2.00	0 / TRAP
4.19	.00498													.0
493.90	57.03	.584	57.611	2.8	.61 / .006	.009098	57.617 / .05	.00 / .58	.173 / .151	8.90 / .708	1.00 / .150	6.56	2.00	0 / TRAP
5.85	.00498													.0
499.75	57.06	.608	57.665	2.8	.58 / .005	.007888	57.670 / .07	.00 / .61	.173 / .141	8.99 / .708	1.00 / .150	6.56	2.00	0 / TRAP
8.61	.00498													.0
508.37	57.10	.634	57.733	2.8	.55 / .005	.006841	57.738 / .10	.00 / .63	.173 / .132	9.10 / .708	1.00 / .150	6.56	2.00	0 / TRAP
13.99	.00498													.0
522.35	57.17	.660	57.829	2.8	.53 / .004	.006071	57.834 / .10	.00 / .66	.173 / .124	9.20 / .708	1.00 / .150	6.56	2.00	0 / TRAP
16.29	.00498													.0
538.64	57.25	.679	57.929	2.8	.51 / .004	.004531	57.933 / .03	.00 / .68	.173 / .119	9.27 / .035	1.00 /	6.56	2.00	0 / TRAP
TRANS STR	.00153													.0
545.16	57.26	.646	57.906	2.8	1.73 / .046	.000957	57.952 / .00	.00 / .65	.339 / .379	2.46 / .000	1.00 / .015	2.46	.00	0 / RECTANG
.91	.00000												.00	.0
546.07	57.26	.647	57.907	2.8	1.73 / .046	.000851	57.953 / .00	.00 / .65	.339 / .379	2.46 / .015	1.00 /	2.46	.00	0 / RECTANG
JUNCT STR	.00000												.00	.0
547.07	57.26	.663	57.923	2.5	1.54 / .037	.000762	57.960 / .00	.00 / .66	.319 / .334	2.46 / .349	1.00 / .015	2.46	.00	0 / RECTANG
2.00	.00500												.00	.0

WATER PROFILE FOR PALOMAR AIRPORT ROAD AND I-5
1 YEAR FLOW USING RATIONAL METHOD, PREPARED BY JOE CASTANEDA
FILENAME:1YR6GR

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"		ZR	Type Ch
549.07	57.27	.654	57.924	2.5	1.57	.038	57.962	.00	.319	2.46	1.00	2.46	.00	0 .0
TRANS STR	.00000							.65	.341		.015		.00	RECTANG
554.98	57.27	.582	57.852	2.5	4.33	.291	58.143	.00	.582	1.00	1.00	1.00	.00	0 .0
TRANS STR	.00000					.005796	.01	.58	1.000		.015		.00	RECTANG
555.98	57.27	.873	58.143	2.5	1.44	.032	58.175	.02	.367	2.00	1.00	2.00	.00	0 .0
6.56	.00000					.000584	.00	.89	.272	.000	.015		.00	RECTANG
562.54	57.27	.877	58.147	2.5	1.44	.032	58.179	.00	.367	2.00	1.00	2.00	.00	0 .0
6.56	.00152					.000586	.00	.88	.270	.619	.015		.00	RECTANG
569.10	57.28	.871	58.151	2.5	1.45	.033	58.183	.00	.367	2.00	1.00	2.00	.00	0 .0

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T1 WATER PROFILE FOR PALOMAR AIRPORT ROAD AND I-5                                0
T2 1 YEAR FLOW USING RATIONAL METHOD, PREPARED BY JOE CASTANEDA
T3 FILENAME:25Y6G
SO       .00  53.84  1                              53.84
R       6.71  53.85  1      .015                                .000
TS      8.71  53.86  2      .015                                .000
TS      9.71  53.86  1      .015                                .000
R      16.27  53.87  1      .015                                .000
TS     22.80  54.20  3      .015                                .000
R     116.98  55.09  3      .150                              -1.442
R     200.90  55.51  3      .150                                .000
TS    207.50  55.52  7      .035                                .000
R     221.40  55.63  7      .015                               .000
JX    222.40  55.64  7 2    .015     .56          56.65        45.0          .000
R     233.18  55.68  7      .015                              -42.714
TS    240.07  55.70  3      .015                               42.714
R     283.23  55.94  3      .150                               44.562
TS    289.75  55.98  7      .035                              -44.562
R     325.39  56.16  7      .015                                .000
JX    326.39  56.17  7 2    .015     .56          56.65         .00          .000
R     360.02  56.34  7      .015                                .000
TS    363.02  56.35  3      .015                               44.272
R     407.11  56.58  3      .150                               44.329
TS    413.68  56.62  7      .035                              -44.329
R     475.87  56.93  7      .015                              -21.695
TS    482.40  56.97  4      .015                               21.695
R     538.64  57.25  4      .150                                .000
TS    545.16  57.26  1      .035                                .000
R     546.07  57.26  7      .015                                .000
JX    547.07  57.26  7 2    .015     .56          56.65         .00          .000
R     549.07  57.27  7      .015                                .000
TS    554.98  57.27  2      .015                                .000
TS    555.98  57.27  1      .015                                .000
R     562.54  57.27  1      .015                               46.272
R     569.10  57.28  1      .015                                .000
SH    569.10  57.28  1                              57.28
CD   1  2   0     .00   1.00    2.00  .00  .00   .0
CD   2  2   0     .00   1.00    1.00  .00  .00   .0
CD   3  1   0     .00   1.00    9.84 2.00 4.00   .0
CD   4  1   0     .00   1.00    6.56 2.00 2.00   .0
CD   5  1   0     .00   1.00    1.64 3.33 0.20   .0
CD   6  1   0     .00   1.00    9.84 2.00 4.00   .0
CD   7  2   0     .00   1.00    2.46  .00  .00   .0
Q              5.75   .0
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** WARNING NO. 2 ** - WATER SURFACE ELEVATION GIVEN IS LESS THAN OR EQUALS INVERT ELEVATION IN HDWKDS, W.S.ELEV = INV + DC
ERROR MESSAGE NO. 2 - WATER SURFACE ELEVATION GIVEN IS LESS THAN OR EQUALS INVERT ELEVATION IN OTLTUS, W.S.ELEV = INV + DC

W S P G N - CIVILDESIGN Vers 6.0

For: CASC Engineering Group, Riverside, California - S/N 615

WATER SURFACE PROFILE LISTING

Date: 2- 1-2000 Time: 2:59:36

WATER PROFILE FOR PALOMAR AIRPORT ROAD AND I-5

1 YEAR FLOW USING RATIONAL METHOD, PREPARED BY JOE CASTANEDA

FILENAME:25Y6G

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/Dia.-FT / "N"	Base Wt or I.D.	ZL / ZR	No Wth Prs/Pip / Type Ch
.00	53.84	.468	54.308	7.4	7.94	.978	55.286	.00	.754	2.00	1.00	2.00	.00	0 .0
1.75	.00149					.030968	.05	.47	2.044	1.393	.015		.00	RECTANG
1.75	53.84	.453	54.295	7.4	8.21	1.046	55.341	.00	.754	2.00	1.00	2.00	.00	0 .0
2.50	.00149					.034900	.09	.45	2.149	1.393	.015		.00	RECTANG
4.25	53.85	.432	54.278	7.4	8.61	1.150	55.428	.00	.754	2.00	1.00	2.00	.00	0 .0
2.46	.00149					.040133	.10	.43	2.308	1.393	.015		.00	RECTANG
6.71	53.85	.412	54.262	7.4	9.03	1.265	55.527	.00	.754	2.00	1.00	2.00	.00	0 .0
TRANS STR	.00500					.029362	.06	.41	2.479		.015		.00	RECTANG
8.71	53.86	1.197	55.057	7.4	6.21	.598	55.655	.00	1.197	1.00	1.00	1.00	.00	0 .0
TRANS STR	.00000					.008274	.01	1.20	1.000		.015		.00	RECTANG
9.71	53.86	1.790	55.650	7.4	2.08	.067	55.717	.00	.754	2.00	1.00	2.00	.00	0 .0
6.56	.00152					.000796	.01	1.79	.273	1.381	.015		.00	RECTANG
16.27	53.87	1.785	55.655	7.4	2.08	.067	55.722	.00	.754	2.00	1.00	2.00	.00	0 .0
TRANS STR	.05054					.000404	.00	1.79	.274		.015		.00	RECTANG
22.80	54.20	1.530	55.730	7.4	.34	.002	55.732	.00	.254	19.02	1.00	9.84	2.00	0 .0
6.47	.00945					.001054	.01	1.53	.055	.820	.150		4.00	TRAP
29.27	54.26	1.476	55.737	7.4	.35	.002	55.739	.00	.254	18.69	1.00	9.84	2.00	0 .0
6.39	.00945					.001206	.01	1.48	.059	.820	.150		4.00	TRAP

WATER PROFILE FOR PALOMAR AIRPORT ROAD AND I-5
1 YEAR FLOW USING RATIONAL METHOD, PREPARED BY JOE CASTANEDA
FILENAME:25Y6G

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"		ZR	Type Ch
35.66	54.32	1.423	55.744	7.4	.37	.002	55.746	.00	.254	18.38	1.00	9.84	2.00	0 .0
6.33	.00945					.001381	.01	1.42	.062	.820	.150		4.00	TRAP
41.98	54.38	1.371	55.753	7.4	.39	.002	55.755	.00	.254	18.07	1.00	9.84	2.00	0 .0
6.29	.00945					.001582	.01	1.37	.066	.820	.150		4.00	TRAP
48.27	54.44	1.322	55.762	7.4	.41	.003	55.765	.00	.254	17.77	1.00	9.84	2.00	0 .0
6.27	.00945					.001813	.01	1.32	.071	.820	.150		4.00	TRAP
54.54	54.50	1.274	55.774	7.4	.43	.003	55.776	.00	.254	17.48	1.00	9.84	2.00	0 .0
6.29	.00945					.002078	.01	1.27	.075	.820	.150		4.00	TRAP
60.84	54.56	1.227	55.786	7.4	.45	.003	55.789	.00	.254	17.20	1.00	9.84	2.00	0 .0
6.36	.00945					.002382	.02	1.23	.080	.820	.150		4.00	TRAP
67.19	54.62	1.182	55.801	7.4	.47	.003	55.805	.00	.254	16.93	1.00	9.84	2.00	0 .0
6.47	.00945					.002732	.02	1.18	.086	.820	.150		4.00	TRAP
73.67	54.68	1.138	55.818	7.4	.49	.004	55.822	.00	.254	16.67	1.00	9.84	2.00	0 .0
6.66	.00945					.003135	.02	1.14	.091	.820	.150		4.00	TRAP
80.32	54.74	1.095	55.839	7.4	.52	.004	55.843	.00	.254	16.41	1.00	9.84	2.00	0 .0
6.95	.00945					.003598	.03	1.10	.097	.820	.150		4.00	TRAP
87.27	54.81	1.054	55.864	7.4	.54	.005	55.868	.00	.254	16.17	1.00	9.84	2.00	0 .0
7.39	.00945					.004131	.03	1.05	.104	.820	.150		4.00	TRAP

WATER PROFILE FOR PALOMAR AIRPORT ROAD AND I-5
1 YEAR FLOW USING RATIONAL METHOD, PREPARED BY JOE CASTANEDA
FILENAME:25Y6G

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/Dia.-FT / "N"	Base Wt or I.D.	ZL / ZR	No Wth Prs/Pip / Type Ch
94.66	54.88	1.015	55.894	7.4	.57	.005	55.899	.00	.254	15.93	1.00	9.84	2.00	0 .0
8.07	.00945					.004745	.04	1.01	.111	.820	.150		4.00	TRAP
102.73	54.96	.976	55.931	7.4	.60	.006	55.937	.00	.254	15.70	1.00	9.84	2.00	0 .0
9.17	.00945					.005452	.05	.98	.118	.820	.150		4.00	TRAP
111.90	55.04	.939	55.981	7.4	.63	.006	55.987	.00	.254	15.47	1.00	9.84	2.00	0 .0
5.08	.00945					.006034	.03	.94	.126	.820	.150		4.00	TRAP
116.98	55.09	.921	56.011	7.4	.64	.006	56.018	.00	.254	15.37	1.00	9.84	2.00	0 .0
43.57	.00501					.005832	.25	.92	.130	.980	.150		4.00	TRAP
160.55	55.31	.958	56.266	7.4	.61	.006	56.272	.00	.254	15.59	1.00	9.84	2.00	0 .0
40.35	.00501					.005305	.21	.96	.122	.980	.150		4.00	TRAP
200.90	55.51	.970	56.480	7.4	.60	.006	56.486	.00	.254	15.66	1.00	9.84	2.00	0 .0
TRANS STR	.00152					.008328	.05	.97	.119		.035		4.00	TRAP
207.50	55.52	.871	56.391	7.4	3.47	.187	56.578	.00	.657	2.46	1.00	2.46	.00	0 .0
4.66	.00791					.003221	.02	.87	.655	.619	.015		.00	RECTANG
212.16	55.56	.830	56.387	7.4	3.64	.205	56.593	.00	.657	2.46	1.00	2.46	.00	0 .0
4.28	.00791					.003681	.02	.83	.703	.619	.015		.00	RECTANG
216.44	55.59	.792	56.383	7.4	3.81	.226	56.608	.00	.657	2.46	1.00	2.46	.00	0 .0
3.85	.00791					.004208	.02	.79	.755	.619	.015		.00	RECTANG

WATER PROFILE FOR PALOMAR AIRPORT ROAD AND I-5
1 YEAR FLOW USING RATIONAL METHOD, PREPARED BY JOE CASTANEDA
FILENAME:25Y6G

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/Dia.-FT / "N"	Base Wt or I.D.	ZL / ZR	No Wth Prs/Pip / Type Ch
220.28	55.62	.755	56.376	7.4	4.00	.249	56.625	.00	.657	2.46	1.00	2.46	.00	0 .0
1.12	.00791					.004584	.01	.75	.811	.619	.015		.00	RECTANG
221.40	55.63	.744	56.374	7.4	4.06	.256	56.630	.00	.657	2.46	1.00	2.46	.00	0 .0
JUNCT STR	.01000					.003662	.00	.83	.829		.015		.00	RECTANG
222.40	55.64	.862	56.502	6.9	3.24	.163	56.665	.06	.623	2.46	1.00	2.46	.00	0 .0
10.78	.00371					.002721	.03	.92	.615	.764	.015		.00	RECTANG
233.18	55.68	.845	56.525	6.9	3.30	.169	56.695	.09	.623	2.46	1.00	2.46	.00	0 .0
TRANS STR	.00290					.001416	.01	.94	.633		.015		.00	RECTANG
240.07	55.70	1.017	56.717	6.9	.52	.004	56.721	.00	.241	15.94	1.00	9.84	2.00	0 .0
24.76	.00556					.004021	.10	1.02	.102	.910	.150		4.00	TRAP
264.83	55.84	.978	56.816	6.9	.55	.005	56.821	.00	.241	15.71	1.00	9.84	2.00	0 .0
18.40	.00556					.004463	.08	.98	.109	.910	.150		4.00	TRAP
283.23	55.94	.959	56.899	6.9	.56	.005	56.904	.02	.241	15.59	1.00	9.84	2.00	0 .0
TRANS STR	.00613					.007973	.05	.98	.112		.035		4.00	TRAP
289.75	55.98	.836	56.816	6.9	3.34	.173	56.989	.00	.623	2.46	1.00	2.46	.00	0 .0
11.00	.00505					.003089	.03	.84	.644	.685	.015		.00	RECTANG
300.75	56.04	.797	56.833	6.9	3.50	.191	57.023	.00	.623	2.46	1.00	2.46	.00	0 .0
11.86	.00505					.003531	.04	.80	.692	.685	.015		.00	RECTANG

WATER SURFACE PROFILE LISTING Date: 2- 1-2000 Time: 2:59:36

WATER PROFILE FOR PALOMAR AIRPORT ROAD AND I-5
1 YEAR FLOW USING RATIONAL METHOD, PREPARED BY JOE CASTANEDA
FILENAME:25Y6G

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS) / SF Ave	Vel Head / HF	Energy Grd.El. / SE Dpth	Super Elev / Froude N	Critical Depth / Norm Dp	Flow Top Width / "N"	Height/ Dia.-FT / ZR	Base Wt or I.D.	ZL	No Wth Prs/Pip / Type Ch
312.61	56.10	.760	56.855	6.9	3.67	.210	57.065	.00	.623	2.46	1.00	2.46	.00	0 .0
12.78	.00505					.004014	.05	.76	.743	.685	.015		.00	RECTANG
325.39	56.16	.728	56.888	6.9	3.84	.229	57.116	.00	.623	2.46	1.00	2.46	.00	0 .0
JUNCT STR	.01000					.003475	.00	.73	.793		.015		.00	RECTANG
326.39	56.17	.806	56.976	6.3	3.18	.157	57.134	.00	.589	2.46	1.00	2.46	.00	0 .0
10.04	.00506					.002882	.03	.81	.624	.646	.015		.00	RECTANG
336.43	56.22	.769	56.990	6.3	3.34	.173	57.163	.00	.589	2.46	1.00	2.46	.00	0 .0
10.53	.00506					.003297	.03	.77	.670	.646	.015		.00	RECTANG
346.96	56.27	.733	57.007	6.3	3.50	.190	57.197	.00	.589	2.46	1.00	2.46	.00	0 .0
11.80	.00506					.003774	.04	.73	.720	.646	.015		.00	RECTANG
358.76	56.33	.699	57.033	6.3	3.67	.209	57.242	.00	.589	2.46	1.00	2.46	.00	0 .0
1.26	.00506					.004051	.01	.70	.773	.646	.015		.00	RECTANG
360.02	56.34	.696	57.036	6.3	3.68	.211	57.247	.27	.589	2.46	1.00	2.46	.00	0 .0
TRANS STR	.00333					.002059	.01	.96	.778		.015		.00	RECTANG
363.02	56.35	.920	57.270	6.3	.54	.005	57.275	.00	.228	15.36	1.00	9.84	2.00	0 .0
44.09	.00522					.004724	.21	.92	.110	.884	.150		4.00	TRAP
407.11	56.58	.898	57.478	6.3	.56	.005	57.483	.02	.228	15.23	1.00	9.84	2.00	0 .0
TRANS STR	.00609					.008118	.05	.92	.115		.035		4.00	TRAP

WATER PROFILE FOR PALOMAR AIRPORT ROAD AND I-5
1 YEAR FLOW USING RATIONAL METHOD, PREPARED BY JOE CASTANEDA
FILENAME:25Y6G

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/Dia.-FT / "N"	Base Wt or I.D.	ZL / ZR	No Wth Prs/Pip / Type Ch
413.68	56.62	.782	57.402	6.3	3.28	.167	57.569	.01	.589	2.46	1.00	2.46	.00	0 .0
10.69	.00499					.003144	.03	.79	.654	.649	.015		.00	RECTANG
424.37	56.67	.746	57.419	6.3	3.44	.184	57.603	.01	.589	2.46	1.00	2.46	.00	0 .0
11.77	.00499					.003598	.04	.75	.702	.649	.015		.00	RECTANG
436.14	56.73	.711	57.443	6.3	3.61	.202	57.645	.01	.589	2.46	1.00	2.46	.00	0 .0
14.88	.00499					.004120	.06	.72	.754	.649	.015		.00	RECTANG
451.02	56.81	.678	57.484	6.3	3.78	.222	57.706	.01	.589	2.46	1.00	2.46	.00	0 .0
24.85	.00499					.004663	.12	.68	.810	.649	.015		.00	RECTANG
475.87	56.93	.652	57.582	6.3	3.94	.241	57.822	.07	.589	2.46	1.00	2.46	.00	0 .0
TRANS STR	.00613					.002524	.02	.72	.859		.015		.00	RECTANG
482.40	56.97	.881	57.851	6.3	.86	.012	57.863	.00	.297	10.08	1.00	6.56	2.00	0 .0
5.33	.00498					.011393	.06	.88	.178	1.132	.150		2.00	TRAP
487.73	57.00	.916	57.913	6.3	.82	.010	57.923	.00	.297	10.22	1.00	6.56	2.00	0 .0
7.19	.00498					.009916	.07	.92	.167	1.132	.150		2.00	TRAP
494.92	57.03	.953	57.985	6.3	.78	.010	57.995	.00	.297	10.37	1.00	6.56	2.00	0 .0
10.07	.00498					.008634	.09	.95	.156	1.132	.150		2.00	TRAP
504.99	57.08	.990	58.073	6.3	.75	.009	58.082	.00	.297	10.52	1.00	6.56	2.00	0 .0
15.01	.00498					.007521	.11	.99	.147	1.132	.150		2.00	TRAP

WATER PROFILE FOR PALOMAR AIRPORT ROAD AND I-5
1 YEAR FLOW USING RATIONAL METHOD, PREPARED BY JOE CASTANEDA
FILENAME:25Y6G

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/Dia.-FT / "N"	Base Wt or I.D.	ZL / ZR	No Wth Prs/Pip / Type Ch
520.01	57.16	1.029	58.187	6.3	.71	.008	58.194	.00	.297	10.68	1.00	6.56	2.00	0 .0
18.63	.00498					.006643	.12	1.03	.138	1.132	.150		2.00	TRAP
538.64	57.25	1.061	58.311	6.3	.69	.007	58.318	.00	.297	10.80	1.00	6.56	2.00	0 .0
TRANS STR	.00153							1.06	.131		.035		2.00	TRAP
545.16	57.26	.403	57.663	6.3	7.82	.949	58.613	.00	.676	2.00	1.00	2.00	.00	0 .0
TRANS STR	.00153							.40	2.169		.035		.00	RECTANG
546.07	57.26	.979	58.239	6.3	2.62	.107	58.346	.00	.589	2.46	1.00	2.46	.00	0 .0
JUNCT STR	.00000					.001371	.00	.98	.467		.015		.00	RECTANG
547.07	57.26	1.018	58.278	5.8	2.30	.082	58.360	.00	.554	2.46	1.00	2.46	.00	0 .0
2.00	.00500					.001185	.00	1.02	.401	.608	.015		.00	RECTANG
549.07	57.27	1.009	58.279	5.8	2.32	.083	58.363	.00	.554	2.46	1.00	2.46	.00	0 .0
TRANS STR	.00000							1.01	.406		.015		.00	RECTANG
554.98	57.27	1.009	58.279	5.8	5.70	.504	58.783	.00	1.009	1.00	1.00	1.00	.00	0 .0
TRANS STR	.00000					.007494	.01	1.01	1.000		.015		.00	RECTANG
555.98	57.27	1.510	58.780	5.8	1.90	.056	58.836	.03	.635	2.00	1.00	2.00	.00	0 .0
6.56	.00000					.000724	.00	1.54	.273	.000	.015		.00	RECTANG
562.54	57.27	1.516	58.786	5.8	1.90	.056	58.842	.00	.635	2.00	1.00	2.00	.00	0 .0
6.56	.00152					.000724	.00	1.52	.272	1.133	.015		.00	RECTANG

For: CASC Engineering Group, Riverside, California - S/N 615
WATER SURFACE PROFILE LISTING Date: 2- 1-2000 Time: 2:59:36

WATER PROFILE FOR PALOMAR AIRPORT ROAD AND I-5
1 YEAR FLOW USING RATIONAL METHOD, PREPARED BY JOE CASTANEDA
FILENAME:25Y6G

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"		ZR	Type Ch
569.10	57.28	1.510	58.790	5.8	1.90	.056	58.847	.00	.635	2.00	1.00	2.00	.00	0 .0

Type A Concrete Channel
Worksheet for Rectangular Channel

Project Description	
Project File	c:\fmw\fmw\palomar.fm2
Worksheet	Intermediate Concrete Channel
Flow Element	Rectangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Channel Slope	0.001000	ft/ft
Bottom Width	2.50	ft
Discharge	3.200	cfs

Results		
Depth	0.632	ft
Flow Area	0.15	m^2
Wetted Perimeter	1.15	m
Top Width	0.76	m
Critical Depth	0.11	m
Critical Slope	0.004847	m/m
Velocity	0.62	m/s
Velocity Head	0.02	m
Specific Energy	0.21	m
Froude Number	0.45	
Flow is subcritical.		

Type B Concrete Swale
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\fmw\fmw\palomar.fm2
Worksheet	CONCRETE INTERCEPTION SWALE
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Channel Slope	0.002000	ft/ft
Left Side Slope	8.000000	H : V
Right Side Slope	6.000000	H : V
Bottom Width	1.310	ft
Discharge	3.200	cfs

Results		
Depth	0.400	ft
Flow Area	0.15	m^2
Wetted Perimeter	2.12	m
Top Width	2.10	m
Critical Depth	0.10	m
Critical Slope	0.004216	m/m
Velocity	0.59	m/s
Velocity Head	0.02	m
Specific Energy	0.14	m
Froude Number	0.71	
Flow is subcritical.		

Type C Concrete Channel
Worksheet for Rectangular Channel

Project Description	
Project File	c:\fmw\fmw\palomar.fm2
Worksheet	Inlet and Outlet Concrete Channel
Flow Element	Rectangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Channel Slope	0.001000	ft/ft
Bottom Width	2.00	ft
Discharge	3.200	cfs

Results		
Depth	0.771	ft
Flow Area	0.14	m^2
Wetted Perimeter	1.08	m
Top Width	0.61	m
Critical Depth	0.13	m
Critical Slope	0.005257	m/m
Velocity	0.63	m/s
Velocity Head	0.02	m
Specific Energy	0.26	m
Froude Number	0.42	
Flow is subcritical.		

PROJECT 2, SITE 1 AND 2
HYDRAULIC CALCULATIONS
CARLSBAD MAINTENANCE STATION

AEI·CASC ENGINEERING

DATE: 3/6/98 JOB NO.: 77401 CLIENT: RBF / CALTRANS PROJECT: PILOT STUDIES (NPDES PROGRAM)/D.S.#7	SHEET 1 OF 2 DESIGNER CWA QA/QC

DRAINAGE SYSTEM NO. 7

< CARLSBAD M.S. >

* D.A. = A1+A2 (SEE HYDROLOGY CALCS & MAP)

INFILTRATION TRENCH DESIGN CALCULATIONS

TOTAL TRIBUTARY D.A. = 1.72* AC = 0.70 ha

PER CALTRANS' STORM WATER QUALITY HANDBOOK, PDIIB(1), STORM VOLUME CHART, AND BASED ON ZONE ① "RIVERSIDE" AND 100 % IMPERVIOUS AREA (CONSERVATIVE ASSUMPTION), THE UNIT BASIN STORAGE VOLUME IS 119.2 m^3/ha. THE TOTAL BASIN STORAGE VOLUME IS:

$V = 119.2\ m^3/ha \times 0.7\ ha = 83.44\ m^3$ USE $\underline{\underline{83\ m^3}}$

DESIGN CONSTRAINTS FOR PROPOSED TRENCH:

$W = 2\ m$, $L = \pm 45\ m$, FIND DEPTH.

ASSUME AGGREGATE HAS 30 % VOID SPACE

$\therefore V = W \times L \times H \times 0.3 = 2 \times 45 \times H \times 0.3 = 83; H = 3.07$

USE $H = 3m$ AND ADJUST LENGTH.

$L = 83 \div (2 \times 3 \times 0.3) = 46.11\ m$ USE $\underline{L = 47\ m}$

DETERMINE TOTAL TIME TO EXFILTRATE TOTAL VOLUME OF 83 m^3:

$I_1 = 2.8 \times 10^{-5}$ FPS (AVG. PERMEABILITY RATE FOR IN-DRILL HOLE

$I_2 = 2.3 \times 10^{-6}$ FPS (AVG. PERMEABILITY RATE FOR LABORATORY SAMPLE)

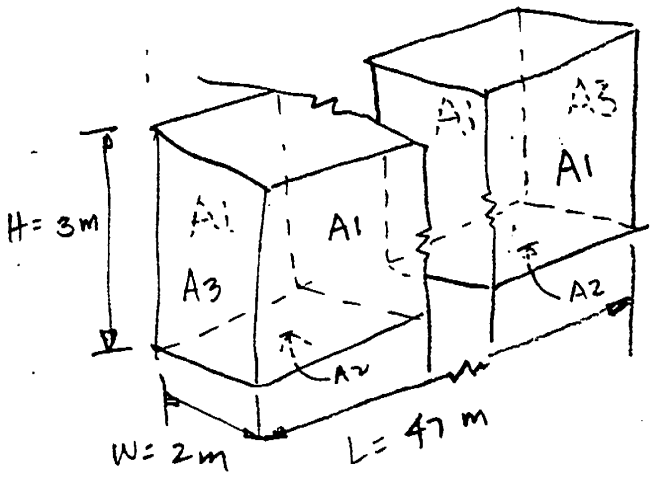
OR $I_1 = 8.7 \times 10^{-6}$ MPS

$I_2 = 7.1 \times 10^{-7}$ MPS

AEI·CASC ENGINEERING

DATE: 3/6/98 JOB NO.: 77401 CLIENT: RBF / CALTRANS PROJECT: PILOT STUDIES (NPDES PROGRAM) TO: #7	SHEET 2 OF 2 DESIGNER CWA QA/QC

COMPUTE EFFECTIVE AREA (A):



A_1 = SIDE (LONGITUDINAL)
A_2 = BOTTOM
A_3 = SIDE (TRANSVERSE)

ADJUST A1 & A3 BY DIVIDING H BY 2:

EFFECTIVE AREA (A) = $A_1 + A_2 + A_3$

$A_1 = 47\,m \times \frac{3\,m}{2} \times 2\ \text{SIDES} = 141\,m^2$

$A_2 = 2\,m \times 47\,m = 94\,m^2$

$A_3 = 2\,m \times \frac{3\,m}{2} \times 2\ \text{SIDES} = 6\,m^2$

(NOTE: A3 CAN BE IGNORED)

$A = 141\,m^2 + 94\,m^2 + 6\,m^2 = 241\,m^2$

USING I_1:

$$t_1 = \frac{83\,m^3}{8.7 \times 10^{-6}\,mps\,(241\,m^2)} \times \frac{HR}{3600\,SEC} \quad 11\ hrs.$$

OR t_2 =

$$\frac{83\,m^3}{7.1 \times 10^{-7}\,mps\,(241\,m^2)} \times \frac{HR}{3600\,SEC} \times \frac{day}{24\,hr} = 5.61\ days$$

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DATE: _____ JOB NO: _____ SHEET ___ OF ___
CLIENT: _____ DESIGNER _____
PROJECT: _____ QA/QC _____

LOCATION #7

HEAD CREATED BY PARSHALL FLUME UTILIZED FOR INFILTRATION TRENCH FLOW MONITORING:

FOR 1 YEAR STORM EVENT

$Q = 1.40$ cfs

FIND $H = 0.783'$

$Q = 1.391$ cfs

$H = 0.78$ ft

$Q = 1.419$

$H = 0.79$ ft

INTERPOLATE TO FIND H

$\frac{\Delta H}{0.009} = \frac{0.01'}{0.028}$ $\Delta H = 0.0032$ ft

$H = 0.78 + 0.0032 = 0.783'$

FOR 25 YEAR STORM EVENT

$Q = 2.90$

FIND $H = 1.241'$

$Q = 2.894$

$H = 1.24$

$Q = 2.931$

$H = 1.25$

$\frac{\Delta H}{0.006} = \frac{0.01}{0.037}$

$\Delta H = 0.0016$ $H = 0.0016 + 1.24$

$H = 1.241'$

AEI·CASC ENGINEERING

DATE: _____ JOB NO.: _____
CLIENT: _____
PROJECT: _____

SHEET ___ OF ___
DESIGNER _____
QA/QC _____

ELEVATION DIFFERENCE BETWEEN PARSHALL FLUME AND TOP OF CURB.

CURB ELEVATION 85.236'

FLUME ELEVATION @ UPSTREAM POINT 83.061'

DIFFERENCE = 2.175'

2.17' GREATER THAN 1.24' OK

EXCESSIVE STORM WATER WILL POND WITHIN THE CONCRETE GUTTER.

Q1 STORM EVENT FOR CONCRETE GUTTER
Worksheet for Triangular Channel

Project Description	
Project File	c:\haestad\fmw\location.fm2
Worksheet	LOCATION 7 INLET GUTTER FOR Q1 STORM
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

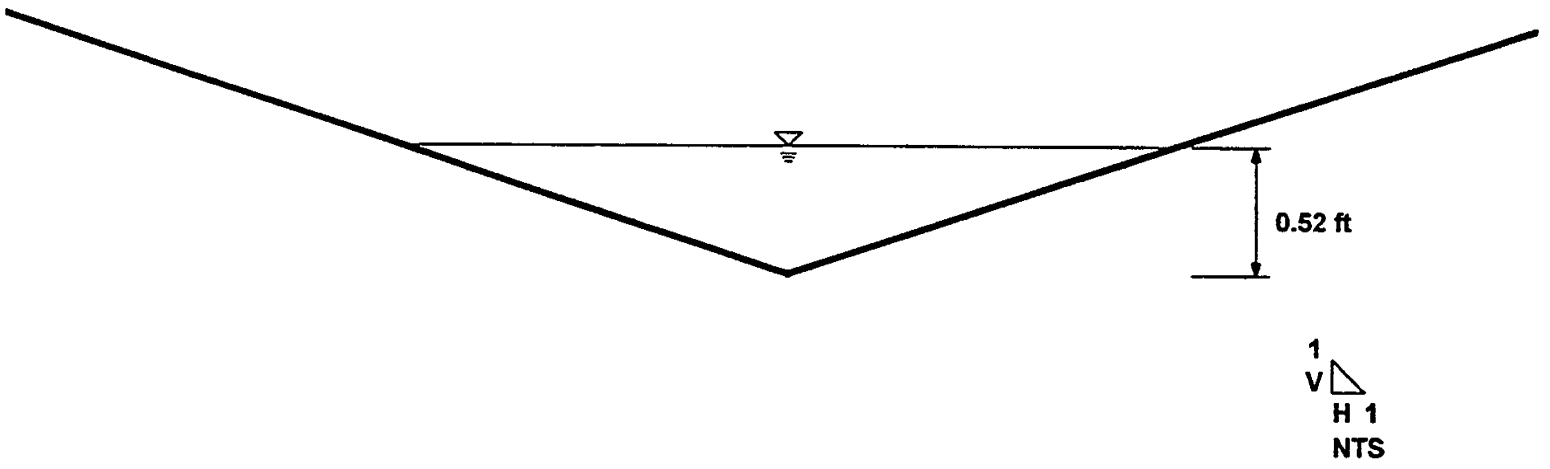
Input Data		
Mannings Coefficient	0.015	
Channel Slope	0.002000	ft/ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Discharge	1.40	cfs

Results		
Depth	0.52	ft
Flow Area	0.81	ft^2
Wetted Perimeter	3.28	ft
Top Width	3.11	ft
Critical Depth	0.42	ft
Critical Slope	0.005903	ft/ft
Velocity	1.74	ft/s
Velocity Head	0.05	ft
Specific Energy	0.57	ft
Froude Number	0.60	
Flow is subcritical.		

CROSS SECTION FOR CONCRETE GUTTER Q1 STORM
Cross Section for Triangular Channel

Project Description	
Project File	c:\haestad\fmw\location.fm2
Worksheet	LOCATION 7 INLET GUTTER FOR Q1 STORM
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.015	
Channel Slope	0.002000	ft/ft
Depth	0.52	ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Discharge	1.40	cfs



Q25 STORM EVENT FOR CONCRETE GUTTER
Worksheet for Triangular Channel

Project Description	
Project File	c:\haestad\fmw\location.fm2
Worksheet	LOCATION 7 INLET GUTTER FOR Q25 STORM
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

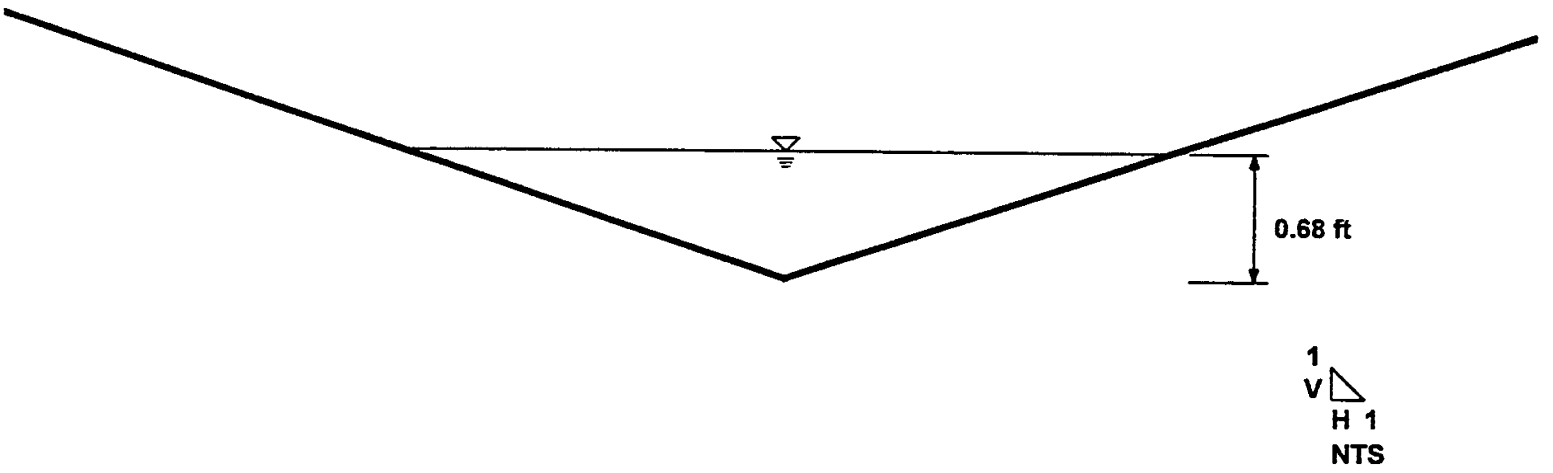
Input Data		
Mannings Coefficient	0.015	
Channel Slope	0.002000	ft/ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Discharge	2.90	cfs

Results		
Depth	0.68	ft
Flow Area	1.39	ft^2
Wetted Perimeter	4.31	ft
Top Width	4.09	ft
Critical Depth	0.57	ft
Critical Slope	0.005357	ft/ft
Velocity	2.09	ft/s
Velocity Head	0.07	ft
Specific Energy	0.75	ft
Froude Number	0.63	
Flow is subcritical.		

CROSS SECTION FOR CONCRETE GUTTER Q25 STORM
Cross Section for Triangular Channel

Project Description	
Project File	c:\haestad\fmw\location.fm2
Worksheet	LOCATION 7 INLET GUTTER FOR Q25 STORM
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.015	
Channel Slope	0.002000	ft/ft
Depth	0.68	ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Discharge	2.90	cfs



AE·CASC ENGINEERING

737 SOUTH VIA LATA,
SUITE 500
COLTON, CALIFORNIA 92324

(909) 783-0101
FAX (909) 783-0108

SUBJECT:	BIOFILTER STRIP		
JOB No.:	57704	SHEET No.:	
CALC. BY:	JC	DATE:	
CHECKED BY:		DATE:	

VELOCITY OF BIOFILTER STRIP

* ASSUME STRIPS ACTS AS A RECTANGULAR CHANNEL, SINCE DEPTH OF FLOW IS SMALL WITH RESPECT TO WIDTH OF BIOFILTER STRIP.

WIDTH: 88.6'

SLOPE: 0.02

Q: 0.60 cfs

"n": 0.20 (VALUE AGREED UPON BY AUTHORIZED AGENCIES)

$V_{1YR} = 0.14$ ft/s

$V_{25_{YR}} = 0.19$ ft/s

Q25 STORM EVENT FOR BIOFILTER SWALE
Worksheet for Rectangular Channel

Project Description	
Project File	c:\haestad\fmw\location.fm2
Worksheet	LOCATION 7 BIOFILTER STRIP FOR Q25 STORM
Flow Element	Rectangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.200	
Channel Slope	0.020000	ft/ft
Bottom Width	88.60	ft
Discharge	1.30	cfs

Results		
Depth	0.08	ft
Flow Area	6.84	ft^2
Wetted Perimeter	88.75	ft
Top Width	88.60	ft
Critical Depth	0.02	ft
Critical Slope	2.191613	ft/ft
Velocity	0.19	ft/s
Velocity Head	0.56e-3	ft
Specific Energy	0.08	ft
Froude Number	0.12	
Flow is subcritical.		

Q1 STORM EVENT FOR BIOFILTER STRIP
Worksheet for Rectangular Channel

Project Description	
Project File	c:\haestad\fmw\location.fm2
Worksheet	LOCATION 7 BIOFILTER STRIP FOR Q1 STORM
Flow Element	Rectangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.200	
Channel Slope	0.020000	ft/ft
Bottom Width	88.60	ft
Discharge	0.60	cfs

Results		
Depth	0.05	ft
Flow Area	4.30	ft^2
Wetted Perimeter	88.70	ft
Top Width	88.60	ft
Critical Depth	0.01	ft
Critical Slope	2.601868	ft/ft
Velocity	0.14	ft/s
Velocity Head	0.3e-3	ft
Specific Energy	0.05	ft
Froude Number	0.11	
Flow is subcritical.		

Q1 STORM EVENT- BIOFILTER STRIP OUTLET
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\haestad\fmw\location.fm2
Worksheet	LOCATION 7 BIOFILTER STRIP OUTLET
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.015	
Channel Slope	0.005000	ft/ft
Left Side Slope	0.250000	H : V
Right Side Slope	0.250000	H : V
Bottom Width	2.00	ft
Discharge	0.60	cfs

Results		
Depth	0.16	ft
Flow Area	0.32	ft²
Wetted Perimeter	2.32	ft
Top Width	2.08	ft
Critical Depth	0.14	ft
Critical Slope	0.007258	ft/ft
Velocity	1.87	ft/s
Velocity Head	0.05	ft
Specific Energy	0.21	ft
Froude Number	0.84	
Flow is subcritical.		

Q25 STORM EVENT - BIOFILTER STRIP OUTLET
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\haestad\fmw\location.fm2
Worksheet	LOCATION 7 BIOFILTER STRIP OUTLET Q25
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

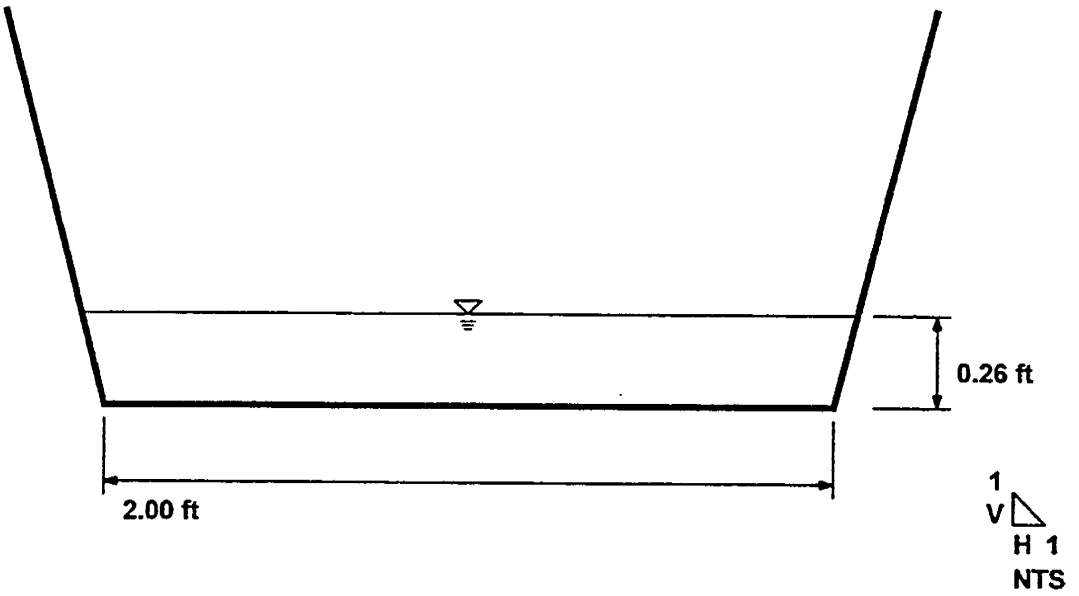
Input Data		
Mannings Coefficient	0.015	
Channel Slope	0.005000	ft/ft
Left Side Slope	0.250000	H : V
Right Side Slope	0.250000	H : V
Bottom Width	2.00	ft
Discharge	1.30	cfs

Results		
Depth	0.26	ft
Flow Area	0.53	ft^2
Wetted Perimeter	2.53	ft
Top Width	2.13	ft
Critical Depth	0.23	ft
Critical Slope	0.006642	ft/ft
Velocity	2.46	ft/s
Velocity Head	0.09	ft
Specific Energy	0.35	ft
Froude Number	0.87	
Flow is subcritical.		

CROSS SECTION - BIOFILTER STRIP OUTLET Q25 STORM
Cross Section for Trapezoidal Channel

Project Description	
Project File	c:\haestad\fmw\location.fm2
Worksheet	LOCATION 7 BIOFILTER STRIP OUTLET Q25
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.015	
Channel Slope	0.005000	ft/ft
Depth	0.26	ft
Left Side Slope	0.250000	H : V
Right Side Slope	0.250000	H : V
Bottom Width	2.00	ft
Discharge	1.30	cfs



PROJECT 2, SITE 3
HYDRAULIC CALCULATIONS
SR-78/ MELROSE AVENUE

AEI·CASC ENGINEERING

737 SOUTH VIA LATA,
SUITE 500
COLTON, CALIFORNIA 92324

(909) 783-0101
FAX (909) 783-0108

SUBJECT:	NPDES PILOT STUDY		
JOB No.:	57704	SHEET No.:	
CALC. BY:	[illegible]	DATE:	
CHECKED BY:		DATE:	

DRAINAGE SYSTEM NO. 5
SR 78 / MELROSE DRIVE

CALCULATION OF BIOFILTRATION SWALE UTILIZING CAL-TRANS DESIGN PROCEDURES.

1) PEAK FLOW UTILIZING RATIONAL METHOD

$Q = 3.74$ cfs

2) SLOPE OF SWALE BASED ON DRAINAGE SITE;

$S = 0.008$

3) CHANNEL WIDTH & GEOMETRY

DEPTH OF FLOW: 0.47

SIDE SLOPES: 2:1

CHANNEL SLOPE: 0.008

CHANNEL WIDTH: $W = 19.68$ ft

$W = 9.84$ ft

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737 SOUTH VIA LATA,
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COLTON, CALIFORNIA 92324

(909) 783-0101
FAX (909) 783-0108

SUBJECT:			
JOB No.:		SHEET No.:	
CALC. BY:		DATE:	
CHECKED BY:		DATE:	

4) VELOCITY OF FLOW FOR 1 YEAR RUNOFF:

V (@ $W = 19.68$ ft) = 0.39 ft/s

V (@ $W = 9.84$ = 0.48 ft/s

WEIGHTED AVERAGE VELOCITY

W	V	L	L·V
19.68	0.39	283.57	110.59
9.84	0.48	64.85	31.13
TRANSITION	0.435	19.14	8.32
	Σ	367.56	150.04

AVE $V = \frac{L \cdot V}{V} \rightarrow$ 0.41 ft/s

5) RESIDENCE TIME:

$T = \frac{367.56 \text{ ft}}{0.41 \text{ ft/s}}$ $T = 896.49$ s

T (min) = 15.0 minutes

BIOFILTER SWALE FOR SITE 5 W=19.84 FT
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\haestad\fmw\location.fm2
Worksheet	BIOFILTER SWALE FOR SITE 5
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

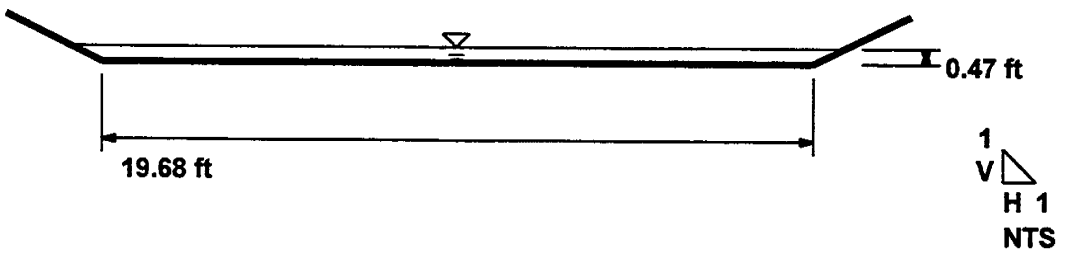
Input Data		
Mannings Coefficient	0.200	
Channel Slope	0.008000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	19.68	ft
Discharge	3.74	cfs

Results		
Depth	0.47	ft
Flow Area	9.67	ft^2
Wetted Perimeter	21.78	ft
Top Width	21.56	ft
Critical Depth	0.10	ft
Critical Slope	1.249592	ft/ft
Velocity	0.39	ft/s
Velocity Head	0.23e-2	ft
Specific Energy	0.47	ft
Froude Number	0.10	
Flow is subcritical.		

Cross Section
Cross Section for Trapezoidal Channel

Project Description	
Project File	c:\haestad\fmw\location.fm2
Worksheet	BIOFILTER SWALE FOR SITE 5
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.200	
Channel Slope	0.008000	ft/ft
Depth	0.47	ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	19.68	ft
Discharge	3.74	cfs



BIOFILTER SWALE FOR SITE 5 W=9.84 FT
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\haestad\fmw\location.fm2
Worksheet	BIOFILTER SWALE FOR SITE 5
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

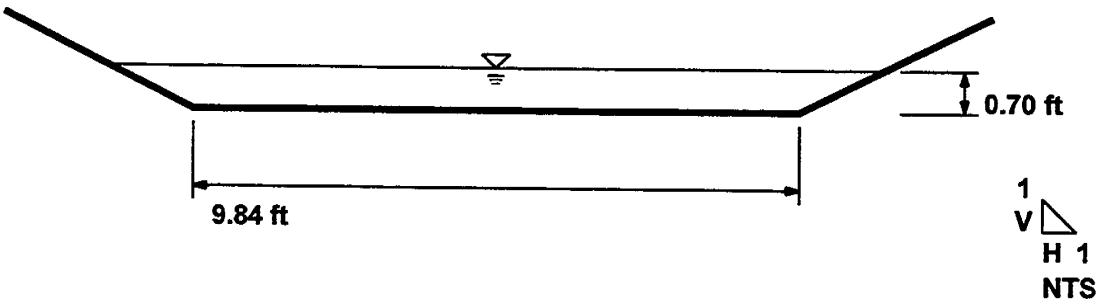
Input Data		
Mannings Coefficient	0.200	
Channel Slope	0.008000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	9.84	ft
Discharge	3.74	cfs

Results		
Depth	0.70	ft
Flow Area	7.86	ft^2
Wetted Perimeter	12.97	ft
Top Width	12.64	ft
Critical Depth	0.16	ft
Critical Slope	1.088646	ft/ft
Velocity	0.48	ft/s
Velocity Head	0.35e-2	ft
Specific Energy	0.70	ft
Froude Number	0.11	
Flow is subcritical.		

Cross Section
Cross Section for Trapezoidal Channel

Project Description	
Project File	c:\haestad\fmw\location.fm2
Worksheet	BIOFILTER SWALE FOR SITE 5
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.200	
Channel Slope	0.008000	ft/ft
Depth	0.70	ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	9.84	ft
Discharge	3.74	cfs



AE·CASC ENGINEERING

397 SOUTH VIA LATA,
SUITE 500
COLTON, CALIFORNIA 92324

(909) 783-0101
FAX (909) 783-0108

SUBJECT:			
JOB No.:		SHEET No.:	
CALC. BY:		DATE:	
CHECKED BY:		DATE:	

CALCULATION FOR HEAD AT UPSTREAM END OF FLUME, FOR SITE 5 (SR78/MELROSE AVE)

GIVEN

$Q = 2.0$ $H_1 = 0.62'$

$Q = 2.75$ $H_2 = 0.69'$

$\Delta Q_1 = 0.75$ $\Delta H_1 = 0.07'$

FIND HEAD @ $Q = 3.74$

$\Delta Q_2 = 1.74$ $\Delta H_2 =$

$$\Delta H_2 = \frac{0.07}{0.75} \times 1.74$$

$\Delta H_2 = 0.1624$

$H = \Delta H_2 + H_1$

$H = 0.1624 + 0.62$

$H = 0.78'$

```
T1 WATER PROFILE FROM OUTLET FLUME TO OVERSIDE DRAIN                                0
T2 FILENAME SR78ML
T3 SITE 5 MELROSE DR/SR78
SO       .00 289.92  1                          290.70
R       2.64 289.95  1      .015  CONC TRANS TO BIOFILTER SWALE   .000
TS      9.21 290.01  2      .015                                   .000
R     179.02 291.36  2      .175                                -2.750
R     299.36 292.27  2      .175                                  .000
TS    318.49 292.43  3      .175                                -12.000
R     383.34 292.95  3      .175  BIOFILTER SWALE TRANS TO CONC   .000
TS    383.70 292.96  4      .030                                   .000
TS    384.70 292.96  5      .030                                   .000
TS    385.70 292.97  6      .030                                   .000
TS    386.70 292.98  7      .030                                   .000
TS    387.70 292.99  8      .030                                   .000
TS    388.70 293.00  9      .030                                   .000
TS    389.70 293.00 10      .030                                   .000
TS    390.70 293.01 11      .030                                   .000
TS    391.70 293.02 12      .030                                   .000
R     394.98 293.03 12      .015                                   .000
R     395.23 293.03 12      .015                                   .000
TS    395.93 293.03 13      .015 FLUME TRANS                       .000
R     396.64 293.03 13      .015                                   .000
TS    397.34 293.03 14      .015 FLUME TRANS TO CONC SWALE         .000
R     398.01 293.03 14      .015                                   .000
R     400.30 293.04 14      .015                                   .000
WX    400.30 293.04 15
R     406.87 293.05 15      .015                                   .000    .000 0
JX    409.82 293.12 17  1   .015    1.78          295.05        90.0       27.283
R     445.58 295.05 17      .015                                   .000    .000 0
WE    445.58 295.05 18      .250
SH    445.58 295.05 18                            295.05
CD   1  4   1    .00   1.00     .00  .00  .00   .0
CD   2  1   0    .00   3.28   19.68 2.00 2.00   .0
CD   3  1   0    .00   3.28    9.84 2.00 2.00   .0
CD   4  1   0    .00   3.28    9.45 2.00 2.00   .0
CD   5  1   0    .00   3.28    8.37 2.00 2.00   .0
CD   6  1   0    .00   3.28    7.29 2.00 2.00   .0
CD   7  1   0    .00   3.28    6.21 2.00 2.00   .0
CD   8  1   0    .00   3.28    5.14 2.00 2.00   .0
CD   9  1   0    .00   3.28    4.06 2.00 2.00   .0
CD  10  1   0    .00   3.28    2.98 2.00 2.00   .0
CD  11  1   0    .00   3.28    1.90 2.00 2.00   .0
CD  12  1   0    .00    .83     .41 1.73 1.73   .0
CD  13  1   0    .00    .83     .17 1.73 1.73   .0
CD  14  1   0    .00    .83     .41 1.73 1.73   .0
CD  15  4   1    .00   1.00     .00  .00  .00   .0
CD  16  4   1    .00   1.00     .00  .00  .00   .0
CD  17  4   1    .00   1.00     .00  .00  .00   .0
CD  18  2   0    .00    .83    1.00  .00  .00   .0
Q             1.96   .0
```

```
T1 WATER PROFILE FROM OUTLET FLUME TO OVERSIDE DRAIN                                  0
T2 FILENAME SR78ML
T3 SITE 5 MELROSE DR/SR78
SO       .00 289.92  1                              290.70
R       2.64 289.95  1      .015                                    .000
TS      9.21 290.01  2      .015                                    .000
R     179.02 291.36  2      .175                                  -2.750
R     299.36 292.27  2      .175                                    .000
TS    318.49 292.43  3      .175                                 -12.000
R     383.34 292.95  3      .175                                    .000
TS    383.70 292.96  4      .030                                    .000
TS    384.70 292.96  5      .030                                    .000
TS    385.70 292.97  6      .030                                    .000
TS    386.70 292.98  7      .030                                    .000
TS    387.70 292.99  8      .030                                    .000
TS    388.70 293.00  9      .030                                    .000
TS    389.70 293.00 10      .030                                    .000
TS    390.70 293.01 11      .030                                    .000
TS    391.70 293.02 12      .030                                    .000
R     394.98 293.03 12      .015                                    .000
R     395.23 293.03 12      .015                                    .000
TS    395.93 293.03 13      .015                                    .000
R     396.64 293.03 13      .015                                    .000
TS    397.34 293.03 14      .015                                    .000
R     398.01 293.03 14      .015                                    .000
R     400.30 293.04 14      .015                                    .000
WX    400.30 293.04 15
R     406.87 293.05 15      .015                                    .000     .000 0
JX    409.82 293.12 17  1   .015    1.78          295.05        90.0        27.283
R     445.58 295.05 17      .015                                    .000     .000 0
WE    445.58 295.05 18      .250
SH    445.58 295.05 18                              295.05
CD   1  4   1    .00   1.00     .00  .00  .00   .0
CD   2  1   0    .00   3.28   19.68 2.00 2.00   .0
CD   3  1   0    .00   3.28    9.84 2.00 2.00   .0
CD   4  1   0    .00   3.28    9.45 2.00 2.00   .0
CD   5  1   0    .00   3.28    8.37 2.00 2.00   .0
CD   6  1   0    .00   3.28    7.29 2.00 2.00   .0
CD   7  1   0    .00   3.28    6.21 2.00 2.00   .0
CD   8  1   0    .00   3.28    5.14 2.00 2.00   .0
CD   9  1   0    .00   3.28    4.06 2.00 2.00   .0
CD  10  1   0    .00   3.28    2.98 2.00 2.00   .0
CD  11  1   0    .00   3.28    1.90 2.00 2.00   .0
CD  12  1   0    .00    .83     .41 1.73 1.73   .0
CD  13  1   0    .00    .83     .17 1.73 1.73   .0
CD  14  1   0    .00    .83     .41 1.73 1.73   .0
CD  15  4   1    .00   1.00     .00  .00  .00   .0
CD  16  4   1    .00   1.00     .00  .00  .00   .0
CD  17  4   1    .00   1.00     .00  .00  .00   .0
CD  18  2   0    .00    .83    1.00  .00  .00   .0
Q              1.96   .0
```

W S P G N - CIVILDESIGN Vers
For: CASC Engineering Group, Riverside, California - S/N 615
WATER SURFACE PROFILE LISTING
Date: 7-28-1998 Time: 9:59:44

WATER PROFILE FROM OUTLET FLUME TO OVERSIDE DRAIN
FILENAME SR78ML
SITE 5 MELROSE DR/SR78

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT) /	Water Elev /	Q (CFS) /	Vel (FPS) / SF Ave	Vel Head / HF	Energy Grd.El. / SE Dpth	Super Elev / Froude N	Critical Depth / Norm Dp	Flow Top Width / "N"	Height/Dia.-FT / Base Wt or I.D. / ZR	ZL	No Wth Prs/Pip / Type Ch
.00	289.92	.824	290.744	3.7	5.40	.453	291.197	.00	.824	.76	1.00	.00	1 .0
2.28	.01136				.013948	.03	.82	.999	1.000	.015		.00	PIPE
2.28	289.95	.871	290.817	3.7	5.15	.412	291.229	.00	.824	.67	1.00	.00	1 .0
.36	.01136				.013334	.00	.87	.872	1.000	.015		.00	PIPE
2.64	289.95	.874	290.824	3.7	5.14	.410	291.234	.00	.824	.66	1.00	.00	1 .0
TRANS STR	.00913				.006653	.04	.87	.864		.015		.00	PIPE
9.21	290.01	1.309	291.319	3.7	.13	.000	291.319	.00	.104	24.92	3.28	19.68 2.00	0 .0
7.07	.00795				.000205	.00	1.31	.021	.434	.175		2.00	TRAP
16.28	290.07	1.254	291.320	3.7	.13	.000	291.321	.00	.104	24.70	3.28	19.68 2.00	0 .0
6.83	.00795				.000238	.00	1.25	.022	.434	.175		2.00	TRAP
23.10	290.12	1.202	291.322	3.7	.14	.000	291.322	.00	.104	24.49	3.28	19.68 2.00	0 .0
6.59	.00795				.000275	.00	1.20	.024	.434	.175		2.00	TRAP
29.70	290.17	1.151	291.324	3.7	.15	.000	291.324	.00	.104	24.28	3.28	19.68 2.00	0 .0
6.37	.00795				.000319	.00	1.15	.026	.434	.175		2.00	TRAP
36.07	290.22	1.102	291.326	3.7	.16	.000	291.326	.00	.104	24.09	3.28	19.68 2.00	0 .0
6.17	.00795				.000370	.00	1.10	.027	.434	.175		2.00	TRAP
42.24	290.27	1.055	291.328	3.7	.16	.000	291.328	.00	.104	23.90	3.28	19.68 2.00	0 .0
5.97	.00795				.000428	.00	1.06	.029	.434	.175		2.00	TRAP

For: CASC Engineering Group, Riverside, California - S/N 615

WATER SURFACE PROFILE LISTING

Date: 7-28-1998 Time: 9:59:44

WATER PROFILE FROM OUTLET FLUME TO OVERSIDE DRAIN

FILENAME SR78ML

SITE 5 MELROSE DR/SR78

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"		ZR	Type Ch
48.21	290.32	1.011	291.331	3.7	.17	.000	291.331	.00	.104	23.72	3.28	19.68	2.00	0 .0
5.79	.00795					.000497	.00	1.01	.031	.434	.175		2.00	TRAP
54.00	290.37	.967	291.333	3.7	.18	.000	291.334	.00	.104	23.55	3.28	19.68	2.00	0 .0
5.62	.00795					.000576	.00	.97	.033	.434	.175		2.00	TRAP
59.61	290.41	.926	291.337	3.7	.19	.001	291.337	.00	.104	23.38	3.28	19.68	2.00	0 .0
5.46	.00795					.000669	.00	.93	.036	.434	.175		2.00	TRAP
65.07	290.45	.886	291.340	3.7	.20	.001	291.341	.00	.104	23.22	3.28	19.68	2.00	0 .0
5.32	.00795					.000776	.00	.89	.038	.434	.175		2.00	TRAP
70.39	290.50	.848	291.344	3.7	.21	.001	291.345	.00	.104	23.07	3.28	19.68	2.00	0 .0
5.19	.00795					.000901	.00	.85	.041	.434	.175		2.00	TRAP
75.58	290.54	.811	291.349	3.7	.22	.001	291.350	.00	.104	22.92	3.28	19.68	2.00	0 .0
5.09	.00795					.001046	.01	.81	.044	.434	.175		2.00	TRAP
80.67	290.58	.776	291.354	3.7	.23	.001	291.355	.00	.104	22.78	3.28	19.68	2.00	0 .0
5.00	.00795					.001216	.01	.78	.047	.434	.175		2.00	TRAP
85.67	290.62	.742	291.360	3.7	.24	.001	291.361	.00	.104	22.65	3.28	19.68	2.00	0 .0
4.94	.00795					.001413	.01	.74	.050	.434	.175		2.00	TRAP
90.61	290.66	.710	291.367	3.7	.25	.001	291.368	.00	.104	22.52	3.28	19.68	2.00	0 .0
4.91	.00795					.001643	.01	.71	.054	.434	.175		2.00	TRAP

WATER PROFILE FROM OUTLET FLUME TO OVERSIDE DRAIN
FILENAME SR78ML
SITE 5 MELROSE DR/SR78

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"		ZR	Type Ch
95.51	290.70	.679	291.375	3.7	.26	.001	291.376	.00	.104	22.40	3.28	19.68	2.00	0 .0
4.91	.00795					.001910	.01	.68	.058	.434	.175		2.00	TRAP
100.42	290.74	.649	291.384	3.7	.27	.001	291.385	.00	.104	22.28	3.28	19.68	2.00	0 .0
4.96	.00795					.002222	.01	.65	.062	.434	.175		2.00	TRAP
105.38	290.77	.621	291.395	3.7	.29	.001	291.396	.00	.104	22.16	3.28	19.68	2.00	0 .0
5.07	.00795					.002585	.01	.62	.066	.434	.175		2.00	TRAP
110.45	290.81	.593	291.408	3.7	.30	.001	291.410	.00	.104	22.05	3.28	19.68	2.00	0 .0
5.27	.00795					.003009	.02	.59	.071	.434	.175		2.00	TRAP
115.72	290.86	.567	291.424	3.7	.32	.002	291.425	.00	.104	21.95	3.28	19.68	2.00	0 .0
5.60	.00795					.003502	.02	.57	.076	.434	.175		2.00	TRAP
121.33	290.90	.542	291.443	3.7	.33	.002	291.445	.00	.104	21.85	3.28	19.68	2.00	0 .0
6.16	.00795					.004078	.03	.54	.082	.434	.175		2.00	TRAP
127.49	290.95	.518	291.468	3.7	.35	.002	291.470	.00	.104	21.75	3.28	19.68	2.00	0 .0
7.13	.00795					.004750	.03	.52	.087	.434	.175		2.00	TRAP
134.62	291.01	.495	291.502	3.7	.37	.002	291.504	.00	.104	21.66	3.28	19.68	2.00	0 .0
9.03	.00795					.005534	.05	.49	.094	.434	.175		2.00	TRAP
143.65	291.08	.473	291.552	3.7	.38	.002	291.554	.00	.104	21.57	3.28	19.68	2.00	0 .0
13.89	.00795					.006449	.09	.47	.100	.434	.175		2.00	TRAP

WATER PROFILE FROM OUTLET FLUME TO OVERSIDE DRAIN
FILENAME SR78ML
SITE 5 MELROSE DR/SR78

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"		ZR	Type Ch
157.54	291.19	.452	291.641	3.7	.40	.003	291.644	.00	.104	21.49	3.28	19.68	2.00	0 .0
21.48	.00795					.007314	.16	.45	.108	.434	.175		2.00	TRAP
179.02	291.36	.438	291.798	3.7	.42	.003	291.801	.00	.104	21.43	3.28	19.68	2.00	0 .0
26.18	.00756					.007627	.20	.44	.113	.440	.175		2.00	TRAP
205.20	291.56	.440	291.998	3.7	.41	.003	292.001	.00	.104	21.44	3.28	19.68	2.00	0 .0
94.16	.00756					.007566	.71	.44	.112	.440	.175		2.00	TRAP
299.36	292.27	.440	292.710	3.7	.41	.003	292.713	.00	.104	21.44	3.28	19.68	2.00	0 .0
TRANS STR	.00836					.012428	.24	.44	.112		.175		2.00	TRAP
318.49	292.43	.516	292.946	3.7	.67	.007	292.953	.00	.163	11.90	3.28	9.84	2.00	0 .0
2.76	.00802					.016083	.04	.52	.171	.646	.175		2.00	TRAP
321.25	292.45	.539	292.991	3.7	.64	.006	292.997	.00	.163	12.00	3.28	9.84	2.00	0 .0
3.97	.00802					.013877	.06	.54	.160	.646	.175		2.00	TRAP
325.23	292.48	.563	293.047	3.7	.61	.006	293.052	.00	.163	12.09	3.28	9.84	2.00	0 .0
6.13	.00802					.011979	.07	.56	.150	.646	.175		2.00	TRAP
331.36	292.53	.588	293.121	3.7	.58	.005	293.126	.00	.163	12.19	3.28	9.84	2.00	0 .0
10.90	.00802					.010344	.11	.59	.140	.646	.175		2.00	TRAP
342.26	292.62	.613	293.234	3.7	.55	.005	293.239	.00	.163	12.29	3.28	9.84	2.00	0 .0
28.83	.00802					.008935	.26	.61	.131	.646	.175		2.00	TRAP

For: CASC Engineering Group, Riverside, California - S/N 615

WATER SURFACE PROFILE LISTING Date: 7-28-1998 Time: 9:59:44

WATER PROFILE FROM OUTLET FLUME TO OVERSIDE DRAIN

FILENAME SR78ML

SITE 5 MELROSE DR/SR78

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"		ZR	Type Ch
371.08	292.85	.640	293.492	3.7	.53	.004	293.496	.00	.163	12.40	3.28	9.84	2.00	0 .0
12.26	.00802					.008220	.10	.64	.122	.646	.175		2.00	TRAP
383.34	292.95	.643	293.593	3.7	.52	.004	293.597	.00	.163	12.41	3.28	9.84	2.00	0 .0
TRANS STR	.02772					.000257	.00	.64	.121		.030		2.00	TRAP
383.70	292.96	.633	293.593	3.7	.55	.005	293.598	.00	.167	11.98	3.28	9.45	2.00	0 .0
TRANS STR	.00000					.000309	.00	.63	.129		.030		2.00	TRAP
384.70	292.96	.633	293.593	3.7	.61	.006	293.599	.00	.181	10.90	3.28	8.37	2.00	0 .0
TRANS STR	.01001					.000410	.00	.63	.144		.030		2.00	TRAP
385.70	292.97	.622	293.592	3.7	.70	.008	293.600	.00	.198	9.78	3.28	7.29	2.00	0 .0
TRANS STR	.01001					.000579	.00	.62	.169		.030		2.00	TRAP
386.70	292.98	.611	293.591	3.7	.82	.011	293.602	.00	.219	8.65	3.28	6.21	2.00	0 .0
TRANS STR	.00998					.000859	.00	.61	.200		.030		2.00	TRAP
387.70	292.99	.599	293.589	3.7	.99	.015	293.604	.00	.246	7.54	3.28	5.14	2.00	0 .0
TRANS STR	.01001					.001385	.00	.60	.245		.030		2.00	TRAP
388.70	293.00	.584	293.584	3.7	1.22	.023	293.607	.00	.283	6.40	3.28	4.06	2.00	0 .0
TRANS STR	.00000					.002435	.00	.58	.312		.030		2.00	TRAP
389.70	293.00	.575	293.575	3.7	1.57	.039	293.614	.00	.338	5.28	3.28	2.98	2.00	0 .0
TRANS STR	.01001							.57	.414		.030		2.00	TRAP

WATER PROFILE FROM OUTLET FLUME TO OVERSIDE DRAIN
FILENAME SR78ML
SITE 5 MELROSE DR/SR78

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"		ZR	Type Ch
390.70	293.01	.256	293.266	3.7	6.06	.571	293.837	.00	.422	2.92	3.28	1.90	2.00	0 .0
TRANS STR	.00998					.088610	.09	.26	2.327		.030		2.00	TRAP
391.70	293.02	.556	293.576	3.7	4.91	.374	293.950	.00	.673	2.33	.83	.41	1.73	0 .0
1.19	.00305					.013309	.02	.56	1.514	.758	.015		1.73	TRAP
392.89	293.02	.547	293.570	3.7	5.05	.396	293.966	.00	.673	2.30	.83	.41	1.73	0 .0
2.09	.00305					.014738	.03	.55	1.568	.758	.015		1.73	TRAP
394.98	293.03	.531	293.561	3.7	5.29	.435	293.997	.00	.673	2.25	.83	.41	1.73	0 .0
.25	.00000					.015831	.00	.53	1.664	.000	.015		1.73	TRAP
395.23	293.03	.529	293.559	3.7	5.33	.442	294.001	.00	.673	2.24	.83	.41	1.73	0 .0
TRANS STR	.00000					.014315	.01	.53	1.680		.015		1.73	TRAP
395.93	293.03	.618	293.648	3.7	4.88	.370	294.018	.00	.734	2.31	.83	.17	1.73	0 .0
.71	.00000					.013025	.01	.62	1.494	.000	.015		1.73	TRAP
396.64	293.03	.611	293.641	3.7	4.99	.387	294.028	.00	.734	2.28	.83	.17	1.73	0 .0
TRANS STR	.00000					.017291	.01	.61	1.535		.015		1.73	TRAP
397.34	293.03	.497	293.527	3.7	5.92	.545	294.072	.00	.673	2.13	.83	.41	1.73	0 .0
.67	.00000					.021711	.01	.50	1.918	.000	.015		1.73	TRAP
398.01	293.03	.492	293.522	3.7	6.03	.565	294.087	.00	.673	2.11	.83	.41	1.73	0 .0
.09	.00437					.022320	.00	.49	1.963	.702	.015		1.73	TRAP

WATER SURFACE PROFILE LISTING

Date: 7-28-1998 Time: 9:59:44

WATER PROFILE FROM OUTLET FLUME TO OVERSIDE DRAIN
FILENAME SR78ML
SITE 5 MELROSE DR/SR78

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/Dia.-FT / "N"	Base Wt or I.D.	ZL / ZR	No Wth Prs/Pip / Type Ch
398.10	293.03	.491	293.521	3.7	6.05	.568	294.090	.00	.673	2.11	.83	.41	1.73	0 .0
2.20	.00437					.023917	.05	.49	1.969	.702	.015		1.73	TRAP
400.30	293.04	.477	293.517	3.7	6.34	.625	294.142	.00	.673	2.06	.83	.41	1.73	0 .0
WALL EXIT														
400.30	293.04	.824	293.864	3.7	5.40	.453	294.317	.00	.824	.76	1.00	.00	.00	1 .0
.48	.00152					.013948	.01	.82	.999	1.000	.015		.00	PIPE
400.78	293.04	.871	293.912	3.7	5.15	.412	294.324	.00	.824	.67	1.00	.00	.00	1 .0
1.87	.00152					.013019	.02	.87	.872	1.000	.015		.00	PIPE
402.65	293.04	.930	293.974	3.7	4.91	.375	294.348	.00	.824	.51	1.00	.00	.00	1 .0
4.12	.00152					.013056	.05	.93	.708	1.000	.015		.00	PIPE
406.77	293.05	1.000	294.050	3.7	4.76	.352	294.402	.00	.824	.00	1.00	.00	.00	1 .0
.10	.00152					.014054	.00	1.00	.000	1.000	.015		.00	PIPE
406.87	293.05	1.001	294.051	3.7	4.76	.352	294.403	.00	.824	.00	1.00	.00	.00	1 .0
JUNCT STR	.02373					.009350	.03	.00	.000		.015		.00	PIPE
409.82	293.12	1.470	294.590	2.0	2.50	.097	294.686	.00	.597	.00	1.00	.00	.00	1 .0
9.41	.05397					.003975	.04	1.47	.000	.357	.015		.00	PIPE
419.23	293.63	1.000	294.628	2.0	2.50	.097	294.724	.00	.597	.00	1.00	.00	.00	1 .0
1.17	.05397					.003724	.00	1.00	.000	.357	.015		.00	PIPE

For: CASC Engineering Group, Riverside, California - S/N 615

WATER SURFACE PROFILE LISTING Date: 7-28-1998 Time: 9:59:44

WATER PROFILE FROM OUTLET FLUME TO OVERSIDE DRAIN

FILENAME SR78ML

SITE 5 MELROSE DR/SR78

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT) / SF Ave	Water Elev / HF	Q (CFS) / SE Dpth	Vel (FPS) / Froude N	Vel Head / Norm Dp	Energy Grd.El. / "N"	Super Elev / ZR	Critical Depth / Type Ch	Flow Top Width / No Wth Prs/Pip	Height/Dia.-FT /	Base Wt or I.D. /	ZL
420.40	293.69	.907	294.598	2.0	2.62	.106	294.704	.00	.597	.58	1.00	.00	.00
HYDRAULIC JUMP													
420.40	293.69	.359	294.050	2.0	7.72	.926	294.976	.00	.597	.96	1.00	.00	.00
4.23	.05397					.050435	.21	.36	2.646	.357	.015		.00
												PIPE	1 .0
424.63	293.92	.368	294.288	2.0	7.46	.864	295.152	.00	.597	.96	1.00	.00	.00
7.36	.05397					.045057	.33	.37	2.519	.357	.015		.00
												PIPE	1 .0
431.99	294.32	.381	294.698	2.0	7.11	.786	295.483	.00	.597	.97	1.00	.00	.00
3.98	.05397					.039523	.16	.38	2.354	.357	.015		.00
												PIPE	1 .0
435.96	294.53	.395	294.926	2.0	6.78	.714	295.641	.00	.597	.98	1.00	.00	.00
2.64	.05397					.034680	.09	.40	2.199	.357	.015		.00
												PIPE	1 .0
438.61	294.67	.409	295.083	2.0	6.47	.649	295.732	.00	.597	.98	1.00	.00	.00
1.87	.05397					.030435	.06	.41	2.053	.357	.015		.00
												PIPE	1 .0
440.48	294.77	.424	295.199	2.0	6.17	.590	295.789	.00	.597	.99	1.00	.00	.00
1.38	.05397					.026740	.04	.42	1.916	.357	.015		.00
												PIPE	1 .0
441.86	294.85	.440	295.289	2.0	5.88	.537	295.826	.00	.597	.99	1.00	.00	.00
1.08	.05397					.023499	.03	.44	1.788	.357	.015		.00
												PIPE	1 .0
442.94	294.91	.456	295.363	2.0	5.61	.488	295.851	.00	.597	1.00	1.00	.00	.00
.79	.05397					.020670	.02	.46	1.667	.357	.015		.00
												PIPE	1 .0

For: CASC Engineering Group, Riverside, California - S/N 615

WATER SURFACE PROFILE LISTING Date: 7-28-1998 Time: 9:59:44

WATER PROFILE FROM OUTLET FLUME TO OVERSIDE DRAIN

FILENAME SR78ML

SITE 5 MELROSE DR/SR78

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"		ZR	Type Ch
443.73	294.95	.474	295.424	2.0	5.34	.444	295.868	.00	.597	1.00	1.00	.00	.00	1 .0
.65	.05397					.018187	.01	.47	1.554	.357	.015		.00	PIPE
444.38	294.99	.491	295.476	2.0	5.10	.403	295.880	.00	.597	1.00	1.00	.00	.00	1 .0
.47	.05397					.016001	.01	.49	1.448	.357	.015		.00	PIPE
444.84	295.01	.510	295.520	2.0	4.86	.367	295.887	.00	.597	1.00	1.00	.00	.00	1 .0
.33	.05397					.014104	.00	.51	1.348	.357	.015		.00	PIPE
445.18	295.03	.530	295.558	2.0	4.63	.333	295.892	.00	.597	1.00	1.00	.00	.00	1 .0
.22	.05397					.012443	.00	.53	1.254	.357	.015		.00	PIPE
445.40	295.04	.551	295.591	2.0	4.42	.303	295.894	.00	.597	.99	1.00	.00	.00	1 .0
.15	.05397					.010979	.00	.55	1.165	.357	.015		.00	PIPE
445.55	295.05	.572	295.621	2.0	4.21	.275	295.896	.00	.597	.99	1.00	.00	.00	1 .0
.03	.05397					.009678	.00	.57	1.082	.357	.015		.00	PIPE
445.58	295.05	.597	295.647	2.0	4.01	.249	295.896	.00	.597	.98	1.00	.00	.00	1 .0
WALL	ENTRANCE													
445.58	295.05	.800	295.850	2.0	2.45	.093	295.943	.00	.492	1.00	.83	1.00	.00	0 .0

```
T1 WATER PROFILE FROM OUTLET FLUME TO OVERSIDE DRAIN                                0
T2 FILENAME SR78ML
T3 SITE 5 MELROSE DR/SR78  25 YEAR STORM RUNOFF
SO       .00 289.92  1                          290.70
R       2.64 289.95  1       .015  CONC TRANS TO BIOFILTER SWALE   .000
TS      9.21 290.01  2       .015                                   .000
R     179.02 291.36  2       .175                                 -2.750
R     299.36 292.27  2       .175                                   .000
TS    318.49 292.43  3       .175                                -12.000
R     383.34 292.95  3       .175  BIOFILTER SWALE TRANS TO CONC    .000
TS    383.70 292.96  4       .030                                   .000
TS    384.70 292.96  5       .030                                   .000
TS    385.70 292.97  6       .030                                   .000
TS    386.70 292.98  7       .030                                   .000
TS    387.70 292.99  8       .030                                   .000
TS    388.70 293.00  9       .030                                   .000
TS    389.70 293.00 10       .030                                   .000
TS    390.70 293.01 11       .030                                   .000
TS    391.70 293.02 12       .030                                   .000
R     394.98 293.03 12       .015                                   .000
R     395.23 293.03 12       .015                                   .000
TS    395.93 293.03 13       .015 FLUME TRANS                       .000
R     396.64 293.03 13       .015                                   .000
TS    397.34 293.03 14       .015 FLUME TRANS TO CONC SWALE         .000
R     398.01 293.03 14       .015                                   .000
R     400.30 293.04 14       .015                                   .000
WX    400.30 293.04 15
R     406.87 293.05 15       .015                                   .000     .000 0
JX    409.82 293.12 17  1    .015    2.90          295.05         90.0       27.283
R     445.58 295.05 17       .015                                   .000     .000 0
WE    445.58 295.05 18       .250
SH    445.58 295.05 18                              295.05
CD   1  4   1     .00   1.00     .00  .00  .00   .0
CD   2  1   0     .00   3.28   19.68 2.00 2.00   .0
CD   3  1   0     .00   3.28    9.84 2.00 2.00   .0
CD   4  1   0     .00   3.28    9.45 2.00 2.00   .0
CD   5  1   0     .00   3.28    8.37 2.00 2.00   .0
CD   6  1   0     .00   3.28    7.29 2.00 2.00   .0
CD   7  1   0     .00   3.28    6.21 2.00 2.00   .0
CD   8  1   0     .00   3.28    5.14 2.00 2.00   .0
CD   9  1   0     .00   3.28    4.06 2.00 2.00   .0
CD  10  1   0     .00   3.28    2.98 2.00 2.00   .0
CD  11  1   0     .00   3.28    1.90 2.00 2.00   .0
CD  12  1   0     .00    .83     .41 1.73 1.73   .0
CD  13  1   0     .00    .83     .17 1.73 1.73   .0
CD  14  1   0     .00    .83     .41 1.73 1.73   .0
CD  15  4   1     .00   1.00     .00  .00  .00   .0
CD  16  4   1     .00   1.00     .00  .00  .00   .0
CD  17  4   1     .00   1.00     .00  .00  .00   .0
CD  18  2   0     .00    .83    1.00  .00  .00   .0
Q             3.20   .0
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T1 WATER PROFILE FROM OUTLET FLUME TO OVERSIDE DRAIN                                  0
T2 FILENAME SR78ML
T3 SITE 5 MELROSE DR/SR78
SO       .00 289.92  1                                 290.70
R       2.64 289.95  1      .015                                        .000
TS      9.21 290.01  2      .015                                        .000
R     179.02 291.36  2      .175                                      -2.750
R     299.36 292.27  2      .175                                        .000
TS    318.49 292.43  3      .175                                     -12.000
R     383.34 292.95  3      .175                                        .000
TS    383.70 292.96  4      .030                                        .000
TS    384.70 292.96  5      .030                                        .000
TS    385.70 292.97  6      .030                                        .000
TS    386.70 292.98  7      .030                                        .000
TS    387.70 292.99  8      .030                                        .000
TS    388.70 293.00  9      .030                                        .000
TS    389.70 293.00 10      .030                                        .000
TS    390.70 293.01 11      .030                                        .000
TS    391.70 293.02 12      .030                                        .000
R     394.98 293.03 12      .015                                        .000
R     395.23 293.03 12      .015                                        .000
TS    395.93 293.03 13      .015                                        .000
R     396.64 293.03 13      .015                                        .000
TS    397.34 293.03 14      .015                                        .000
R     398.01 293.03 14      .015                                        .000
R     400.30 293.04 14      .015                                        .000
WX    400.30 293.04 15
R     406.87 293.05 15      .015                                        .000     .000 0
JX    409.82 293.12 17  1   .015     2.90          295.05          90.0        27.283
R     445.58 295.05 17      .015                                        .000     .000 0
WE    445.58 295.05 18      .250
SH    445.58 295.05 18                                295.05
CD   1  4   1    .00   1.00     .00  .00  .00   .0
CD   2  1   0    .00   3.28   19.68 2.00 2.00   .0
CD   3  1   0    .00   3.28    9.84 2.00 2.00   .0
CD   4  1   0    .00   3.28    9.45 2.00 2.00   .0
CD   5  1   0    .00   3.28    8.37 2.00 2.00   .0
CD   6  1   0    .00   3.28    7.29 2.00 2.00   .0
CD   7  1   0    .00   3.28    6.21 2.00 2.00   .0
CD   8  1   0    .00   3.28    5.14 2.00 2.00   .0
CD   9  1   0    .00   3.28    4.06 2.00 2.00   .0
CD  10  1   0    .00   3.28    2.98 2.00 2.00   .0
CD  11  1   0    .00   3.28    1.90 2.00 2.00   .0
CD  12  1   0    .00    .83     .41 1.73 1.73   .0
CD  13  1   0    .00    .83     .17 1.73 1.73   .0
CD  14  1   0    .00    .83     .41 1.73 1.73   .0
CD  15  4   1    .00   1.00     .00  .00  .00   .0
CD  16  4   1    .00   1.00     .00  .00  .00   .0
CD  17  4   1    .00   1.00     .00  .00  .00   .0
CD  18  2   0    .00    .83    1.00  .00  .00   .0
Q              3.20   .0
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W S P G N - CIVILDESIGN Vers

For: CASC Engineering Group, Riverside, California - S/N 615

WATER SURFACE PROFILE LISTING

Date: 7-28-1998 Time:10:12:39

WATER PROFILE FROM OUTLET FLUME TO OVERSIDE DRAIN

FILENAME SR78ML

SITE 5 MELROSE DR/SR78

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/ Dia.-FT / "N"	Base Wt or I.D.	ZL / ZR	No Wth Prs/Pip / Type Ch
.00	289.92	.958	290.878	6.1	7.88	.964	291.842	.00	.958	.40	1.00	.00	.00	1 .0
.61	.01136					.034847	.02	.96	1.000	1.000	.015		.00	PIPE
.61	289.93	1.000	290.927	6.1	7.77	.937	291.864	.00	.958	.00	1.00	.00	.00	1 .0
2.03	.01136					.037386	.08	1.00	.000	1.000	.015		.00	PIPE
2.64	289.95	1.056	291.006	6.1	7.77	.937	291.943	.00	.958	.00	1.00	.00	.00	1 .0
TRANS STR	.00913					.019514	.13	1.06	.000		.015		.00	PIPE
9.21	290.01	2.155	292.165	6.1	.12	.000	292.165	.00	.143	28.30	3.28	19.68	2.00	0 .0
10.89	.00795					.000098	.00	2.16	.015	.581	.175		2.00	TRAP
20.10	290.10	2.069	292.166	6.1	.12	.000	292.166	.00	.143	27.96	3.28	19.68	2.00	0 .0
10.53	.00795					.000112	.00	2.07	.016	.581	.175		2.00	TRAP
30.63	290.18	1.987	292.167	6.1	.13	.000	292.167	.00	.143	27.63	3.28	19.68	2.00	0 .0
10.18	.00795					.000129	.00	1.99	.018	.581	.175		2.00	TRAP
40.81	290.26	1.907	292.169	6.1	.14	.000	292.169	.00	.143	27.31	3.28	19.68	2.00	0 .0
9.84	.00795					.000149	.00	1.91	.019	.581	.175		2.00	TRAP
50.65	290.34	1.831	292.170	6.1	.14	.000	292.170	.00	.143	27.00	3.28	19.68	2.00	0 .0
9.52	.00795					.000172	.00	1.83	.020	.581	.175		2.00	TRAP
60.16	290.42	1.756	292.172	6.1	.15	.000	292.172	.00	.143	26.71	3.28	19.68	2.00	0 .0
9.20	.00795					.000199	.00	1.76	.021	.581	.175		2.00	TRAP

For: CASC Engineering Group, Riverside, California - S/N 615

WATER SURFACE PROFILE LISTING Date: 7-28-1998 Time:10:12:39

WATER PROFILE FROM OUTLET FLUME TO OVERSIDE DRAIN

FILENAME SR78ML

SITE 5 MELROSE DR/SR78

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/Dia.-FT / "N"	Base Wt or I.D.	ZL / ZR	No Wth Prs/Pip / Type Ch
69.37	290.49	1.685	292.173	6.1	.16	.000	292.174	.00	.143	26.42	3.28	19.68	2.00	0 .0
8.90	.00795					.000229	.00	1.69	.023	.581	.175		2.00	TRAP
78.27	290.56	1.616	292.175	6.1	.16	.000	292.176	.00	.143	26.15	3.28	19.68	2.00	0 .0
8.62	.00795					.000265	.00	1.62	.024	.581	.175		2.00	TRAP
86.88	290.63	1.550	292.178	6.1	.17	.000	292.178	.00	.143	25.88	3.28	19.68	2.00	0 .0
8.34	.00795					.000306	.00	1.55	.026	.581	.175		2.00	TRAP
95.23	290.69	1.486	292.180	6.1	.18	.001	292.181	.00	.143	25.63	3.28	19.68	2.00	0 .0
8.08	.00795					.000354	.00	1.49	.028	.581	.175		2.00	TRAP
103.31	290.76	1.425	292.183	6.1	.19	.001	292.183	.00	.143	25.38	3.28	19.68	2.00	0 .0
7.83	.00795					.000409	.00	1.42	.030	.581	.175		2.00	TRAP
111.14	290.82	1.366	292.186	6.1	.20	.001	292.187	.00	.143	25.14	3.28	19.68	2.00	0 .0
7.60	.00795					.000473	.00	1.37	.032	.581	.175		2.00	TRAP
118.74	290.88	1.309	292.190	6.1	.21	.001	292.190	.00	.143	24.92	3.28	19.68	2.00	0 .0
7.39	.00795					.000547	.00	1.31	.034	.581	.175		2.00	TRAP
126.13	290.94	1.254	292.194	6.1	.22	.001	292.194	.00	.143	24.70	3.28	19.68	2.00	0 .0
7.19	.00795					.000633	.00	1.25	.036	.581	.175		2.00	TRAP
133.32	291.00	1.201	292.198	6.1	.23	.001	292.199	.00	.143	24.49	3.28	19.68	2.00	0 .0
7.00	.00795					.000733	.01	1.20	.039	.581	.175		2.00	TRAP

WATER PROFILE FROM OUTLET FLUME TO OVERSIDE DRAIN
FILENAME SR78ML
SITE 5 MELROSE DR/SR78

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"		ZR	Type Ch
140.32	291.05	1.151	292.203	6.1	.24	.001	292.204	.00	.143	24.28	3.28	19.68	2.00	0 .0
6.84	.00795					.000849	.01	1.15	.042	.581	.175		2.00	TRAP
147.16	291.11	1.102	292.209	6.1	.25	.001	292.210	.00	.143	24.09	3.28	19.68	2.00	0 .0
6.70	.00795					.000984	.01	1.10	.045	.581	.175		2.00	TRAP
153.86	291.16	1.055	292.215	6.1	.27	.001	292.216	.00	.143	23.90	3.28	19.68	2.00	0 .0
6.58	.00795					.001140	.01	1.06	.048	.581	.175		2.00	TRAP
160.45	291.21	1.010	292.223	6.1	.28	.001	292.224	.00	.143	23.72	3.28	19.68	2.00	0 .0
6.50	.00795					.001322	.01	1.01	.051	.581	.175		2.00	TRAP
166.94	291.26	.967	292.231	6.1	.29	.001	292.232	.00	.143	23.55	3.28	19.68	2.00	0 .0
6.44	.00795					.001534	.01	.97	.055	.581	.175		2.00	TRAP
173.38	291.32	.926	292.241	6.1	.31	.001	292.242	.00	.143	23.38	3.28	19.68	2.00	0 .0
5.64	.00795					.001762	.01	.93	.058	.581	.175		2.00	TRAP
179.02	291.36	.891	292.251	6.1	.32	.002	292.252	.00	.143	23.24	3.28	19.68	2.00	0 .0
6.91	.00756					.002027	.01	.89	.062	.589	.175		2.00	TRAP
185.93	291.41	.852	292.265	6.1	.33	.002	292.266	.00	.143	23.09	3.28	19.68	2.00	0 .0
7.04	.00756					.002353	.02	.85	.066	.589	.175		2.00	TRAP
192.97	291.47	.816	292.281	6.1	.35	.002	292.283	.00	.143	22.94	3.28	19.68	2.00	0 .0
7.28	.00756					.002733	.02	.82	.071	.589	.175		2.00	TRAP

For: CASC Engineering Group, Riverside, California - S/N 615

WATER SURFACE PROFILE LISTING

Date: 7-28-1998 Time:10:12:39

WATER PROFILE FROM OUTLET FLUME TO OVERSIDE DRAIN

FILENAME SR78ML

SITE 5 MELROSE DR/SR78

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"		ZR	Type Ch
200.26	291.52	.780	292.301	6.1	.37	.002	292.303	.00	.143	22.80	3.28	19.68	2.00	0 .0
7.69	.00756					.003175	.02	.78	.076	.589	.175		2.00	TRAP
207.94	291.58	.746	292.325	6.1	.39	.002	292.327	.00	.143	22.67	3.28	19.68	2.00	0 .0
8.34	.00756					.003690	.03	.75	.081	.589	.175		2.00	TRAP
216.28	291.64	.714	292.356	6.1	.40	.003	292.358	.00	.143	22.54	3.28	19.68	2.00	0 .0
9.45	.00756					.004289	.04	.71	.087	.589	.175		2.00	TRAP
225.74	291.71	.683	292.396	6.1	.42	.003	292.399	.00	.143	22.41	3.28	19.68	2.00	0 .0
11.51	.00756					.004987	.06	.68	.093	.589	.175		2.00	TRAP
237.25	291.80	.653	292.453	6.1	.45	.003	292.456	.00	.143	22.29	3.28	19.68	2.00	0 .0
16.11	.00756					.005801	.09	.65	.100	.589	.175		2.00	TRAP
253.35	291.92	.624	292.546	6.1	.47	.003	292.549	.00	.143	22.18	3.28	19.68	2.00	0 .0
33.39	.00756					.006749	.23	.62	.107	.589	.175		2.00	TRAP
286.74	292.17	.597	292.771	6.1	.49	.004	292.775	.00	.143	22.07	3.28	19.68	2.00	0 .0
12.62	.00756					.007322	.09	.60	.115	.589	.175		2.00	TRAP
299.36	292.27	.594	292.864	6.1	.49	.004	292.867	.00	.143	22.05	3.28	19.68	2.00	0 .0
TRANS STR	.00836					.012886	.25	.60	.116		.175		2.00	TRAP
318.49	292.43	.675	293.105	6.1	.81	.010	293.115	.00	.225	12.54	3.28	9.84	2.00	0 .0
3.11	.00802					.017143	.05	.67	.183	.859	.175		2.00	TRAP

WATER PROFILE FROM OUTLET FLUME TO OVERSIDE DRAIN
FILENAME SR78ML
SITE 5 MELROSE DR/SR78

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"		ZR	Type Ch
321.60	292.45	.704	293.159	6.1	.77	.009	293.168	.00	.225	12.66	3.28	9.84	2.00	0 .0
4.34	.00802					.014827	.06	.70	.172	.859	.175		2.00	TRAP
325.94	292.49	.735	293.224	6.1	.73	.008	293.233	.00	.225	12.78	3.28	9.84	2.00	0 .0
6.41	.00802					.012828	.08	.73	.160	.859	.175		2.00	TRAP
332.35	292.54	.766	293.307	6.1	.70	.008	293.315	.00	.225	12.90	3.28	9.84	2.00	0 .0
10.41	.00802					.011103	.12	.77	.150	.859	.175		2.00	TRAP
342.75	292.62	.799	293.424	6.1	.67	.007	293.431	.00	.225	13.04	3.28	9.84	2.00	0 .0
20.95	.00802					.009614	.20	.80	.140	.859	.175		2.00	TRAP
363.70	292.79	.833	293.626	6.1	.64	.006	293.632	.00	.225	13.17	3.28	9.84	2.00	0 .0
19.64	.00802					.008684	.17	.83	.131	.859	.175		2.00	TRAP
383.34	292.95	.847	293.797	6.1	.62	.006	293.803	.00	.225	13.23	3.28	9.84	2.00	0 .0
TRANS STR	.02772					.000263	.00	.85	.128		.030		2.00	TRAP
383.70	292.96	.837	293.797	6.1	.66	.007	293.804	.00	.231	12.80	3.28	9.45	2.00	0 .0
TRANS STR	.00000					.000314	.00	.84	.135		.030		2.00	TRAP
384.70	292.96	.837	293.797	6.1	.73	.008	293.805	.00	.249	11.72	3.28	8.37	2.00	0 .0
TRANS STR	.01001					.000411	.00	.84	.151		.030		2.00	TRAP
385.70	292.97	.826	293.796	6.1	.83	.011	293.807	.00	.272	10.59	3.28	7.29	2.00	0 .0
TRANS STR	.01001					.000568	.00	.83	.174		.030		2.00	TRAP

WATER PROFILE FROM OUTLET FLUME TO OVERSIDE DRAIN
FILENAME SR78ML
SITE 5 MELROSE DR/SR78

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope				SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"			ZR	Type Ch
386.70	292.98	.814	293.794	6.1	.96	.014	293.808	.00	.300	9.47	3.28	6.21	2.00	0 .0
TRANS STR	.00998					.000825	.00	.81	.205		.030		2.00	TRAP
387.70	292.99	.801	293.791	6.1	1.13	.020	293.811	.00	.337	8.34	3.28	5.14	2.00	0 .0
TRANS STR	.01001					.001288	.00	.80	.247		.030		2.00	TRAP
388.70	293.00	.785	293.785	6.1	1.38	.030	293.815	.00	.386	7.20	3.28	4.06	2.00	0 .0
TRANS STR	.00000					.002186	.00	.78	.310		.030		2.00	TRAP
389.70	293.00	.774	293.774	6.1	1.74	.047	293.821	.00	.455	6.08	3.28	2.98	2.00	0 .0
TRANS STR	.01001							.77	.404		.030		2.00	TRAP
390.70	293.01	.310	293.320	6.1	7.82	.948	294.268	.00	.558	3.14	3.28	1.90	2.00	0 .0
TRANS STR	.00998					.136211	.14	.31	2.762		.030		2.00	TRAP
391.70	293.02	.591	293.611	6.1	7.21	.808	294.419	.00	.840	2.45	.83	.41	1.73	0 .0
.66	.00305					.026225	.02	.59	2.166	.931	.015		1.73	TRAP
392.36	293.02	.586	293.608	6.1	7.30	.828	294.436	.00	.840	2.44	.83	.41	1.73	0 .0
2.62	.00305					.028446	.07	.59	2.198	.931	.015		1.73	TRAP
394.98	293.03	.570	293.600	6.1	7.66	.910	294.511	.00	.840	2.38	.83	.41	1.73	0 .0
.25	.00000					.030486	.01	.57	2.334	.000	.015		1.73	TRAP
395.23	293.03	.568	293.598	6.1	7.70	.921	294.519	.00	.840	2.38	.83	.41	1.73	0 .0
TRANS STR	.00000					.029889	.02	.57	2.351		.015		1.73	TRAP

For: CASC Engineering Group, Riverside, California - S/N 615

WATER SURFACE PROFILE LISTING Date: 7-28-1998 Time:10:12:39

WATER PROFILE FROM OUTLET FLUME TO OVERSIDE DRAIN

FILENAME SR78ML

SITE 5 MELROSE DR/SR78

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT) / SF Ave	Water Elev / HF	Q (CFS) / SE Dpth	Vel (FPS) / Froude N	Vel Head / Norm Dp	Energy Grd.El. / "N"	Super Elev / ZR	Critical Depth	Flow Top Width	Height/ Dia.-FT or I.D.	Base Wt ZL	No Wth Prs/Pip / Type Ch
395.93	293.03	.637	293.667	6.1	7.54	.882	294.549	.00	.902	2.37	.83	.17 1.73	0 .0
.71	.00000					.029658	.02	.64	2.274	.000	.015		1.73 TRAP
396.64	293.03	.631	293.661	6.1	7.65	.909	294.571	.00	.902	2.35	.83	.17 1.73	0 .0
TRANS STR	.00000					.033336	.02	.63	2.318		.015		1.73 TRAP
397.34	293.03	.548	293.578	6.1	8.21	1.046	294.624	.00	.840	2.30	.83	.41 1.73	0 .0
.67	.00000					.037103	.02	.55	2.547	.000	.015		1.73 TRAP
398.01	293.03	.543	293.573	6.1	8.32	1.075	294.648	.00	.840	2.29	.83	.41 1.73	0 .0
2.29	.00437					.040100	.09	.54	2.592	.864	.015		1.73 TRAP
400.30	293.04	.529	293.569	6.1	8.69	1.172	294.742	.00	.840	2.24	.83	.41 1.73	0 .0
WALL	EXIT												
400.30	293.04	.958	293.998	6.1	7.88	.964	294.962	.00	.958	.40	1.00	.00 .00	1 .0
.43	.00152					.034847	.02	.96	1.000	1.000	.015		.00 PIPE
400.73	293.04	1.000	294.041	6.1	7.77	.937	294.977	.00	.958	.00	1.00	.00 .00	1 .0
6.14	.00152					.037386	.23	1.00	.000	1.000	.015		.00 PIPE
406.87	293.05	1.230	294.280	6.1	7.77	.937	295.217	.00	.958	.00	1.00	.00 .00	1 .0
JUNCT STR	.02373					.024884	.07	.00	.000		.015		.00 PIPE
409.82	293.12	2.591	295.711	3.2	4.07	.258	295.969	.00	.766	.00	1.00	.00 .00	1 .0
35.76	.05397					.010740	.38	2.59	.000	.468	.015		.00 PIPE

WATER SURFACE PROFILE LISTING

WATER PROFILE FROM OUTLET FLUME TO OVERSIDE DRAIN
FILENAME SR78ML
SITE 5 MELROSE DR/SR78

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"		ZR	Type Ch
445.58	295.05	1.046	296.096	3.2	4.07	.258	296.353	.00	.766	.00	1.00	.00	.00	1 .0
WALL	ENTRANCE													
445.58	295.05	1.471	296.521	3.2	2.18	.074	296.594	.00	.683	1.00	.83	1.00	.00	0 .0

PROJECT 5, SITE 1
HYDRAULIC CALCULATIONS
ESCONDIDO MAINTENANCE STATION

AEI·CASC ENGINEERING

DATE: _____ JOB NO.: STE 2 CLIENT: _____ PROJECT: CALTRANS NPDES PROJECT	SHEET ____ OF ____ DESIGNER _____ QA/QC _____

TRIBUTARY AREA = 0.80 AC.

PER DELAWARE FILTER DESIGN GUIDELINE

SEDIMENT CHAMBER = FILTER CHAMBER = 540 FT³ PER ACRE

ALSO THE SURFACE AREA MUST HAVE 720 SQUARE FEET (EQUALLY DIVIDED) PER ACRE OF DRAINAGE AREA

∴ SURFACE AREA = $\left(\frac{720}{2}\right) \times 0.80 = 288 \text{ FT}^2 = 26.7 \text{ m}^2$

MIN. DEPTH = $\frac{0.80 \times 540}{320} = 1.35$ FT

PEAK 1-YR STORM = 2.23

CHECK PONDING DEPTH INSIDE OF GT3 CATCH BASIN

$Q = Ca\sqrt{2gh}\,\frac{\pi}{2}$ ASSUME 12" DISCHARGE PIPE

$h = \frac{\left(\frac{Q}{Ca}\right)^2 \frac{1}{2g}\,\frac{\pi}{2}}{2} = \left(\frac{2.23}{(.545)(.9)}\right)^2 \frac{1}{64.32} + \frac{1'}{2} = 0.848 = 0.85'$

AVAILABLE HEAD = TOP OF GRATE ELEV. — RIM INFLOW PIPE FLOW
= 203.189 m — 202.786 m = 0.403 meters
= 1.32 FEET O.K.

DELAWARE FILTER LENGTH = $\frac{288 \text{ (CHAMBER AREA)}}{3.5 \text{ (GRATE WIDTH)}} = 82.3 = 25.1$ METERS

CHECKING PIPE COVER WIDTH = 0.86 m FOR FIRST COVER AND 0.90 m FOR BOTH ADDITIONAL GRATE

∴ USE LENGTH OF 27.86 m

```
==========================================================================
INLET NUMBER                    LENGTH    0.0         STATION

  TOTAL PEAK DISCHARGE =  2.20 (cfs)

GUTTER SLOPE = 0.0200 FT/FT        PAVEMENT CROSS SLOPE =  0.0200 FT/FT


SPREAD AT A SLOPE OF .020 (ft./ft.) AND   2.20 (cfs) IS  7.96 (ft.)

    XXXXXXXXXX GRATE INLET IN A SUMP XXXXXXXXXX
    DEPTH OF WATER (ft) =   0.06           SPREAD (ft)   =  3.24
Grate operates as A WEIR
```

NORMAL DEPTH CALC FOR SITE 2
Worksheet for Circular Channel

Project Description	
Project File	c:\fmw\fmw\project1.fm2
Worksheet	NORMAL DEPTH CALCS FOR SITE 2
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

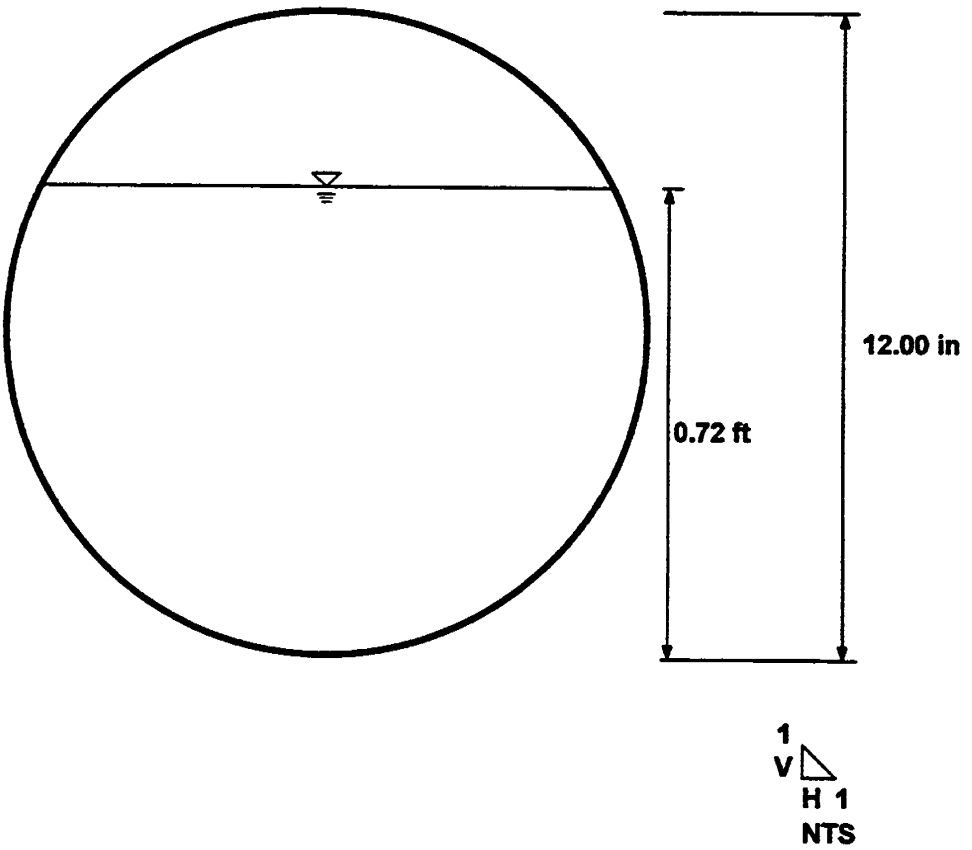
Input Data		
Mannings Coefficient	0.013	
Channel Slope	0.005000	ft/ft
Diameter	12.00	in
Discharge	2.20	cfs

Results		
Depth	0.72	ft
Flow Area	0.61	ft^2
Wetted Perimeter	2.03	ft
Top Width	0.89	ft
Critical Depth	0.63	ft
Percent Full	72.35	
Critical Slope	0.007157	ft/ft
Velocity	3.62	ft/s
Velocity Head	0.20	ft
Specific Energy	0.93	ft
Froude Number	0.77	
Maximum Discharge	2.71	cfs
Full Flow Capacity	2.52	cfs
Full Flow Slope	0.003813	ft/ft
Flow is subcritical.		

Cross Section
Cross Section for Circular Channel

Project Description	
Project File	c:\fmw\fmw\project1.fm2
Worksheet	NORMAL DEPTH CALCS FOR SITE 2
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.013	
Channel Slope	0.005000	ft/ft
Depth	0.72	ft
Diameter	12.00	in
Discharge	2.20	cfs



PROJECT 5, SITE 2
HYDRAULIC CALCULATIONS
I5/SR78 PARK & RIDE

AEI·CASC ENGINEERING

DATE: 3/9/98 JOB NO.: 57764 CLIENT: RBF - CALTRANS PROJECT: NPDES PILOT PROGRAM	SHEET ___ OF ___ DESIGNER ERF QA/QC

SITE No. 4 - SR78 / I5 PARK AND RIDE

1 YR PEAK FLOW = 1.29 cfs

25 YR PEAK FLOW = 1.74 cfs

1 YR - 24 HR STORM VOLUME = 3,734 FT^3 = 105.7 m^3

AVAILABLE HEAD = 3m ± THEREFORE USE 2 m DEPTH

∴ REQUIRED FULL SEDIMENTATION CHAMBER AREA = $\frac{105.7}{2}$ = 52.9

∴ USE 7 m WIDE x 8 m LONG SED. CHAMBER

PER THE AUSTIN SAND FILTER GUIDELINE THE FILTRATION RATE THROUGH THE SAND FILTER IS 0.0545 GAL/MIN/FT^2

USING THE STORM VOLUME OF 3,734 FT^3 (27,930 GAL) AND A MINIMUM PERC. RATE OF 24 HOURS:

$$\text{FILTER AREA} = \frac{27{,}930}{(24)(.0545)(60)} = 356 \text{ FT}^2 = 33.1 \text{ m}^2$$

USE FILTER SIZE OF 7.0 m WIDE x 4.5 m LONG

AEI AGUILAR ENGINEERING INCORPORATED
CIVIL ENGINEERING • LAND SURVEYING
937 SOUTH VIA LATA, SUITE 500
COLTON, CA 92324
PH. (909) 783-0101 FAX (909) 783-0108

SUBJECT:	RBF / CALTRANS PILOT STUDY		
JOB No.:	57704	SHEET No.:	1 OF 3
CALC. BY:	J. C	DATE:	
CHECKED BY:		DATE:	

INLET CALCULATIONS

INLET NO. 1

KNOWN VARIABLES

- Q_1 0.626 cfs Q_{25} = 1.324 cfs
- INLET TYPE: GO INLET
- PROPOSED SLOPE = 0.01
- EXIST OUTLET PIPE 18"

DETERMINE PIPE SIZE:

ASSUME 8" D_N = 0.37 F_R = 1.01

BASED ON ORIFICE & D_c EQN, DETERMINE MAXIMUM PONDING DEPTH INSIDE G.O. INLET.

* ORIFICE EQ. $Q = CA\sqrt{2gh}$

Q = 0.63 cfs C = 0.6

A = 0.3526

$$h = \left(\frac{Q}{CA}\right)^2 / 64.32 \rightarrow \left(\frac{0.63}{0.6 \cdot 0.3526}\right)^2 / 64.32$$

h = 0.138'

TOTAL HEAD OF H_2O

$H_o = h + D/2 \rightarrow 0.138 + 0.67/2$

H_o = 0.473'

* D_c EQN: $H = D_c + K\frac{V^2}{2g}$ D_c = 0.37 A_c = 0.2 ft²

Q_1 = 0.63 K = 1.25

$$H = 0.37 + 1.25 \frac{0.63^2}{(0.2)^2(64.32)}$$

H_o = 0.56'

∴ D_c CONTROLS PONDING DEPTH $H_D > H_o$

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SUBJECT:			
JOB No.:		SHEET No.:	2 OF 3
CALC. BY:	K	DATE:	
CHECKED BY:		DATE:	

MAXIMUM PONDING DEPTH FOR EXISTING 18" PIPE

BASED ON ORIFICE & D_C EQN

$Q_{25} = 1.32$ $A_{18"} = 1.77 ft^2$

$Q = CA\sqrt{2gh}$ $h = \left(\frac{Q}{CA}\right)^2 / 64.32$ $h = \left[\frac{1.32}{0.6(1.77)}\right]^2 / 64.32$

$h = 0.024'$

$H = h + D/2$ $H = 0.024 + 0.75/2$

$H_D = 0.77'$

D_C EQN. $H = D_C + K\frac{Q^2}{A^2 2g}$ $D_C = 0.52$ $A = 0.54$

$H_D = 0.52 + 1.25\left(\frac{1.32}{0.54}\right)^2 / 64.32$ $H = 0.568'$

∴ ORIFICE CONTROLS $H_D > H_O$

INLET #2

KNOWN VAR: • $Q_1 = 1.29$ $Q_{25} = 1.41$

• INLET TYPE: GO

• PROPOSED SLOPE 0.01

• EXISTING PIPE OUTLET 18"

MAXIMUM PONDING DEPTH BASED ON ORIFICE & D_C EQ.

ASSUME 10" PIPE $D_N = 0.51'$ $FF_R = 1.01$

ORIFICE EQ: $Q = CAN\sqrt{2gh}$ $Q = 1.29$ $A = 0.545 ft^2$ $C = 0.6$

$h = \left[\frac{1.29}{0.6(.545)}\right]^2 / 64.32$ $h = 0.242$

$H_O = h + D/2$ $H_O = 0.242 + 0.83/2$ $H_O = 0.67"$

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SUBJECT:			
JOB No.:		SHEET No.:	3 of 3
CALC. BY:	K	DATE:	
CHECKED BY:		DATE:	

MAX. PONDING DEPTH BASED ON D_c EQN.

$H = D_c + 1.25\frac{V^2}{2g}$ $\quad D_c = 0.51 \quad A = 0.34 ft^2$ $\quad Q_1 = 1.29 cfs$

$H_D = 0.51 + 1.25\left[\frac{1.29}{0.34}\right]^2 / 64.32 \quad H_D = 0.79'$

$\therefore H_D > H_O$ $\quad D_c$ CONTROLS!

MAXIMUM PONDING DEPTH FOR Q_{25} & EXISTING 18" OUTLET PIPE. UTILIZE ORIFICE & D_c EQN.

ORIFICE EQN: $h = \left(\frac{Q}{CA}\right)^2 / 64.32 \quad Q = 1.41 \quad A = 1.77 \quad C = 0.6$

$h = \left[\frac{1.41}{0.6(1.77)}\right]^2 / 64.32 \quad h = 0.0274$

$H_O = 0.0274 + 0.75 \quad H_O = 0.78'$

D_c EQN. $\quad D_c = 0.52 \quad A = 0.54$

$H_D = 0.52 + \left(\frac{1.41}{0.54}\right)^2 \left(\frac{1.25}{64.32}\right) \quad H_D = 0.65'$

$H_O > H_D$ ORIFICE CONTROLS!

Q1 STORM EVENT FOR 10 IN. PIPE INLET
Worksheet for Circular Channel

Project Description	
Project File	c:\haestad\fmw\location.fm2
Worksheet	LOCATION 4 SAND FILTER INLET 10" PIPE
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

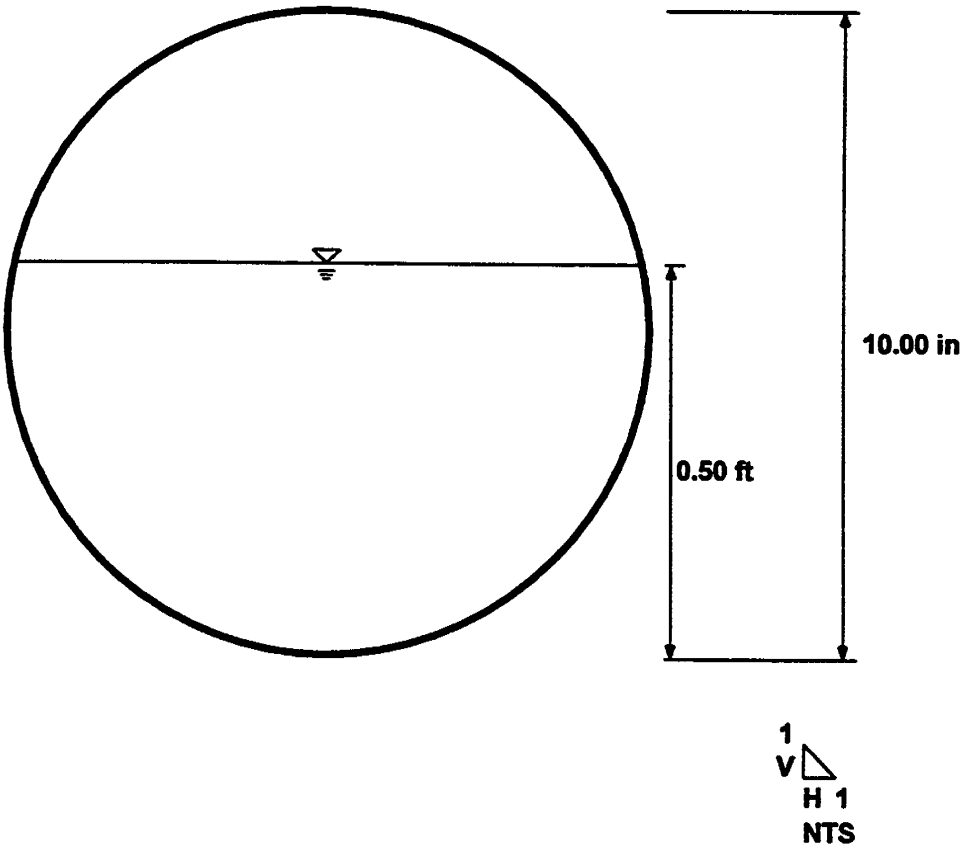
Input Data		
Mannings Coefficient	0.015	
Channel Slope	0.010000	ft/ft
Diameter	10.00	in
Discharge	1.29	cfs

Results		
Depth	0.50	ft
Flow Area	0.34	ft^2
Wetted Perimeter	1.48	ft
Top Width	0.81	ft
Critical Depth	0.51	ft
Percent Full	60.44	
Critical Slope	0.009774	ft/ft
Velocity	3.74	ft/s
Velocity Head	0.22	ft
Specific Energy	0.72	ft
Froude Number	1.01	
Maximum Discharge	2.04	cfs
Full Flow Capacity	1.90	cfs
Full Flow Slope	0.004616	ft/ft
Flow is supercritical.		

CROSS SECTION FOR 10 IN PIPE INLET
Cross Section for Circular Channel

Project Description	
Project File	c:\haestad\fmw\location.fm2
Worksheet	LOCATION 4 SAND FILTER INLET 10" PIPE
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.015	
Channel Slope	0.010000	ft/ft
Depth	0.50	ft
Diameter	10.00	in
Discharge	1.29	cfs



PROJECT 5, SITE 3
HYDRAULIC CALCULATIONS
LA COSTA PARK & RIDE

AEI·CASC ENGINEERING

DATE: 3/13/98 JOB NO.: 57704 CLIENT: RBF PROJECT: BMP SITES, DISTRICT 11	SHEET 1 OF ___ DESIGNER ___ QA/QC ___

1. SEDIMENTATION BASIN DESIGN

a. BASIN SIZING

1 YR UNIT HYDROGRAPH VOLUME, V

$V = .1855 \text{ AC FT.} = L \times W \times D$

$= 8080.38 \text{ ft}^3$

$= 228.675 \text{ m}^3$

GIVEN: $L_s = 15 \text{ m}$

$W = 12 \text{ m}$

$\therefore D = 1.2704 \text{ m} = D_{AVG}$

$D_{AVG} = \frac{D_1 + D_2}{2}$

$D_2 = D_1 + L S \quad ; \quad S = 0.001$

$D_{AVG} = D_1 + 15(.001) + D_1 = 1.2704$

$2D_1 = \frac{1.2704}{.015}$

$D_1 = 1.2629$

$D_2 = 1.2629 + .015 = 1.278$

AEI·CASC ENGINEERING

DATE: _____ JOB NO.: _____ CLIENT: _____ PROJECT: _____	SHEET 2 OF ____ DESIGNER _____ QA/QC _____

b. SEDIMENTATION OUTFLOW SYSTEM

MAX OUTFLOW for 24 hr MIN DRAW DOWN TIME

$$Q_{out} = \frac{V}{T} = \frac{8080.38}{24 \times 3600} = 0.094 \text{ cfs}$$

2. FILTRATION BASIN DESIGN

C q = Filtration rate = 0.0545 gal/min/ft²

= 78.48 gpd/ft²

$$A = \frac{V}{q} = \frac{8080.38 \times 7.48}{78.48} = 770.148 \text{ ft}^2$$

$$= 71.549 \text{ m}^2$$

$$L_f = \frac{71.549}{12} = 5.962 \quad \text{Say } 6.0 \text{ m}$$

AEI·CASC ENGINEERING

DATE: _____ JOB NO.: _____ CLIENT: _____ PROJECT: _____	SHEET 1 OF 2 DESIGNER _____ QA/QC _____

GRATE INLET

$A = 2' \times 3' = 6\ ft^2$

i USE ORIFICE EQN

$$H = \left(\frac{Q}{CA \times .5}\right)^2 / 2g \qquad C = .6$$

FOR $Q_R = 2.64$ cfs F.S. = 0.5

$$H = \left(\frac{2.64}{.6 \times 6 \times .5}\right)^2 / 64.4 = 0.033' = .01m$$

ii Check $Q_{25} = 4.91$ cfs

$$H = \left(\frac{4.91}{.6 \times 6 \times .5}\right)^2 / 64.4 = .116' = 0.035m$$

AVAILABLE HEAD = 0.3m > .035 ∴ OK

AEI·CASC ENGINEERING

DATE: _____ JOB NO.: _____ CLIENT: _____ PROJECT: _____	SHEET 2 OF 2 DESIGNER _____ QA/QC _____

1- BMP inlet H= 0.66', See Seperate Calcs.

2- BMP inlet Channel Water Surface equation - Varies

See WSPG calcs.

3- overflow channel flow depth = 0.43' see Seperate

Calcs.

937 South Via Lata, Suite 500, Colton, CA 92324 - 909-783-0101

Rectangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name:

Comment: Site 3 - BMP Inflow Channel

Solve For Depth

Given Input Data:

Bottom Width.....	3.28 ft
Manning's n.....	0.014
Channel Slope....	0.0002 ft/ft
Discharge.....	2.30 cfs

Computed Results:

Depth.....	0.73 ft
Velocity.....	0.95 fps
Flow Area.....	2.41 sf
Flow Top Width...	3.28 ft
Wetted Perimeter.	4.75 ft
Critical Depth...	0.25 ft
Critical Slope...	0.0055 ft/ft
Froude Number....	0.20 (flow is Subcritical)

FIND CHANNEL ENTRANCE DEPTH:

USING WEIR EQN:

$$Q = CLH^{3/2}$$

$$H = \left(\frac{Q}{CL}\right)^{2/3} = \left(\frac{2.3}{(2.8)(3.28)}\right)^{2/3}$$

$$= 0.40 \text{ FT} \quad (1\text{YR } Q)$$

USING Q25 $H = 0.66'$

Open Channel Flow Module, Version 3.21 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Rectangular Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name:

Comment: Site 3 Overflow Channel

Solve For Depth

Given Input Data:

Bottom Width.....	3.28 ft
Manning's n.....	0.014
Channel Slope....	0.1100 ft/ft
Discharge.....	2.60 cfs

Computed Results:

Depth.....	0.11 ft
Velocity.....	7.53 fps
Flow Area.....	0.35 sf
Flow Top Width...	3.28 ft
Wetted Perimeter.	3.49 ft
Critical Depth...	0.27 ft
Critical Slope...	0.0054 ft/ft
Froude Number....	4.09 (flow is Supercritical)

FIND WEIR FLOW DEPTH INTO CHANNEL: (OVERFLOW CHNL)

$Q = CLH^{3/2}$ $\left(Q = Q_{25} - Q_{\substack{BMP \\ INLET \\ CHNL}} = 4.9 - 2.3 = 2.6 cfs\right)$

$H = \left(\frac{2.6}{(2.8)(3.28)}\right)^{2/3}$

$= 0.43'$

Open Channel Flow Module, Version 3.21 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Site 3 BMP Inflow Water Surface Profile
1 year storm
Filename: Site3.wsn

AR Used Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS) / Vel Head / SF Ave	Energy Grd.El. / HF	Super Elev / SE Dpth	Critical Depth / Froude N	Flow Top Width / Norm Dp	Height/Dia.-FT / "N"	Base Wt or I.D.	ZL / ZR	No Wth Prs/Pip / Type Ch
.00	17.82	.521	18.341	2.3	3.37 / .176 /	18.517 /	.00 /	.537	2.21	.83	.41	1.73	0 .0
.50	.00203				/ .006857	.00	.52	1.068	.671	.015		1.73	TRAP
.50	17.82	.509	18.330	2.3	3.50 / .191 /	18.520 /	.00 /	.537	2.17	.83	.41	1.73	0 .0
.85	.00203				/ .007712	.01	.51	1.123	.671	.015		1.73	TRAP
1.35	17.82	.494	18.317	2.3	3.68 / .210 /	18.527 /	.00 /	.537	2.12	.83	.41	1.73	0 .0
1.05	.00203				/ .008761	.01	.49	1.193	.671	.015		1.73	TRAP
2.40	17.82	.481	18.305	2.3	3.86 / .231 /	18.536 /	.00 /	.537	2.07	.83	.41	1.73	0 .0
1.20	.00203				/ .009952	.01	.48	1.266	.671	.015		1.73	TRAP
3.61	17.83	.467	18.294	2.3	4.04 / .254 /	18.548 /	.00 /	.537	2.03	.83	.41	1.73	0 .0
1.31	.00203				/ .011306	.01	.47	1.345	.671	.015		1.73	TRAP
4.92	17.83	.454	18.284	2.3	4.24 / .279 /	18.563 /	.00 /	.537	1.98	.83	.41	1.73	0 .0
.25	.00000				/ .012234	.00	.45	1.428	.000	.015		1.73	TRAP
5.17	17.83	.450	18.280	2.3	4.30 / .286 /	18.567 /	.00 /	.537	1.97	.83	.41	1.73	0 .0
TRANS STR	.00000				/ .009109	.01	.45	1.451		.015		1.73	TRAP
5.87	17.83	.596	18.426	2.3	3.21 / .160 /	18.586 /	.00 /	.596	2.23	.83	.17	1.73	0 .0
.62	.00000				/ .005113	.00	.60	1.000	.000	.015		1.73	TRAP
6.49	17.83	.626	18.456	2.3	2.93 / .134 /	18.589 /	.00 /	.596	2.34	.83	.17	1.73	0 .0
.09	.00000				/ .004463	.00	.63	.892	.000	.015		1.73	TRAP

Site 3 BMP Inflow Water Surface Profile
1 year storm
Filename: Site3.wsn

AR Used Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS) / SF Ave	Vel Head / HF	Energy Grd.El. / SE Dpth	Super Elev / Froude N	Critical Depth / Norm Dp	Flow Top Width / "N"	Height/ Dia.-FT / ZR	Base Wt or I.D. / ZL	No Wth Prs/Pip / Type Ch
6.58	17.83	.628	18.458	2.3	2.92 /	.132 /	18.590 /	.00 /	.596 /	2.34 /	.83 /	.17 /	1.73 /	0 /	.0 /
TRANS STR	.00000					.003008	.00	.63	.886		.015		1.73	TRAP	
7.27	17.83	.708	18.538	2.3	1.99 /	.061 /	18.599 /	.00 /	.537 /	2.86 /	.83 /	.41 /	1.73 /	0 /	.0 /
.67	.00000					.001579	.00	.71	.550	.000	.015		1.73	TRAP	
7.94	17.83	.710	18.540	2.3	1.98 /	.061 /	18.600 /	.00 /	.537 /	2.86 /	.83 /	.41 /	1.73 /	0 /	.0 /
TRANS STR	.00305					.000891	.00	.71	.548		.015		1.73	TRAP	
11.22	17.84	.755	18.595	2.3	.93 /	.013 /	18.608 /	.00 /	.248 /	3.29 /	.83 /	3.29 /	.00 /	0 /	.0 /
18.95	.00106					.000217	.00	.75	.188	.440	.015		.00	RECTANG	
30.17	17.86	.739	18.599	2.3	.95 /	.014 /	18.613 /	.00 /	.248 /	3.29 /	.83 /	3.29 /	.00 /	0 /	.0 /

PROJECT 5, SITE 4
HYDRAULIC CALCULATIONS
KEARNY MESA MAINTENANCE STATION

AGE-CASC ENGINEERING

737 SOUTH VIA LATA,
SUITE 500
COLTON, CALIFORNIA 92324

(909) 783-0101
FAX (909) 783-0108

SUBJECT:	NPDES PILOT STUDY		
JOB No.:	5704	SHEET No.:	
CALC. BY:	JC	DATE:	
CHECKED BY:		DATE:	

SITE 1 KEARNY MESA M.S

INLET PIPE SYSTEM

DIA = 12" Q_1 = 2.48 cfs

SLOPE = 0.002 Q_{25} = 4.68 cfs

DETERMINE HEAD AT INLET USING WSPGN:

Q_1 = 2.48 cfs H = 1.45'

Q_{25} = 4.68 cfs H = 2.97'

FIND Q_{MAX} H_{INLET} = 1.71' (AVERAGE HEIGHT OF INLET)

INTERPOLATION

$$\Delta Q = \frac{2.2}{1.52}(0.26)$$

$$\Delta Q = 0.38 \text{ cfs}$$

$$Q_{MAX} = 2.86 \text{ cfs}$$

AGI·CASC ENGINEERING

737 SOUTH VIA LATA,
SUITE 500
COLTON, CALIFORNIA 92324

(909) 783-0101
FAX (909) 783-0108

SUBJECT:	NPDES PILOT STUDY		
JOB No.:	57704	SHEET No.:	
CALC. BY:	K	DATE:	
CHECKED BY:		DATE:	

AT Q_{MAX} = 2.86 cfs INLET SYSTEM REACHES MAXIMUM FLOW CAPABILITY.

NUMBER OF CARTRIDGES IN FILTER SYSTEM (D-16)

NO. CARTRIDGES: 86

MANUFACTURER RECOMMENDS 1cfs PER 30 CARTRIDGES:

MAXIMUM FLOW FOR FILTER Q_{FILTER}

$$Q_{FILTER} = \frac{86}{30} \rightarrow 2.87 \text{ cfs}$$

$Q_{FILTER} > Q_{max}$ ok

PROJECT 1
HEC12 Version: V2.91 Run Date: 05-06-1998

==========

INLET NUMBER 1 LENGTH 3.3 STATION 1

TOTAL PEAK DISCHARGE = 2.67 (cfs)

GUTTER SLOPE = 0.0100 FT/FT PAVEMENT CROSS SLOPE = 0.0300 FT/FT

SPREAD	W	W/T	SW	SW/SX	Eo	a	S'W	SE
6.93	4.0	0.57	0.0500	1.7	0.90	2.0	0.041	0.067

XXXXXXXXXX GRATE INLET ON A GRADE XXXXXXXXXX
CFS INTERCEPTED= 2.48 CFS CARRYOVER= 0.19

==========

INLET NUMBER 1 LENGTH 3.3 STATION 1

TOTAL PEAK DISCHARGE = 5.79 (cfs)

GUTTER SLOPE = 0.0100 FT/FT PAVEMENT CROSS SLOPE = 0.0300 FT/FT

SPREAD	W	W/T	SW	SW/SX	Eo	a	S'W	SE
9.83	4.0	0.40	0.0500	1.7	0.75	2.0	0.041	0.061

XXXXXXXXXX GRATE INLET ON A GRADE XXXXXXXXXX
* CFS INTERCEPTED= 4.68 CFS CARRYOVER= 1.11

* NOTE Q_{MAX} FOR INLET SYSTEM IS 2.82 cfs.

```
T1 KEARNY MESA MAINTENANCE STATION                                                0
T2 1 YEAR STORM RUNOFF
T3 FILENAME:KEARNY
SO       .00 389.39  1                          389.39
R      12.80 389.41  1      .015                              .000    .000 0
WE     12.80 389.41  2      .250
R      16.74 389.42  2      .015                              .000
WX     16.74 389.42  3
R      33.64 389.45  3      .015                              .000    .000 0
WE     33.64 389.45  4      .250
SH     33.64 389.45  4                          389.45
CD   1  4   1    .00   1.00     .00  .00  .00   .0
CD   2  2   0    .00   1.33    3.28  .00  .00   .0
CD   3  4   1    .00   1.00     .00  .00  .00   .0
CD   4  2   0    .00   1.96    2.95  .00  .00   .0
Q             2.48   .0
```

KEARNY MESA M.S FILENAME KM25YR
25 YEAR FLOW

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"		ZR	Type Ch
.00	389.39	.898	390.288	4.7	6.30	.616	390.904	.00	.898	.61	1.00	.00	.00	1 .0
1.02	.00156					.020287	.02	.90	1.001	1.000	.015		.00	PIPE
1.02	389.39	.973	390.365	4.7	6.00	.560	390.924	.00	.898	.32	1.00	.00	.00	1 .0
.98	.00156					.020676	.02	.97	.682	1.000	.015		.00	PIPE
2.00	389.39	1.000	390.393	4.7	5.96	.551	390.944	.00	.898	.00	1.00	.00	.00	1 .0
10.80	.00156					.022006	.24	1.00	.000	1.000	.015		.00	PIPE
12.80	389.41	1.231	390.641	4.7	5.96	.551	391.193	.00	.898	.00	1.00	.00	.00	1 .0
WALL	ENTRANCE													
12.80	389.41	1.930	391.340	4.7	.74	.008	391.349	.00	.398	3.28	1.33	3.28	.00	0 .0
3.94	.00254					.000066	.00	1.93	.094	.527	.015		.00	RECTANG
16.74	389.42	1.921	391.341	4.7	.74	.009	391.349	.00	.398	3.28	1.33	3.28	.00	0 .0
WALL	EXIT													
16.74	389.42	1.921	391.341	4.7	5.96	.551	391.892	.00	.898	.00	1.00	.00	.00	1 .0
16.90	.00178					.022972	.39	1.92	.000	1.000	.015		.00	PIPE
33.64	389.45	2.279	391.729	4.7	5.96	.551	392.281	.00	.898	.00	1.00	.00	.00	1 .0
WALL	ENTRANCE													
33.64	389.45	2.968	392.418	4.7	.53	.004	392.423	.00	.428	2.95	1.96	2.95	.00	0 .0

W S P G N - CIVILDESIGN Vers 6.0

For: CASC Engineering Group, Riverside, California - S/N 615

WATER SURFACE PROFILE LISTING

Date: 7-30-1998 Time:11:57:49

KEARNY MESA MAINTENANCE STATION
1 YEAR STORM RUNOFF
FILENAME:KEARNY

Station / L/Elem	Invert Elev / Ch Slope	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS) / SF Ave	Vel Head / HF	Energy Grd.El. / SE Dpth	Super Elev / Froude N	Critical Depth / Norm Dp	Flow Top Width / "N"	Height/Dia.-FT / ZR	Base Wt or I.D.	ZL	No Wth Prs/Pip / Type Ch
.00	389.39	.675	390.065	2.5	4.40 / .009589	.300 / .00	390.365 / .68	.00 / .999	.675 / 1.000	.94 / .015	1.00	.00	.00	1 / PIPE	.0
.23	.00156														
.23	389.39	.704	390.094	2.5	4.19 / .008555	.273 / .01	390.367 / .70	.00 / .918	.675 / 1.000	.91 / .015	1.00	.00	.00	1 / PIPE	.0
1.03	.00156														
1.25	389.39	.736	390.128	2.5	4.00 / .007671	.248 / .02	390.376 / .74	.00 / .840	.675 / 1.000	.88 / .015	1.00	.00	.00	1 / PIPE	.0
2.20	.00156														
3.46	389.40	.772	390.168	2.5	3.81 / .006918	.226 / .02	390.393 / .77	.00 / .763	.675 / 1.000	.84 / .015	1.00	.00	.00	1 / PIPE	.0
3.45	.00156														
6.91	389.40	.811	390.212	2.5	3.63 / .006292	.205 / .04	390.417 / .81	.00 / .686	.675 / 1.000	.78 / .015	1.00	.00	.00	1 / PIPE	.0
5.57	.00156														
12.48	389.41	.856	390.266	2.5	3.46 / .006001	.186 / .00	390.452 / .86	.00 / .605	.675 / 1.000	.70 / .015	1.00	.00	.00	1 / PIPE	.0
.32	.00156														
12.80	389.41	.858	390.268	2.5	3.46 / .186	390.454 / .00	.675 / .70	1.00	.00	.00	1 /	.0			
WALL ENTRANCE															
12.80	389.41	1.190	390.600	2.5	.64 / .000068	.006 / .00	390.607 / 1.19	.00 / .103	.261 / .348	3.28 / .015	1.33	3.28	.00	0 / RECTANG	.0
3.94	.00254														
16.74	389.42	1.181	390.601	2.5	.64 / .006	390.608 / .00	.261 / 3.28	1.33	3.28	.00	0 /	.0			
WALL EXIT															

```
T1                                                                                  0
T2 KEARNY MESA M.S  FILENAME KM25YR
T3 25 YEAR FLOW
SO       .00 389.39  1                          389.39
R      12.80 389.41  1      .015                                  .000    .000 0
WE     12.80 389.41  2      .250
R      16.74 389.42  2      .015                                  .000
WX     16.74 389.42  3
R      33.64 389.45  3      .015                                  .000    .000 0
WE     33.64 389.45  4      .250
SH     33.64 389.45  4                          389.45
CD   1  4   1    .00   1.00     .00  .00  .00   .0
CD   2  2   0    .00   1.33    3.28  .00  .00   .0
CD   3  4   1    .00   1.00     .00  .00  .00   .0
CD   4  2   0    .00   1.96    2.95  .00  .00   .0
Q             4.68   .0
```

KEARNY MESA MAINTENANCE STATION
1 YEAR STORM RUNOFF
FILENAME:KEARNY

Station	Invert Elev	Depth (FT)	Water Elev	Q (CFS)	Vel (FPS)	Vel Head	Energy Grd.El.	Super Elev	Critical Depth	Flow Top Width	Height/ Dia.-FT	Base Wt or I.D.	ZL	No Wth Prs/Pip
L/Elem	Ch Slope					SF Ave	HF	SE Dpth	Froude N	Norm Dp	"N"		ZR	Type Ch
16.74	389.42	1.182	390.602	2.5	3.16	.155	390.757	.00	.675	.00	1.00	.00	.00	1 .0
16.90	.00178					.006451	.11	1.18	.000	1.000	.015		.00	PIPE
33.64	389.45	1.261	390.711	2.5	3.16	.155	390.866	.00	.675	.00	1.00	.00	.00	1 .0
WALL	ENTRANCE													
33.64	389.45	1.454	390.904	2.5	.58	.005	390.910	.00	.280	2.95	1.96	2.95	.00	0 .0

APPENDIX C BIO-FILTER SWALE AND STRIP SEED AND PLANTING DESIGN MIX

April 30, 1998

Bill Whittenberg
RBF & Associates
14725 Alton Parkway
Irvine, CA 92618

Project: Caltrans Storm Water Management - Retrofit Pilot Study

Subject: Planting Recommendations for Bio-Filter Strips

Dear Bill:

In response to your request, enclosed herein is information on candidate plant species for planting within the bio-filter strips. Per our discussions and the background information you provided, the species chosen must perform certain functions and meet specific criteria, as follows:

- Filter suspended solids within runoff from paved areas
- Withstand one-year storm events
- Adapt to climate conditions within Caltrans Districts 7 and 11
- Tolerate periods of both high and low moisture
- Be low-growing
- Require little or no maintenance

Species that meet these criteria are shown on Table 1 (attached), along with information on plant life form, height, origin, beneficial/detrimental characteristics and comments. *Trifolium willdenovii* (tomcat clover), which was recommended previously by others, is also included on Table 1 for the purpose of comparison.

Leguminous plant species were researched because of their ability to add nitrogen to soils. Few legume species are available that meet the criteria listed above, particularly adaptability (i.e., drought tolerance) and low maintenance (most are annuals that may require replanting). To obtain some benefit from the use of nitrogen-fixing species, it is recommended that annual leguminous species be planted initially, but without expectation for natural reseeding.

In order to increase the likelihood of adequate plant cover in the shortest possible time, while fulfilling the criteria above, it is recommended that a mixture of species be planted together. This approach is also beneficial in reducing the potential for damage from diseases and pests that could occur with a one-species, monoculture type planting.

A recommended mixture of species for planting within the bio-filter strips is shown on Table 2 (attached). The table shows the preferred planting method, material application rates for seeds and container plant densities for plants.

If you need information on other plant mixtures/assemblages, additional lists could be developed. Please contact me with any questions or comments and/or if you would like further assistance.

Sincerely,

Martha Blane

Attachments: Table 1
Table 2
References and Sources of Information

TABLE 1
PLANT SPECIES SUITABLE FOR BIO-FILTER PLANTINGS

Genus species	Common Name	Life Form	Height	Origin/Range
Bromus carinatus	California brome	grass, perennial, short-lived (± 2 years)	18" - 36"	Western US, British Columbia to Central America
Deschampsia caespitosa	Tufted hairgrass	grass, perennial, clumping	12" - 30"	North America
Distichlis spicata	Saltgrass	grass, perennial, rhizome/stolon forming	6" - 20"	North America to South America
Elymus glaucus	Blue wildrye	grass, perennial, clumping	18" - 36"	Alaska to Baja California
Hordeum brachyantherum	Meadow barley	grass, perennial, clumping	12" - 18"	North America to Baja California
Leymus triticoides "Rio"	Creeping wildrye	grass, perennial, creeping rhizomes	18" - 36"+	Western US and Baja California
Lupinus bicolor	Pygmy-leaf lupine	legume, annual	4" - 12"	California deserts, mountains and coastal areas
Nasella lepida	Foothill needlegrass	grass, perennial, clumping	12" - 24"	Northern California to Baja California
Nasella pulchra	Purple needlegrass	grass, perennial, clumping	12" - 24"	Northern California to Baja California
Trifolium willdenovii	Tomcat clover	legume, annual	4" - 16"	Western North America

TABLE 1
(Continued)

Genus species	Common Name	Benefits	Detriments	Comments
Bromus carinatus	California brome	Fast-growing, adapted to drought and poor soils.	Short-lived, may be too tall	Often used for soil stabilization and revegetation.
Deschampsia caespitosa	Tufted hairgrass	Grows in dense stands, adapted to moist soils, recovers well from disturbance.	May be too tall, too dense and require too much moisture.	Important range species, widely distributed, sometimes used for erosion control.
Distichlis spicata	Saltgrass	Stout, hardy, adapts to harsh soil conditions (wet or dry) and silt build-up, recovers well from disturbance.	Foliage may turn brown during coldest months.	Spreads by creeping stolons (similar to Bermuda grass in appearance, but not as vigorous), can form a tough mat-like cover.
Elymus glaucus	Blue wildrye	Fast-growing, fast-spreading, good for erosion control.	May be too tall.	Foliage is bluish-green.
Hordeum brachyantherum	Meadow barley	Fast-growing, begins spring growth early, tolerates moist soils.	May be short-lived.	Can provide cover while slower-growing species become established.
Leymus triticoides "Rio"	Creeping wildrye	Tolerates harsh conditions, heavy soils, forms a dense ground cover, long-lived.	May be too tall and too dense.	Stays green late into summer.
Lupinus bicolor	Pygmy-leaf lupine	Nitrogen-fixing, adapts to many soils, germinates early.	Annual, may not reseed if other vegetation is present.	Frequently included in erosion control and revegetation seed mixes.
Nasella lepida	Foothill needlegrass	Adapted to drought and poor/disturbed soils, long-lived, low fuel.	Best in well-drained soils.	Common component of California grasslands; often used for revegetation.
Nasella pulchra	Purple needlegrass	Adapted to drought and poor/disturbed soils, long-lived, low fuel.	Best in clayey soils.	Major component of California grasslands; often used for revegetation.
Trifolium willdenovii	Tomcat clover	Nitrogen-fixing, adapts to heavy soils, germinates early.	Annual, may not reseed.	Seed recently became available for erosion control and revegetation plantings.

TABLE 2
RECOMMENDED SPECIES MIXTURE FOR BIO-FILTER PLANTINGS(1)

Genus species	**Common Name**	**Seed Application Rate Per Acre %Purity/%Germination**	**Container Plant Spacing and Container Size/Type**
Bromus carinatus	California brome	6.0 pounds per acre 95/80	--
Distichlis spicata	Saltgrass	--	12" on-center spacing of "plugs" from cut-up flats
Deschampsia caespitosa	Tufted hairgrass	1.0 pound per acre 80/60	--
Hordeum brachyantherum	Meadow barley	5.0 pounds per acre 90/80	--
Lupinus bicolor	Pygmy-leaf lupine	3.0 pounds per acre 98/80	--
Nasella lepida	Foothill needlegrass	--	12" on-center spacing of groove tubes (2" deep x 3/4" wide)
Nasella pulchra	Purple needlegrass	--	12" on-center spacing of groove tubes (2" deep x 3/4" wide)
Trifolium willdenovii	Tomcat clover	1.5 pounds per acre 95/75	--

1. Seed and container plant recommendations based on which material will provide the most reliable and fastest cover. Some container species are also available as seed.

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APPENDIX D INITIAL NRDC COMMENTS WITH ENGINEERS' RESPONSE

ROBERT BEIN, WILLIAM FROST & ASSOCIATES
PROFESSIONAL ENGINEERS, PLANNERS & SURVEYORS

May 8, 1998

Dr. Richard Horner
230 N.W. 55th Street
Seattle Washington 98107

Re: Response to Review of District 11 Procurement Design Package No. 1

Dear Rich:

We have received the comments you submitted on behalf of the plaintiffs dated May 1, 1998. Your review covered District 11 Consent Decree and the Stipulation of the Court overseeing the District 7 Permanent Injunction and two which apply to the District 11 Consent Decree only. The responses were prepared by Robert Bein, William Frost and Associates (RBF) and AEI-CASC, peer reviewed and finalized RBF. Final review and authorization for distribution was performed by Caltrans.

For the sake of clarity, your original comment is stated first, including your original headings, followed by the response in italic. Your original comments and our responses are as follows:

CONCLUSION OF REVIEW

The hydrologic analysis for Location 6, at least, seems to be inaccurate (see comments on that location for details). That observation calls into question all of the hydrologic estimates made for the projects in these and the other design packages. We do not have the necessary information or time to make a determination of the correctness of these analyses, but we can not proceed further with any projects until a qualified person from the design team reexamines the calculations and affirms their accuracy or makes corrections.

Assuming for the moment that the flow estimates are correct, we tentatively approve the designs for Locations 1, 3, and 4 pending resolution of several issues that we raise in specific comments on those facilities, as well as the hydrologic question.

We do not approve the remaining designs in their present form because of various deviations from accepted design practices and consequent reduced potential to make the fullest possible improvement in runoff water quality. The unapproved designs are inconsistent with paragraph 6.60 of the District 11 Consent Decree, which establishes "... potential for improvements in water quality ..." as a criterion. They are also non-compliant with paragraph 1.A of the District 7 Stipulation stating that, "These devices shall be designed, ... at state-of-the-art levels." The problems that we describe, and have also objected to in the first two sets of comments, would have the individual and collective impact of skewing the apparent efficacy of the BMPs, a principal concern of the plaintiffs from the beginning of this process. We elaborate on our objections to both the tentatively approved and unapproved designs in the next series of comments

LOCATION 1--KEARNY MESA MAINTENANCE STATION COMPOST FILTER, DISTRICT 11 PROGRAM

The design is approved pending successful resolution of the following issues:

1. It is not certain enough that the anticipated runoff will flow to the compost filter and that other runoff will not. Please provide a breakdown of the maintenance station into the subcatchment that is expected to flow to the filter and the subcatchment(s) expected to be excluded (a simple diagram showing major station facilities and subcatchment boundaries would serve this purpose best). Please indicate if the existing topography is considered to control flow direction reliably, or if any devices (e. g., low berms) will be used to direct flow toward or away from the filter.

Response: The location of the proposed interception drain inlet has been selected from the subcatchments available on the station in an area that has space to construct the filter and access and maintain it. The watershed area consists of an asphalt paved storage area. Flow is being conveyed into the proposed interception drain inlet by way of an existing concrete gutter. A normal depth calculation was performed for the gutter to verify required capacity and flow depth. A hydrology map is included for clarification. It is not practical to regrade the station or divert flow which would otherwise require modification to the existing drainage systems. Consequently, no berms or other devices are used to change the existing drainage flow patterns at the station.

2. We corresponded with Stormwater Management, the manufacturer of the unit that will be used, and received the strong recommendation that pretreatment and a high-flow bypass be provided. We understand that you got the same recommendation. We believe this recommendation is sound, and it must be followed for our approval. According to the manufacturer, pretreatment significantly reduces maintenance, even in a situation where sediment loading should be relatively low. The StormGate system offered by Stormwater Management provides both high flow bypass and sufficient pretreatment capability for the needs of this application. Selecting it would meet with our approval.

Response: In regard to the first point concerning the pre-treatment, we also spoke with Felon Wilson of Stormwater Management and we agreed with him that because the tributary area is fully paved pre-treatment is not warranted. In regard to the second point concerning the high flow bypass, the proposed drain inlet has been sized to intercept 2.5 c.f.s. of the tributary 1-year storm total 2.7 c.f.s. Runoff resulting from significantly more intense storms will exceed the hydraulic capacity of the BMP inlet works. This will force a flow-by condition at the proposed interception drain inlet and thusly serve as a high flow bypass. The compost filter has been sized to accommodate 2.7 c.f.s. The maximum inflow into the filter is 2.5 c.f.s.

LOCATION 2--ESCONDIDO MAINTENANCE STATION SAND FILTER, DISTRICTS 7 AND 11 PROGRAMS

This design is not approved in its present configuration, because it does not properly use the "Delaware design" and is thus not an appropriate pilot test of it. The Delaware design intends for sheet flow to enter over the full length of the sediment chamber through slots in its lid, and not as a series of concentrated flows through a distribution pipe as in this design. In our experience the intended design leads to reliable and trouble-free operation, and we object to deviating to a system that may not distribute flow as uniformly nor be as problem-free. To obtain sheet flow introduction the filter could be moved to the location where the grated inlet is in the current design and low berms provided to direct flow.

We surmise that the distribution system was designed to provide for inflow monitoring at a single point. However, we have not demanded that all inflows and outflows be monitored; in fact, we have emphasized other means of judging performance. While monitoring would increase information, it does not yield a full picture of performance because of the inability to monitor all flow. We therefore do not favor sacrificing realistic pilot testing to monitoring exigencies.

Nevertheless, adequate monitoring can still be performed with sheet flow introduction. The inflow sampler can draw from a well mixed point in the sediment chamber and be triggered by a flow meter at the outlet point. This scheme implicitly assumes equality in the influent and effluent flows, a good assumption with a tightly built filter. There is a short lag between runoff beginning to enter and triggering, but the error introduced is much smaller than any error from sampling only a few storms a year.

We are willing to discuss options that may be mutually agreeable on certain conditions. First, the extra expense of a distribution system must not be counted as part of the capital cost. Second, considerable care must be taken to get uniform flow distribution simulating the intended Delaware design. Third, any extra maintenance burden and expense needed to keep the distribution system functioning to provide uniform flow distribution must not be counted in accounting for maintenance problems and costs.

Response: Please note that the series of distribution pipes are for the outlet side of the filter and that the single 250mm pipe is the inflow pipe. Additionally, we spoke with Randy Grier at the State of Delaware Water Resource concerning using a piped inflow versus allowing the flow to enter the sediment chamber via grates. He stated that while the grate inflow is the standard approach the filtering ability of the system will not be appreciably altered using the pipe inflow. Attached is the standard drawing of the sand filter that we obtained from Mr. Grier. Please note that the design shown on the plan matches the standard drawing except for the mentioned grates. The discharge velocity in the inlet pipe is low, and given that the sedimentation chamber works on an overflow principle, even distribution of flow to the sand filter will occur.

In addition to reaching agreement on this point, our approval will depend on successful resolution of the following issues:

1. It is not certain enough that the anticipated runoff will flow to the sand filter and that other runoff will not. Please provide a breakdown of the maintenance station into the subcatchment that is expected to flow to the filter and the subcatchment(s) expected to be excluded (a simple diagram showing major station facilities and subcatchment boundaries would serve this purpose best). Please indicate if the existing topography is considered to control flow direction reliably, or if any devices (e. g., low berms) will be used to direct flow toward or away from the filter.

Response: The location of the proposed interception drain inlet has been placed to capture the maximum amount of available watershed area. The watershed area consists of asphalt paved storage and parking area. Flow is being conveyed into the proposed filter by way of an existing AC dike. The proposed interception drain inlet has been sized to intercept the entire 1-year storm runoff. A hydrology map is included for clarification.

2. Two alternative designs are proposed for this project, but the differences in their purposes and which is preferred are not clear. These points must be clarified.

Response: An alternative design was developed to provide flow attenuation for the site also, this approach has since been abandoned by way of the analysis prepared by RBF.

LOCATION 3--LA COSTA PARK AND RIDE SAND FILTER, DISTRICT 11 PROGRAM;
LOCATION 4--SR 78/I-5 PARK AND RIDE SAND FILTER, DISTRICT 7 PROGRAM

These designs are approved pending successful resolution of the following issues:

1. Are these sand filters fully according to the standard "Austin design?" Figure 1-60 in the City of Austin Guidelines has more detail on entrance energy dissipation features (before the sedimentation chamber) than is present on the design plan. We want those features to be included.

Response: The "Austin Design" standard does include an energy dissipation feature but also specifies a clay lining for the sedimentation chamber. The design proposed incorporates a concrete lining due to site constraints. Therefore, the energy dissipation element is not needed. This point was clarified with Dr. Barrett.

2. At Location 3, will some runoff bypass to the lagoon that could be channeled into the filter with minor work such as low berms? We wish to include all runoff for which treatment is feasible.

Response: The sand filter inflow system is designed to capture all runoff originating from the paved area as well as some landscape areas for the design storm. The remaining landscape/natural area directly tributary to the lagoon is minimal. Capture of this area is not practical from a drainage diversion standpoint, nor would it be desirable to direct additional pervious area to the filter.

3. Outlet energy dissipation must be specified.

Response: The filter outflow and high flow bypass are routed to the existing culvert system. Overall head on the system is reduced with the installation of the filter, therefore, the existing condition will be improved. Currently, there does not appear to be a significant scour problem around the existing outfall pipe. Finally, the existing culvert outfall is located outside of Caltrans right of way in an ecological preserve. Permitting for such an effort would not be forthcoming in the timeframe of this project.

LOCATION 5--MELROSE/SR 78 BIOFILTRATION SWALE, DISTRICTS 7 AND 11 PROGRAMS

The design is not approved because it deviates from state-of-the-art design criteria (e. g., Federal Highway Administration's Evaluation and Management of Highway Runoff Water Quality) in the following ways:

1. The design storm flow velocity (1.2 ft./sec.) is too high. The velocity must be kept under 1 ft./sec. to maintain grass in an upright position for filtering.

Response: The Scoping Study does not specify a maximum velocity of 1 foot per second. It specifies a maximum of 4 feet per second with a preferred velocity of less than 0.9 feet per second. The same document also specifies a minimum swale slope of 1%. The current proposed design utilizes a slope of 0.80% and varying bottom width resulting in a calculated velocity of 1.1 to 1.5 feet per second. The values are in line with the Scoping Study.

2. The design storm residence time is too short. We calculated less than the 5 minutes claimed with a 1.2 ft./sec. velocity and a length measured from the design plan (~ 190 ft). Excessive velocity and insufficient residence time can be remedied by allowing increased flow depth (up to 4 inches, if vegetation is left higher than that), greater swale width, or both. It has been found that width should be limited to 10 ft., because of the difficulty of constructing a level bottom in a very wide swale. However, a wide swale can be separated into two parallel ones separated by a berm (see King County Surface Water Design Manual, 1996 draft). Flow must be well distributed at the inlet to ensure uniformity across the full width. Of course, insufficient residence time can also be corrected by more length if it is available. These options must be explored to bring the swale into compliance with all state-of-the-art design criteria.

Response: Please note that the plans submitted to you are half-sized plots (see bar scale). The proposed biofilter swale is 114 meters (374feet) in length and varies from 3 to 6 meters (10 to 20 feet) in width. Using the velocities stated above and this correct length produces a residence time of 5.2 minutes. Agreed that a residence time beyond the minimum is desirable. The current design already uses all of the available area and therefore the length cannot be extended.

3. The inlet design creates a great risk of erosion and tendency toward flow short circuiting. It is proposed to discharge the influent water on a 16 percent slope at 4.4 ft./sec. velocity into a concrete entrance section with no roughness elements to dissipate energy. The design must ensure that entering flow will not erode, nor at any point within the vegetated swale flow at more than 1ft./sec.

Response: The mentioned 16% occurs upstream of the proposed trapezoidal flume. The proposed slope downstream of the flume is only 0.8%. Hydraulics were computed to determine the water surface profile and associated velocities through the entire inflow and BMP system. We will modify the BMP inlet such that the velocity entering the grass win not exceed 2.5 ft/s (HDMI, 873.3I).

In addition to correction of these deficiencies, our approval will depend on resolution of these additional points:

1. We need reassurance on the vegetation specification from authorities with relevant experience in the San Diego area. We are pleased to learn that you have retained Martha Blane to evaluate vegetation specifications and provide recommendations.

Response: We will incorporate recommendations per her report into the plans and specifications.

2. Two alternative designs are proposed for this project, but the differences in their purposes and which is preferred are not clear. These points must be clarified.

Response: An alternative design was developed to provide flow attenuation for the site also, this approach has since been abandoned by way of the analysis prepared by RBF.

3. It is unclear from the plans what kind of flume will be used as a control device for flow measurement at the inlet. Normally, an off-the-shelf device appropriate for the service would be purchased from a supplier. We request information because of the relationship of this question and the inlet section design covered above. A way must be found to perform monitoring without having a design that will create erosion. Also, very high entrance velocity is inimical to accurate flow measurement.

Response: The plans indicate a trapezoidal flume. Flume details have been added to the plan set.

LOCATION 6--PALOMAR AIRPORT ROAD BIOFILTRATION SWALE, DISTRICTS 7 AND 11 PROGRAMS

The design is not approved for the following reasons:

1. The design storm flow rate estimate (1.0 cfs) is very questionable. The contributing catchment sizes here and at Melrose/SR 78 are almost identical, and both are virtually all paved. However, the flow rate estimate here is only one-fourth the estimate at Melrose/SR 78. We have not been given the details, nor do we have the time now, to check the estimate; but see no way that it can be as low as 1.0 cfs. This disparity must be investigated and calls into question all of the hydrologic estimates.

Response: The difference in peak discharge for the two sites can be attributed to the difference in the length of the two flow paths. This produces different time of concentration values and subsequent runoff totals. The shape of an area can greatly influence the peak discharge value but all other things being equal, has no influence on the runoff volume.

2. A great deal of the space available for biofiltration is devoted instead to a concrete entrance channel. The space must be used to maximum water quality advantage, allowing flow to pass over the shoulder along the full available length, onto vegetation, and then along a vegetated channel. Poor use of space makes the hydraulic residence time insufficient. We calculated less than the 5 minutes claimed with a 1.0 ft./sec. velocity (with the unlikely assumption that this velocity is correct, given the suspect flow rate) and a length measured from the design plan (~ 160 ft). We surmise that the project was designed in this way to allow influent monitoring at a single point. However, we have not demanded that all inflows and outflows be monitored; in fact, we have emphasized other means of judging performance. While monitoring would increase information, it does not yield a full picture of performance because of the inability to monitor all flow. Therefore, it is better to monitor some facilities of a given type more intensively than to monitor all with less coverage. In these circumstances we can not see sacrificing the main goal (learning how best to gain the most water quality benefit) to an imperfect means to that end and a secondary consideration.

Response: Please note that the plans submitted to you are half-sized plots (see bar scale). The proposed biofilter swale is 92.5 meters (304 feet) in length. The concrete swale has been designed to convey the complete 1-year storm runoff into the biofilter swale while allowing for the required 5 minutes of residence time. The concrete swale is inexpensive and requires minimal maintenance.

In addition to correction of these deficiencies, our approval will depend on resolution of these additional points:

1. As with the Melrose/SR 78 swale, we need reassurance on the vegetation specification from Martha Blane.

Response: Will incorporate recommendations

2. The swale side slopes are inconsistent between the design plans and written information and must be reconciled.

Response: The plans are correct. The written information will be updated.

LOCATIONS 7A AND B--CARLSBAD MAINTENANCE STATION INFILTRATION TRENCH AND BIOFILTRATION STRIP, DISTRICTS 7 AND 11 PROGRAMS

This design is not approved at this time, because the intended operation is obscure and seems to be ill conceived. The plan shows the biofiltration strip paralleling the entire infiltration trench. Section B-B suggests that the portion of the strip nearest the inlet of the trench drains onto the trench, with the balance discharging into a biofiltration swale that bypasses the infiltration trench. However, the printed information about this project does not seem to be consistent with that interpretation. It implies that the two treatment devices are entirely separate and that the trench receives all inflow at one point from the concrete swale. We thought that the strip was to be a pre-treatment device prior to the trench. Feeding all flow to the trench at a single point, if that is the design, will overload the media near there. What is the point of having a trench open to receive flow all along its length?

We are left to speculate about what is being attempted here. Is the idea to use monitoring of the trench influent to characterized the water quality of the inflow to both it and the strip? Monitoring will then occur at the end of the grass swale, which will represent treatment in both the strip and the swale, instead of in just the primary device being studied at this site, the strip. Before we can consider approval, we need an explanation and justification of this design and how the monitoring scheme will yield reliable performance information. As we have stated before, we object to compromising the performance of the treatment units in favor of monitoring requirements, when we have emphasized techniques of judging performance other than conventional stormwater monitoring practices.

Response: The trench inflow has been redesigned to sheet flow across the biofilter strip by way of a channel side weir. The redesign also incorporates additional features to separate the strip into two parts to facilitate monitoring monitoring. The trench inflow sample is used for compiling data for the effectiveness of the biofliter strip. The second portion of the strip enters the outlet monitoring device. There was insufficient room at this location to monitor inflow and outflow from the strip while maintaining all flow to the trench. Consequently, about one-third of the site flow (strip outflow monitoring) bypasses the trench and discharges to an existing curb and gutter. We have included a revised layout sheet showing the new configuration for your information/use.

In addition to these points, our approval will depend on resolution of these additional items:

1. It is not certain enough that the anticipated runoff will flow to the treatment units and that other runoff will not. Please provide a breakdown of the maintenance station into the subcatchment that is expected to flow to the units and the subcatchment(s) expected to be excluded (a simple diagram showing major station facilities and subcatchment boundaries would serve this purpose best). Please indicate if the existing topography is considered to control flow direction reliably, or if any devices (e. g., low berms) will be used to direct flow toward or away from the filter.

Response: A hydrology map has been attached for clarification. No berms or other devices are used to redirect flow.

2. We want to see dissipation of energy in concentrated flow such as would enter the trench from a concrete swale at the head end.

Response: The revised inflow system results in adequately low velocities unto the biofilter strip.

3. As with the swales at other locations, we need reassurance on the vegetation specification from Martha Blane.

Response: Will incorporate recommendations .

4. We understand that maintenance base employees are unhappy with parking spaces near the work areas being taken for the treatment system. In this situation we want explanatory signage and education ("tailgate training") to be included as part of the project.

Response: The project plans include work to restore their parking in the immediate area. Caltrans employees will be properly notified and alerted to required sensitivity to the BMP installation at all sites. Signage is not necessary.

Please feel free to contact us with any questions or if we can provide any additional information. We would be happy to meet with you to discuss these comments in person.

Sincerely,

ROBERT BEIN, WILLIAM FROST & ASSOCIATES

William R. Whittenberg, P.E., DEE
Task Order Manager

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Enclosures

Cc: Chris May, NRDC
David Beckman, NRDC
Terry Tamminen, Santa Monica Bay Keeper
Jeremy Johnstone, EPA
Ken Moser, San Diego Bay Keeper
Steve Borroum, Caltrans
Yulya Davidova, Caltrans
Scott Taylor, RBF
Erwin Fogerson, AEI-CASC

APPENDIX E CLARIFICATION OF HYDROLOGY CALCULATIONS FOR PROJECT 2, SITES 3 AND PROJECT 2, SITE 4 (RATIONAL METHOD HAND CALCULATIONS)

ROBERT BEIN, WILLIAM FROST & ASSOCIATES
PROFESSIONAL ENGINEERS, PLANNERS & SURVEYORS

May 29, 1998 JN 34358

Dr. Richard Horner
Consultant
230 N.W. 55th Street
Seattle Washington 98107

SUBJECT: Clarification of Hydrology Calculations for District 11, Sites 5 and 6

Dear Rich:

Enclosed please find a detailed set of calculations comparing the design discharge for Sites 5 and 6 of the San Diego Procurement Package. These calculations are in response to your original comments on the designs dated May 1, 1998, and your additional reference to this comment in your May 22, 1998 letter commenting on the District 7 procurement packages.

As we have previously discussed, the hydrology for the sites is being completed using the Rational Method. The Rational Method is a standard procedure for the computation of storm water runoff from relatively small areas (generally less than from about 400 acres to a square mile). The procedure is prescribed for use in both Los Angeles and San Diego by the respective public works agencies. The Rational Method is familiar to the licensed engineers responsible for the design of the pilots and as with all engineering computations and analysis, is subject to review and interpretation by the engineer.

The attached calculations show that at Site 5 (Melrose Drive), the peak 1-year discharge is about 3.7 cfs with a time of concentration of about 15 minutes, from a drainage area of about 2.4 acres. The peak discharge at Site 6 (Palomar Airport Road) is about 1.7 cfs with a time of concentration of 31 minutes from a drainage area of about 2.3 acres. The discharge is substantially lower from about the same area due to the significant difference in the time of concentration between the two sites. The intensity-duration curves for the southern California area fall sharply as the time from the beginning of rain becomes greater. The Palomar Airport Road site is relatively long, and very flat (about 0.0015 ft/ft), resulting in a relatively long time of concentration as compared to the Melrose Drive site.

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Please be assured that the hydrology studies are being performed with the general standard of care and proficiency of the industry. The engineers performing the work are licensed to practice in California, licensure is a requirement to perform the hydrology calculations in the state.

I would be happy to discuss this matter further, or answer any additional questions you may have. Please feel free to contact me at 714 855 3629.

Sincerely,

Scott Taylor, P.E.
Project Manager

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Enclosures

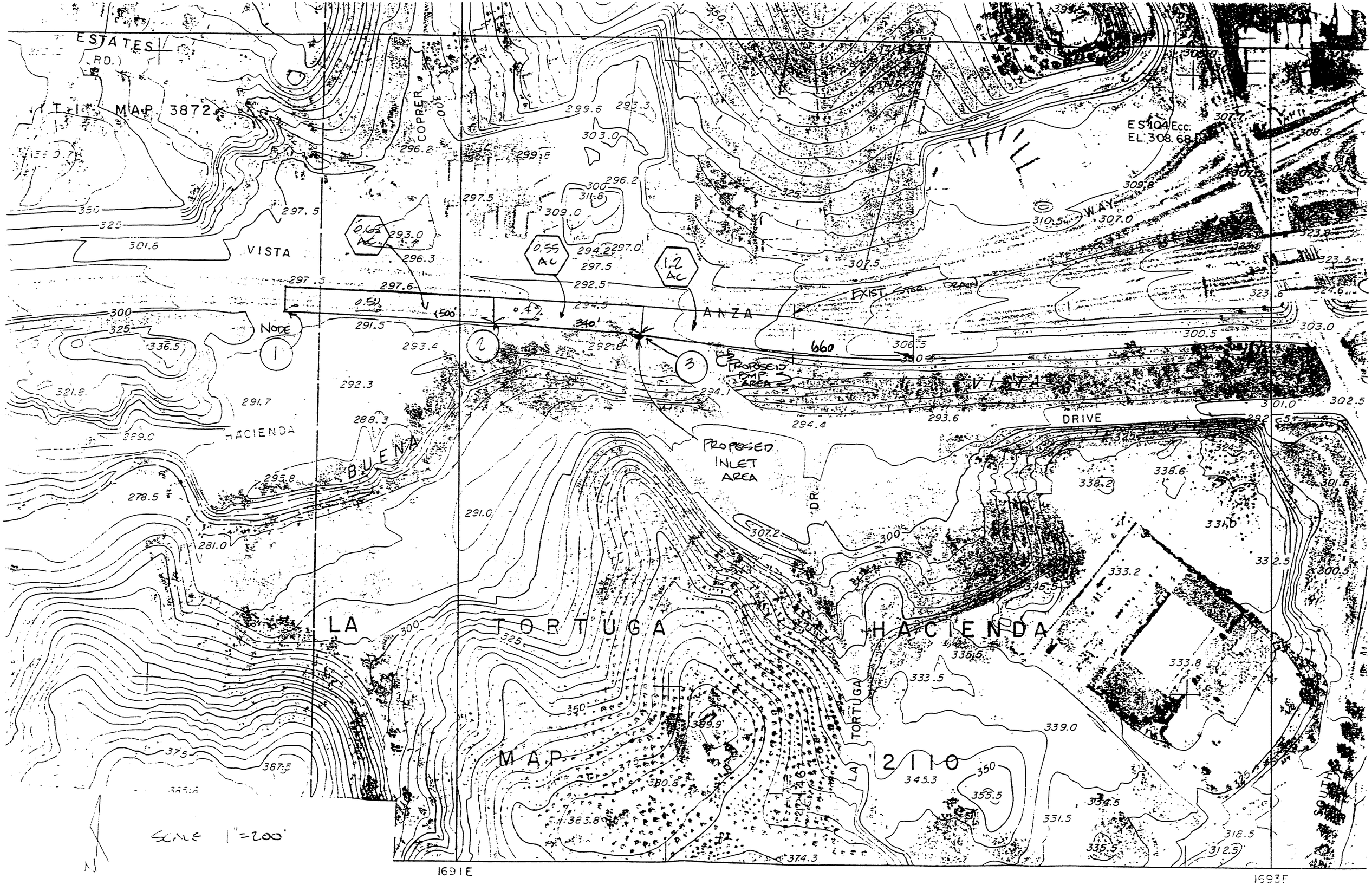
Pc Yulya Davidova
Chris May
Erwin Fogerson
Bill Whittenberg

CALTRANS DISTRICT 11 NPDES PROJECT SITE 5 & 6 SUMMARY

DRN SYS NO.	LOCATION	BMP	TRIBUTARY AREA			1yr Peak Flow Computer Calc (ft^3/s)	1yr Peak Flow Hand Calc (ft^3/s)
			AREA (acre)	LENGTH (ft)	PERVIOUS %		
5	MELROSE DRIVE / SR 78	BIOFILTRATION SWALE (BSw)	2.40	1500	10	3.74	3.63
6	PALOMAR AIRPORT RD	BIOFILTRATION SWALE (BSw)	2.32	1700	10	1.66	1.70

Note : Site No. 5 original design Q equaled 4.1 c.f.s. This flow was based on 2 separate subarea calculations (for each overside drain) and the assumation of equal time of concentrations for each subarea ($Q_{total}=Q_{subarea\ a}+Q_{subarea\ b}$).

PROJECT 2, SITE 3
RATIONAL METOHD HYDROLOGY CALCULATIONS
SR-78/ MELROSE AVENUE
(SITE 5)



ESTATES
RD.
MAP 3872
COPPER
VISTA
ANZA
WAY
ES 104 Ecc.
EL 308.68
EXIST. STORM DRAIN
NODE
1
2
3
0.65 AC
0.55 AC
1.2 AC
PROPOSED BMP AREA
PROPOSED INLET AREA
VISTA
DRIVE
HACIENDA
BUENA
DR.
LA TORTUGA
HACIENDA
MAP 2110
LA TORTUGA
SOUTH
SCALE 1"=200'
1691E
1693E

SITE #5
MELROSE
SR 78

SITE #4
SR 78/I-5
PARK & RIDE

SITE #6
ROUTE 5
PROJECT SITE

Soil Classification Map

```
Top of street segment elevation =    295.000(Ft.)
End of street segment elevation =    293.600(Ft.)
Length of street segment  =   340.000(Ft.)
Height of curb above gutter flowline  =    6.0(In.)
Width of half street (curb to crown)  =  10.000(Ft.)
Distance from crown to crossfall grade break  =   9.000(Ft.)
Slope from gutter to grade break (v/hz) =   0.050
Slope from grade break to crown (v/hz)  =   0.050
Street flow is on [1] side(s) of the street
Distance from curb to property line  =  10.000(Ft.)
Slope from curb to property line (v/hz) =   0.000
Gutter width =   0.000(Ft.)
Gutter hike from flowline =  0.000(In.)
 Manning's N in gutter =  0.0150
 Manning's N from gutter to grade break =  0.0150
 Manning's N from grade break to crown =  0.0150
Estimated mean flow rate at midpoint of street =      1.635(CFS)
Depth of flow =   0.305(Ft.), Average velocity =   1.756(Ft/s)
Streetflow hydraulics at midpoint of street travel:
Halfstreet flow width =   6.104(Ft.)
Flow velocity =   1.76(Ft/s)
Travel time =    3.23 min.     TC =   13.37  min.
 Adding area flow to street
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[INDUSTRIAL area type                    ]
Rainfall intensity =      1.644(In/Hr) for a     1.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.900
Subarea runoff =      0.814(CFS) for    0.550(Ac.)
Total runoff =      1.963(CFS)      Total area =        1.20(Ac.)
Street flow at end of street =      1.963(CFS)
Half street flow at end of street =      1.963(CFS)
Depth of flow =   0.327(Ft.), Average velocity =   1.838(Ft/s)
Flow width (from curb towards crown)=   6.536(Ft.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station        3.000
**** SUBAREA FLOW ADDITION ****
------------------------------------------------------------------------------
Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[INDUSTRIAL area type                    ]
Time of concentration =    13.37 min.
Rainfall intensity =      1.644(In/Hr) for a     1.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.900
Subarea runoff =      1.775(CFS) for    1.200(Ac.)
Total runoff =      3.738(CFS)      Total area =        2.40(Ac.)
End of computations, total study area =           2.40 (Ac.)
```

RATIONAL METHOD CALCULATION FORM

Sheet No. 1 of 1 Sheet

PROJECT SITE 5 - SR 73 @ MELROSE

FREQUENCY 1 YR

Calculated by ERP DATE

Checked by DATE

DRAINAGE AREA	Soil & Development	A Acres	I In/hr.	C	ΔQ CFS	Σ Q CFS	SLOPE	SECTION	v FPS	L FT.	T MIN.	Σ T	REMARKS
NODE 1 TO NODE 2	INDUSTRIAL	0.65	1.9	0.90	1.11		0.5	I.A.		500			
NODE 2 TO NODE 3		0.55	1.6	0.90	0.79	1.11	0.4%	GUTTER	1.4	340	4.0	11.0	INITIAL AREA
NODE 3		1.30	1.6	0.90	1.73	1.90	-	-	-	-	-	15.0	FIRST INLET
						3.63						15.0	ADD IN ADDITIONAL OVERSIDE FROM NO 2

RUNOFF COEFFICIENTS (RATIONAL METHOD)

DEVELOPED AREAS (URBAN)

Land Use	Coefficient, C Soil Group [1] A	B	C	D
Residential:				
Single Family	.40	.45	.50	.55
Multi-Units	.45	.50	.60	.70
Mobile Homes	.45	.50	.55	.65
Rural (lots greater than 1/2 acre)	.30	.35	.40	.45
Commercial [2]				
80% Impervious	.70	.75	.80	.85
Industrial [2]				
90% Impervious	.80	.85	.90	.95

NOTES:

[1] Soil Group maps are available at the offices of the Department of Public Works.

[2] Where actual conditions deviate significantly from the tabulated imperviousness values of 80% or 90%, the values given for coefficient C, may be revised by multiplying 80% or 90% by the ratio of actual imperviousness to the tabulated imperviousness. However, in no case shall the final coefficient be less than 0.50. For example: Consider commercial property on D soil group.

Actual imperviousness = 50%

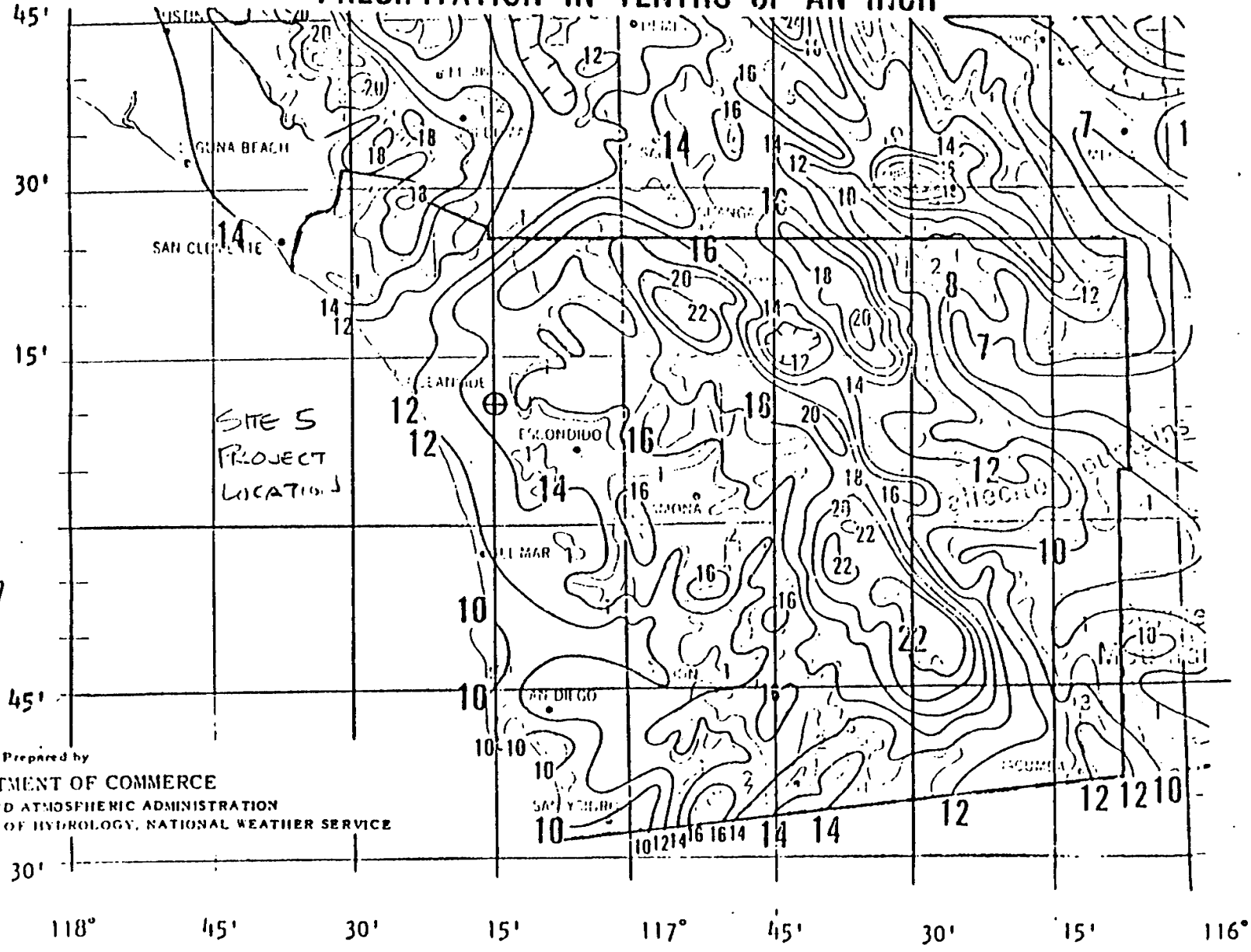
Tabulated imperviousness = 80%

$$\text{Revised } C = \frac{50}{80} \times 0.85 = 0.53$$

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

2-YEAR 6-HOUR PRECIPITATION

—10— ISOPLUVIALS OF 2-YEAR 6-HOUR PRECIPITATION IN TENTHS OF AN INCH



6 HR - 6 HR P = 1.5 IN

6 HR / 24 HR RATIO = 0.787

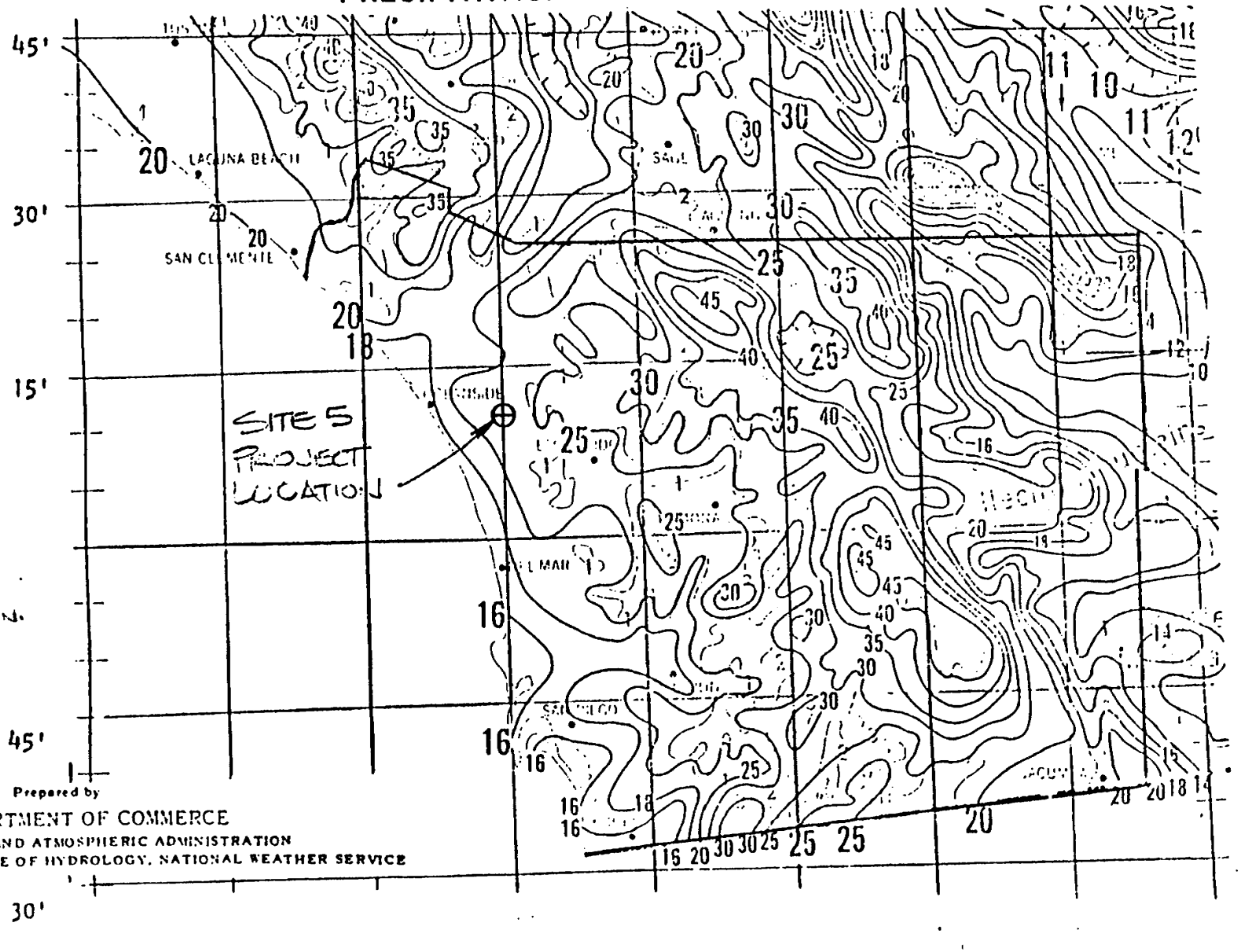
6 HR - 6 HR P = 1.5 × .787
= 1.18 IN.

Prepared by
U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
SPECIAL STUDIES BRANCH, OFFICE OF HYDROLOGY, NATIONAL WEATHER SERVICE

2-YEAR 24-HOUR PRECIPITATION

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

—10— ISOPLUVIALS OF 2-YEAR 24-HOUR PRECIPITATION IN TENTHS OF AN INCH



2 YR - 24 HR : P = 2.3 IN.

1 YR / 2 YR RATIO = 0.787

1 YR - 24 HR 33°

P = 2.3 × .787 = 1.81 IN.

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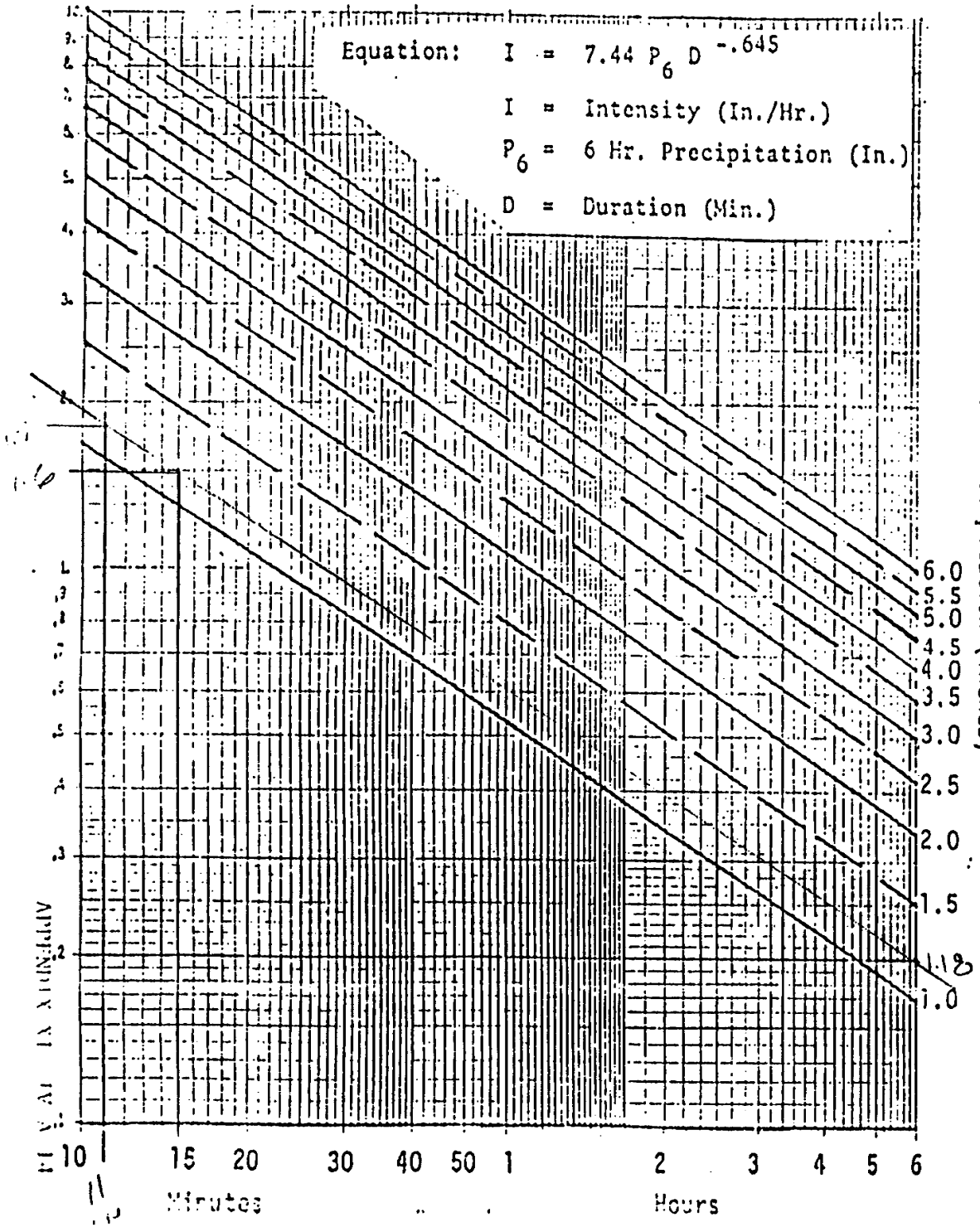
SPECIAL STUDIES BRANCH, OFFICE OF HYDROLOGY, NATIONAL WEATHER SERVICE

INTENSITY-DUR. . DESIGN CHART



Directions for Application:

1) From precipitation maps determine 6 hr. and 24 hr. amounts for the selected frequency. These maps are printed in the County Hydrology Manual (10, 50 and 100 yr. maps included in the Design and Procedure Manual).

2) Adjust 6 hr. precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr. precipitation. (Not applicable to Desert)

3) Plot 6 hr. precipitation on the right side of the chart.

4) Draw a line through the point parallel to the plotted lines.

5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

0) Selected Frequency 1 yr.

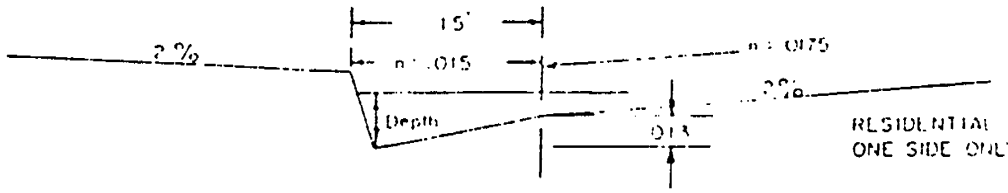
1) P_6 = 1.18 in., P_{24} = 1.31, $\frac{*P_6}{P_{24}}$ = 65%*

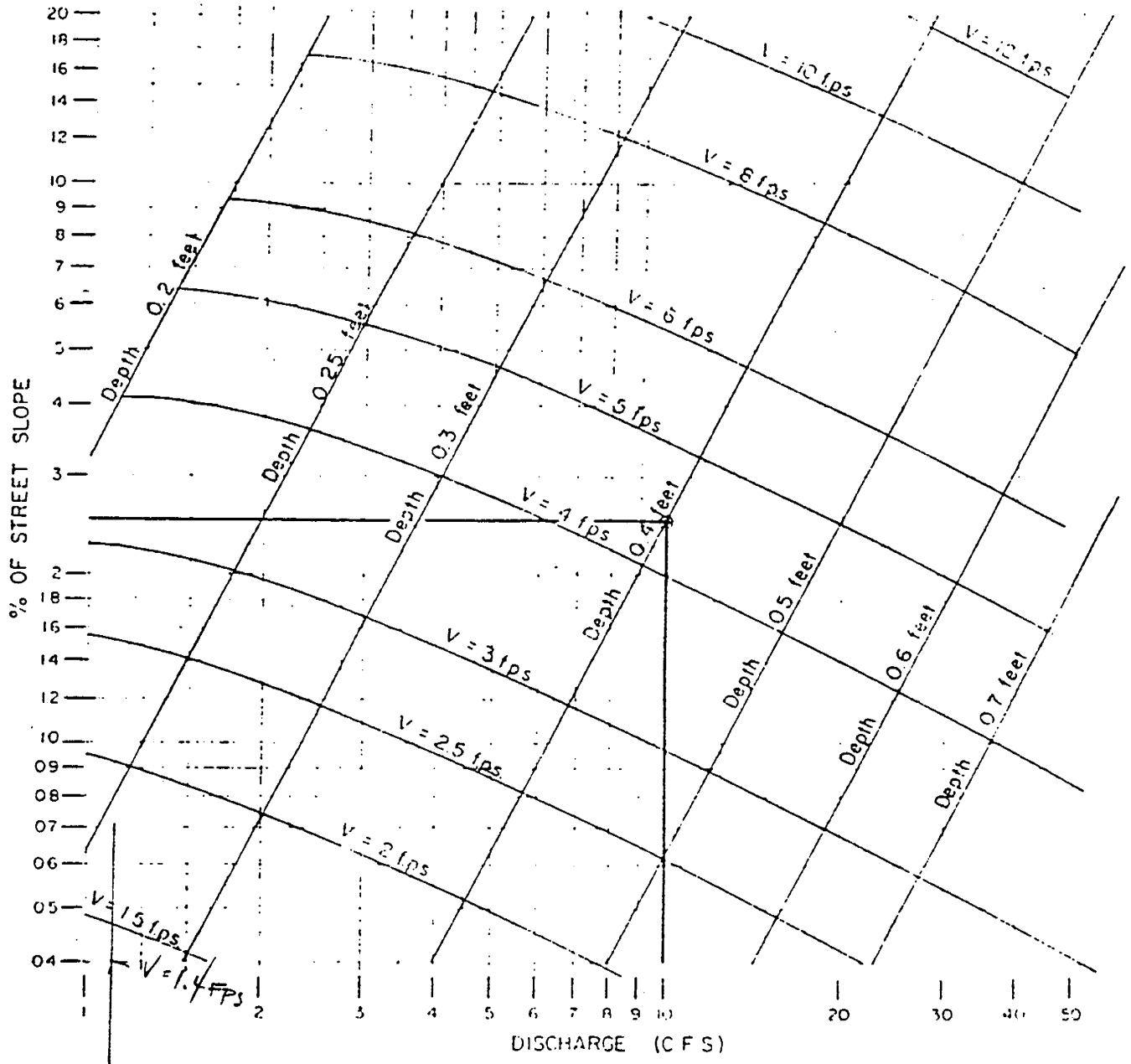
2) Adjusted $*P_6$ = 1.18 in.

3) t_c = 11 min.

4) I = 1.7 in/hr.

*Not Applicable to Desert Region





EXAMPLE:

Given: Q = 10 S = 2.5%
Chart gives Depth = 0.4, Velocity = 4.4 fps

SAN DIEGO COUNTY DEPARTMENT OF SPECIAL DISTRICT SERVICES DESIGN MANUAL APPROVED B.N. Hoffman	GUTTER AND ROADWAY DISCHARGE – VELOCITY CHART DATE 12/30/69	APPENDIX X-D

PROJECT 2, SITE 4
RATIONAL METOHD HYDROLOGY CALCULATIONS
I-5/ PALOMAR AIRPORT ROAD
(SITE 6)

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1996 Version 3.3

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/27/98

Site 5 - Rational Method Hydrology Calculation
1yr storm

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

AEI-CASC Engineering, Colton, California - S/N 615

Rational hydrology study storm event year is 1.0

Map data precipitation entered:
6 hour, precipitation(inches) = 1.180
24 hour precipitation(inches) = 1.810
Adjusted 6 hour precipitation (inches) = 1.177
P6/P24 = 65.2%
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++
Process from Point/Station 1.000 to Point/Station 2.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 0.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 1.000
Decimal fraction soil group D = 0.000
[INDUSTRIAL area type]
Initial subarea flow distance = 500.00(Ft.)
Highest elevation = 297.50(Ft.)
Lowest elevation = 295.00(Ft.)
Elevation difference = 2.50(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 10.14 min.
TC = [1.8*(1.1-C)*distance^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.9000)*(500.00^.5)/(0.50^(1/3)]= 10.14
Rainfall intensity (I) = 1.964 for a 1.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.900
Subarea runoff = 1.149(CFS)
Total initial stream area = 0.650(Ac.)

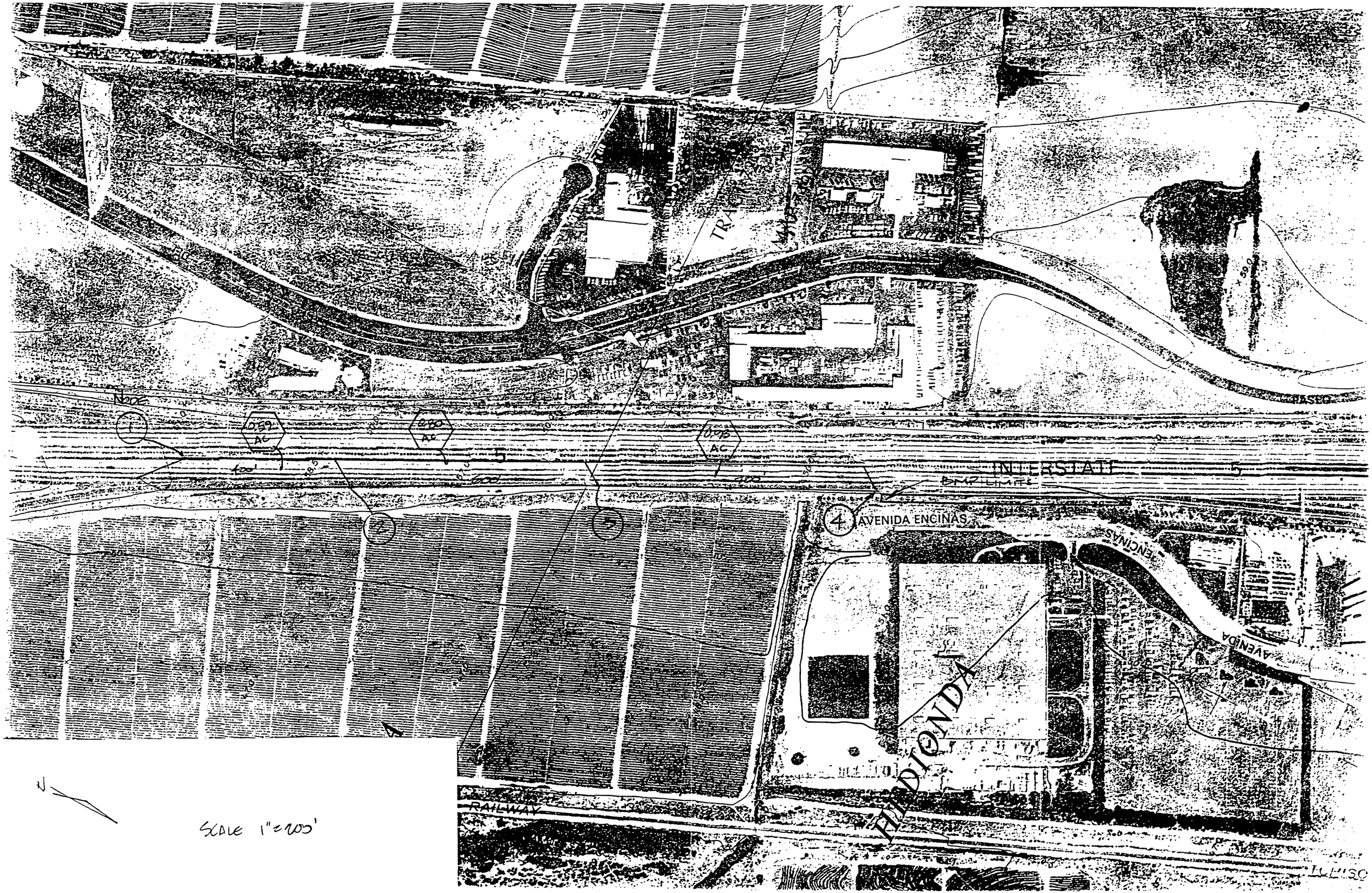
++
Process from Point/Station 2.000 to Point/Station 3.000
**** STREET FLOW TRAVEL TIME + SUBAREA FLOW ADDITION ****

SITE #5
MELROSE
SR 78

SITE #4
SR78/I-5
PARK & RIDE

SITE #6
ROUTE 5
PROJECT SITE

Soil Classification MAP



NODE
1
0.59 AC
0.80 AC
0.93 AC
400'
600'
INTERSTATE 5
BMP LIMITS
2
3
4
AVENIDA ENCINAS
ENCINAS
AVENIDA
HIDIONDA
RAILWAY
PASEO
N
SCALE 1"=200'

San Diego County Rational Hydrology Program

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1996 Version 3.3

Rational method hydrology program based on
San Diego County Flood Control Division 1985 hydrology manual
Rational Hydrology Study Date: 05/27/98

Site 6 Rational Method Hydrology Calculation

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

AEI-CASC Engineering, Colton, California - S/N 615

Rational hydrology study storm event year is 1.0

Map data precipitation entered:
6 hour, precipitation(inches) = 0.944
24 hour precipitation(inches) = 1.338
Adjusted 6 hour precipitation (inches) = 0.870
P6/P24 = 70.6%
San Diego hydrology manual 'C' values used
Runoff coefficients by rational method

++
Process from Point/Station 1.000 to Point/Station 2.000
**** INITIAL AREA EVALUATION ****

Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[INDUSTRIAL area type]
Initial subarea flow distance = 400.00(Ft.)
Highest elevation = 59.75(Ft.)
Lowest elevation = 57.70(Ft.)
Elevation difference = 2.05(Ft.)
Time of concentration calculated by the urban
areas overland flow method (App X-C) = 13.50 min.
TC = [1.8*(1.1-C)*distance^.5)/(% slope^(1/3)]
TC = [1.8*(1.1-0.8000)*(400.00^.5)/(0.51^(1/3)]= 13.50
Rainfall intensity (I) = 1.208 for a 1.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.800
Subarea runoff = 0.570(CFS)
Total initial stream area = 0.590(Ac.)

++
Process from Point/Station 2.000 to Point/Station 3.000
**** IMPROVED CHANNEL TRAVEL TIME ****

Upstream point elevation = 57.70(Ft.)
Downstream point elevation = 56.80(Ft.)

```
Channel length thru subarea  =    600.00(Ft.)
Channel base width       =    2.000(Ft.)
Slope or 'Z' of left channel bank =   6.000
Slope or 'Z' of right channel bank =   6.000
Estimated mean flow rate at midpoint of channel =      0.957(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      0.957(CFS)
Depth of flow =   0.239(Ft.), Average velocity =   1.165(Ft/s)
Channel flow top width =    4.869(Ft.)
Flow Velocity =    1.16(Ft/s)
Travel time  =    8.58 min.
Time of concentration =   22.08 min.
Critical depth =      0.162(Ft.)
 Adding area flow to channel
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[INDUSTRIAL area type                    ]
Rainfall intensity =      0.879(In/Hr) for a     1.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.800
Subarea runoff =      0.563(CFS) for    0.800(Ac.)
Total runoff =      1.133(CFS)      Total area =        1.39(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station        3.000 to Point/Station        4.000
**** IMPROVED CHANNEL TRAVEL TIME ****
--------------------------------------------------------------------------------
Upstream point elevation =     56.80(Ft.)
Downstream point elevation =     55.75(Ft.)
Channel length thru subarea  =    700.00(Ft.)
Channel base width       =    2.000(Ft.)
Slope or 'Z' of left channel bank =   6.000
Slope or 'Z' of right channel bank =   6.000
Estimated mean flow rate at midpoint of channel =      1.512(CFS)
Manning's 'N'    = 0.015
Maximum depth of channel  =    1.000(Ft.)
Flow(q) thru subarea =      1.512(CFS)
Depth of flow =   0.301(Ft.), Average velocity =   1.322(Ft/s)
Channel flow top width =    5.608(Ft.)
Flow Velocity =    1.32(Ft/s)
Travel time  =    8.83 min.
Time of concentration =   30.91 min.
Critical depth =      0.211(Ft.)
 Adding area flow to channel
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
[INDUSTRIAL area type                    ]
Rainfall intensity =      0.708(In/Hr) for a     1.0 year storm
Runoff coefficient used for sub-area, Rational method,Q=KCIA, C = 0.800
Subarea runoff =      0.527(CFS) for    0.930(Ac.)
Total runoff =      1.659(CFS)      Total area =        2.32(Ac.)
End of computations, total study area =          2.32 (Ac.)
```

Sheet No. 1 of 1 Sheet

RATIONAL METHOD CALCULATION FORM

PROJECT SITE 6 - ROUTE 5 BETWEEN CANNON & PALOMAR AIRPORT RD

Calculated by ERE DATE ---

FREQUENCY 1 YR

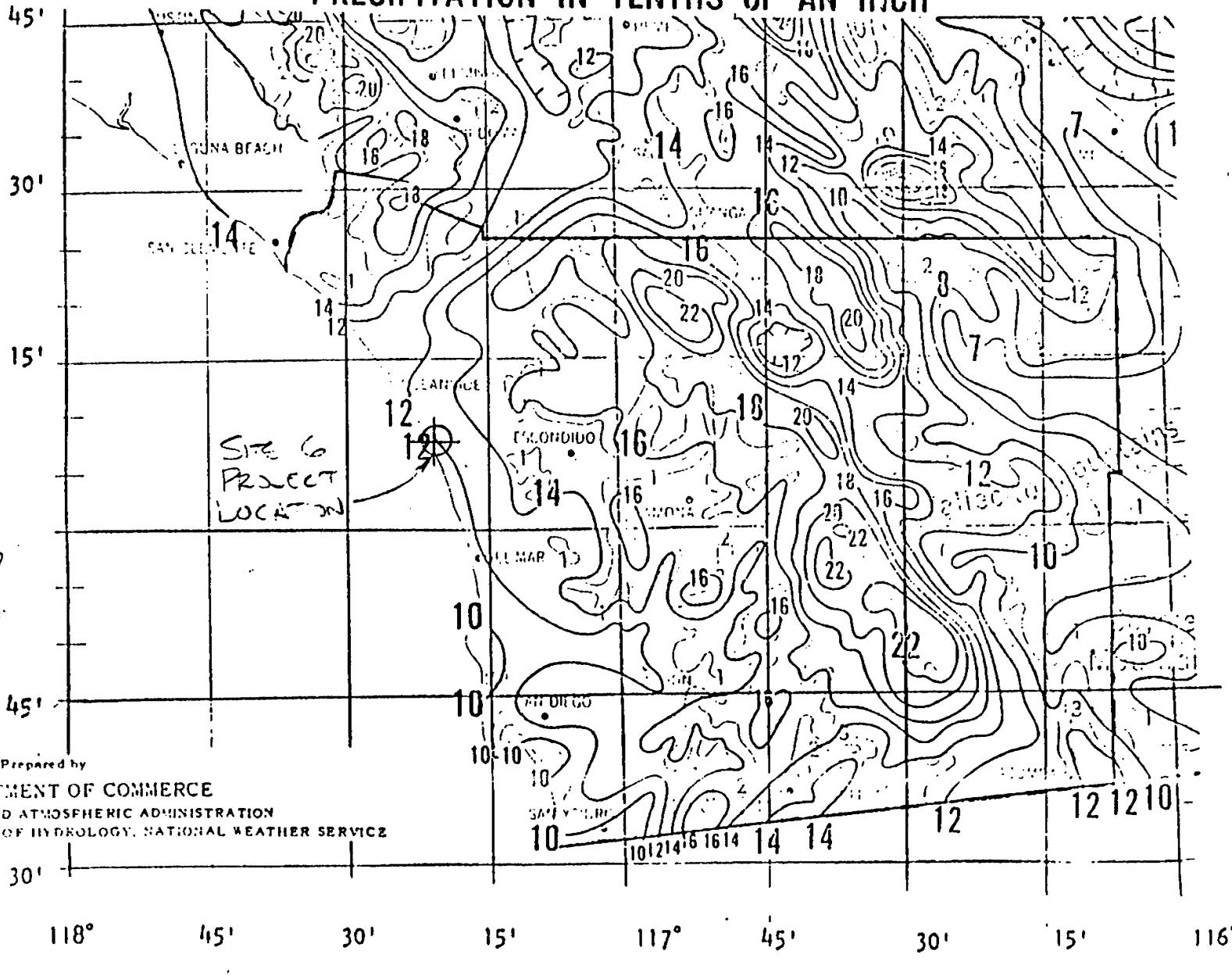
Checked by --- DATE ---

DRAINAGE AREA	Soil & Development	A Acres	I In/hr.	C	ΔQ CFS	ΣQ CFS	SLOPE	SECTION	V FPS	L FT.	T MIN.	ΣT	REMARKS
							0.50	1.0'		400			
None 1 to 2	INDUSTRIAL	0.59	1.24	0.80	0.59	0.59	0.15	TRAP	1.7*	1000	8.3	13	INITIAL AREA
None 2 to 3	"	0.80	0.90	0.80	0.58	1.17	0.15	TRAP	1.7*	700	9.7	21.3	GUTTER FLOW
None 3 to 4	"	0.93	0.71	0.80	0.53	1.70	—	—	—	—		31.0	GUTTER FLOW
* SEE NORMAL DEPTH CALC FOR VELOCITY													
	WIND SWALE												

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

2-YEAR 6-HOUR PRECIPITATION

—10— ISOPLUVIALS OF 2-YEAR 6-HOUR PRECIPITATION IN TENTHS OF AN INCH



2 YR - 6 HR P = 1.2 IN

$\frac{1 \text{ YR}}{2 \text{ YR}}$ RATIO = 0.787

1 YR - 6 HR P = 1.2 × .787

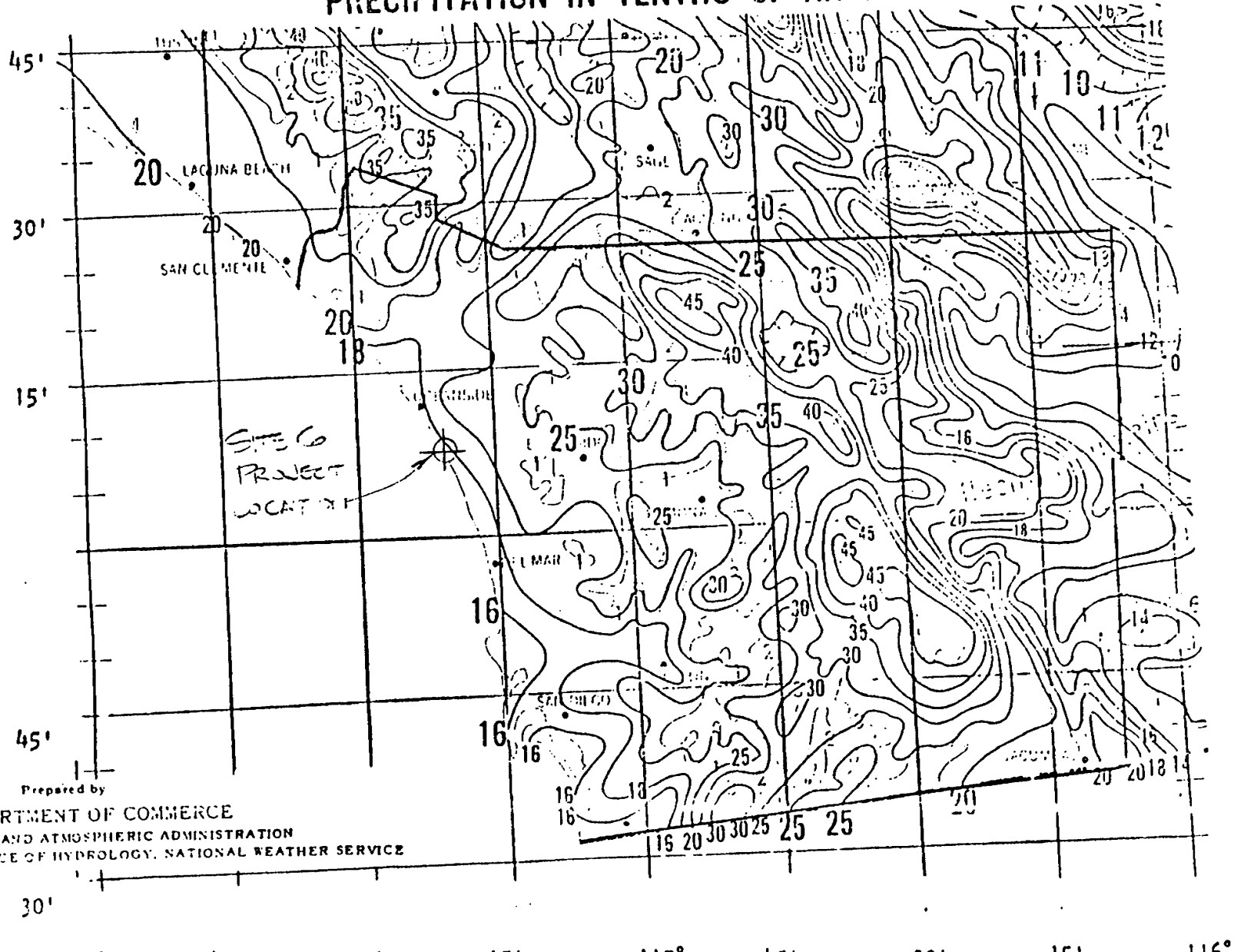
= 0.944 IN

Prepared by
U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
SPECIAL STUDIES BRANCH, OFFICE OF HYDROLOGY, NATIONAL WEATHER SERVICE

2-YEAR 24-HOUR PRECIPITATION

COUNTY OF SAN DIEGO
DEPARTMENT OF SANITATION &
FLOOD CONTROL

—10— ISOPLUVIALS OF 2-YEAR 24-HOUR PRECIPITATION IN TENTHS OF AN INCH



Prepared by
U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
SPECIAL STUDIES BRANCH, OFFICE OF HYDROLOGY, NATIONAL WEATHER SERVICE

8-V-11

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name:

Comment: Site 6 - Node 3 to Node 4 Vel. Calc, (avg Q)

Solve For Depth

Given Input Data:

Bottom Width.....	2.00 ft
Left Side Slope..	6.00:1 (H:V)
Right Side Slope.	6.00:1 (H:V)
Manning's n.....	0.015
Channel Slope....	0.0015 ft/ft
Discharge.....	1.20 cfs

Computed Results:

Depth.....	0.27 ft
Velocity.....	1.24 fps
Flow Area.....	0.97 sf
Flow Top Width...	5.22 ft
Wetted Perimeter.	5.26 ft
Critical Depth...	0.18 ft
Critical Slope...	0.0064 ft/ft
Froude Number....	0.51 (flow is Subcritical)

Open Channel Flow Module, Version 3.21 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name:

Comment: Site 6 - Node 2 to Node 3 Vel. Calc, (avg Q)

Solve For Depth

Given Input Data:

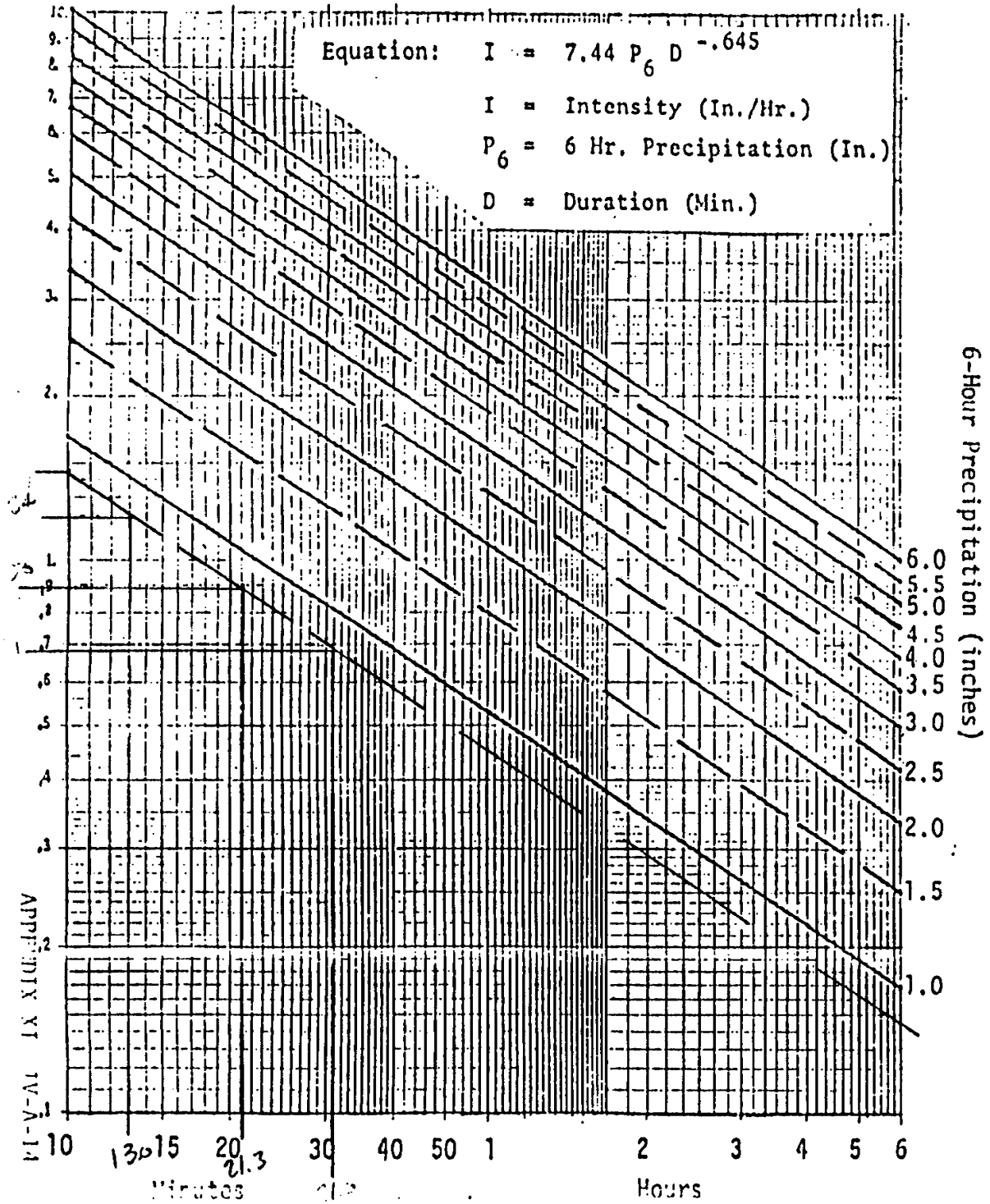
Bottom Width.....	2.00 ft
Left Side Slope..	6.00:1 (H:V)
Right Side Slope.	6.00:1 (H:V)
Manning's n.....	0.015
Channel Slope....	0.0015 ft/ft
Discharge.....	1.00 cfs

Computed Results:

Depth.....	0.24 ft
Velocity.....	1.18 fps
Flow Area.....	0.85 sf
Flow Top Width...	4.93 ft
Wetted Perimeter.	4.97 ft
Critical Depth...	0.17 ft
Critical Slope...	0.0066 ft/ft
Froude Number....	0.50 (flow is Subcritical)

Open Channel Flow Module, Version 3.21 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

INTENSITY-DURAT. . DESIGN CHART



Directions for Application:

1) From precipitation maps determine 6 hr. and 24 hr. amounts for the selected frequency. These maps are printed in the County Hydrology Manual (10, 50 and 100 yr. maps included in th Design and Procedure Manual).

2) Adjust 6 hr. precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr. precipitation. (Not applicable to Desert)

3) Plot 6 hr. precipitation on the right side of the chart.

4) Draw a line through the point parallel to the plotted lines.

5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

0) Selected Frequency 1 yr.

1) P_6 = 0.744 in., P_{24} = 1.338, $\frac{{}^*P_6}{P_{24}}$ = 70.6%*

2) Adjusted $*P_6$ = 0.87 in.

3) t_c = 15 min. (∴ use 15 min.)

4) I = _____ in/hr.

*Not Applicable to Desert Region

RUNOFF COEFFICIENTS (RATIONAL METHOD)

DEVELOPED AREAS (URBAN)

Land Use	Coefficient, C Soil Group [1] A	B	C	D
Residential:				
Single Family	.40	.45	.50	.55
Multi-Units	.45	.50	.60	.70
Mobile Homes	.45	.50	.55	.65
Rural (lots greater than 1/2 acre)	.30	.35	.40	.45
Commercial [2]				
80% Impervious	.70	.75	.80	.85
Industrial [2] 90% Impervious	.80	.85	.90	.95

NOTES:

(1) Soil Group maps are available at the offices of the Department of Public Works.

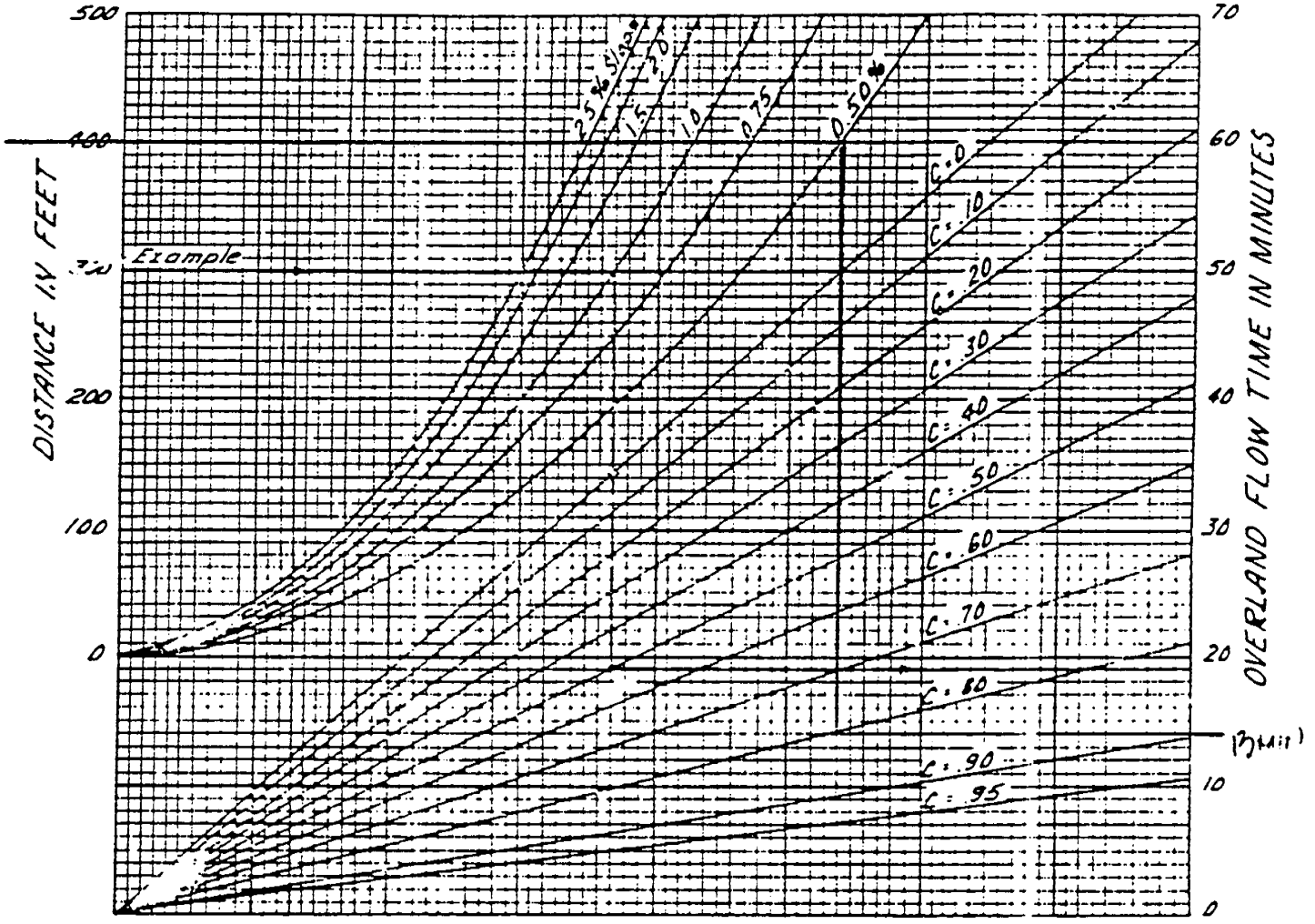
(2) Where actual conditions deviate significantly from the tabulated imperviousness values of 80% or 90%, the values given for coefficient C, may be revised by multiplying 80% or 90% by the ratio of actual imperviousness to the tabulated imperviousness. However, in no case shall the final coefficient be less than 0.50. For example: Consider commercial property on D soil group.

Actual imperviousness = 50%

Tabulated imperviousness = 80%

$$\text{Revised } C = \frac{50}{80} \times 0.85 = 0.53$$

URBAN AREAS OVERLAND TIME OF FLOW CURVES



Example:
Given: Length of Flow = 300 ft
Slope = 1.0 %
Coefficient of Runoff C = 50
Read: Overland Flowtime = 19 Minutes

SAN DIEGO COUNTY DEPARTMENT OF SPECIAL DISTRICT SERVICES DESIGN MANUAL APPROVED _____	URBAN AREAS OVERLAND TIME OF FLOW CURVES DATE 1/1/64	APPENDIX X-C

APPENDIX F CONSTRUCTION COSTS (BID COST ONLY)

COST ESTIMATE FOR CALTRANS DISTRICT 11 PROCUREMENTS

PROJECT	SITE	SITE DESCRIPTION	SITE EST. CONST. COST
2	4	I-5 NORTH OFPALOMAR AIRPORT ROAD INTERCHANGE	$ 163,089.30
2	1&2	CARLSBAD MAINTENANCE STATION	$ 202,096.40
2	3	SR 78 WEST OF MELROSE DRIVE INTERCHANGE	$ 108,740.23
5	1	ESCONDIDO MAINTENANCE STATION	$ 328,372.28
5	2	I 5 / SR 78 PARK AND RIDE	$ 304,016.08
5	3	LA COSTA PARK AND RIDE	$ 277,216.50
5	4	KEARNY MESA MAINTENANCE STATION	$ 256,019.50
	TOTAL		$ 1,639,550.28

LOCATION 1: KEARNY MESA MAINTENANCE STATION

Item	Item Discription	Quantity	Unit	Unit Cost	Cost
100	Mobilization	1.0	LS	$22,000.00	$ 22,000.00
101	Clearing and Grubbing	1.0	LS	$5,000.00	$ 5,000.00
102	50mm Plastic Conduit	4.8	M	$20.00	$ 96.00
103	250mm AP	1.7	M	$85.00	$ 144.50
104	380mm AP	30.3	M	$150.00	$ 4,545.00
105	380mm DIP	6.8	M	$250.00	$ 1,700.00
106	900mm RCP	4.1	M	$650.00	$ 2,665.00
107	Minor Concrete (Minor Structure)	5.9	M^3	$800.00	$ 4,720.00
108	Minor Concrete (Misc Construction)	2.1	M^3	$300.00	$ 630.00
109	Miscellaneous Iron and Steel (F)	780.0	KG	$10.00	$ 7,800.00
110	Palmer-Bowlus Flume	2.0	EA	$4,000.00	$ 8,000.00
111	Compost Filter BMP	3.0	EA	$54,860.00	$ 164,580.00
112	300mm AP	9.1	M	$95.00	$ 864.50
113	Pretreatment Vault	1.0	EA	$10,000.00	$ 10,000.00
				SUBTOTAL	$232,745.00
				10% Cont.	$23,274.50
				TOTAL	**$256,019.50**

LOCATION 2: ESCONDIDO MAINTENANCE STATION

Item	Item Discription	Quantity	Unit	Unit Cost	Cost
200	Mobilization	1.0	LS	$26,000.00	$ 26,000.00
201	Clearing and Grubbing	1.0	LS	$5,000.00	$ 5,000.00
202	50mm Plastic Conduit	7.5	M	$20.00	$ 150.00
203	150mm AP	10.0	M	$86.00	$ 860.00
204	200 mm AP	4.3	M	$92.50	$ 397.75
205	300 mm AP	7.7	M	$100.00	$ 770.00
206	380mm AP	27.3	M	$150.00	$ 4,095.00
207	900mm RCP	2.5	M	$650.00	$ 1,625.00
208	Electrical Systems	1.0	LS	$18,422.50	$ 18,422.50
209	Minor Concrete (Minor Structure)	4.9	M^3	$800.00	$ 3,920.00
210	Minor Concrete (Misc Construction)	3.3	M^3	$300.00	$ 990.00
211	Miscellaneous Iron and Steel (F)	1329.0	KG	$10.00	$ 13,290.00
212	Type II Sand Filter	1.0	EA	$215,000.00	$ 215,000.00
213	Palmer-Bowlus Flume	2.0	EA	$4,000.00	$ 8,000.00
				SUBTOTAL	$ 298,520.25
				10% Cont	$ 29,852.03
				TOTAL	**$ 328,372.28**

LOCATION 3: LA COSTA PARK AND RIDE

Item	Item Discription	Quantity	Unit	Unit Cost	Cost
300	Mobilization	1.0	LS	$20,000.00	$ 20,000.00
301	Clearing and Grubbing	1.0	LS	$5,000.00	$ 5,000.00
302	Remove Drainage Facility	1.0	EA	$3,000.00	$ 3,000.00
303	Remove Pipe	4.8	M	$40.00	$ 192.00
304	Remove AC Curb/Dike	44.0	M	$10.00	$ 440.00
305	Remove AC	423.0	M^2	$5.00	$ 2,115.00
306	50mm Plastic Conduit	6.4	M	$20.00	$ 128.00
307	380mm AP	41.3	M	$150.00	$ 6,195.00
308	900mm RCP	3.7	M	$650.00	$ 2,405.00
309	1200mm RCP	1.9	M	$800.00	$ 1,520.00
310	Minor Concrete (Minor Structure)	1.9	M^3	$800.00	$ 1,520.00
311	Minor Concrete (Misc Construction)	5.2	M^3	$300.00	$ 1,560.00
312	Miscellaneous Iron and Steel (F)	310.5	KG	$10.00	$ 3,105.00
313	Chain Link Gate	4.0	EA	$800.00	$ 3,200.00
314	Chain Link Fence	76.0	M	$100.00	$ 7,600.00
315	Type I Sand Filter	1.0	EA	$170,000.00	$ 170,000.00
316	Parshall Flume	1.0	EA	$2,500.00	$ 2,500.00
317	Palmer-Bowlus Flume	1.0	EA	$4,000.00	$ 4,000.00
318	Electrical Systems	1.0	LS	$8,451.50	$ 8,451.50
319	Asphalt Concrete Dike	48.0	M	$45.00	$ 2,160.00
320	Asphalt Concrete (Type B)	78.3	TONN	$45.00	$ 3,523.50
321	Aggregate Base (Class II)	136.0	TONN	$25.00	$ 3,400.00
				SUBTOTAL	$ 252,015.00
				10% Cont.	$ 25,201.50
				TOTAL	**$ 277,216.50**

LOCATION 4: I-5/ SR-78 PARK AND RIDE

Item	Item Discription	Quantity	Unit	Unit Cost	Cost
400	Mobilization	1.0	LS	$25,000.00	$ 25,000.00
401	Clearing and Grubbing	1.0	LS	$5,000.00	$ 5,000.00
402	Traffic Control System	1.0	LS	$5,000.00	$ 5,000.00
403	Construction Area Signs	1.0	LS	$7,000.00	$ 7,000.00
404	Traffic Plastic Drums	8.0	EA	$50.00	$ 400.00
405	Temporary Railing(Type k)	92.0	M	$50.00	$ 4,600.00
406	Temporary Crash Cushion Module	12.0	EA	$250.00	$ 3,000.00
407	Relocate Irrigation System	1.0	EA	$1,500.00	$ 1,500.00
408	Remove Concrete Curb	8.0	M	$10.00	$ 80.00
409	Remove Pipe	4.8	M	$40.00	$ 192.00
410	Remove Fence	41.0	M	$25.00	$ 1,025.00
411	Remove Drainage Facility	3.0	EA	$3,000.00	$ 9,000.00
412	Aggegate Base (Class II)	119.3	TONN	$25.00	$ 2,982.50
413	Asphalt Concrete Dike	10.0	M	$45.00	$ 450.00
414	Asphalt Concrete (Type B)	69.1	TONN	$45.00	$ 3,109.50
415	Minor Concrete (Misc Construction)	8.3	M^3	$300.00	$ 2,490.00
416	Minor Concrete (Minor Structure)	6.7	M^3	$800.00	$ 5,360.00
417	50mm Plastic Conduit	4.4	M	$20.00	$ 88.00
418	200mm AP	17.1	M	$92.50	$ 1,581.75
419	250mm AP	12.1	M	$95.00	$ 1,149.50
420	380mm AP	5.0	M	$150.00	$ 750.00
421	450mm AP	10.1	M	$175.00	$ 1,767.50
422	900mm RCP	10.3	M	$650.00	$ 6,695.00
423	450mm CSP(Smooth)	20.8	M	$175.00	$ 3,640.00
424	Miscellaneous Iron and Steel (F)	745.0	KG	$10.00	$ 7,450.00
425	Type I Sand Filter	1.0	EA	$153,867.50	$ 153,867.50
426	Palmer-Bowlus Flume	2.0	EA	$4,000.00	$ 8,000.00
427	Junction Structure	1.0	EA	$3,500.00	$ 3,500.00
428	Chain Link Gate	4.0	EA	$800.00	$ 3,200.00
429	Chain Link Fence	85.0	M	$100.00	$ 8,500.00
				SUBTOTAL	$ 276,378.25
				10% Cont.	$ 27,637.83
				TOTAL	**$ 304,016.08**

LOCATION 5: SR-78 WEST OF MELROSE AVENUE INTERCHANGE

Item	Item Discription	Quantity	Unit	Unit Cost	Cost
500	Mobilization	1.0	LS	$3,500.00	$ 3,500.00
501	Clearing and Grubbing	1.0	LS	$4,469.25	$ 4,469.25
502	Traffic Control System	1.0	LS	$5,000.00	$ 5,000.00
503	Construction Area Signs	1.0	LS	$7,000.00	$ 7,000.00
504	Traffic Plastic Drums	8.0	EA	$50.00	$ 400.00
505	Temporary Railing (Type k)	170.0	M	$50.00	$ 8,500.00
506	Temporary Crash Cushion Module	12.0	EA	$250.00	$ 3,000.00
507	Remove Fence	6.2	M	$25.00	$ 155.00
508	Remove AC Curb/Dike	12.0	M	$10.00	$ 120.00
509	Ditch Excavation	625.6	M^3	$25.00	$ 15,640.00
510	Place AC (Misc Area)	20.0	M^2	$100.00	$ 2,000.00
511	Asphalt Concrete (Type B)	4.6	TONN	$45.00	$ 207.00
512	50mm Plastic Conduit	14.0	M	$20.00	$ 280.00
513	300mm AP	16.7	M	$100.00	$ 1,670.00
514	900mm RCP	0.8	M	$650.00	$ 539.50
515	Minor Concrete (Minor Structure)	0.3	M^3	$800.00	$ 232.00
516	Minor Concrete (Misc Construction)	3.9	M^3	$300.00	$ 1,170.00
517	Miscellaneous Iron and Steel (F)	51.0	KG	$10.00	$ 510.00
518	Chain Link Gate	2.0	EA	$800.00	$ 1,600.00
519	Trapezoidal Flume	2.0	EA	$3,500.00	$ 7,000.00
520	Bio-Filter Swale BMP	834.0	M^2	$43.00	$ 35,862.00
				SUBTOTAL	$ 98,854.75
				10% Cont.	$ 9,885.48
				TOTAL	**$ 108,740.23**

LOCATION 6: I-5 NORTH OF PALOMAR AIRPORT ROAD INTERCHANGE

Item	Item Discription	Quantity	Unit	Unit Cost	Cost
600	Mobilization	1.0	LS	$8,000.00	$ 8,000.00
601	Clearing and Grubbing	1.0	LS	$10,000.00	$ 10,000.00
602	Traffic Control System	1.0	LS	$5,000.00	$ 5,000.00
603	Construction Area Signs	1.0	LS	$7,000.00	$ 7,000.00
604	Traffic Plastic Drums	8.0	EA	$50.00	$ 400.00
605	Temporary Railing (Type k)	220.0	M	$50.00	$ 11,000.00
606	Temporary Crash Cushion Module	12.0	EA	$250.00	$ 3,000.00
607	Remodel Drainage Facility	1.0	EA	$750.00	$ 750.00
608	Relocate Irrigation System	1.0	LS	$2,000.00	$ 2,000.00
609	Ditch Excavation	410.0	M^3	$25.00	$ 10,250.00
610	Aggegate Base (Class II)	119.3	TONN	$25.00	$ 2,982.50
611	Asphalt Concrete (Type B)	64.1	TONN	$45.00	$ 2,884.50
612	Minor Concrete (Misc Construction)	157.1	M^3	$300.00	$ 47,130.00
613	50mm Plastic Conduit	34.0	M	$20.00	$ 680.00
614	Bio-Filter Swale BMP	702.0	M^2	$43.00	$ 30,186.00
615	Trapezoidal Flume	2.0	EA	$3,500.00	$ 7,000.00
				SUBTOTAL	$ 148,263.00
				10% Cont.	$ 14,826.30
				TOTAL	**$ 163,089.30**

LOCATION 7: CARLSBAD MAINTENANCE STATION

Item	Item Discription	Quantity	Unit	Unit Cost	Cost
700	Mobilization	1.0	LS	$22,000.00	$ 22,000.00
701	Clearing and Grubbing	1.0	LS	$5,000.00	$ 5,000.00
702	Remove AC	871.0	M^2	$10.00	$ 8,710.00
703	Remove AC Curb/Dike	2.0	M	$10.00	$ 20.00
704	Remove Concrete (Gutter)	67.0	M^2	$30.00	$ 2,010.00
705	Remove Concrete Curb	66.0	M	$10.00	$ 660.00
706	Ditch Excavation	110.0	M^3	$25.00	$ 2,750.00
707	Infiltration Trench	1.0	EA	$59,385.00	$ 59,385.00
708	Aggegate Base (Class II)	768.0	TONN	$25.00	$ 19,200.00
709	Asphalt Concrete (Type B)	415.0	TONN	$45.00	$ 18,675.00
710	Minor Concrete (Misc Construction)	39.3	M^3	$300.00	$ 11,790.00
711	Electrical Systems	1.0	LS	$11,500.00	$ 11,500.00
712	Trapezoidal Flume	1.0	EA	$3,500.00	$ 3,500.00
713	Parshall Flume	1.0	EA	$2,500.00	$ 2,500.00
714	50mm Plastic Conduit	10.0	M	$20.00	$ 200.00
715	Bio-Filter Strip BMP	368.0	M^2	$43.00	$ 15,824.00
				SUBTOTAL	$ 183,724.00
				10% Cont.	$ 18,372.40
				TOTAL	**$ 202,096.40**

APPENDIX G BMP LAYOUT AND PROFILE DRAWINGS

COORDINATE POINT	NORTHING	EASTING
1	573218.788	1914574.275
2	573215.574	1914578.363
3	573214.820	1914579.321
4	573218.334	1914581.311
5	573211.122	1914583.919
6	573207.746	1914588.244
7	573206.809	1914589.446
8	573203.434	1914593.771
9	573202.496	1914594.972
10	573199.121	1914599.297

COORDINATE POINT	NORTHING	EASTING
11	573198.063	1914600.652
12	573194.683	1914600.311
13	573195.696	1914604.078
14	573192.331	1914605.202
15	573196.012	1914605.255
16	573197.349	1914610.230
17	573219.675	1914574.624
18	573218.947	1914573.335
19	573195.763	1914613.587
20	573212.297	1914582.475

COORDINATE POINT	NORTHING	EASTING
21	573212.940	1914581.659
22	573213.026	1914582.388
23	573208.464	1914590.931
24	573209.194	1914590.845
25	573208.537	1914591.650
26	573207.676	1914590.316
27	573203.363	1914595.842
28	573204.546	1914596.765
29	573214.739	1914583.739

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No.	TOTAL SHEETS
11	SD	var	var	13	60

REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ERWIN FOGERSON — 049060 — 9-30-99 — CIVIL — STATE OF CALIFORNIA

AGUILAR ENGINEERING INCORPORATED
937 SOUTH VIA LATA, SUITE 500
COLTON, CA 92324

Metric

DATE	REVISED BY	DATE REVISED
1		7-8-98

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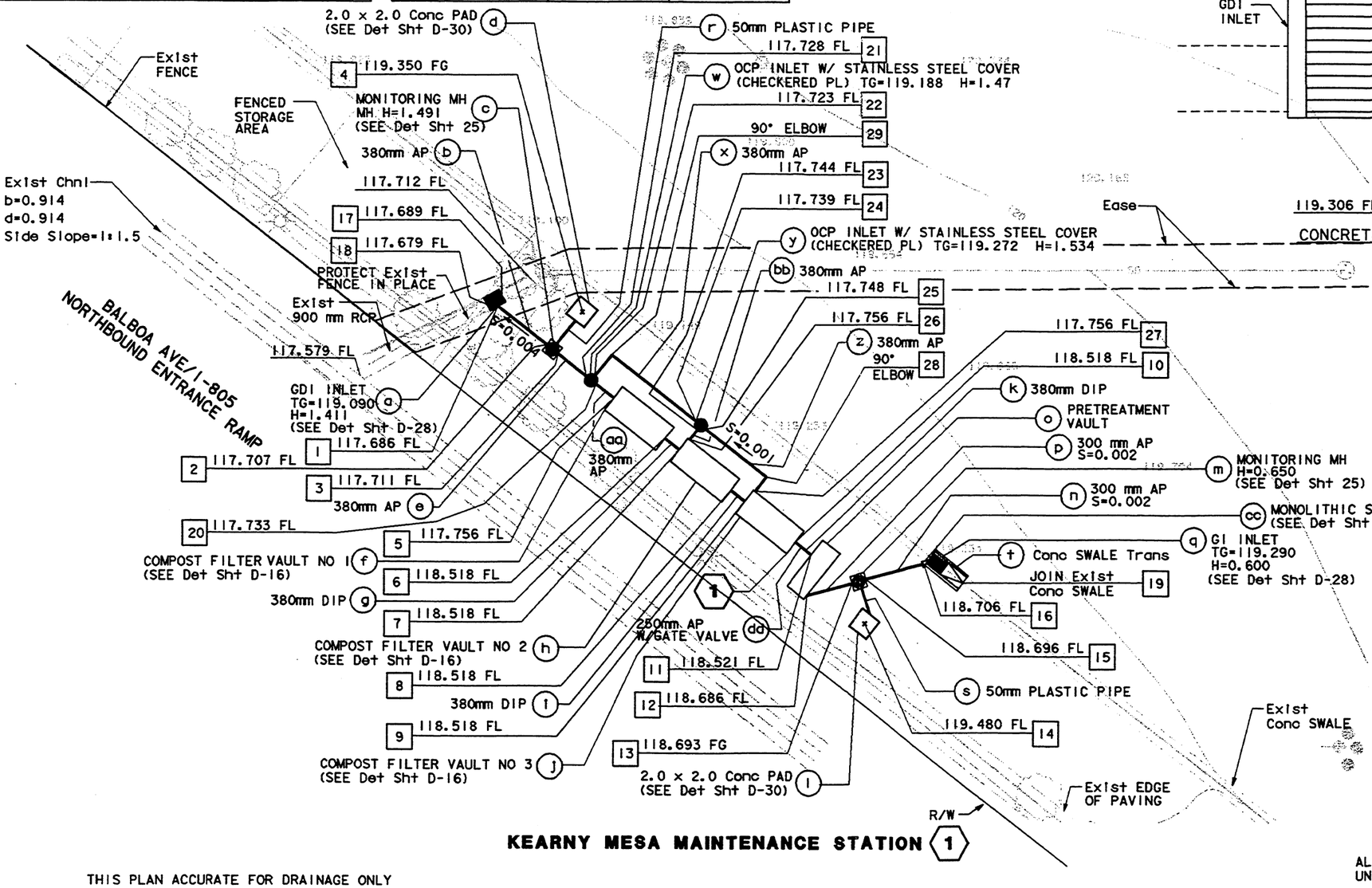
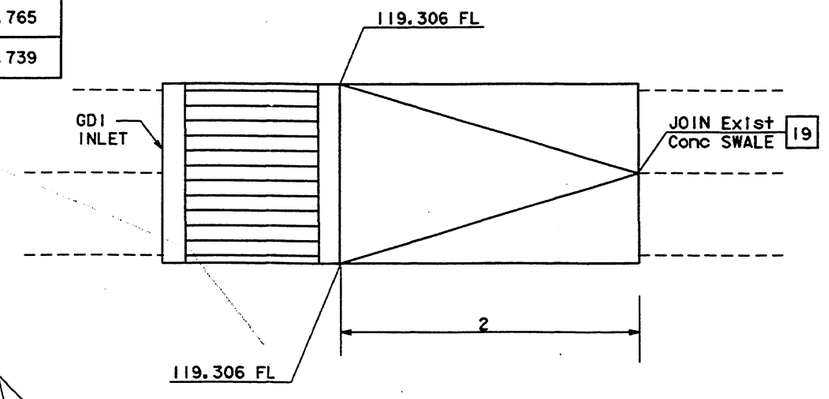
CHECKED BY

PROJECT ENGINEER



KEARNY MESA MAINTENANCE STATION (1)

THIS PLAN ACCURATE FOR DRAINAGE ONLY



CONCRETE SWALE TRANSITION DETAIL

SCALE 1 : 20

NOTE:

1. FOR COMPLETE R/W AND ACCURATE ACCESS DATA, SEE R/W RECORD MAPS AT DISTRICT 11 OFFICE.

LEGEND

DIP : DUCTILE IRON PIPE
GTD : GRADE TO DRAIN

(1)

DRAINAGE PLAN LOCATION 1

SCALE 1 : 200

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

D-1

31 JUL 98 11:1

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LAST REVISION DATE PLOTTED => $DATE

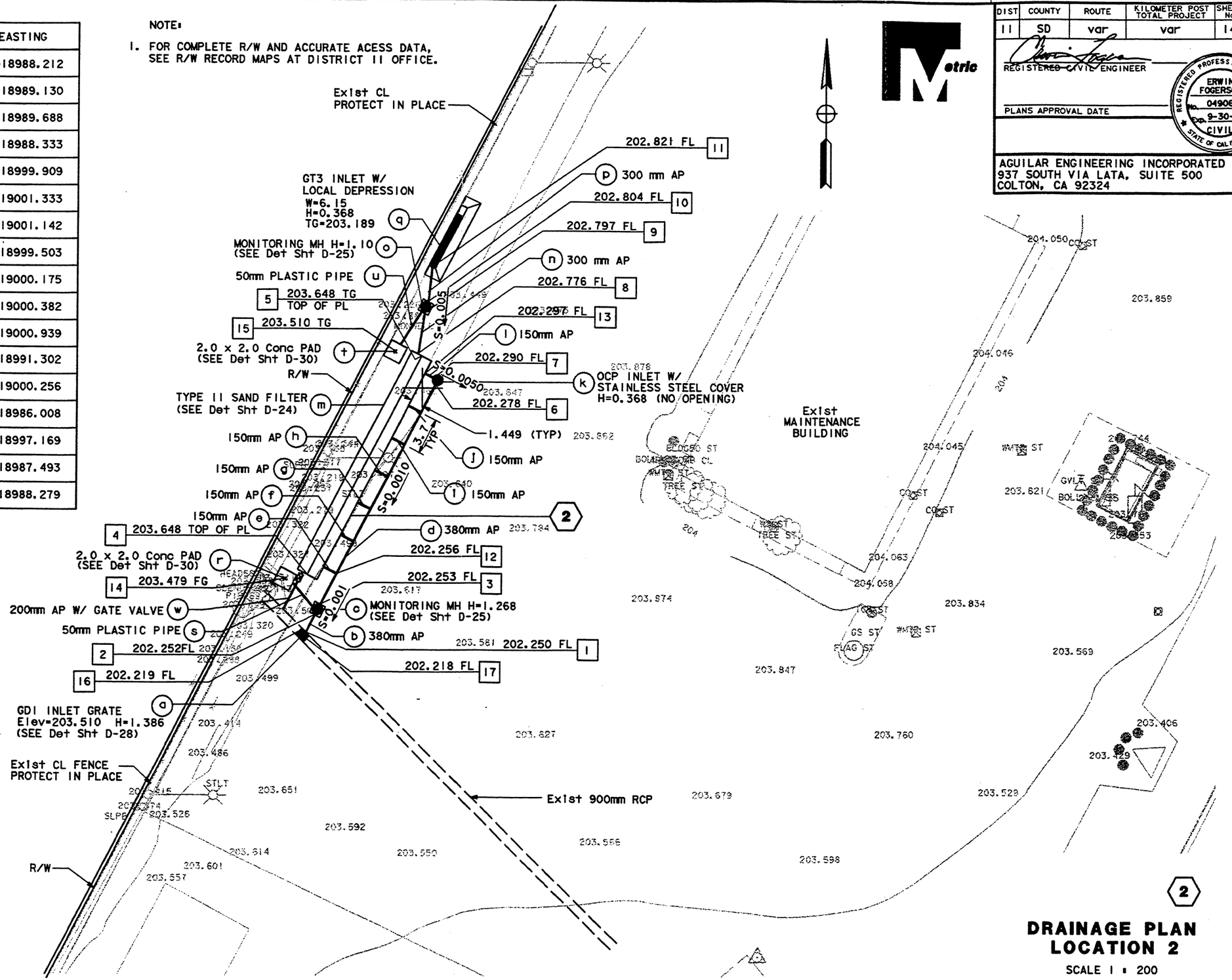
FOR REDUCED PLANS ORIGINAL 0 20 40 60 80

USERNAME => $USER

COORDINATE POINT	NORTHING	EASTING
1	607075.146	1918988.212
2	607076.912	1918989.130
3	607077.985	1918989.688
4	607080.999	1918988.333
5	607103.271	1918999.909
6	607100.389	1919001.333
7	607100.996	1919001.142
8	607103.482	1918999.503
9	607107.614	1919000.175
10	607108.885	1919000.382
11	607112.315	1919000.939
12	607081.091	1918991.302
13	607101.456	1919000.256
14	607080.548	1918986.008
15	607103.681	1918997.169
16	607075.226	1918987.493
17	607074.449	1918988.279

NOTE:

1. FOR COMPLETE R/W AND ACCURATE ACESS DATA, SEE R/W RECORD MAPS AT DISTRICT 11 OFFICE.



ESCONDIDO MAINTENANCE STATION (2)

DRAINAGE PLAN LOCATION 2

SCALE 1 = 200

D-2

THIS PLAN ACCURATE FOR DRAINAGE ONLY

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No.	TOTAL SHEETS
11	SD	var	var	14	60

REGISTERED CIVIL ENGINEER

REGISTERED PROFESSIONAL ENGINEER — ERWIN FOGERSON — No. 049060 — Exp. 9-30-99 — CIVIL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

AGUILAR ENGINEERING INCORPORATED
937 SOUTH VIA LATA, SUITE 500
COLTON, CA 92324

DATE REVISED BY / DATE REVISED

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PROJECT ENGINEER

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23 JUL 98 16:

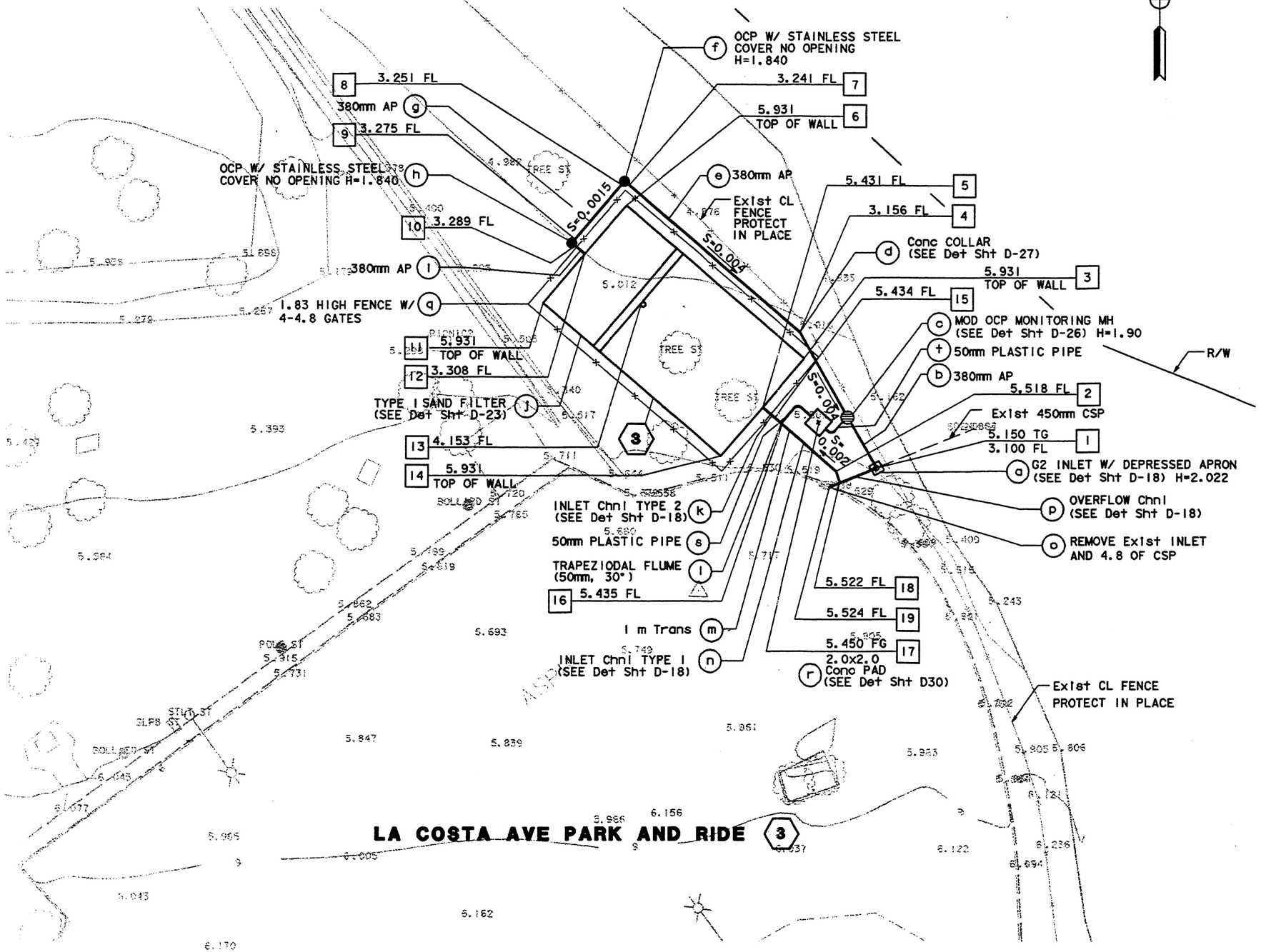
FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

USERNAME => $USER

LAST REVISION 00-00-00 DATE PLOTTED => $DATE

NOTES:

1. FOR COMPLETE R/W AND ACCURATE ACCESS DATA, SEE R/W RECORD MAPS AT DISTRICT II OFFICE.
2. SEE Sht D-18 AND D-19 FOR Const DETAILS.



COORDINATE POINT	NORTHING	EASTING
1	602424.049	1902243.455
2	602423.723	1902239.635
3	602434.259	1902236.540
4	602436.693	1902236.155
5	602429.698	1902232.643
6	602448.551	1902219.813
7	602450.468	1902220.132
8	602450.470	1902219.336
9	602445.376	1902214.984
10	602444.742	1902215.034
11	602439.427	1902212.018
12	602443.989	1902215.916
13	602439.441	1902221.238
14	602425.136	1902228.745
15	602428.716	1902233.792
16	602428.118	1902234.492
17	602428.288	1902238.003
18	602422.643	1902239.996
19	602422.256	1902239.045

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
11	SD	var	var	15	60

REGISTERED CIVIL ENGINEER

REGISTERED PROFESSIONAL ENGINEER ERWIN FOGERSON No. 049060 Exp. 9-30-99 CIVIL STATE OF CALIFORNIA

PLANS APPROVAL DATE

AGUILAR ENGINEERING INCORPORATED
937 SOUTH VIA LATA, SUITE 500
COLTON, CA 92324

DRAINAGE PLAN LOCATION 3

SCALE 1 = 200

D-3

THIS PLAN ACCURATE FOR DRAINAGE ONLY

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DATE REVISED | REVISED BY | DATE | CALCULATED/ DESIGNED BY | CHECKED BY | PROJECT ENGINEER

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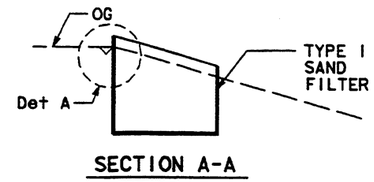
23 JUL 98 16:0

FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

USERNAME => $USER

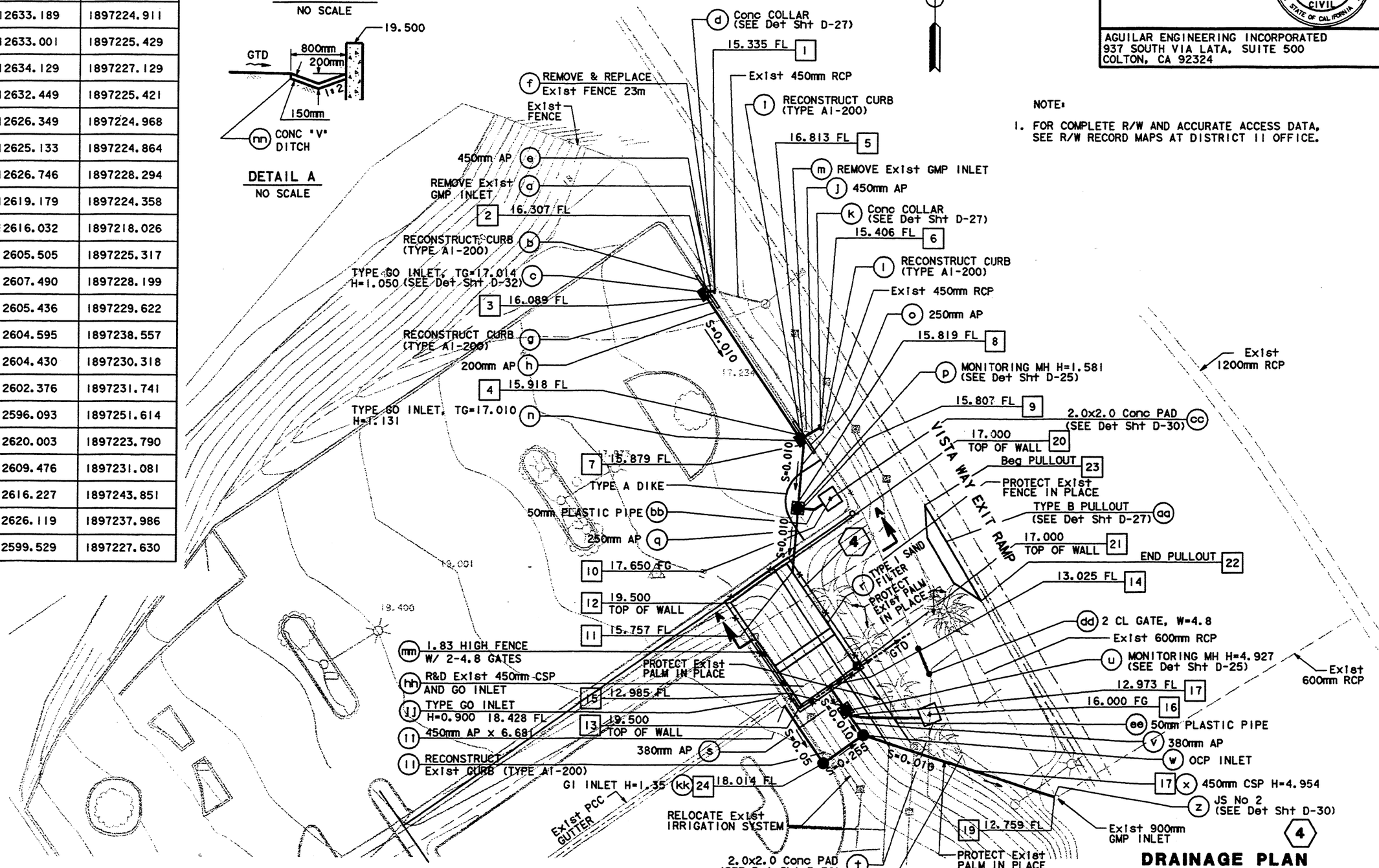
LAST REVISION 00-00-00 DATE PLOTTED => $DATE

COORDINATE POINT	NORTHING	EASTING
1	612648.116	1897216.213
2	612647.974	1897215.402
3	612647.422	1897215.386
4	612633.189	1897224.911
5	612633.001	1897225.429
6	612634.129	1897227.129
7	612632.449	1897225.421
8	612626.349	1897224.968
9	612625.133	1897224.864
10	612626.746	1897228.294
11	612619.179	1897224.358
12	612616.032	1897218.026
13	612605.505	1897225.317
14	612607.490	1897228.199
15	612605.436	1897229.622
16	612604.595	1897238.557
17	612604.430	1897230.318
18	612602.376	1897231.741
19	612596.093	1897251.614
20	612620.003	1897223.790
21	612609.476	1897231.081
22	612616.227	1897243.851
23	612626.119	1897237.986
24	612599.529	1897227.630



SECTION A-A
NO SCALE

DETAIL A
NO SCALE



NOTE:

1. FOR COMPLETE R/W AND ACCURATE ACCESS DATA, SEE R/W RECORD MAPS AT DISTRICT 11 OFFICE.

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

THIS PLAN ACCURATE FOR DRAINAGE ONLY

SR-78/I-5 PARK AND RIDE

DRAINAGE PLAN LOCATION 4

SCALE 1 = 200

D-4

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
11	SD	var	var	16	60

REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ERWIN FOGERSON — No. 049060 — Exp. 9-30-99 — CIVIL — STATE OF CALIFORNIA

AGUILAR ENGINEERING INCORPORATED
937 SOUTH VIA LATA, SUITE 500
COLTON, CA 92324

DATE	REVISED BY	DATE REVISED

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CHECKED BY

PROJECT ENGINEER

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23 JUL 98 16:

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USERNAME => @USER

LAST REVISION

DATE PLOTTED => @DATE

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
11	SD	var	var	17	60

REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ERWIN FOGERSON — No. 049060 — EXP. 9-30-99 — CIVIL — STATE OF CALIFORNIA

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COLTON, CA 92324

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DATE REVISED BY | DATE REVISED

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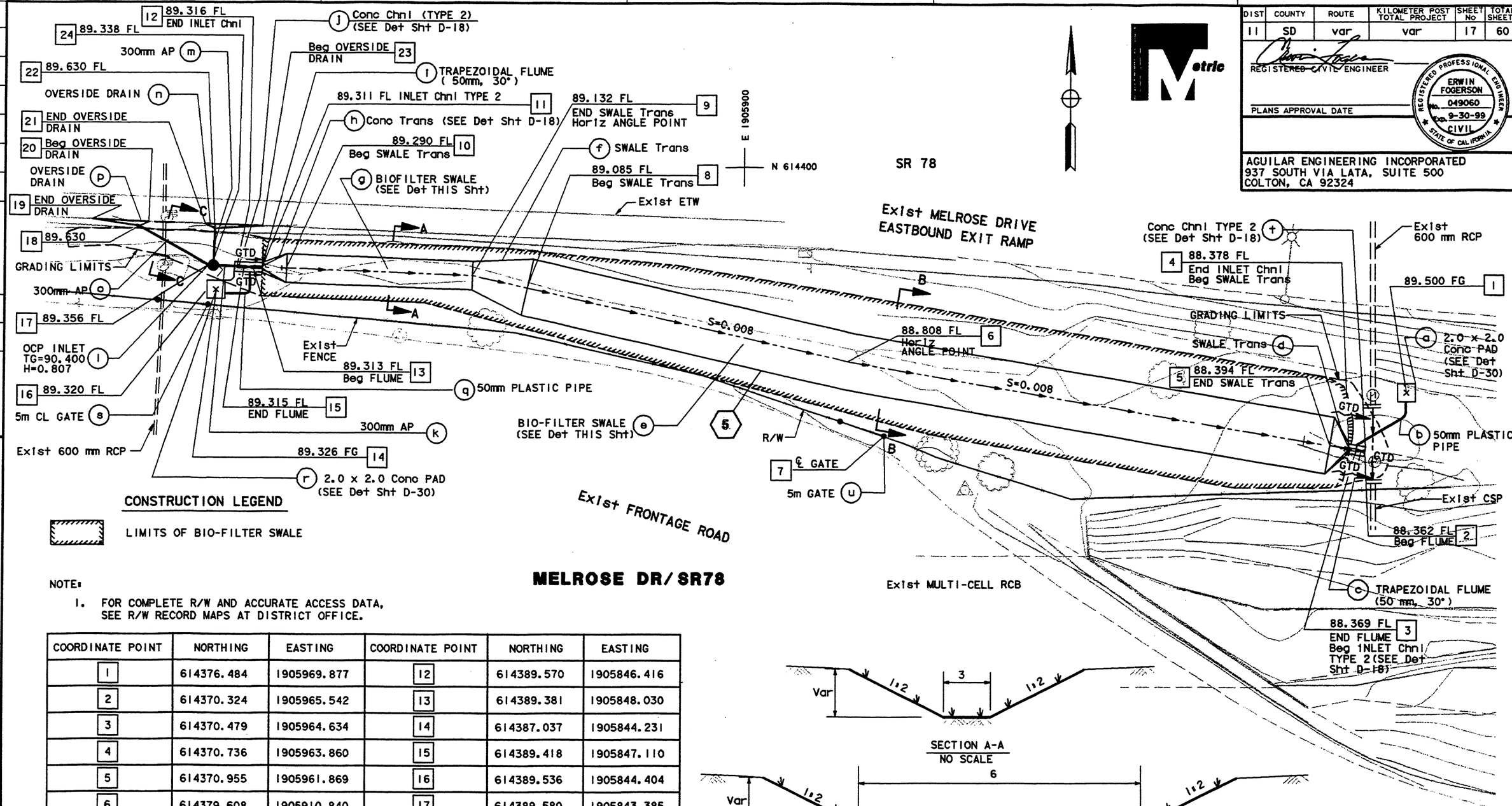
PROJECT ENGINEER



CONSTRUCTION LEGEND

LIMITS OF BIO-FILTER SWALE

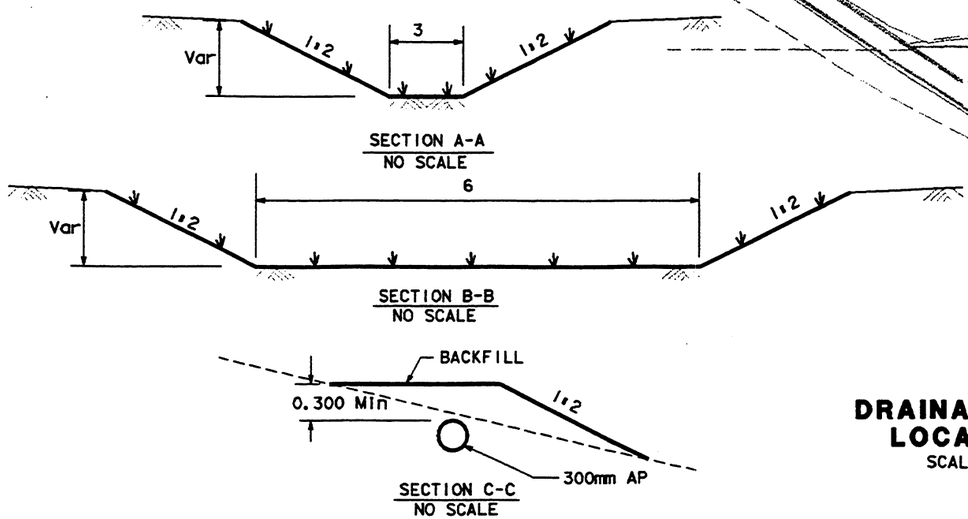
NOTE:

1. FOR COMPLETE R/W AND ACCURATE ACCESS DATA, SEE R/W RECORD MAPS AT DISTRICT OFFICE.

COORDINATE POINT	NORTHING	EASTING	COORDINATE POINT	NORTHING	EASTING
1	614376.484	1905969.877	12	614389.570	1905846.416
2	614370.324	1905965.542	13	614389.381	1905848.030
3	614370.479	1905964.634	14	614387.037	1905844.231
4	614370.736	1905963.860	15	614389.418	1905847.110
5	614370.955	1905961.869	16	614389.536	1905844.404
6	614379.608	1905910.840	17	614389.580	1905843.385
7	614371.821	1905914.718	18	614393.685	1905836.157
8	614387.252	1905877.017	19	614394.431	1905831.157
9	614388.538	1905871.328	20	614394.137	1905837.157
10	614389.271	1905851.576	21	614393.930	1905843.047
11	614389.344	1905849.029	22	614393.406	1905844.047
			23	614393.701	1905849.047
			24	614390.055	1905843.923

THIS PLAN ACCURATE FOR DRAINAGE ONLY

MELROSE DR/SR78



5

DRAINAGE PLAN LOCATION 5

SCALE 1 : 200

D-5

ALL DIMENSIONS SHOWN ARE IN METERS UNLESS OTHERWISE SHOWN

FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

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LAST REVISION 00-00-00 DATE PLOTTED => @DATE

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23 JUL 98 16:

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
11	SD	var	var	18	60

REGISTERED CIVIL ENGINEER

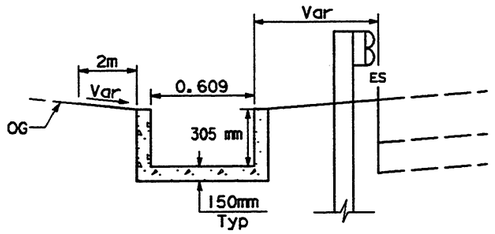
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ERWIN FOGERSON — No. 049060 — Exp. 9-30-99 — CIVIL — STATE OF CALIFORNIA

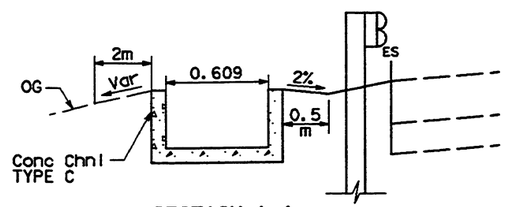
AGUILAR ENGINEERING INCORPORATED
937 SOUTH VIA LATA, SUITE 500
COLTON, CA 92324

NOTE:

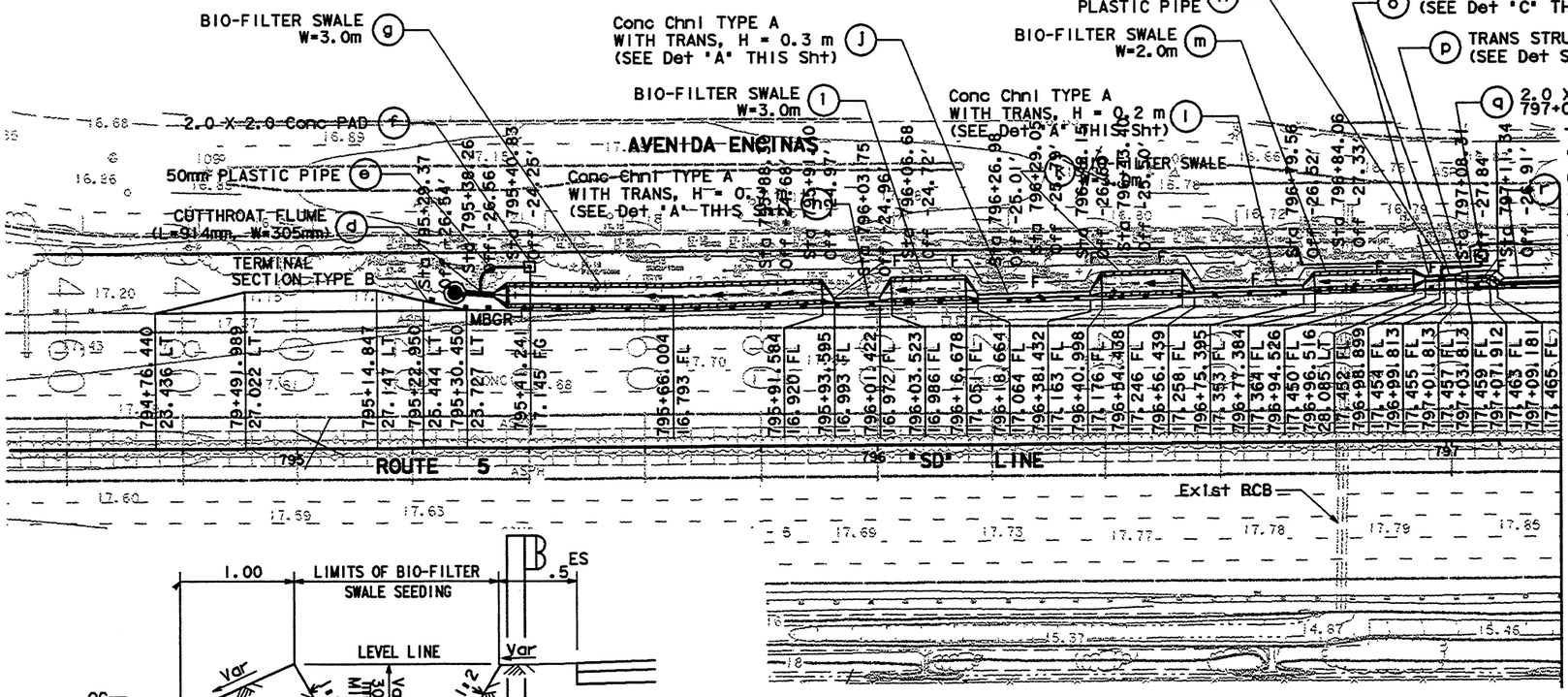
1. FOR COMPLETE R/W AND ACCURATE ACCESS DATA, SEE R/W RECORD MAPS AT DISTRICT 11 OFFICE.
2. PROTECT ALL TREES IN PLACE.
3. SEE SHEET D-37 FOR DETAILED SECTIONS.

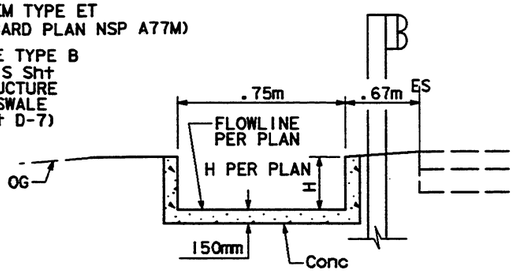


CONCRETE CHANNEL TYPE C
DETAIL C
NO SCALE

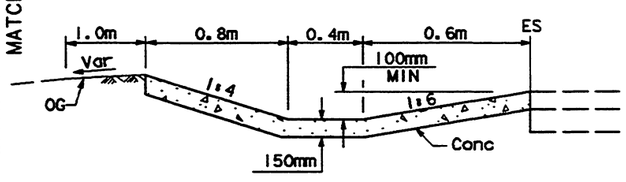


SECTION A-A
NO SCALE

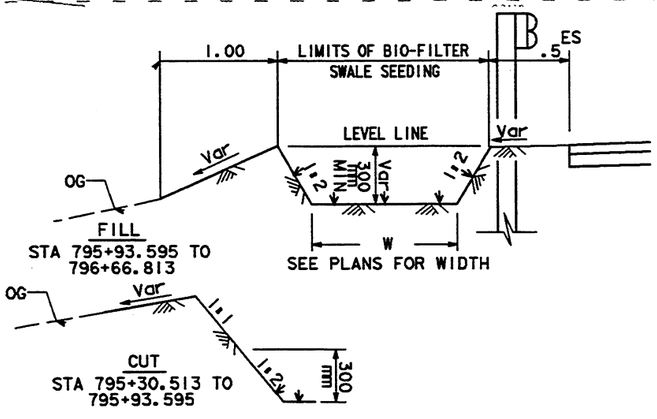




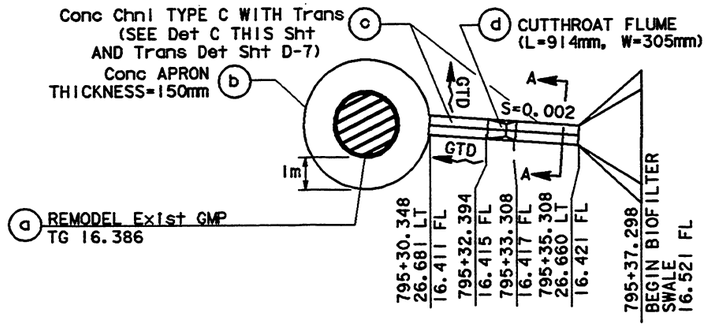
DETAIL A
CONCRETE CHANNEL TYPE A
NO SCALE



DETAIL B
CONCRETE SWALE TYPE B
NO SCALE



BIO-FILTER SWALE
NO SCALE



Conc Chnl OUTLET AND FLUME DETAIL

CONSTRUCTION LEGEND

LIMITS OF BIO-FILTER SWALE

GTD GRADE TO DRAIN

6

DRAINAGE PLAN LOCATION 6
SCALE 1 : 500

D-6

THIS PLAN ACCURATE FOR DRAINAGE ONLY ALL DIMENSIONS SHOWN ARE IN METERS UNLESS OTHERWISE SHOWN

FOR REDUCED PLANS ORIGINAL 0 20 40 60 80

USERNAME => $USER

CU 00000 CONTRACT NO 430004A

PROJECT ENGINEER

CALCULATED/ DESIGNED BY

CHECKED BY

DATE	REVISED BY	DATE REVISED
1		7-8-98
2		10-5-98
3		12-17-98

LAST REVISION 00-00-00 DATE PLOTTED => $DATE

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
11	SD	var	var	19	60

REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ERWIN FOGERSON — No. 049060 — Exp. 9-30-99 — CIVIL — STATE OF CALIFORNIA

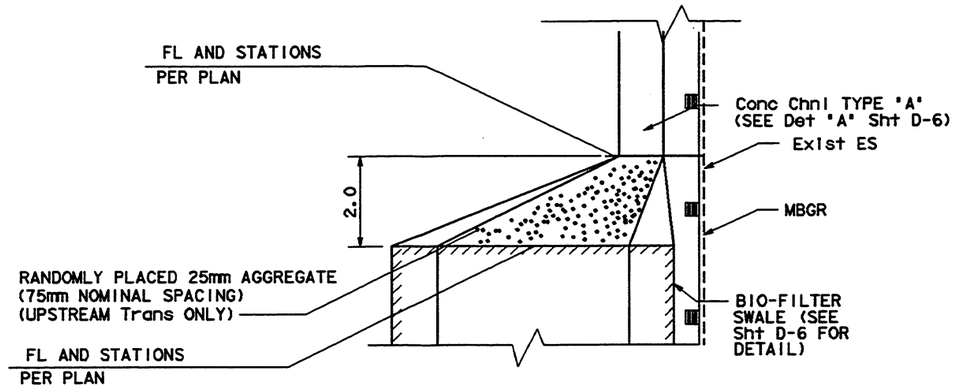
AGUILAR ENGINEERING INCORPORATED
937 SOUTH VIA LATA, SUITE 500
COLTON, CA 92324

Metric

NOTE:

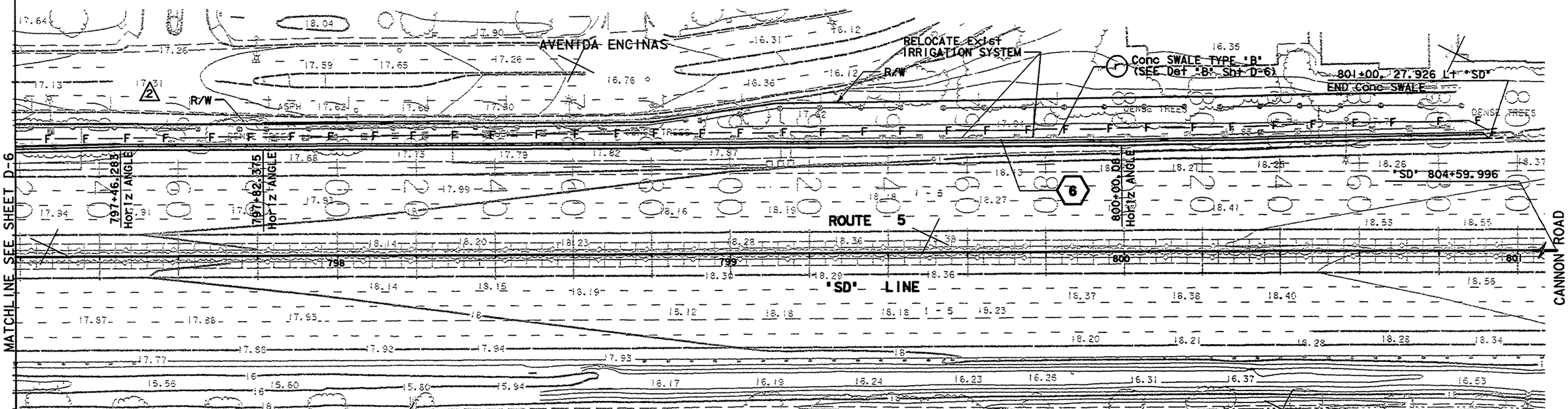
1. FOR COMPLETE R/W AND ACCURATE ACCESS DATA, SEE R/W RECORD MAPS AT DISTRICT 11 OFFICE.
2. PROTECT ALL TREES IN PLACE.

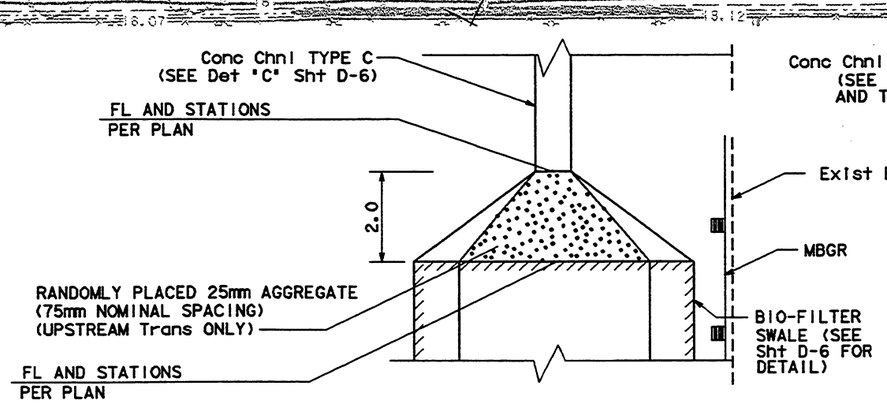
—F— F —



CONCRETE CHANNEL TYPE A TRANSITION DETAIL

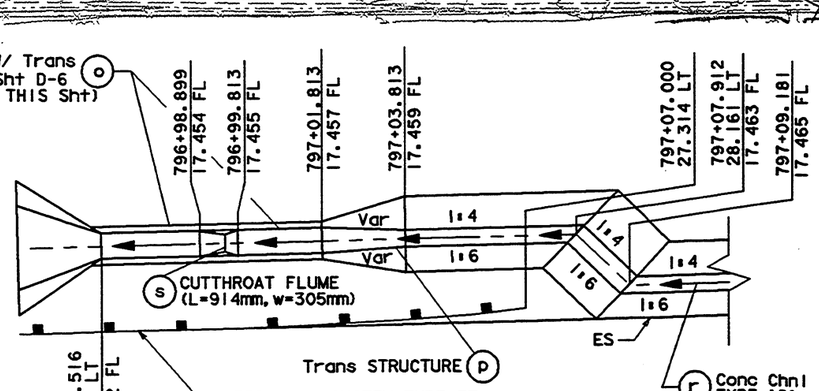
NO SCALE





Conc Chnl TRANSITION DETAIL

NO SCALE



TRANSITION STRUCTURE FOR CONCRETE SWALE TYPE "B"

NO SCALE

DRAINAGE PLAN LOCATION 6

SCALE 1 : 500

D-7

THIS PLAN ACCURATE FOR DRAINAGE ONLY

ALL DIMENSIONS SHOWN ARE IN METERS UNLESS OTHERWISE SHOWN

DATE | REVISED BY | DATE REVISED
1 | 7-8-98 | 10-5-98
2 | 10-5-98 | 12-17-98
3 | 12-17-98

CALCULATED/ DESIGNED BY
CHECKED BY
PROJECT ENGINEER

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LAST REVISION 00-00-00 DATE PLOTTED => 00ATE

FOR REDUCED PLANS ORIGINAL 0 20 40 60 80

USERNAME => %USER

CU 00000

CONTRACT NO 4300044

COORDINATE POINT	NORTHING	EASTING	COORDINATE POINT	NORTHING	EASTING
1	606319.168	1900283.939	21	606321.814	1900362.132
2	606321.235	1900303.114	22	606315.872	1900362.129
3	606318.933	1900306.196	23	606319.638	1900362.768
4	606318.927	1900307.117	24	606324.060	1900336.207
5	606318.668	1900332.969	25	606318.833	1900308.138
6	606316.788	1900310.099			
7	606316.377	1900357.072			
8	606314.788	1900360.778			
9	606314.591	1900361.912			
10	606318.652	1900362.604			
11	606314.493	1900367.111			
12	606325.449	1900334.460			
13	606316.858	1900362.296			
14	606320.699	1900362.948			
15	606320.700	1900361.782			
16	606324.082	1900334.219			
17	606313.722	1900310.614			
18	606314.652	1900310.610			
19	606313.780	1900305.034			
20	606319.052	1900294.408			

NOTE:

1. FOR COMPLETE R/W AND ACCURATE ACCESS DATA, SEE R/W RECORD MAPS AT DISTRICT 11 OFFICE.

Metric

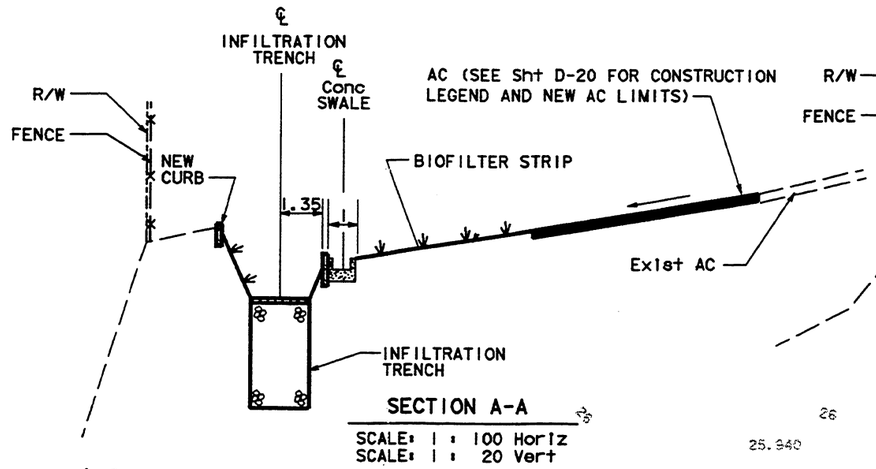
DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No.	TOTAL SHEETS
11	SD	var	var	20	60

REGISTERED CIVIL ENGINEER

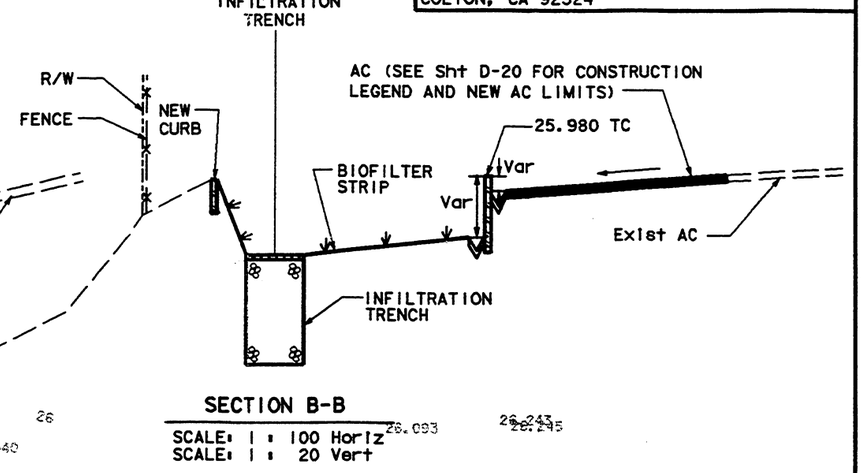
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ERWIN FOGERSON — No. 049060 — Exp. 9-30-99 — CIVIL — STATE OF CALIFORNIA

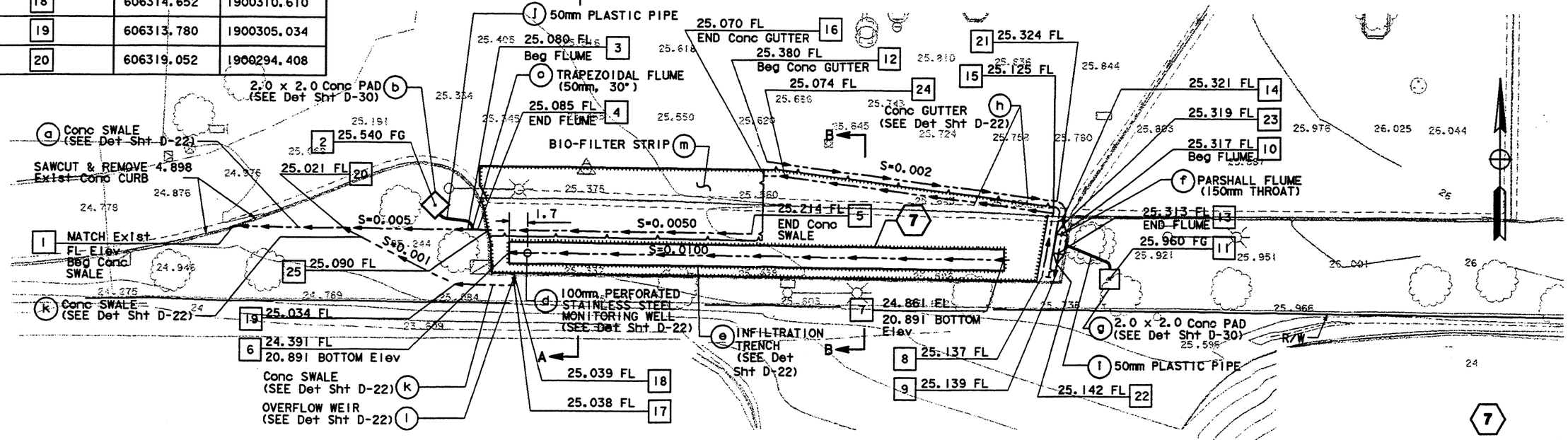
AGUILAR ENGINEERING INCORPORATED
937 SOUTH VIA LATA, SUITE 500
COLTON, CA 92324



SECTION A-A
SCALE: 1 : 100 Horiz
SCALE: 1 : 20 Vert



SECTION B-B
SCALE: 1 : 100 Horiz
SCALE: 1 : 20 Vert



CONSTRUCTION LEGEND

BIO-FILTER STRIP

RETAINING CURB (MOD TYPE A1-200)

CARLSBAD MAINTENANCE STATION

DRAINAGE PLAN LOCATION 7

SCALE 1 : 200

THIS PLAN ACCURATE FOR DRAINAGE ONLY

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

D-8

DATE | REVISED BY | DATE REVISED
CALCULATED/ DESIGNED BY
CHECKED BY
PROJECT ENGINEER

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans

23 JUL 98 16:1 q:\57704\34358\dgn\dlv\d08.dlv

LAST REVISION 00-00-00 DATE PLOTTED => 9DATE

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
11	SD	var	var	21	60

REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ERWIN FOGERSON — No. 049060 — Exp. 9-30-99 — CIVIL — STATE OF CALIFORNIA

AGUILAR ENGINEERING INCORPORATED
937 SOUTH VIA LATA, SUITE 500
COLTON, CA 92324

Metric

1

OCP INLET W/ STAINLESS STEEL COVER
TG=119.188, H=1.47 (w)

300 mm AP (x)

380 mm x 3.02 AP (e)

MONITORING MH H=1.491 (c)
(SEE Det Sht D-25)

380 mm x 5.23 AP (b)

GDI INLET
TG=119.090, H=1.410 (a)
(SEE Det Sht D-28)

Exist 900mm RCP

S=0.004 S=0.004

17 117.689 FL
1 117.686 FL
2 117.707 FL
3 117.711 FL
21 117.728 FL
22 117.723 FL

117.733 FL 20

380 mm x 1.86 AP (aa)

117.756 FL 5

COMPOST FILTER VAULT NO 1 (f)
(SEE Det Sht D-16 AND D-17)

380 mm x 1.52 DIP (g)

COMPOST FILTER VAULT NO 2 (h)
(SEE Det Sht D-16 AND D-17)

380 mm x 1.52 DIP (i)

COMPOST FILTER VAULT NO 3 (j)
(SEE Det Sht D-16 AND D-17)

380 mm x 1.72 DIP (k)

PRETREATMENT VAULT (o)

300 mm x 3.90 AP (p)

MONITORING MH H=0.650 (m)
(SEE Det Sht D-25)

300 mm x 5.15 AP (n)

Conc COLLAR (qc)

GI INLET (q)
TG=119.290
H=0.600

OG

S=0.002 S=0.002

118.706 FL 16
118.696 FL 15
118.693 FL 13
118.686 FL 12
118.521 FL 11
117.756 BOTTOM

300mm AP W/ GATE VALVE (dd)

IDENTICAL

8 118.518 FL
9 118.518 FL

117.756 FL 26

8 118.518 FL
9 118.518 FL

10 118.518 FL

117.756 FL 27

IDENTICAL

OCP INLET W/ STAINLESS STEEL COVER (y)
TG=119.272
H=1.534

OG

bb
380 mm x 0.97 AP

25 117.748 FL
23 117.744 FL
117.756 FL 26

IDENTICAL

OCP INLET W/ STAINLESS STEEL COVER (w)
TG=119.188, H=1.47

380 mm AP (e)

x 380 mm x 11.20 AP

S=0.001

20 117.733 FL
22 117.728 FL
29 117.730 FL

IDENTICAL

OCP INLET W/ STAINLESS STEEL COVER (y)
TG=119.272, H=1.534

OG

300 mm AP

z 380 mm x 7.98 AP

S=0.001

24 117.739 FL
23 117.744 FL

117.756 FL 27

117.755 FL 28

117.748 FL 25

NOTE:
SEE Sht D-1 FOR [XX] Coord POINT NORTHING AND EASTING UNLESS OTHERWISE NOTED ON PLAN.

DRAINAGE PROFILES LOCATION 1

SCALE: HORIZ 1: 100
VERT 1: 20

D-9

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DATE	REVISED BY	DATE REVISED
1		7-8-98

CALCULATED/DESIGNED BY
CHECKED BY
PROJECT ENGINEER

Station
Cu
M Exc Emb

FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

USERNAME => $$$$$$USER$$$$$$

LAST REVISION 00-00-00 TIME PLOTTED => $$$$$$$SYTIME$$$$$$

31 JUL 98 11:

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DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
11	SD	var	var	22	60

REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
ERWIN FOGERSON
No. 049060
Exp. 9-30-99
CIVIL
STATE OF CALIFORNIA

AGUILAR ENGINEERING INCORPORATED
937 SOUTH VIA LATA, SUITE 500
COLTON, CA 92324

DATE | REVISED BY | DATE REVISED

CALCULATED/ DESIGNED BY

CHECKED BY

PROJECT ENGINEER

380mm x 2.00 AP (b)
S=0.0010

GDI INLET
GRATE Elev
TG= 203.510
H = 1.386 (a)

Exist
900mm RCP

(c) MONITORING MH H=1.268
(SEE Det Sht D-25)

TYPE 11 SAND FILTER
(SEE Det Sht D-24)

9 202.797 FL

300mm x 4.19 AP (n)

OG

(o) MONITORING MH
H = 1.110
(SEE Det Sht D-25)

(p) 300mm x 3.48 AP

(q) GT3 INLET W/
LOCAL DEPRESSION
W = 0.15
H = 0.368
TG = 203.189

S = 0.005

S = 0.005

(e)

16 202.125 FL

1 202.250 FL

2 202.253 FL

3 202.253 FL

202.256 FL 12

202.776 FL 8

202.821 FL 11

202.804 FL 10

OG

380mm x 25.25 AP (d)
S=0.0010

150mm x 1.45 AP
Typ

(e) (f) (g) (h) (i) (j)

S=0.0010

IDENTICAL

202.256 FL 12

6 202.278 FL

7 202.290 FL

(k) OCP INLET W/
CHECKERED PL
(NO OPENING)
H=1.320

NOTE :
SEE Sht D-2 FOR XX Coord POINT NORTHING AND EASTING UNLESS OTHERWISE NOTED ON PLAN.

2

DRAINAGE PROFILES
LOCATION 2

SCALE: HORIZ 1 : 100
VERT 1 : 20

D-10

ALL DIMENSIONS ARE IN METERS
UNLESS OTHERWISE SHOWN

Station
Cu
M Exc Emb

LAST REVISION 00-00-00

TIME PLOTTED => $$$$$$$SYTIME$$$$$$$

23 JUL 98 16:(

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FOR REDUCED PLANS ORIGINAL 0 20 40 60 80

USERNAME => $$$$$$USER$$$$$$

DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
11	SD	var	var	23	60

REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER — ERWIN FOGERSON — No. 049060 — Exp. 9-30-99 — CIVIL — STATE OF CALIFORNIA

AGUILAR ENGINEERING INCORPORATED
937 SOUTH VIA LATA, SUITE 500
COLTON, CA 92324

DATE REVISED BY | DATE REVISED
CALCULATED/ DESIGNED BY
CHECKED BY
PROJECT ENGINEER

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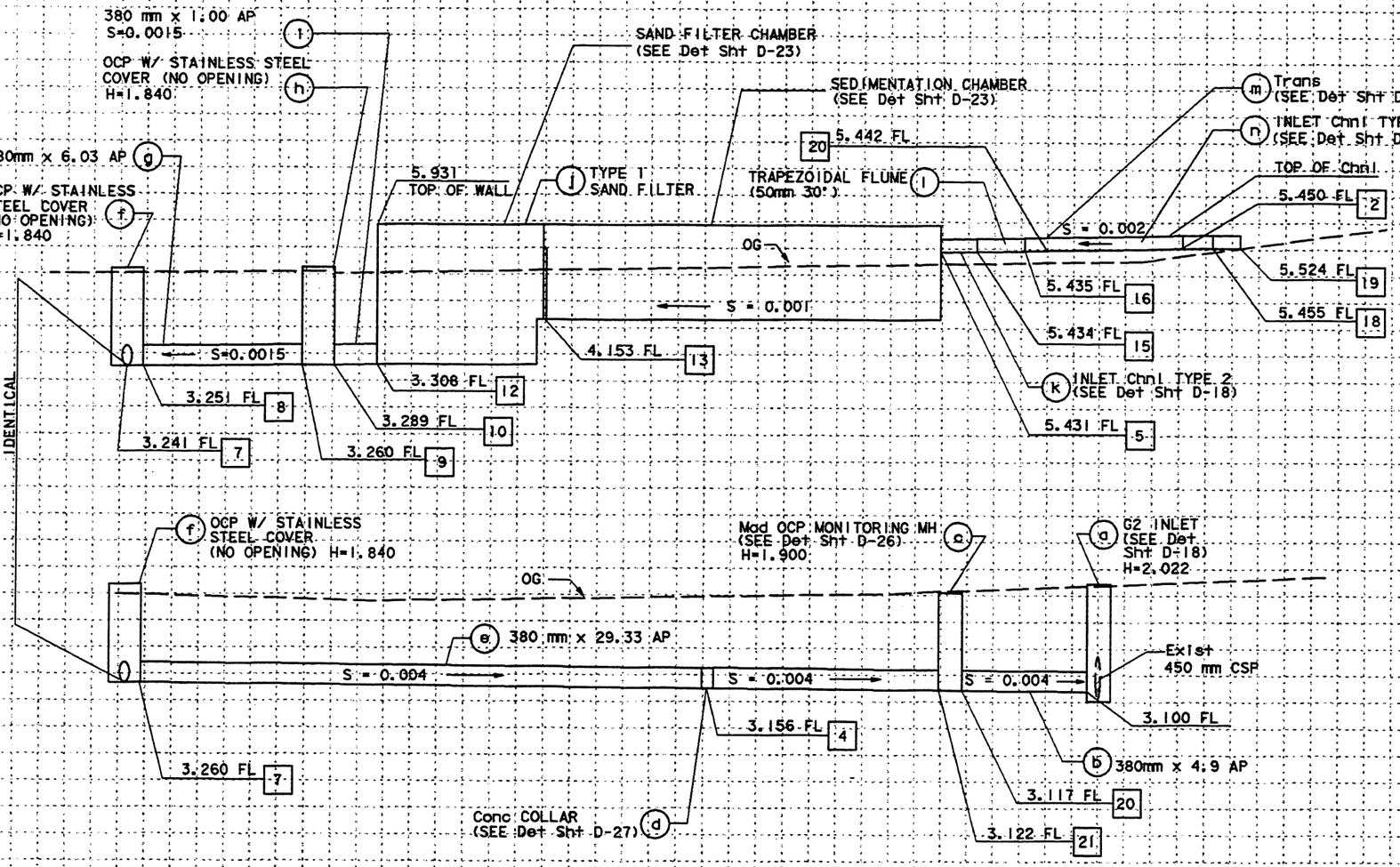


COORDINATE POINT	NORTHING	EASTING
20	602428.259	1902241.025
21	602429.298	1902240.425
22	602424.846	1902242.844

NOTE :
SEE Sht D-3 AND D-18 FOR XX Coord POINT NORTHING AND EASTING UNLESS OTHERWISE NOTED ON PLAN.

3

DRAINAGE PROFILES LOCATION 3

SCALE: Horiz 1 : 100
Vert 1 : 50

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

D-11

Station
Cu
M Exc Emb

FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

USERNAME => $$$$$$USER$$$$$$

CU 00000 EA 000000

LAST REVISION 00-00-00 TIME PLOTTED => $$$$$$$SYTIME$$$$$$$

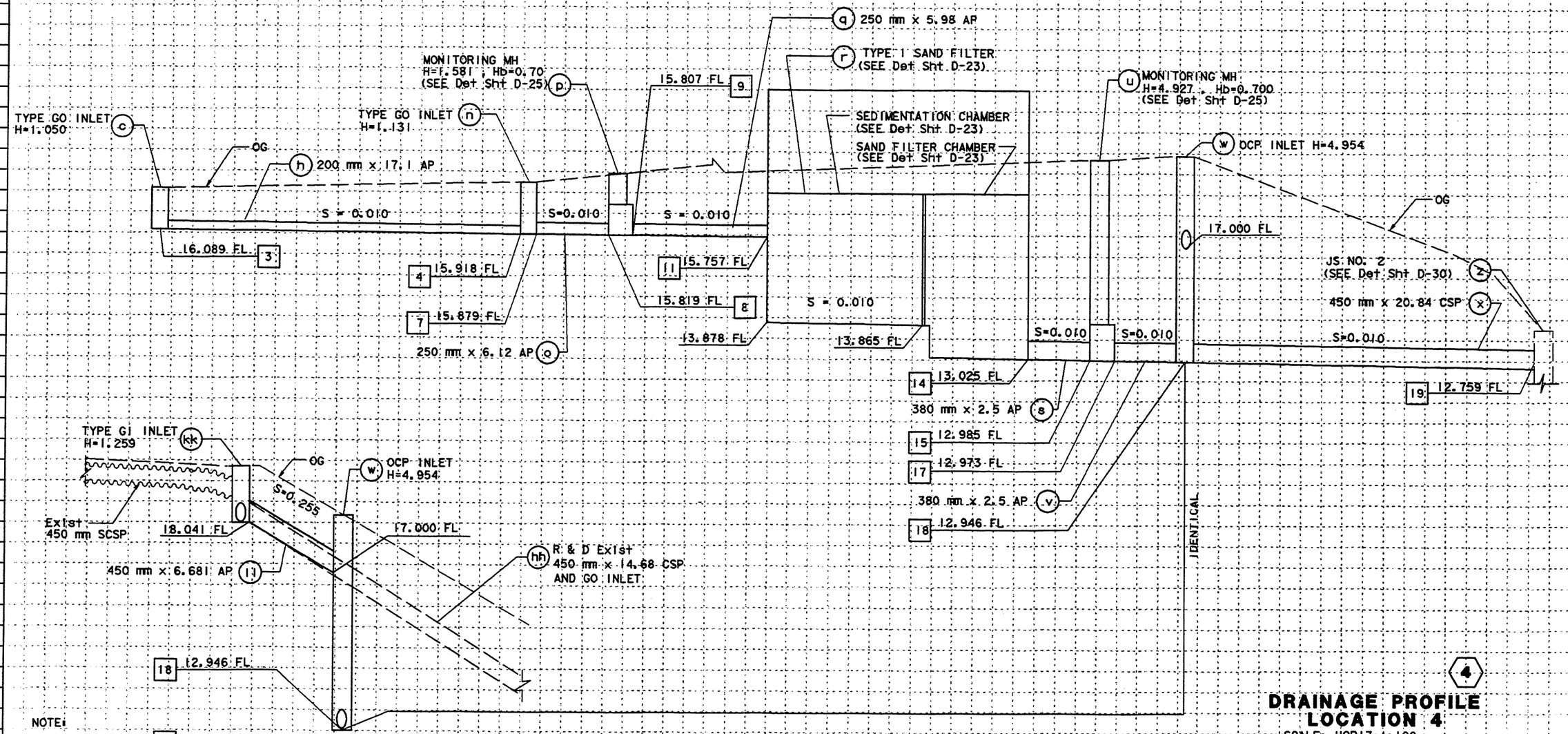
DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
11	SD	var	var	24	60

REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER ERWIN FOGERSON No. 049060 Exp. 9-30-99 CIVIL STATE OF CALIFORNIA

AGUILAR ENGINEERING INCORPORATED
937 SOUTH VIA LATA, SUITE 500
COLTON, CA 92324



NOTE:
SEE Sht D-4 FOR XX Coord POINT NORTHING AND EASTING UNLESS OTHERWISE NOTED ON PLAN.

4

DRAINAGE PROFILE
LOCATION 4
SCALE: HORIZ 1:100
VERT 1:50

D-12

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

Station
Cu
M Exc Emb

PROJECT ENGINEER
CALCULATED/DESIGNED BY
CHECKED BY
DATE
REVISED BY
DATE REVISED

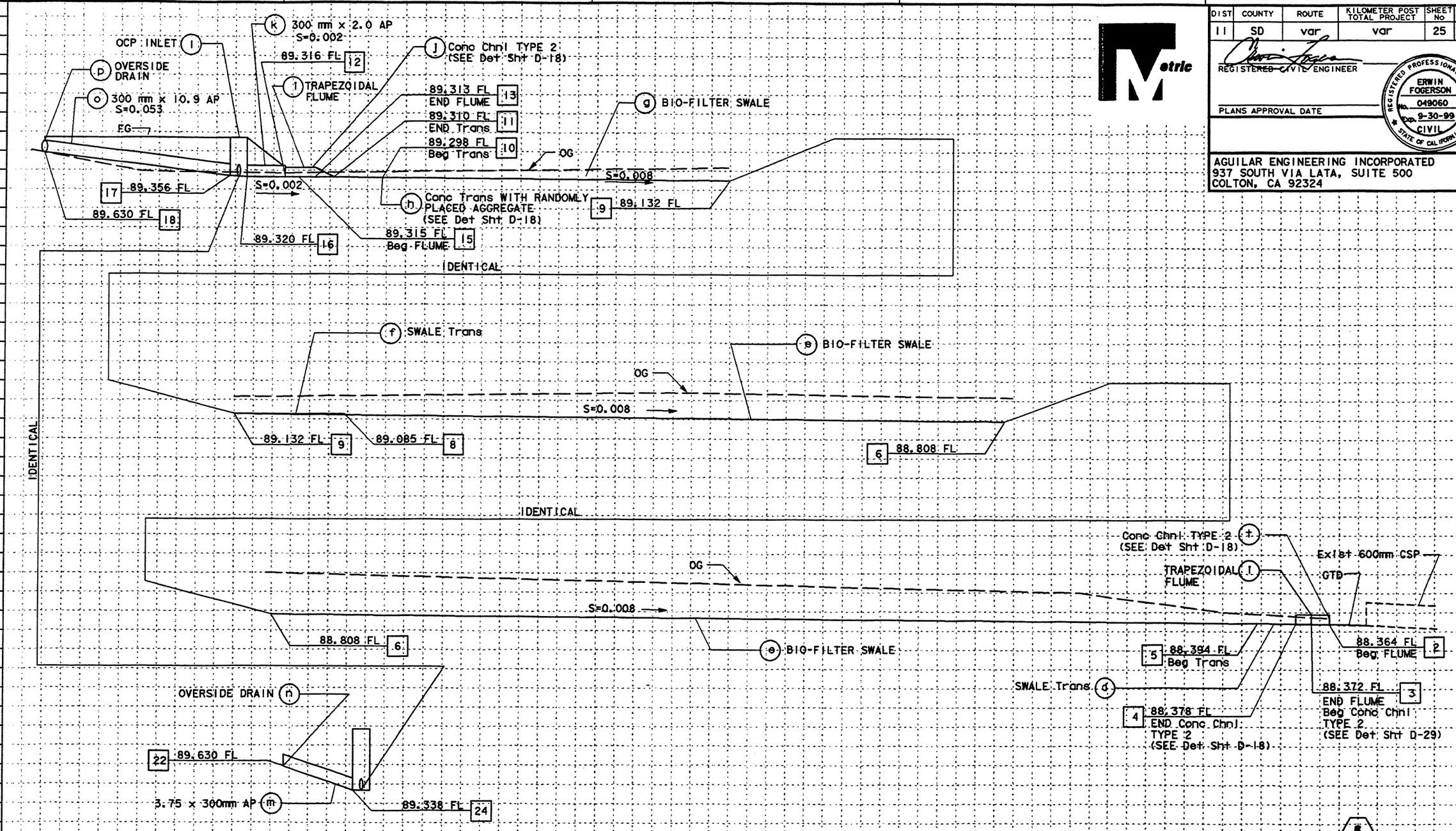
23 JUL 98 16: q:\57704\34358\dgn\div\d12.div

TIME PLOTTED => $$$$$$SYTIME$$$$$$

LAST REVISION 00-00-00

FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

USERNAME => $$$$$$USER$$$$$$



DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
11	SD	var	var	25	60

REGISTERED CIVIL ENGINEER

REGISTERED PROFESSIONAL ENGINEER — ERWIN FOGERSON — No. 049060 — Exp. 9-30-99 — CIVIL — STATE OF CALIFORNIA

PLANS APPROVAL DATE

AGUILAR ENGINEERING INCORPORATED
937 SOUTH VIA LATA, SUITE 500
COLTON, CA 92324

NOTE:
SEE Sht D-5 FOR XX Coord POINT NORTHING AND EASTING UNLESS OTHERWISE NOTED ON PLAN.

DRAINAGE PROFILE LOCATION 5

SCALE: HORIZ 1:100
VERT 1:50

D-13

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

DATE REVISED BY | DATE REVISED
CALCULATED/ DESIGNED BY
CHECKED BY
PROJECT ENGINEER

Station
Cu
M Exc Emb

23 JUL 98 16: q:\57704\34358\dgn\dlv\dl3.dlv

FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

USERNAME => $$$$$$USER$$$$$$

LAST REVISION 00-00-00 TIME PLOTTED => $$$$$$SYTIME$$$$$$

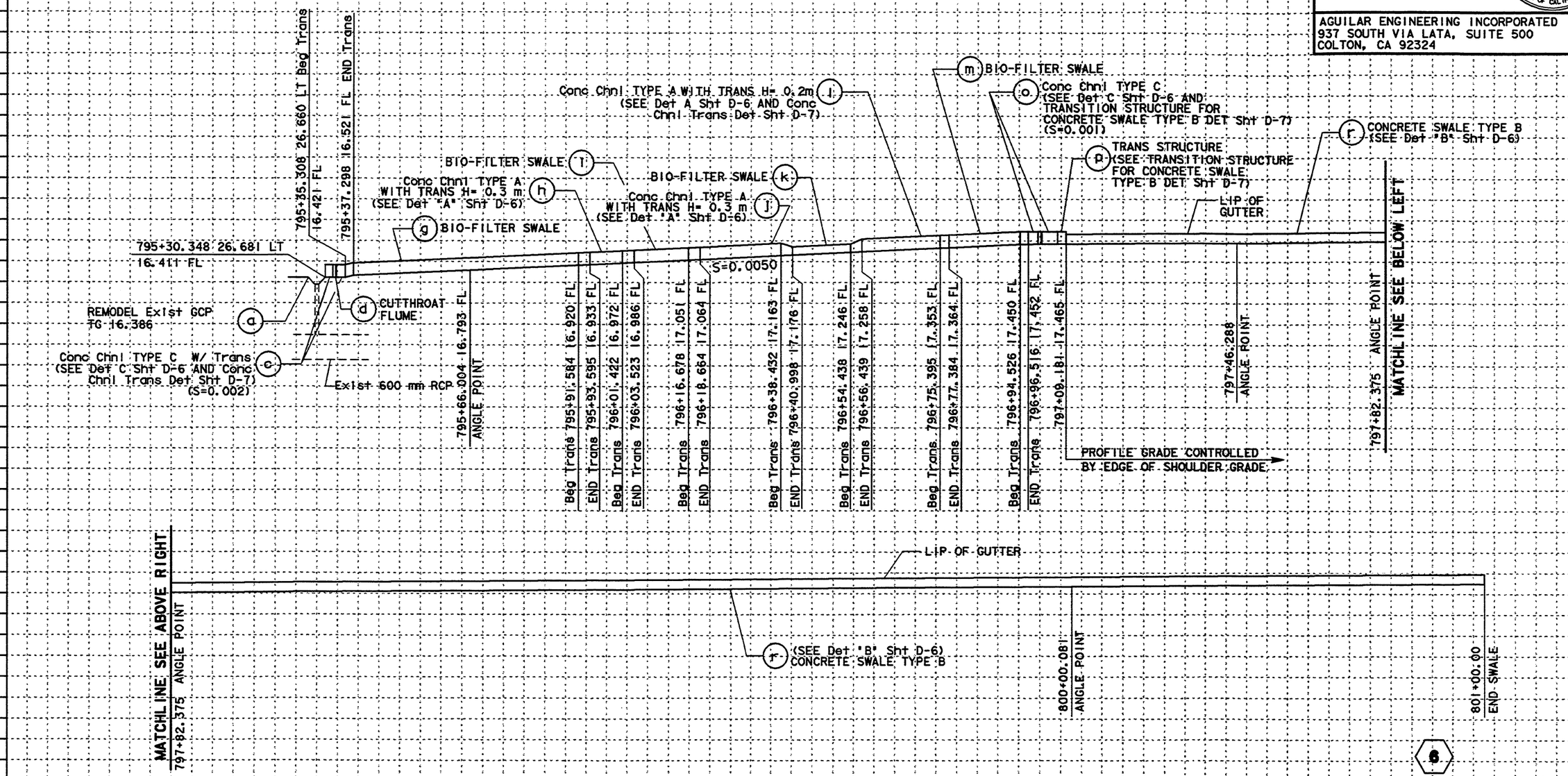
DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
11	SD	var	var	26	60

REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER ERWIN FOGERSON No. 049060 Exp. 9-30-99 CIVIL STATE OF CALIFORNIA

AGUILAR ENGINEERING INCORPORATED
937 SOUTH VIA LATA, SUITE 500
COLTON, CA 92324



DRAINAGE PROFILES
LOCATION 6

SCALE: HORIZ 1 : 500
VERT 1 : 50

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

D-14

Station	
Cu	
M	Exc
	Emb

PROJECT ENGINEER

CALCULATED/DESIGNED BY | CHECKED BY | DATE | REVISED BY | DATE REVISED | 7-8-98 | 10-5-98

12 JUN 10014:) q:\57704\34358\dgn\location 6\d14r.dlv

TIME PLOTTED => $$$$$$SYTIME$$$$$$

LAST REVISION 00-00-00

FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

USERNAME => $$$$$$USER$$$$$$
DGN FILE => $$$$$$$$$$DGNSPEC$$$$$$$$$$

CU 08236

CONTRACT NO 430004A

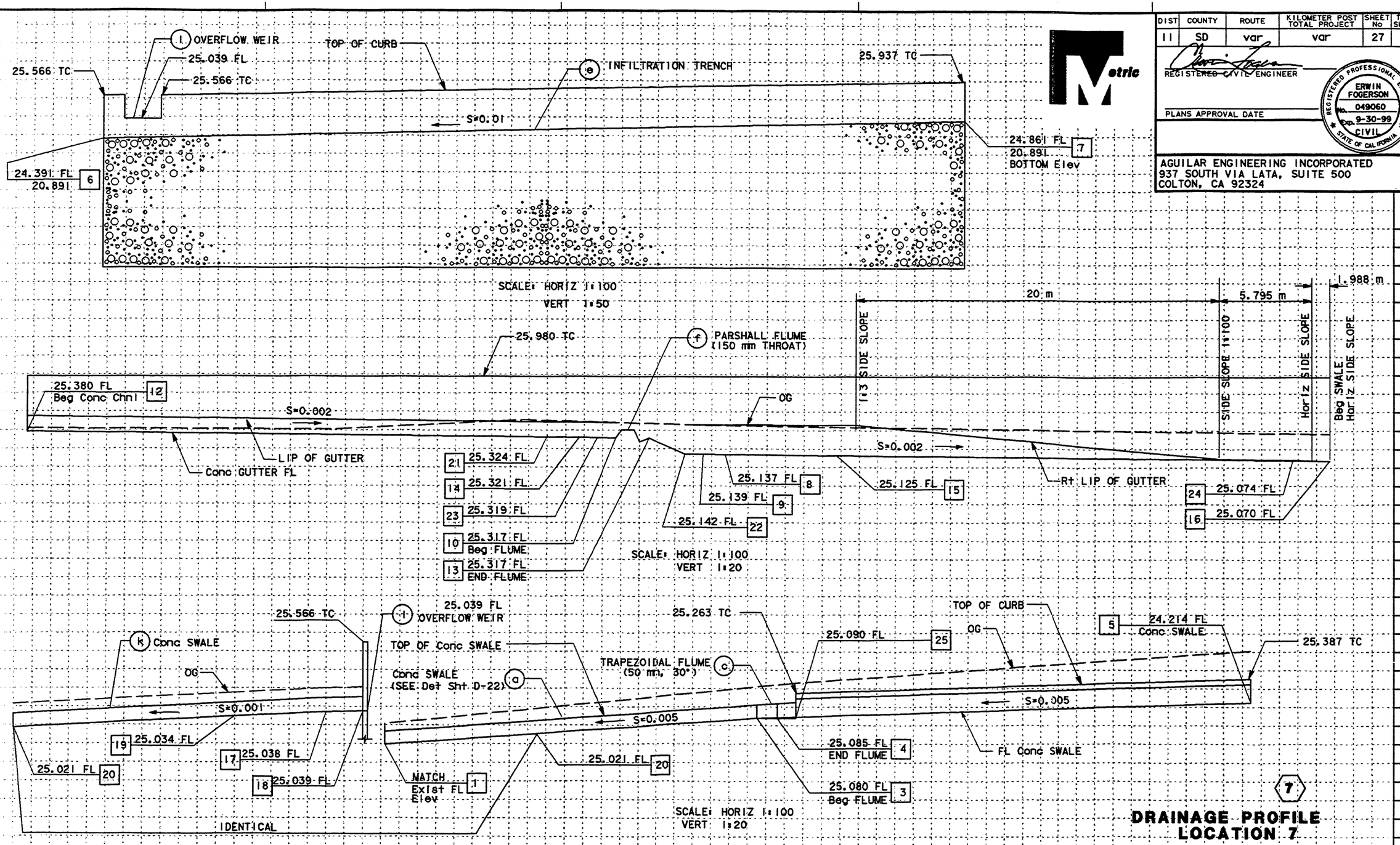
DIST	COUNTY	ROUTE	KILOMETER POST TOTAL PROJECT	SHEET No	TOTAL SHEETS
11	SD	var	var	27	60

REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER ERWIN FOGERSON No. 049060 Exp. 9-30-99 CIVIL STATE OF CALIFORNIA

AGUILAR ENGINEERING INCORPORATED
937 SOUTH VIA LATA, SUITE 500
COLTON, CA 92324



7

DRAINAGE PROFILE LOCATION 7

SCALE: AS SHOWN

NOTE:
SEE Sht D-8 FOR XX Coord POINT NORTHING AND EASTING UNLESS OTHERWISE NOTED ON PLAN.

D-15

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SHOWN

Station	
Cu	
M	Exc / Emb

REVISED BY | DATE REVISED | DATE | CALCULATED/DESIGNED BY | CHECKED BY | PROJECT ENGINEER

23 JUL 98 16. q:\57704\34358\dgn\div\d15.div

TIME PLOTTED => $$$$$$SYTIME$$$$$$

LAST REVISION 00-00-00

FOR REDUCED PLANS ORIGINAL SCALE IS IN MILLIMETERS 0 20 40 60 80

USERNAME => $$$$$$USER$$$$$$
DGN FILE => $$$$$$$$$$$DGNSPEC$$$$$$$$$$$

CU 00000 | EA 000000