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MARK GOODWIN & ASSOCIATES
CONSULTING ENGINEERS

DRAINAGE REPORT

for

THE CITY OF ALBUQUERQUE

SPECIAL ASSESSMENT DISTRICT 219

CITY PROJECT NO. 3558

Presented to

THE CITY OF ALBUQUERQUE

June 1990

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EXECUTIVE SUMMARY

This drainage study for SAD 219 was performed in accordance with guidelines established by the City of Albuquerque Development Process Manual, the Albuquerque Master Drainage Study, and various other local drainage plans applicable to each of the different areas that lie within proposed SAD 219. This analysis recommends the improvements of the existing Boca Negra Arroyo from Tesuque to San Ildefonso. Because of funding limitations, no crossing structures over the Boca Negra are proposed at this time for either Mojave or Tesuque. The proposed typical arroyo section is to be continued through the existing Tesuque and Mojave rights of way, while Tesuque and Mojave roadways will be barricaded on each side of the arroyo until crossing structures may be constructed. The potential crossing structures were considered during the design of the streets and the arroyo allowing for the relative ease in placing these structures. In addition to the arroyo improvements, this report recommends the construction of a significant amount of storm sewer pipe on Tesuque from Sonora to the Mariposa Channel, on Tesuque from Agate to the Boca Negra, on Corona and Atrisco to the new West Bluffs system, and in the Regina Addition. A stormwater detention facility is recommended in the Regina Addition with controlled discharge via an 18" diameter outlet pipe with an 8" orifice located at the outlet. Only local inlets with relatively short laterals that are necessary to carry stormwater to the nearest major structure will be required in other areas in addition to these major recommendations. These study results also indicate that the proposed design and construction of improvements for SAD 219 will not adversely affect the existing and/or masterplanned drainage infrastructure within the bounds of SAD 219. Utilizing accepted design and study principals, this analysis shows that all improved areas of SAD 219 will provide adequate drainage noting the following:

1. Future homebuilders should be aware that it will be their responsibility to develop each lot to provide positive drainage to the public street in accordance with City of Albuquerque drainage policy. Due to current limitations of Special Assessment District statutes and ordinances, the City is not permitted to provide grading for drainage purposes on private

property. Therefore, modifications and responsibility for providing proper drainage for each private property are left to the respective developer.

2. Downstream drainage provisions existing for the portion of SAD 219 located around Regina Circle are already significantly substandard. Proposed improvements for SAD 219 in this area are only meant to be a stopgap measure. However, it is recommended that a relatively high priority be placed on resolving the substandard downstream drainage provisions there.

This study proposes to construct a 3,000 cubic yard detention basin with controlled discharge in order to control runoff from the Regina Area, so that it does not enter the downstream storm sewer system until that system has substantially cleared from other contributing runoff. It appears that the only viable location for a detention pond is a portion of vacant land located along the west side of the Arenal Canal southeast of the intersection of Bluewater Road and Regina Drive. Three tracts of land are proposed to be acquired, and a detention facility constructed.

The reader will note that none of the areas under study by this report required any measures out of the ordinary. This is in spite of the fact that the analysis was based upon fully developed conditions for each area. In short, SAD 219 improvements while not impacting other systems, will also accommodate all future adjacent development.

I. VOLCANO CLIFFS AREA

Proposed street improvements for SAD 219 in the Volcano Cliffs Area consist of the following (see Sheet 1 of 9, Map Pockets; Zone Atlas Pages D-10, 11 and E-10, 11):

E-11	San Ildefonso Drive from Montano Road to Mojave Street
E-11	Sierra Linda Avenue from San Ildefonso to Mojave Street
E-11	Meadow Lake Place from Sierra Linda Avenue to Mojave Street
E-10, 11	Mojave Street from San Ildefonso Drive to Boca Negra Arroyo
E-10, 11	Kiva Street from San Ildefonso Drive to Pojoaque Drive
E-10	Pojoaque Drive from Kiva Street to Mojave Street
E-10	Mojave Street from Pojoaque Drive to Atrisco Road
D/E-10, D-11	Tesuque Drive from Mojave Street to Homestead Circle
E-10, 11	Agate Avenue from Tesuque Drive to Agate Lane
D/E-10	Mariposa Place from Agate Avenue to Seville Place
D/E-10	Seville Place from Mariposa Place to Agate Avenue
D-11	Acacia Street from Tesuque Drive to Hokona Place
D-11	Tamarisk Place from Acacia Street to Hokona Place
D-11	Hokona Place from Tamarisk Place to Acacia Street
D-10	Acacia Street from Tesuque Drive to Sonora Avenue
D-10, 11	Sonora Avenue from Acacia Street to Tesuque Drive
D-11	Tesuque Court from Tesuque Drive to end of Tesuque Court
D-11	Jasmine Street from Sonora Avenue to Tesuque Drive
E-11	Carousal Street from San Ildefonso to Pojoaque
E-11	Thunderbird Circle

A. Hydrology / Hydraulics

Hydrologic analysis criteria utilized for this area of study are listed as follows:

1. City of Albuquerque Development Process Manual
2. Albuquerque Master Drainage Study
3. Far Northwest Drainage Management Plan Final Report
4. Northwest Mesa Drainage Management Plan.

Other pertinent information was obtained from the Special Assessment District 197 Final Storm Drainage Report, Montano Road from Atrisco to the Mariposa Channel, and from the Drainage Report for Butterfield Subdivision.

There are four major outfall points for the Volcano Cliffs Area of SAD 219; those being the Boca Negra Arroyo, Montano Blvd., Kachina Street east of San Ildefonso, and the Mariposa North Arroyo.

The Soil Survey of Bernalillo County and Parts of Sandoval and Valencia Counties, New Mexico, as published by the US Department of Agriculture Soil Conservation Service and Forest Service, records that the larger part of soils within this area of SAD 219 are in Hydrologic Soil Group A. However, the very southeast portion of this area bounded on the north by Mojave, on the east by San Ildefonso, on the south by Montano, and on the west by Whiteman Drive are in Hydrologic Soil Group B.

The Rational Method was used to compute runoff rates for these drainage areas since the areas in this basin are relatively small (usually less than 30 acres). Rainfall Intensities and C Factors utilized, and 100 year runoff rates resulting, are summarized in the table on Sheet 8 of 15.

The drainage areas utilized in this study are defined on Sheet 1 of 3 in the map pockets at the end of this report. The drainage areas designated above on the escarpment to the west of SAD 219 taken from the Far Northwest Drainage Management Plan were considered during this study, but the condition is such that the majority of flows from the upper bluffs would be intercepted by Atrisco Drive, the Boca Negra Arroyo, or the Mariposa North Channel. These are some of the major outfalls that will also be utilized for SAD 219.

Mariposa North Channel Outfall (See Sheet 1 of 3, Drainage Maps D-10, D-11, E-10, and E-11)

There are approximately 29 acres upon the escarpment (Area M11A) which historically drain onto SAD 219 Drainage Area D11-2a. The 100 year peak runoff rate for this basin is estimated at 54 cfs. The Northwest Mesa Drainage Management Plan defines a 128' drop structure (Project No. 17310) to be constructed in the future to collect the escarpment drainage. Since the construction date for the 128' drop structure is unknown, we will assume that it is to be constructed substantially later than SAD 219. To accommodate

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this offsite drainage as well as the onsite runoff, it is proposed to construct a 48" RCP storm sewer pipe from the Mariposa Channel at Tesuque west on Tesuque to the intersection of Sonora and Tesuque, then 36" RCP storm drain west on Sonora to Jasmine. Catch basins are proposed upstream of that intersection on both Tesuque and Sonora to intercept the difference between the combined peak flow rates entering the intersection and the capacity of the street to carry stormwater. Street grades have been designed in conjunction with inlet placement in order to avoid potential problems in the Sonora and Tesuque intersection due to high velocity heads. In addition, inlets have been designed upstream of the Tesuque and Jasmine intersection to avoid a similar problem. The remainder of the Mariposa North Outfall Area drainage can be facilitated by street surface flows.

<u>Boca Negra Channel Outfall</u> (See Sheet 1 of 3, Drainage Maps D-10, D-11, E-10, and E-11.)

The Boca Negra Channel from the San Ildefonso west is currently an unimproved natural earthen arroyo. In order to protect properties in Special Assessment District No. 219 that abut the Boca Negra Channel right of way, it is proposed to armor the Boca Negra Channel from Tesuque east to San Ildefonso. Proposed design of the channel will utilize rip-rap side slopes and a natural earthen bottom. Sediment transport and equilibrium slope analysis, design calculations, and a typical section of the channel and the drainage easement rundowns are shown in the Appendix of this report. Drop inlets and storm drains adjacent to the channel in the streets are proposed to collect and convey surface runoff from Tesuque, Mojave, and San Ildefonso Streets into the improved channel. Flows from existing Agate Lane currently pass through existing sidewalk culverts on the south end of the cul-de-sac and surface flow to the Boca Negra Arroyo. We propose to construct a concrete rundown connecting the sidewalk culverts to the proposed lined channel (see Sheet 14 of 14 in Appendix). Street crossing structures for Tesuque and Mojave are not proposed in this project; Mojave and Tesuque will therefore be barricaded at the Boca Negra Channel. Rational analysis of stormwater flows indicate that the 100 year runoff from SAD 219 Drainage areas E10-1 and E10-2 will exceed the surface carrying capacity of Tesuque Street just north of the Boca Negra Channel. Therefore, it is proposed to construct a 54" RCP storm sewer pipe from the Boca Negra Channel at Tesuque north on Tesuque to Agate and south on Tesuque to Mojave. Catch basins are proposed just upstream of Agate on Tesuque to intercept excess runoff that would exceed the street capacity. It is proposed to construct a 27" RCP storm sewer pipe from the Boca Negra Channel at Tesuque south on Tesuque almost to Mojave to intercept local runoff and carry it to the channel. A relatively short length of 24" RCP storm sewer pipe and drop inlets are proposed to be constructed on the south side of the Boca Negra Channel on Mojave, and a V-ditch will be constructed to collect the flows from the north side of the Boca Negra off Mojave. The proposed ditch would discharge to the arroyo by way of a concrete surface inlet. The estimated 100 year peak flow rate from Mojave north of the Boca Negra is 1.3 cfs. A system of catch basins and storm drains already exists on San Ildefonso to convey street surface runoff from the existing east half of San Ildefonso to the Boca Negra. As part of SAD 219 it is proposed to construct drop inlets and 30" diameter storm drains on the west half of San Ildefonso, to convey water to the Boca Negra Channel. Since the capacity of the San Ildefonso system is limited, it is proposed to drain Thunderbird Circle directly into the Boca Negra Channel via a concrete drainage channel proposed along the lot lines between two lots on the north side of Thunderbird Circle as shown on Sheet 1 of 9 in the Map Pockets. The public drainage easement for this structure will be acquired prior to construction of this project. The easement documents have been prepared in accordance with City Standards and are currently being processed.

With the exception of the above mentioned storm drain improvements, all stormwater runoff in the Boca Negra Channel Outfall area of SAD 219 can be facilitated by street surface flows.

Times of concentration determined in the Far Northwest Drainage Management Plan ranged from 35 minutes to 1 hour and 19 minutes. Even though the Volcano Cliffs Area of SAD 219 is intended to discharge directly into the Boca Negra Arroyo and the Mariposa North Channel, the calculated times of concentration for the drainage subareas in SAD 219 do not exceed 10 minutes. The Far Northwest Drainage Management Plan states on page 25 in the last paragraph that "In some instances, the runoff hydrograph generated by development adjacent to outfall does not adversely affect the system capacity due to the timing of the hydrograph peaks." Therefore, it is proposed that the assigned flowrate/acre criteria as outlined on page 25 of the FNDMP not be applied to this area of SAD 219 because the entire SAD 219 area is at the extreme lower reaches of the watershed. Direct discharge into the Boca Negra Arroyo and the Mariposa North Channel will be acceptable.

Montano Outfall (see Sheet 1 of 3, Drainage Maps D-10, D-11, E-10, and E-11)

Portions of the SAD 219 Volcano Cliffs Area will discharge into Montano Road which was designed and constructed under SAD 197. The SAD 197 drainage areas that correspond with improvements proposed in SAD 219 are Drainage Areas 3, 4, 5, and 6. A summary of these drainage areas and their associated runoff rates are summarized in the following table:

SAD 197 DRAINAGE AREAS SUMMARY

Drainage Area Designation	Area (acres)	Q10 (cfs)	Q100 (cfs)
3	26	46	70
4	7	12	19
5	7	12	19
6	45	80	121
Total	59	150	229
Totals for Areas 1 thru 7		224	341

The SAD 197 Drainage Report allots 150 cfs peak flows for the 10 year storm and 229 cfs peak flows for the 100 year storm for Areas 3, 4, 5, and 6 combined. The Report utilizes calculations based on the Rational Method utilizing a C value of 0.58. By redefining the drainage areas somewhat during the design of SAD 219 and utilizing a C Factor of 0.60 to calculate the flows, the runoff from those areas was reduced to 91 cfs for the 10 year storm, and 137 cfs for the 100 year storm. At the catch basin located on San Ildefonso at Montano, the capacity of the 48" storm sewer pipe is 143 cfs as shown on Sheet 32 of 35 of the record drawings of SAD 197 (City Drawing No. 1635). However, the street capacities of Kiva Street and of San Ildefonso are limited to approximately 50 cfs each. In order to accommodate the excess runoff for this street, it is proposed to construct drop inlets on the end of the existing

24" RCP stubout on Kiva approximately 200 feet east of Pojoaque. The capacity of this 24" pipe will be about 13 cfs. The calculated cumulative peak flow rate at the intersection of Kiva Street with San Ildefonso is 97 cfs. Adjusting for the flows to be collected upstream on Kiva, there still remains 83 cfs surface flow at the Kiva/San Ildefonso intersection. This would cause the 100 year runoff to be approximately 0.2' above the top of the curb on San Ildefonso from Kiva south about 250 feet to the existing drop inlets on San Ildefonso at Montano. The proposed 100 year discharge from SAD 219 will be within the allowances of the SAD 197 report and within the capacity of the existing 48" storm sewer on Montano. It would also be required to utilize the existing 25' wide public drainage easement, and construct a relatively small (6' wide x 1' deep) concrete rectangular channel to intercept approximately 14 cfs on Kiva just east of Pojoaque, and carry the flows directly to Montano.

Kachina Street Outfall (see Sheet 1 of 9, Drainage Map E-11)

SAD 219 Drainage Area E11-3 is proposed to discharge across San Ildefonso east to Kachina Street. Research into the Butterfield Subdivision Drainage Report revealed that an allowance of 32 cfs offsite flows from the west across San Ildefonso was anticipated and taken into account for design purposes. However, due to changes during construction, Kachina Street was not constructed to carry these flows. This study resulted in a developed discharge rate of 12 cfs for the 100 year storm. The discharge rate onto Kachina Street east of San Ildefonso is within the limits of the design of existing Kachina as established by a hydraulic analysis of the capacity of Kachina Street as constructed, having a capacity of approximately 15 cfs.

B. Summary

The proposed public improvements for SAD 219 and the resulting private development thereafter will drain in conformance with and within the limits of previously accepted drainage plans assuming no future density changes or zone changes. The four major outfalls for the Volcano Cliffs Area of SAD 219 are the Mariposa North Channel, the Boca Negra Arroyo, Montano Road (SAD 197), and Kachina Street east of San Ildefonso. The table on the following page summarizes the proposed conditions for each of the basins in this area.

In conformance with the recommendations of the Northwest Mesa Drainage Management Plan, the Boca Negra Arroyo is proposed to be improved as part of Special Assessment District 219.

Interim Undeveloped Drainage

After the streets are paved, there will be two small areas of land along the east side of Tesuque which, until the lots are developed, will temporarily drain in the undeveloped state to the east into an adjacent drainage basin indicated on Sheet 1 of 3 in the Map Pockets. These two areas are shown as thin dashed lines on the map (Sheet 1 of 3). The area at the south corner of Tesuque and Acacia contains 1.26 acres. Utilizing an undeveloped C factor of 0.4, the additional runoff generated by this area will be 2.3 cfs. This could increase the 29.7 cfs developed runoff rate of Area D11-1 to 32.0 cfs, which is still an acceptable rate. The other area east of Agate and Tesuque contains 0.89 acres. The additional runoff generated by this undeveloped area will be 1.7 cfs. This could increase the 56.4 cfs for Drainage Area E10-2 to 58.1 cfs. The current design of the storm drain at Tesuque and Agate will accommodate these potential additional flows.

SAD 219 DRAINAGE SUMMARY SHEET

VOLCANO CLIFFS AREA

Area Designation	Area (Acres)	Rainfall Intensity (i)	C Factor	100 year Runoff Rate
Mariposa Channel Outfall		Outfall Capacity:	936 cfs, Tc = 0.77 hrs	
D11-1 *	10.65	4.65	0.60	29.71
D11-2	26.00	4.65	0.60	72.54
M11-A **	29.00	4.65	0.40	53.94
D11-2A	9.60	4.65	0.60	26.78
D11-2B	4.90	4.65	0.60	13.67
D11-2C	3.20	4.65	0.60	8.93
Boca Negra Arroyo Outfall		Outfall Capacity:	2,823 cfs, Tc = 1.00 hrs	
E10-1	39.50	4.65	0.60	110.21
E10-2	20.20	4.65	0.60	56.36
E10-3	17.08	4.65	0.90	71.48
E10-4	2.54	4.65	0.90	10.63
E10-5	3.49	4.65	0.90	14.61
E10-6	8.90	4.65	0.60	24.83
E11-1	11.67	4.65	0.60	32.50
E11-2a	12.00	4.65	0.60	33.60
E11-2b	13.00	4.65	0.60	37.80
Kachina Street Outfall		Outfall Capacity:	32 cfs reserved ***	
E11-3	3.20	4.65	0.80	11.90
Montano Road Outfall		Outfall Capacity:	231 cfs ****	
E11-4	26.00	4.65	0.60	72.54
E11-5	9.70	4.65	0.60	27.06
E11-5A	3.70	4.65	0.60	10.32
Future	14.6	4.65	0.40	27.16

* Area D11-1 is accompanied by a detail drainage plan.

** Area taken from B.H.A.'s Far Northwest Drainage Master Plan.

*** Kachina Street Outfall Capacity as defined by the Butterfield Subdivision's Drainage Report reserved 32 cfs for offsite flows. However, field observation of As-built conditions indicate the capacity reserved for offsite flows is 15 cfs.

**** Montano Road Outfall Capacity: 100 cfs surface flow plus 135 cfs storm sewer pipe.

II. 94TH / TOWER / EUCARIZ AREA

This portion of the project was deleted from SAD 219.

III. CORONA AREA / I-40 AREA

Proposed street improvements for SAD 219 in the Corona Area consist of the following: (1) Atrisco Drive from I-40 to Corona, and (2) Corona from Atrisco Drive to Ouray Road.

A. Hydrology

Hydrologic analysis criteria used for this area of study are listed as follows:

1. City of Albuquerque Development Process Manual (DPM)
2. Albuquerque Master Drainage Study
3. West Bluff Drainage Study

The prevalent hydrologic soil classification for this area of SAD 219 is Class B. The current zoning is predominantly SU-1 for C-2. Therefore, a C Factor of 0.90 was used. Based on this criteria, the Rational formula was used to calculate runoff for the three drainage basins defined on Sheet 2 of 9 located in the map pockets at the end of this report. Also shown on that sheet are the discharge rates for the 100 year storm for each of the drainage basins.

B. Hydraulics

The area is relatively flat, and it is anticipated that the proposed street grades will be approximately 0.50%. Therefore, the capacity of the streets will be approximately 52 cfs. There are four drainage basins defined as shown on Drainage Map H-11 (Sheet 2 of 9) in the map pockets of this report. It is proposed to discharge the 48 cfs runoff from Area H-11-1b into the West Bluffs System via a 36" and 42" RCP pipe running down Corona and Atrisco. Drainage Area H11-2 (82 cfs) will be carried via a combination of street and channel surface flow to Atrisco, and then conveyed to the West Bluffs System via drop inlets and a 42" RCP pipe on Atrisco. Flows generated on the north cul-de-sac of Atrisco (Area H11-1a) will be picked up by a proposed drop inlet in the end of the cul-de-sac, and carried to the West Bluffs drainage pipe along Coors Boulevard by way of an existing 60" storm drain, or can be routed to the existing drop inlet on the south side of Ouray ± 600 feet east of Coors Boulevard.

Drainage basin H11-3 will generate peak flows of 38 cfs during the 100 year rainfall event. It is proposed that these flows be carried on site to the west, and collected at the central point at which time they will be directly discharged into the West Bluff storm sewer system. The point of discharge for this drainage basin will be the 14' x 14' CBC section with a 2,349 cfs capacity. Time of concentration for this drainage basin in SAD 219 is 0.12 hours (7 minutes). As each tract in Area H11-3 is developed, the drainage system should be constructed which will convey the developed flows into the adjacent West Bluffs system. The collection system for Area H11-3 is not proposed to be part of SAD 219. Additionally, stormwater runoff from Drainage Area H11-3 should not be permitted to drain onto Atrisco Drive.

SAD 219 DRAINAGE SUMMARY SHEET

ATRISCO / CORONA AREA

Area Designation	Area (Acres)	Rainfall Intensity (i)	C Factor	100 year Runoff Rate
West Bluffs Channel Outfall				
H11-1a	5.10	4.65	0.90	21.30
H11-1b	11.50	4.65	0.90	48.10
H11-2	19.51	4.65	0.90	81.65
H11-3	9.09	4.65	0.90	38.04

IV. REGINA STREET AREA

Proposed street improvements for SAD 219 in the Regina Street Area consist of Regina Road, Regina Place, and Regina Circle from Regina Place to Bluewater Road.

A. Hydrology

Hydrologic analysis criteria used for this area of study are listed as follows:

1. City of Albuquerque DPM
2. Albuquerque Master Drainage Study.

Generally, the hydrologic soil classification use for this area is soil class B. The land is zoned R-1 (approximately 1/4 acre tracts) except for about 10 acres of City owned park space located at the northwest corner of this area. Therefore, the C Factor used for this area was 0.60.

Utilizing the above criteria and parameters for the Regina Street Area, drainage calculations were performed utilizing the Rational formula for the four drainage basins of this area as defined on Sheet 3 of 9 located in the map pockets at the end of this report. Also shown are the discharge rates for the 100 year storm for each of the drainage basins.

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B. Hydraulics

City master storm sewer maps show an existing drop inlet at Rincon Road and 51st Street connected to a 12" diameter storm sewer at an unknown grade. The approximate capacity of this storm sewer pipe is 13 cfs (from Isleta Watershed Study). It is clearly evident that the street and storm sewer capacity combined fall significantly short of the anticipated runoff for the 100 year storm. Most of the streets in this area are already paved. Paving of the two streets proposed in SAD 219 will not have a significant impact on the existing undersized system. Consideration was given to converting the existing baseball field / park located at the southwest corner of Regina Drive and Bluewater Road into a detention pond. However, the conversion would require an average excavation of 2 feet to the existing field, and a substantial cost burden to the lots currently in the SAD 219 while all lots in the drainage basin are benefiting. An additional alternative that was considered and ultimately selected was to purchase a portion of land along the west side of the Arenal Canal at the southeast corner of Bluewater Road and Regina Drive to use as a detention pond facility (see map, Sheet 3 of 9). It is proposed to construct a 3,000 cubic yard pond which will carry the 100 year - 24 hour runoff volume with an emergency spillway to discharge excess water back onto Regina Drive. This would create a 6 foot deep pond which will require fencing. The water retained in this pond would be discharged via a buried 18" pipe into the storm sewer manhole at 51st and Rincon. The easements and R.O.W. for the proposed pond will be acquired prior to construction of this project. This process is currently underway. Discharge time would be about 3 to 4 hours at a 3 to 4 cfs discharge rate. We feel that acquiring this land to construct the above described pond and outlet system is the best alternative.

Another problem inherent with the paving of Regina Road and Regina Place is the velocity of runoff down the two steep paved roads. Runoff from Regina Place presents a potential hazard to property since it could flood the house(s) at the south end of the street. Slopes on both streets will approach the 8% maximum permitted by the DPM. This high velocity runoff must be handled in a proper manner to prevent it from becoming a hazard to downstream properties. The most reasonable solution to this problem is to construct storm sewer pipe from the pond to the south end of both Regina Road and Regina Place, and locate drop inlets to intercept virtually 100% of the 100 year runoff.

SAD 219 DRAINAGE SUMMARY SHEET

REGINA AREA

Area Designation	Area (Acres)	Rainfall Intensity (i)	C Factor	100 year Runoff Rate
51st and Rincon Outfall				
J11-1	12.66	4.65	0.60	35.32
J11-2	10.47	4.65	0.60	29.21
J11-3	19.83	4.65	0.60	55.33
J11-4	18.04	3.78	0.60	40.91

APPENDIX

BOCA NEGRA CHANNEL

Rip Rap Design

Copy of Rip rap design Section

HYDRAULICS AND CHANNEL ALIGNMENT

Because of the nature of the terrain and the alignment of the existing Boca Negra Arroyo, the design of the channel was able to take advantage of subcritical flow and very "gentle" horizontal curves. In order to maintain an equilibrium velocity for the design flow that would not cause significant degradation or aggradation, the channel slope was set somewhat flatter than the existing arroyo. This required the provision of two drop structures, which were designed using standard rock gabions.

Using appropriate criteria, a typical channel section was developed. A trapezoidal channel with an 80 foot bottom width, 2:1 side slopes, and a depth of 6.5 feet (including 2 feet of freeboard) is the resulting section. Erosive velocities along the sidewalls of the channel will require armoring to provide a stable channel shape, but because design velocities are non-erosive with the amount of sediment being carried in the storm discharges, armoring of the channel invert will not be required. Early design provided for use of rip-rap for the channel side slopes, and for the inverts of the transition sections at the beginning and end of the project. Although this design was adequate from a technical standpoint, economic consideration dictated less costly alternatives, and the design finally settled on 6" concrete slope paving of the 2:1 side slopes. For aesthetic reasons, colored concrete will be used to make the concrete less obtrusive on the local terrain. For economic reasons, the upstream terminus of the project was moved approximately four hundred feet downstream to a point below Tesuque Drive. Wire enclosed rip-rap will be used to stabilize the low profile "entrance flume" below Tesuque Drive. For economic reasons, rip-rap has been omitted from the inverts of the transition sections at the beginning and end of the project. While this will not present a problem for storms of 10 year frequency or less, the 100 year storm will tend to erode the transition inverts. Thus, following the larger storms (50 year and 100 year), City crews will have to perform maintenance repairs in these areas.

Concrete sidewalls will provide a stable channel shape, but because design velocities are non-erosive with the amount of sediment being carried, lining is not required on the channel invert.

The adequacy of the design was checked and verified by computing the water surface profile, using the Corps of Engineers HEC-2 computer program to run a backwater curve from below the lower end of the project. The analysis confirmed the suitability of the channel as designed. Sediment transport analysis was employed to set channel invert slopes. A scour analysis was made of the channel invert / channel wall intercept to verify the adequacy of the design relative to the need for scour protection.

The following pages contain the text, tables, graphs & calculations to form the design analysis for the design of the Boca Negra Channel.

The following sources were used to develop the channel design:

"Development Process Manual" - City of Albuquerque
Open-Channel Hydraulics - Ven te Chow
"Design Charts for Open Channel Flow" - Fed. Hwy Admin.
"Hydra Flow Open Channels" - Computer Prog - Intelisolve
"Design of Open Channels" - TR-25 - Soil Conservation Service
HEC-2 Water Surface Profiles - U.S. Army Corps of Engineers

Sediment Transport:

To determine the equilibrium channel velocity to minimize channel aggradation or degradation, procedures in Soil Conservation Service Tech Release No. 25 were followed. Strong evidence in surrounding arroyos in the general area indicates significant sediment load can be expected during the larger (10yr+) flows in the Boca Negra Arroyo. This situation is probably perpetuated by wind deposited sands and silts which constantly replenish the watershed.

Following the "Channel Evaluation Procedural Guide" from TR-25 (attached), the procedures in TR-25 indicate the necessity to design the channel to move the sediment through the system. Criteria used for this design is from "Design Guidelines & Criteria - Channels & Hydraulic Structures on Sandy Soil" by Simons, Li & Associates, June 1981.

Attached is the grain size distribution for material sizes from .062 mm to 2mm.

Pertinent Info:

	Upstream	Downstream
Discharge	2858 cfs	2858 cfs
Channel Shape	Irreg.	trapezoid
Sediment size distrib.	See attached	
Channel resist. (n)	.030	.033
Side slopes	Irreg.	2:1
Channel slope	0.00805	?

Upstream Channel - from "Hydro Flow" program (Sheet _)

For 2858 cfs -

$y = d = 4.13$ ft $\quad A = 376.8$ sf

$V = 7.6$ fps $\quad W = 194$ ft

$Y_n = \frac{A}{W} = 1.94$ ft $\quad F_r =$ sub-critical

Sediment Supply Calculation

$$q_s = C_1 Y_n^{C_2} V^{C_3}$$

JOB DESCR: Exist Channel Hyd
RUN DATE: 03-16-1989

PROFILE No. 1 — - HYDRAULIC ANALYSIS - — FILE: BOCANEGII.HYD

SECTION 3 - MAIN CHANNEL - CHANNEL - STA 4 + 0 - Q = 2858

	FLOW RATE	AREA	VEL	CONVEY	n-VAL	RCH	WET PR
CHANNEL	2858.0	376.8	7.6	29034	0.030	200	194
OVERBNK	0.0	0.0	0.0	0	0.000	0	0

WSEL =	65.77	VEL HD =	0.893	JUMP ELEV =	0.00
CRWSEL =	0.00	EN LOSS =	1.925	STA JUMP =	0.00
TOP WID =	194 = W	EN GD LN =	66.66	JMP LOSS =	0.000
CHNL SLP =	0.8050 %	DEPTH =	4.13 = y	SUBCRITICAL FLOW	

SECTION DATA

POINT	STATION	ELEVATION	POINT	STATION	ELEVATION
1	0.00	68.17	2	90.00	65.88
3	104.00	64.61	4	132.00	64.56
5	140.00	62.43	6	180.00	61.64
7	212.00	62.87	8	220.00	64.55
9	310.00	66.24	10	0.00	0.00

STA OF LEFT OVERBANK = 0 — STA OF RIGHT OVERBANK = 310

CHANNEL EVALUATION PROCEDURAL GUIDE

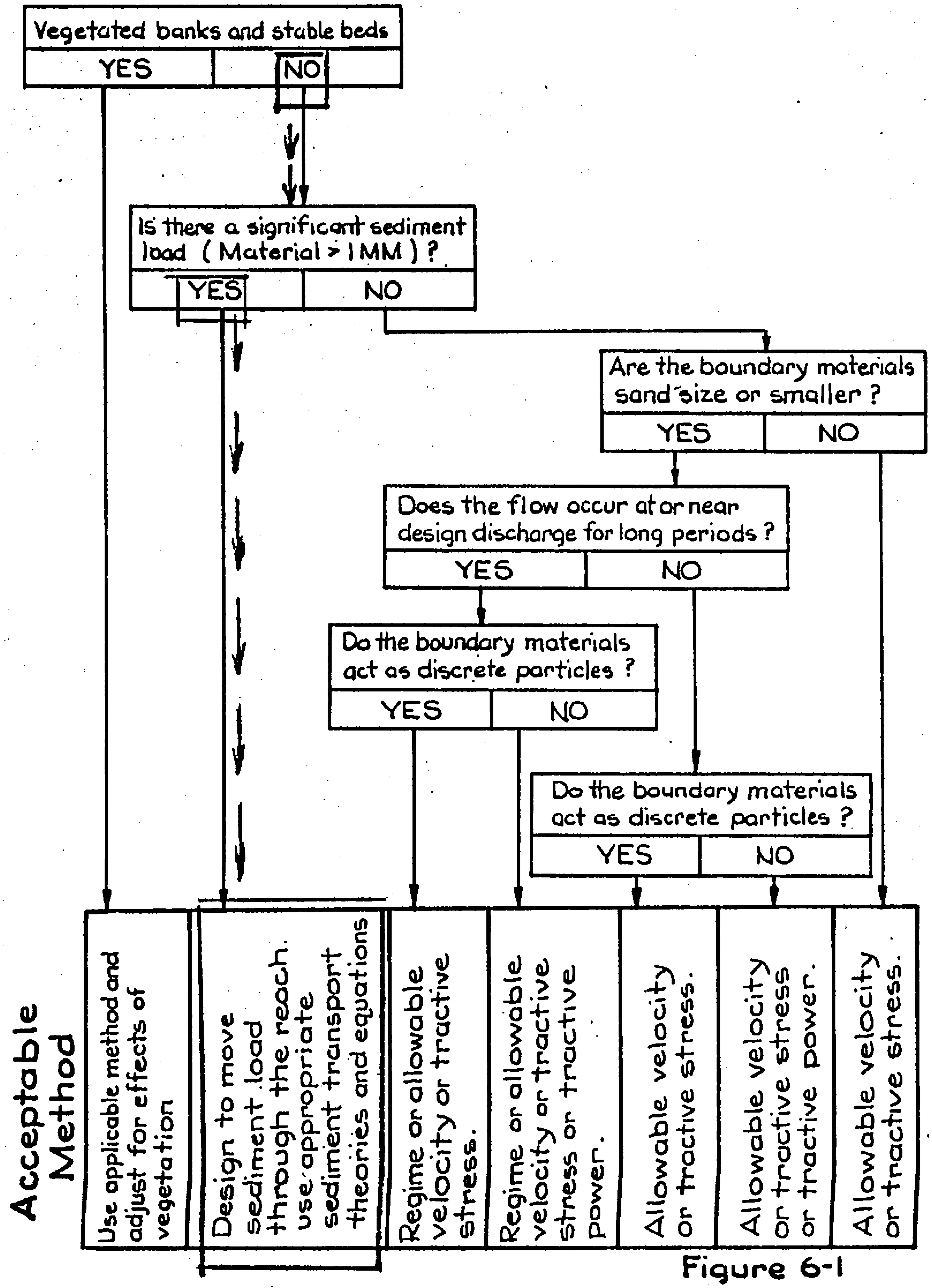
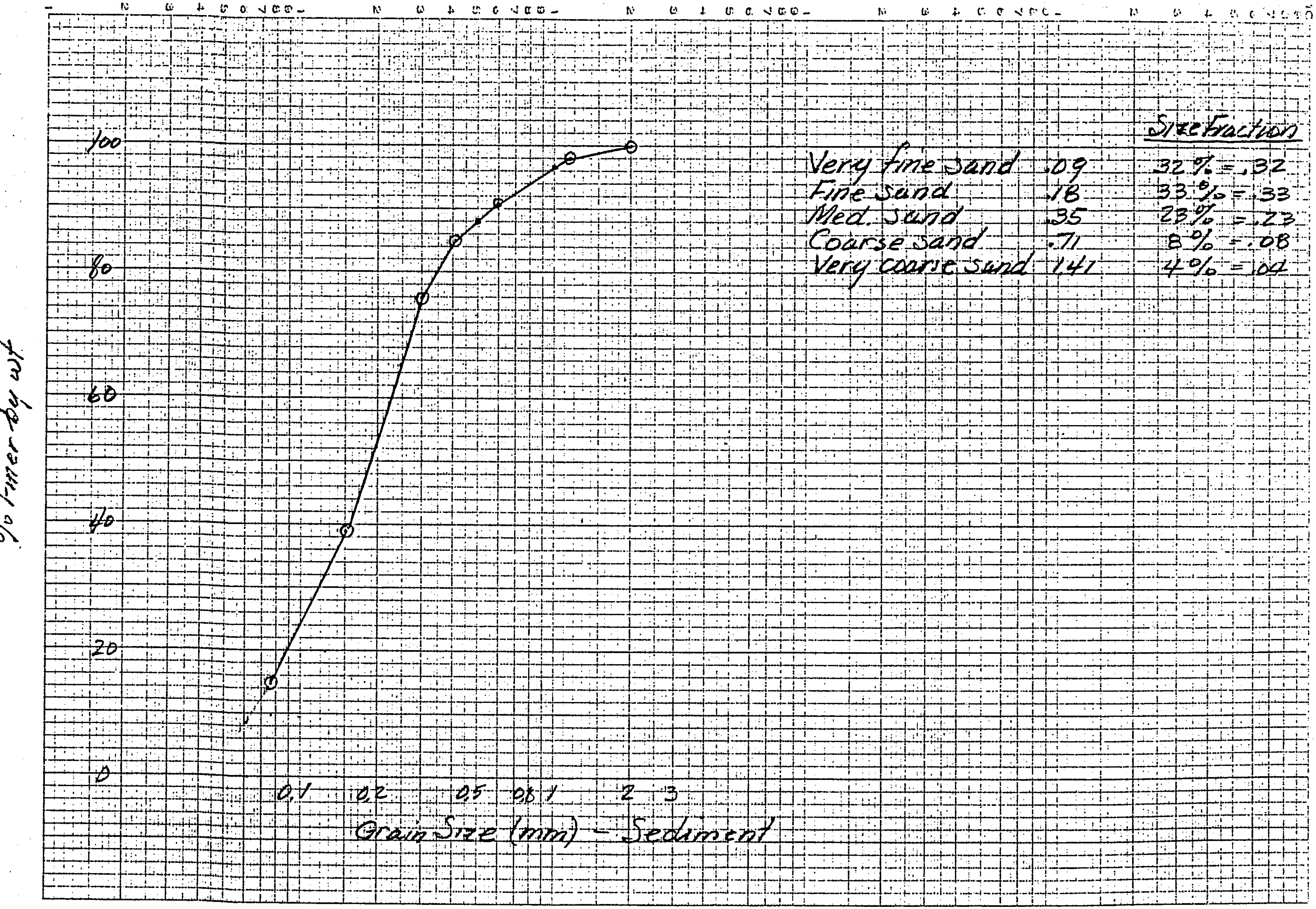


Figure 6-1


NO. 340-L310 DIETZGEN GRAPH PAPER
SEMI-LOGARITHMIC
2 CYCLES X 10 DIVISIONS PER INCH
DIETZGEN CORPORATION
Size Fraction
Very fine sand .09 32% = .32
Fine sand .18 33% = .33
Med. sand .35 23% = .23
Coarse sand .71 8% = .08
Very coarse sand 1.41 4% = .04
100
80
60
40
20
0
0.1
0.2
0.5
0.8
1
2
3
Grain Size (mm) – Sediment
% Finer by wt

	C_1	C_2	C_3
S_1 very fine sand	58.50×10^{-6}	1.040	3.20
S_2 fine sand	21.40×10^{-6}	0.837	3.59
S_3 med. sand	6.47×10^{-6}	0.535	4.05
S_4 coarse sand	2.90×10^{-6}	0.239	4.36
S_5 very coarse sand	2.37×10^{-6}	−0.044	4.44

$q_{s1} = (58.50 \times 10^{-6})(1.94)^{1.04}(7.6)^{3.20} = 0.0767$ cfs/ft

$q_{s2} = (21.40 \times 10^{-6})(1.94)^{0.837}(7.6)^{3.59} = 0.0541$ "

$q_{s3} = (6.47 \times 10^{-6})(1.94)^{0.535}(7.6)^{4.05} = 0.0343$ "

$q_{s4} = (2.90 \times 10^{-6})(1.94)^{0.239}(7.6)^{4.36} = 0.0235$ "

$q_{s5} = (2.37 \times 10^{-6})(1.94)^{-0.044}(7.6)^{4.44} = 0.0190$ "

Total Sediment Supply $Q_s = W(k_1 q_{s1} + k_2 q_{s2} + k_3 q_{s3} + k_4 q_{s4} + k_5 q_{s5})$

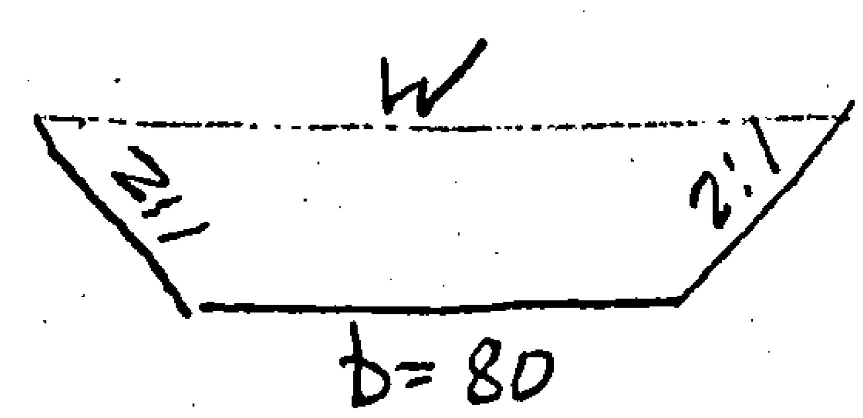
where k = fraction of sediment size q.

$Q_s = 194(0.32 \times 0.0767 + 0.33 \times 0.0541 + 0.23 \times 0.0343 + 0.08 \times 0.0235 + 0.04 \times 0.0190)$

$Q_s = \underline{\underline{10.27 \text{ cfs}}}$ (entering the system. ←

Determine Equilibrium Slope -

Try design $V = 9.29$ fps -



$A = \frac{2858}{9.29} = 307.6$ sf

$y = d = 3.63$

$W = 94.12$

$y_n = \frac{A}{w} = 3.27$

W.P. = 95.79

$R = \frac{A}{WP} = 3.21$

$(s = 0.009)$

for V = 9.29 fps,

$q_{s1} = (58.50\times10^{-6})(3.27)^{1.04}(9.29)^{3.20} = 0.2504$

$q_{s2} = (21.40\times10^{-6})(3.27)^{0.837}(9.29)^{3.59} = 0.2987$

$q_{s3} = (6.47\times10^{-6})(3.27)^{0.535}(9.29)^{4.05} = 0.1024$

$q_{s4} = (2.90\times10^{-6})(3.27)^{0.239}(9.29)^{4.36} = 0.0631$

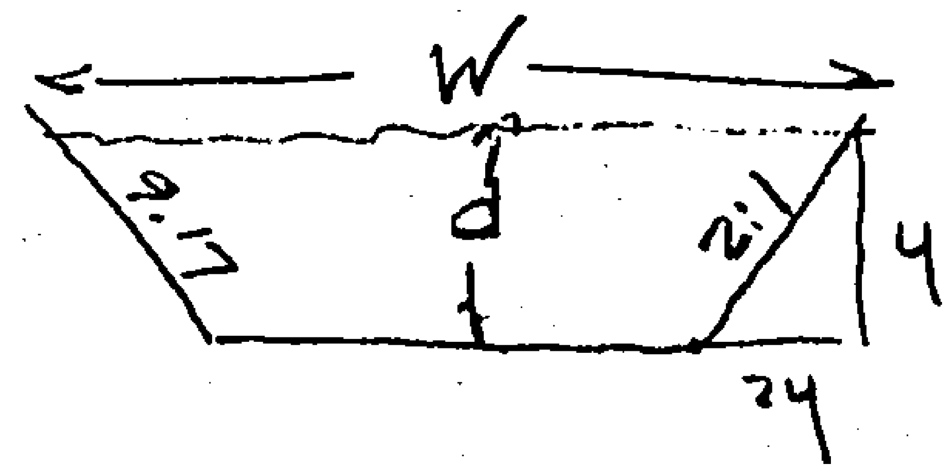
$q_{s5} = (2.37\times10^{-6})(3.27)^{-0.044}(9.29)^{4.44} = 0.0283$

$Q_{s(OUT)} = 94.12(.32\times.2504 + .33\times.2987 + .23\times.1024 + .08\times.0631 + .04\times.0283)$

= <u>19.62</u> cfs > 10.27 cfs, ∴ velocity is too high

by trials of V = 7.5, 7.7, & 7.9, the equilibrium velocity calculated at 7.9 fps (the velocity at which the channel is stable).

At V = 7.9, $A = \frac{2858}{7.9} = 361.77$



$d = y = 4.10$ $\quad y_n = \frac{A}{W} = 3.75$

W = 96.40

WP = 98.34

$V = \frac{1.486}{0.033}(R)^{\frac{2}{3}}(S)^{\frac{1}{2}}$

$7.9 = 45.03(3.68)^{\frac{2}{3}}\sqrt{S}$

$S = 0.0054$ equilibrium slope ←

Design slope = 0.0054

Largest particle being transported:

Bed shear stress $\tau = \gamma R S$

γ = specific wt of water
R = hydraulic radius
S = energy slope

$\tau_o = 62.4\times3.68\times.0054 = 1.24$ psf

$D = \tau_o / .047(S_{sed} - 1)\gamma$

D = diam of largest part. moving
S_{sed} = Sp. gr. of sediment

$D = 1.24/.047(2.65-1)62.4$

D = 78 mm. – all grain sizes are moving – (armoring will not control).

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JOB S.A.D. 219
SUBJECT Boca Negra Channel
JOB NO. ______ SHEET 8 OF 14
BY ZMG DATE 29 Mar 89
CHECKED ______ DATE ______

Set design slope $s = .0054$ -

Begin at Sta 10+00, upstream of San Ildefonso Bridge, matching top of exist. project at invert = 5131.31.

Since this will flatten the existing natural channel, it will be necessary to construct drop sections in the channel to stabilize the flow line at $s = 0.0054$.

Drop structures are proposed at station 19+00 (6.0' drop) and station 33+00 (4.5' drop).

Since velocities are generally at or near equilibrium velocity, channel bottom can be formed by shaping & compacting existing sand-gravel material. Channel sides should be rip-rap to retain stable channel slope, to match downstream channel. Simple transitions will be provided at the upstream "flume" entrance structure (200 ft.) and at the downstream junction with existing project (100 ft.)

Check Froude Number -

$$F = \frac{V}{\sqrt{gd}} = \frac{8}{\sqrt{g5}} = 0.6; \therefore \text{ flow is subcritical -}$$

Calculate Freeboard -

Per City of Albuquerque DPM -

$$FB = 0.7(2 + .025\, V d^{1/3}) = 0.7(2. + .025 \times 8 \times 5^{1/3})$$

$FB = 1.67$ - use $\underline{\underline{2.0}}$

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JOB S.A.D. 219
SUBJECT Boca Negra Channel
JOB NO.
SHEET 9 OF 14
BY Z.A.G.
DATE 27 Mar 89
CHECKED
DATE

Rip Rap Design

Rip Rap design based on ~~Channel side slope &~~ ~~following~~ Table 5-5 from Drainage Criteria Manual:

Table 5-5
RIPRAP REQUIREMENTS FOR CHANNEL LININGS

$V^2/R^{.33}$	Channel Side Slope			
	4:1	3:1	2.5:1	2:1
20- 70	Type L	Type L	Type L	Type L
70- 90	Type L	Type L	Type L	Type M
90- 95	Type L	Type L	Type L	Type M
95-100	Type L	Type L	Type L	Type H
100-105	Type L	Type L	Type M	Type H
105-110	Type L	Type M	Type M	Type H
110-115	Type M	Type M	Type M	Type H
115-120	Type M	Type M	Type M	Type VH
120-125	Type M	Type M	Type M	Type VH
125-130	Type M	Type M	Type H	Type VH

Type L riprap should be buried to reduce vandalism.
Side slopes steeper than 2:1 should be designed as retaining walls.
SM9 slope mattress may be substituted for Type L riprap.
G12 gabion may be substituted for Type M and Type H riprap.
Table valid for Froude numbers less than 0.8.

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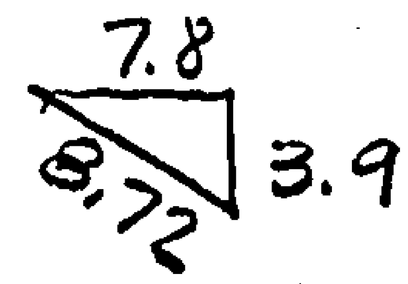
JOB S.A.D. 219
SUBJECT Boca Negra Channel
JOB NO.
SHEET 10 OF 14
BY Z.L.
DATE 10/23/89
CHECKED
DATE

Rip Rap Design

Downstream (25') of drop structures

$V = 7.5$ fps.

$R = \frac{A}{W.P.} = \frac{381}{97.6} = 3.9$



$\frac{V^2}{R^{.33}} = \frac{56.25}{1.57} = \underline{\underline{36}}$

Use type L rip-rap, 9" K_m, w/ 6" Type II granular bedding, rip-rap thickness = 18".

Table 5-1
CLASSIFICATION AND GRADATION OF ORDINARY RIPRAP

Riprap Designation	% Smaller Than Given Size By Weight	Minimum Dimension Inches	K_m* Inches
Type VL	100 35-55 10	9** 6 2	6***
Type L	100 35-55 10	12** 9 2	9***
Type M	100 35-55 10	18** 12 3	12
Type H	100 35-55 10	24** 18 6	18
Type VH	100 35-55 10	36** 24 6	24

Table 5-3
GRADATION FOR GRANULAR BEDDING

Sieve Size	% by Weight passing Square Mesh Sieves	
	Type I	Type II
2"	-	90-100
1-1/2"	-	-
3/4"	-	20-90
3/8"	100	-
#4	95-100	0-20
#16	45-80	-
#50	10-30	-
#100	2-10	-
#200	0-2	0-3

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JOB SAD 219
SUBJECT BOCA NEGRA CHANNEL
JOB NO.
SHEET 12 OF 14
BY ZC
DATE 10/23/89
CHECKED
DATE

Check discharge from Agate Ave:

Area = 420' × 330' = 138600 s.f. = 3.2 acres.

$Q = CiA$

$C = 0.75$

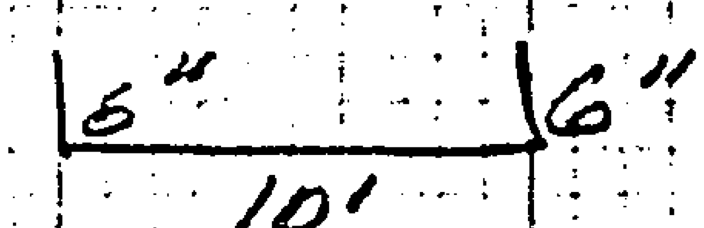
$i = 6.84\,p\,T_c^{-.51}$ $T_c = 10^{-.51} = 0.31$

$= 6.84(2.2)(0.31)$

$i = 4.66$

$Q = 0.75(4.66)(3.2) = 11$ cfs.

Try concrete channel rundown -



$V = \frac{1.49}{n} R^{2/3} S^{1/2}$ $n = .015$

$R = \frac{10(.5)}{10+1} = 0.5$

$A = 10(.5) = 5$

$Q = \frac{1.49}{.015}(0.5)^{\frac{2}{3}}(0.02)^{\frac{1}{2}} 5$

Q = 44 cfs, V = 8.8 fps, ∴ design is ok.

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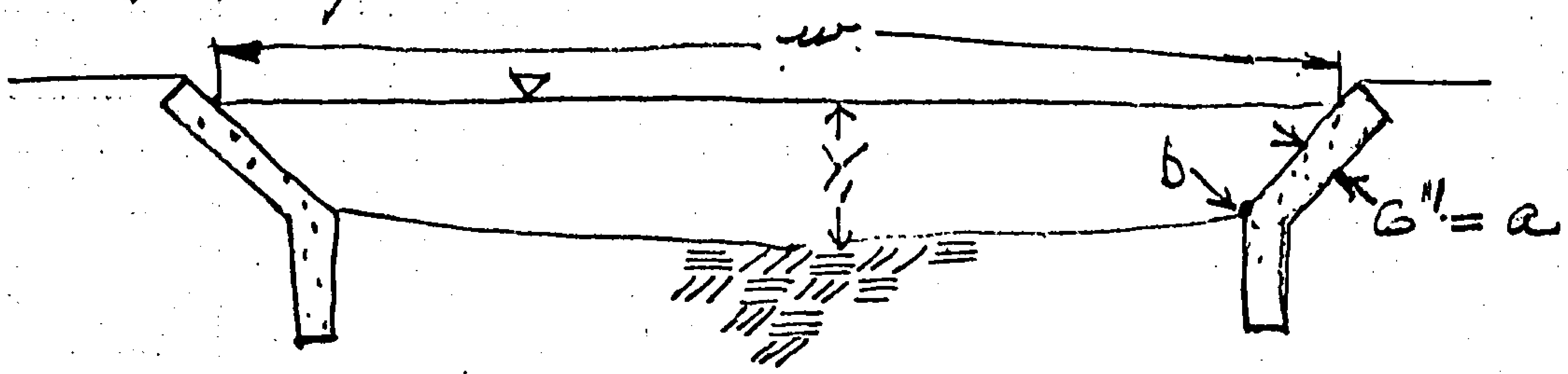
JOB: Boca Negra Arroyo
SUBJECT:
JOB NO.:
SHEET 13 OF 14
BY: ZMG
DATE: 9-22-89
CHECKED:
DATE:

Scour Analysis -



Compute equilibrium scour depth (Y_s) at "b" -

$$\frac{Y_s}{Y_1} = 1.1\left(\frac{a}{Y_1}\right)^{0.40} Fr_1^{\,0.33}$$

(from Design Guidelines & Criteria for Channels & Hydraulic Structures on Sandy Soils by Simons, Li & Assoc.).

where Y_1 = upstream flow depth
a = embankment length measured normal to the bank.
Fr_1 = upstream Froude number.

$$Fr_1 = \frac{V}{\sqrt{gD}}, \quad D = \frac{Area_w}{w} = \frac{3.23}{93.05} = 3.47'$$

$$Fr_1 = \frac{9.39}{\sqrt{3.47g}} = 0.9$$

$$Y_s = 4.27(1.1)\left(\frac{0.5}{4.27}\right)^{0.4}(0.9)^{0.33}$$

$$Y_s = \underline{1.9\ FT}$$

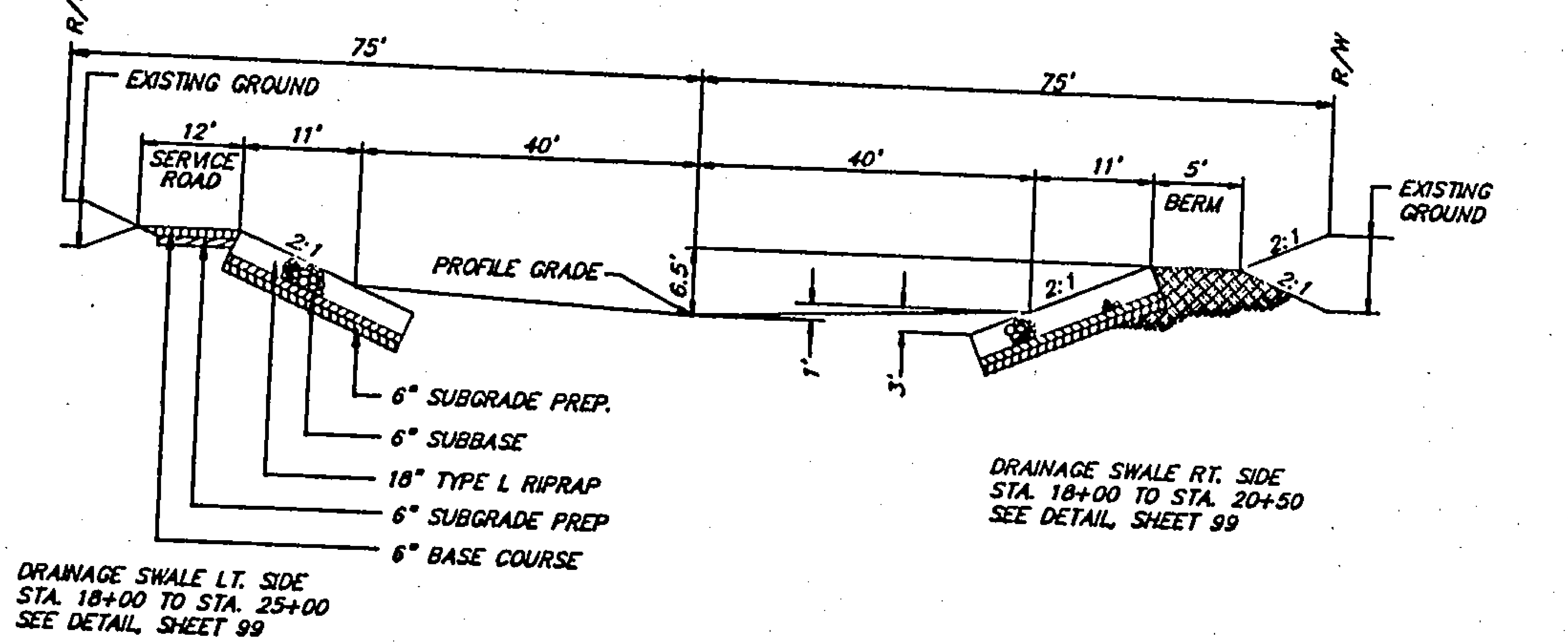
Superelevation at curves:

Most critical curve, 21+39 – R = 3819.71'

$$S = \frac{V^2 b}{2gr}$$

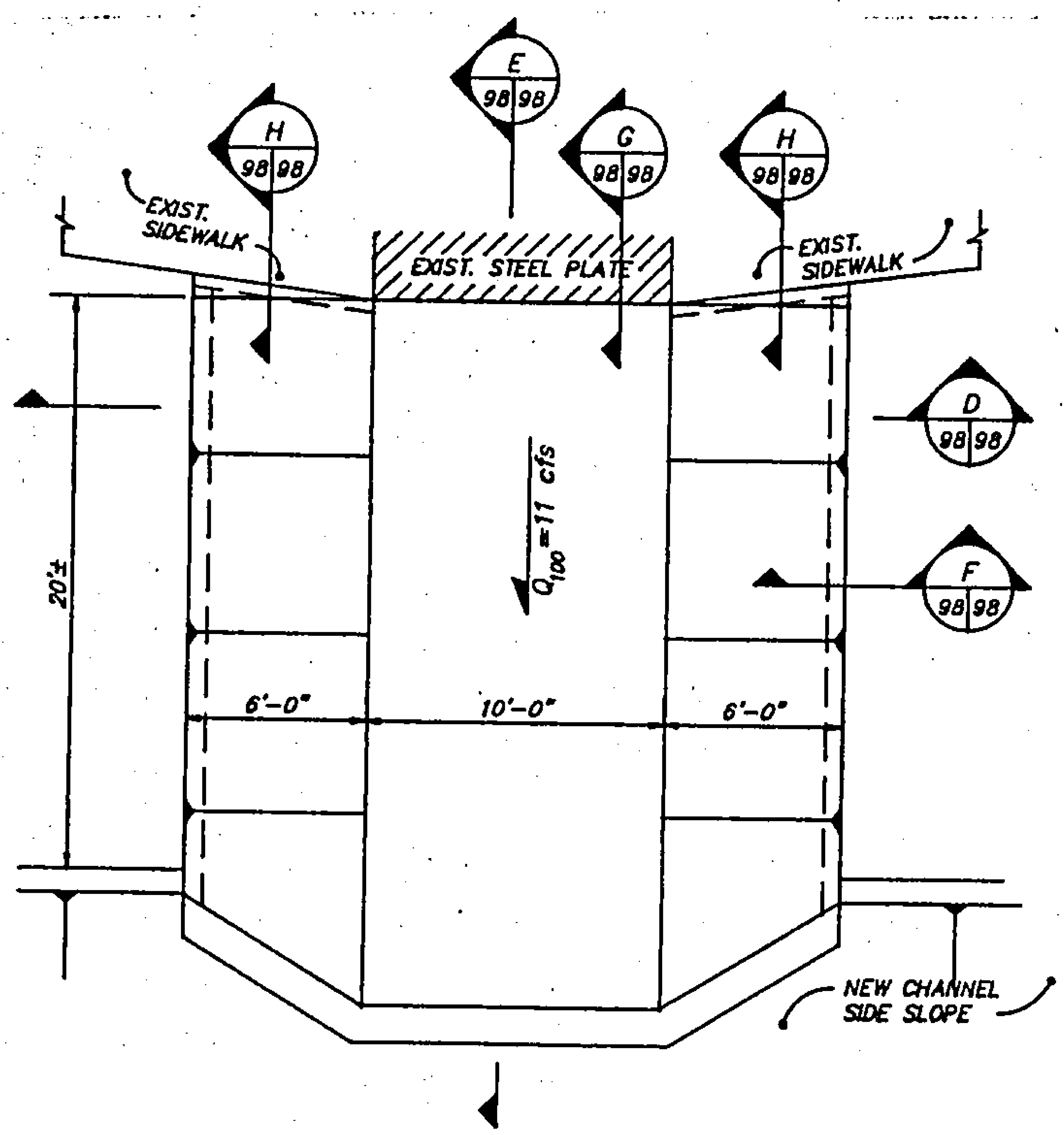
V = flow velocity, f.p.s.
b = channel width, ft
g = acceleration of gravity
r = radius of channel centerline curve, ft.

$$S = \frac{(8.8)^2(108)}{2g(3819)} = 0.034\ ft$$, which is negligible.



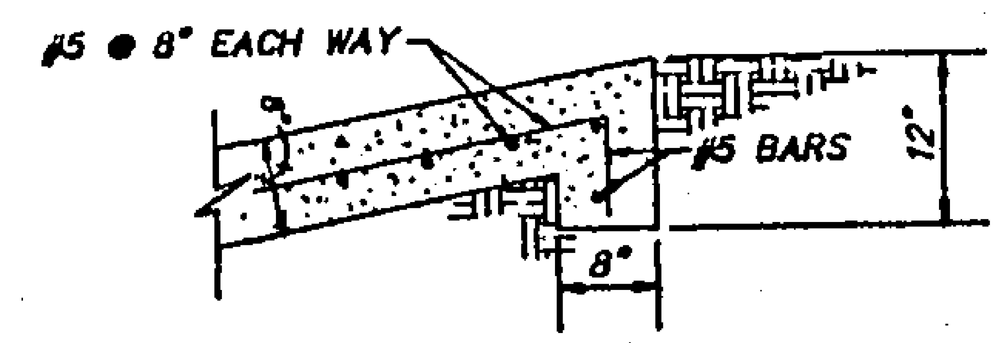
TYPICAL CHANNEL SECTION

N.T.S.



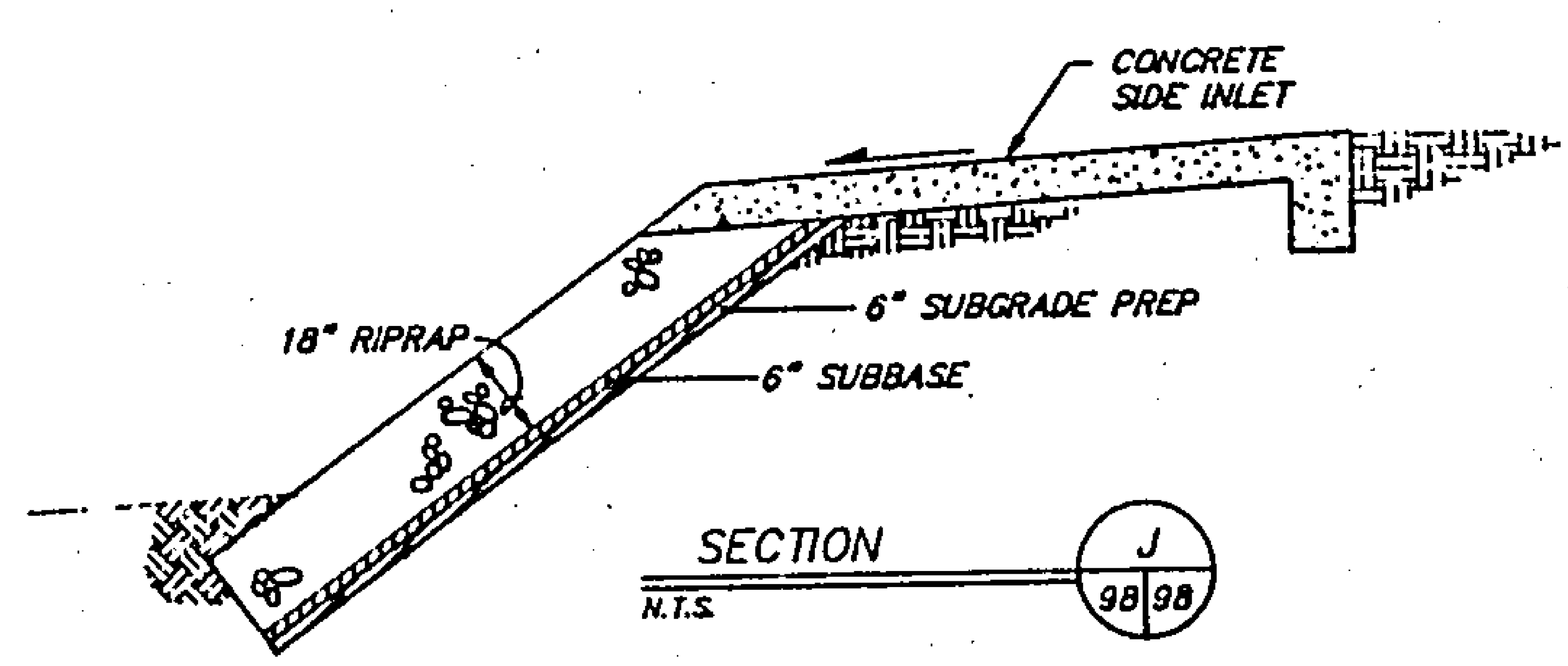
PLAN VIEW C 96|98

N.T.S.



SECTION F 98|98

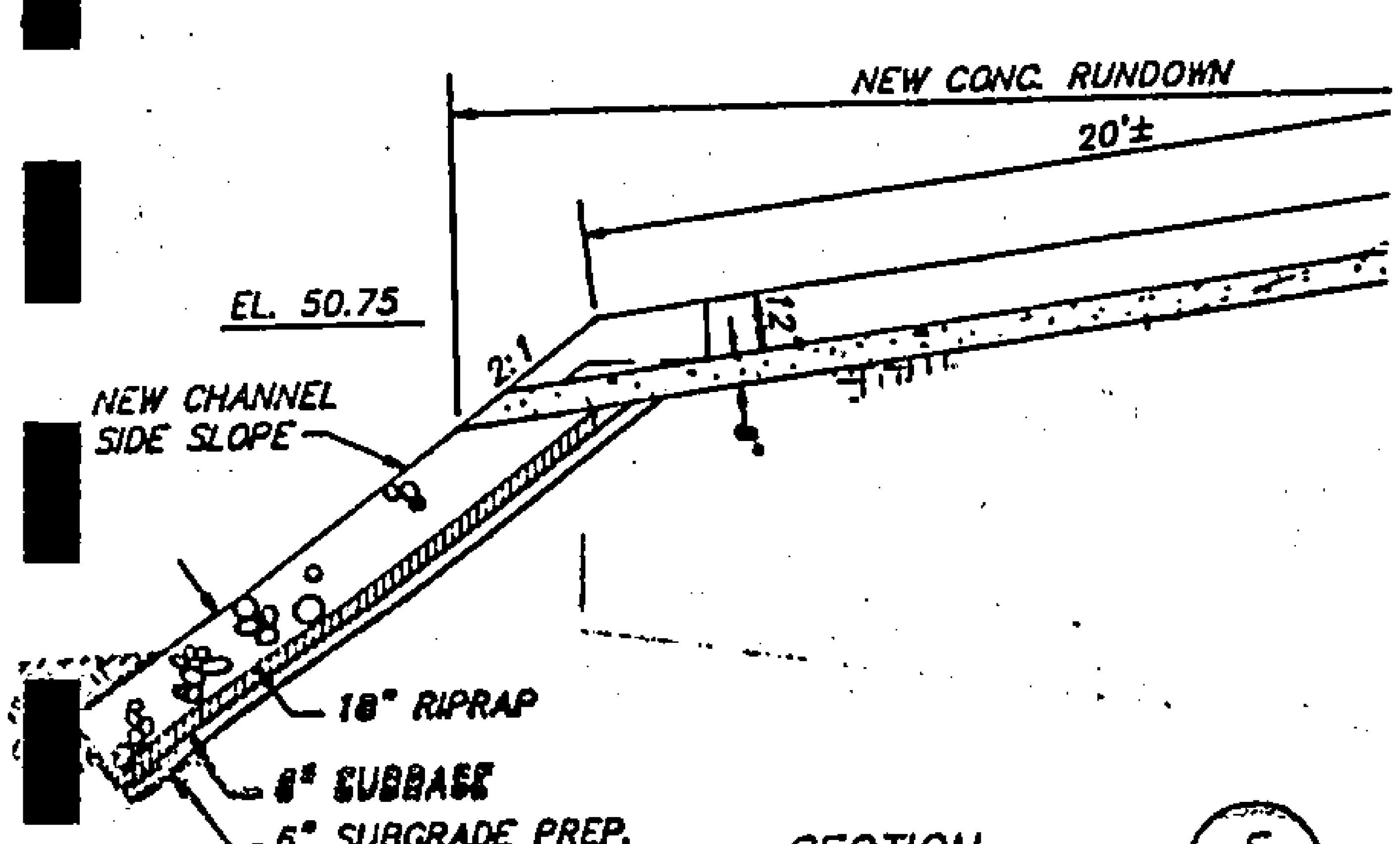
N.T.S.



SECTION J 98|98

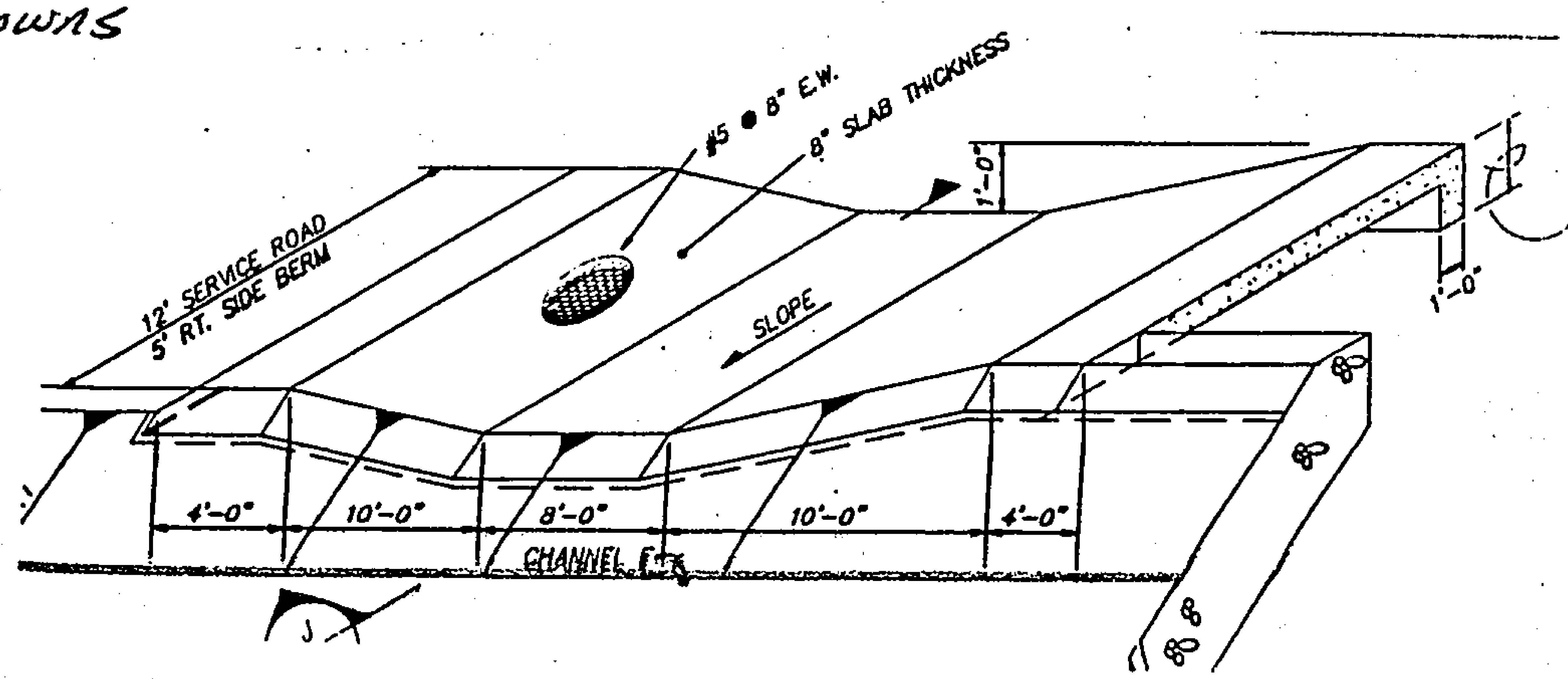
N.T.S.

Side Channel Rundowns



SECTION E 98|98

N.T.S.



STORM DRAIN DESIGN

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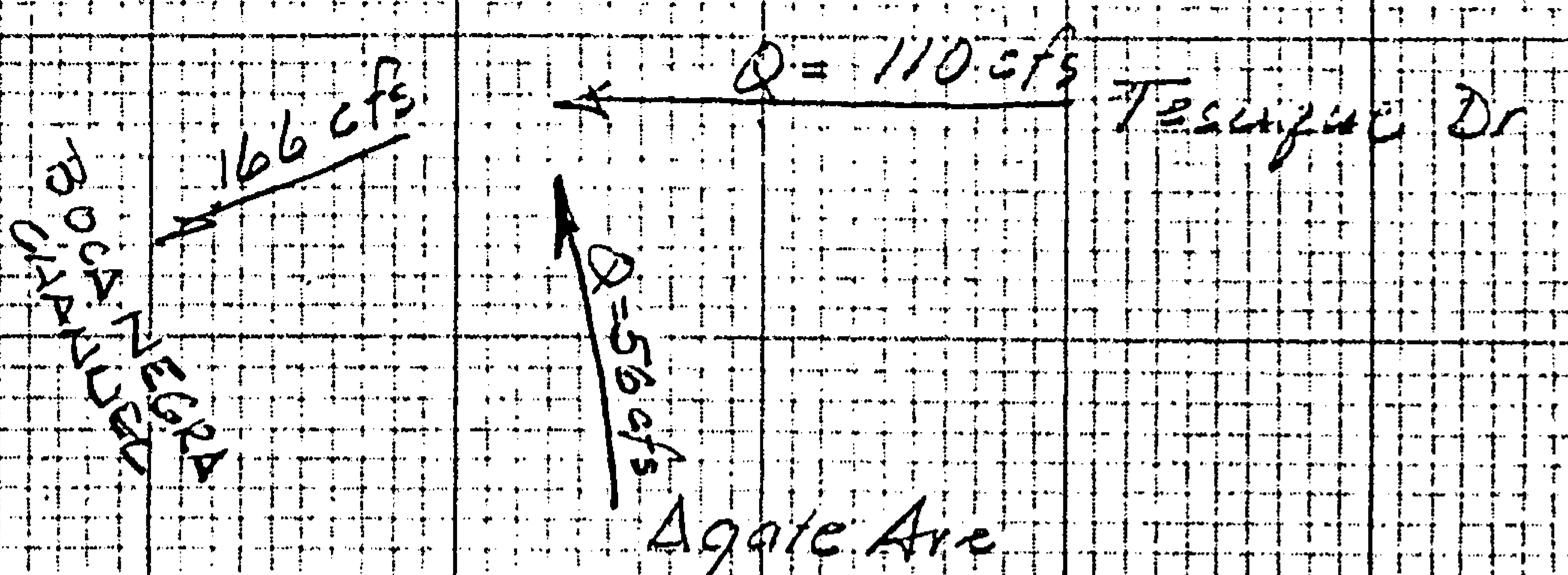
JOB SAD 219 - Tesuque/Agate
SUBJECT Storm Drains
JOB NO. ______ SHEET 1 OF ____
BY ZMG DATE 11-6-89
CHECKED ______ DATE ______

Tesuque - N. side of Boca Negra Arroyo - See Sheet 1 of 9 (Map Pockets)



Use Bureau of Public Roads, "Capacity of Curb Opening Inlets on Continuous Grade" -

Assume depth (a) of flow line depression at curb inlet $a = 0.23$

Tesuque:

$Q_{a_1} = \frac{110}{2} = 55$ cfs (each side of street) -

$y = 1.0'$, & from 1073.01, $\frac{Q_a}{L_a} = 0.96$

$L_a = Q_{a_1} / Q_a/L_a = \frac{55}{0.96} = 57.3$

$\frac{L}{L_a} = \frac{7.42}{57.3} = 0.13$ (for Type Double C inlet)

Assume $a/y = 0$, $\frac{L}{L_a} = 0.13$, then $Q/Q_{a_1} = 0.3$

→ $Q_{intercept} = Q_{I_1} = \frac{Q}{Q_a}(Q_a) = 0.30(55) = \underline{16.5 \text{ cfs}}$

$Q_{carryover} = 55 - 16.5 = 38.5$ cfs $= Q_{A_2}$

$L_{a_2} = \frac{38.5}{0.96} = 40.10$ $\frac{L}{L_{a_2}} = \frac{7.42}{40.10} = 0.185$

→ $\frac{Q}{Q_{A_2}} = 0.42$, $Q_{I_2} = 0.42(38.5) = \underline{16.2 \text{ cfs}}$

$Q_{a_3} = 38.5 - 16.2 = 22.3$ cfs

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JOB SAD 219 - Tesuque/Agate
SUBJECT Storm Drains
JOB NO. ____ SHEET 2 OF ____
BY ZMC DATE 11-7-89
CHECKED ____ DATE ____

$L_{a_3} = \frac{22.3}{0.96} = 23.23 \quad \frac{L}{L_{a_3}} = \frac{7.42}{23.23} = 0.32$

→ $\frac{Q}{Q_{a_3}} = 0.62 \quad Q_{I_3} = 0.62(22.3) = \underline{13.8}$ cfs

$Q_{CARROVER} = 22.3 - 13.8 = \underline{8.5}$ cfs (pass on to low spot on Tesuque)

For Tesuque, provide 3-Type Double C inlets each side of street:

Flows in each inlet:

$Q_1 = 16.5$ cfs

$Q_2 = 16.2$ cfs

$Q_3 = \underline{13.8}$ cfs

$T = 46.5$ cfs, carryover $= 55 - 46.5 = 8.5$ cfs (each side)

Agate Ave at Tesuque -

$Q_{a_1} = \frac{56}{2} = \tilde{28}$ cfs (each side of street) $y = 1.0$

$\frac{Q_a}{L_a} = 0.96 \quad L_a = \frac{28}{0.96} = 29 \quad \frac{L}{L_{a_1}} = \frac{7.42}{29} = 0.26$

→ $\frac{Q}{Q_{a_1}} = 0.53, \quad Q_{I_1} = 0.53(28) = \underline{14.8 \text{ cfs}}$

$Q_{a_2} = 28 - 14.8 = 13.2$ cfs.

$\frac{Q_a}{L_a} = 0.96, \quad L_a = \frac{13.2}{0.96} = 13.8 \quad \frac{L}{L_{a_2}} = \frac{7.42}{13.8} = 0.54$

→ $\frac{Q}{Q_{a_2}} = 0.88 \quad Q_{I_2} = 0.88(13.8) = \underline{12.1}$ cfs

Carryover $= 13.8 - 12.1 = 1.7$ cfs.

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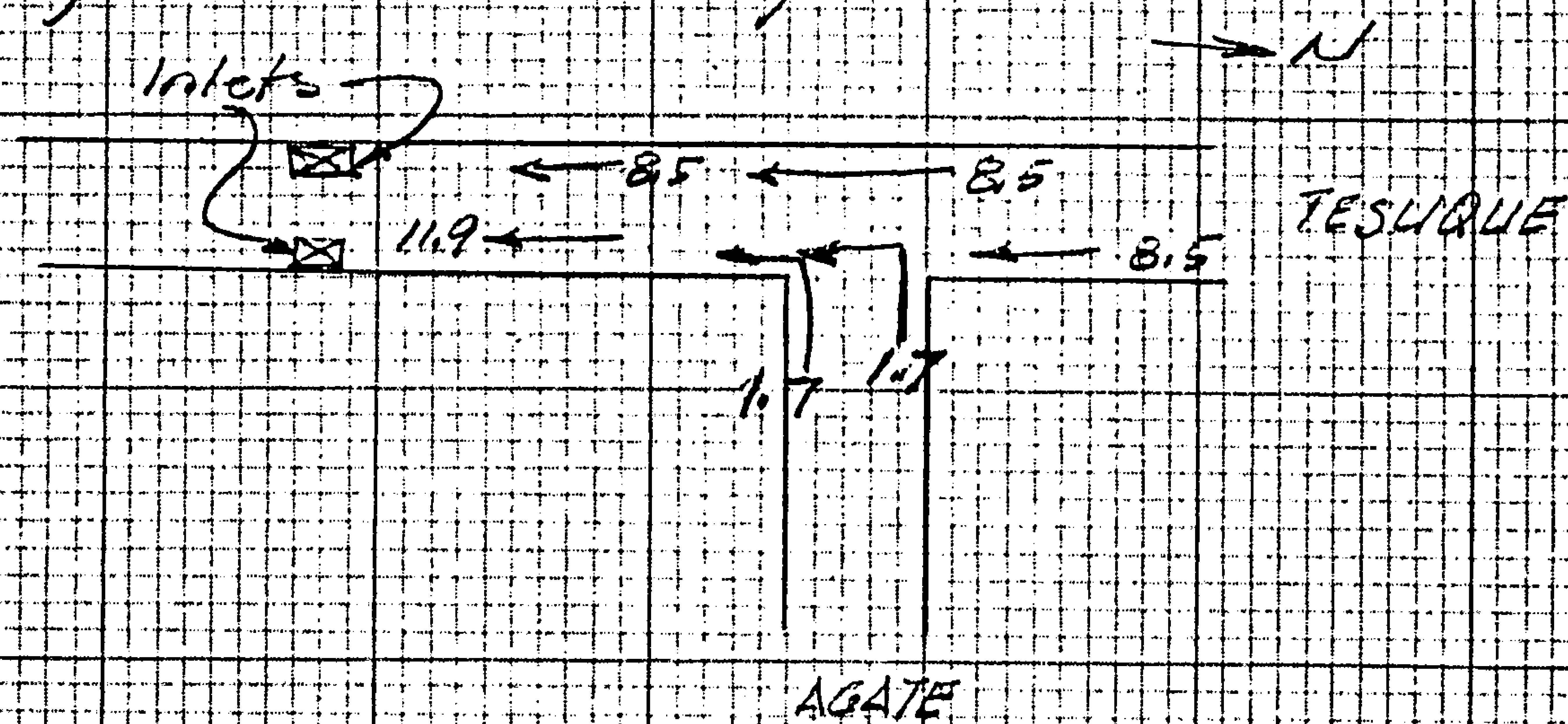
JOB SAD 219 - Tesuque / Agate
SUBJECT Storm Drains
JOB NO. ____ SHEET 3 OF ____
BY ZMG DATE 11-7-89
CHECKED ____ DATE ____

Carryover street drainage



Use criteria for grate inlets in a sump -

Try Single C inlets -

Perimeter under flow = 4' + 2(2.5) = 9.0'

$P = 9/2 = 4.5'$

West Side $\frac{Q}{P} = \frac{8.5}{4.5} = 1.89$ cfs/ft

H at inlet:

$\frac{Q}{P} = 3.0 H^{3/2}$

$H = \left(\frac{Q/P}{3}\right)^{2/3} = \left(\frac{1.89}{3}\right)^{2/3} = \underline{0.73 \text{ ft}}$ ok

East Side $\frac{Q}{P} = \frac{11.9}{4.5} = 2.64$ cfs/ft

$H = \left(\frac{2.64}{3}\right)^{2/3} = \underline{0.92 \text{ ft}}$

Storm Drain Connector Pipes - & Storm Inlets -

Tesuque - W. Side (sta 19+00) (3 ea dbl "C" inlets)

Q = 46.5 cfs -

H: CF = 10" = 0.83', curb = 5169.00

H.G. = 5166.46

H = (5169.00' - 1.33) - 5166.46

H = 1.21' L = 45'

From nomograph in IE 22.3, DPM; (p. 78)

→ D = 36"

$\sqrt{\ } = C.F. + 1.2 \frac{V^2}{2g} + d + 0.5$

$v = \frac{Q}{A} = \frac{46.5 \times 4}{\pi (3^2)} = 6.58$ fps

$\sqrt{\ } = 0.83 + \frac{1.2 (6.58)^2}{2g} + 3 + 0.5 = 5.14'$

→ Invert = 5169.00 - 5.14 = 5163.86

Tesuque - E. Side (sta 18+85) (3 ea dble "C" inlets)

Q = 46.5 cfs -

C.F. = 10" = 0.83' curb = 5168.67

H.G. = 5166.46

H = (5168.67 - 0.83) - 5166.46

H = 0.88 L = 15'

→ D = 36"

$v = \frac{Q}{A} = 6.58$ fps

$\sqrt{\ } = 5.14'$

→ Invert = 5168.67 - 5.14 = 5163.53

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JOB SAD 219 Tesuque/Agate
SUBJECT Storm Drains
JOB NO. ______ SHEET 5 OF ___
BY ZMG DATE 11-9-89
CHECKED ______ DATE ______

Agate Ave - N. Side sta 10+55 - 2 ea. dbl "C" inlets -
Q = 26.3 cfs.
H: CF = 0.83 curb = 5167.40 L = 37'
H.G. = 5164.02
H = (5167.40 - 1.33) - 5164.02 = 2.05
→ D = 24"
From 12 22.3 D-9 (DPM)
→ V = 4.55' Invert = 5167.40 - 4.55 = 5162.85

Agate Ave - S. Side sta 10+25 - 2 ea. dbl "C" inlets -
Q = 26.3 cfs.
C.F. = 0.83 curb = 5167.43 L = 53
HG = 5164.02
H = (5167.43 - 1.33) - 5164.02 = 2.08
→ D = 24"
→ V = 4.55', Invert = 5167.43 - 4.55 = 5162.88

Tesuque - W. Side sta 17+14 - 1 ea single "C" inlet
Q = 8.5 cfs H.G. = 5162.11 curb = 5166.22 L = 30'
H = (5166.22 - 1.33) - 5162.11 = 2.78
→ D = 18"
→ V = 3.26 Invert = 5166.22 - 3.26 = 5162.96

Tesuque - E Side sta 17+14 1 ea. single "D" inlet
Q = 11.9 cfs H.G. = 5162.11 FL = 5165.55 L = 10'
D = 18"
V = 3.65, Invert = 5165.55 - 3.65 = 5161.90

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JOB SAD 219 - Tesuque - Boca
SUBJECT Storm Drain
JOB NO. ____ SHEET 6 OF ____
BY ZMG DATE 11-9-89
CHECKED ____ DATE ____

Tesuque - S. side of Boca Negra Arroyo - (See Sheet 1 of 4) Map Pockets

Tesuque Dr. —25 cfs→

Boca Negra Channel

$Q_a = \frac{25}{2} = 12.5$ cfs (each side)

Use BPR - "Capacity of Grate Inlets in a Sump" -
Assume one single "C" inlet, each side

Perimeter under flow = 4'-0" + 2(2'-6") = 9.00'

$P = \frac{9.00}{2} = 4.50$

$Q = 12.5$ cfs

$\frac{Q}{P} = \frac{12.5}{4.5} = 2.78$ cfs/ft

H at inlet $= \left(\frac{Q/P}{3.0}\right)^{2/3} = \left(\frac{2.78}{3}\right)^{2/3} = 0.95$ (too high)

try dbl "C" inlet

Perimeter = 7.5 + 2(2'-6") = 12.42

$P = \frac{12.42}{2} = 6.21$

$Q/P = \frac{12.5}{6.21} = 2.01$

$H = \left(\frac{2.01}{3}\right)^{2/3} = 0.76$ — ok use Dbl "C" inlets

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JOB SAD 219 - Tesuque - Boca
SUBJECT Storm Drains
JOB NO. ____ SHEET 7 OF ____
BY ZMG DATE 11-9-89
CHECKED ____ DATE ____

Tesuque - South - cont.
Connector pipes & inlets - cont
W side -

$Q = 12.5$ cfs curb = 5167.67 HG = 5162.36 L = 40'

$H = (5167.67 - 1.33) - 5162.36 = 3.98$

→ use 18" on both sides

$v = \frac{Q}{A} = \frac{12.5(4)}{\pi 2.25} = 7.07$

$V_L = 0.83 + 1.2 \frac{v^2}{2g} + 3 + 0.15$
$= 5.26$

→ $Invert_L = Invert_R = 5167.67 - 5.26 = 5162.41$

JOB DESCR: BOCA TESUQUE SOUTH
RUN DATE :03-02-1987

STORM SEWER - HYDRAULIC ANALYSIS - FILE: BOCATES2.STM

RAINFALL LOCATION: SOMEWHERE UNITED STATES
RETURN PERIOD = 100 YRS

LINE 1 / DFQ = 25.0 / HT = 27 / WID = 27 / N = .015 / L = 40 / JLC = 1

1

OUTFALL

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	5156.50	24.00	5154.50	6.67	5157.19	16.69	21.17	3.75
UPSTRM	5156.68	21.33	5154.90	7.42	5157.53	21.99	21.17	3.37

DA = 0 C = 0 Tc = 1.1 INL TM = 0 INT = 11.32 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 1.000 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

LINE 2 / DFQ = 25.0 / HT = 27 / WID = 27 / N = .015 / L = 117 / JLC = 1

DNLN = 1

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	5157.53	27.00	5154.91	6.29	5158.15	0.00	21.17	3.98
UPSTRM	5158.55	27.00	5156.07	6.29	5159.16	0.00	21.17	3.98

DA = 0 C = 0 Tc = .7 INL TM = 0 INT = 11.52 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 0.991 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

LINE 3 / DFQ = 25.0 / HT = 27 / WID = 27 / N = .015 / L = 24 / JLC = 1

DNLN = 2

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	5159.16	27.00	5156.07	6.29	5159.78	0.00	21.17	3.98
UPSTRM	5159.37	27.00	5156.31	6.29	5159.98	0.00	21.17	3.98

DA = 0 C = 0 Tc = .6 INL TM = 0 INT = 11.56 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 1.001 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

LINE 4 / DFQ = 25.0 / HT = 27 / WID = 27 / N = .015 / L = 203 / JLC = 1

DNLN = 3

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	5159.98	27.00	5156.31	6.29	5160.60	0.00	21.17	3.98
UPSTRM	5162.36	27.00	5158.34	6.29	5162.98	0.00	21.17	3.98

DA = 0 C = 0 Tc = 0 INL TM = 0 INT = 11.93 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 1.000 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

JOB DESCR: BOCATEL1
RUN DATE :03-02-1987

STORM SEWER - HYDRAULIC ANALYSIS - FILE: BOCATES1.STM

RAINFALL LOCATION: SOMEWHERE UNITED STATES
RETURN PERIOD = 100 YRS

LINE 1 / DFQ =166.0 / HT = 54 / WID = 54 / N = .015 / L = 20 / JLC = 1

OUTFALL

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	5153.50	48.00	5149.50	11.07	5155.40	33.39	45.49	14.99
UPSTRM	5153.52	45.78	5149.70	11.55	5155.59	38.80	45.49	14.38

DA = 0 C = 0 Tc = 2.1 INL TM = 0 INT = 10.86 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 1.001 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

LINE 2 / DFQ =166.0 / HT = 54 / WID = 54 / N = .015 / L = 280 / JLC = 1

DNLN = 1

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	5155.59	54.00	5149.70	10.44	5157.28	0.00	45.49	15.90
UPSTRM	5158.24	54.00	5152.50	10.44	5159.93	0.00	45.49	15.90

DA = 0 C = 0 Tc = 1.1 INL TM = 0 INT = 11.31 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 1.000 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

LINE 3 / DFQ =166.0 / HT = 54 / WID = 54 / N = .015 / L = 229 / JLC = 1

DNLN = 2

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	5159.93	54.00	5152.50	10.44	5161.63	0.00	45.49	15.90
UPSTRM	5162.11	54.00	5154.79	10.44	5163.80	0.00	45.49	15.90

DA = 0 C = 0 Tc = .4 INL TM = 0 INT = 11.71 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 1.000 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

LINE 4 / DFQ =146.0 / HT = 54 / WID = 54 / N = .015 / L = 30 / JLC = 1

DNLN = 3

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	5163.80	54.00	5154.79	9.18	5165.11	0.00	42.89	15.90
UPSTRM	5164.02	54.00	5155.09	9.18	5165.33	0.00	42.89	15.90

DA = 0 C = 0 Tc = .3 INL TM = 0 INT = 11.76 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 0.999 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

LINE 5 / DFQ =110.0 / HT = 54 / WID = 54 / N = .015 / L = 93 / JLC = 1

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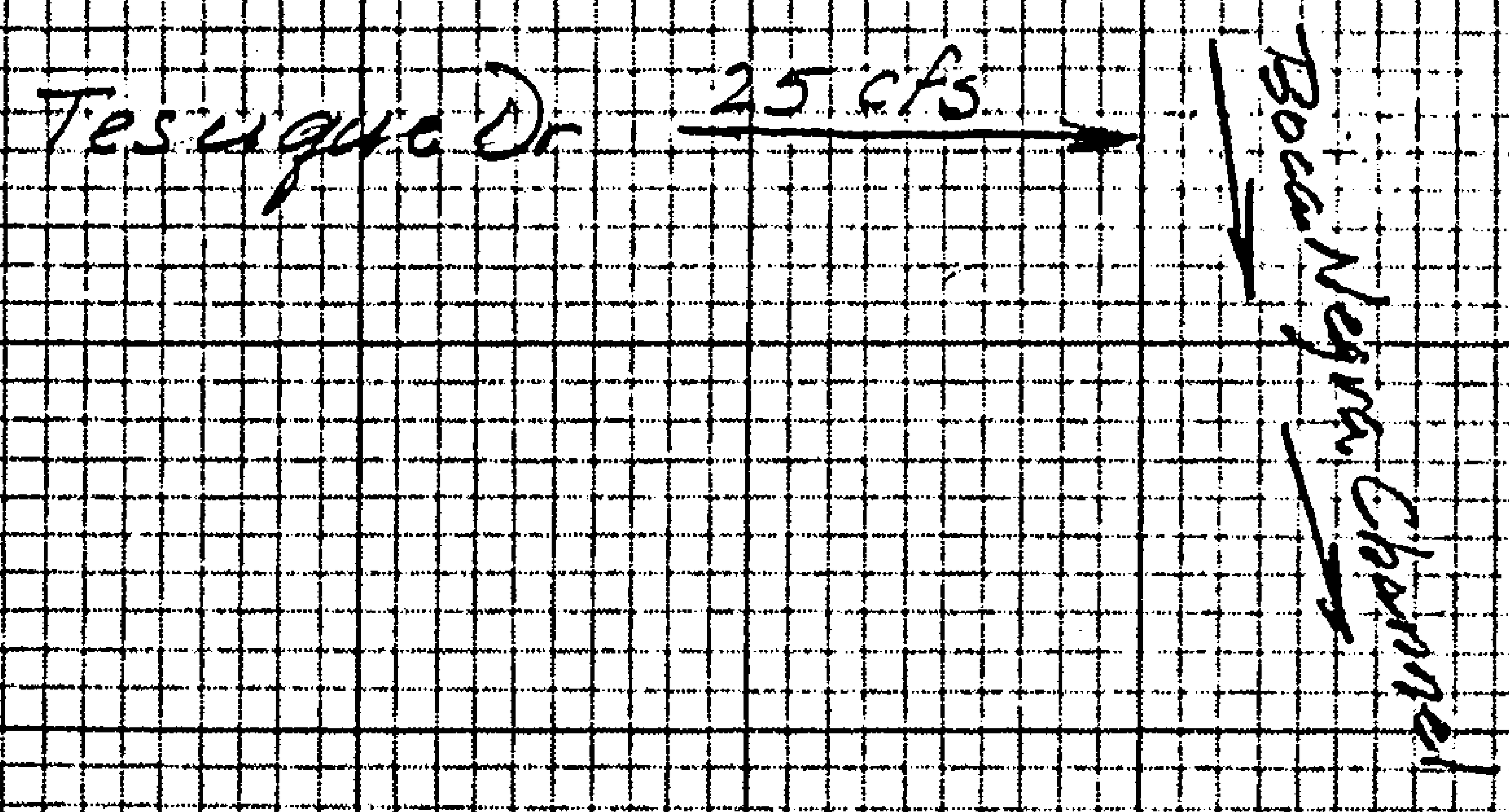
JOB
SUBJECT
JOB NO. SHEET OF
BY DATE
CHECKED DATE

"Plan Sheet 89":

The comment is not clear. Criteria requires the limitation of flow depth in flow line at face of curb to 0.87 feet for the 100 year storm, and this criteria was used in design of the drain in question. Q_{100} (24.5 cfs) was rounded off to 25, and ½ street flows are 25/2 = 12.5 and this flow (12.5) was used to design the inlets. The inlets are, therefore, designed for a total flow of 25 cfs (2 × 12.5). The inlets are in a sump but will have a total Q ~~of~~ 12.5 cfs when ponded to a depth of 0.76 feet. (See design analysis.) ~~The~~

Calculations have been checked and are considered correct. The 27" storm drain will flow full and under pressure. HGL will be as shown on the drawings. Use of a 24" pipe will produce an unacceptable HGL at the uppermost manhole. (5167.42 vs 5162.57). The 27" pipe is considered necessary.

Tesuque - S. side of Boca Negra Arroyo -



$Q_a = \frac{25}{2} = \underline{12.5\ cfs}$ (each side)

Use BPR - "Capacity of Grate Inlets in a Sump" -
Assume one single "C" inlet, each side

Perimeter under flow = 4'0" + 2(2'-6") = 9.00'

$P = \frac{9.00}{2} = 4.50$

$Q = 12.5\ cfs$

$\frac{Q}{P} = \frac{12.5}{4.5} = 2.78\ cfs/ft$

H at inlet $= \left(\frac{Q/P}{3.0}\right)^{2/3} = \left(\frac{2.78}{3}\right)^{2/3} = 0.95$ (too high)

try dbl "C" inlet

Perimeter = 7'-5 + 2(2'-6") = 12.42

$P = \frac{12.42}{2} = 6.21$

$Q/P = \frac{12.5}{6.21} = 2.01$

$H = \left(\frac{2.01}{3}\right)^{2/3} = \underline{0.76}$ - ok use Dbl "C" inlets

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JOB SAD 219 - Tesuque - Boca
SUBJECT Storm Drains
JOB NO. ________ SHEET 7 OF ____
BY ZMG DATE 11-9-89
CHECKED ________ DATE ________

Tesuque - South - cont.
Connector pipes & inlets - cont
W side -

Q = 12.5 cfs curb = 5167.65 HG = 5162.57 L = 40'

H = (5167.65 - 1.33) - 5162.57 = 3.75

→ Use 18" on both sides ✓ $v = \frac{Q}{A} = \frac{12.5(4)}{\pi 2.25} = 7.07$

$V_L = 0.83 + 1.2\frac{v^2}{2g} + 3 + 0.15$
$= 5.26$

→ $Invert_L = Invert_R = 5167.65 - 5.26 = \underline{5162.39}$

Connector pipe LEFT will have to be installed at a flat grade to get over the 20" water line with 18" separation between the 18" S.D. & the 20" W.

Top 20" W @ intersection w/ 18" S.D. =	61.35
add for separation	1.50
Inv of 18" S.D. @ intersection =	62.85

Set slope of 18" S.D. @ 1%
Inv @ INLET = 62.85 + 10'(.01) = 62.95
Inv where 18" S.D. (LEFT) ENTERS MH
= 62.95 - 40(.01) = 62.55 ←

RT. SIDE IS NO PROBLEM -
Inv where 18" S.D. (RIGHT) ENTERS MH = 58.34 + 0.20

JOB DESCR: BOCA TESUQUE SOUTH
RUN DATE :01-23-1990

STORM SEWER - HYDRAULIC ANALYSIS - FILE: BOCATES2.STM

RAINFALL LOCATION: SOMEWHERE UNITED STATES
RETURN PERIOD = 100 YRS

LINE 1 / DFQ = 25.0 / HT = 27 / WID = 27 / N = .015 / L = 70 / JLC = 1

OUTFALL

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	5156.50	24.00	5154.50	6.67	5157.19	16.69	21.17	3.75
UPSTRM	5157.12	26.64	5154.90	6.30	5157.74	6.20	21.17	3.97

DA = 0 C = 0 Tc = 1.1 INL TM = 0 INT = 11.32 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 0.571 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

LINE 2 / DFQ = 25.0 / HT = 27 / WID = 27 / N = .015 / L = 117 / JLC = 1

DNLN = 1

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	5157.74	27.00	5154.91	6.29	5158.35	0.00	21.17	3.98
UPSTRM	5158.75	27.00	5156.07	6.29	5159.37	0.00	21.17	3.98

DA = 0 C = 0 Tc = .7 INL TM = 0 INT = 11.52 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 0.991 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

LINE 3 / DFQ = 25.0 / HT = 27 / WID = 27 / N = .015 / L = 24 / JLC = 1

DNLN = 2

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	5159.37	27.00	5156.07	6.29	5159.98	0.00	21.17	3.98
UPSTRM	5159.58	27.00	5156.31	6.29	5160.19	0.00	21.17	3.98

DA = 0 C = 0 Tc = .6 INL TM = 0 INT = 11.56 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

LINE 4 / DFQ = 25.0 / HT = 27 / WID = 27 / N = .015 / L = 203 / JLC = 1

DNLN = 3

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	5160.19	27.00	5156.31	6.29	5160.80	0.00	21.17	3.98
UPSTRM	5162.57	27.00	5158.34	6.29	5163.18	0.00	21.17	3.98

DA = 0 C = 0 Tc = 0 INL TM = 0 INT = 11.93 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 1.000 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

L = 40 D = 18"
Q = 12.5
INV UP = 100.00
✓ DN 99.60

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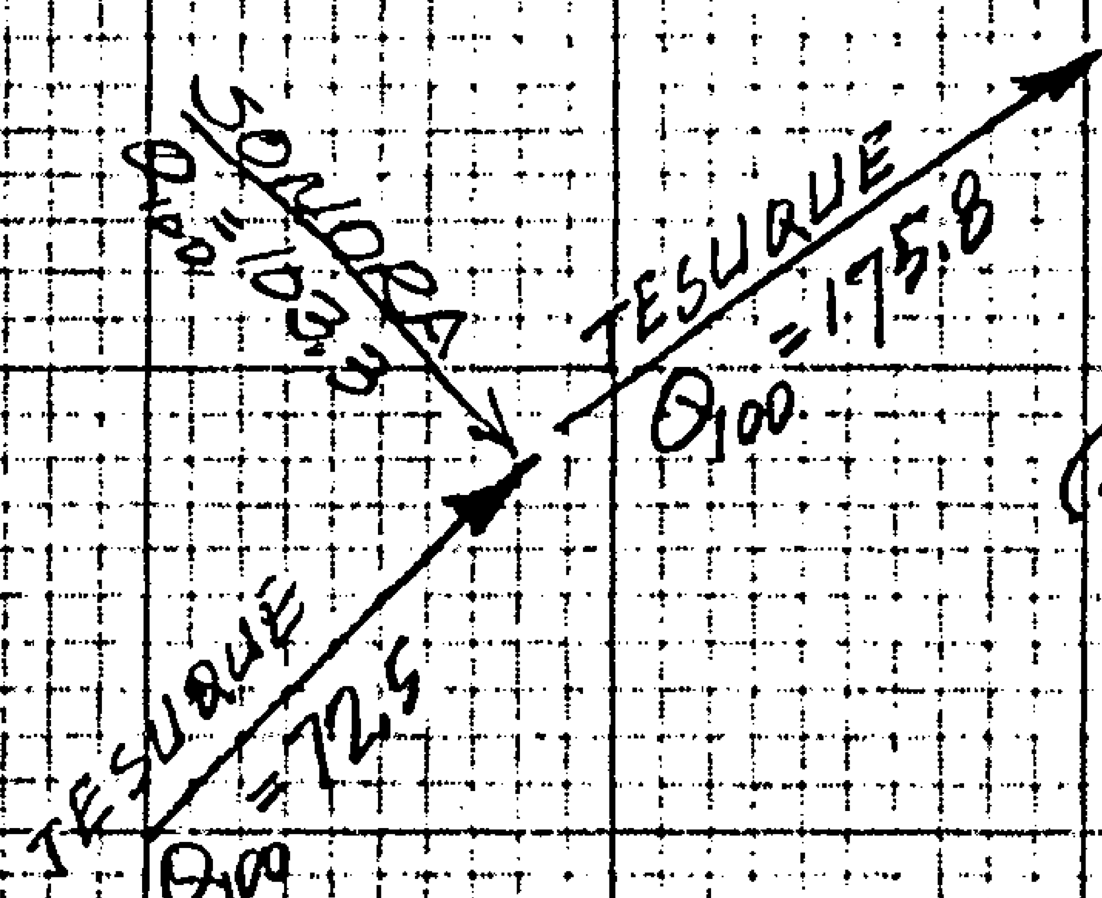
JOB SAD-219
SUBJECT Tesuque-Mariposa S.D.
JOB NO. ______ SHEET 1 OF ___
BY ZMG DATE 11-20-89
CHECKED ______ DATE ______

From Drainage Report: See Sheet 1 of 9 Map Pockets



From City of Alb. DPM Vol 2, Pl 22.3 D-2, p. 71:

Street capacity:

(1) $Q_{100} = 176$ cfs
Allow $d = 0.87$
$Q_{STREET} = 60 \times 2 = 120$ cfs
$Q_{PIPE} = 176 - 120 = \underline{56 \text{ cfs}}$

(2) $Q_{10} = 176 \times 0.657 = 116$ cfs
Allow $d = 0.50$
$Q_{STREET} = 14 \times 2 = 28$ cfs
$Q_{PIPE} = 116 - 28 = 88$ cfs

∴ It will be necessary to design for the 10yr storm, & $Q_{PIPE} = \underline{88 \text{ cfs}}$.

Use Bureau of Public Roads "Capacity of Curb Opening Inlets on Continuous Grade":

$Q_{a_1} = \frac{88}{2} = 44$ cfs (each side of street) $a = 0.23$

$y = 1.00'$ & from BPR 107301, $\frac{Q_a}{L_a} = 0.96$

$L_a = Q_a / Q_a/L_a = \frac{44}{0.96} = 45.8$

for dbl "C" inlet, $L = 7.42$ & $\frac{L}{L_a} = \frac{7.42}{45.8} = 0.16$

assume $a/y = 0$ (conservative)

since $L/L_a = 0.16$, $Q/Q_a = 0.35$

& $Q_I = Q/Q_A (Q_A) = 0.35 (44) = 15.4$ cfs (Q intercept)

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JOB SAD 219
SUBJECT Tesuque-Mariposa SD
JOB NO.
SHEET 2 OF
BY ZMG
DATE 11-28-89
CHECKED
DATE

$Q_{CARRYOVER} = 44 - 15.4 = 28.6$ cfs.
Obviously - 3 ea dbl "C" inlets w/b required, each side

Connector pipes:

Drop inlets, each side, 3 ea dble "C", Q = 44 cfs
Curb face CF = 10" = 0.83'
Curb = 5173.00
H.G. = 5170.96 ~1.91
H = (5173.00 - 1.33) - 5170.96
H = 0.71
From nomograph in DPM, Pl 22.3, p. 78
→ D = 42"

$L_L = 40'$
$L_R = 25'$

$V = CF + 1.2\frac{v^2}{2g} + d + 0.5$

$v = \frac{Q}{A} = \frac{44 \times 4}{\pi d^2} = \frac{176}{38.5}$

$v = 4.6$ fps

$V = 0.83 + 1.2\frac{(4.6)^2}{2g} + 3.5 + 0.5$

$V = 5.22$

Invert = 5173.00 - 5.22 = 5167.78

JOB SAD 219
SUBJECT Tesuque-Mariposa S.D.
JOB NO. ______ SHEET 3 OF ____
BY Z.M.G. DATE 11-30-89
CHECKED ______ DATE ______

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48" (circled: 42") Storm Drain Outfall:

The 42" storm drain will have to terminate by discharging into the Mariposa Arroyo. The Mariposa 100 yr storm peak = 936 cfs but this peak will likely occur much later than the 88 cfs peak in the 42" S.D.

There appear to be 3 alternatives for discharging into the Mariposa from the Tesuque storm drain:

#1. Pass storm drain underneath the arroyo & turn downstream along the East bank to a suitable elevation for turning the storm drain into the channel.

#2. Route storm drain along West bank of the arroyo to a suitable elevation for turning into the channel.

#3. Construct a drop structure along the downstream edge of the concrete dip section where the arroyo crosses Tesuque Dr. Set the bottom of the drop section to permit constructing the storm drain invert in the concrete retaining wall forming the drop structure. Excavate the arroyo downstream to a suitable daylight.

Alt.#1 did not prove to be practical because the excessive depth required to get underneath the dip section would have required a very long run of 48" RCP to get to a suitable discharge point downstream.

Alt#2 proved to be too expensive since the storm drain excavation along the West bank of the channel would require shoring full length to protect the home owners walls that run along the boundary of the drainage easement.

Alt#3 proved to be the most practical alternative. Backwater calculations were run using HEC-2 software. A 30 ft excavated channel bottom width was selected, with 3:1 side slopes. The slope of the channel bottom to daylight ≈ 2%.

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JOB SAD-219
SUBJECT Tesuque-Mariposa S.D.
JOB NO. ________ SHEET 4 OF ____
BY ZMG DATE 11-30-89
CHECKED ________ DATE ________

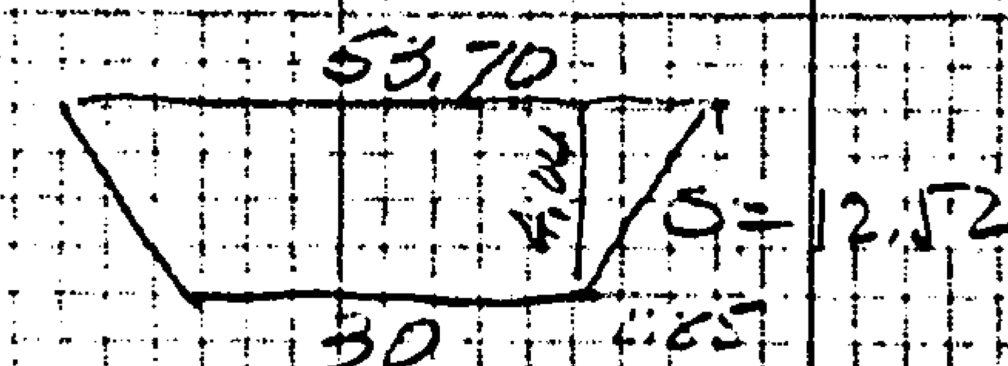
Rip-Rap @ S.D. outlet:

Rip-rap size:

Compute $V^2/R^{0.33}$

From HEC-2 run, V @ Sec 6 = 5.32 fps (V of Q_{100} in channel –

A = 169 sf   R:



WP = 55.04

$R = A/WP = 169/55.04 = 3.07$

$V^2/R^{0.33} = \frac{28.30}{1.45} = 19.5$

Use Type L rip-rap, K_m = 9"

Bedding, use 4" Type I & 4" Type II

Length, "L" of channel protection –

$L = f_e \left[\frac{A_t}{y_t} - W \right]$

L = Length of protection

f_e = expansion factor (See Simons & Li fig. 5-6)

$A_t = Q/V$, where Q = design discharge, Storm Drain
V = Allowable non-eroding velocity in d.s. channel (use V = 5.5 fps)

Y_t = tailwater depth

W = diameter of storm drain –

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JOB SAD 219
SUBJECT Tesuque-Mariposa S.D.
JOB NO. ______ SHEET 5 OF ____
BY ______ DATE ______
CHECKED ______ DATE ______

$y_t \approx 3.0$, $\frac{y_t}{D} = \frac{35}{42} = 0.8$, from Simons & Li, $f_c = 6.7$

$A_t = \frac{Q}{V} = \frac{88}{5.5} = 16$

$L = 6.7\left[\frac{16}{3} - 3.5\right] = 12$, use $\underline{\underline{25'}}$ //

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**************************************************              **************************************
*  WATER SURFACE PROFILES                         *             *  U.S. ARMY CORPS OF ENGINEERS       *
*  VERSION OF NOVEMBER 1976                       *             *  THE HYDROLOGIC ENGINEERING CENTER  *
*  UPDATED MAY 1984                               *             *  609 SECOND STREET, SUITE D         *
*  IBM-PC-XT VERSION                              *             *  DAVIS, CALIFORNIA 95616            *
*  RUN DATE  12/03/89  TIME  09:49:45             *             *  (916) 440-2105  (FTS) 448-2105     *
**************************************************              **************************************


                    X     X  XXXXXXX   XXXXX           XXXXX
                    X     X  X        X     X         X     X
                    X     X  X        X                     X
                    XXXXXXX  XXXX     X        XXXXX   XXXXX
                    X     X  X        X               X
                    X     X  X        X     X         X
                    X     X  XXXXXXX   XXXXX          XXXXXXX
```

THIS RUN EXECUTED 12/08/89 09:49:49

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**********************************************
HEC2 RELEASE DATED NOV 76 UPDATED MAY 1984
ERROR CORR - 01,02,03,04,05,06
MODIFICATION - 50,51,52,53,54,55,56
IBM-PC-XT VERSION APRIL 1985
**********************************************
```

T1 MARIPOSA CHANNEL-SAD 219
T2 WATER SURFACE PROFILE-BACKWATER CURVE
T3 100 YEAR DESIGN STORM

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	-10.	0.	0.	0.	-1.000000	.00	.0	900.	31.000	.000

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*PROF 1

CCHV= .100 CEHV= .300

*SECNO 1.000

3720 CRITICAL DEPTH ASSUMED

4.00	2.75	50.75	50.75	51.00	51.90	1.15	.00	.00	52.00
900.	0.	900.	0.	0.	105.	0.	0.	0.	54.00
.00	.00	8.61	.00	.030	.030	.030	.000	48.00	15.53
.010389	0.	0.	0.	0	10	0	.00	46.04	61.80

*SECNO 2.000

3301 HV CHANGED MORE THAN HVINS

2.00	3.73	51.85	.00	.00	52.41	.56	.45	.06	57.00
900.	0.	900.	0.	0.	150.	0.	0.	0.	54.00
.00	.00	6.02	.00	.030	.030	.030	.000	48.15	14.16
.003571	79.	79.	79.	2	0	0	.00	50.33	64.49

*SECNO 3.000

3.00	3.83	52.15	.00	.00	52.71	.56	.30	.00	60.00
900.	0.	900.	0.	0.	150.	0.	1.	0.	54.00
.01	.00	5.99	.00	.070	.030	.030	.000	48.32	17.50
.003358	93.	87.	84.	2	0	0	.00	48.31	65.81

*SECNO 4.000

4.00	4.36	52.47	.00	.00	52.85	.37	.12	.02	59.00
900.	0.	900.	0.	0.	183.	0.	1.	0.	55.00
.01	.03	4.91	.00	.070	.030	.030	.000	48.11	12.03
.002115	47.	45.	42.	2	0	0	.00	56.31	68.56

*SECNO 5.000

3265 DIVIDED FLOW

3280 CROSS SECTION 5.00 EXTENDED .58 FEET

5.00	4.93	52.48	.00	.00	52.92	.44	.05	.02	51.60
900.	0.	900.	0.	0.	170.	0.	1.	0.	54.00
.01	.00	5.31	.00	.070	.030	.030	.000	13.45	.00
.002727	22.	22.	22.	2	0	0	.00	55.26	67.34

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 6.000

6.00	8.04	52.54	.00	.00	52.98	.44	.07	.00	59.00
900.	0.	900.	0.	0.	169.	0.	1.	0.	55.00
.01	.04	5.32	.00	.030	.030	.030	.040	48.50	15.30
.002537	25.	25.	25.	0	0	0	.00	57.70	67.01

*SECNO 7.000
3495 20 TRIALS ATTEMPTED WSEL,CWSEL
3493 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

7.00	2.64	56.64	56.64	.00	57.63	.99	.00	.11	57.50
900.	0.	900.	0.	0.	126.	0.	1.	0.	57.00
.01	.00	7.14	.00	.015	.015	.015	.000	54.00	1.53
.002255	1.	1.	1.	20	14	0	.00	80.66	82.19

*SECNO 8.000
3280 CROSS SECTION 8.00 EXTENDED 1.78 FEET

3304 HV CHANGED MORE THAN HVINS

8.00	7.23	57.48	.00	.00	57.70	.22	.01	.06	55.50
900.	0.	900.	0.	0.	240.	0.	1.	0.	56.00
.01	.00	3.75	.00	.015	.015	.015	.000	54.20	.00
.000436	16.	16.	16.	3	0	0	.00	75.00	75.00

*SECNO 9.000
3280 CROSS SECTION 9.00 EXTENDED 1.60 FEET

9.00	2.90	57.60	.00	.00	57.72	.11	.01	.01	56.30
900.	0.	900.	0.	0.	332.	0.	1.	0.	56.00
.02	.00	2.71	.00	.015	.015	.015	.000	54.70	.00
.000255	16.	16.	16.	2	0	0	.00	145.00	145.00

*SECNO 10.000
3280 CROSS SECTION 10.00 EXTENDED .82 FEET

10.00	1.82	57.52	.00	.00	57.73	.26	.02	.04	56.70
900.	0.	900.	0.	0.	219.	0.	1.	1.	56.70
.02	.00	4.12	.00	.015	.015	.015	.000	55.70	.00
.001154	42.	42.	42.	2	0	0	.00	140.00	140.00

IBM *Mariposa Channel - SAD-219* — **FORTRAN Coding Form**

GX28-7327-6 U/M 050**
Printed in U.S.A.

PROGRAM		PUNCHING INSTRUCTIONS	GRAPHIC	PAGE OF
PROGRAMMER	DATE		PUNCH	CARD ELECTRO NUMBER*

	STATEMENT NUMBER / CONT. (1)	2	3	4	5 FORTRAN	STATEMENT 6	7	8	9	IDENTIFICATION SEQUENCE 10
1	T1	MARIPOSA CHANNEL-SAD 219								
2	T2	WATER SURFACE PROFILE-BACKWATER CURVE								
3	T3	100 YEAR DESIGN STORM								
4	J1 -10	0	0	0	-1	0	0	900	.51	0
5	NC .030	.030	.030	.1	.3					
6	X1 1	6	0	70	0	0	0	0	0	0
7	GR 55.00	0	53.00	4	51.00	~~45~~ 15	48.00	35	48.00	55
8	GR 54.00	70								
9	X1 2	5	0	70	79	79	79	0	0	0
10	GR 57.00	0	49.00	22	48.15	25	48.15	55	54.00	79
11	X1 3	5	0	71	93	84	87	0	0	0
12	GR 60.00	0	56.00	10	48.32	25	48.32	55	54.00	71
13	X1 4	7	0	77	47	42	45	0	0	0
14	GR 59.00	0	56.00	8	53.00	11	52.00	13	48.11	25
15	GR 48.41	55	55.00	77						
16	X1 5	6	0	72	22	22	22	0	0	0
17	GR 51.60	0	56.00	7	53.00	12	48.45	25	48.45	55
18	GR 54.00	72								
19	X1 6	5	0	81	25	25	25	0	0	0
20	GR 59.00	0	56.00	7	48.50	25	48.50	55	56.00	81
21	NC .015	.015	.015	0	0					
22	X1 7	5	0	83	1	1	1	0	0	0
23	GR 57.50	0	56.20	3	54.20	38	56.20	79	57.00	83
24	X1 8	5	0	95	16	13	16	0	0	0

*A standard card form, IBM electro 888157, is available for punching statements from this form.

**Number of forms per pad may vary slightly

GX28-7327-6 U/M 050**
Printed in U.S.A.

FORTRAN Coding Form

PROGRAM		PUNCHING INSTRUCTIONS	GRAPHIC		PAGE OF
PROGRAMMER	DATE		PUNCH		CARD ELECTRO NUMBER*

	STATEMENT NUMBER / CONT. 1	2	3	4	FORTRAN STATEMENT 5	6	7	8	9	IDENTIFICATION SEQUENCE 10
5	GR 55.50	0	55.00	10	54.20	39	55.00	65	56.00	95
26	X1 9	6	0	145	16	16	16	0	0	0
27	GR 56.30	0	56.00	7	55.00	45	54.70	70	55.00	93
28	GR 56.00	145								
29	X1 10	6	0	160	42	42	42	0	0	0
30	GR 56.70	0	56.50	20	56.00	48	55.70	25	56.00	115
31	GR 56.70	160								

1 2 3 4 5 6 7 8 9 10

*A standard card form, IBM electro 888157, is available for punching statements from this form

*Number of forms per pad may vary slightly

```
T1      MARIPOSA CHANNEL-EAD 219
T2      WATER SURFACE PROFILE-BACKWATER CURVE
T3      100 YEAR DESIGN STORM
J1   -10      0       0      0      -1      0       0     900     51      0
NC  .030   .030    .030     .1      .3
X1     1      6       0     70       0      0       0       0      0      0
GR 55.00      0   53.00      4   51.00     15   48.00      35  48.00     55
GR 54.00     70
X1     2      5       0     70      79     79      79       0      0      0
GR 57.00      0   49.00     22   48.15     25   48.15      55  54.00     70
X1     3      5       0     71      93     84      87       0      0      0
GR 60.00      0   56.00     10   48.32     25   48.32      53  54.00     71
X1     4      7       0     77      47     42      45       0      0      0
GR 57.00      0   56.00      8   53.00     11   52.00      13  48.11     25
GR 48.41     55   55.00     77
X1     5      6       0     72      22     22      22       0      0      0
GR 51.60      0   56.00      7   53.00     12   48.45      25  48.45     55
GR 54.00     72
X1     6      5       0     81      25     25      25       0      0      0
GR 59.00      0   56.00      7   48.50     25   48.50      55  56.00     81
NC  .015   .015    .015      0       0
X1     7      5       0     83       1      1       1       0      0      0
GR 57.50      0   56.20      3   54.20     38   56.20      79  57.00     83
X1     8      5       0     95      16     16      16       0      0      0
GR 55.50      0   55.00     10   54.20     39   55.00      65  56.00     95
X1     9      6       0    145      16     16      16       0      0      0
GR 56.30      0   56.00      7   55.00     45   54.70      70  55.00     93
GR 56.00    145
X1    10      6       0    160      42     42      42       0      0      0
GR 56.70      0   56.50     20   56.00     49   55.70      85  56.00    115
GR 56.70    160
EJ

ER
```

JOB DESCR: MARITES3
RUN DATE :12-07-1989

Te

STORM SEWER - HYDRAULIC ANALYSIS - FILE: MARITES3.STM

RAINFALL LOCATION: SOMEWHERE UNITED STATES
RETURN PERIOD = 100 YRS

LINE 1 / DFQ = 88.0 / HT = 42 / WID = 42 / N = .015 / L = ~~28~~ 38 / JLC = 1

OUTFALL

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	5151.45	35.38	5148.50	10.18	5153.06	30.61	35.38	8.65
UPSTRM	5151.94	39.21	5148.67	9.42	5153.31	20.93	35.38	9.35

DA = 0 C = 0 Tc = 3 INL TM = 0 INT = 10.44 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 0.607 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

LINE 2 / DFQ = 88.0 / HT = 42 / WID = 42 / N = .015 / L = 288 / JLC = 1

DNLN = 1

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	5153.31	42.00	5148.77	9.15	5154.61	0.00	35.38	9.62
UPSTRM	5157.50	35.46	5154.55	10.16	5159.11	30.47	35.38	8.66

DA = 0 C = 0 Tc = 2.1 INL TM = 0 INT = 10.86 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 2.007 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

LINE 3 / DFQ = 88.0 / HT = 42 / WID = 42 / N = .015 / L = 85 / JLC = 1

DNLN = 2

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	5159.11	42.00	5154.75	9.15	5160.41	0.00	35.38	9.62
UPSTRM	5159.97	42.00	5156.21	9.15	5161.27	0.00	35.38	9.62

DA = 0 C = 0 Tc = 1.8 INL TM = 0 INT = 10.99 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 1.753 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

LINE 4 / DFQ = 88.0 / HT = 42 / WID = 42 / N = .015 / L = 193 / JLC = 1

DNLN = 3

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	5161.27	42.00	5156.40	9.15	5162.57	0.00	35.38	9.62
UPSTRM	5162.99	39.31	5159.80	9.56	5164.41	23.77	35.38	9.31

DA = 0   C = 0   Tc = 1.1   INL TM = 0   INT = 11.31   TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT ,   REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 1.762 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

LINE 5 / DFQ = 88.0 / HT = 42 / WID = 42 / N = .015 / L = 154 / JLC = 1

DNLN = 4

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	5164.41	42.00	5160.00	9.15	5165.71	0.00	35.36	9.62
UPSTRM	5165.68	35.61	5162.71	10.12	5167.27	30.18	35.36	8.7[illegible]

DA = 0   C = 0   Tc = .6   INL TM = 0   INT = 11.57   TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT ,   REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 1.760 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

LINE 6 / DFQ = 88.0 / HT = 42 / WID = 42 / N = .015 / L = 200 / JLC = 1

DNLN = 5

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	5167.27	42.00	5162.91	9.15	5168.57	0.00	35.36	9.62
UPSTRM	5170.96	35.46	5166.40	10.16	5172.56	30.47	35.36	8.66

DA = 0   C = 0   Tc = 0   INL TM = 0   INT = 11.93   TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT ,   REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 1.745 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

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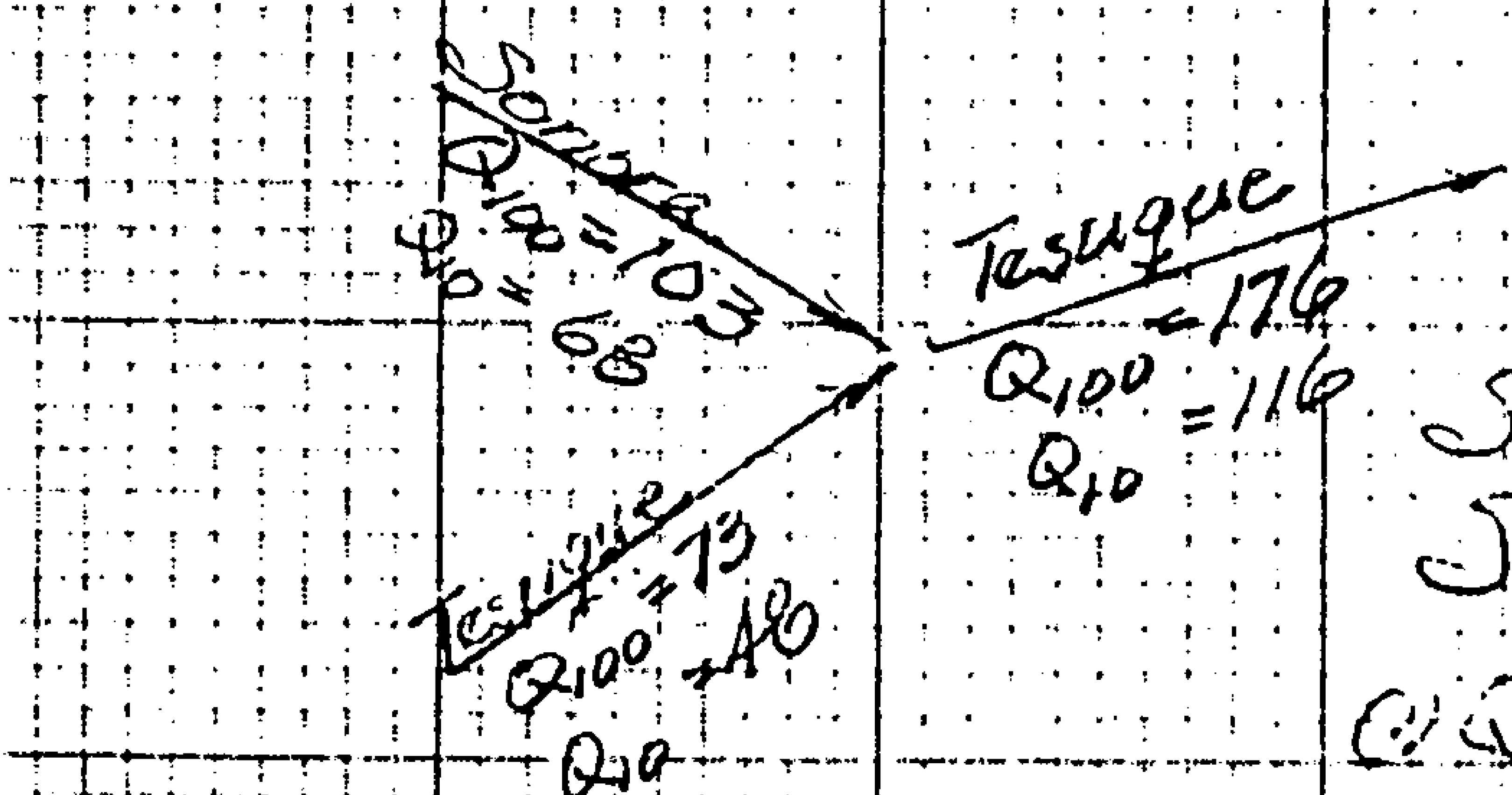
JOB SAD 219
SUBJECT Tesuque-Mariposa S.D.
JOB NO.
SHEET 1 OF
BY DMG
DATE 2-1-90
CHECKED
DATE

From Drainage Rpt



From City of Alb DPM Vol. 2

Street grades
Tesuque = 0.010 '/'
Sonora = 0.010 '/'

Street capacity (see pg 22-3)
Sonora : (w = 32')

@ Q_{100} = 103
allow d = 0.37
Q_{street} = 58 × 2 = 116 cfs
Q_{diff} = 0

@ Q_{10} = 68
allow d = 0.30
Q_{street} = 15 × 2 = 30 cfs
Q_{diff} = 68 − 30 = 38 cfs

If we intercept 38 cfs in storm drain on Sonora, 30 cfs will flow into Tesuque at a depth of 0.26 ft & velocity of 2 fps (for the 10 yr storm).

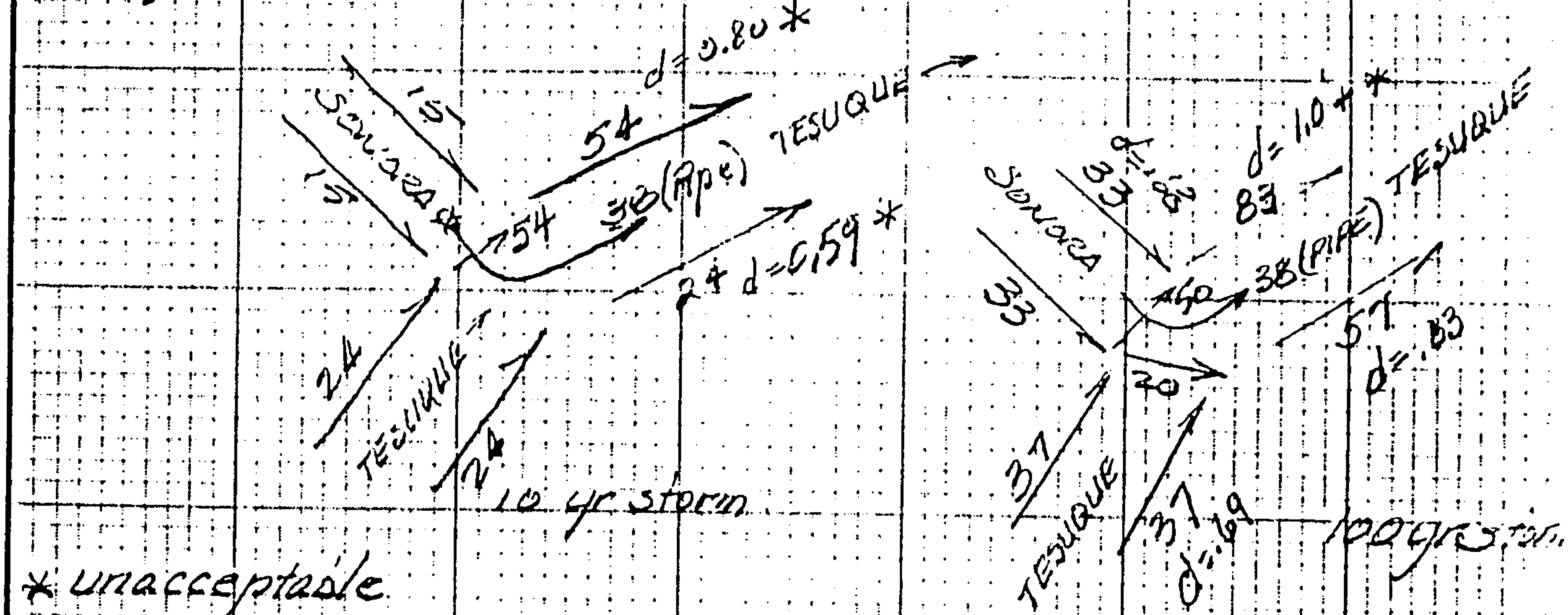
On Tesuque (upstream)

Q_{100} = 73
allow. d = 0.37
Q_{street} = 54 × 2 = 108

Q_{10} = 48
allow d = 0.30
Q_{street} = 14 × 2 = 28
Q_{diff} = 20 cfs

If we only intercept 38 cfs on Sonora, when the 100 yr event occurs, 103 − 38 = 65 cfs will by-pass the curb inlets & intersect Tesuque at d = 0.33 & V = 2.2 fps.
For the 73 cfs already on Tesuque, d = 0.34 & V = 2.3 fps
While the velocity head is quite low ($\frac{V^2}{2g}$ = 0.08), the [illegible]

depth of flow (0.33 + 0.50 = 0.83) will cause some flow over Tesuque to the east side of the street.



* unacceptable

BECAUSE OF THE MORE RESTRICTIVE criteria for d_{max}, the 10 yr storm is more critical.

Since the max. acceptable flow on each side of Tesuque for the 10 yr storm is 14 cfs (d = 0.50)

The intersection design could be improved by intercepting some of the flow on Tesuque upstream of the intersection. Try a DBL "C" INLET on each side - (OR MORE).

INLETS =

Senora:

$Q_A = \frac{38}{2} = 19$ CFS $\quad a = 0.25'$ (3")

Assume $y = 0.68$ (from DPM, Ch 22, p 70)

From BPR 1073.01, $Q_A/L_A = 0.68$

$L_A = \frac{Q_A}{Q_A/L_A} = \frac{19}{0.68} = 27.9$

For DBL "C" INLET, $L = 7.42$; $\frac{L}{L_A} = \frac{7.42}{27.9} = 0.27$

$a/y = 0.25/0.68 = 0.37$

$Q/Q_A = 0.43$

→ $Q_{INTERCEPT} = 0.43(19) = 8$ CFS

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JOB SAD 219
SUBJECT Tesuque-Mariposa S.D.
JOB NO.
SHEET 3 OF
BY ZMG
DATE 2-1-90
CHECKED
DATE

$Q_{CARRYOVER} = 19 - 8 = 11$ CFS $= Q_{A2}$ $a = 0.25$

$y = 0.47$ ft

$Q_{A2}/L_{A2} = 0.40$

$L_{A2} = \frac{11}{0.40} = 27.5$

DBL "C" INLET, $L = 7.42$ & $\frac{L}{L_{A2}} = \frac{7.42}{27.5} = 0.27$

$a/y = 0.25/0.47 = 0.53$

$Q/Q_{A2} = 0.41$

→ $Q_{I2} = 0.41(11)$ 4.5 CFS

& $Q_{CARRYOVER} = 11 - 4.5 = 6.5$ CFS $= Q_{A3}$ $a = 0.25$

$y = 0.41$

$Q_{A3}/L_{A3} = 0.34$

$L_{A3} = \frac{6.5}{0.34} = 19.1$

DBL "C" INLET $L = 7.42$ & $\frac{L}{L_{A3}} = \frac{7.42}{19.1} = 0.39$

$a/y = 0.25/0.41 = 0.61$

$Q/Q_{A3} = 0.55$

→ $Q_{I3} = 0.55(6.5) = 3.6$ CFS

& $Q_{CARRYOVER} = 6.5 - 3.6 = 2.9 \approx 3$ CFS

SONORA (SUMMARY)

PROVIDE 3 EA DBL "C" INLETS - each side - locate as near as possible to intersection & try to discharge into the new MH 10' RT of intersection lines.

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JOB SAD 219
SUBJECT Tesuque-Mariposa S.D.
JOB NO. ____ SHEET 1 OF ____
BY DMG DATE 2-1-90
CHECKED ____ DATE ____

Tesuque - Upstream -

T-4

$Q_{A1} = \frac{48}{2} = 24$ CFS $a = 0.25'$ (3")

$y = 0.59$

$Q_A/L_A = 0.53$

$L_A = \frac{Q_A}{Q_A/L_A} = \frac{24}{0.53} = 45.3$

DBL "C", $L = 7.42$ $\frac{L}{L_A} = \frac{7.42}{45.3} = 0.16$

$a/y = \frac{0.25}{0.59} = 0.42$

$Q/Q_A = 0.26$

→ $Q_{I1} = 0.26 (24) = 6.2$ CFS

$Q_{c/o} = 24 - 6.2 = 17.8 = Q_{A2}$ $a = 0.25$

$y = 0.54$

$Q_{A2}/L_{A2} = 0.47$

$L_{A2} = \frac{Q_{A2}}{Q_{A2}/L_{A2}} = \frac{17.8}{0.47} = 37.9$

DBL "C" $L = 7.42$ $\frac{L}{L_{A2}} = \frac{7.42}{37.9} = 0.20$

$a/y = \frac{0.25}{0.54} = 0.46$

$Q/Q_{A2} = 0.33$

→ $Q_{I2} = 0.33 (17.8) = 5.9$ CFS

$Q_{c/o} = 17.8 - 5.9 = 11.9 = Q_{A3}$ $a = 0.25$

$y = 0.48$

$Q_{A3}/L_{A3} = 0.42$

$L_{A3} = \frac{11.9}{0.42} = 28.3$ | $L = 7.42$, $\frac{L}{L_{A3}} = \frac{7.42}{28.3} = 0.26$

$a/y = 0.25/0.48 = 0.52$ | $Q/Q_{A3} = 0.4$

→ $Q_{I3} = 0.4 (11.9) = 4.8$ $Q_{c/o} = 11.9 - 4.8 = 7.1 \approx 7$ CFS

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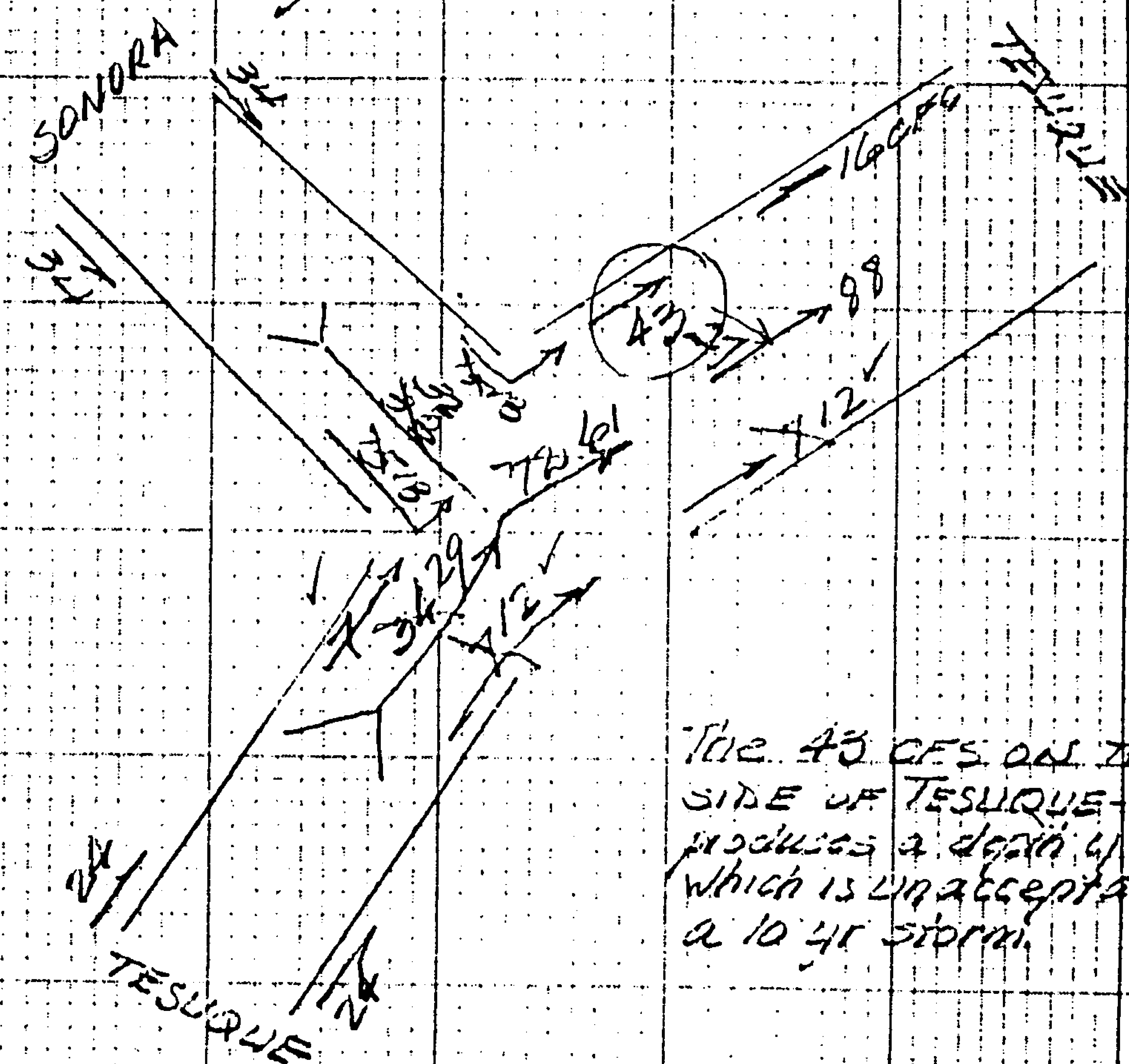
JOB SAD 219
SUBJECT Tesuque-Mariposa S.D.
JOB NO. ______ SHEET 5 OF ___
BY ZMG DATE 2-2-??
CHECKED ______ DATE ______

Interim Summary



The 43 CFS ON THE WEST SIDE OF TESUQUE-DOWNSTREAM produces a depth y of 0.72' which is unacceptable for a 10 yr storm.

Tesuque - downstream (T-D) -

To reduce y from 0.72 to 0.50' (criteria) flow must be reduced from 43 CFS to 14 CFS. However, flow on the East side of the street can be increased from 7 CFS to 14 CFS & stay w/i allowable. Eliminating one DBL "C" inlet upstream on east side of street will approximately accomplish this.

Investigate a bank of DBL "C" inlets on West side of Tesuque

$Q_{A_1} = 43$ CFS $\qquad a = .25'$

$y = 0.72 \qquad Q_{A_1}/L_{A_1} = 0.65$

$L_{A_1} = \frac{43}{0.65} = 66.2$

dmg D. MARK GOODWIN & ASSOC.
CONSULTING ENGINEERS

JOB SAD 219
SUBJECT Tesuque - Mariposa S.D.
JOB NO. ____ SHEET 6 OF ____
BY ZMG DATE 2-2-90
CHECKED ____ DATE ____

$L = 7.42 \quad \frac{L}{L_{A_1}} = \frac{7.42}{66.2} = 0.11$

$a/y = 0.25/0.72 = 0.35 \quad \frac{Q_i}{Q_A} = 0.18$

→ $Q_{I_1} = 0.18(43) = \underline{8\ CFS} \quad Q_{A_2} = 43 - 8 = 37\ CFS$

$y_2 = 0.68 \quad Q_{A_2}/L_{A_2} = 0.61$

$L_{A_2} = \frac{37}{.61} \quad 60.7$

$\frac{L}{L_{A_2}} = \frac{7.42}{60.7} = 0.12 \quad \Big| \quad \frac{a}{y} = \frac{0.25}{0.68} = 0.37 \quad \Big| \quad \frac{Q_i}{Q_{A_2}} = 0.20$

→ $Q_{I_2} = 0.20(37) = \underline{7\ CFS} \quad Q_{A_3} = 37 - 7 = 30\ CFS$

$y_3 = 0.63 \quad Q_{A_3}/L_{A_3} = 0.55$

$L_{A_3} = \frac{30}{0.55} = 54.5 \quad \frac{L}{L_{A_3}} = \frac{7.42}{54.5} = 0.14 \quad \frac{a}{y} = \frac{0.25}{0.63} = 0.40$

$\frac{Q_i}{Q_{A_3}} = 0.26$

→ $Q_{I_3} = 0.26(30) = 8\ CFS$

$Q_{A_4} = 30 - 8 = 22\ CFS \quad y_4 = 0.58 \quad Q_{A_4}/L_{A_4} = 0.50$

$L_{A_4} = \frac{22}{0.50} = 44.0 \quad \frac{L}{L_{A_4}} = \frac{7.42}{44.0} = 0.17 \quad \frac{a}{y} = \frac{.25}{0.58} = 0.43$

$\frac{Q_i}{Q_{A_4}} = .28$

→ $Q_{I_4} = .28(22) = 6\ CFS$ ∴ $Q_{c/o} = 22 - 6 = \underline{16\ CFS}$

PROVIDE 4 DBL "C" INLETS ON W SIDE TESUQUE, DOWNSTREAM OF SONORA.

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JOB SAD 319
SUBJECT Tesuque-Mariposa S.D.
JOB NO. ______ SHEET 2 OF ____
BY ZMG DATE 2-2-90
CHECKED ______ DATE ______

Laterals.

Sonora

3-EA DBL "C" INLETS, EA SIDE, Q = 16 CFS EA SIDE

Curb Face = 10" = 0.33'

Curb = 5176.02 HGL = 5172.89 L_L = 68

L_R = 65

H = (5176.02 - 1.33) - 5172.89

H = 1.80

See DPM, Chap. 22, p. 78 -

$D_L = D_R = 24"$

Velocity $= \frac{Q}{A} = \frac{16}{3.14} = 5.09$ fps ✓

$V = CF + 0.5 + 1.2 \frac{v^2}{2g} + d$

$= 0.83 + 0.5 + 1.2 \frac{(5.09)^2}{2g} + 2 = 3.33 + 0.48$

V = 3.81'

Invert = 5176.02 - 3.81 = 5172.21

Tesuque - Upstream of Sonora

3 EA DBL "C" INLETS - WEST SIDE (LEFT) Q = 17 CFS
2 EA DBL "C" INLETS - East SIDE (RIGHT) Q = 12 CFS

Curb face = 0.83'

Curb (L&R) = 5174.75 HGL = 5171.29 L_L = 56
L_R = 49

H(L&R) = (5174.75 - 1.33) - 5171.29

H = 2.13

from DPM, Ch. 2, p. 78

D_L = 24" D_R = 18"

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SUBJECT Tesuque - 4OF(DOSS) S.D.
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$v_L = \frac{Q_L}{A_L} = \frac{17}{3.14} = 5.4$ fps

$v_R = \frac{12}{1.77} = 6.8$ fps

$V_L = 0.33 + 0.50 + \frac{1.2(5.4)^2}{2g} + 2 = 3.33 + 0.54$

$V_L = 3.87'$

$Inv_L = 5174.75 - 3.87 = 5170.88$

$V_R = 0.83 + 0.50 + \frac{1.2(6.8)^2}{2g} + 1.5 = 2.83 + 0.86 = 3.69$

$Inv_R = 5174.75 - 3.69 = 5171.06$

TESUQUE - DOWNSTREAM OF SONORA (LEFT ONLY)

4 EA DBL "C" INLETS — Q = 27 cfs

Curb face = 0.83'

Curb = 5173.50 HGL = 5169.35 L = 40'

$H = (5173.50 - 1.33) - 5169.35 = 2.82$

from DPM, Ch. 2, p.73

D = 24" $v = \frac{27}{3.14} = 8.6$ fps

$V = 0.33 + 0.50 + \frac{1.2(8.6)^2}{2g} + 2 = 3.33 + 1.38 = 4.71$

$Inv = 5173.50 - 4.71 = 5168.79$

42" Storm Drain Outfall:

The 42" storm drain will have to terminate by discharging into the Mariposa Arroyo. The Mariposa 100 yr storm peak = 936 cfs but this peak will likely occur much later than the 83 cfs peak in the 42" S.D.

There appear to be 3 alternatives for discharging into the Mariposa from the Tesuque storm drain:

#1 Pass storm drain underneath the arroyo & turn downstream along the East bank to a suitable elevation for turning the storm drain into the channel.

#2 Route storm drain along West bank of the arroyo to a suitable elevation for turning into the channel.

#3 Construct a drop structure along the downstream edge of the concrete dip section where the arroyo crosses Tesuque Dr. Set the bottom of the drop section to permit constructing the storm drain invert in the concrete retaining wall forming the drop structure. Excavate the arroyo downstream to a suitable daylight.

Alt #1 did not prove to be practical because the excessive depth required to get underneath the dip section would have required a very long run of 48" RCP to get to a suitable discharge point downstream.

Alt #2 proved to be too expensive since the storm drain excavation along the West bank of the channel would require shoring full length to protect the home owners walls that run along the boundary of the drainage easement.

Alt #3 proved to be the most practical alternative. Backwater calculations were run using HEC-2 software. A 30 ft excavated channel bottom width was selected, with 3:1 side slopes. The slope of the channel bottom to daylight ≈ 2%.

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Rip-Rap @ S.D. outlet:

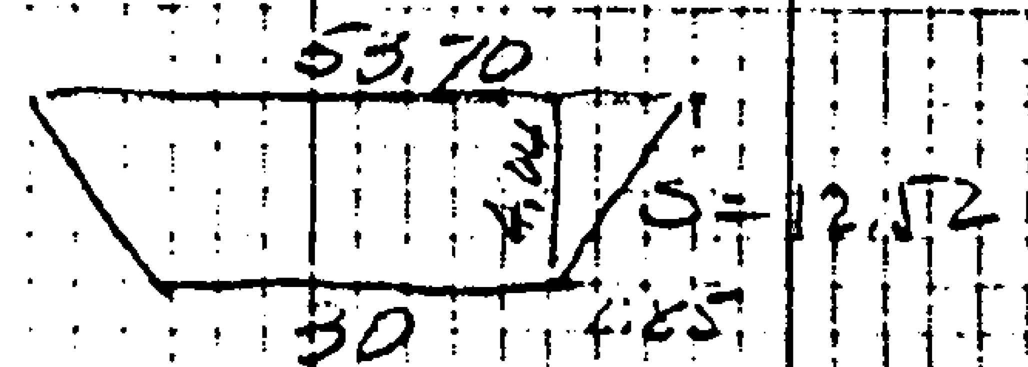
Rip-rap size:

Compute $V^2/R^{0.33}$

From HEC-2 run, V @ Sec 6 = 5.32 fps (V of Q_{100} in channel –

$A = 169$ sf

R:



WP = 55.04

$R = A/WP = 169/55.04 = 3.07$

$V^2/R^{0.33} = \frac{28.30}{1.45} = 19.5$

Use Type L rip-rap, $K_m = 9"$

Bedding, use 4" Type I & 4" Type II

Length, "L" of channel protection –

$L = f_c\left[\frac{A_t}{y_t} - W\right]$

L = Length of protection –

f_c = expansion factor (See Simons & Li fig. 5-6)

$A_t = Q/V$, where Q = design discharge, Storm Drain
V = Allowable non-eroding velocity in d.s. channel (use V = 5.5 fps)

Y_t = tailwater depth

W = diameter of storm drain –

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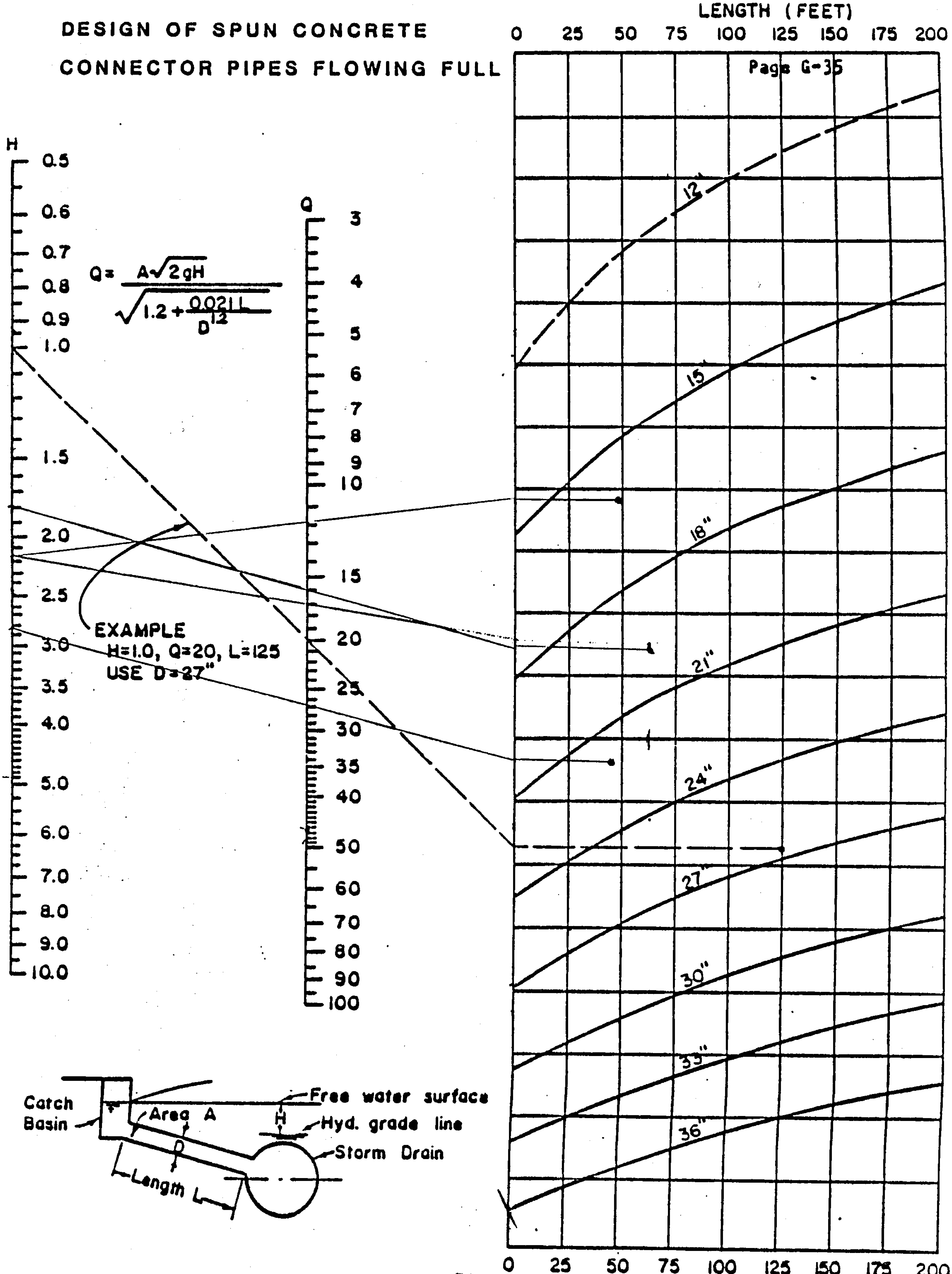
$y_t \approx 3.0$, $\frac{y_t}{D} = \frac{35}{42} = 0.8$, ∴ from Simons & Li, $f_c = 6.7$

$A_t = \frac{Q}{V} = \frac{88}{5.5} = 16$

$L = 6.7\left[\frac{16}{3} - 3.5\right] = 12$, use 25'

DESIGN OF SPUN CONCRETE CONNECTOR PIPES FLOWING FULL



JOB DESCR: TESUQUE MARIPOSA S.D.
RUN DATE :02-02-1990

STORM SEWER - HYDRAULIC ANALYSIS - FILE: MARITES4.STM

RAINFALL LOCATION: SOMEWHERE UNITED STATES
RETURN PERIOD = 10 YRS

LINE 1 / DFQ = 88.0 / HT = 42 / WID = 42 / N = .015 / L = 38 / JLC = 1

OUTFALL

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	5151.45	35.38	5148.50	10.18	5153.06	30.61	35.38	8.65
UPSTRM	5152.10	41.17	5148.67	9.19	5153.41	11.67	35.38	9.58

DA = 0 C = 0 Tc = 3.5 INL TM = 0 INT = 7.59 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 0.447 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

LINE 2 / DFQ = 88.0 / HT = 42 / WID = 42 / N = .015 / L = 288 / JLC = 1

DNLN = 1

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	5153.41	42.00	5148.77	9.15	5154.71	0.00	35.38	9.62
UPSTRM	5157.50	35.46	5154.55	10.16	5159.11	30.47	35.38	8.66

DA = 0 C = 0 Tc = 2.6 INL TM = 0 INT = 7.93 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 2.007 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

LINE 3 / DFQ = 88.0 / HT = 42 / WID = 42 / N = .015 / L = 103.62 / JLC = 1

DNLN = 2

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	5159.11	42.00	5154.65	9.15	5160.41	0.00	35.38	9.62
UPSTRM	5160.16	42.00	5156.24	9.15	5161.46	0.00	35.38	9.62

DA = 0 C = 0 Tc = 2.2 INL TM = 0 INT = 8.06 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

LINE 4 / DFQ = 88.0 / HT = 42 / WID = 42 / N = .015 / L = 180.29 / JLC = 1

DNLN = 3

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	5161.46	42.00	5156.34	9.15	5162.76	0.00	35.38	9.62
UPSTRM	5163.30	42.00	5159.80	9.15	5164.60	0.00	35.38	9.62

DA = 0 C = 0 Tc = 1.6 INL TM = 0 INT = 8.3 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 1.919 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

LINE 5 / DFQ = 88.0 / HT = 42 / WID = 42 / N = .015 / L = 149.22 / JLC = 1

DNLN = 4

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	5164.60	42.00	5159.90	9.15	5165.90	0.00	35.38	9.62
UPSTRM	5165.90	38.31	5162.71	9.56	5167.32	23.77	35.38	9.21

DA = 0 C = 0 Tc = 1.1 INL TM = 0 INT = 8.51 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 1.883 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

LINE 6 / DFQ = 88.0 / HT = 42 / WID = 42 / N = .015 / L = 196.89 / JLC = 1

DNLN = 5

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	5167.32	42.00	5162.81	9.15	5168.62	0.00	35.38	9.62
UPSTRM	5169.35	35.46	5166.40	10.16	5170.96	30.47	35.38	8.66

DA = 0 C = 0 Tc = .5 INL TM = 0 INT = 8.81 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 1.823 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

LINE 7 / DFQ = 61.0 / HT = 42 / WID = 42 / N = .015 / L = 101.63 / JLC = 1

DNLN = 6

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	5170.96	42.00	5166.50	6.34	5171.58	0.00	29.74	9.62
UPSTRM	5171.29	35.53	5168.33	7.03	5172.06	30.32	29.74	8.68

DA = 0   C = 0   Tc = .1   INL TM = 0   INT = 8.97   TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT ,   REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 1.801 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

LINE 8 / DFQ = 32.0 / HT = 36 / WID = 36 / N = .015 / L = 50.37 / JLC = 1

DNLN = 7

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	5172.06	36.00	5168.53	4.53	5172.38	0.00	22.53	7.07
UPSTRM	5172.52	31.27	5169.54	4.91	5172.89	24.32	22.53	6.52

DA = 0   C = 0   Tc = 0   INL TM = 0   INT = 9.06   TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT ,   REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 2.006 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

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Plans - Sheet 87 -

The Jasmine - Sonora - Tesuque - Mariposa storm drain system has been redesign and the design analysis is attached. Flows originating in watersheds above the Jasmine / Sonora intersection which would be contained in Jasmine Street upstream of above Sonora have largely been intercepted to prevent crossing Sonora, flooding property on NE corner of intersection, and jumping across Tesuque Dr. into another watershed. These intercepted flows are carried down Sonora and joined to the Tesuque - Mariposa storm drain. At Sonora / Tesuque intersection, additional street flows are intercepted to (a) facilitate turning flows from Sonora around the corner and downstream on Tesuque, and (b) prevent street flooding on Tesuque. 100 yr flows in streets, inlets and storm drains are shown on attached design analysis.

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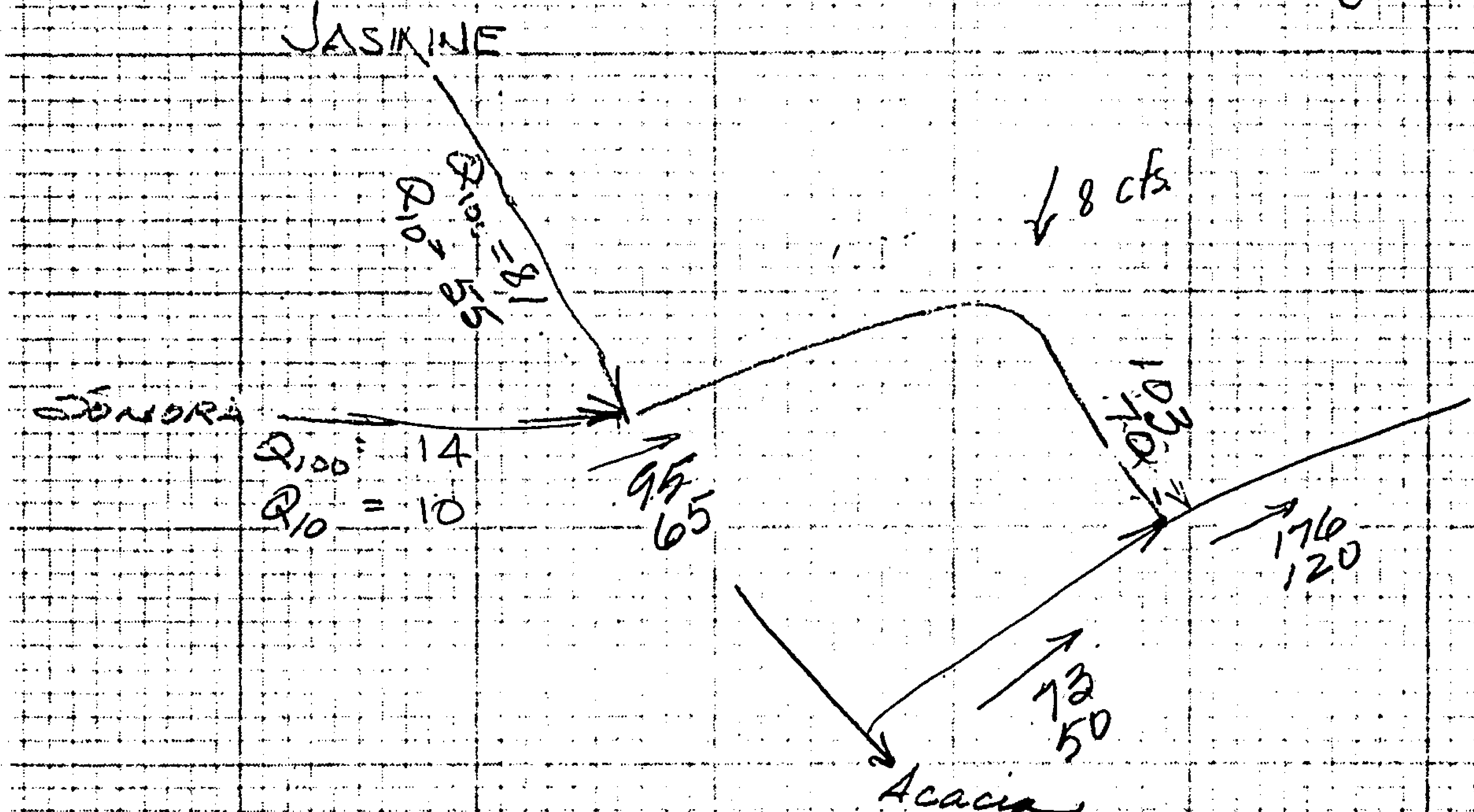
10 yr = 0.5
100 yr = 0.87



JASMINE = 6.36% RT, 7.01% LT ⟩ 32'

SONORA 2.38% 32'

JASMINE

		100 yr			10 yr	
Allow d_{100} = 0.87'	40 cfs	0.52	(R) ok	28	0.46	(R) ok
d_{10} = 0.50'	✓	✓ 0.50	(L) ok	28	0.45	(L) ok

			V	$V^2/2g$	$V^2/2g + d$
VELOCITY	40 cfs	(R)	9.9	1.52	2.04
		(L)	10.0	1.55	2.05

Jasmine
For both Q_{10} & Q_{100}, the flows will cross Sonora & continue downhill, some will turn on Sonora (unknown Q) some will continue on Jasmine & there is a good possibility of runup on to the handicap ramp on NE corner Jasmine & Sonora. One acceptable solution to this potential problem would be to intercept a significant amount (80-90%) of the flows on Jasmine before they reach the intersection.

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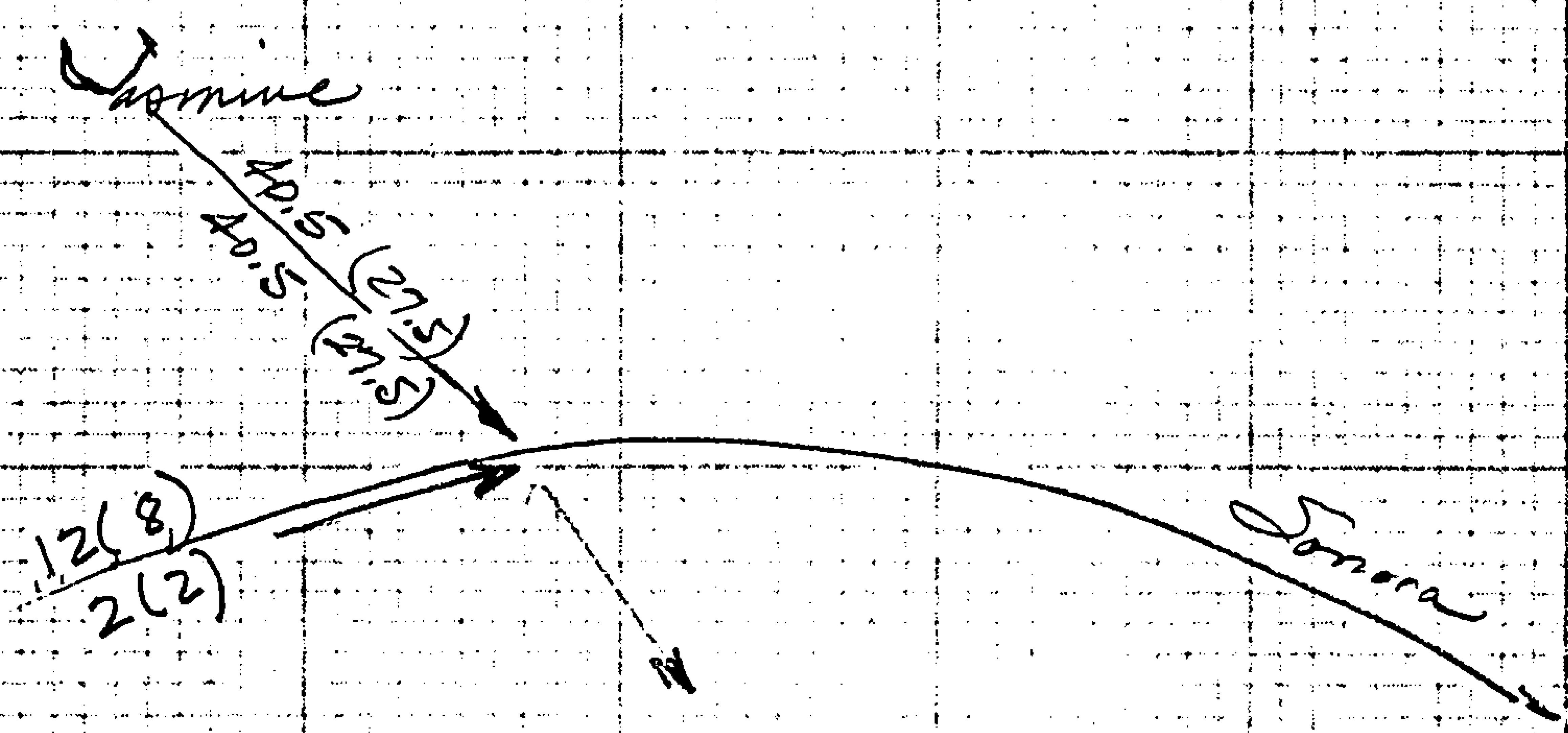

INLETS - JASMINE

$\frac{1}{2}$ street flows $Q_{100} = \frac{81}{2} = 40.5$

$a = 0.25'$

I: $y = 0.52$

$Q_A/L_A = 0.45 \quad L_A = \frac{40.5}{0.45} = 90$ & $\frac{L}{L_A} = \frac{7.42}{90} = 0.0824$

$\frac{a}{y} = \frac{0.25}{0.52} = 0.48$ & $Q/Q_A = 0.16$

$Q_I = 0.16(40.5) = 7$ cfs. $Q_{CARRYOVER} = 40.5 - 7 = 33.5$

II $y = 0.48$

$Q_A/L_A = 0.42 \quad L_A = \frac{33.5}{0.42} = 80$ & $\frac{L}{L_A} = \frac{7.42}{80} = 0.09$

$\frac{a}{y} = \frac{0.25}{0.48} = 0.52$ & $Q/Q_A = 0.17$

$Q_I = 0.17(33.5) = 6$ CFS $Q_{CARRYOVER} = 33.5 - 6 = 27.5$

III: $y = 0.46$

$Q_A/L_A = 0.38 \quad L_A = \frac{27.5}{0.38} = 72$ & $\frac{L}{L_A} = \frac{7.42}{72} = 0.10$

$\frac{a}{y} = \frac{0.25}{0.46} = 0.54$ & $Q/Q_A = 0.18$

$Q_I = 0.18(27.5) = 5$ CFS & $Q_{CARRYOVER} = 27.5 - 5 = 22$ CFS.

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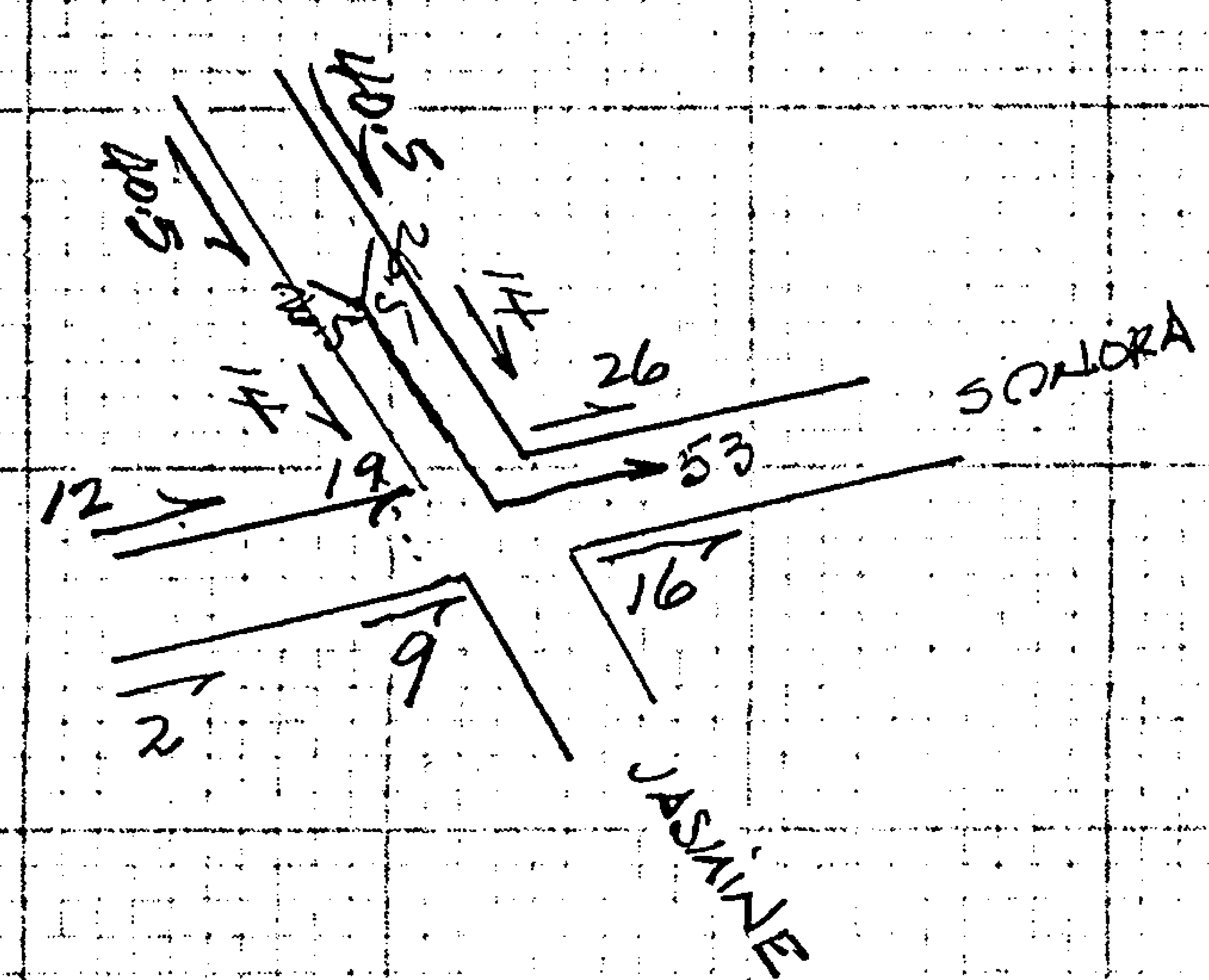
FOR 22 CFS, $d = 0.43$ & $v = 8$, $v^2/2g = 0.99$
& $d + \frac{v^2}{2g} = 1.42$ (unacceptable)

IV $y = 0.42$
$Q_A/L_A = 0.36$ $L_A = \frac{22}{0.36} = 61$ & $\frac{L}{L_A} = \frac{7.42}{61} = 0.12$
$\frac{a}{y} = \frac{0.25}{0.42} = 0.60$ & $Q/Q_A = 0.18$
$Q_I = 0.18(22) = 4$ CFS. $Q_{CARRYOVER} = 22 - 4 = 18$ CFS.
$d = 0.40$ & $v = 6$ FPS $v^2/2g = 0.6$

V $y = 0.40$
$Q_A/L_A = 0.33$ $L_A = \frac{18}{.33} = 55$ $\frac{L}{L_A} = \frac{7.42}{55} = 0.13$
$\frac{a}{y} = \frac{.25}{.40} = 0.63$ $Q/Q_A = 0.19$
$Q_I = 0.19(18) = 4$ CFS $Q_{CARRYOVER} = 18 - 4 = 14$ CFS
$d = 0.37$ $v = 6$ fps

PROVIDE 5 EA DBL "C" INLETS, EA SIDE — JASMINE



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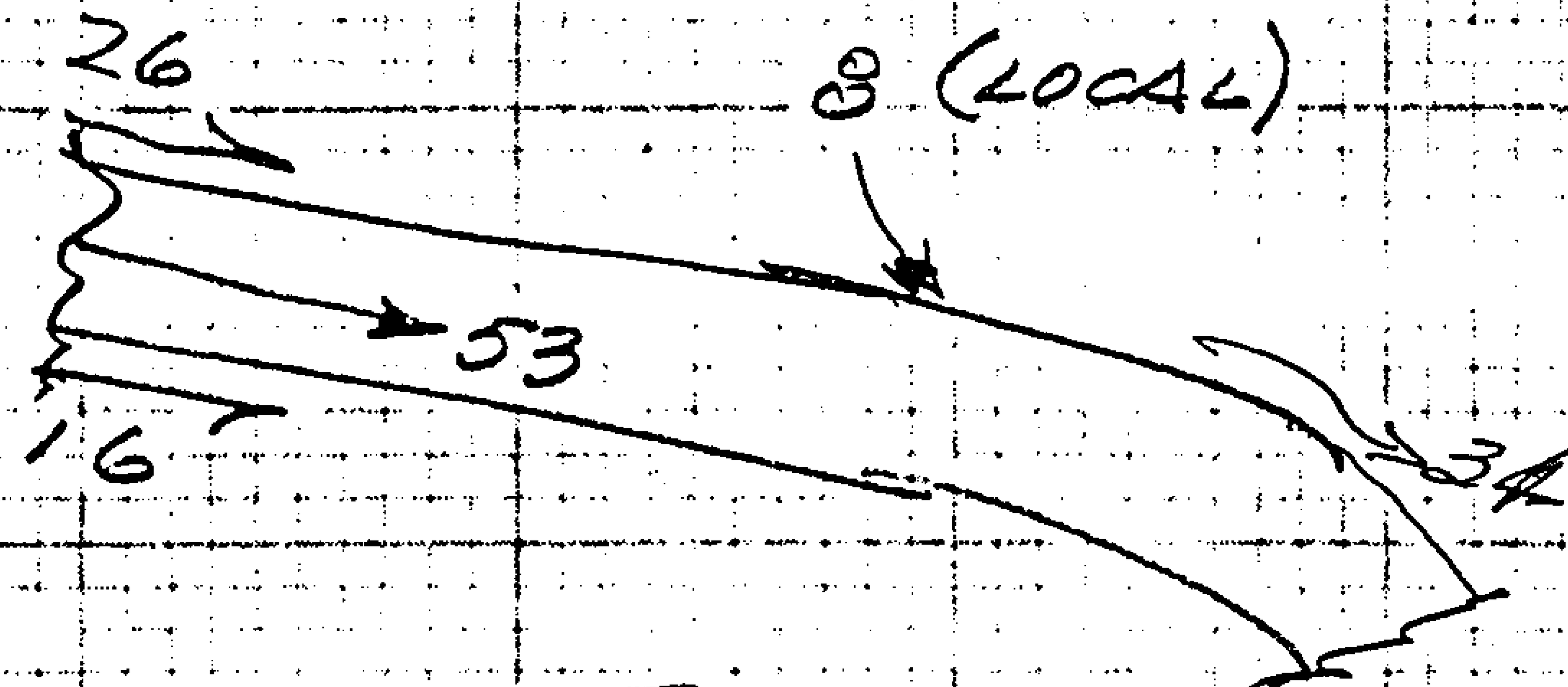
Sonora - downstream of Jasmine -



TO REDUCE FLOW ACROSS TESUQUE AT SONORA/TESUQUE INTERSECTION, IT WILL BE NECESSARY TO REDUCE FLOW IN THE LEFT FLOWLINE TO APPROX 15-17 CFS (REDUCE FROM 34 CFS) & IN THE RIGHT FLOWLINE TO APPROX 10-11 CFS (FROM 16 CFS).

@ 34 CFS (LEFT), $d = 0.68$, $v = 4.8$ FPS & $v^2/2g = 0.36$, $H = 1.04$ FT (AT TESUQUE)

TRY A SERIES OF DBL "C" INLETS: (LEFT FLOWLINE)

I. $Q = 34$, $a = 0.25$, $y = d = 0.68$

$Q_A/L_A = 0.65$ $L_A = \frac{34}{0.65} = 52$, $L/L_A = \frac{7.42}{52} = 0.14$

$\frac{a}{y} = \frac{.25}{.68} = 0.4$, $Q/Q_A = 0.28$

$Q_I = 0.28(34) = 10$ CFS $Q_C = 34 - 10 = 24$

$d = y = 0.59$ $v = 4.2$ $H = d + v^2/2g = 0.86$

II $Q = 24$, $y = 0.59$

$Q_A/L_A = 0.54$ $L_A = \frac{24}{.54} = 44$ $L/L_A = \frac{7.42}{44} = 0.17$

$\frac{a}{y} = 0.4$ $Q/Q_A = 0.29$

$Q_I = 0.29(24) = 7$ CFS $Q_C = 24 - 7 = 17$ CFS

$d = y = 0.52$, $v = 2.7$ $H = d + v^2/2g = 0.63$

when this small stream strikes the Tesuque flow crossing the intersection, most, if not all, of this flow will be readily diverted down the left flowline on Tesuque.

PROVIDE 2 EA DBL "C" INLETS IN L. FLOWLINE - SONORA

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SONORA (RIGHT FLOWLINE).

I. $Q = 16$ CFS $y = 0.52$

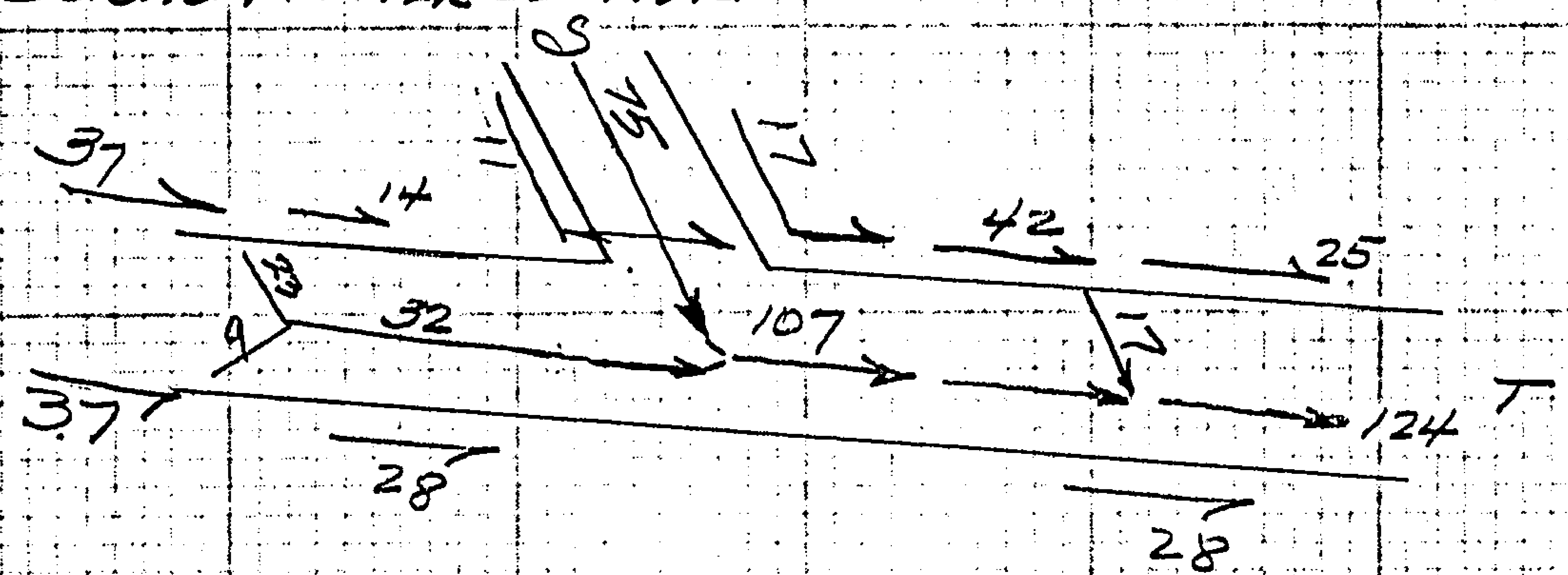
$Q_A/L_A = 0.44$ $L_A = \frac{16}{0.44} = 36$ $\frac{L}{L_A} = \frac{7.42}{36} = 0.21$

$a/y = 0.5$, $Q/Q_A = 0.34$

$Q_I = 0.34(16) = 5$ CFS $Q_C = 16 - 5 = 11$ CFS

PROVIDE 1 EA DBL "C" INLET IN RT. FLOWLINE - SONORA

TESUQUE / SONORA INTERSECTION



TESUQUE - UPSTREAM OF SONORA

$Q = 37$ $d = y = 0.70$ $v = 4.6$ $H = d + v^2/2g = 1.03$

I: $Q = 37$ CFS $y = 0.70$

$Q_A/L_A = 0.63$ $L_A = \frac{37}{0.63} = 59$ $\frac{L}{L_A} = \frac{7.42}{59} = 0.13$

$a/y = 0.36$ $Q/Q_A = 0.23$

$Q_I = 0.23(37) = 9$ CFS $Q_c = 37 - 9 = 28$

$d = 0.62$, $v = 4.1$ $H = d + v^2/2g = 0.88$

(SO - 1 - DBL "C" INLET ON E. SIDE WILL SUFFICE — HOWEVER, ON W. SIDE, IT IS OBVIOUS THAT ADDITIONAL INLETS WILL BE NEEDED TO PREVENT D.S. FLOODING FROM THE L. FLOWLINE).

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Tesuque – u.s. – cont –

II = $Q = 28$ $y = 0.62$

$Q_A/L_A = 0.54$ $L_A = \frac{28}{.54} = 52$ $\frac{L}{L_A} = \frac{7.42}{52} = 0.14$

$a/y = 0.40$ $Q/Q_A = 0.27$

$Q_I = .27(28) = 8$ CFS $Q_{CARRYOVER} = 28 - 8 = 20$

$d = 0.56$ $v = 2.6$ $v^2/2g = 0.20$ $H = 0.76$

III $Q = 20$ $y = 0.56$

$Q_A/L_A = 0.48$ $L_A = \frac{20}{.48} = 42$ $\frac{L}{L_A} = \frac{7.42}{42} = 0.18$

$a/y = \frac{.25}{.56} = 0.45$ $Q/Q_A = 0.32$

$Q_I = .32(20) = 6$ CFS $Q_{CARRYOVER} = 20 - 6 = 14$ CFS

PROVIDE 3 EA DBL "C" INLETS - W. SIDE, S. OF INTERSECTION

Tesuque – d.s. – W. side

$Q = 42$ $d = 0.72$ $v = 4.8$ $v^2/2g = 0.36$ $H = 1.08$

I – $Q = 42$ $y = 0.72$

$Q_A/L_A = 0.66$ $L_A = \frac{42}{.66} = 63.6$ $L/L_A = \frac{7.42}{63.6} = 0.12$

$a/y = 0.35$ $Q/Q_A = 0.21$

$Q_I = 0.21(42) = 9$ CFS $Q_C = 42 - 9 = 33$

$d = 0.64$ $v = 4.3$ $v^2/2g = 0.29$ $H = 0.93$

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Tesuque – cont:

II $Q = 33$ $y = 0.64$

$Q_A/L_A = 0.57$ $L_A = \frac{33}{.57} = 57.9$ $\frac{L}{L_A} = \frac{7.42}{57.9} = \underline{0.13}$

$a/y = 0.4$ $Q/Q_A = 0.23$

$Q_I = 0.23(33) = 8$ CFS $Q_C = 33 - 8 = 25$

$d = 0.59$ $v = 3.9$ $v^2/2g = 0.24$ $H = 0.83$ ok

PROVIDE 2 EA DBL "C" INLETS – d.s. – W. side –

(8)

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JOB NO. ______ SHEET ___ OF ___
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LATERALS -

JASMINE - L & R   5 EA DBL "C" INLETS - EA SIDE

Q = 26.5 CFS L & R   CURB = 5194.50 LT

✓ = 5195.07 RT

HGL = 5190.39

L = 20 (L & R)

H_L = (5194.50 - 1.33) - 5190.39 = 2.78   8v

H_R = (5195.07 - 1.33) - 5190.39 = 3.35

→ $D_L = D_R$ = 24"

V_1 C.F. + 0.5 + $1.2 v^2/2g$ + D $v = \frac{Q}{A} = \frac{26.5}{\pi(1)^2}$ = 8.44 fps

V_1 0.83 + 0.5 + 1.33 + 2.0 = 4.66

Inv. (L) = 5194.50 - 4.66 = 5189.84

Inv. (R) = 5195.07 - 4.66 = 5190.41

SONORA -

L - 2 EA DBL "C" INLETS - Q = 17 CFS   L = 30

CURB = 5190.62

HGL = ~~5185.51~~ 5186.71

H = (5190.62 - 1.33) - ~~5185.51~~ 5186.71 = ~~3.78~~ 2.58

→ D = 18" ✓✓ $v = \frac{Q}{A} = \frac{17}{\pi(.75)^2} = \frac{17}{1.77}$ = 9.6

V = 0.83 + 0.5 + $\frac{9.6^2}{g}$ + 1.5 = 4.26

INV = 5190.62 - 4.26 = 5186.36

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CONSULTING ENGINEERS

JOB ______
SUBJECT ______
JOB NO. ______ SHEET ___ OF ___
BY ______ DATE ______
CHECKED ______ DATE ______

R: 1 EA DBL "C" INLET   Q = 5 CFS.
CURB = 5190.28
HGL = ~~5185.51~~ 5186.71

H = (5190.28 − 1.33) − ~~5185.51~~ 5186.71 = ~~3.44~~ 2.24

D = 18" (MIN. SIZE ALLOW.) $v = \frac{Q}{A} = \frac{5}{1.77} = 2.82$

$V = 1.33 + 1.5 + \frac{v^2}{2g} = 2.95$

INVERT = 5190.28 − 2.95 = **5187.33**

TESUQUE — UPSTREAM OF SONORA =

LEFT: 3 EA DBL "C" INLETS   Q = 23 CFS   L = 55
CURB = 5174.75
HGL = 5172.85 ✓

H = (5174.75 − 1.33) − 5172.85 = 0.57

→ D = 30" $v = \frac{Q}{A} = \frac{23}{\pi(1.25)^2} = \frac{23}{4.91} = 4.7$ FPS

$V = 1.33 + \frac{v^2}{2g} + 2.50 = 1.33 + 0.34 + 2.50 = 4.17$

→ INVERT = 5174.75 − 4.17 = **5170.58**

RIGHT: 1 EA DBL "C" INLET.   Q = 9 CFS   L = 50
CURB = 5174.75
HGL = 5172.85

H = (5174.75 − 1.33) − 5172.85 = 0.57

→ D = 24" $v = \frac{Q}{A} = \frac{9}{\pi(1)^2} = 2.9$ FPS

$V = 1.33 + \frac{v^2}{2g} + 2.00 = 3.33 + 0.13 = 3.46$

→ INVERT = 5174.75 − 3.46 = **5171.29**

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JOB
SUBJECT
JOB NO. SHEET OF
BY DATE
CHECKED DATE

TESUQUE – DOWNSTREAM OF SONORA – LEFT FLOWLINE

2 EA DBL "C" INLETS = $Q = 17$ CFS, $L = 40$

CURB = 5173.50

HGL = 5170.58

$H = (5173.50 - 1.33) - 5170.58 = 1.59'$

$D = 24"$ $v = \frac{Q}{A} = \frac{17}{\pi(1)^2} = 5.4$ FPS $v^2/2g = 0.45$

$\nabla = 1.33 + 0.45 + 2.0 = 3.78$

INVERT = 5173.50 − 3.78 = 5169.72

HYDRAULIC STUDY FOR

STORM DRAIN SYSTEM

JASMINE-SONORA-TESUQUE

MARIPOSA DRAIN

HYDRAULIC ANALYSIS

Run date: 05-04-1990
File: MARITES5.ST3

Return Period = 100 Yrs
Rainfall file: Not specified

LINE 1 / Q = 124.0 / HT = 48 / WID = 48 / N = .015 / L = 38 / JLC = 1.25

OUTFALL

	HGL	DEPTH	INVERT	VEL	EGL	T WID	COVER	AREA
DNSTRM	5151.91	40.86	5148.50	10.88	5153.74	34.15	4.00	11.40
UPSTRM	5152.54	46.49	5148.67	9.96	5154.08	16.76	4.00	12.45

Drainage area (ac) =	0	Slope of invert (%) =	0.447
Runoff coefficient =	0	Slope energy grade line (%) =	0.899
Time of conc (min) =	9	Critical depth (in) =	41
Inlet time (min) =	0	Req'd length curb inlet (ft) =	0.0
Intensity (in/hr) =	0.00	Req'd grate area (sf) =	0.0
Cumulative C*A =	0.0	Natural ground elev (ft) =	0
Flow contrib (cfs) =	124	Minimum cover (ft) =	4
Default Q (cfs) =	124	Depth at inlet opening (in) =	0
Line capac. (cfs) =	83.2		

LINE 2 / Q = 124.0 / HT = 48 / WID = 48 / N = .015 / L = 288 / JLC = 1

DNLN = 1

	HGL	DEPTH	INVERT	VEL	EGL	T WID	COVER	AREA
DNSTRM	5154.47	48.00	5148.77	9.87	5155.98	0.00	4.00	12.56
UPSTRM	5157.96	40.95	5154.55	10.86	5159.79	33.98	4.00	11.42

Drainage area (ac) =	0	Slope of invert (%) =	2.007
Runoff coefficient =	0	Slope energy grade line (%) =	1.323
Time of conc (min) =	7	Critical depth (in) =	41
Inlet time (min) =	0	Req'd length curb inlet (ft) =	0.0
Intensity (in/hr) =	0.00	Req'd grate area (sf) =	0.0
Cumulative C*A =	0.0	Natural ground elev (ft) =	0
Flow contrib (cfs) =	124	Minimum cover (ft) =	4
Default Q (cfs) =	124	Depth at inlet opening (in) =	0
Line capac. (cfs) =	176.4		

LINE 3 / Q = 124.0 / HT = 48 / WID = 48 / N = .015 / L = 103.62 / JLC = 1

DNLN = 2

	HGL	DEPTH	INVERT	VEL	EGL	T WID	COVER	AREA
DNSTRM	5159.79	48.00	5154.65	9.87	5161.31	0.00	4.00	12.56
UPSTRM	5160.82	48.00	5156.24	9.87	5162.33	0.00	4.00	12.57

Drainage area (ac) =	0	Slope of invert (%)	= 1.535
Runoff coefficient =	0	Slope energy grade line (%)	= 0.992
Time of conc (min) =	7	Critical depth (in)	= 41
Inlet time (min) =	0	Req'd length curb inlet (ft) =	0.0
Intensity (in/hr) =	0.00	Req'd grate area (sf) =	0.0
Cumulative C*A =	0.0	Natural ground elev (ft)	= 0
Flow contrib (cfs) =	124	Minimum cover (ft)	= 4
Default Q (cfs) =	124	Depth at inlet opening (in)	= 0
Line capac. (cfs) =	154.2		

LINE 4 / Q = 124.0 / HT = 48 / WID = 48 / N = .015 / L = 180.29 / JLC = 1

DNLN = 3

	HGL	DEPTH	INVERT	VEL	EGL	T WID	COVER	AREA
DNSTRM	5162.33	48.00	5156.34	9.87	5163.85	0.00	4.00	12.56
UPSTRM	5164.12	48.00	5159.80	9.87	5165.64	0.00	4.00	12.57

Drainage area (ac) =	0	Slope of invert (%)	= 1.919
Runoff coefficient =	0	Slope energy grade line (%)	= 0.992
Time of conc (min) =	6	Critical depth (in)	= 41
Inlet time (min) =	0	Req'd length curb inlet (ft) =	0.0
Intensity (in/hr) =	0.00	Req'd grate area (sf) =	0.0
Cumulative C*A =	0.0	Natural ground elev (ft)	= 0
Flow contrib (cfs) =	124	Minimum cover (ft)	= 4
Default Q (cfs) =	124	Depth at inlet opening (in)	= 0
Line capac. (cfs) =	172.5		

LINE 5 / Q = 124.0 / HT = 48 / WID = 48 / N = .015 / L = 149.22 / JLC = 1

DNLN = 4

	HGL	DEPTH	INVERT	VEL	EGL	T WID	COVER	AREA
DNSTRM	5165.64	48.00	5159.90	9.87	5167.15	0.00	4.00	12.56
UPSTRM	5167.12	48.00	5162.71	9.87	5168.63	0.00	4.00	12.57

Drainage area (ac) =	0	Slope of invert (%)	= 1.883
Runoff coefficient =	0	Slope energy grade line (%)	= 0.992
Time of conc (min) =	5	Critical depth (in)	= 41
Inlet time (min) =	0	Req'd length curb inlet (ft) =	0.0
Intensity (in/hr) =	0.00	Req'd grate area (sf) =	0.0
Cumulative C*A =	0.0	Natural ground elev (ft)	= 0
Flow contrib (cfs) =	124	Minimum cover (ft)	= 4
Default Q (cfs) =	124	Depth at inlet opening (in)	= 0
Line capac. (cfs) =	170.8		

LINE 6 / Q = 124.0 / HT = 48 / WID = 48 / N = .015 / L = 196.89 / JLC = 1

DNLN = 5

	HGL	DEPTH	INVERT	VEL	EGL	T WID	COVER	AREA
DNSTRM	5168.63	48.00	5162.81	9.87	5170.14	0.00	4.00	12.56
UPSTRM	5170.58	48.00	5166.40	9.87	5172.10	0.00	4.00	12.57

Drainage area (ac) =	0	Slope of invert (%)	= 1.823
Runoff coefficient =	0	Slope energy grade line (%)	= 0.992
Time of conc (min) =	4	Critical depth (in)	= 41
Inlet time (min) =	0	Req'd length curb inlet (ft) =	0.0
Intensity (in/hr) =	0.00	Req'd grate area (sf) =	0.0
Cumulative C*A =	0.0	Natural ground elev (ft)	= 0
Flow contrib (cfs) =	124	Minimum cover (ft)	= 4
Default Q (cfs) =	124	Depth at inlet opening (in)	= 0
Line capac. (cfs) =	168.1		

LINE 7 / Q = 107.0 / HT = 48 / WID = 48 / N = .015 / L = 101.63 / JLC = 1

DNLN = 6

	HGL	DEPTH	INVERT	VEL	EGL	T WID	COVER	AREA
DNSTRM	5172.10	48.00	5166.50	8.52	5173.22	0.00	4.00	12.56
UPSTRM	5172.85	48.00	5168.33	8.51	5173.97	0.00	4.00	12.57

Drainage area (ac)	= 0	Slope of invert (%)	= 1.801
Runoff coefficient	= 0	Slope energy grade line (%)	= 0.739
Time of conc (min)	= 3	Critical depth (in)	= 38
Inlet time (min)	= 0	Req'd length curb inlet (ft)	= 0.0
Intensity (in/hr)	= 0.00	Req'd grate area (sf)	= 0.0
Cumulative C*A	= 0.0	Natural ground elev (ft)	= 0
Flow contrib (cfs)	= 107	Minimum cover (ft)	= 4
Default Q (cfs)	= 107	Depth at inlet opening (in)	= 0
Line capac. (cfs)	= 167.1		

LINE 8 / Q = 75.0 / HT = 48 / WID = 48 / N = .015 / L = 115.37 / JLC = 1

DNLN = 7

	HGL	DEPTH	INVERT	VEL	EGL	T WID	COVER	AREA
DNSTRM	5173.97	48.00	5168.53	5.97	5174.53	0.00	4.00	12.56
UPSTRM	5174.39	48.00	5168.65	5.97	5174.94	0.00	4.00	12.57

Drainage area (ac)	= 0	Slope of invert (%)	= 0.104
Runoff coefficient	= 0	Slope energy grade line (%)	= 0.363
Time of conc (min)	= 2	Critical depth (in)	= 33
Inlet time (min)	= 0	Req'd length curb inlet (ft)	= 0.0
Intensity (in/hr)	= 0.00	Req'd grate area (sf)	= 0.0
Cumulative C*A	= 0.0	Natural ground elev (ft)	= 0
Flow contrib (cfs)	= 75	Minimum cover (ft)	= 4
Default Q (cfs)	= 75	Depth at inlet opening (in)	= 0
Line capac. (cfs)	= 40.2		

LINE 9 / Q = 75.0 / HT = 36 / WID = 36 / N = .015 / L = 95 / JLC = 1

DNLN = 8

	HGL	DEPTH	INVERT	VEL	EGL	T WID	COVER	AREA
DNSTRM	5174.94	36.00	5168.75	10.61	5176.69	0.00	4.00	7.07
UPSTRM	5176.55	36.00	5173.38	10.61	5178.29	0.00	4.00	7.07

Drainage area (ac)	= 0	Slope of invert (%)	= 4.874
Runoff coefficient	= 0	Slope energy grade line (%)	= 1.684
Time of conc (min)	= 2	Critical depth (in)	= 33
Inlet time (min)	= 0	Req'd length curb inlet (ft)	= 0.0
Intensity (in/hr)	= 0.00	Req'd grate area (sf)	= 0.0
Cumulative C*A	= 0.0	Natural ground elev (ft)	= 0
Flow contrib (cfs)	= 75	Minimum cover (ft)	= 4
Default Q (cfs)	= 75	Depth at inlet opening (in)	= 0
Line capac. (cfs)	= 127.6		

LINE 10 / Q = 75.0 / HT = 36 / WID = 36 / N = .015 / L = 48 / JLC = 1

DNLN = 9

	HGL	DEPTH	INVERT	VEL	EGL	T WID	COVER	AREA
DNSTRM	5178.29	36.00	5173.48	10.61	5180.04	0.00	4.00	7.07
UPSTRM	5179.10	36.00	5175.26	10.61	5180.85	0.00	4.00	7.07

Drainage area (ac)	= 0	Slope of invert (%)	= 3.708
Runoff coefficient	= 0	Slope energy grade line (%)	= 1.684
Time of conc (min)	= 2	Critical depth (in)	= 33
Inlet time (min)	= 0	Req'd length curb inlet (ft)	= 0.0
Intensity (in/hr)	= 0.00	Req'd grate area (sf)	= 0.0
Cumulative C*A	= 0.0	Natural ground elev (ft)	= 0
Flow contrib (cfs)	= 75	Minimum cover (ft)	= 4
Default Q (cfs)	= 75	Depth at inlet opening (in)	= 0
Line capac. (cfs)	= 111.3		

LINE 11 / Q = 75.0 / HT = 36 / WID = 36 / N = .015 / L = 50 / JLC = 1

DNLN = 10

	HGL	DEPTH	INVERT	VEL	EGL	T WID	COVER	AREA
DNSTRM	5180.85	36.00	5175.36	10.61	5182.60	0.00	4.00	7.07
UPSTRM	5181.69	36.00	5177.22	10.61	5183.44	0.00	4.00	7.07

Drainage area (ac)	= 0	Slope of invert (%)	= 3.721
Runoff coefficient	= 0	Slope energy grade line (%)	= 1.684
Time of conc (min)	= 1	Critical depth (in)	= 33
Inlet time (min)	= 0	Req'd length curb inlet (ft)	= 0.0
Intensity (in/hr)	= 0.00	Req'd grate area (sf)	= 0.0
Cumulative C*A	= 0.0	Natural ground elev (ft)	= 0
Flow contrib (cfs)	= 75	Minimum cover (ft)	= 4
Default Q (cfs)	= 75	Depth at inlet opening (in)	= 0
Line capac. (cfs)	= 111.5		

LINE 12 / Q = 75.0 / HT = 36 / WID = 36 / N = .015 / L = 90 / JLC = 1

DNLN = 11

	HGL	DEPTH	INVERT	VEL	EGL	T WID	COVER	AREA
DNSTRM	5183.44	36.00	5177.32	10.61	5185.19	0.00	4.00	7.07
UPSTRM	5184.96	36.00	5180.75	10.61	5186.71	0.00	4.00	7.07

Drainage area (ac)	= 0	Slope of invert (%)	= 3.811
Runoff coefficient	= 0	Slope energy grade line (%)	= 1.684
Time of conc (min)	= 1	Critical depth (in)	= 33
Inlet time (min)	= 0	Req'd length curb inlet (ft)	= 0.0
Intensity (in/hr)	= 0.00	Req'd grate area (sf)	= 0.0
Cumulative C*A	= 0.0	Natural ground elev (ft)	= 0
Flow contrib (cfs)	= 75	Minimum cover (ft)	= 4
Default Q (cfs)	= 75	Depth at inlet opening (in)	= 0
Line capac. (cfs)	= 112.8		

LINE 13 / Q = 53.0 / HT = 36 / WID = 36 / N = .015 / L = 90 / JLC = 1

DNLN = 12

	HGL	DEPTH	INVERT	VEL	EGL	T WID	COVER	AREA
DNSTRM	5186.71	36.00	5180.85	7.50	5187.53	0.00	4.00	7.07
UPSTRM	5187.46	36.00	5184.28	7.50	5188.34	0.00	4.00	7.07

Drainage area (ac)	= 0	Slope of invert (%)	= 3.811
Runoff coefficient	= 0	Slope energy grade line (%)	= 0.841
Time of conc (min)	= 0	Critical depth (in)	= 29
Inlet time (min)	= 0	Req'd length curb inlet (ft)	= 0.0
Intensity (in/hr)	= 0.00	Req'd grate area (sf)	= 0.0
Cumulative C*A	= 0.0	Natural ground elev (ft)	= 0
Flow contrib (cfs)	= 53	Minimum cover (ft)	= 4
Default Q (cfs)	= 53	Depth at inlet opening (in)	= 0
Line capac. (cfs)	= 112.8		

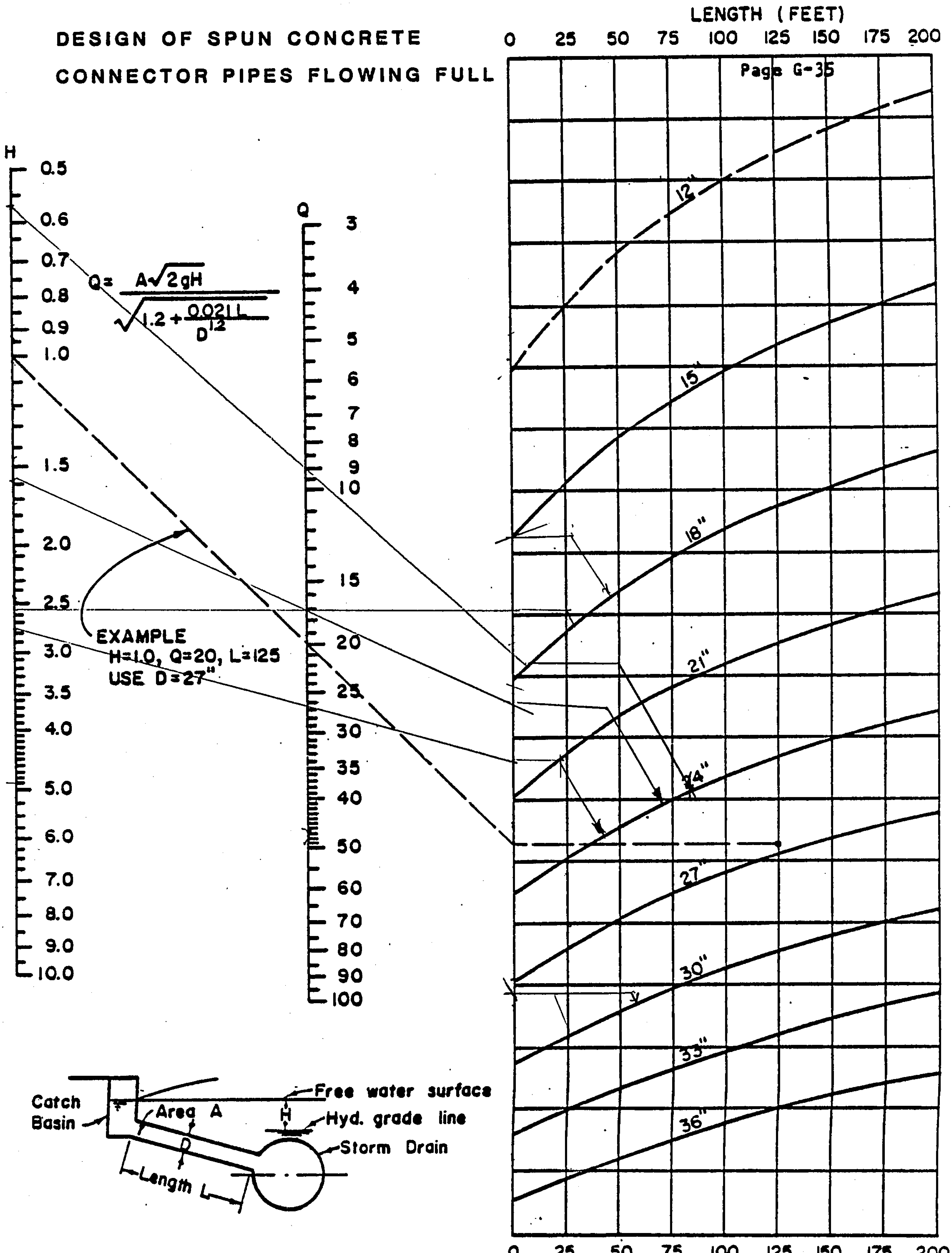
LINE 14 / Q = 53.0 / HT = 36 / WID = 36 / N = .015 / L = 63 / JLC = 1

DNLN = 13

	HGL	DEPTH	INVERT	VEL	EGL	T WID	COVER	AREA
DNSTRM	5188.34	36.00	5184.38	7.50	5189.21	0.00	4.00	7.07
UPSTRM	5190.39	29.33	5186.80	8.58	5191.54	27.90	4.00	6.18

Drainage area (ac)	= 0	Slope of invert (%)	= 3.841
Runoff coefficient	= 0	Slope energy grade line (%)	= 1.875
Time of conc (min)	= 0	Critical depth (in)	= 29
Inlet time (min)	= 0	Req'd length curb inlet (ft)	= 0.0
Intensity (in/hr)	= 0.00	Req'd grate area (sf)	= 0.0
Cumulative C*A	= 0.0	Natural ground elev (ft)	= 0
Flow contrib (cfs)	= 53	Minimum cover (ft)	= 4
Default Q (cfs)	= 53	Depth at inlet opening (in)	= 0
Line capac. (cfs)	= 113.3		

DESIGN OF SPUN CONCRETE CONNECTOR PIPES FLOWING FULL



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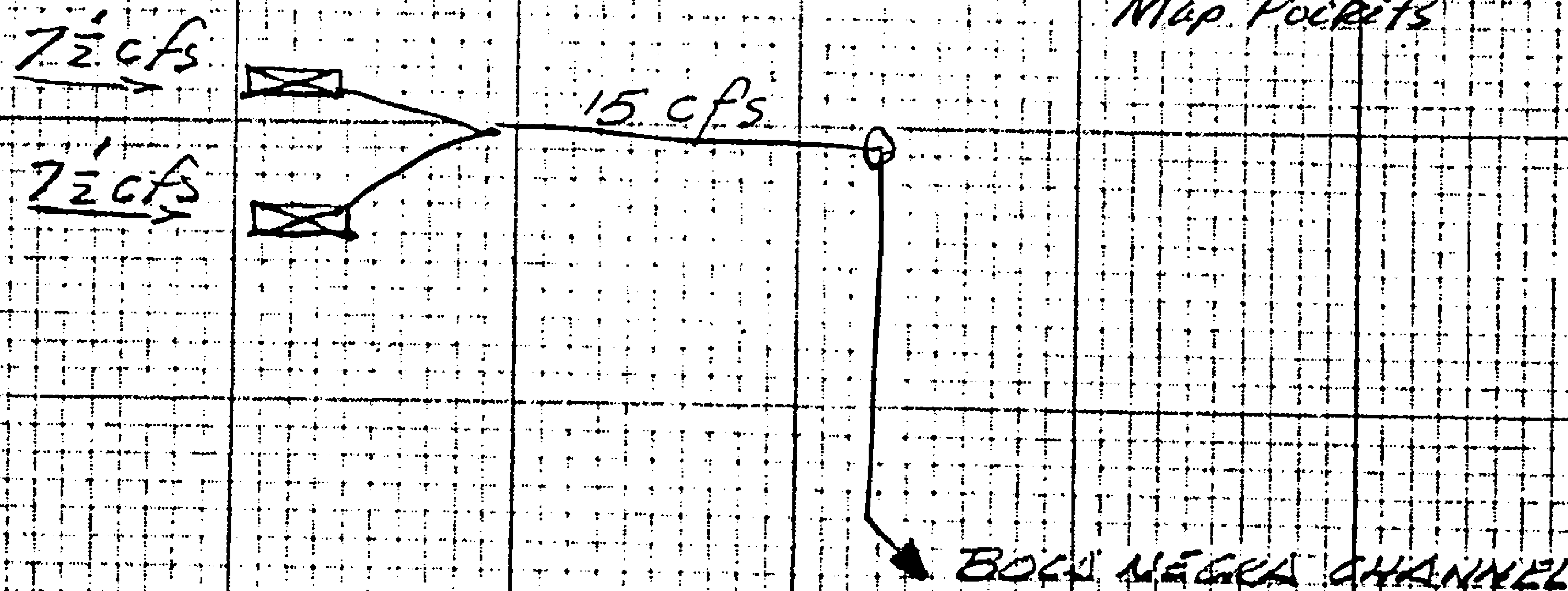
JOB SAD 219 - Mojave-South
SUBJECT Storm Drain
JOB NO. ______ SHEET 1 OF ___
BY ZMG DATE 11-27-89
CHECKED ______ DATE ______

Street drainage = 15 cfs

See Sheet 1 of 9 Map Pockets



Since drop inlets w/b located at a low point, use criteria for grated inlets in a sump -

Try Single "C" inlets -

Perimeter under flow = 4' + 2(2.5) = 9.0'

$P = \frac{9}{2} = 4.5'$

Each side: $\frac{Q}{P} = \frac{7.5}{4.5} = 1.67$ cfs/ft

Head H at inlet $= \left(\frac{Q/P}{3}\right)^{\frac{2}{3}} = \left(\frac{1.67}{3}\right)^{\frac{2}{3}} = 0.68$ ft OK

use Single "C"'s

Connector pipes at inlets: (Single "C" inlets)

Q = 7.5 cfs; H.G. = 5144.41 Curb = 5147.95 L = 35' (W)
L = 20' (E)

H = (5147.95 - 1.33) - 5144.41 = 2.21'

D(W) = 18" (City minimum)

D(E) = 18"

V = 3.15' Invert = FL - 3.15 = 5147.28 - 3.15 = 5144.13

JOB DESCR: MOJAVES
RUN DATE :11-27-1989

STORM SEWER - HYDRAULIC ANALYSIS - FILE: MOJAVES.STM

RAINFALL LOCATION: SOMEWHERE UNITED STATES
RETURN PERIOD = 100 YRS

LINE 1 / DFQ = 15.0 / HT = 24 / WID = 24 / N = .015 / L = 40 / JLC = 1

OUTFALL

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	5137.16	24.00	5136.74	4.78	5139.51	0.00	16.99	3.14
UPSTRM	5139.39	24.00	5137.14	4.77	5139.74	0.00	16.99	3.14

DA = 0 C = 0 Tc = 1.8 INL TM = 0 INT = 10.97 TOT CA = 0
REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT
SLOPE OF INVERT = 1.000 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

LINE 2 / DFQ = 15.0 / HT = 24 / WID = 24 / N = .015 / L = 310 / JLC = 1

DNLN = 1

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	5139.74	24.00	5137.34	4.78	5140.10	0.00	16.99	3.14
UPSTRM	5141.70	17.00	5140.28	6.28	5142.31	21.77	16.99	2.39

DA = 0 C = 0 Tc = .8 INL TM = 0 INT = 11.47 TOT CA = 0
REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT
SLOPE OF INVERT = 0.948 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

LINE 3 / DFQ = 15.0 / HT = 24 / WID = 24 / N = .015 / L = 163 / JLC = 1

DNLN = 2

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	5142.31	22.01	5140.48	4.95	5142.69	12.88	16.99	3.03
UPSTRM	5143.14	22.13	5141.30	4.95	5143.52	12.88	16.99	3.03

DA = 0 C = 0 Tc = .3 INL TM = 0 INT = 11.76 TOT CA = 0
REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT
SLOPE OF INVERT = 0.503 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

LINE 4 / DFQ = 15.0 / HT = 24 / WID = 24 / N = .015 / L = 91 / JLC = 1

DNLN = 3

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	5143.52	24.00	5141.50	4.78	5143.88	0.00	16.99	3.14
UPSTRM	5144.41	24.00	5141.95	4.77	5144.77	0.00	16.99	3.14

DA = 0 C = 0 Tc = 0 INL TM = 0 INT = 11.93 TOT CA = 0
REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT
SLOPE OF INVERT = 0.495 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

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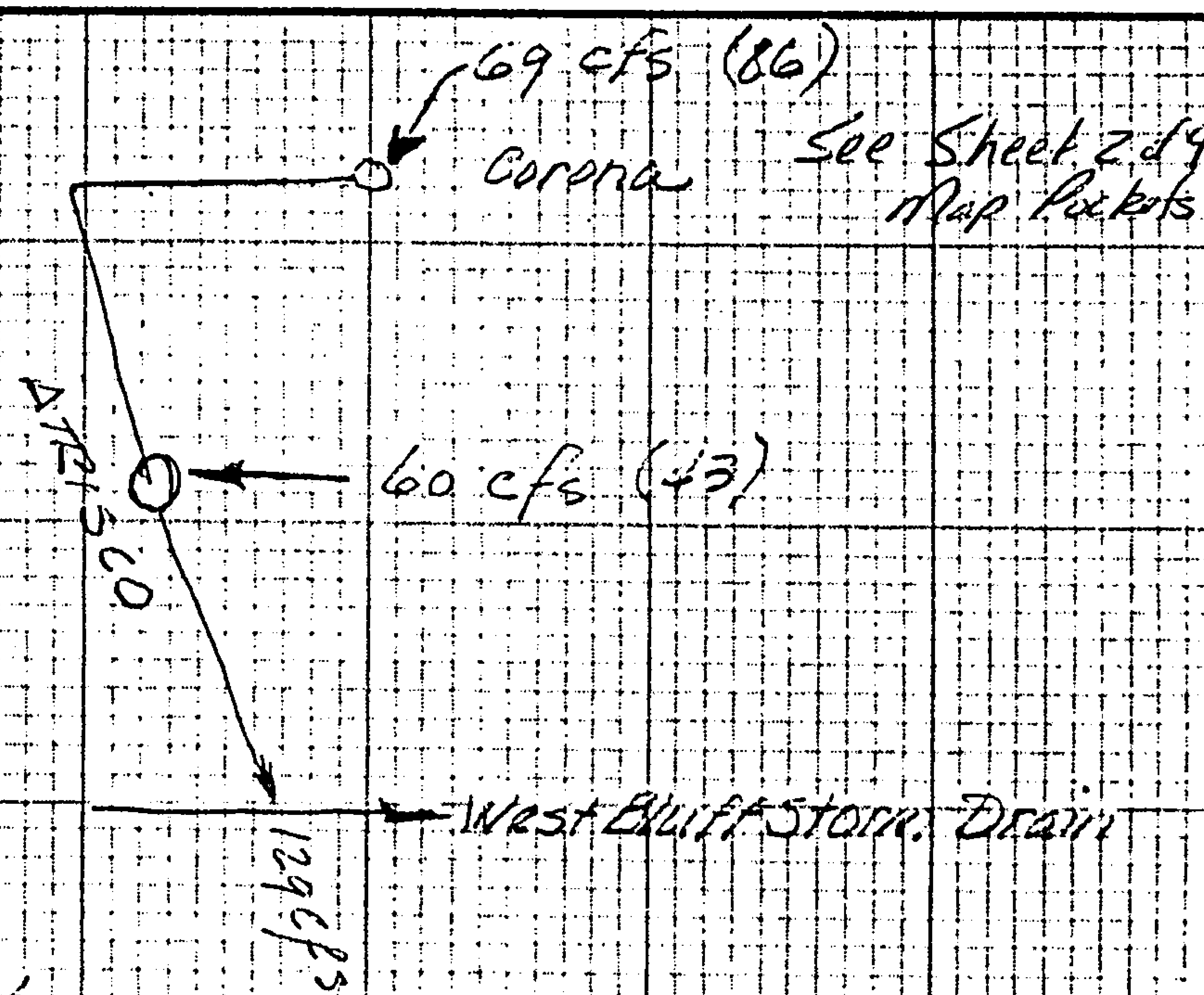
JOB SAD 219- Atrisco/Corona
SUBJECT Storm Drains
JOB NO. ______ SHEET 1 OF ___
BY ZMG DATE 11-10-89
CHECKED ______ DATE ______



See computer printout
for line sizes, & HGL determination -

Drop inlets:

Corona:-

Use BPR criteria for grated inlets in a sump:

$Q = \frac{69}{2} = \underline{34\ cfs}$ each side of street -

Try 2 ea. Dbl "C" inlets each side

Perimeter under flow = 2(7.42 + 2(2.5)) = 24.84 l.f.

$P = \frac{24.84}{2} = 12.42$

$H = \left(\frac{Q/P}{3}\right)^{2/3} = \left(\frac{34/12.42}{3}\right)^{2/3} = 0.94 \quad (> 0.87)$

Try 3 ea. Dbl "C" inlets ea. side -

Perimeter = 37.26, $P = \frac{37.26}{2} = 18.63$

$H = \left(\frac{34/18.63}{3}\right)^{\frac{2}{3}} = \underline{\underline{0.72}}$, OK

Use 3 ea Dble "C" inlets, each side

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JOB SAD 219 - Atrisco/Corona
SUBJECT Storm Drains
JOB NO. ____ SHEET 2 OF ____
BY ZMG DATE 11-10-89
CHECKED ____ DATE ____

Inlets:

Q = 34 cfs curb = 5095.67 H.G. = 5091.84 L = 25

H = (5095.67 - 1.33) - 5091.84 = 2.50'

From nomograph, DPM, p. 78:

→ D = 27" $v = \frac{Q}{A} = \frac{34(4)}{\pi(2.25)^2} = 8.55$ fps.

$V = 0.83 + 1.2\frac{v^2}{2g} + d + 0.5$

$= 0.83 + \frac{1.2(8.55)^2}{2g} + 2.25 + 0.5 = 4.94$

Invert = 5095.67 - 4.94 = 5090.73

Atrisco (

$Q = \frac{60}{2} = 30$ cfs each side of street -

Try 2 ea. Dble "C" inlets, ea side -

Perimeter = 2(7.42 + 2(2.5)) = 24.84

$P = \frac{24.84}{2} = 12.42$

$H = \left(\frac{Q/P}{3}\right)^{2/3} = \left(\frac{30/12.42}{3}\right)^{0.67} = 0.86$, ok (< 0.87)

Inlet - Q = 30 cfs curb = 5094.56 H.G. = 86.46 L = 25

H = (5094.56 - 1.33) - 5086.46 = 6.77

From DPM, p. 78

D = 21", use 24" $v = \frac{Q}{A} = \frac{30}{\pi(1)} = 9.56$ fps.

$V = 0.83 + \frac{1.2(9.56)^2}{2g} + 2.0 + 0.5 = 5.03$

Invert = 5094.56 - 5.03 = 5089.53

JOB DESCR: ATRISCO DRAIN
RUN DATE :11-10-1989

STORM SEWER - HYDRAULIC ANALYSIS - FILE: ATRISCO.STM

RAINFALL LOCATION: SOMEWHERE UNITED STATES
RETURN PERIOD = 100 YRS

LINE 1 / DFQ =129.0 / HT = 36 / WID = 36 / N = .015 / L = 108 / JLC = 1

OUTFALL

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	65.73	36.00	62.60	18.25	70.90	0.00	35.67	7.07
UPSTRM	75.95	35.69	72.98	18.27	81.14	6.68	35.67	7.06

DA = 0 C = 0 Tc = 4.8 INL TM = 0 INT = 9.76 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 9.611 % , ALLOWABLE DEPTH AT INLET OPENING = 6.0 IN

LINE 2 / DFQ =129.0 / HT = 54 / WID = 54 / N = .015 / L = 227 / JLC = 1

DNLN = 1

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	81.14	54.00	73.06	8.11	82.16	0.00	40.63	15.90
UPSTRM	82.44	54.00	75.33	8.11	83.46	0.00	40.63	15.90

DA = 0 C = 0 Tc = 4 INL TM = 0 INT = 10.03 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 1.000 % , ALLOWABLE DEPTH AT INLET OPENING = 6.0 IN

LINE 3 / DFQ =129.0 / HT = 54 / WID = 54 / N = .015 / L = 300 / JLC = 1.25

DNLN = 2

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	83.46	54.00	75.41	8.11	84.48	0.00	40.63	15.90
UPSTRM	85.18	54.00	78.41	8.11	86.20	0.00	40.63	15.90

DA = 0 C = 0 Tc = 3 INL TM = 0 INT = 10.43 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 1.000 % , ALLOWABLE DEPTH AT INLET OPENING = 6.0 IN

LINE 4 / DFQ = 69.0 / HT = 48 / WID = 48 / N = .015 / L = 250 / JLC = 1

DNLN = 3

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	86.46	48.00	78.49	5.49	86.93	0.00	30.61	12.56
UPSTRM	87.23	48.00	80.99	5.49	87.70	0.00	30.61	12.57

DA = 0 C = 0 Tc = 2.2 INL TM = 0 INT = 10.79 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 1.000 % , ALLOWABLE DEPTH AT INLET OPENING = 6.0 IN

LINE 5 / DFQ = 69.0 / HT = 48 / WID = 48 / N = .015 / L = 300 / JLC = 1

DNLN = 4

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	87.70	48.00	81.07	5.49	88.16	0.00	30.61	12.56
UPSTRM	88.62	48.00	84.07	5.49	89.09	0.00	30.61	12.57

DA = 0 C = 0 Tc = 1.2 INL TM = 0 INT = 11.27 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 1.000 % , ALLOWABLE DEPTH AT INLET OPENING = 6.0 IN

LINE 6 / DFQ = 69.0 / HT = 48 / WID = 48 / N = .015 / L = 77 / JLC = 1

DNLN = 5

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	89.09	48.00	84.15	5.49	89.55	0.00	30.61	12.56
UPSTRM	89.32	48.00	84.92	5.49	89.79	0.00	30.61	12.57

DA = 0 C = 0 Tc = 1 INL TM = 0 INT = 11.4 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 1.000 % , ALLOWABLE DEPTH AT INLET OPENING = 6.0 IN

LINE 7 / DFQ = 69.0 / HT = 48 / WID = 48 / N = .015 / L = 300 / JLC = 1.25

DNLN = 6

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	89.79	48.00	85.00	5.49	90.26	0.00	30.61	12.56
UPSTRM	91.84	30.96	88.00	8.05	92.84	45.94	30.61	8.57

DA = 0 C = 0 Tc = 0 INL TM = 0 INT = 11.93 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 1.000 % , ALLOWABLE DEPTH AT INLET OPENING = 6.0 IN

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JOB Atrisco-Corona
SUBJECT
JOB NO. SHEET OF
BY DATE 5/90
CHECKED DATE

Corona / I-40 Area

(1) System has been redesigned to reduce input on Corona from 69 to 48 CFS.

(2) System has been ~~provided~~ designed to flow under pressure and provide HGL @ manholes receiving flows from drop inlets low enough to receive flows from inlets efficiently. Design is considered efficient.

(3) Design at MH #28 has been altered to show supercritical flow in the connection between MH #28 and the existing West Bluff Storm Drain. System design reflects these changes.

HYDRAULIC STUDY FOR

ATRISCO-CORONA

STORM DRAINS

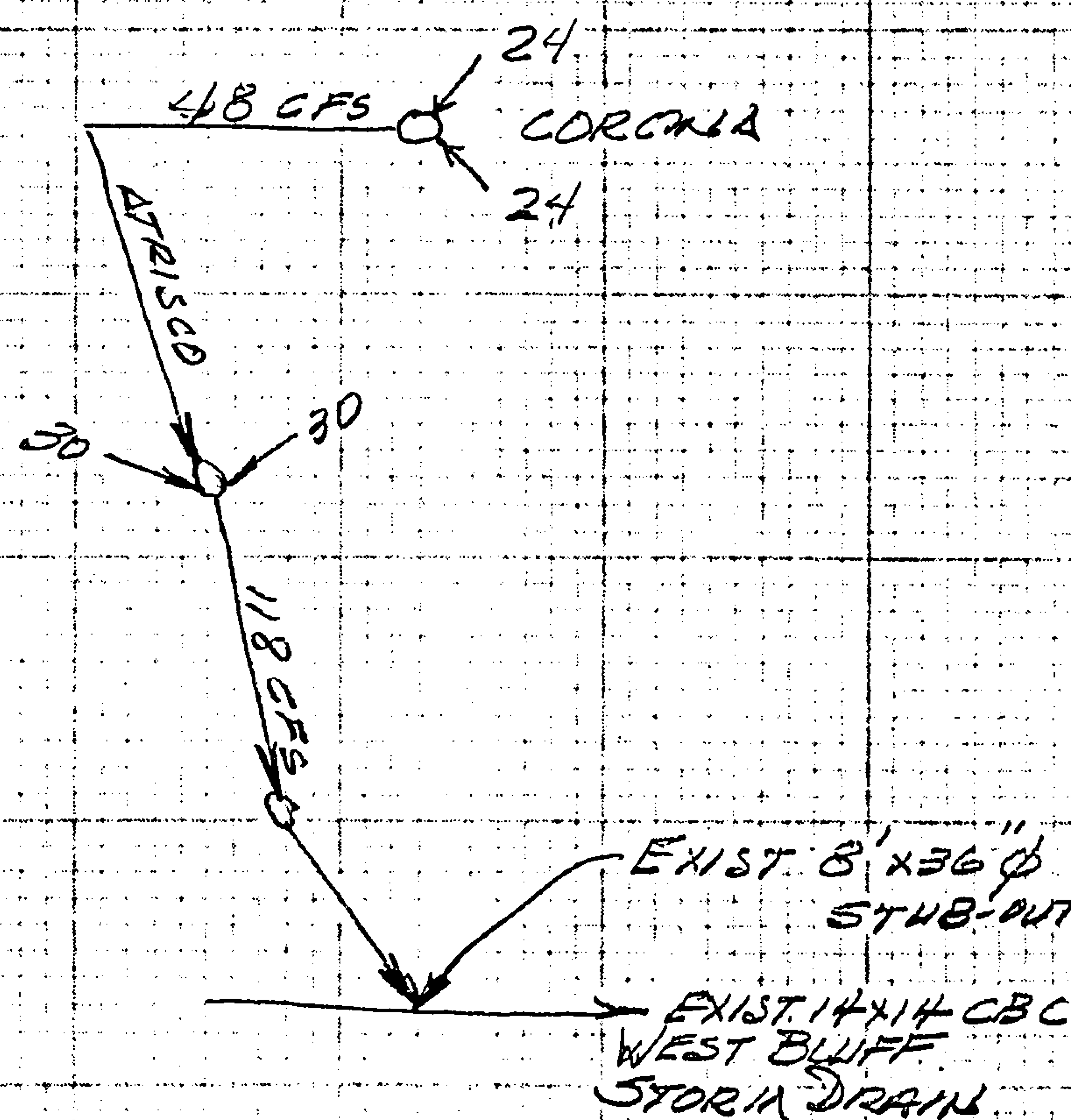
SAD-219

MAY 1990

D. MARK GOODWIN & ASSOC.
CONSULTING ENGINEERS

JOB: ATRISCO - CORONA
SUBJECT: STORM DRAINS
JOB NO.:
SHEET 1 OF
BY: ZMG
DATE: 5-8-90
CHECKED:
DATE:

SCHEMATIC



INLETS -

CORONA (BPR criteria for grated inlets in a sump)

$Q = 48/2 = 24$ CFS each side -

Try 2 ea. DBL "C" INLETS (1-TYPE "A" & 1-DBL "C")

Perimeter under flow = $2(7.42 + 2(2.5)) = 24.84$

$P = 24.84/2 = 12.42$

$H = \left(\frac{Q/P}{3}\right)^{2/3} = \left(\frac{24/12.42}{3}\right)^{2/3} = 0.75$ ok (< 0.87)

Use 1-Type "A" & 1-DBL "C" EACH SIDE

ATRISCO $Q = 60/2 = 30$ CFS each side TRY 2-EA DBL "C"

$P = 12.42$

$H = \left(\frac{30/12.42}{3}\right)^{2/3} = 0.86$ ok (< 0.87)

Use 1-Type "A" & 1-DBL "C"

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JOB Atrisco - Corona
SUBJECT Storm Drains
JOB NO. ______ SHEET 2 OF ____
BY DMG DATE 5-8-90
CHECKED ______ DATE ______

LATERALS:

Corona

Q = 24 CFS CURB = 5095.88 HG = 5095.65 L = 30 (L)
L = 22 (R)

H = (5095.88 - 1.33) - 5095.65 = 0.71

D_L = 36" D_R = 36"

$V = 1.33 + 1.2\frac{v^2}{2g} + d$ $v = \frac{Q}{A} = \frac{24}{\pi(1.5)^2} = 3.4$

= 1.33 + 0.21 + 1.5 = 3.05

INVERT (L & R) = 5095.88 - 3.05 = **5092.83**

Atrisco

Q = 30 CURB = 5094.69 HGL = 5085.79 L = 40 (R)
L = 26 (L)

H = (5094.69 - 1.33) - 5085.79 = 7.57

D_R = 24" $v_R = \frac{30}{\pi(1)^2} = 9.5$ FPS $\frac{v^2}{2g} = 1.40$

D_L = 18" $v_L = \frac{30}{\pi(0.75)^2} = 16.9$ FPS $\frac{v^2}{2g} = 4.43$

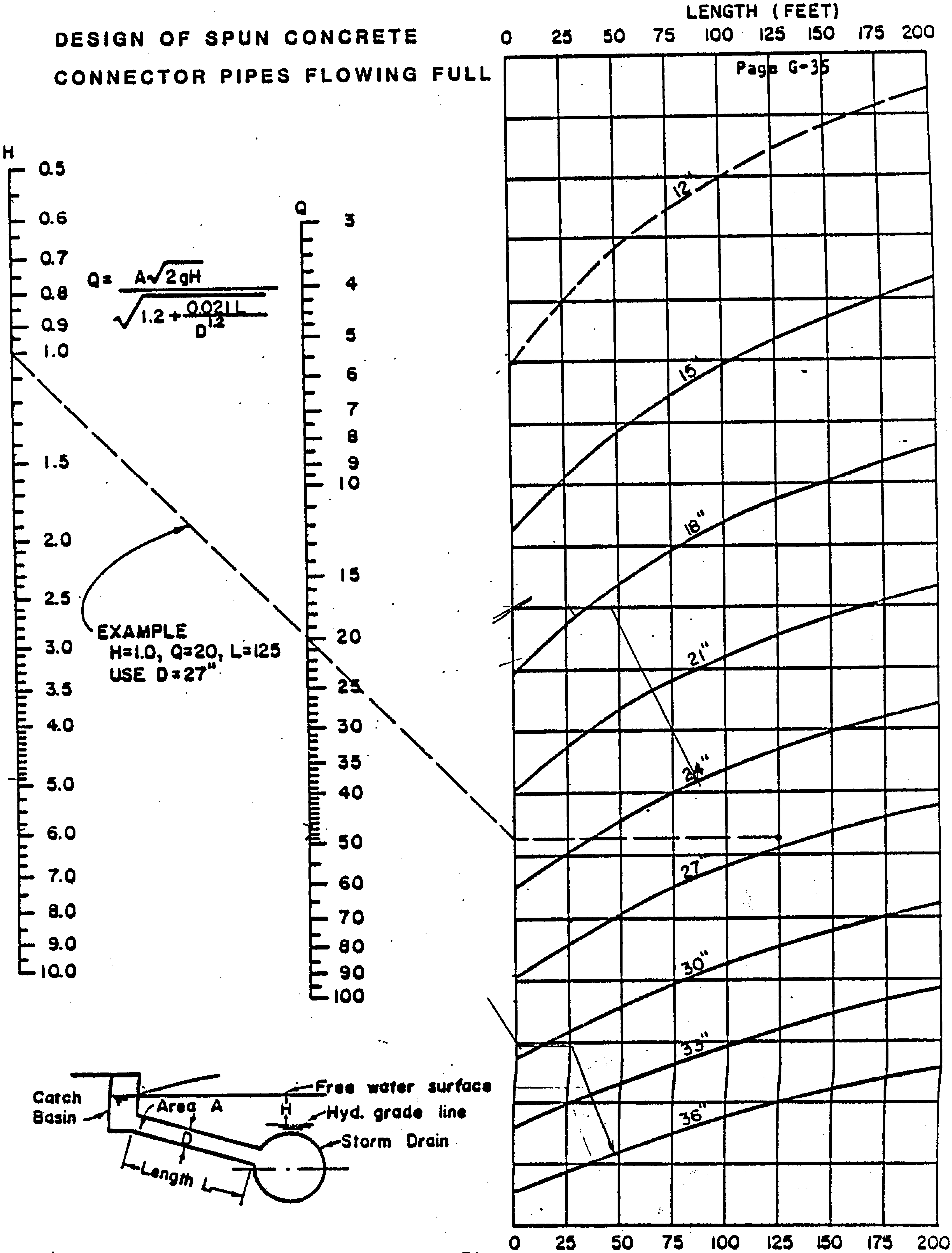
$V_R = 1.33 + 1.40 + 2 = 4.73$

$V_L = 1.33 + 4.43 + 1.5 = 7.26$

INVERT (R) = 5094.69 - 4.73 = 5089.96

INVERT (L) = 5094.69 - 7.26 = 5087.43

DESIGN OF SPUN CONCRETE CONNECTOR PIPES FLOWING FULL



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JOB Atrisco - Corona
SUBJECT Storm Drains
JOB NO. ______ SHEET 3 OF ___
BY ZMG DATE 5-8-90
CHECKED ______ DATE ______

ENTRANCE INTO WEST BLUFF STORM DRAIN -
STUB-OUT IS 8' × 36" φ, S = 13.394 %

CONNECTION BETWEEN MH & STUB-OUT:
$l = 124.68'$
$S = 8.718\%$

FLOWS IN CONNECTION & STUB-OUT ARE SUPERCRITICAL =

AT MANHOLE = Q = 118 CFS -

FOR FLOW INTO CONNECTION, CONSIDER CONNECTION AS ORIFICE IN MH,

$Q = CA\sqrt{2gh}$

Q = 118
A = X-section area of connection
h = req'd head at manhole
C ≈ 0.70

$118 = 0.70\, a \sqrt{2gh}$

$\sqrt{2gh} = \frac{118}{0.70a} = \frac{168.57}{a}$

$2gh = \frac{28{,}415.84}{a^2}$

$h = \frac{441.24}{a^2}$

D	a	a^2	h
36"	7.07	49.96	8.83
42"	9.62	92.57	4.77
48"	12.57	157.91	2.79

Using a 36" connection would require an 8.8' head in the manhole to flow 118 CFS & the pipe sizes upstream would be too large to obtain the required HGL at the drop inlets. 48" connection offered no upstream size advantages over the 42", so 42" was selected.

For the transition from 42" to 36" (42×36 REDUCER) sufficient head is available at the interface to push the 118 CFS into the 36" φ stub-out.

Run date: 05-20-1998
File: atrisco2.ST3

Return Period = 100 Yrs
Rainfall file: Not specified

LINE 1 / Q = 108.0 / HT = 48 / WID = 48 / N = .015 / L = 227 / JLC = 1.25

OUTFALL

	HGL	DEPTH	INVERT	VEL	EGL	T WID	COVER	AREA
DNSTRM	5079.58	48.00	5073.00	8.60	5080.73	0.00	4.00	12.56
UPSTRM	5081.29	48.00	5075.23	8.59	5082.44	0.00	4.00	12.57

Drainage area (ac) =	0	Slope of invert (%)	= 0.982
Runoff coefficient =	0	Slope energy grade line (%)	= 0.753
Time of conc (min) =	7	Critical depth (in)	= 39
Inlet time (min) =	0	Req'd length curb inlet (ft) =	0.0
Intensity (in/hr) =	0.00	Req'd grate area (sf) =	0.0
Cumulative C*A =	0.0	Natural ground elev (ft)	= 0
Flow contrib (cfs) =	108	Minimum cover (ft)	= 4
Default Q (cfs) =	108	Depth at inlet opening (in)	= 0
Line capac. (cfs) =	123.4		

LINE 2 / Q = 108.0 / HT = 48 / WID = 48 / N = .015 / L = 273 / JLC = 1

DNLN = 1

	HGL	DEPTH	INVERT	VEL	EGL	T WID	COVER	AREA
DNSTRM	5082.72	48.00	5075.33	8.60	5083.87	0.00	4.00	12.56
UPSTRM	5084.78	48.00	5078.03	8.59	5085.93	0.00	4.00	12.57

Drainage area (ac) =	0	Slope of invert (%)	= 0.957
Runoff coefficient =	0	Slope energy grade line (%)	= 0.753
Time of conc (min) =	5	Critical depth (in)	= 39
Inlet time (min) =	0	Req'd length curb inlet (ft) =	0.0
Intensity (in/hr) =	0.00	Req'd grate area (sf) =	0.0
Cumulative C*A =	0.0	Natural ground elev (ft)	= 0
Flow contrib (cfs) =	108	Minimum cover (ft)	= 4
Default Q (cfs) =	108	Depth at inlet opening (in)	= 0
Line capac. (cfs) =	122.4		

LINE 3 / Q = 48.0 / HT = 36 / WID = 36 / N = .015 / L = 277 / JLC = 1

DNLN = 2

	HGL	DEPTH	INVERT	VEL	EGL	T WID	COVER	AREA
DNSTRM	5085.93	36.00	5078.13	6.79	5086.64	0.00	4.00	7.07
UPSTRM	5087.84	36.00	5080.81	6.79	5088.55	0.00	4.00	7.07

Drainage area (ac) =	0	Slope of invert (%)	= 0.968
Runoff coefficient =	0	Slope energy grade line (%)	= 0.690
Time of conc (min) =	4	Critical depth (in)	= 28
Inlet time (min) =	0	Req'd length curb inlet (ft)	= 0.0
Intensity (in/hr) =	0.00	Req'd grate area (sf)	= 0.0
Cumulative C*A =	0.0	Natural ground elev (ft)	= 0
Flow contrib (cfs) =	48	Minimum cover (ft)	= 4
Default Q (cfs) =	48	Depth at inlet opening (in)	= 0
Line capac. (cfs) =	56.9		

LINE 4 / Q = 48.0 / HT = 36 / WID = 36 / N = .015 / L = 332 / JLC = 1

DNLN = 3

	HGL	DEPTH	INVERT	VEL	EGL	T WID	COVER	AREA
DNSTRM	5088.55	36.00	5080.91	6.79	5089.27	0.00	4.00	7.07
UPSTRM	5090.84	36.00	5084.14	6.79	5091.56	0.00	4.00	7.07

Drainage area (ac) =	0	Slope of invert (%)	= 0.973
Runoff coefficient =	0	Slope energy grade line (%)	= 0.690
Time of conc (min) =	2	Critical depth (in)	= 28
Inlet time (min) =	0	Req'd length curb inlet (ft)	= 0.0
Intensity (in/hr) =	0.00	Req'd grate area (sf)	= 0.0
Cumulative C*A =	0.0	Natural ground elev (ft)	= 0
Flow contrib (cfs) =	48	Minimum cover (ft)	= 4
Default Q (cfs) =	48	Depth at inlet opening (in)	= 0
Line capac. (cfs) =	57.0		

LINE 5 / Q = 48.0 / HT = 36 / WID = 36 / N = .015 / L = 87 / JLC = 1

DNLN = 4

	HGL	DEPTH	INVERT	VEL	EGL	T WID	COVER	AREA
DNSTRM	5031.55	36.00	5084.24	6.79	5032.27	0.00	4.00	7.07
UPSTRM	5032.16	36.00	5085.01	6.79	5032.88	0.00	4.00	7.07

Drainage area (ac) =	0	Slope of invert (%)	= 0.885
Runoff coefficient =	0	Slope energy grade line (%)	= 0.690
Time of conc (min) =	2	Critical depth (in)	= 28
Inlet time (min) =	0	Req'd length curb inlet (ft) =	0.0
Intensity (in/hr) =	0.00	Req'd grate area (sf)	= 0.0
Cumulative C*A =	0.0	Natural ground elev (ft)	= 0
Flow contrib (cfs) =	48	Minimum cover (ft)	= 4
Default Q (cfs) =	48	Depth at inlet opening (in)	= 0
Line capac. (cfs) =	54.4		

LINE 6 / Q = 48.0 / HT = 36 / WID = 36 / N = .015 / L = 272 / JLC = 1.25

DNLN = 5

	HGL	DEPTH	INVERT	VEL	EGL	T WID	COVER	AREA
DNSTRM	5032.88	36.00	5085.11	6.79	5033.59	0.00	4.00	7.07
UPSTRM	5035.65	36.00	5087.80	6.79	5035.35	0.00	4.00	7.07

Drainage area (ac) =	0	Slope of invert (%)	= 0.989
Runoff coefficient =	0	Slope energy grade line (%)	= 0.690
Time of conc (min) =	0	Critical depth (in)	= 28
Inlet time (min) =	0	Req'd length curb inlet (ft) =	0.0
Intensity (in/hr) =	0.00	Req'd grate area (sf)	= 0.0
Cumulative C*A =	0.0	Natural ground elev (ft)	= 0
Flow contrib (cfs) =	48	Minimum cover (ft)	= 4
Default Q (cfs) =	48	Depth at inlet opening (in)	= 0
Line capac. (cfs) =	57.5		

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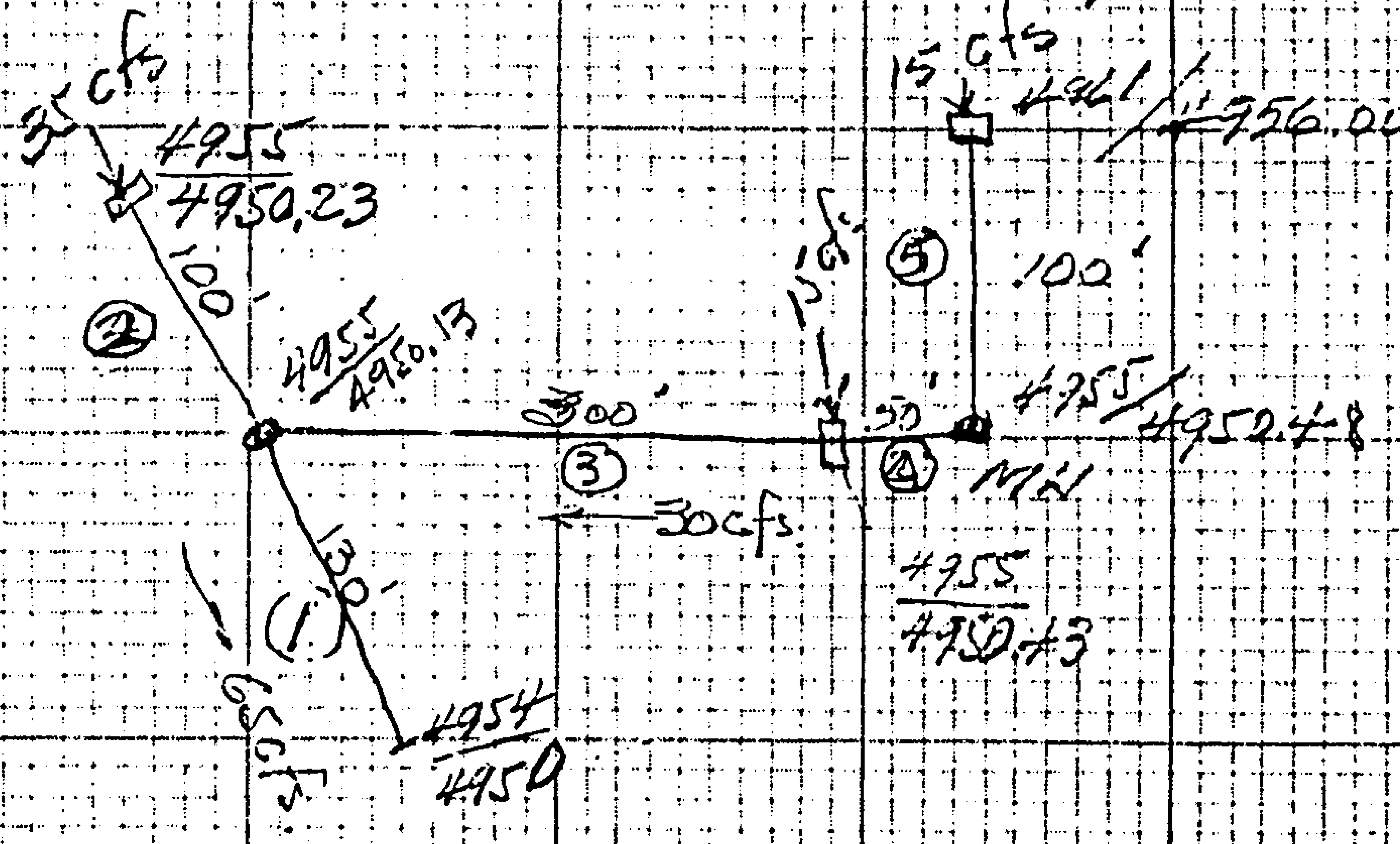
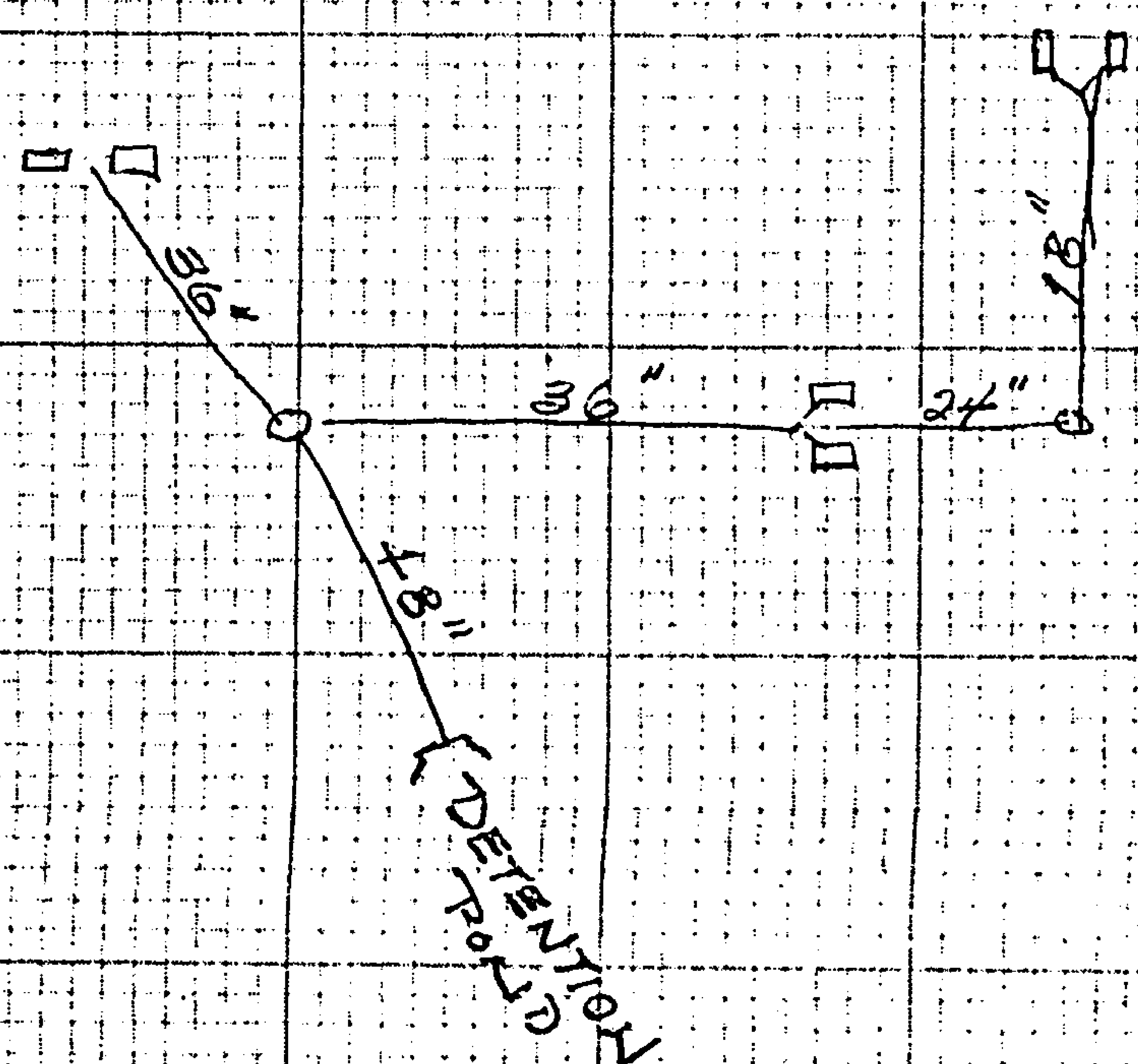
CONSULTING ENGINEERS

JOB Regina —
SUBJECT Storm Drains
JOB NO.
SHEET 1 OF 1
BY ZMG
DATE 11-13-89
CHECKED
DATE

See Sheet 3 of 9 Map Pockets



1-	65	42-36-		-42	-48
2-	48	30	36		
3-	48	30	36		
4-	33	24			
5-	18	18			



JOB DESCR: REGINA I
RUN DATE :11-13-1989

STORM SEWER - HYDRAULIC ANALYSIS - FILE: REGINA 1.STM

RAINFALL LOCATION: SOMEWHERE UNITED STATES
RETURN PERIOD = 100 YRS

LINE 1 / DFQ = 65.0 / HT = 48 / WID = 48 / N = .015 / L = 130 / JLC = 1

OUTFALL

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	4952.61	31.27	4950.30	7.37	4953.45	45.42	30.04	8.82
UPSTRM	4953.37	38.89	4950.13	5.96	4953.92	37.65	30.04	10.91

DA = 0 C = 0 Tc = 1.5 INL TM = 0 INT = 11.15 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 0.100 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

LINE 2 / DFQ = 35.0 / HT = 36 / WID = 36 / N = .015 / L = 100 / JLC = 1

DNLN = 1

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	4953.92	36.00	4950.13	4.95	4954.30	0.00	23.39	7.07
UPSTRM	4954.67	36.00	4950.23	4.95	4955.05	0.00	23.39	7.07

DA = 0 C = 0 Tc = 0 INL TM = 0 INT = 11.93 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 0.100 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

LINE 3 / DFQ = 30.0 / HT = 36 / WID = 36 / N = .015 / L = 300 / JLC = 1

DNLN = 1

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	4953.92	36.00	4950.13	4.24	4954.20	0.00	21.65	7.07
UPSTRM	4954.73	36.00	4950.43	4.24	4955.01	0.00	21.65	7.07

DA = 0 C = 0 Tc = .5 INL TM = 0 INT = 11.66 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 0.100 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

LINE 4 / DFQ = 15.0 / HT = 24 / WID = 24 / N = .015 / L = 50 / JLC = 1

DNLN = 3

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	4955.01	24.00	4950.43	4.78	4955.36	0.00	16.99	3.14
UPSTRM	4955.30	24.00	4950.48	4.77	4955.66	0.00	16.99	3.14

DA = 0 C = 0 Tc = .3 INL TM = 0 INT = 11.75 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 0.100 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

LINE 5 / DFQ = 15.0 / HT = 18 / WID = 18 / N = .015 / L = 100 / JLC = 1

DNLN = 4

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	4955.66	18.00	4950.48	8.49	4956.78	0.00	16.93	1.77
UPSTRM	4959.49	18.00	4956.00	8.49	4960.61	0.00	16.93	1.77

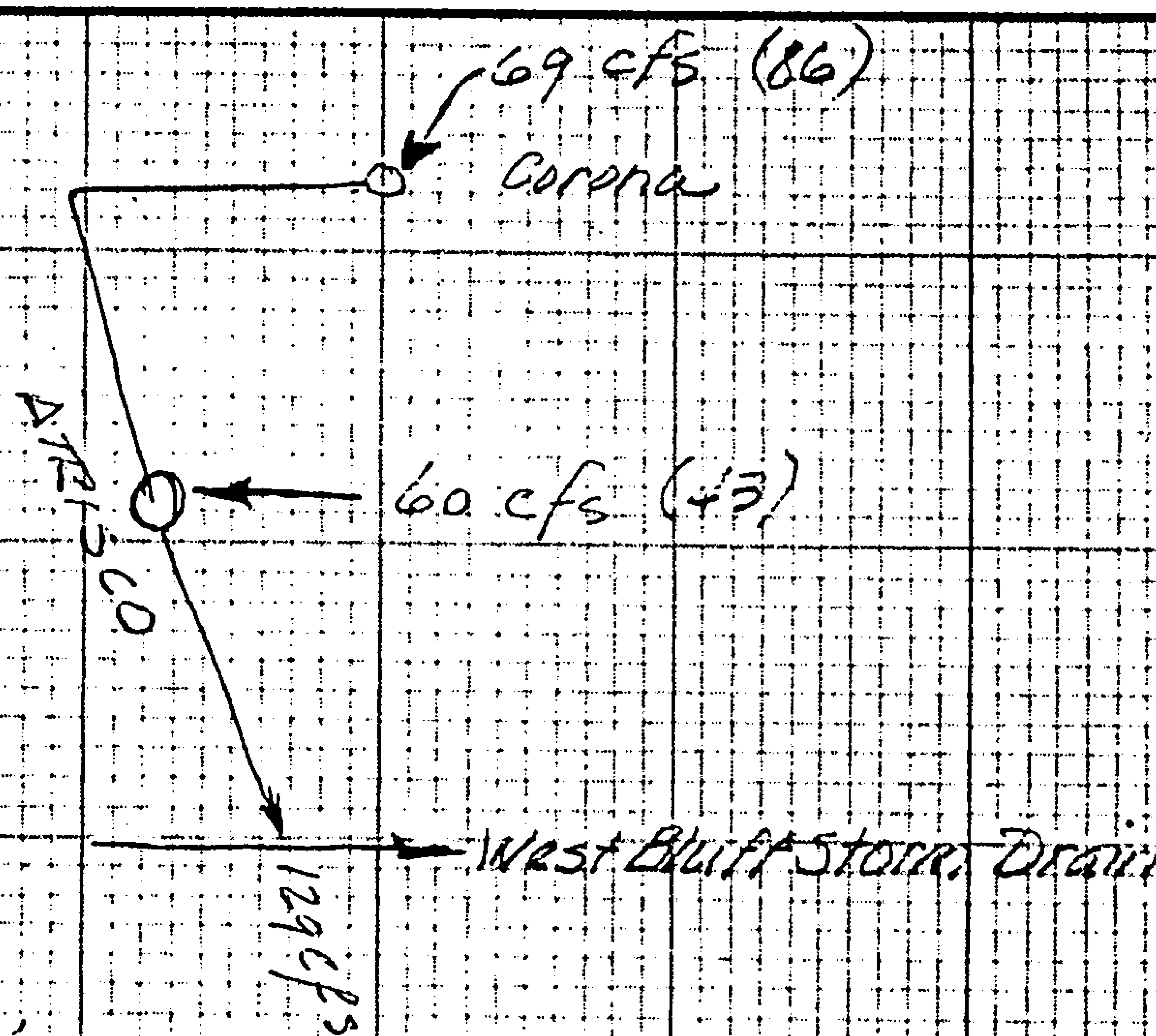
DA = 0 C = 0 Tc = 0 INL TM = 0 INT = 11.93 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 5.520 % , ALLOWABLE DEPTH AT INLET OPENING = 0.0 IN

D. MARK GOODWIN & ASSOC.
CONSULTING ENGINEERS

JOB SAD 219 - Atrisco/Corona
SUBJECT Storm Drains
JOB NO. ____ SHEET 1 OF ____
BY ZMG DATE 11-10-89
CHECKED ____ DATE ____



See computer printout for line sizes, & HGL determination –

Drop inlets:

Corona –

Use BPR criteria for grated inlets in a sump:

$Q = \frac{69}{2} = \underline{34\ cfs}$ each side of street –

Try 2 ea Dbl "C" inlets each side

Perimeter under flow = 2(7.42 + 2(2.5)) = 24.84 l.f.

$P = \frac{24.84}{2} = 12.42$

$H = \left(\frac{Q/P}{3}\right)^{2/3} = \left(\frac{34/12.42}{3}\right)^{2/3} = 0.94\ (> 0.87)$

Try 3 ea Dbl "C" inlets ea. side –

Perimeter = 37.26, $P = \frac{37.26}{2} = 18.63$

$H = \left(\frac{34/18.63}{3}\right)^{\frac{2}{3}} = \underline{0.72}$, OK

Use 3 ea Dble "C" inlets, each side

dmg D. MARK GOODWIN & ASSOC.
CONSULTING ENGINEERS

JOB SAD 219 - Atrisco/Coronado
SUBJECT Storm Drains
JOB NO. ______ SHEET 2 OF ___
BY ZMG DATE 11-10-89
CHECKED ______ DATE ______

Inlets:
$Q = 34$ cfs curb = 5095.67 H.G. = 5091.84 L = 25
$H = (5095.67 - 1.33) - 5091.84 = 2.50'$
From nomograph, DPM, p. 78:
→ $D = 27''$ $v = \frac{Q}{A} = \frac{34(4)}{\pi(2.25)^2} = 8.55$ fps.

$V = 0.83 + 1.2\frac{v^2}{2g} + d + 0.5$
$= 0.83 + \frac{1.2(8.55)^2}{2g} + 2.25 + 0.5 = 4.94$
Invert = 5095.67 − 4.94 = 5090.73

Atrisco (
$Q = \frac{60}{2} = 30$ cfs each side of street –
Try 2 ea. Dble "C" inlets, ea side –
Perimeter = $2(7.42 + 2(2.5)) = 24.84$
$P = \frac{24.84}{2} = 12.42$
$H = \left(\frac{Q/P}{3}\right)^{2/3} = \left(\frac{30/12.42}{3}\right)^{0.67} = 0.86$, ok ($< 0.87$)

Inlet – $Q = 30$ cfs curb = 5094.56 H.G. = 86.46 L = 25
$H = (5094.56 - 1.33) - 5086.46 = 6.77$
From DPM, p. 78
$D = 21''$, use 24'' $v = \frac{Q}{A} = \frac{30}{\pi(1)} = 9.56$ fps.

$V = 0.83 + \frac{1.2(9.56)^2}{2g} + 2.0 + 0.5 = 5.03$

Invert = 5094.56 − 5.03 = 5089.53

JOB DESCR: ATRISCO DRAIN
RUN DATE :11-10-1989

STORM SEWER - HYDRAULIC ANALYSIS - FILE: ATRISCO.STM

RAINFALL LOCATION: SOMEWHERE UNITED STATES
RETURN PERIOD = 100 YRS

LINE 1 / DFQ =129.0 / HT = 36 / WID = 36 / N = .015 / L = 108 / JLC = 1

OUTFALL

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	65.73	36.00	62.60	18.25	70.90	0.00	35.67	7.07
UPSTRM	75.95	35.69	72.98	18.27	81.14	6.68	35.67	7.06

DA = 0 C = 0 Tc = 4.8 INL TM = 0 INT = 9.76 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 9.611 % , ALLOWABLE DEPTH AT INLET OPENING = 6.0 IN

LINE 2 / DFQ =129.0 / HT = 54 / WID = 54 / N = .015 / L = 227 / JLC = 1

DNLN = 1

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	81.14	54.00	73.06	8.11	82.16	0.00	40.63	15.90
UPSTRM	82.44	54.00	75.33	8.11	83.46	0.00	40.63	15.90

DA = 0 C = 0 Tc = 4 INL TM = 0 INT = 10.03 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 1.000 % , ALLOWABLE DEPTH AT INLET OPENING = 6.0 IN

LINE 3 / DFQ =129.0 / HT = 54 / WID = 54 / N = .015 / L = 300 / JLC = 1.25

DNLN = 2

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	83.46	54.00	75.41	8.11	84.48	0.00	40.63	15.90
UPSTRM	85.18	54.00	78.41	8.11	86.20	0.00	40.63	15.90

DA = 0 C = 0 Tc = 3 INL TM = 0 INT = 10.43 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 1.000 % , ALLOWABLE DEPTH AT INLET OPENING = 6.0 IN

LINE 4 / DFQ = 69.0 / HT = 48 / WID = 48 / N = .015 / L = 250 / JLC = 1

DNLN = 3

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	86.46	48.00	78.49	5.49	86.93	0.00	30.61	12.56
UPSTRM	87.23	48.00	80.99	5.49	87.70	0.00	30.61	12.57

DA = 0 C = 0 Tc = 2.2 INL TM = 0 INT = 10.79 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 1.000 % , ALLOWABLE DEPTH AT INLET OPENING = 6.0 IN

LINE 5 / DFQ = 69.0 / HT = 48 / WID = 48 / N = .015 / L = 300 / JLC = 1

DNLN = 4

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	87.70	48.00	81.07	5.49	88.16	0.00	30.61	12.56
UPSTRM	88.62	48.00	84.07	5.49	89.09	0.00	30.61	12.57

DA = 0 C = 0 Tc = 1.2 INL TM = 0 INT = 11.27 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 1.000 % , ALLOWABLE DEPTH AT INLET OPENING = 6.0 IN

LINE 6 / DFQ = 69.0 / HT = 48 / WID = 48 / N = .015 / L = 77 / JLC = 1

DNLN = 5

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	89.09	48.00	84.15	5.49	89.55	0.00	30.61	12.56
UPSTRM	89.32	48.00	84.92	5.49	89.79	0.00	30.61	12.57

DA = 0 C = 0 Tc = 1 INL TM = 0 INT = 11.4 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

SLOPE OF INVERT = 1.000 % , ALLOWABLE DEPTH AT INLET OPENING = 6.0 IN

LINE 7 / DFQ = 69.0 / HT = 48 / WID = 48 / N = .015 / L = 300 / JLC = 1.25

DNLN = 6

	HGL	DEPTH	INVERT	VEL	EGL	T WID	CR DP	AREA
DNSTRM	89.79	48.00	85.00	5.49	90.26	0.00	30.61	12.56
UPSTRM	91.84	30.96	88.00	8.05	92.84	45.94	30.61	8.57

DA = 0 C = 0 Tc = 0 INL TM = 0 INT = 11.93 TOT CA = 0

REQ'D GRATE AREA = 0.0 SQFT , REQ'D LENGTH OF CURB INLET = 0.0 FT

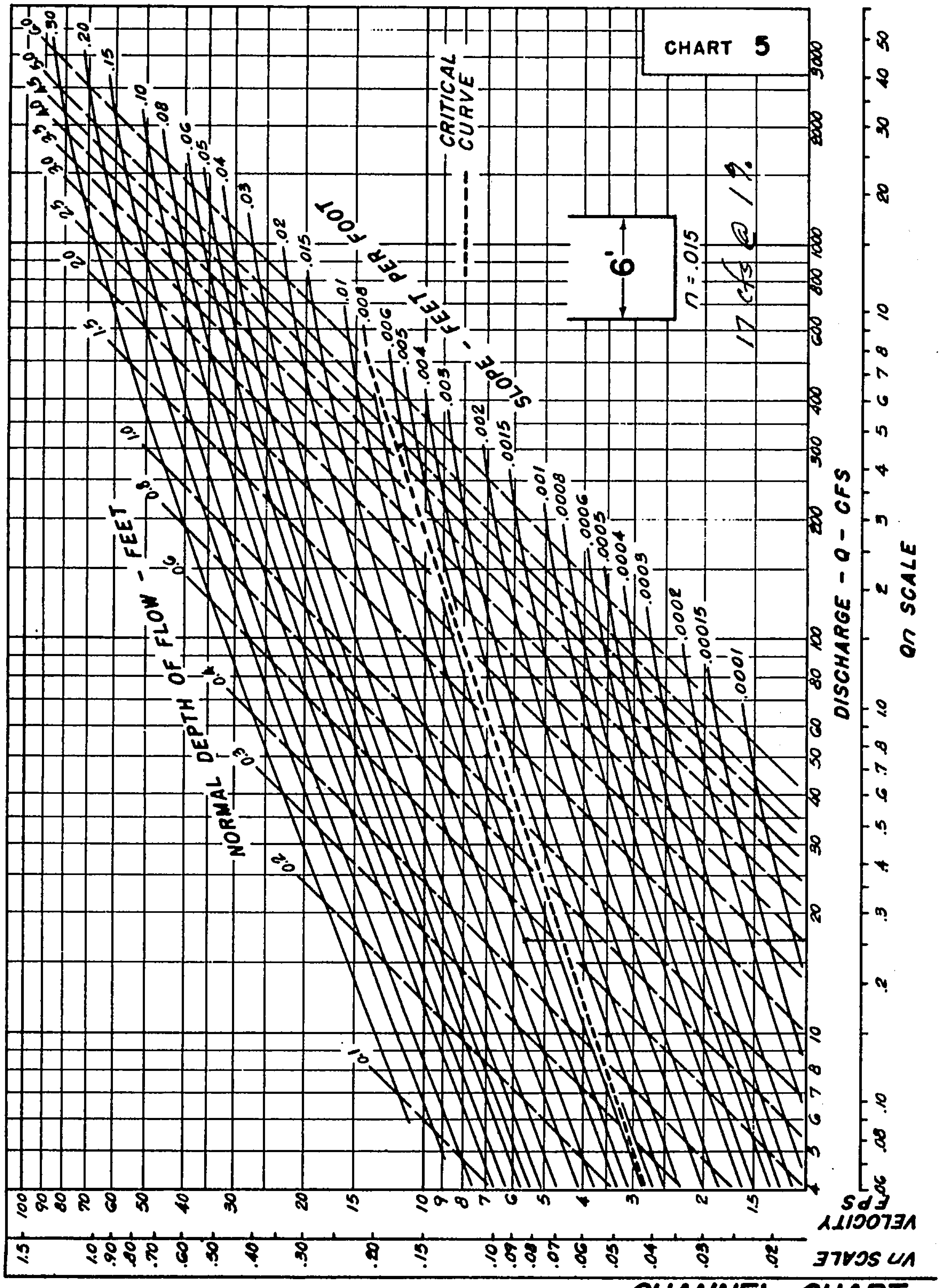
SLOPE OF INVERT = 1.000 % , ALLOWABLE DEPTH AT INLET OPENING = 6.0 IN

D. MARK GOODWIN & ASSOC.
CONSULTING ENGINEERS

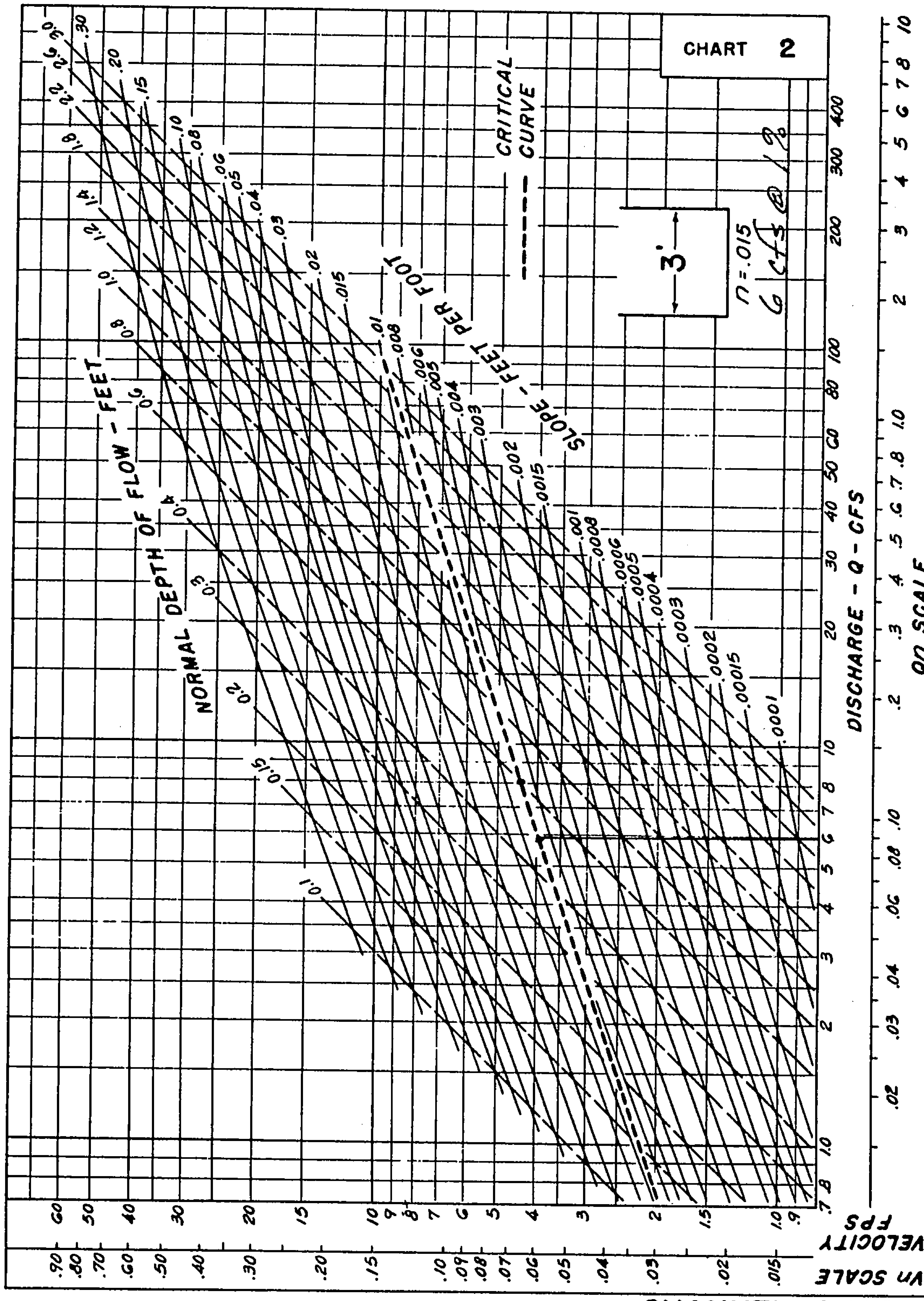
JOB SAD 219
SUBJECT Rear Yard Channels
JOB NO. 88-10 SHEET 1 OF
BY TJB DATE 3/12/90
CHECKED DATE

*Design of Rear Yard Concrete Drainage Channels in SAD 219 Volcano Cliffs Subdivision

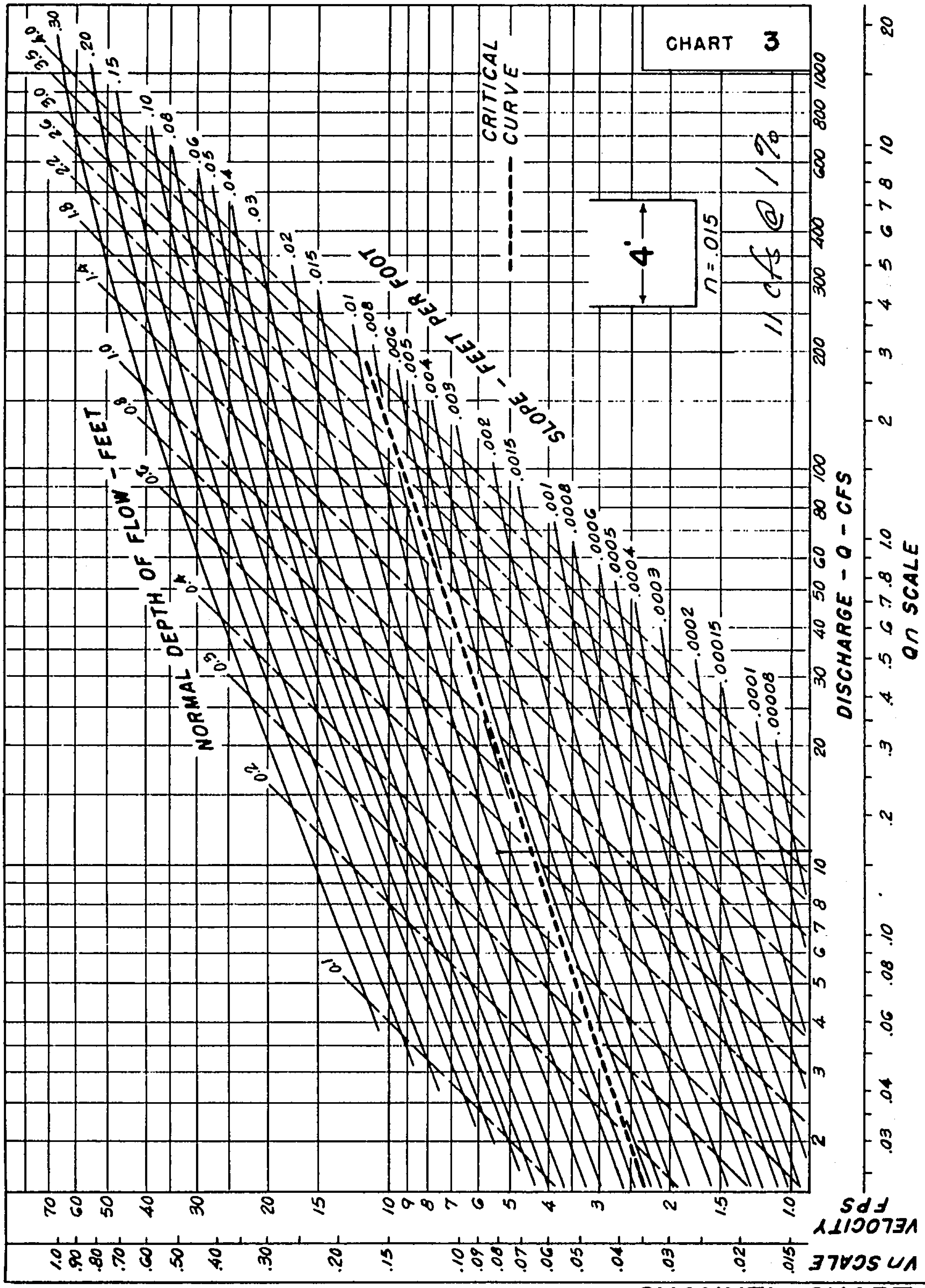
* Assumed slope of channel = 1%
Assumed flow depth = 6"



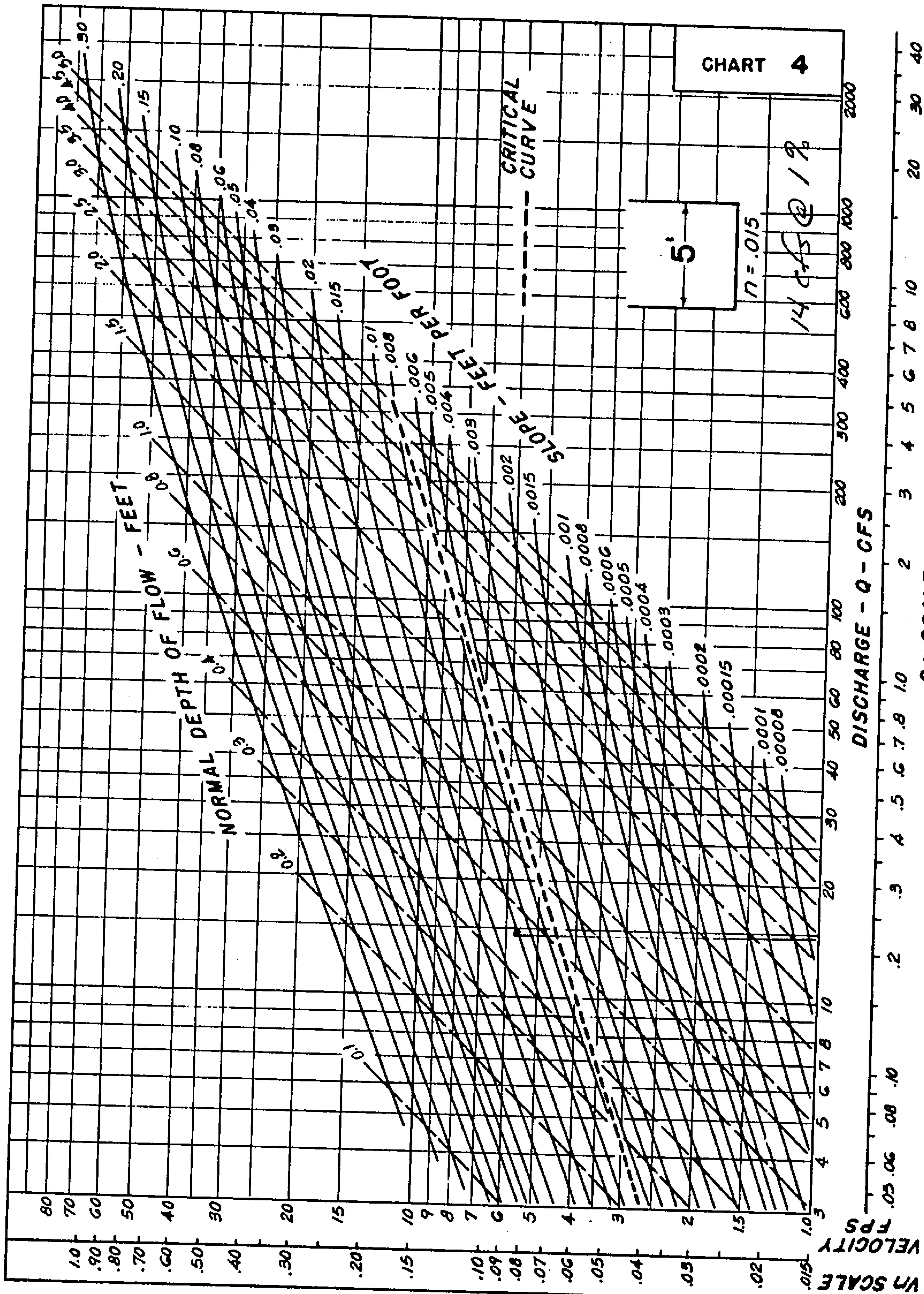
CHANNEL CHART
VERTICAL b = 6 FT.



CHANNEL CHART
VERTICAL b = 3 FT.



CHANNEL CHART
VERTICAL b = 4 FT.



CHANNEL CHART
VERTICAL b = 5 FT.

DEVELOPMENT & BUILDING SERVICE CENTER
ONE STOP
600 SECOND ST. N.W./2ND FLOOR
ATTENTION: ____________________
505-924-3900

Records Withdrawal Form

Project No. N/A   Date: 11/12/99

Project Title: NA

(a.) File   b. Mylars   c. Redlines/Comments
d. Other ____________________

St. Anthony Plaza

Requested By: Paul Mueller **Phone No.:** 833-1840
Company

Comments: ____________________

return document to John Murray

Anticipated Return Date: ____________________

Receipt Acknowledged

I here by accept full responsibility for the security of the above noted records/plans until return receipt acknowledgement is completed. Records/plans will be returned to the Development & Building Services Center on or before the indicated anticipated return date.

Delivery Picked Up By:

Name: Ray Valdez   Organization: Reliable Repro,
Print

Signed: Ray Valdez   Date: 11-12-99
Phone No. 247-2578

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Received by: Gloria D. Saavedra   **Date:** 11-15-99
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SOLD TO: TIERRA WEST
INVOICE # 109282

SHIP TO: COA - ONE STOP

ORDERED	SHIPPED	BACK ORD.	UNIT	CATALOG NO.	DESCRIPTION	SQ. FT.
					RETURN ORIGINALS CITY PROJ # 3558 DRAINAGE REPORT FOR COA. SPECIAL ASSESMENT DIST 219	

Gloria O Saavedra

DELIVERY MEMO NO. 4015