SPEED MEMO

COLORADO DIVISION OF HIGHWAYS

==========

SH 50 IN LA JUNTA
MP 377 TO MP 381

DATE: SEPTEMBER 28, 1990

TO: WARREN CRAMER, D-2 DESIGN (PUEBLO)

FROM: STEVEN P. SMITH, HYDRAULICS SPS

SUBJECT: DRAINAGE PROBLEMS ALONG SH 50 IN LA JUNTA

We have completed our preliminary hydraulic analysis of the drainage problems associated with flooding in La Junta. Our investigation consisted of a field trip, discussions with maintenance personal, and review of the FEMA Flood Insurance Study for the City of La Junta.

Our visit to La Junta was prompted by the report of severe flooding on July 13, 1990. This recent flooding was not an isolated event as La Junta has a history of drainage problems. The flooding on July 13th was the result of 3" of rainfall in a period of 30 minutes. This corresponds to approximately a 20 to 25 year runoff event.

There are significant drainage problems along SH 50 throughout La Junta but major flooding can be localized to four areas: (See attached map & photos)

1. MP 377 to MP 378.5 - West approach to city (Near Walmart)

Flooding in this area is a result of inadequate cross drainage and side drainage. Runoff from the south is overtopping borrow ditches and flowing across the highway. Larger borrow ditches and additional cross culverts are required. A grade raise may be needed. It is possible that drainage through the railroad may also need to be addressed.

2. MP 378.8 - Railroad underpass

Flooding at this site is as a result of concentrated flows entering the sump from the south. The railroad runs north-south at this area and acts as a dam directing flows directly into the underpass. Additional runoff flows into this sump from the south-east at Potter's Park and from both east and west off the roadway surface.

Flooding has occurred up to a depth of 8' and taken greater than 6 hour to recede. Flooding of this type is very hazardous and a considerable liability to the Department.

Remedial measures should be taken to minimize runoff to the underpass as soon as is practical. We recommend that runoff from the south be intercepted with a berm at the top of the cut slope before it overtops the existing retaining walls. A grade adjustment to create crest verticals both east and west of the underpass will reduce runoff into the sump. Additional inlets and storm drain capacity should be provided to drain remaining water. If sufficient fall is not available between the bottom of the underpass and the storm drain outfall a pump may be needed.

3. MP 379.1 to MP 380.5 - 1st ST. through La Junta

Much of 1st St. is located in the 100 year FEMA floodplain for the Arkansas River. Flooding here can be caused by both surface runoff and overbank flow from the Arkansas River. The recent flooding was from localized storm event causing excess surface runoff and not from overbank flow in the Arkansas. Flood depths of 3' to 4' were reported in this area. Maintenance reported that the flap gate outlet for this storm drain system did not open because of high water in the King Arroyo.

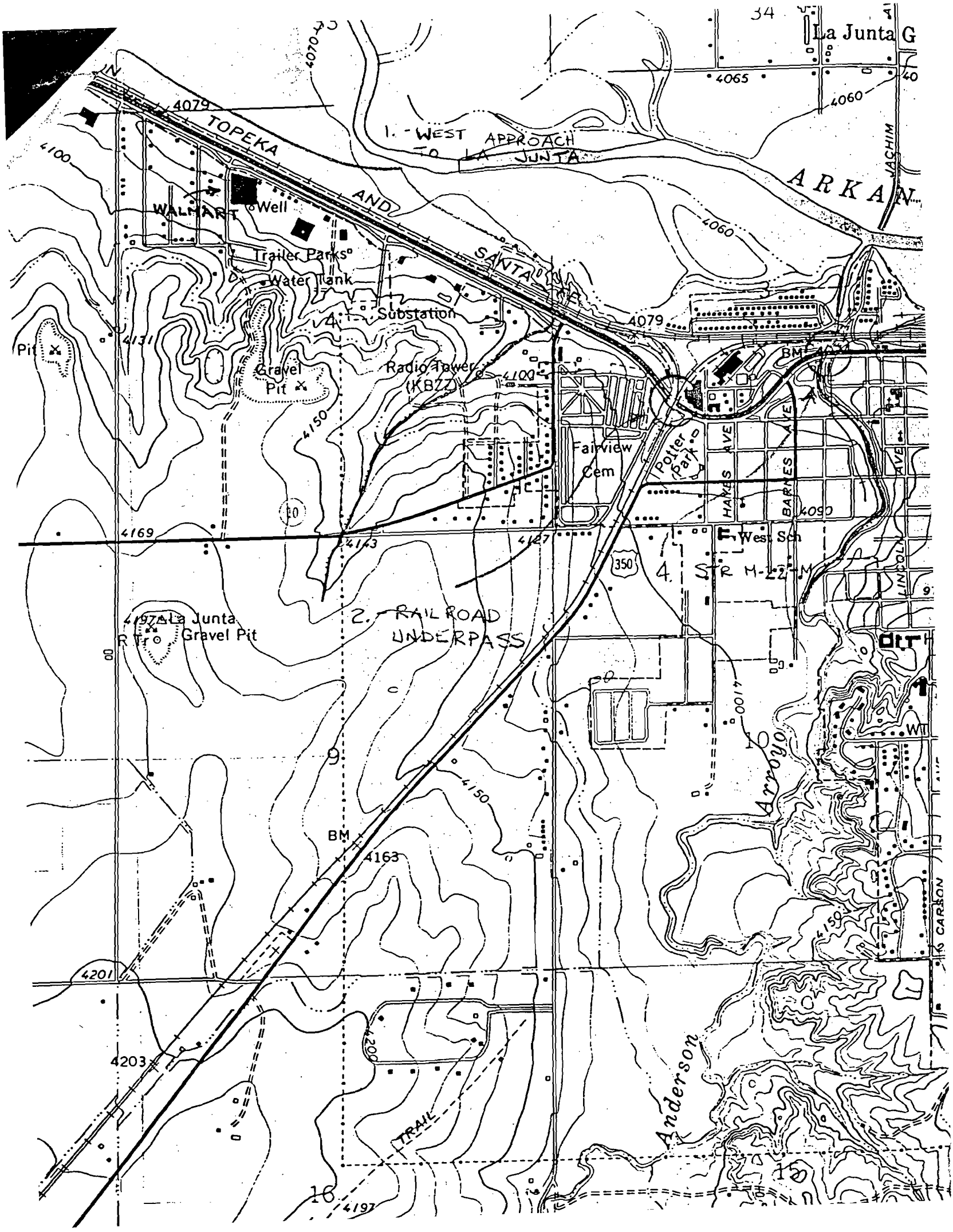
Although we can't control flooding from high water in the Arkansas, an analysis of this storm drains adequacy to convey surface runoff should be performed.

4. MP 379.1 (Anderson Arroyo - Str. M-22-M) and MP 380.6 (King Arroyo - Str. M-22-X)

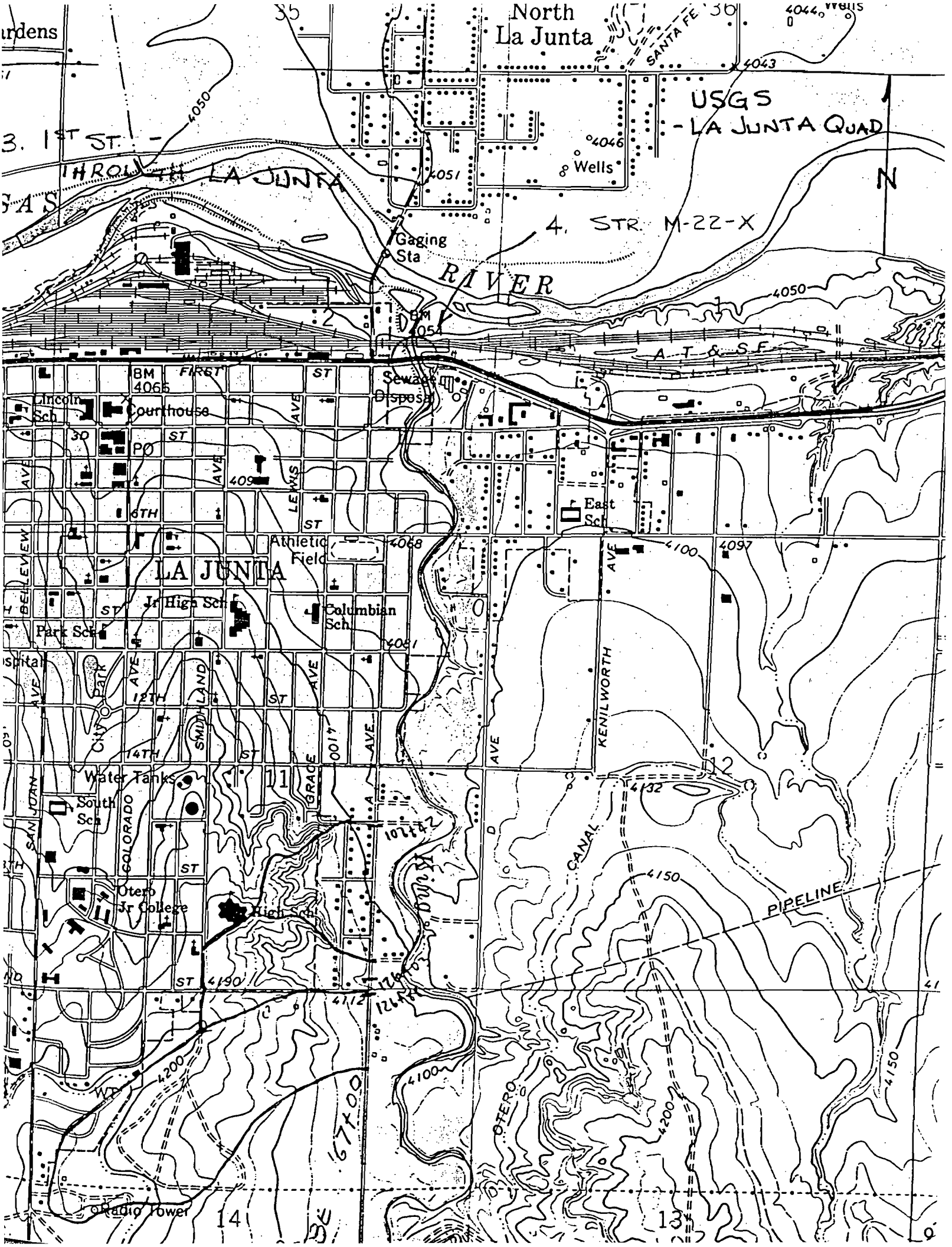
Both of these structures under SH 50 appear to be inadequate to convey the 100 year flow according to the FEMA Flood Insurance Study for La Junta. With sufficient debris these structures could be overtopped by much smaller events. Future bridge replacement projects will require structures with greater capacity and possible downstream channel work.

Any future projects through La Junta should address these drainage concerns. If you have any questions, please contact us at 757-9342.

Attachments 9-28
cc: G. Johnson, Hydraulics/File
Albert Ackers, D-2 Maintenance (La Junta)



La Junta G
4065
4060
4070
4079
TOPEKA
AND
SANTA
1. - WEST APPROACH TO LA JUNTA
ARKAN
JACHIM
4100
WALMART
Well
Trailer Parks
Water Tank
Substation
4131
Pit
Gravel Pit
Radio Tower (KBZZ)
4150
Fairview Cem
Potter Park
HAYES AVE
BARNES AVE
LINCOLN AVE
4090
West Sch
4169
4143
4127
350
4. STR M-22-M
2. - RAILROAD UNDERPASS
4197
La Junta Gravel Pit
R Tr
9
10
Arroyo
BM
4163
4201
4203
4200
TRAIL
Anderson
CARSON
16
15
4197


North
La Junta
SANTA FE
USGS
- LA JUNTA QUAD
3. 1ST ST.
THROUGH LA JUNTA
4. STR. M-22-X
Wells
Gaging Sta
RIVER
BM 4054
A. T. & S. F.
Sewage Disposal
BM 4065
FIRST
Lincoln Sch
Courthouse
PO
LEWIS
East Sch
Athletic Field
LA JUNTA
Jr High Sch
Columbian Sch
Park Sch
City Park
SMITHLAND
Water Tanks
South Sch
COLORADO
GRACE
KENILWORTH
CANAL
PIPELINE
Otero Jr College
High Sch
OTERO
Radio Tower
14
13
12
11

PRELIMINARY HYDROLOGY AND HYDRAULICS

ASSESSMENT FOR

SH 50 IN LA JUNTA

(MP 377.0 TO MP 378.73)
JUNE, 1992

G. JOHNSON
HYDRAULICS UNIT

BY S.P. SMITH

SH 50 IN LA JUNTA
MP 377 TO MP 379
JUNE, 1992

PRELIMINARY HYDROLOGY AND HYDRAULICS ASSESSMENT FOR SH 50 IN LA JUNTA

INDEX

Introduction 1

Site Location 1

Hydrology 1

Existing Drainage 10

Design Discussion 15

Conceptual Design 17

References 21

Figures
- FIG. 1 - Site Location Map 2
- FIG. 2 - Map of Small Basins 4
- FIG. 3 - Map of Crooked Arroyo Basin 5
- FIG. 4 - Rainfall Intensity-Duration-Frequency Curve 6
- FIG. 5 - Tabulation of Design Discharges 9
- FIG. 6 - Photos of Study Corridor 12
- FIG. 7 - Preliminary Drainage Plan 18

APPENDIX A - Preliminary Hydrologic Calculations

APPENDIX B - Preliminary Hydraulic Design

G. JOHNSON
HYDRAULICS UNIT

BY S.P. SMITH

SH 50 IN LA JUNTA
MP 377 TO MP 379
JUNE, 1992

INTRODUCTION

The purpose of this study is to assess drainage requirements for a section of SH 50 in the vicinity of La Junta, Colorado. The study corridor extends from mile post 377.0 near Crooked Arroyo in the west to mile post 378.73 near the railroad underpass. Average daily traffic is 10,900 vehicles and it is estimated that it will increase by a factor of 1.6 over the next 20 years.

This study was requested by District 2 personnel after flooding and maintenance problems were identified in the study corridor. This report identifies these problems and provides recommendations for drainage improvements.

SITE LOCATION

The City of La Junta is located in south east Colorado in eastern Otero County. It is located in the Arkansas River Valley approximately 65 miles east of Pueblo. It's major economic activities include agriculture, ranching and tourism. Several factories and the main office of the Atchison, Topeka and Sante Fe railroad (AT & SF) are located in the City.

La Junta is growing steadily every year with commercial development concentrated on the south side of SH 50. Basins in the study corridor are characterized by such development.

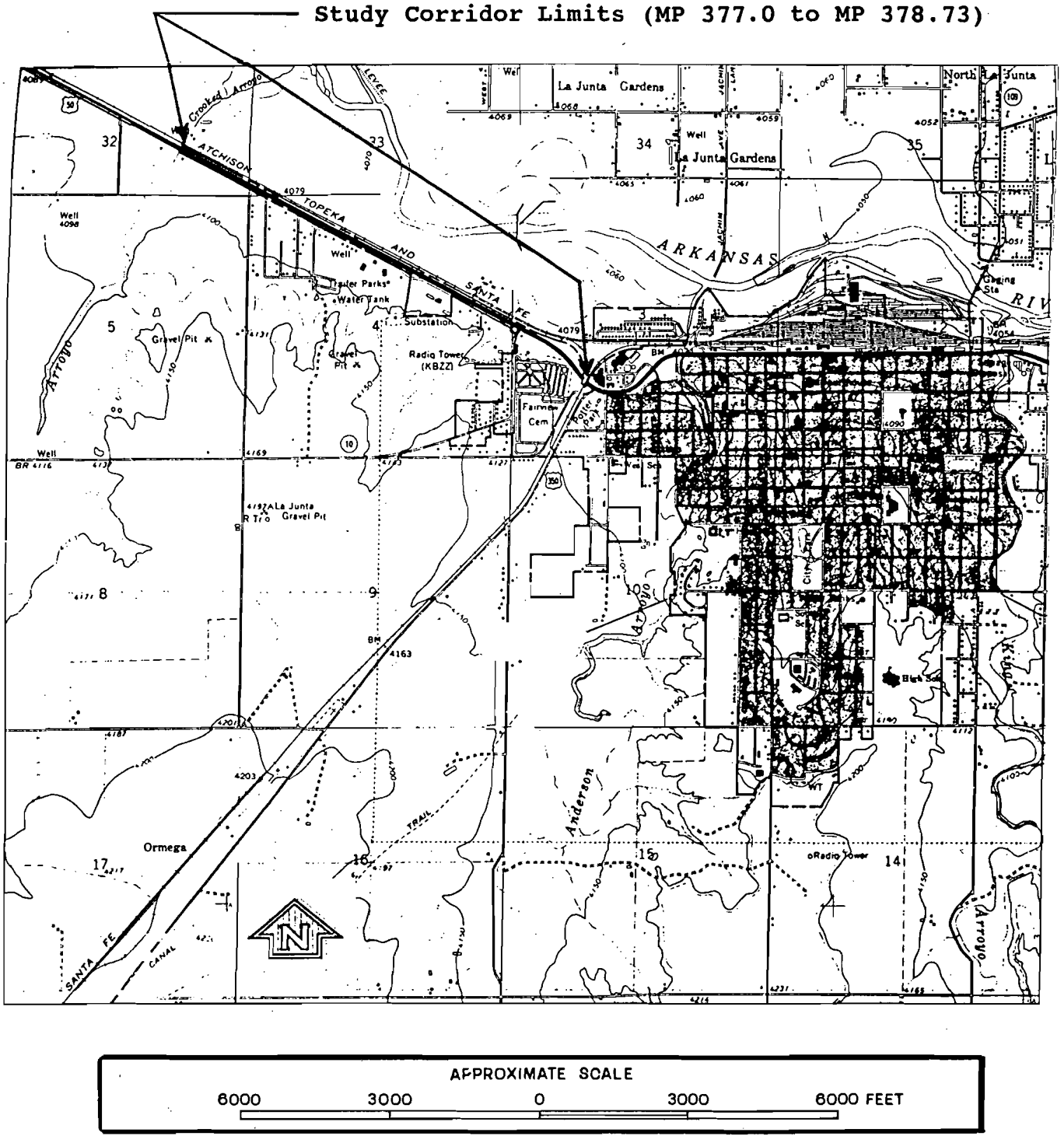
HYDROLOGY

- Topographic and Hydrologic Setting

The topography of the basins draining to SH 50 in the study corridor is low, rolling hills and plains characteristic of the Arkansas River Valley. Exposed geology is mainly interbedded, light-colored shales and limestones. Elevations vary between 4960 feet at the peak of the Crooked Arroyo basin to an average of 4075 feet at SH 50. Basins vary in size from 103 square miles to 110 acres. Drainage is from the south to the north and all basins in the study area are tributary to the Arkansas River.

SH 50 IN LA JUNTA
MP 377 TO MP 379
JUNE, 1992

FIGURE 1 - SITE LOCATION MAP



- Watershed Characteristics

Surficial deposits are mainly residual soils from eroded shale and limestone and are moderately permeable. They are classified as Type B by the Soil Conservation Service. Land use is predominantly agricultural and some of the basins are partially irrigated. Irrigation of crops has increased over the years as agriculture developed. This irrigation causes saturation of soils decreasing soil perviousness and increasing runoff. Eroded soil from cultivated fields are carried in irrigation waste water and precipitation runoff to SH 50 R.O.W. where it is deposited in borrow ditches.

Much of the land immediately south of SH 50 R.O.W. has been commercially developed. Land further south has been developed for housing and trailer courts. Much of the development occurred before the Department began reviewing drainage plans as part of the access permitting process. Subsequently, most of this development has occurred without adequate provisions for detention of storm water runoff to historic levels. Peak runoff has increased from the time of construction of existing drainage structures.

Development has been steady and will likely continue in the future. Further reduction in basin perviousness and increasing storm runoff peaks should be expected.

Basins were delineated on the USGS 7.5 minute quadrangle for La Junta and are shown in Figure 2.

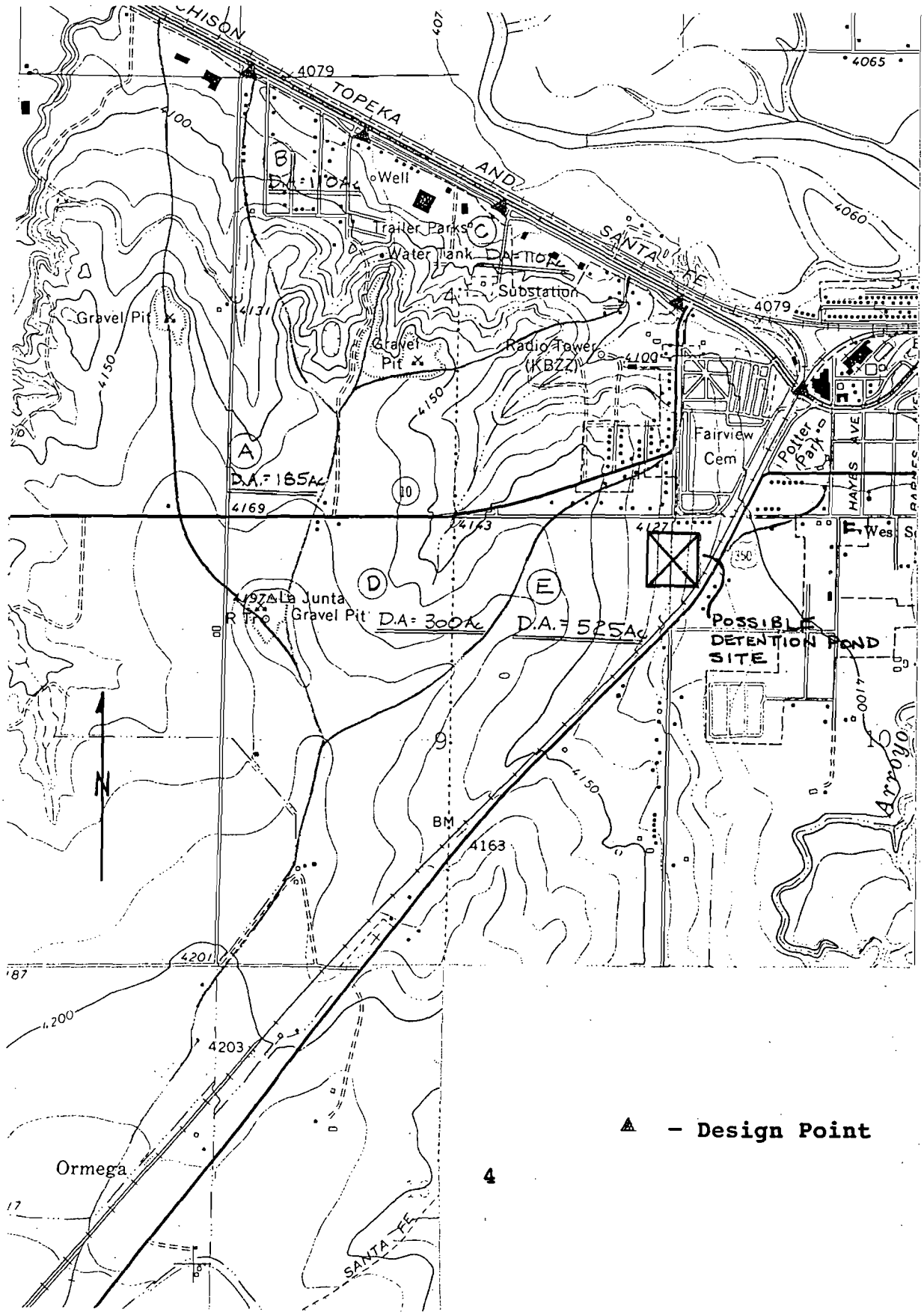
- Precipitation

The climate in La Junta is characterized as semi-arid. Average annual precipitation is 12.3 inches. This is based on 72 years of record at Rocky Ford, seven miles to the west of the study corridor. Periods of drought are common and result in the uneven distribution of precipitation. Variations occur from year to year as well as seasonally.

The greatest recorded rainfall in a 24 hour period is 6.2 inches. This occurred on July 8, 1893. The flood history in the study corridor indicates that the principal cause of flooding is localized high intensity, short duration convective thunderstorms. These events occur generally between May and September.

SH 50 IN LA JUNTA
MP 377 TO MP 379
JUNE, 1992

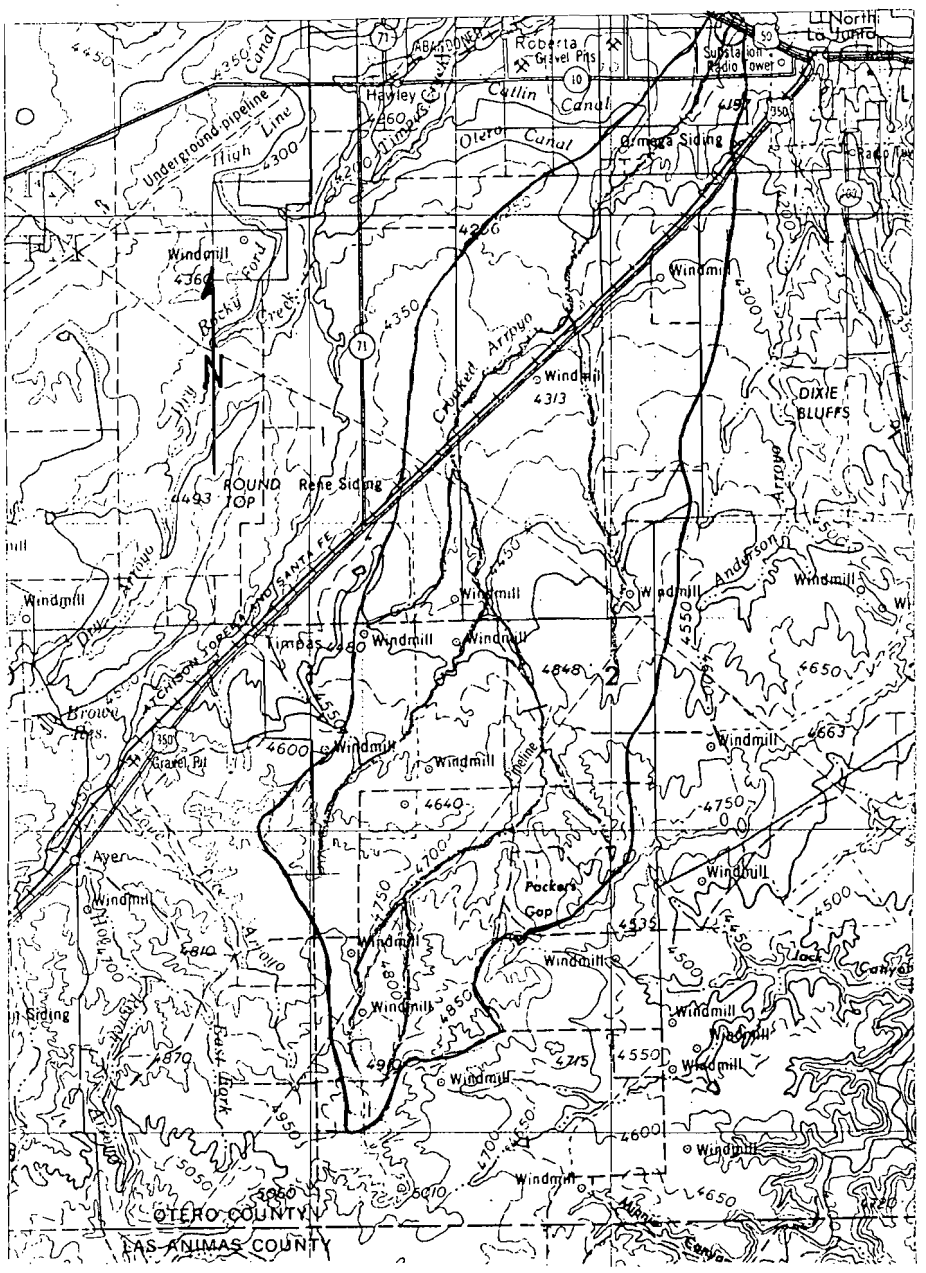
FIGURE 2 - MAP OF SMALL BASINS



▲ - Design Point

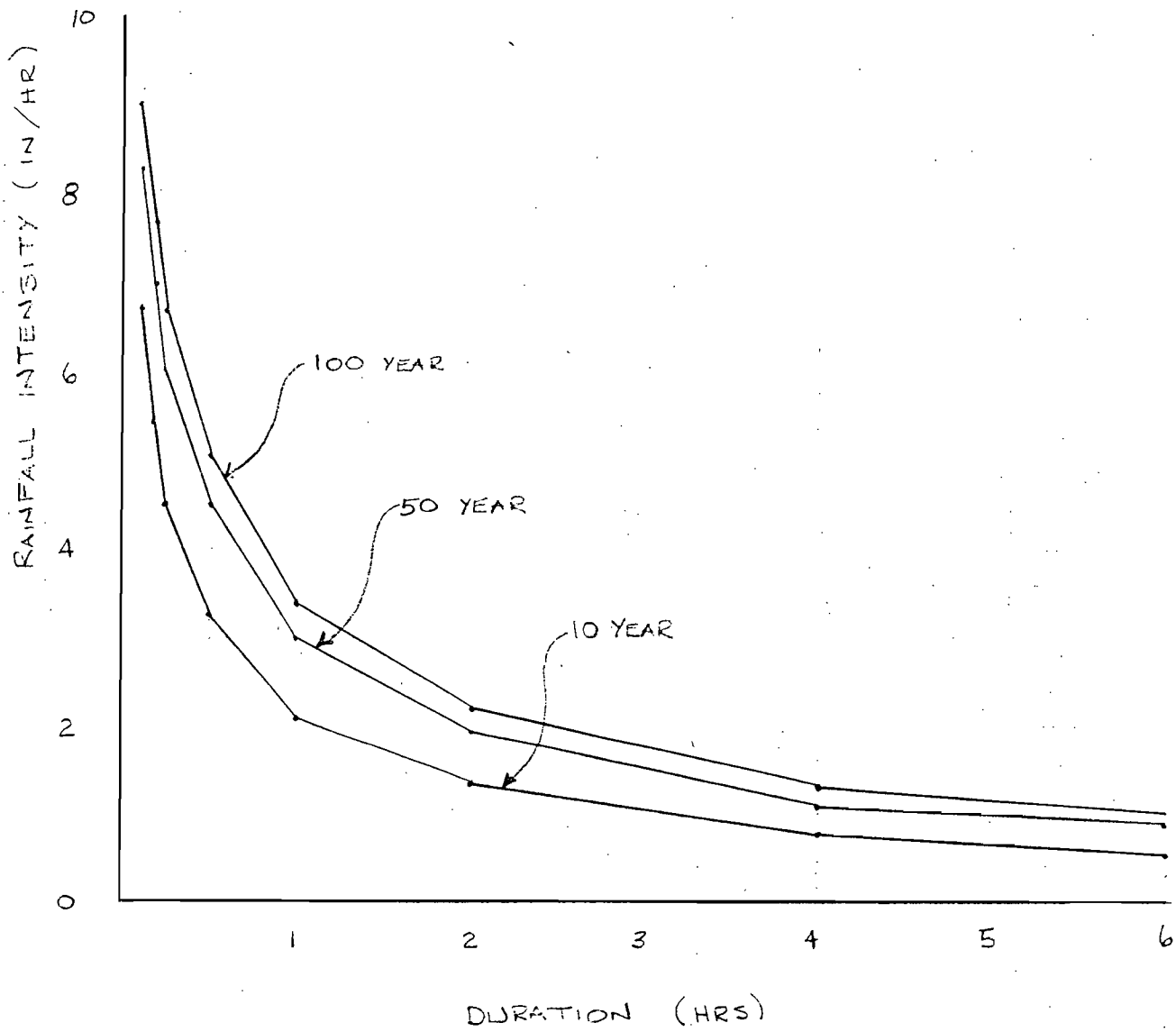
SH 50 IN LA JUNTA
MP 377 TO MP 379
JUNE, 1992

FIGURE 3 - MAP OF CROOKED ARROYO BASIN
(D.A.= 103 sq. mi.)



Scale - 1:250,000

FIGURE 4 - RAINFALL INTENSITY-DURATION-FREQUENCY CURVE FOR LA JUNTA



*** From Hydrain (Hydro) computer package**
Output is included in Appendix A

- Flood History

Historical records reference many floods in the Arkansas River valley. The worst of these occurred in June, 1921 when the river reached a discharge of 200,000 cfs. Floods in the valley are of two general types. One is represented by spring floods which result from snow melt and are characterized by moderate flow rates over long durations. The other, summer floods, are caused by localized convective storms which are characterized by higher peak rates of shorter duration.

Although the study area itself is in the fringe of the Arkansas River flood plain, most flooding along the study area is caused by localized convective storms and flooding is not necessarily associated with that on the Arkansas.

Flooding has been a problem at the AT & SF railroad underpass at MP 378.73 and frequent localized ponding has occurred at various other locations within the SH 50 study corridor. Flooding was reported throughout the entire study corridor on July 20, 1990. This flooding was the result of 3.5 inches of precipitation in less than one hour. This rainfall was recorded at Swink, less than 5 miles west of La Junta and is a reasonable estimate of precipitation rates in the study corridor. It is estimated that this rainfall intensity was greater than a 100 year event. Runoff may actually have been considerably greater than a 100 year flood as soils were saturated by more than double the average monthly precipitation and above normal crop irrigation. Decreased basin perviousness from soil saturation likely caused increased runoff for this rainfall event.

- Basis for Design Flood Frequency

The 1990 Federal Aid Urban System and Urban Area Boundary Map for La Junta shows that the study corridor is now designated as urban. As an urban area, CDOT drainage criteria recommends that any drainage structures built on future projects be designed to convey the 100 year runoff.

The 100 year frequency shall be used for the design of any future drainage structures in La Junta unless an economic analysis indicates otherwise. This report assumes that the 100 year frequency will be used for design.

- Prediction of Design Discharge

Preliminary hydrologic analysis was performed on each of the watersheds tributary to the study corridor. The Soil Conservation Service hydrology method, Technical Release 55 (TR 55), was used to estimate runoff and peak discharges for each minor basin. A regional relationship of basin area to peak discharge was used to estimate design discharge for Crooked Arroyo.

TR 55 is a simplified method for estimating runoff and peak discharges in small watersheds. While this method was developed primarily for urban and urbanizing watersheds, its procedures apply to any small watersheds and it is well suited to the developing basins in the study corridor.

Hydrology work sheets are included in Appendix A and results of the TR 55 hydrologic analyses are tabulated in Figure 5.

A drainage area-discharge relationship of similar watersheds was developed to estimate design discharge for Crooked Arroyo at SH 50. A peak discharge - frequency relationship was derived from published data for Anderson and King Arroyos, both in La Junta. This data was plotted on a drainage area / discharge curve (Figure in Appendix A) and was supplemented with hydrology used to perform the preliminary sizing for the structure proposed over Crooked Arroyo on SH 10.

There is a gaging station on Crooked Arroyo near SH 50 that has been collecting data since 1968. A Log Pearson statistical analysis was performed using this data. Because of the limited period of record this analysis grossly underestimated peak flow rates and was not used for hydraulic analysis. A short term gaging station on Crooked Arroyo near La Junta recorded a flow rate of 24,300 cfs on July 12, 1953. This data would indicate that the regional relationship is a much better estimate of peak flow on Crooked Arroyo than the Log Pearson statistical analysis.

The following peak discharges are recommended for hydraulic design of structures at Crooked Arroyo on SH 50:

Q100 = 15,500 cfs
Q50 = 11,000 cfs
Q10 = 4,000 cfs

No detention was assumed in calculating basin runoff. It is assumed that all depressed areas or ditches that could potentially detain runoff will be full of irrigation waste water or sediment during the design flood.

FIGURE 5 - TABULATION OF DESIGN DISCHARGES FOR SMALL BASINS

Basin Designation	* Design Point	Existing Structure	Drainage Area (Acres)	Q100 (cfs)
A	East of Co. Rd. 27	24" CMP	135	370
B	East of Cuchara St.	24" CMP	110	320
C	North of trailer court	2-29"x 18" CMPA	110	300
D	Jct. SH 10 and SH 50	48" CMP	300	600
E	Railroad underpass	4 Inlets/ 36" Outfall	525	665

* Design points are located at existing drainage structures.

EXISTING DRAINAGE

- General Discussion

Existing structures were placed during construction of the present west bound lanes. These structures were extended when the eastbound lanes were built on Project F 001-4(10) in 1962.

The existing culverts were installed prior to development on the south side of SH 50. Development has rapidly progressed decreasing the perviousness of the basins draining to the highway and increasing the storm runoff. Little detention has been provided and most of these developments were built before the department began reviewing developer's drainage plans.

Existing culverts and borrow ditches do not meet present CDOT design criteria given the present design practices and increased design discharges. Overtopping of SH 50 is reported annually by maintenance personnel and borrow ditches require frequent cleaning to remove sediment. This sediment is soil eroded from cultivated fields in tributary watersheds. Areas of pronounced flooding and roadway overtopping include the intersection of SH 50 and Cuchara St. near the recently constructed Walmart and the junction of SH 50 and SH 10.

Drainage is further hindered by inadequate drainage under the AT & SF railroad embankment. Although ponding water between westbound SH 50 and the railroad embankment has not been reported to back up onto the highway it does provide sufficient tail water to reduce the capacity of culverts under SH 50 and increase the duration of ponding in the borrow ditches south of SH 50.

- Crooked Arroyo (MP 377.0)

Two major structures convey runoff from Crooked Arroyo under SH 50. Structure M-22-K, west bound, was built in 1955 and structure M-22-A, east bound, was built in 1949. Preliminary calculations indicate that both these structures are undersized to convey the 100 year flood as required by present CDOT criteria. These structures are only capable of conveying the 30 year flood.

Structure M-22-A and Structure M-22-K have sufficiency ratings of 62.9 and 61.9 respectively. These bridges are presently not recommended for rehabilitation or replacement but sufficiency ratings are low enough that they could be considered for replacement on a future project.

- Railroad Underpass (MP 378.73)

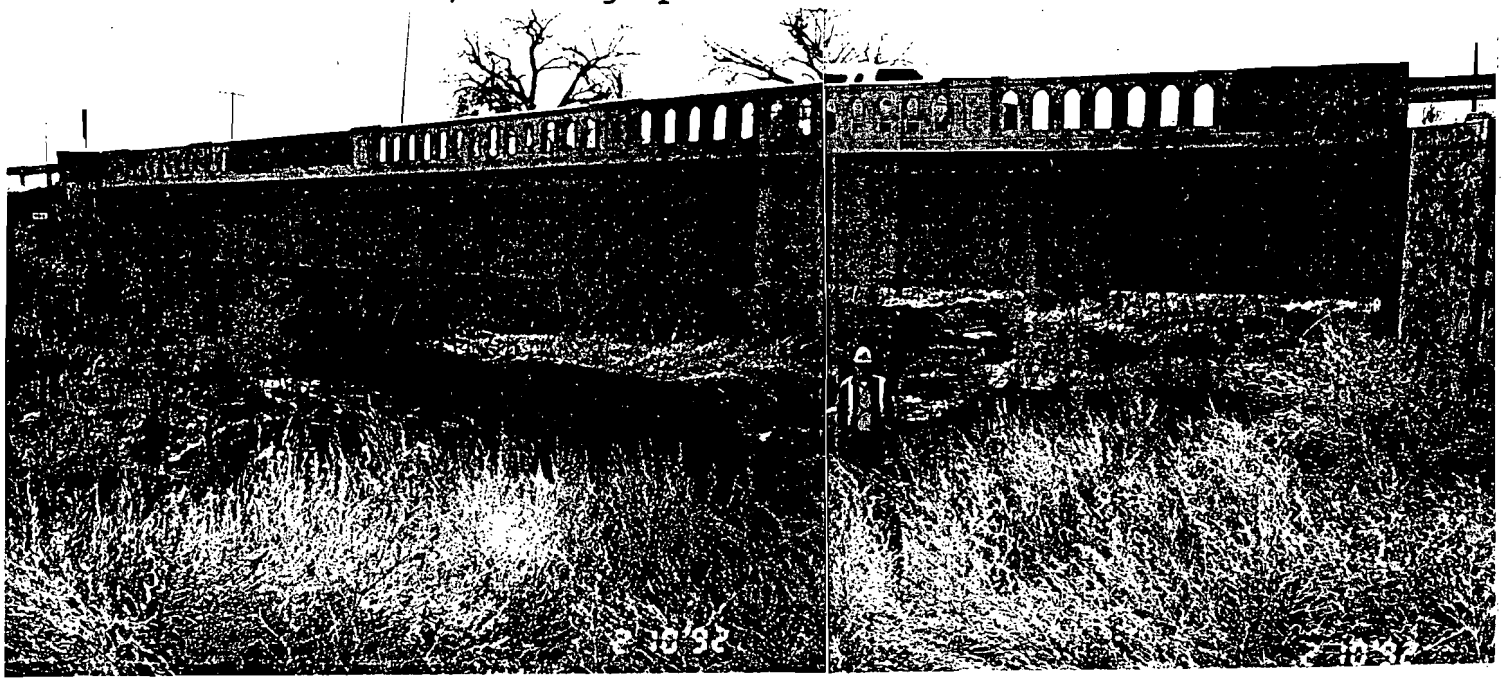
SH 50 is in a sag vertical cut section where it passes under the Atchison, Topeka and Sante Fe Railroad at MP 378.73. This location has been the site of flooding of up to 8' depth and it is reported to have taken greater than 6 hours to drain. The existing inlets are frequently clogged with sediment and debris. This is a very hazardous situation and flooding has frequently caused SH 50 to be closed.

Runoff to the underpass is generated in a 525 acre basin draining from the south west. The At & SF railroad defines the south east boundary to this basin. Flow is concentrated along the railroad embankment and conveyed directly into the sump area. In addition, approximately 2000 feet of roadway runoff flows to the sump.

The outfall from the underpass drains to the north and flows are conveyed to the Arkansas River. This outfall is a 36" RCP. The depth and duration of flooding at the sump would indicate that it is undersized and on a very mild slope.

FIGURE 6(a) - PHOTOS OF STUDY CORRIDOR

1. Crooked Arroyo (MP 377.0) - February 10, 1992
   - Str. M-22-K, looking upstream from north side



2. Crooked Arroyo (MP 377.0) - February 10, 1992
   - Looking downstream from under Str. M-22-A

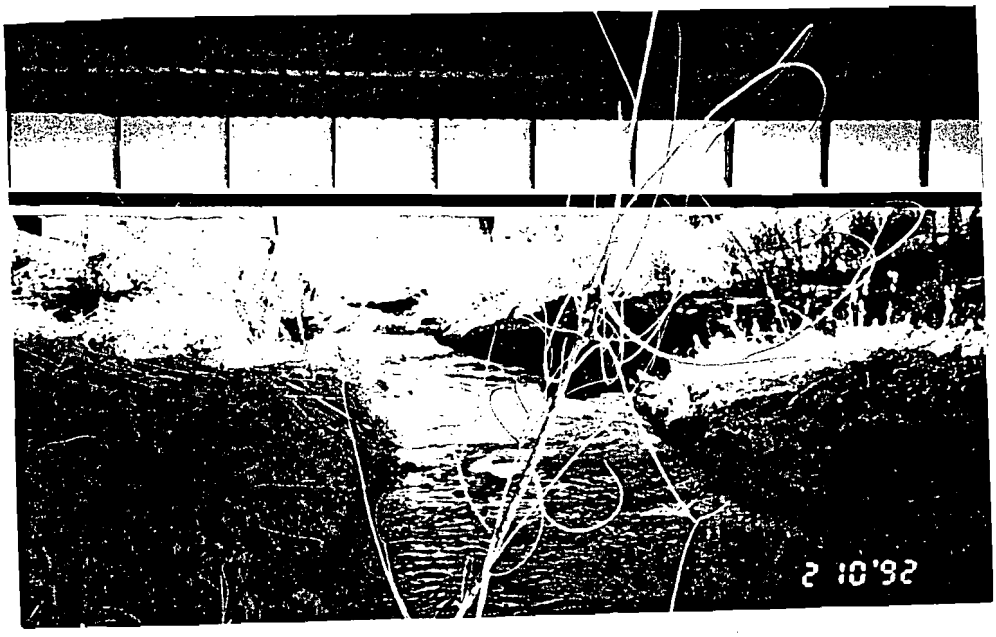
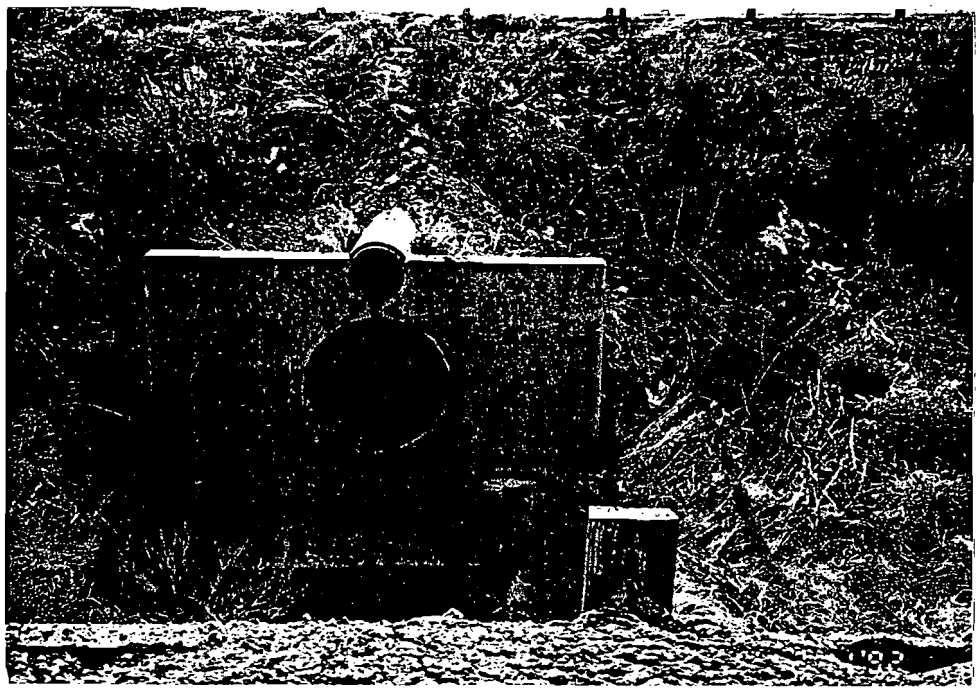
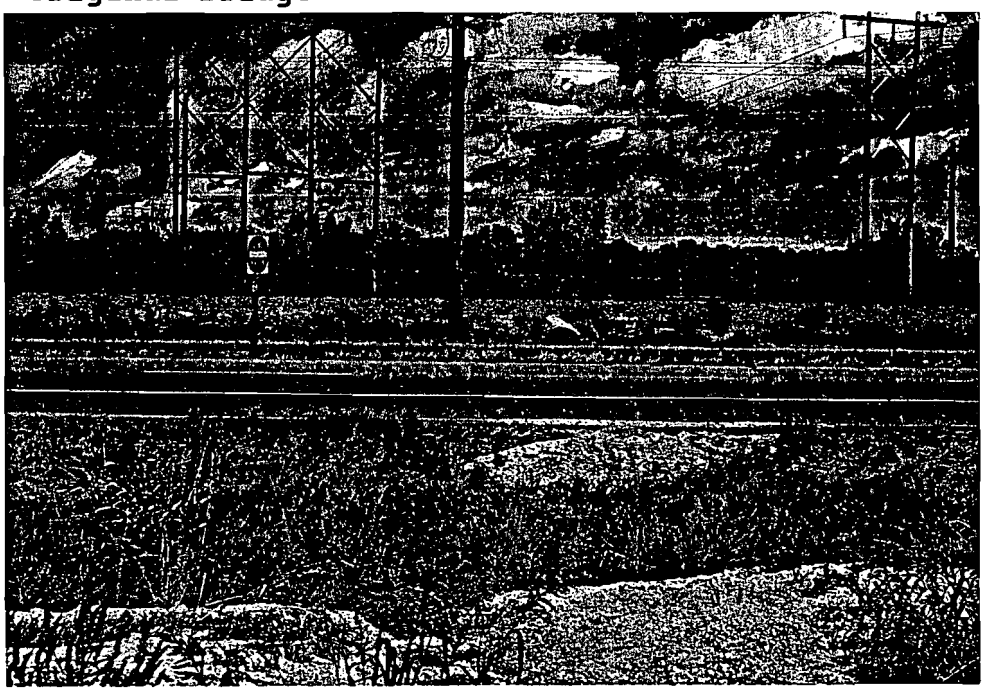


FIGURE 6(b) - PHOTOS OF STUDY CORRIDOR

3. Outfall at Jct. SH 50/SH 10 - February 10, 1992



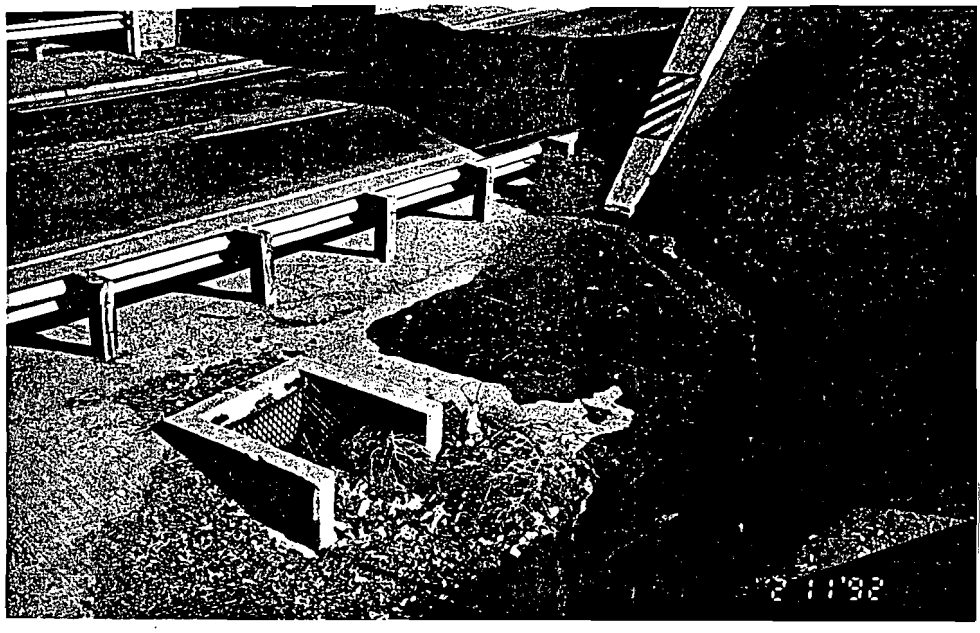
4. AT & SF railroad embankment - September 27, 1990
- Looking N. from Jct. SH 50/SH 10, 6-42" CMP have replaced original bridge



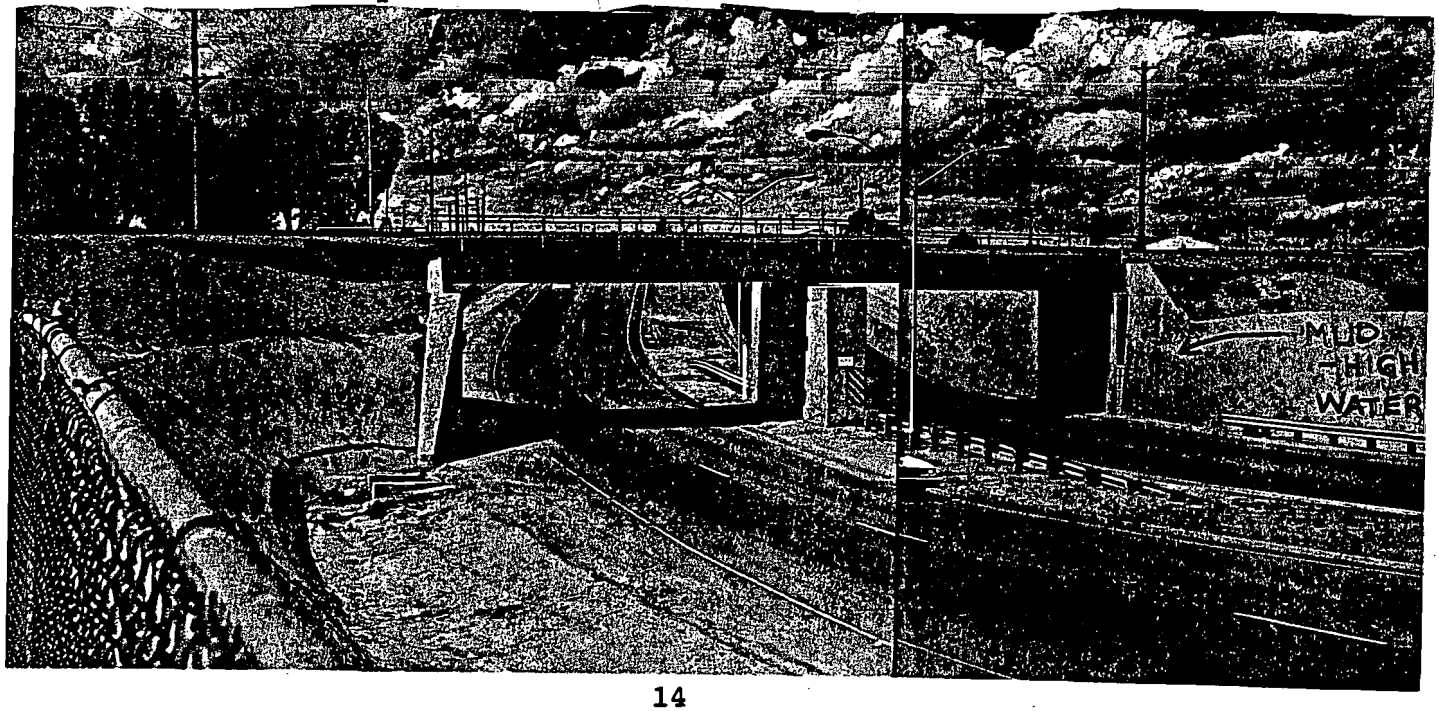
SH 50 IN LA JUNTA
MP 377 TO MP 379
JUNE, 1992

FIGURE 6(c) - PHOTOS OF STUDY CORRIDOR

5. Railroad Underpass (MP 378.73) - February 10, 1992
   - South west of railroad structure, note debris in inlet



6. Railroad Underpass (MP 378.73) - September 27, 1990
   - Looking west from Potter's Park, note high water mark indicate by mud on north abutment



DESIGN DISCUSSION

- General Discussion

All culverts, borrow ditches and storm drains in the study corridor are greatly undersized and should be replaced by culverts with capacity to convey the 100 year flood. Borrow ditches should be improved to convey intercepted runoff to the cross culverts without overtopping SH 50 or backing water up onto adjacent property. Additional ditch capacity should be provided to allow for freeboard and sedimentation. Increased borrow ditch sizes will likely require additional R.O.W. and utility relocations on the south side of the SH 50 frontage road.

Additional capacity through SH 50 will only be effective in reducing flooding if capacity is also increased through the railroad embankment. This will require extension of culverts through the railroad embankment and therefore work within AT & SF R.O.W. Channel work may be needed north of the railroad to prevent downstream erosion and to ensure drainage to the Arkansas River.

Several structure types and sizes were assessed for each drainage crossing. Culvert data sheets with this analysis are included in Appendix B. This report assumes that multiple culvert installations will be best suited at most locations within the study corridor. This will allow us to spread out the flow and minimize roadway grade raises.

Erosion control during construction and long term erosion control after completion of construction is required to be addressed on any future project by present water quality regulations. Erosion control features for construction applications are intended mainly to prevent erosion from exposed slopes, ditches and stockpiled material. These features are discussed in CDOT's Erosion Control Manual and include such items as hay bales, silt fences and temporary sediment traps.

Long term water quality features are intended to prevent eroded material and storm water pollutants from entering receiving waters. Long term water quality features are required by present regulations and are included in projects when the need is justified. Although this report does not specifically address long term erosion control, given the maintenance history of sedimentation of borrow ditches, sediment ponds or traps to collect soil eroded from cultivated fields within the tributary watersheds should be considered. This may require additional R.O.W.

- Crooked Arroyo (MP 377)

Although there is no history of flooding at the existing structures across Crooked Arroyo, both structures are undersized to convey the 100 year flow as required by present CDOT design criteria. The structural sufficiency ratings are low enough that both could be considered for replacement on a future project.

We have performed a preliminary sizing for the replacement of Structures M-22-K and M-22-A on SH 50 at Crooked Arroyo. It is assumed that these structures will be considered for replacement on a future project to convey the 100 year flood. Recommended sizes are preliminary and for scoping and budgeting purposes should the District choose to replace these structures.

- Railroad Underpass (MP 378.73)

In order to prevent flooding at the railroad underpass, the primary goal should be to intercept runoff before it enters the sump. Basin runoff should be intercepted and collected before it overtops the underpass retaining wall and flows to the low point. Roadway runoff should be intercepted at the curb in on grade inlets above the sump. Roadway runoff could be further reduced if the roadway grade was adjusted to provide crests in the vertical alignment of SH 50 close
to the sump.

Additional inlets should be provided in the sump area itself and flanking inlets are recommended to ensure drainage if the sump inlets are clogged by debris and sediment. If sufficient fall is not available between the underpass sump and the drainage outfall, a pump station may be needed.

It may be possible to construct a detention pond in the tributary basin to reduce peak flows to the underpass. This would be an effective means of limiting outfall drain size and drainage costs. A detention pond alternative has not been assessed or addressed in this report but it should be considered during project design. Preliminary calculations were performed to approximate size and location for interception ditches, storm drain culverts and inlets. These features will likely require additional right of way takings and utility relocations.

CONCEPTUAL DESIGN

Preliminary sizes and locations for all culverts, ditches and inlets except the structures at Crooked Arroyo are shown on Figure 7.

Recommended culvert sizes are preliminary estimates based on inlet control calculations. They are for scoping and budgeting purposes and will be subject to revision after a thorough investigation and analysis of field survey. Actual sizes and final locations should be determined during project design.

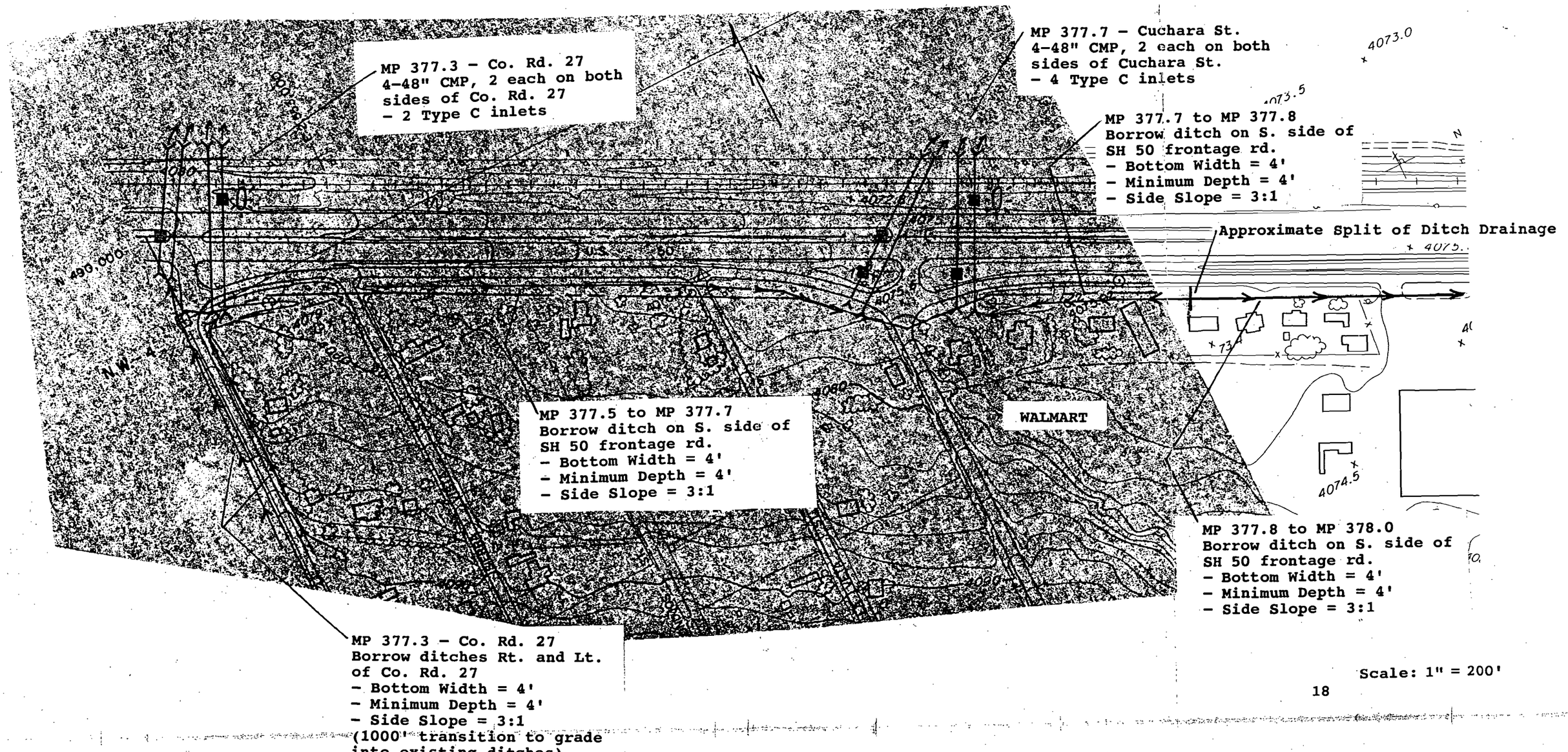
Detailed survey will be required for hydraulic design. Cross sections of existing structures across SH 50 frontage road and SH 50 will be needed. Survey will be required to extend a minimum of 200' north of the railroad and 200' south of CDOT R.O.W. Aerial mapping supplemented with ground verification of drainage flow lines might be practical.

- Crooked Arroyo (MP 377.0)

Our preliminary sizing for structures to replace Structures M-22-K and M-22-A indicates that a 130'x 15' vertical abutment bridge or a 140' to 150' spill abutment bridge will be needed to convey the 100 year flood with adequate freeboard.

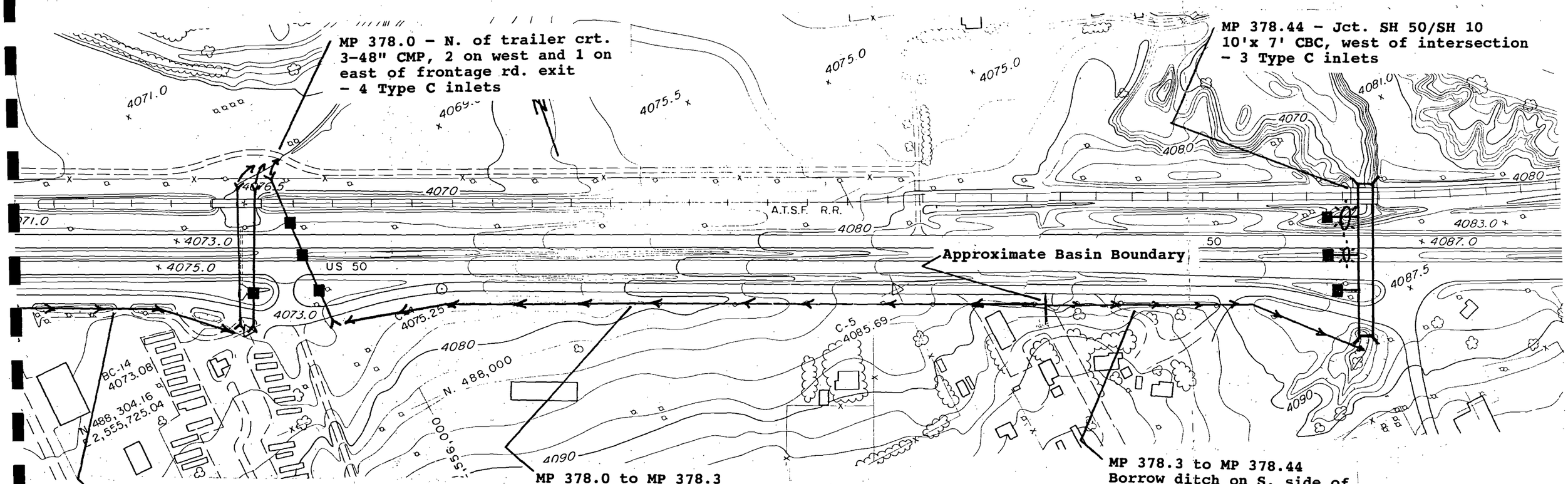
SH 50 IN LA JUNTA
MP 377 TO MP 379
JUNE, 1992

FIGURE 7 – PRELIMINARY DRAINAGE PLAN



SH 50 IN LA JUNTA
MP 377 TO MP 379
JUNE, 1992

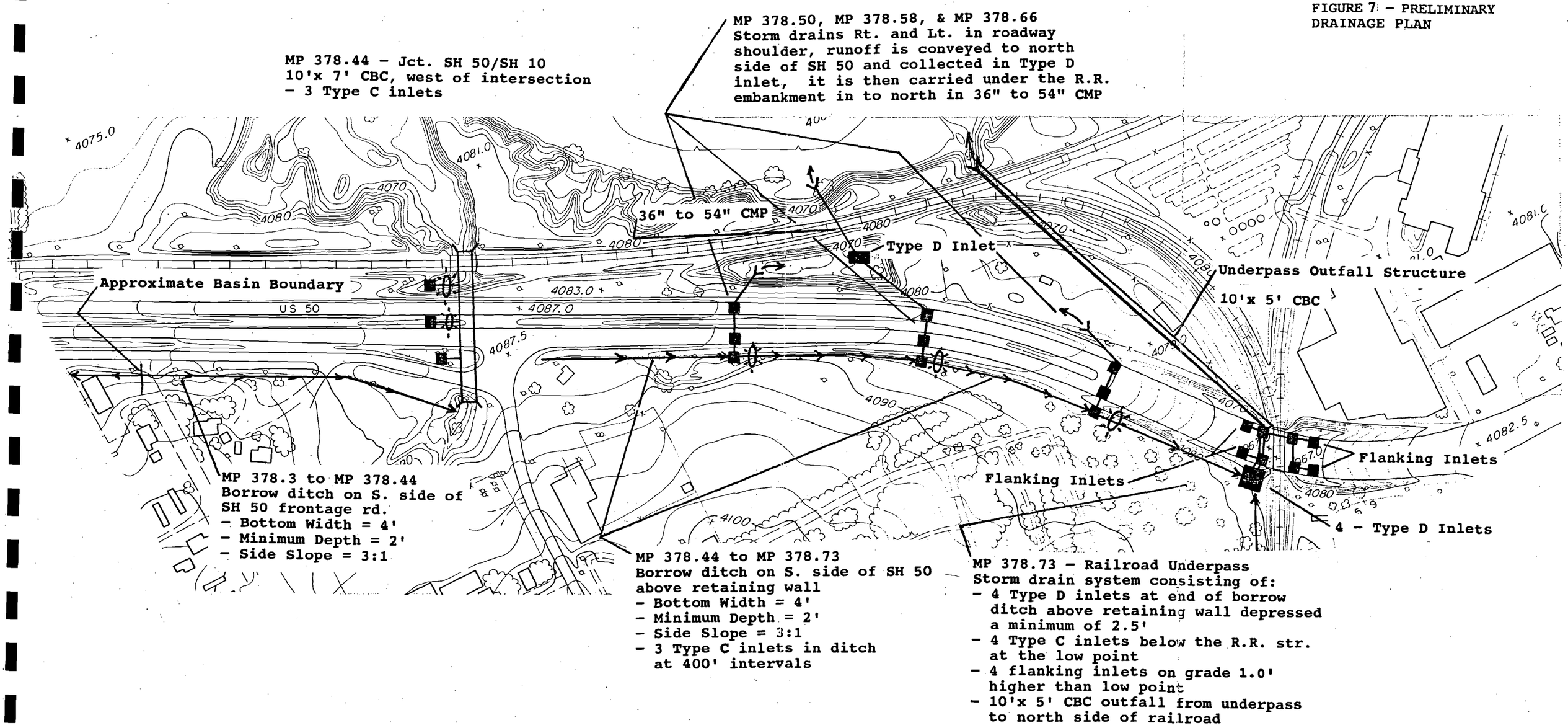
FIGURE 7 - PRELIMINARY DRAINAGE PLAN



Scale: 1" = 200'

SH 50 IN LA JUNTA
MP 377 TO MP 379
JUNE, 1992

FIGURE 7 – PRELIMINARY DRAINAGE PLAN



REFERENCES

1. Flood Insurance Study; City of La Junta, Colorado; Federal Emergency Management Agency, June,1982.

2. Special Flood Hazard Information; Arkansas River, Anderson and King Arroyos; La Junta, Otero County, Colorado; Department of the Army, Albuquerque District, Corps of Engineers; August, 1977.

3. Roadway Design Manual; Colorado Department of Transportation, 1990.

4. Magnitude and Frequency of Floods in the United States, Part 7, Lower Mississippi River Basin, Geological Survey Water-Supply Paper 1681, Department of the Interior, 1964.

APPENDIX A

HYDROLOGIC CALCULATIONS

- Calculations for Rainfall-Intensity-Duration Curve
- Regional Drainage Area / Discharge Analysis for Crooked Arroyo
- Log Pearson Analysis on Crooked Arroyo
- Peak Recorded Flow for Crooked Arroyo near La Junta
- Hydrologic Calculations for Small Basins

SH 50 IN LA JUNTA
MP 377 TO MP 379
MAY, 1992

Calculations for Rainfall-Intensity-Duration Curve

```
*************** HYDRO - Version 4.0 ***************
*  HEC19 / Design Event vs Return Period Program  *
*              Date of Run: 05-27-92              *
```


LA JUNTA RAINFALL INTENSITY DURATION FREQUENCY CURVE (100 YEAR)

```
--- Input File: C:\HYDRO\LAJUNT.HDO

JOBLA JUNTA RAINFALL INTENSITY DURATION FREQUENCY CURVE (100 YEAR)
IDFLA JUNTA, COLORADO

*** THE IDF CURVE OPTION HAS BEEN SELECTED.

LOC38 00 103 30

*** THE LATITUDE IS  38 DEGREES,  0 MINUTES
*** THE LONGITUDE IS 103 DEGREES, 30 MINUTES

RPD100

*** THE SELECTED RETURN PERIOD IS   100 YEARS

END

*** END OF COMMAND FILE
```

***** HYDRO ***** (Version 4.0) ***** DATE 05-27-92

LA JUNTA RAINFALL INTENSITY DURATION FREQUENCY CURVE (100 YEAR)

IDF CURVE FOR VARIOUS RETURN PERIODS

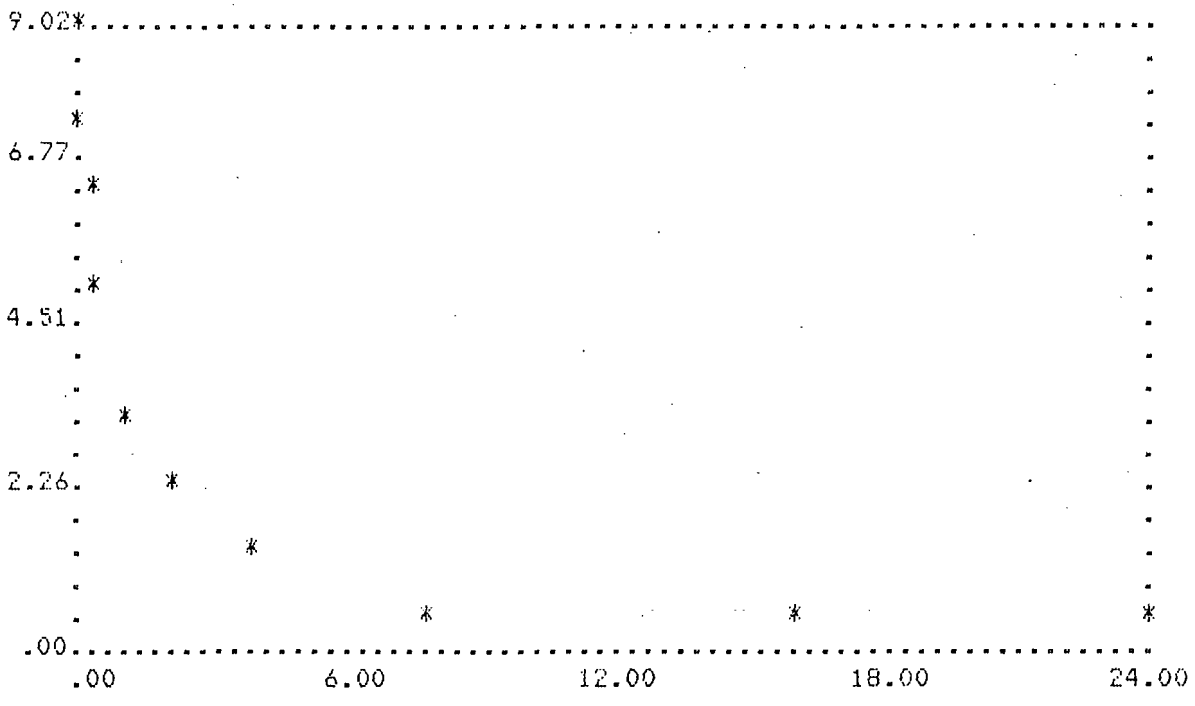
INTENSITIES (IN/HR)

DURATION	100 YR	2 YEAR	5 YEAR	10 YEAR	25 YEAR	50 YR
5 MIN	9.025	4.628	5.910	6.677	7.653	8.357
10 MIN	7.666	3.577	4.723	5.429	6.345	7.019
15 MIN	6.721	2.846	3.899	4.562	5.437	6.088
30 MIN	5.054	1.916	2.733	3.263	3.978	4.520
60 MIN	3.405	1.189	1.748	2.119	2.627	3.017
120 MIN	2.197	.767	1.128	1.367	1.694	1.946
4 HRS	1.283	.448	.659	.798	.990	1.137
8 HRS	.700	.245	.360	.436	.540	.621
16 HRS	.367	.128	.188	.228	.283	.325
24 HRS	.249	.087	.128	.155	.192	.220

LA JUNTA RAINFALL INTENSITY DURATION FREQUENCY CURVE (100 YEAR)

LA JUNTA, COLORADO

INTENSITY CURVE FOR 100 YEAR RETURN PERIOD
RAINFALL INTENSITY(INCHES/HOUR)-VS-DURATION(HOURS)



*** FILE CREATED ON INTERMEDIATE DIRECTORY = LAJUNT.IDF

*** END OF RUN

SH 50 IN LA JUNTA
MP 377 TO MP 379
MAY, 1992

Regional Drainage Area / Discharge Analysis for Crooked Arroyo

SH 50 IN LA JUNTA

Project No.

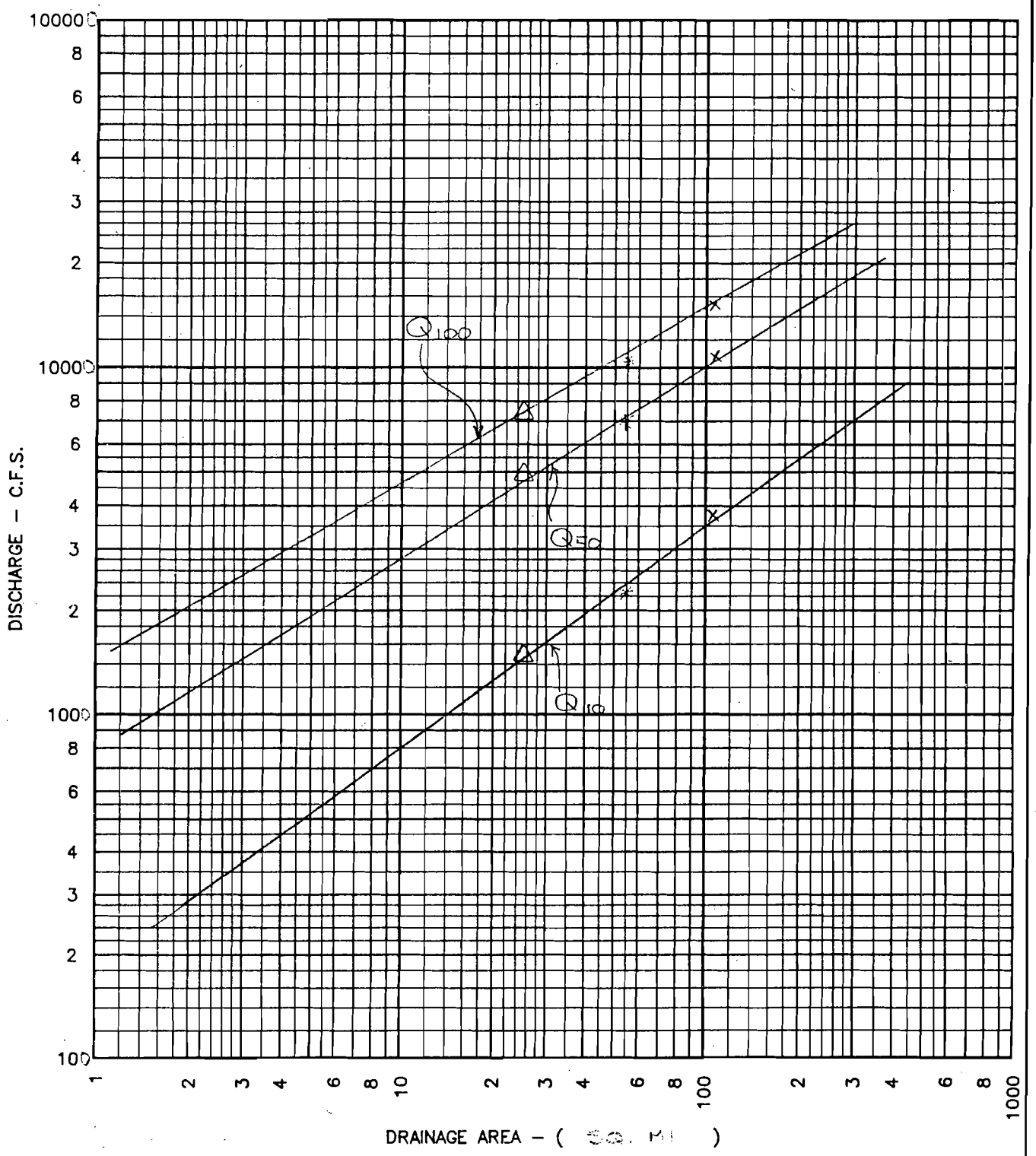
CROOKED ARROYO

Location

DPA 4-20-9?

By Date

DISCHARGE vs DRAINAGE AREA



COMMENTS: * ANDERSON ARROYO - 1982 F.I.S. STUDY (D.A. = 54 mi²)

△ KING ARROYO - 1983 F.I.S. STUDY (D.A. = 25 mi²)

X CROOKED ARROYO AT SH 10 - BRS 010-1(22) (D.A. = 101.7 mi²)

CDOH Form #1059
8-86

Work Sheet
No. (09000) 61C
MAY, 1980

BRF 010-1(22)
Project No.

9-20-90
Date

SPS
By

HYDROLOGY SUMMARY

LOCATION: Sta. MP 69.7 Stream Name CROOKED ARROYO S.H. 10

Existing Str. No. M-22-Z Basin Map OTERO COUNTY

At/Near LA JUNTA USGS

Drainage Area 101.7 Acres / Sq. Mi. Main Channel Length _____ ft. 27.6 mi.

△ Elev. = 4960 - _____ = _____ ft. Tc = _____ hr.

METHOD

TM1 - PLAINS REGION

Q_{10} = 5,150 cfs Q_{500} = 42,500 cfs

Q_{50} = 12,900 cfs

Q_{100} = 20,200 cfs

TM1 - UNGAGED

Q_{10} = 3,650 cfs Q_{500} = 16,600 cfs

Q_{50} = 7,650 cfs

Q_{100} = 9,900 cfs

USGS - WATER SUPPLY PAPER

Q_5 = 2,500 cfs Q_{50} = 6,800 cfs

Q_{10} = 3,650 cfs Q_{100} = 8,400 cfs

Q_{25} = 5,320 cfs

Comments

USE LOWER LIMIT OF TM1 FOR PRELIMINARY DESIGN, HYDROLOGY MAY NEED TO BE ADJUSTED

DISCHARGES

Q_{10} = 3,800 cfs

Q_{50} = 11,000 cfs

Q_{100} = 15,400 cfs

SH 50 IN LA JUNTA
MP 377 TO MP 379
MAY, 1992

Table 1 - Summary of Discharges

Flood Source and Location	Drainage Area (sq. mi.)	Peak Discharge (cfs) 10-year	50-year	100-year	500-year
Arkansas River at La Junta	12,210	28,000	68,000	92,000	156,200
King Arroyo at La Junta	25	1,550	5,000	7,500	17,000
Anderson Arroyo at La Junta	54	2,225	7,000	10,500	23,000

From Flood Insurance Study for the City of La Junta, FEMA, 1982

Discharges for King and Anderson Arroyos used for Drainage Area vs Discharge relationship developed for Crooked Arroyo.

SH 50 IN LA JUNTA
MP 377 TO MP 379
MAY, 1992

Log Pearson Analysis on Crooked Arroyo

```
*************** HYDRO - Version 3.2 ***************
*  HEC19 / Design Event vs Return Period Program  *
*              Date of Run: 06-07-92              *
                                                 PAGE NO   1
   LOG PEARSON ANALYSIS - CROOKED ARROYO

 --- Input File: C:\HYDRO\CROOK.HDO

 JOBLOG PEARSON ANALYSIS - CROOKED ARROYO
 FLW2

*** THE FLOW ANALYSIS OPTION HAS BEEN
*** SELECTED WITH THE USGS SUBOPTION.

 LPA* 0 69120 A
*** THE GAGING STATION AREA IS     69120. ACRES
*** THE STUDY BASIN SITE IS AT THE SAME LOCATION AS THE GAGING STATION.

 GFLCROOK.FLW
 BAS69120

*** THE BASIN AREA =  69120.00   ACRES

 RPD100

*** THE SELECTED RETURN PERIOD IS   100 YEARS

 END

*** END OF COMMAND FILE


*****************************************************
   THE MEAN OF THE LOG FLOW VALUES EQUALS   2.3671
      THE STANDARD DEVIATION EQUALS    .41148
    THE COMPUTED SKEW COEFFICIENT EQUALS   .17255
*****************************************************


      ************************************
      * THE PEAK FLOW IS        2378. CFS *
      ************************************


*** END OF RUN
```

Annual Peak Discharges - Crooked Arroyo Nr. Swink (1968 to 1991)

23-YEARS OF RECORD

598
865
1200
124
105
87
72
395
297
141
259
246
70
226
199
1050
342
584
124
63
236
54
790

SH 50 IN LA JUNTA
MP 377 TO MP 379
MAY, 1992

Peak Recorded Flow for Crooked Arroyo near La Junta

Table 3.--Peak discharge at miscellaneous sites and unusual floods at short-term gaging stations--Continued

Flood region, hydrologic area	Stream and place of determination	Drainage area (sq mi)	Peak discharge		
			Date	Cfs	Cfs per sq mi
	Arkansas River basin--Continued				
E24	Sixmile Creek near Avondale, Colo.....	45	June 25, 1945	1,180	26.2
E25	Huerfano River near Nepesta, Colo.....	1,875	Aug. 1, 1923	19,400	10.3
E27	Apishapa River at Aguilar, Colo.....	149	Aug. 10, 1938	5,200	34.9
E24	Crooked Arroyo near La Junta, Colo.....	87	July 12, 1953	24,300	279
E27	Purgatoire River above Lorencito canyon, near Weston, Colo.	381	May 19, 1955	1,790	4.70
E27	Zarcillo Canyon near Segundo, Colo.....	36.4	May 19, 1955	1,460	40.1
E27	Burro Canyon at Madrid, Colo.....	28.3	July 22, 1925	23,600	834
E27	Reilly Canyon at Cokedale, Colo.....	36.7	May 19, 1955	2,800	76.3
E27	Long Canyon near Sopris, Colo.....	104	May 19, 1955	9,650	92.8
E27	Purgatoire River at Lopez Diversion Dam, Colo.	691	May 19, 1955	19,800	28.7
E27	Raton Creek at upper U.S. Highways 85 and 87, Colo.	5.27	May 19, 1955	402	76.3
E27	Joe Creek near Morley, Colo.....	4.54	May 19, 1955	642	141
E27	Raton Creek at Starkville, Colo.....	60.5	May 19, 1955	9,400	155
E27	Purgatoire River at Jansen, Colo.....	766	May 19, 1955	26,400	34.5
E27	Colorado Canyon near Jansen, Colo.....	9.88	July or August 1954	3,100	314
E27	Grasmack Arroyo near Trinidad, Colo.....	3.6	May 19, 1955	820	228
E27	Gray Creek near Trinidad, Colo.....	16.0	May 19, 1955	1,960	122
E27	Purgatoire River near Hoehne, Colo.....	857	May 19, 1955	35,000	40.8
E27	Purgatoire River at U.S. Highway 350 Bridge, Colo.	1,015	May 19, 1955	37,900	37.3
E27	Frijole Creek near Alfalfa, Colo.....	80	July 22, 1954	13,500	169
E27	Unnamed draw No. 1 near Alfalfa, Colo...	.84	July 22, 1954	447	532
E27	Unnamed draw No. 2 near Alfalfa, Colo...	1.49	July 22, 1954	1,130	758
E27	San Francisco Creek near Alfalfa, Colo..	160	July 22, 1954	26,300	164
E27	Trinchera Creek near Trinchera, Colo....	129	July 22, 1954	25,100	195
E27	Alkali Arroyo near Trinchera, Colo.....	34.5	July 22, 1954	15,500	449
E24	Mud Creek near Caddoa, Colo.....	200	Aug. 19, 1956	33,800	169
-	Arkansas River at Amity Canal headgate, near Prowers, Colo.	19,050	June 5, 1921	170,000	8.92
E22	Clay Creek near Lamar, Colo.....	228	May 15, 1951	27,500	121
E22	Big Sandy at Ramah, Colo.....	82.7	Aug. 5, 1954	44,500	538
E22	Wolf Creek near Cranada, Colo.				

SH 50 IN LA JUNTA
MP 377 TO MP 379
MAY, 1992

Hydrologic Calculations for Small Basins

ACRY SHEET NO. (59-63) 52
June 1985

SH. 50 IN LA JUNTA
Project No.
4/15/92
Date
APJ
By

HYDROLOGY CALCULATION SHEET
(SOIL CONSERVATION SERVICE)

STATION MP 377.3 - BASIN A DRAINAGE AREA(A) 185Ac ≅ 0.3 SQ. MI.

Basic Data for Determining
Weighted Soil Cover Complex Number

HYDROLOGIC SOIL AND GROUP LETTER (1)	LAND USE (NAME) (2)	HYDROLOGIC CONDITION (3)	SOIL COVER COMPLEX NO. (NUMBER) (4)	AREA (5)	COMPLEX NO. TIMES AREA (COLS. 4x5) (6)
B	COMMERCIAL & BUSINESS	FAIR	92	(10%) 20 Ac	1,840
B	PASTURE / RANGE	FAIR	69	(90%) 165Ac	11,385
			TOTALS	185	13225

Weighted Soil Cover Complex No. is $\frac{\text{(Total Cl.6)}}{\text{(Total Cl.5)}} = \frac{13225}{185} = 71.4 \sim 72$

Channel Length 7200', Δ Elev. 4197 - 4080 = 107'. T_c (Hrs.) = [illegible]
Rainfall Intensity Distribution Zone II - A Area/Point Rainfall Ratio 1
Unit Peak Discharge (q) in cfs per Square Mile per inch of Runoff 520

DESIGN FREQUENCY

	2 YR.	5 YR.	10 YR.	25 YR.	50 YR.	100 YR.
24 Hour Rainfall in Inches		2.8	3.2	4.0	4.6	5.2
Runoff depth "R" in Inches		0.69	0.93	1.46	1.89	[illegible]
Peak Discharge "Q" in cfs = A x R x q		110	145	230	295	370

COMMENTS:

ACRY SHEET NO. (09-03) 52
June 1985

SH 50 IN LA JUNTA
Project No.
4/15/92
Date
APA
By

HYDROLOGY CALCULATION SHEET
(SOIL CONSERVATION SERVICE)

STATION MP 377.7 - BASIN B DRAINAGE AREA (A) 110 AC ≅ 0.17 SQ. MI.

Basic Data for Determining
Weighted Soil Cover Complex Number

HYDROLOGIC SOIL AND GROUP LETTER (1)	LAND USE (NAME) (2)	HYDROLOGIC CONDITION (3)	SOIL COVER COMPLEX NO. (NUMBER) (4)	AREA (5)	COMPLEX NO. TIMES AREA (COLS. 4x5) (6)
B	COMMERCIAL/ BUSINESS	FAIR	92	10% 11 AC	1012
B	RESIDENTIAL	FAIR	75	40% 44 AC	3300
B	PASTURE / RANGE	FAIR	69	50% 55 AC	3795
			TOTALS		8107

Weighted Soil Cover Complex No. is $\frac{\text{(Total Cl.6)}}{\text{(Total Cl.5)}} = \frac{8107}{110} = 73.7 \sim 74$

Channel Length 3400, Δ Elev. 4165 - 4075 = 90'. T_c (Hrs.) = 0.26
Rainfall Intensity Distribution Zone II-A Area/Point Rainfall Ratio 1
Unit Peak Discharge (q) in cfs per Square Mile per inch of Runoff 710

DESIGN FREQUENCY

	2 YR.	5 YR.	10 YR.	25 YR.	50 YR.	100 YR.
24 Hour Rainfall in Inches		2.8	3.2	4.0	4.6	5.2
Runoff depth "R" in Inches		0.78	1.04	1.60	2.05	2.53
Peak Discharge "Q" in cfs = A x R x q		100	130	200	260	320

COMMENTS:

ACRY SHEET No. (09-03) 52
June 1985

SH 50 IN LA JUNTA
Project No.

4/15/92
Date

APA
By

HYDROLOGY CALCULATION SHEET
(SOIL CONSERVATION SERVICE)

STATION MP 378.0 - BASIN C DRAINAGE AREA (A) 110 Ac ≅ 0.17 SQ. MI.

Basic Data for Determining
Weighted Soil Cover Complex Number

HYDROLOGIC SOIL AND GROUP LETTER (1)	LAND USE (NAME) (2)	HYDROLOGIC CONDITION (3)	SOIL COVER COMPLEX NO. (NUMBER) (4)	AREA (5)	COMPLEX NO. TIMES AREA (COLS. 4x5) (6)
B	COMMERCIAL / BUSINESS	FAIR	92	(10%) 11 Ac	1012
B	RESIDENTIAL	FAIR	75	(10%) 11 Ac	825
B	PASTURE / RANGE	FAIR	69	(80%) 88 Ac	6072
			TOTALS		7909

Weighted Soil Cover Complex No. is $\frac{\text{(Total Cl.6)}}{\text{(Total Cl.5)}} = \frac{7909}{110} = 71.9 \sim 72$

Channel Length 3000', Δ Elev. 4165 - 4073 = 92'. T_c (Hrs.) = 0.33

Rainfall Intensity Distribution Zone IIA Area/Point Rainfall Ratio 1

Unit Peak Discharge (q) in cfs per Square Mile per inch of Runoff 7.0

DESIGN FREQUENCY

	2 YR.	5 YR.	10 YR.	25 YR.	50 YR.	100 YR.
24 Hour Rainfall in Inches		2.8	3.2	4.0	4.6	5.2
Runoff depth "R" in Inches		0.69	0.93	1.46	1.89	2.35
Peak Discharge "Q" in cfs = A x R x q		90	120	190	245	300

COMMENTS:

ACRY SHEET NO. (29-03) 52
June 1985

SH. 50 IN LA JUNTA
Project No.
4/15/92
Date
APS
By

HYDROLOGY CALCULATION SHEET
(SOIL CONSERVATION SERVICE)

STATION MP 378.44 - BASIN D DRAINAGE AREA (A) 300 Ac = 0.47 SQ. MI.

Basic Data for Determining
Weighted Soil Cover Complex Number

HYDROLOGIC SOIL AND GROUP LETTER (1)	LAND USE (NAME) (2)	HYDROLOGIC CONDITION (3)	SOIL COVER COMPLEX NO. (NUMBER) (4)	AREA (5)	COMPLEX NO. TIMES AREA (COLS. 4x5) (6)
B	COMMERCIAL/ BUSINESS	FAIR	92	(10%) 30 Ac	2760
B	RESIDENTIAL	FAIR	75	(15%) 45 Ac	3375
B	PASTURE/ RANGE	FAIR	69	(75%) 225 Ac	15525
			TOTALS	300 Ac	21660

Weighted Soil Cover Complex No. is $\frac{\text{(Total Cl.6)}}{\text{(Total Cl.5)}} = \frac{21660}{300} = 72.2 \sim 73$

Channel Length 7400, Δ Elev. 4195 - 4080 = 115', T_c (Hrs.) = 0.6
Rainfall Intensity Distribution Zone IIA Area/Point Rainfall Ratio 1
Unit Peak Discharge (q) in cfs per Square Mile per inch of Runoff 520

DESIGN FREQUENCY

	2 YR.	5 YR.	10 YR.	25 YR.	50 YR.	100 YR.
24 Hour Rainfall in Inches		2.8	3.2	4.0	4.6	5.2
Runoff depth "R" in Inches		0.74	0.98	1.53	1.97	2.44
Peak Discharge "Q" in cfs = A x R x q		180	240	375	480	600

COMMENTS:

ACRY SHEET NO. (09-03)-52
June 1985

SH 50 IN LA JUNTA
Project No.

4/15/92
Date

APA
By

HYDROLOGY CALCULATION SHEET
(SOIL CONSERVATION SERVICE)

STATION MP 378.73 - BASIN E DRAINAGE AREA(A) 525 Ac = 0.82 SQ. MI.

Basic Data for Determining
Weighted Soil Cover Complex Number

HYDROLOGIC SOIL AND GROUP LETTER (1)	LAND USE (NAME) (2)	HYDROLOGIC CONDITION (3)	SOIL COVER COMPLEX NO. (NUMBER) (4)	AREA (5)	COMPLEX NO. TIMES AREA (COLS. 4x5) (6)
B	RESIDENTIAL	FAIR	75	(5%) 26 Ac	1,950
B	PARK / CEMETARY	FAIR	72	(10%) 53 Ac	3,816
B	PASTURE / RANGE	FAIR	60	(85%) 446 Ac	30,774
			TOTALS	525 Ac	36,540

Weighted Soil Cover Complex No. is $\frac{\text{(Total Cl.6)}}{\text{(Total Cl.5)}} = \frac{36540}{525} = 69.6 \sim 70$

Channel Length 14,400, Δ Elev. [illegible] - [illegible] = 155. T_c (Hrs.) = 1.1

Rainfall Intensity Distribution Zone II-A Area/Point Rainfall Ratio 1

Unit Peak Discharge (q) in cfs per Square Mile per inch of Runoff [illegible]

DESIGN FREQUENCY

	2 YR.	5 YR.	10 YR.	25 YR.	50 YR.	100 YR.
24 Hour Rainfall in Inches		2.8	3.2	4.0	4.6	5.2
Runoff depth "R" in Inches		0.61	0.83	1.33	1.75	2.19
Peak Discharge "Q" in cfs = A x R x q		185	250	400	530	665

COMMENTS:

APPENDIX B

PRELIMINARY HYDRAULIC CALCULATIONS

- Preliminary Culvert Sizing

- Preliminary Sizing for Replacement Structures at Crooked Arroyo

SH 50 IN LA JUNTA
MP 377 TO MP 379
MAY, 1992

Preliminary Culvert Sizing

COLORADO DEPARTMENT OF HIGHWAYS

CULVERT DESIGN DATA

Existing Structure

Station _____ S.H. 50

Skew 90° M.P. 377.3

Size 24"

Type CMP

Designer: APJ

Date: 5/12/92

PROJECT: SH 50 IN LA JUNTA

STATION: MP 377.3

Skew: 90°

Q_{100} (Design) = 370 cfs

discharge	Proposed Structure Size	Type	L	F.L. Elev. in	F.L. Elev. out	So	Sc	Control Section*	HW/D	HW	DHW Elev.	Vo	End Treatment and Comments
370	8'×6'	CBC						Inlet	1.07	6.4'			
								Outlet					
370	84"	CMP						Inlet	1.2	8.4'			
								Outlet					
370	4 - 48"	CMP						Inlet	1.22	4.9'			
								Outlet					
								Inlet					
								Outlet					
Q_{100}								Inlet					
								Outlet					

Allowable headwater elevation (AHW) _____ Control _____

Comments: (Discuss inlet and outlet conditions, channel changes, debris, possible corrosion, etc.)

- IT WILL BE DIFFICULT TO PLACE TALL STRUCTURES AT THIS LOCATION, BATTERY OF SMALLER CULVERTS WILL BE BEST ALT.

*See back for outlet control headwater computations.

Hydraulic information to be placed on plans:

D.A. = 185 Ac

Q_{100} = 370 cfs

DHW = _____

AHW = _____

Q_{100} = _____ cfs

HW = _____

CDOH Form #1038
3/86

COLORADO DEPARTMENT OF HIGHWAYS

CULVERT DESIGN DATA

Existing Structure

Station _____ S.H. 50

Skew 90° M.P. 377.7

Size 24"

Type CMP

Designer: SPS

Date: 5/12/92

PROJECT: SH 50 IN LA JUNTA

STATION: MP 377.7

Skew: 90°

Q_{100} (Design) = 320 cfs

discharge	Proposed Structure Size	Type	L	F.L. Elev. in	F.L. Elev. out	So	Sc	Control Section*	HW/D	HW	DHW Elev.	Vo	End Treatment and Comments
320	6'x6'	CBC						Inlet	1.2	7.2'			
								Outlet					
320	84"	CMP						Inlet	1.09	7.6'			
								Outlet					
320	4 - 48"	CMP						Inlet	1.07	4.3'			
								Outlet					
								Inlet					
								Outlet					
Q_{100}								Inlet					
								Outlet					

Allowable headwater elevation (AHW) _____ Control _____

Comments: (Discuss inlet and outlet conditions, channel changes, debris, possible corrosion, etc.)

• BATTERY OF CULVERTS IS BEST ALT., IT WILL NOT PROBABLY REQUIRE GRADE RA

*See back for outlet control headwater computations.

Hydraulic information to be placed on plans:

D.A. = 110 Ac

Q_{100} = 320 cfs

DHW = _____

AHW = _____

Q_{100} = _____ cfs

HW = _____

CDOH Form #1038
3/86

COLORADO DEPARTMENT OF HIGHWAYS

CULVERT DESIGN DATA

Existing Structure

Station —— S.H. 50

Skew 90° M.P. 378.0

Size 2 - 29" x 18"

Type CMPA

Designer DPJ

Date 5/12/92

PROJECT SH 50 IN LA JUNTA

STATION MP 378.0

Skew 90°

Q_{100} (Design) = 300 cfs

discharge	Proposed Structure			Structure Sizing										End Treatment and Comments
	Size	Type	L	F.L. Elev. in	F.L. Elev. out	So	Sc	Control Section*	HW/D	HW	DHW Elev.	Vo		
300	6'x6'	CBC						Inlet	1.12	6.7'				
								Outlet						
300	84"	CMP						Inlet	1.02	7.1'				
								Outlet						
300	3 - 48"	CMP						Inlet	1.3	5.2'				
								Outlet						
								Inlet						
								Outlet						
Q_{100}								Inlet						
								Outlet						

Allowable headwater elevation (AHW) _____ Control _____

Comments: (Discuss inlet and outlet conditions, channel changes, debris, possible corrosion, etc.)

- TO MINIMIZE GRADE CHANGES, BATTERY IS BEST ALT.

*See back for outlet control headwater computations.

Hydraulic information to be placed on plans:

D.A. = 110 Ac

Q_{100} = 300 cfs

DHW = _____

AHW = _____

Q_{100} = _____ cfs

HW = _____

CDOH Form #1038
3/86

COLORADO DEPARTMENT OF HIGHWAYS

CULVERT DESIGN DATA

PROJECT	SH 50 IN LA JUNTA
STATION	378.44
Skew	90°
Q_{100}(Design) =	600 cfs

Existing Structure

Station — S.H. 50
Skew 90° M.P. 378.44
Size 48"
Type CMP

Designer: APA
Date: 5/12/92

discharge	Proposed Structure Size	Type	L	F.L. Elev. in	F.L. Elev. out	So	Sc	Control Section*	HW/D	HW	DHW Elev.	Vo	End Treatment and Comments
600	10'x7'	CBC						Inlet	1.1	7.7'			
								Outlet					
600	120"	CMP						Inlet	0.88	8.8'			
								Outlet					
600	6-48"	CMP						Inlet	1.3	5.2'			
								Outlet					
								Inlet					
								Outlet					
Q_{100}								Inlet					
								Outlet					

Allowable headwater elevation (AHW) _____ Control _____

Comments: (Discuss inlet and outlet conditions, channel changes, debris, possible corrosion, etc.)

- LARGER STRUCTURE CAN BE USED AT THIS LOCATION AND CBC IS ALTERNATE SUGGESTED IN CONCEPTUAL DESIGN.

*See back for outlet control headwater computations.

Hydraulic information to be placed on plans:

D.A. = 300 Ac
Q_{100} = 600 cfs
DHW = _____
AHW = _____
Q_{100} = _____ cfs
HW = _____

CDOH Form #1038
3/86

COLORADO DEPARTMENT OF HIGHWAYS

CULVERT DESIGN DATA

Existing Structure

Station ____ S.H. 50

Skew ____ M.P. 378.73

Size ____

Type ____

Designer: APS

Date: 5/12/92

PROJECT: SH 50 IN LA JUNTA

STATION: MP 378.73

Skew: —

Q_{100} (Design) = 665 cfs

discharge	Proposed Structure Size	Type	L	F.L. Elev. in	F.L. Elev. out	So	Sc	Control Section*	HW/D	HW	DHW Elev.	Vo	End Treatment and Comments
* (60%) 400	10' x 5'	CBC						Inlet	1.2	6'			HW = 1.2 SHOULD BE O.K. IF INLET TOPS ARE > 1' FROM TOP OF BOX.
								Outlet					
								Inlet					
								Outlet					
								Inlet					
								Outlet					
								Inlet					
								Outlet					
Q_{100}								Inlet					
								Outlet					

Allowable headwater elevation (AHW) ____ Control ____

Comments: (Discuss inlet and outlet conditions, channel changes, debris, possible corrosion, etc.)

* ASSUME ~ 40% OF BASIN RUNOFF CAN BE INTERCEPTED IN DITCH @ TOP OF RETAINING WALL, DETAINED IN WATERSHED OR DIVERTED.

- USE 10' x 5' CBC AS OUTFALL ESTIMATE IN CONCEPTUAL DESIGN

*See back for outlet control headwater computations.

Hydraulic information to be placed on plans:

D.A. = 525 Ac

Q_{100} = 665 cfs

DHW = ____

AHW = ____

Q_{100} = ____ cfs

HW = ____

CDOH Form #1038
3/86

SH 50 IN LA JUNTA
MP 377 TO MP 379
MAY, 1992

Preliminary Sizing for Replacement Structures at Crooked Arroyo

By SPD /
Date 4/12/92

PRELIMINARY BRIDGE SIZE

STRUCTURE NO. M-22-K/M-22-A SH No. 50 SEC. ____ T. ____ R ____
COUNTY OTERO At/Nr. LA JUNTA
STREAM NAME CROOKED ARROYO

HYDROLOGY

U.S.G.S. Maps of Basin LA JUNTA - 7½ min QUAD
OTERO COUNTY (USGS) 1 & 2

Drainage Area 103 Sq. Mi. L, Main Channel Length = 28.0 Mi.

Elev. @ 0.85 L-0.10 L = Δ Elev. = 4790 - 4080 = 710 ft.

SB = $\frac{\Delta \text{ Elev.}}{0.75 \text{ L}}$ = 29.4 ft. per mi. P, Precip. 10 - 12 in. per yr.

Ss, Slope of Stream at Site = 21.1 ft. per mi.

Flood Characteristic Region* PLAINS REGION

Q_{10} = 4,000 cfs Q_{50} = 11,000 cfs Q_{100} = 15,500 cfs

D_{10} = ____ ft. D_{50} = ____ ft.

EXISTING STRUCTURE

Length 100 Ft. θ, Skew Angle 90 °

h = Road Profile Elev. 4092 - Flowline Elev. 4072 ≅ 20 ft.

Area of Waterway ~ 900 Sq.Ft.

Flood history MAINTENACE HAS SEEN HIGH WATER BUT NOT REPORTED FLOODING

REQUIRED STRUCTURE

Bridge ☑ W, Channel bottom width 90 ft. at Elev. 4072

Bridge Length = $\frac{(W+10')+4h}{\cos \theta}$ = $\frac{(90'+10')+48}{\cos 0°}$ = 148' ~ 150 ft.

~~Culvert ☐ Size ____ ft.~~

COMMENTS STRUCTURE COULD ALSO BE A VERTICAL ABUTMENT BRIDGE
- 130' x 15'

(Place additional details and comments on back)

* Technical Manual No. 1, McCain & Jarrett, Colorado Water Conservation Board, 1976.

COLORADO DEPARTMENT OF TRANSPORTATION

DESIGN COMPUTATIONS

Project no. SH 50/LA JUNTA

Pay item description	Pay unit	Item code no.
PRELIMINARY SIZING		

Sheet ___ of ___

- SIZING BASED ON PRELIMINARY HYDROLOGY FOR CROOKED ARROYO AT SH 50
- IT IS ASSUMED THAT BOTH M-22-A & M-22-K WILL BE REPLACED TO CONVEY THE Q100 (STRUCTURES ARE BOTH W/IN AN URBAN AREA AS SHOW ON 1990 FEDERAL AID URBAN SYSTEM AND URBAN AREA BOUNDARY MAP FOR LA JUNTA)
- BOTH STRUCTURES ARE 100' SINGLE SPAN BRIDGES
  - AVERAGE HEIGHT IS ~ 8.5' TO 9.0'

ESTIMATE OF EXISTING CAPACITY

$B = 100'$
$H = 9'$
$HW/D = 1.0$

* FROM INLET CONTROL NOMEGRAPH IN CDOT DESIGN MANUAL

$Q/B = 80$ $\qquad Q_{CAP} = 80B$

$Q_{CAP} \cong 8000$ cfs

THIS FLOW IS APPROXIMATELY A 30 YEAR DESIGN

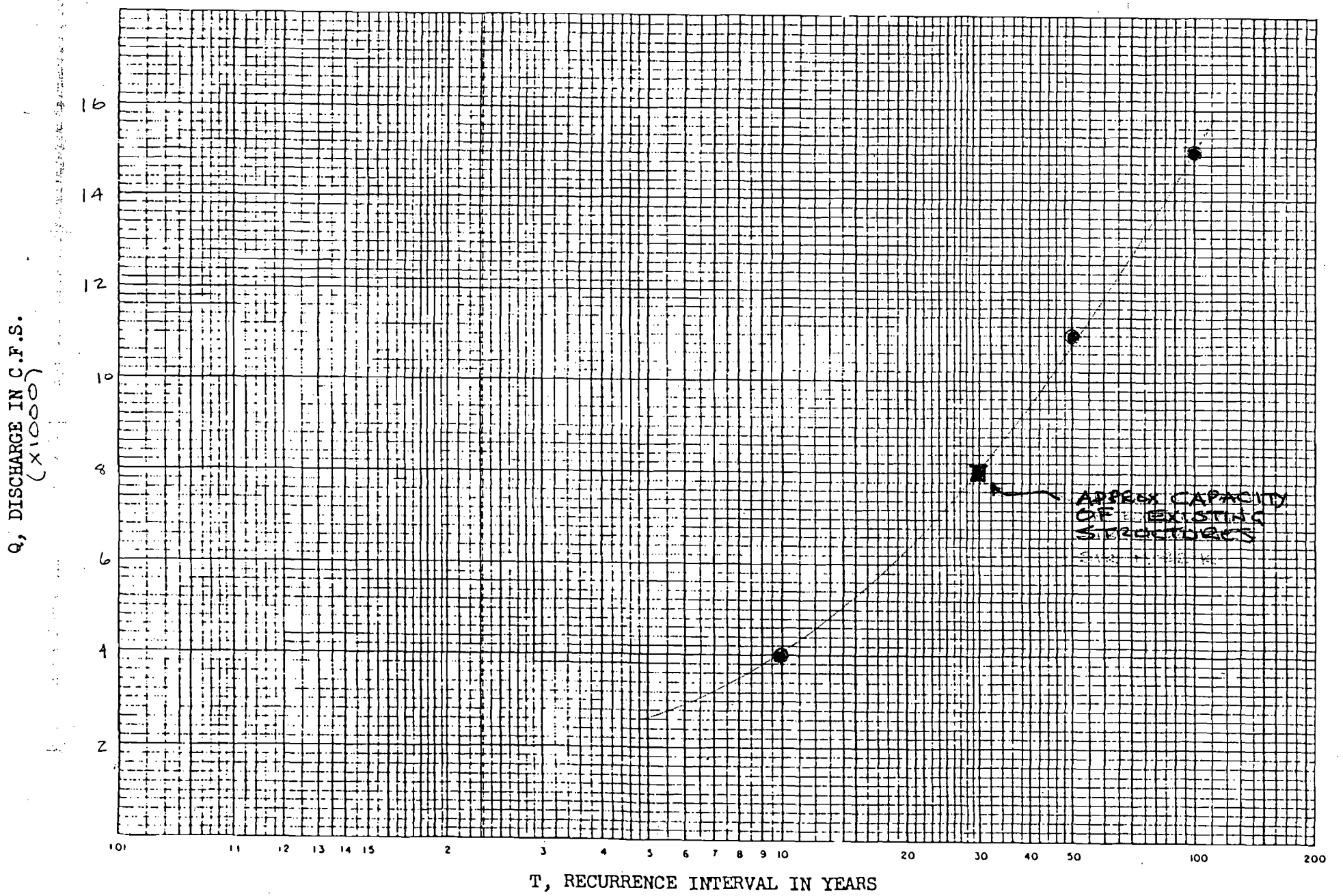
		QUANITY
By: DPS date 4/12/92		Sheet totals
Chk'd: date		Project totals

CDOT Form #1039 8/91

Work Sheet No. (09-03)61b
May 1974

RECURRENCE INTERVAL CURVE

SH 50 IN LA JUNTA
Project No.
4/12/92
Date
APA
By



COLORADO DEPARTMENT OF TRANSPORTATION

DESIGN COMPUTATIONS

Project no. SH 50 / LA JUNTA

Pay item description	Pay unit	Item code no.
PRELIMINARY SIZING		

Sheet ___ of ___

- ALTERNATIVE 1 - VERTICAL ABUTMENT BRIDGE
  - FL TO PG AT EXISTING STRUCTURE = 20'
  - ASSUME 4' GIRDER DEPTH ON NEW BRIDGE
  - ESTIMATE STRUCTURE SIZE W/ INLET CONTROL NOMEGRAPH, ADD FREEBOARD TO STRUCTURE SIZE

1. H = 10', Q/B = 92 - 170' x 10' STR.

F = FREEBOARD = $0.1\ Q^{0.3} + 0.008\ V^2$

$V = Q/A = 15500/1700$, V = 9.1 FPS

F = 2.5' ~ 3'

170' x 13' STR - VERY LONG

2. H = 12', Q/B = 120 - 130' x 12' STR.

V = 9.9 FPS

F = 2.6' ~ 3' STR

130' x 15' STR. - ALLOWS FOR 4' GIRDER DEPTH

- USE AS BUDGET SIZING

		QUANITY
By: JPJ date 4/12/92		Sheet totals
Chk'd: date		Project totals

CDOT Form #1039 8/91

COLORADO DEPARTMENT OF TRANSPORTATION

DESIGN COMPUTATIONS

Project no. SH 50 / LA JUNTA

Pay item description	Pay unit	Item code no.
PRELIMINARY SIZING		

Sheet ___ of ___

ALTERNATIVE #2 - SPILL ABUTMENT BRIDGE

- SLOPE AT STRUCTURE = 0.004 '/'
- ASSUME n = 0.035
- USE HYDCALC TO ESTIMATE CHANNEL BOTTOM WIDTH (B)
- ASSUME ABUTMENT SLOPE (Z) = 2 : 1
- MAXIMUM HIGHWATER

  E - PG ≅ 20'

  ASSUME ~ 3' FREEBOARD
  ~ 4.5' GIRDER } H_{MAX} = 12'

- FROM HYDCALC

BOTTOM WIDTH	FLOW DEPTH
60	14.2
80	12.5
* 90	11.75 ← V = 11.6 fps
100	11.4

90' BOTTOM WIDTH SHOULD BE ADEQUATE

FF = 2.9' ~ INITIAL ASSUMPTION IS OK.

- PROPOSED E TO LOW CHORD = 12' + 3' = 15'

BRIDGE LENGTH = 2 (H·Z) + 90' ; 150'

150' SPILL ABUTMENT BRIDGE

		QUANITY
By: DPS date 4/12/92		Sheet totals
Chk'd: date		Project totals

CDOT Form #1039 8/91