The time is now...

Drainage Assessment Report

Volume 1 of 2

US 50 Corridor
Pueblo to Kansas

Colorado Department of Transportation

State No. NH0504-37, 12812
Contract No. 00HA2 00045
URS No. 67-00042409
Wilson No. 993100007

URS Corporation
9960 Federal Drive, Suite 300
Colorado Springs, CO 80921

Wilson & Company
455 E. Pikes Peak Avenue, Suite 200
Colorado Springs, CO 80903-3675

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This report is conceptual or preliminary in nature and is not to be used as the sole basis for final design, construction or remedial action, or as a basis for major capital decisions. Further studies [describe] should be performed prior to such decisions

PRELIMINARY DRAINAGE ASSESSMENT REPORT
US Highway 50 Corridor
Pueblo to Kansas Border

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EXECUTIVE SUMMARY

Purpose

The purpose of this US Highway 50, Preliminary Drainage Assessment Report was to document known and potential surface drainage problems and related issues for the US Highway 50 corridor from Pueblo to the Colorado – Kansas border. This preliminary report was developed with active involvement of a number of Colorado Department of Transportation (CDOT) officials and employees, irrigation company employees, local officials, land owners, engineers and technicians.

This report is intended to be a reference document to support future analysis and design work for US Highway 50 corridor improvements. The report provides a comprehensive source document of information and data relating to known and existing drainage issues and drainage structures.

Scope

In March 2000, CDOT hired URS to perform engineering consulting services for the US Highway 50 corridor from Pueblo to the Colorado – Kansas border. US Highway 50 traverses the southern one third of the state of Colorado from Kansas to the Utah border. The study included photo documentation and an inventory of all drainage structures listed on the CDOT Field Log of Structures, interviews with CDOT maintenance personnel and irrigation company points of contact (ditch riders), review and analysis of Federal Emergency Management Agency (FEMA) Floodplain studies & maps and preparation of a Preliminary Drainage Assessment Report.

Report Summary

Within the US Highway 50 Corridor, from Pueblo to the Kansas Border, there are approximately seventy nine individual structures listed on the CDOT Field Log of Structures as crossing creeks, rivers, streams or irrigation canals. Each structure location was visited and photographed during the fall of 2000 or spring of 2000. Sixty six specific CDOT structure records were retrieved, reviewed and included in this report for reference.

Thirty three individual locations were identified where future highway construction or improvements might cause or exacerbate the encroachment onto known floodplains of the Arkansas River or its tributaries. Most identified locations and associated issues will require additional detailed study to support the design of any future improvements.

US Highway 50 crosses numerous major and minor irrigation canals and ditches throughout the corridor. Site visits and interviews with irrigation company personnel were conducted for each of the following irrigation facilities:

Excelsior Ditch

Rocky Ford Highline Canal

Oxford Farmers Ditch

Otero Ditch

Catlin Canal

Rocky Ford Ditch

Las Animas Consolidated Canal

Lamar Canal

Manvel Canal

X-Y Canal

In general, existing irrigation crossing sites and structures are adequate for current operations. However, changes in highway alignment or alterations of existing crossings of any of the irrigation canals or ditches should be closely coordinated with the affected irrigation company.

Site visits and interviews were conducted with CDOT maintenance personnel for four separate sections of the US Highway 50 corridor. The four sections were:

Pueblo to Nepesta Road

Nepesta Road to La Junta

La Junta to McClave Junction

McClave Junction to the Kansas Border

Pueblo to Nepesta Road had 9 recurrent drainage issues that will need remediation in the future. The segment from Nepesta Road to La Junta had 13 issues and from La Junta to McClave Junction there were 7 issues. From McClave Junction to the Kansas Border there were a total of 10 issues.

This report includes a review of applicable Hydraulic Design Criteria excerpted from the *CDOT Drainage Design Manual* and Water Quality Issues described in the *CDOT Erosion Control and Stormwater Quality Guide*.

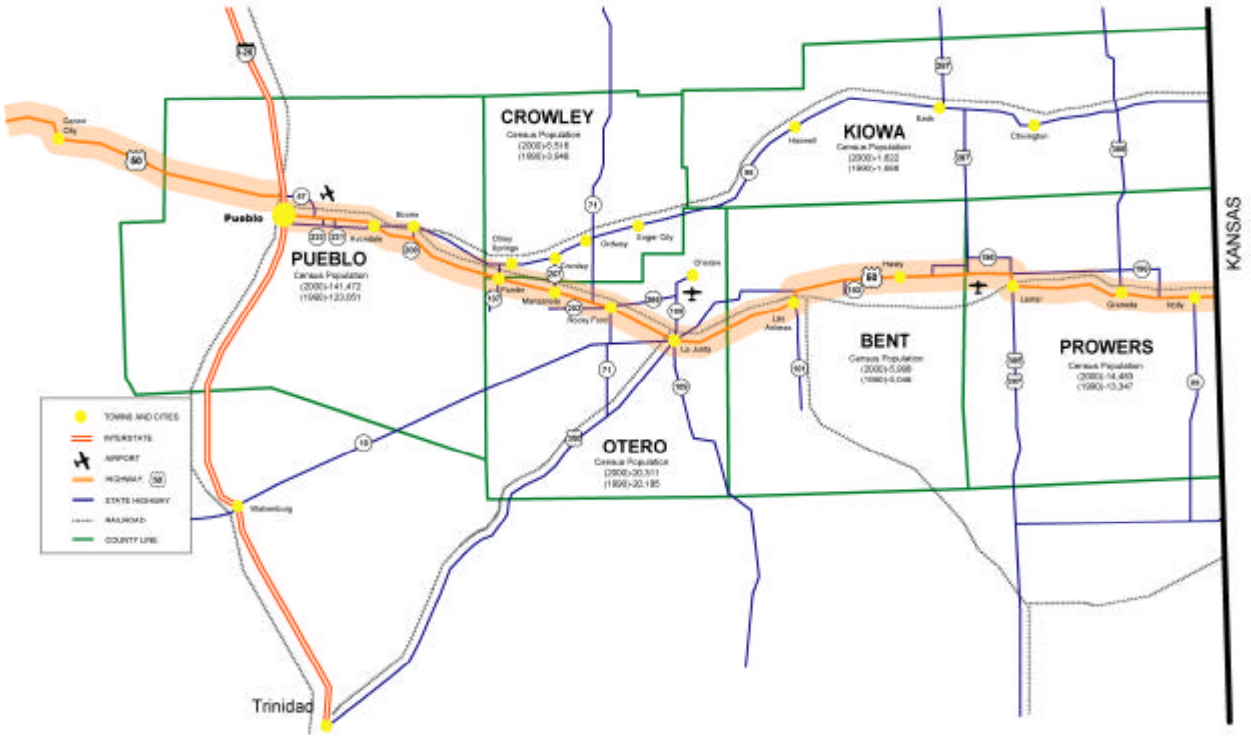
Finally a summary of generic field survey data was compiled for typical drainage structures, irrigation canal crossings and storm drains. This information was based on the combined requirements of the *CDOT Survey Manual* and *CDOT Drainage Design Manual*. Corridor topographic maps, aerial photos, structure photos, interview records with irrigation companies and CDOT structure records are included in the appendices.

1. INTRODUCTION

United States Highway 50 traverses the southern one third of the state of Colorado running from Kansas to the Utah border. In March 2000, the Colorado Department of Transportation hired URS to perform initial design services for the US Highway 50 corridor from Pueblo to the Colorado – Kansas border. These initial services include the inventory of existing drainage and irrigation facilities, the identification of critical floodplain issues and any recurrent drainage problems.

2. PROJECT/CORRIDOR DESCRIPTION

The US 50 project corridor generally traverses east to west across southeastern Colorado from Pueblo to the Kansas border. The highway parallels the Arkansas River through out its entire length. Major water crossing from west to east include Fountain Creek, the Arkansas River at Avondale, Las Animas, Lamar and Granada, the Huerfano River, the Apishapa River, Timpas Creek, Wolf Creek, Wildhorse Creek and Cheyenne Creek. Throughout the corridor, US 50 also spans and parallels several irrigation canals. Various small towns are spread along the corridor, including Fowler, Manzanola, Rocky Ford, La Junta, Las Animas, Lamar, Granada, and Holly.



3. DRAINAGE AND IRRIGATION STRUCTURE INVENTORY

Below is a summary of the major drainage and irrigation structures along US Highway 50, Pueblo to the Colorado – Kansas Border. Only the major structures have been listed as the cost to modify or replace these major structures would be substantial. These structures should be checked for structural and hydraulic capacity if modifications or replacement become necessary. Other minor structures (e.g. culverts over 48-inches) may have impacts to future roadway designs and may not be identified here. See Appendix D for copies of select Structure Records and Appendix E for photos of each major structure.

Mile	Structure Number	Structure Size	Water Way/Remarks	Year Built/Widen
316.00			***Junction I-25 – US 50, Pueblo***	
316.06	K-18-L	404' Bridge	Fountain Creek	1958
318.06	K-18-BZ, BY	124' Bridge, 4 spans	Dry Creek	1958
321.42	K-18-EZ,-FM	11-14-11X10 CBC	Dry Wash	1976 -1982
319.08	K-18-W	187' Bridge, 4 spans	BNSF RR, sump formed on roadway under pass	1936/1954
323.99	K-19-F	10-10X10 CBC	Dry Wash, 5'-7" wide web wall at inlet, 11'-7" high at face	1938/1976
324.82	K-19-AA	11-14-11X4 CBC	Dry Wash	1976
325.29	K-19-AB	11-14-11X6 CBC	Dry Wash	1976
328.87	K-19-U,-Q	306' Bridge	Chico Creek, 18' flowline to profile grade	1953
331.00	L-19-H	406' Bridge	Arkansas River, 17' flowline to profile grade	1955/1986
335.86	L-19-B	416' Bridge	Huerfano River, 17' flowline to profile grade	1921/1948
344.65	L-20-B	65' Arch Bridge	Rocky Ford Highline Canal, severe skew, 25 degree Rt.	1932
347.07	L-20-C	24' Tmbr Bridge	Farmers Oxford Ditch, 10' flowline to profile grade	1938
347.54	L-20-AN	84' Slab Bridge	Chicosa Creek, 3 span with debris wall, 11' vertical clearance, 12.4' ctr	1986
348.84			***Pueblo - Otero County Line***	
352.56	L-21-W	152' Bridge	Hungerford Hollow, 6' flowline to profile grade	1933
354.40	L-21-A	27' Bridge	Otero Canal, 8' flowline to profile grade	1947
355.10	L-21-G,-DA	323' Bridge	Apishapa River, 22' flowline to profile grade	1957-1997
355.20	L-21-I,-DC	33' Bridge	Otero Canal, 10' flowline to profile grade	1957-1998
356.50	L-21-b	12X8 CBC	Otero Canal	1960
358.46	L-21-DB	113' Bridge	Smith Hollow, 20' flowline to profile grade	1997
360.26	L-21-K	20X6 CBC	Catlin Canal	1969
364.18	L-21-Q	4-72" CMP	Patterson Hollow, Full Headwall, no wingwalls (new CBC under construction summer 2001)	1967
368.52	L-22-I	32' Bridge	Rocky Ford Canal, 5' flowline to profile grade	1934
373.64	L-22-A,-AL	268'/264' Bridge	Timpas Creek, 21' flowline to profile grade	1958-1947
374.11	L-22-R,-H	51'/ 48' Bridge	BNSF RR, sump formed on roadway under pass	1958-1928
376.95	M-22-K,-M	104' Bridge	Crooked Arroyo, 18' flowline to profile grade	1955-1947
378.74	M-22-R	90' Bridge, 2 spans	BNSF RR, sump formed on roadway under pass	1934/1961
378.80			***LaJunta, Colorado***	

Mile	Structure Number	Structure Size	Water Way/Remarks	Year Built/Widen
376.95	M-22-K,-A	104' Bridge	Crooked Arroyo, 18' Flowline to Profile Grade	1955-1947
378.74	M-22-R	90' Bridge, 2 spans	BNSF RR, sump formed on roadway under pass	1934/1961
379.14	M-22-M	140' Bridge	Anderson Arroyo; 17' Flowline to Profile Grade, 14' road in channel	1961
380.56	M-22-X	181' Bridge	King Arroyo,	1961
381.89	M-23-J, B	69'&63' Bridges	Otero Canal, 3 span and single span structures	1957 & 1931
382.84	M-23-E, A	93' Bridges	Thompson Arroyo, 3 and 4 span structures	1957 & 1931
385.44	L-23-S, J	157' &169' Bridges	Vandiver Arroyo, 3 and 2 span structures	1957 & 1997
388.11	L-23-K	10-12-10X6 CBC	Draw	1961
388.75			***Otero - Bent County Line***	
392.62	L-23-C	12x4 CBC	Las Animas Canal	1958
397.71	L-24-AB	173'Bridge	BNSF RR Mainline	1989
399.94	L-24-D, A	834' Bridges	Arkansas River, 8 span structures	1974 & 1966
405.01	L-24-AA	5- 60" CMP's	Draw, McCauley Ditch (verify)	1983
460.66	L-24-b	21' Timber Bridge	Draw	1937
408.15	L-24-M	140' Conc Bridge	Gageby Creek, 3 span structure	1937
410.14	L-24-L	116' Tmbr/Conc	McCrae Arroyo, 5 span structure	1937
416.35	L-25-L	24' Tmbr/Conc	Prowers Arroyo/Levere Ditch, single span structure	1937
417.83	L-25-a	16' Conc Bridge	Lubers Drainage Ditch, single span structure	1924/1937
418.12	L-25-E	33' Stl/Conc	Draw	1937
419.67	L-25-N	93' Tmbr/Conc	Limestone Creek, 4 span structure	1937
421.88	L-25-B	47' Tmbr/Conc	Draw, 2 span structure	1936
423.34	L-25-C	45' Conc Bridge	Graveyard Creek, single span structure	1923/1937
423.82	L-25-d	14' Conc Bridge	East Graveyard Creek, single span structure	1924/1937
426.71			***Bent - Prowers County Line***	
426.94	L-26-j	20' Conc Bridge	River View Canal, single span structure	1924/1937
428.71	L-26-BR	62' Conc Bridge	Amity Canal, single span structure	1982
429.00	L-26-BT	6cell 10x8CBC	Wiley Drainage Ditch	1981
431.61	L-26-BO	10-10x6CBC	Vista del Rio Canal	1979
434.12	L-26-H, BH	570' Conc Bridges	Arkansas River, 9 & 5 span structures	1967 & 1989
434.32			***Lamar, Colorado***	
434.80	L-26-E	25' Conc Bridge	Lamar Canal, single span structure	1931/1962
436.76	L-26-BV	22x8 CBC	Lamar Canal	1987
437.72	L-26-M	47' Tmbr/Conc	Willow Creek, 2 span structure	1936
439.53	L-26-X	92' Tmbr Bridge	Willow Creek Overflow, 4 span structure	1936
440.17	L-26-F	306' Conc Bridge	Clay Creek, 5 span structure	1966
445.24	L-27-AM	20-20-20x8CBC	Smith Arroyo	1987
445.85	L-27-S	48' Tmbr Bridge	Draw, 2 span structure	1937
451.32	L-27-B	165' Conc Bridge	Wolf Creek, 3 span structure	1967
452.27	L-27-AL	170' Conc Bridge	Wolf Creek Overflow, 3 span structure	1979
455.64	L-27-M	162' Tmbr/Conc	Granada Creek, 7 span structure	1933
457.38	L-28-AQ	1084' Conc Bridge	Arkansas River, 9 span structure	1975
462.13	L-28-AR	8-8x6CBC	Ditch	1977
462.34	L-28-AP	216' Conc Bridge	Wildhorse Creek, 7 span structure	1960
467.33	L-28-E	124' Conc Bridge	Cheyenne Creek, 3 span structure	1966
467.58			***Colorado - Kansas Border***	

4. CRITICAL DRAINAGE ISSUES

4.1. Floodplain Issues Relating to US Highway 50 and the Arkansas River, *Pueblo to the Colorado - Kansas Border.*

Below is a summary of issues relating to the proximity of the floodplains of the Arkansas River, and its tributaries, to US Highway 50. This work was completed to identify potential locations where future highway construction or improvements might cause or exacerbate the encroachment onto known floodplains. These locations may also require the need for roadway alignment or profile changes to reduce the potential for erosion into the US 50 Right-of-Way. Most identified locations/issues will require additional detailed study to support the design of any future improvements. It is recommended that future discussions and coordination be done with the Colorado Water Conservation Board (CWCB) and US Army Corps of Engineers, Albuquerque District to determine if cooperative projects for hydraulic modeling should be conducted. The following issues were identified utilizing The Federal Emergency Management Agency (FEMA), National Flood Insurance Program; Flood Insurance Rate Maps (FIRM); Flood Boundary and Floodway Maps; U.S. Department of Housing and Urban Development, Federal Insurance Administration (FIA), Flood Hazard Boundary Maps; the April 1966 Flood Report, Arkansas River Basin, Flood of June 1965, US Army Corps of Engineers; the September 15, 1999 Post Flood Assessment Report, Arkansas River, Southern Colorado, US Army Corps of Engineers; and aerial photos taken in July 2000. The floodplain delineations as shown on the Flood Boundary maps were completed in 1977, 1982, and 1985-86. Since publication of the maps, some reaches of the Arkansas River have experienced aggradation, or raising of the riverbed through the deposition of sediments. The raising of the river bottom will most likely cause changes to the limits and alignments of the flood plains as shown on the maps.

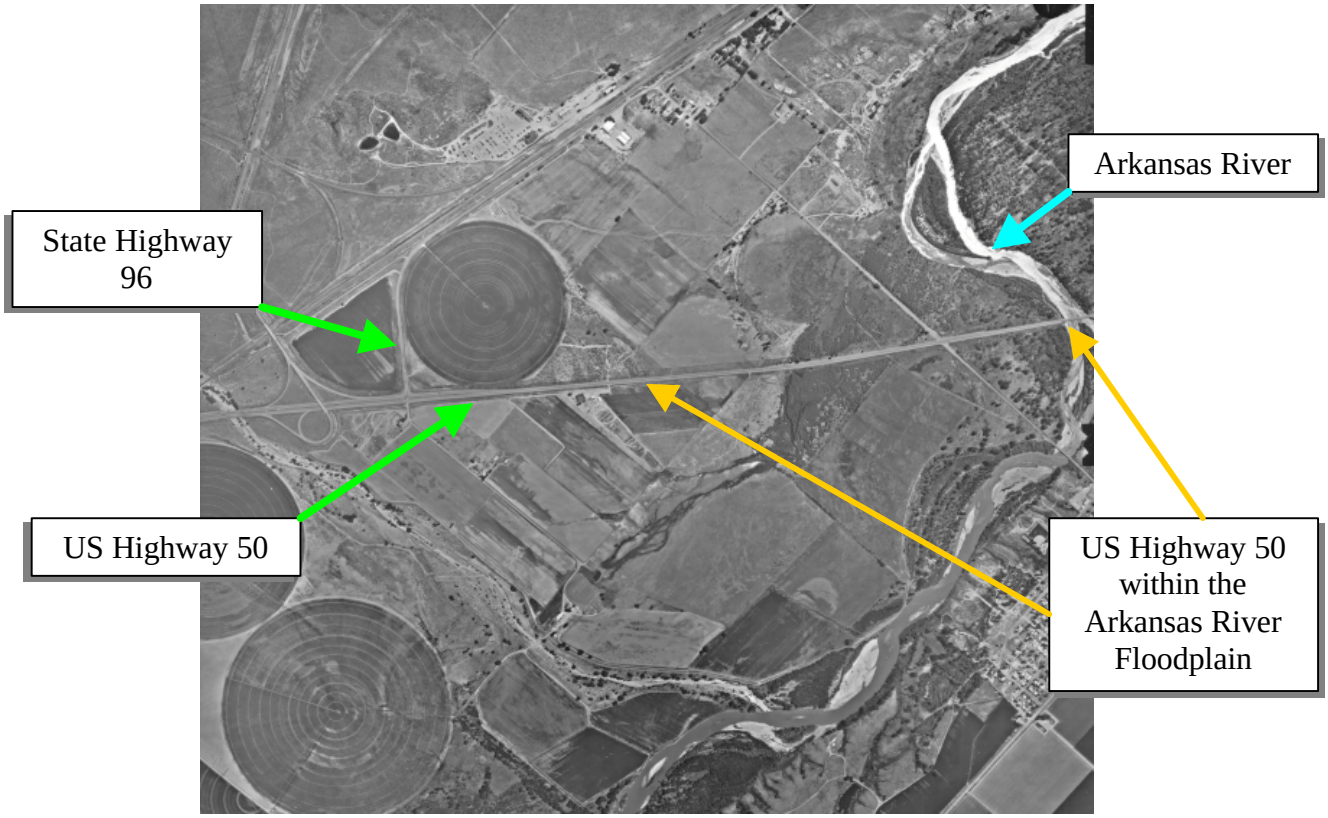
4.1.1. Arkansas River

4.1.1.1. Arkansas River Crossing, approx. miles 329.3 to 332.0, Pueblo County

(FEMA Panels 275,380, & 400 of 725, Community Panel Numbers: 080147 0275B, 080147 0380B, & 080147 0400B)

This area begins just east of the junction of US 50 and Colorado State Highway 96 and extends to the east approximately three miles along US 50 to the bridge over the Arkansas River (structure L-19-H). There are presently only two locations where cross drainage can occur at, a single 72-inch CMP and at a collection of seven 36-inch CMPs located just west of the intersection of US 50 and the roads to Avondale and North Avondale. (See also US 50 Drainage Issues, Pueblo to Nepesta Road, Maintenance Supervisor Interview, 17 Oct 00)

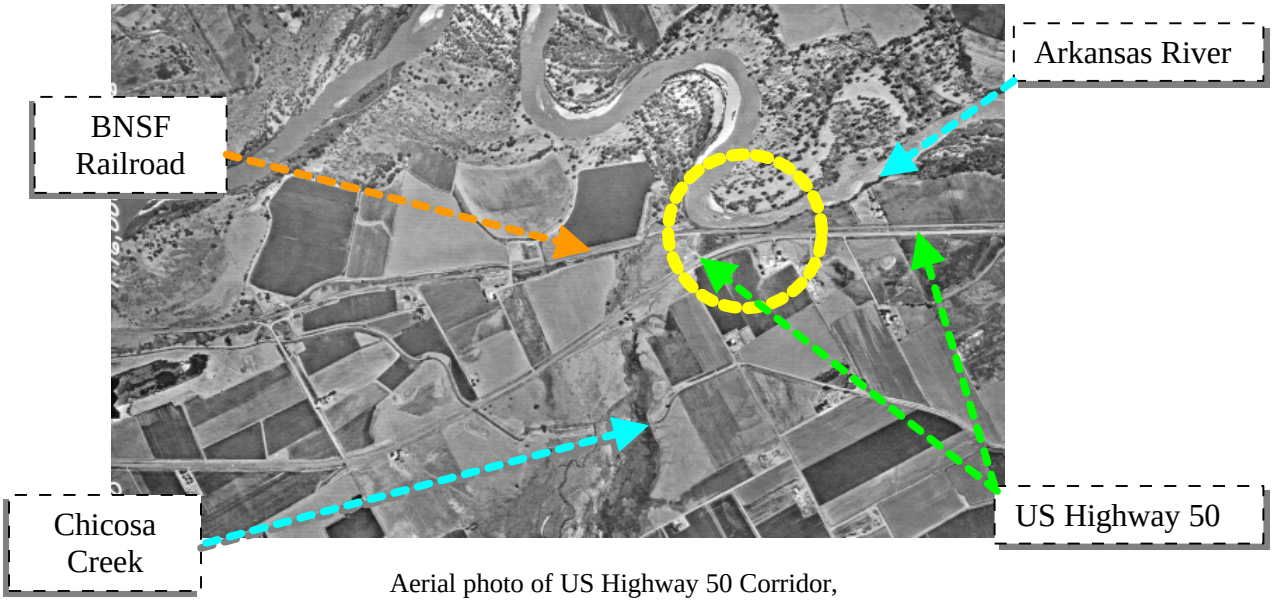
The area is located well within the Flood Hazard Area of the Arkansas River, US 50 is often overtopped even during minor flood events. Flood flows originate from the Arkansas River to the south, flow northeast towards US 50 paralleling the Arkansas River, then return to the river just north of the US 50 bridge. The road was last overtopped in 1999 by as much as 1-ft of water and was closed to traffic for over 14 hours. Improvements will likely require raising the US 50 roadway surface and installing several additional cross culverts.



Aerial photo of US Highway 50 Corridor, vicinity Intersection with SH 96 and the Arkansas River Crossing, miles 329.3 to 332.0

4.1.1.2. Vicinity mile 348, East of the Chicosa Creek Crossing and west of Fowler, CO, Otero County

At this location, the US 50 ROW and the Arkansas River are almost adjoining. The south bank of the river and US 50 are within approximately 200-ft. The elevation difference between the river and the highway is approximately 25-ft. The BNSF railroad grade is just north of the highway and separates the river and US 50. Floodplain encroachment onto US 50 should be a concern here.



Aerial photo of US Highway 50 Corridor,
Vicinity Chicosa Creek crossing, west of Fowler, CO, mile 348

4.1.1.3. Vicinity the Town of Fowler, CO, mile: 351, Otero County

(FEMA Panel 30 of 325, Community Panel Number: 080132 0030)

In the vicinity of the town of Fowler, the southern limit of the 100-yr Flood Boundary of the Arkansas River is approximately 900-ft north of US 50. Between the Flood Boundary and US 50 are the Otero Canal, the mainline of the BNSF Railroad and the Fowler Golf Course. Aggradation of the Arkansas River and possible expansion of the Flood Boundary will almost certainly decrease the distance between the Flood Boundary and the US 50 ROW.

4.1.1.4. Vicinity Otero County Road 21 and US 50 Intersection, east of Rocky Ford, approx. mile: 370.4, Otero County

(FEMA Panel 70 of 325, Community Panel Number: 080132 0070)

The 1985 Flood Boundary map indicates that the 100-yr Flood Boundary is immediately adjacent to the US 50 ROW at this location. The Flood Boundary parallels US 50 from the intersection of CR 21, east for approximately 1200-ft.

FEMA map showing flood boundary adjacent to US 50 ROW

4.1.1.5. Swink to La Junta, CO, approx. miles 374.2 to 379.0, Otero County

(FEMA Panel 155 of 325, Community Panel Number: 080132 0155)

The 100-yr Flood Boundary of the Arkansas River abuts the north shoulder and runs parallel to US 50 for the entire 4.8-miles from Swink to La Junta, CO. With one exception, near the Crooked Arroyo crossing (mile: 376.95), the southern limit of the 100-yr Flood Boundary is the US 50 ROW. Any bed elevation changes in the Arkansas River will most certainly increase the encroachment of the Flood Boundaries onto the US 50 ROW. See also 4.1.9. Crooked Arroyo Crossing, mile 376.95.

4.1.1.6. Vicinity the City of La Junta, CO, mile: 376.95 – 380.86, Otero County

(FEMA Panel La Junta, CO, Community Panel Numbers: 080133 0001, 1982)

US 50 through the City of La Junta is within the 100-year Flood Boundary from the intersection of US 50 and Colorado Avenue to a point just east of the King Arroyo crossing. The entire length of US 50 through the City of La Junta is within the 500-year Flood Boundary. (See also **4.1.10. Anderson Arroyo crossing** and **4.1.11. King Arroyo crossing**). In November 1977, the Colorado Division of Water Resources Division 2 evaluated aggradation in the Arkansas River at La Junta between 1963 and 1977. They found that aggradation had occurred and the corresponding loss of channel conveyance capacity was most significant. Some of the conveyance loss was attributed to increased channel vegetation and debris. Channel aggradation ranged from 1.45 to 4.94-ft with a change in channel conveyance capacity decreasing by 80% to 90% at two separate gage locations. (See *Post Flood Assessment Report, Arkansas River, Southern Colorado*, Department of the Army, Albuquerque District, Corps of Engineers, Sept 15, 1999)

4.1.1.7. Robinson Arroyo crossing, approx. mile: 388, Otero County

(FEMA Panel 100 of 325, Community Panel Numbers: 080132 0100B, 1985)

At this location, the US 50 ROW and the Arkansas River are in very close proximity. The BNSF railroad grade is just north of the highway and separates the river from US 50. At the Robinson Arroyo Crossing, US 50 is within the 100-year Special Flood Hazard Area which extends approximately 2000-ft along the US 50 ROW. The encroachment of the Arkansas River floodplain toward US 50 will be a concern here.

4.1.1.8. Vicinity Riverdale, approx. mile: 394, Bent County

US 50, just east of Riverdale, and approximately 4 miles west of Las Animas was flooded during the 1965 Arkansas River flood. During this flood event, the Arkansas River floodplain abutted the BNSF and US 50 ROW's at Riverdale and crossed US 50 approximately ½ mile east of Riverdale. Flows in the Arkansas River, at the Las Animas gage, were approximately 22,100 cfs when this occurred.

4.1.1.9. Vicinity the Town of Las Animas, CO, approx. mile: 391 - 400, Bent County
(FIA Page 4 of 15, Community Panel Number: 080271 0004A, 1977)

US 50 as it approaches the Town of Las Animas from the west, and through the corporate limits of Las Animas, is outside of the Special Flood Hazard Area and is protected from Arkansas River flood waters by a levee. The levee begins approximately 5.5 miles west of Las Animas and continues for approximately 1.5 miles east of the town. US 50 turns north in Las Animas and crosses the Arkansas River at mile 399.94 on an eight span bridge (Structures L-24-A & D). The US 50 crossing of the Arkansas River appears to be above the 100-year water surface elevation.

4.1.1.10. Vicinity Arkansas River crossing and the City of Lamar, CO, approx. mile: 433.50 – 436.30, Prowers County
(FEMA Panel 1 of 3, and FIA Page 6 of 20, Community Panel Numbers: 080146 0001B and 080272 006A, 1982 & 1977)

The 1977 Flood Hazard Boundary map and the 1982 Flood Insurance Rate map for the City of Lamar both show that US 50 ROW is outside the 100-yr Flood Boundary. However the US 50 crossing of the Arkansas River (Structures L-26-H & BW) is contained within the 100-year Special Flood Hazard Area as depicted on the map delineating flood hazard areas within Prowers County (the Flood Hazard Boundary map). US 50 through the City of Lamar is not within the 100-year Flood Boundary but is fully contained within the 500-year Flood Boundary. This area was inundated during the 1965 Arkansas River Flood. The flood peak of 72,000 cfs destroyed a span of the US 50 bridge over the Arkansas River.

4.1.1.11. Clay Creek crossing and Confluence with the Arkansas River, approx. miles 440.17, Prowers County
(FIA Page 6 of 20, Community Panel Number: 080272 0006A, 1977)

The US 50 crossing of Clay Creek, approximately 3.5 miles east of the City of Lamar, is contained within the 100-year Special Flood Hazard area for Clay Creek and the Arkansas River. Approximately 7000-ft of the US 50 ROW is within the flood hazard area. The confluence of Clay Creek with the Arkansas River is approximately 3000-ft north of the US 50 crossing. Immediately east of the Clay Creek crossing, the Arkansas River Special Flood Hazard Area abuts the BNSF RR ROW which lies just north of and adjacent to the US 50 ROW. The flood hazard area parallels both the BNSF and US 50 ROW's for approximately 4000-ft. (see also **4.1.18. Clay Creek crossing**)

4.1.1.12. Wolf Creek crossing and the Arkansas River, approx. miles 451 - 453, Prowers County

(FIA Page 7 of 20 and Granada, CO, Community Panel Numbers: 080272 0007A, 1977 and 080144 0001A, 1984)

As US 50 approaches the Town of Granada, CO from the west, US 50 enters a Special Flood Hazard Area beginning approximately 1-mile west of town and continues to lie within the Special Flood Hazard area to a point approximately ½-mile east of Granada. Within the corporate limits of the Town of Granada, US 50 is protected from the 100-year Flood Boundary by the Wolf Creek Channel levees; however, the highway is completely within the 500-year Flood Boundary while in the town of Granada. In 1965, during the Arkansas River flood, the levees on Wolf Creek were breached by an estimated flow of 35,300-cfs and the town of Granada was flooded to a depth of about 6-feet.

4.1.1.13. Arkansas River crossing, mile 457.38, Prowers County

(FIA Pages 7 & 8 of 20, Community Panel Numbers: 080272 0007A & 080272 0008A, 1977)

US 50 crosses the Arkansas River for the last time in Colorado at mile 457.38 (Structure L-28-AQ). This crossing site is between the towns of Granada and Holly, CO. From the crossing site east to the town of Holly, US 50 is fully contained within the Special Flood Hazard Area (a distance of approximately 6 miles). This area received substantial flooding during the June 1965 Arkansas River flood with Holly inundated by floodwaters up to eight feet deep. The town had to be completely evacuated and was cut off from all forms of transportation for three days.

4.1.2. Fountain Creek

4.1.2.1. Pueblo, I-25 and US 50 Interchange, mile 316.000, Pueblo County

(FEMA Panel 6 of 15, Community Panel Number: 085077 0006)

The interchange, as currently constructed, is within the 500-year Flood Boundary of Fountain Creek. Fountain Creek is a highly unstable, alluvial stream with its bed and banks composed of easily eroded fine grain sediments. The channel has shifted its position regularly across the floodplain and can be expected to rapidly migrate during future periods of flooding. Sediment transport rates are high and significant quantities of sediment can be transported even during periods of low flow. Flows in Fountain Creek are “flashy” in nature and can fluctuate considerably from less than 100 cubic feet per second (cfs) to several thousand cfs. During the most recent spring floods in 1999, the main channel of

Fountain Creek changed its alignment just upstream of the US 50 crossing and began to erode the western approach of the Highway Bridge. Efforts to retrain the creek have been successful in maintaining realignment of the main channel through the existing bridge opening. For reference, this interchange is located approximately 2-miles upstream from the confluence of Fountain Creek and the Arkansas River.

4.1.3. Huerfano River Crossing, mile: 335.86, Pueblo County

(FEMA Panel 400 of 725, Community Panel Number: 080147 0400B)

The Huerfano River crosses under US 50 at mile 335.86 (structure: L-19-B). The bridge is a five span concrete arch bridge originally constructed in 1921 and widened in 1948. The confluence of the Huerfano and Arkansas Rivers is approximately 1-mile north-northeast of the US 50 crossing. In the vicinity of the US 50 crossing the Huerfano River Flood Hazard Area is relatively narrow and well defined. Dense vegetation within the floodplain may reduce conveyance and possibly cause debris accumulations at the multi-span arches of the US 50 structure.

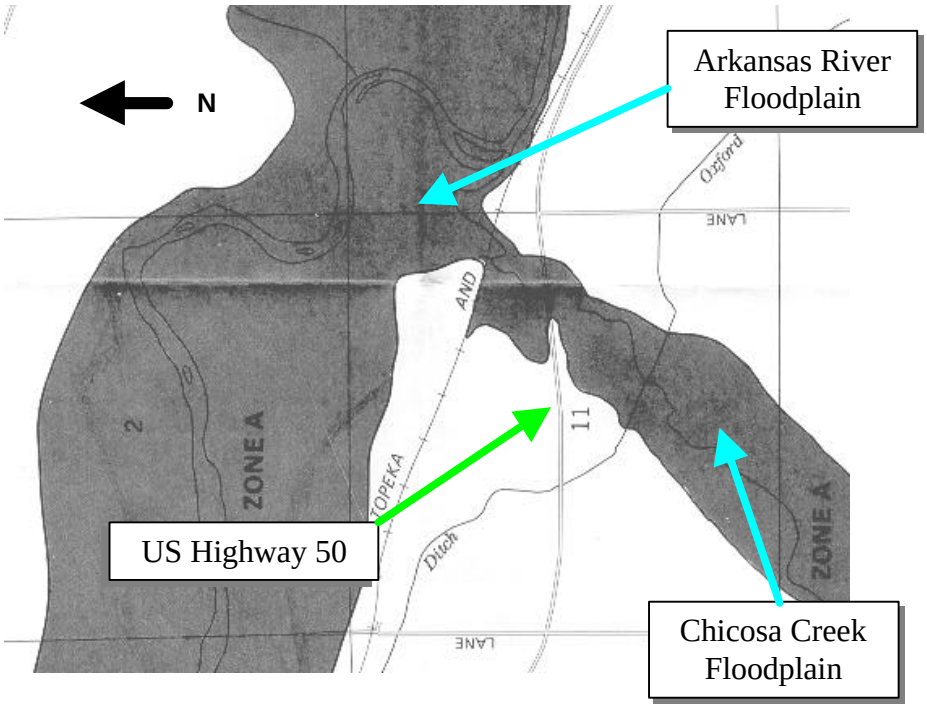
Huerfano River Crossing and floodplain, structure L-19-B

4.1.4. Chicosa Creek Crossing, mile: 347.54, Pueblo County

(FEMA Panel 425 of 725, Community Panel Number: 080147 0425B)

US 50 crosses Chicosa Creek on Structure L-20-AN, a 3 span concrete bridge. The structure is located within the FEMA designated 100-yr Flood Hazard Area however, no base flood elevation has been determined. The confluence of Chicosa Creek with the Arkansas River is approximately 2200 ft downstream of the US 50 crossing. The designated flood hazard area at the US 50 crossing is likely to experience backwater effects from flooding on the Arkansas River. Any changes in the elevation of the Arkansas River due to aggradation will most likely result in a widening of the flood hazard area at the Chicosa Creek crossing.

(See map next page)



4.1.5. Hungerford Hollow Crossing, mile: 352.56, Otero County
(FEMA Panel 30 of 325, Community Panel Number: 080132 0030)

The US 50 crossing of Hungerford Hollow is not located within a FEMA delineated floodplain. The Arkansas River 100-year Flood Boundary extends up the Hungerford Hollow drainage but stops approximately 1300-ft north of US 50. The existing five span concrete bridge (structure: L-21-W) has approximately 6-ft of clearance from flowline to profile grade.

4.1.6. Apishapa River Crossing, mile: 355.11, Otero County
(FEMA Panel 35 of 325, Community Panel Number: 080132 0035)

The confluence of the Apishapa and Arkansas Rivers occurs approximately 2200-ft north of the US 50 bridge(s) over the Apishapa River. The US 50 ROW is within the 100-yr Flood Boundary of the Apishapa River and the flood plain is approximately 1100-ft wide near the existing bridge(s). Any changes in the elevation of the Arkansas River due to aggradation will most likely result in a widening of the Apishapa River Flood Boundary at the US 50 crossing.

(See photo next page)

US 50 bridge over Apishapa River, structure L-21-G/DA, mile: 355.1

4.1.7. Patterson Hollow Crossing, mile: 364.18, Otero County

(FEMA Panel 65 of 325, Community Panel Number: 080132 0065, panel not printed – area of minimal flood hazards)

The Patterson Hollow crossing of US 50 is not within a FEMA designated floodplain. The Arkansas River floodplain does not extend far enough up the Patterson Hollow drainage to directly affect the US 50 crossing. However in 1999 spring floods in Patterson Hollow were significant enough to cause damage to the BNSF railroad structure just upstream of the US 50 structure. Damage to the railroad bridge was severe enough that railroad traffic had to be suspended. The existing US 50 structure (L-21-Q) consists of 4 each 72-inch CMP's and is schedule for replacement in 2000-2001.

4.1.8. Timpas Creek Crossing, mile: 373.64, Otero County

(FEMA Panel 135 of 325, Community Panel Number: 080132 0135)

The US 50 ROW is well within the combined 100-yr Flood Boundary for Timpas Creek and the Arkansas River. The confluence of Timpas Creek and the Arkansas River is approximately 700-ft north of US 50 and the outside edge of a meander of the Arkansas River is within 500-ft of the US 50 ROW. The area of US 50 contained within this Flood Boundary extends from approximately 1000-ft west of the existing Timpas Creek bridge(s) then east for approximately 1-mile to the corporate limits of Swink, CO. Of special concern is the US 50 underpass beneath the BNSF Railroad just west of Swink (See also Mile 374, Swink Underpass below BNSF Railroad, US 50 Drainage Issues,

Nepesta Road to La Junta). According to the 1985 FEMA Flood Insurance Study, the 50-yr, 100-yr and 500-yr events all overtop the US 50 bridges at Timpas Creek.

US 50 bridge over Timpas Creek, structure L-22-AL, mile: 373.64

4.1.9. Crooked Arroyo Crossing, mile: 376.95, Otero County

(FEMA Panel 155 of 325, Community Panel Number: 080132 0155)

US 50 crosses Crooked Arroyo at mile 376.95 just east of the town of LaJunta, CO. The FEMA Flood Boundary for Crooked Arroyo at the US 50 crossing is approximately 150-ft wide. The 100-yr Flood Boundary of the Arkansas River abuts the north shoulder and runs parallel to US 50 for the entire 4.8-miles from Swink to La Junta, CO, which includes the crossing of US 50 over Crooked Arroyo. The Crooked Arroyo floodplain is relatively narrow and very well defined throughout the reach above US 50. Dense juvenile vegetation currently covers most of the floodway. Changes in bed elevation or adjustments of the Flood Boundaries of the Arkansas River will most assuredly affect flows with in the Crooked Arroyo Flood Boundary.

(See map next page)

FEMA map showing flood boundaries for Crooked Arroyo and the Arkansas River adjacent to US 50

4.1.10. Anderson Arroyo crossing, mile 379.14, City of La Junta, Otero County

(FEMA Panel: La Junta, CO, Community Panel Number: 080133 0001, 1982)

Anderson Arroyo crosses beneath US 50 and CDOT structure M-22-M. The west approach to the structure is within the 100-year Flood Boundary while the east approach is within the 500-year Flood Boundary. The 100-year Peak Discharge for Anderson Arroyo is 10,500 cfs. According to the FEMA Flood Insurance Study for the City of La Junta, flood events with a return period greater than 50 years overtop the US 50 bridge (structure: M-22-M) over Anderson Arroyo. The 100-year flood event overtops US 50 by almost 5.5-ft but in contrast flows entirely beneath the BNSF Railroad bridge just north of US 50.

4.1.11. King Arroyo crossing, mile: 380.56, Otero County

(FEMA Panel 155 of 325, Community Panel Number: 080132 0155, 1985)

King Arroyo crosses under US 50 at mile 380.56 (structure: M-22-X) immediately east of the City of La Junta. The bridge is a three span concrete slab and girder originally constructed in 1961. The confluence of King Arroyo and the Arkansas Rivers is less than 1000-ft north of the US 50/King Arroyo crossing. The crossing site is

within the 100-year Flood Boundary; the FEMA 100-year peak discharge is 7,500 cfs, which does not overtop the US 50 structure.

4.1.12. Vandiver Arroyo crossing, mile: 385.44, Otero County

(FEMA Panel 160 of 325, Community Panel Number: 080132 0160, 1985)

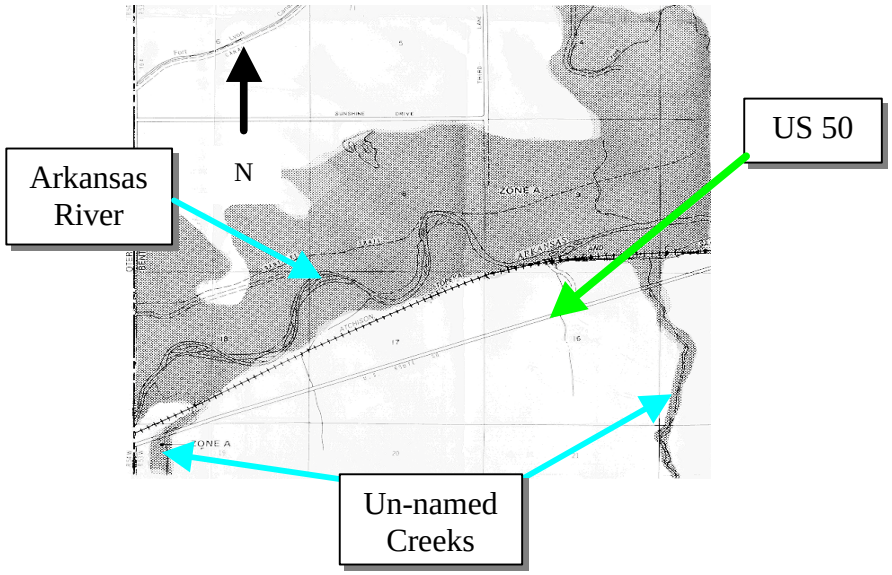
US 50 crosses Vandiver Arroyo on structures L-23-S & J. US 50 is contained within the approximate 100-year Flood Boundary for Vandiver Arroyo along its length (east to west) for approximately 2000-ft. The confluence of Vandiver Arroyo and the Arkansas River is approximately ½-mile north of the US 50 crossing. Backwater affects from the Arkansas River will most certainly impact this crossing site.

US 50, eastbound, vicinity Vandiver Arroyo

4.1.13. Two un-named Creeks, mile: 389, Bent County

(FIA Page 4 of 15, Community Panel Number: 080271 0004A, 1977)

Just east of the Otero/Bent County Line, two un-named creeks cross US 50 and include the US 50 ROW within their respective Special Flood Hazard Areas. These Special Flood Hazard Areas most likely include backwater affects from the Arkansas River, which lies approximately 3000 to 4000-ft north of the US 50 ROW.



4.1.14. Gageby Creek crossing, mile: 408.15, Bent County

(FIA Page 5 of 15, Community Panel Number: 080271 0005A, 1977)

US 50 crosses Gageby Creek on structure L-24-M. Approximately 500-ft of the US 50 ROW is included in the Gageby Creek Special Flood Hazard Area. Gageby Creek flows into John Martin Reservoir approximately 3000-ft downstream from the US 50 crossing site.

4.1.15. Prowers Arroyo crossing, mile: 416.35, Bent County

(FIA Page 6 of 15, Community Panel Number: 080271 0006A, 1977)

1800-ft along US 50 is contained within the Prowers Arroyo Special Flood Hazard Area. US 50 crosses Prowers Arroyo on structure L-25-L. The Verhoeff Catchment Dam is approximately 2200-ft north/upstream of the US 50 ROW.

4.1.16. Limestone Creek crossing, mile: 419.67, Bent County
(FIA Page 6 of 15, Community Panel Number: 080271 0006A, 1977)

600-ft along US 50 is contained within the Limestone Creek Special Flood Hazard Area. US 50 crosses Limestone Creek on structure L-25-N.

4.1.17. Graveyard Creek crossing, mile: 423.34, Bent County
(FIA Page 6 of 15, Community Panel Number: 080271 0006A, 1977)

500-ft along US 50 is contained within the Graveyard Creek Special Flood Hazard Area. US 50 crosses Graveyard Creek on structure L-25-C.

4.1.18. Clay Creek crossing, mile: 440.17, Prowers County
(FIA Page 6 of 20, Community Panel Number: 080272 0006A, 1977)

Clay Creek crosses US 50 at mile 440.17 on structure L-26-F. The combined Special Flood Hazard Area for Clay Creek and the Arkansas River includes over 7000-feet of the US 50 ROW. The confluence of Clay Creek and the Arkansas River is approximately ½-mile north of US 50. The Lamar Canal parallels US 50 from Lamar, CO to Koen, CO (approximately 2-miles west of Granada, CO). The Lamar Canal passes beneath Clay Creek through a siphon approximately 2000-ft south of US 50. During the 1965 floods, flows in Clay Creek reached a peak discharge of approximately 158,000 cfs which overtopped and eventually breached a nearly completed Colorado Department of Fish and Game dam upstream of US 50. Severe damage resulted to the US 50 bridge and BNSF railroad property. The existing 5 span concrete structure is a replacement for the destroyed bridge and was completed in 1966.

4.1.19. Willow Creek crossing, mile: 437.72, Prowers County
(FIA Page 6 of 20, Community Panel Number: 080272 0006A, 1977)

The Willow Creek Special Flood Hazard Area includes approximately 1000-ft of US 50 ROW. This crossing site is just east of the corporate limits of the City of Lamar, Co. On June 17, 1965 Willow Creek had an estimated flow of 24,300 cfs which caused the creek to flow out of its channel, flooding most of the City of Lamar south of the railroad tracks.

4.1.20. Smith Arroyo crossing, mile: 445.24, Prowers County

(FIA Page 6 of 20, Community Panel Number: 080272 0006A, 1977)

The Smith Arroyo Special Flood Hazard Area includes approximately 4000-ft of the US 50 ROW. Floodwaters appear to pond along the south embankment of US 50 before crossing the highway and BNSF railroad. The confluence of Smith Arroyo and the Arkansas River is approximately 1-mile north of US 50. This area was flooded during the 1965 Arkansas River Flood

4.1.21. Cheyenne Creek crossing, mile: 467.33, Prowers County

(FIA Page 8 of 20, Community Panel Number: 080272 0008A, 1977)

The US 50 crossing over Cheyenne Creek on structure L-28-E is within the Special Flood Hazard Area. Length of the Special Flood Hazard Area along US 50 is approximately 600-ft.

4.2 US 50 Irrigation Canal and Ditch Crossing Issues

Below is a summary of issues relating to irrigation ditch and canal crossings of, US Highway 50. Field visits were conducted in October - November 2000 and June 2001 with representatives of the concerned Ditch/Canal companies (See Appendix C for Irrigation Ditch Company Coordination Forms). Future design work should be further discussed and coordinated with the pertinent irrigation company as identified herein.

4.2.1 Excelsior Ditch, Mile: 328 (approximate location).

A telephonic interview was conducted on 13 November 2000 with Mr. Dick Evans, President and majority shareholder in the Excelsior Irrigating Company. The existing structure is a 48" x 60" Concrete Box Culvert constructed in 1952. The existing structure performs adequately to convey decreed ditch flows but can be exceeded during storm flows. The ditch normally conveys approximately 60-cfs, matching the Decreed Flow of 60-cfs. Significant amounts of storm runoff can enter the ditch flowing in from the north and under US 50 at several locations west of the ditch crossing under US 50. The additional storm runoff can raise the flow to the point that the ditch is overtopped in several locations. The ditch was last overtopped by storm runoff in 1998 and 1999. Analysis and improvements are probably warranted to reduce or eliminate roadside and local drainage from US 50 that is now entering the Excelsior Ditch. The addition of an overflow, upstream of the existing CBC, may be required to prevent overtopping of the existing structure during periods of combined irrigation and stormwater flows.

After crossing under US 50, the Excelsior Ditch runs immediately parallel to US 50 for approximately 2000-ft. The close proximity of the ditch to the highway has resulted in vehicle accidents as reported by Mr. Evans. Mr. Evans recommends relocating the ditch further to the north to improve safety and maintainability. Also, as originally constructed, a lateral exists just east of the existing crossing site and crosses back under US 50. Mr. Evans feels re-routing the lateral along the southside of US 50 could eliminate the need for an additional crossing under US 50.

Excelsior Ditch CBC entrance under US 50

Excelsior Ditch running along northside of US 50

4.2.2. Rocky Ford Highline Canal, CDOT Structure: L-20-B, Mile: 344.646.

The existing structure is a 65-ft concrete arch bridge constructed in 1932. The existing structure performs adequately and at present there are no significant issues with this crossing. The Rocky Ford Highline Canal normally conveys 350 to 500-cfs; the Decreed Flow is 505-cfs. Significant amounts of storm runoff can enter the canal raising the flow to near 1000-cfs at the crossing site. Currently there is good access to the Ditch Rider roads off both shoulders of US 50. Any improvements to US 50 at this site would need to consider and include access to the Ditch Rider road in both directions. The existing access for ditch maintenance is adequate and unhampered.

Rocky Ford Highline Canal,
CDOT Structure L-20-B

Rocky Ford Highline Canal looking east

4.2.3. Farmers Oxford Ditch, CDOT Structure: L-20-C, Mile: 347.072.

The existing structure is a 25-ft single span timber bridge constructed in 1938. The ditch has a Decreed Flow of 130 cfs and a normal flow of approximately 130-cfs. Storm water runoff to the canal can be as much as 70 cfs increasing total flow at this site to 200 cfs. There is a head gate located approximately 50-ft just upstream and north of US 50. The existing structure is showing signs of severe deterioration below water level. The timber abutment piles are rotting and have decreased in their overall diameter. The ditch was last overtopped in the Spring of 1999 when an estimated flow of 220 cfs topped the ditch approximately 2 miles upstream of the US 50 crossing. Replacement of this structure will be required in the near future. Capacity of the existing structure is barely adequate for flows approaching 200 cfs. The Ditch Company would prefer a concrete, single span bridge. Access to the Ditch Rider road and structure is adequate but could be improved.

(See photos next page)

Oxford Farmers Ditch, CDOT Structure L-20- C


Headgate approx. 50-ft upstream of structure

4.2.4. Otero Ditch.

4.2.4.1. Otero Ditch, CDOT Structure: L-21-A, Mile: 354.400.

The existing structure is a 27-ft concrete single span bridge constructed in 1947. The Decreed Flow is 123 cfs however normal flow is only about 25 cfs. The ditch collects some storm water but can collect significant amounts of irrigation runoff/tailwater. Access of maintenance equipment at this site is difficult and in some locations impossible. The existing guardrails prohibit the ditch company's backhoe from reaching portions of the ditch channel. Additionally a combined roadside and irrigation drainage ditch discharges into the canal along the west bank at this crossing site. The outfall of the roadside ditch has experienced substantial erosion in the past (see Maintenance Issues Summary, 11 Oct 00) and currently has timber cribbing to control erosion. Placement of the cribbing limits access for the ditch company on the west side of the ditch.


Otero Ditch, CDOT Structure: L-21-A


Guardrails limit access for ditch maintenance

Problems with sediment deposits also occur at the confluence of the irrigation and roadside drainage ditches. Improvements at this location should address improving

access for irrigation ditch maintenance, the outfall of the roadside drainage ditch into the irrigation ditch and the associated erosion, and reducing the accumulation of sediment at the confluence of the irrigation and roadside drainage ditches.

4.2.4.2 Otero Ditch, CDOT Structure: L-21-I & DC, Mile: 355.195.

There are two existing structures at this location. The structures are immediately adjacent to the bridges (structures L-21-G & DA) that span the Apishapa River. The structures over the Otero Ditch are 33 to 34-ft single span concrete bridges. The first was constructed in 1957 and the second in 1998 when improvements were made to the bridges over the Apishapa River. This crossing site is approximately one mile downstream from the previous structure, L-20-C. The existing structures are adequate and perform well. Access for maintenance is good but could be improved. Flows through the structures are excellent with little to no sediment accumulation.

Otero Ditch, CDOT Structure: L-21-I & DC

Ditch channel section looking upstream

4.2.4.3. Otero Ditch, CDOT Structure: L-21-b, Mile: 356.495

The existing structure is a 12-ft by 8-ft CBC constructed in 1960. This structure is marginally adequate when storm water combines with the normal irrigation flows (120-125 cfs). A small steel girder bridge belonging to the BNSF Railroad is located approximately 60-ft upstream of the CBC. The location of the roadside ditch on the south and west sides of the structure limit maintenance access to the irrigation ditch. The ditch company representative would like to see this structure increased in capacity by approximately 10% to better convey flows during storms. Any improvements to this location will need to consider impacts and backwater affects to the BNSF railroad bridge upstream.

(See photos next page)

Otero Ditch, CDOT Structure: L-21-b

BNSF bridge immediately upstream

An additional unique feature to this location is that the existing ditch, after crossing under US 50, parallels the highway for approximately one third of a mile. Any improvements to US 50 would most certainly affect the Otero Ditch since the ROW's are so close together. Dredge spoils from the ditch already appear to encroach upon the US 50 ROW.

Otero Ditch looking east from CDOT structure L-21-b, ditch closely parallels US 50

4.2.5. Catlin Canal, CDOT Structure: L-21-K & N, Mile: 360.262.

The existing structure is a 20 X 6-ft Concrete Box Culvert constructed in 1968/69. The ditch has a Decreed Flow of 345-cfs and a normal flow of approximately 248-cfs. Stormwater runoff can enter the canal but a waste gate upstream of the structure, near the west end of Manzanola, allows excess runoff to be dumped prior to this structure. There is a head gate located approximately 20-ft just upstream and north of US 50. There are no major issues with this structure. Access to the Ditch Rider road will need to be maintained. The existing channel is riprap lined and usually does not require dredging.

(See photos next page)

Catlin Canal, CDOT Structure L-21-K/N
upstream entrance

Catlin Canal, downstream

4.2.6. Rocky Ford Ditch, CDOT Structure: L-22-I, Mile: 368.525.

There are two existing structures in this location, one for the eastbound lanes and one for the westbound lanes. The structure listed on the CDOT Field Log of Structures is a 32-ft concrete single span bridge constructed in 1934. The westbound bridge appears to be a much newer and different type of concrete bridge. The Decreed Flow for the Rocky Ford Ditch is 112-cfs, however the normal flow is only about 52-cfs. It is expected that the Colorado Water Court will reduce the Decreed Flow sometime before 2002. The ditch collects some stormwater runoff but a waste gate approximately ¼ mile upstream of the structure allows excess runoff to be dumped there. The existing structures perform well and there are no special maintenance issues or needs. The existing channel is riprap lined and usually does not require any dredging. There is no requirement for a Ditch Rider road in this location; city streets provide all necessary access.

Rocky Ford Ditch, eastbound bridge
CDOT Structure: L-22-I

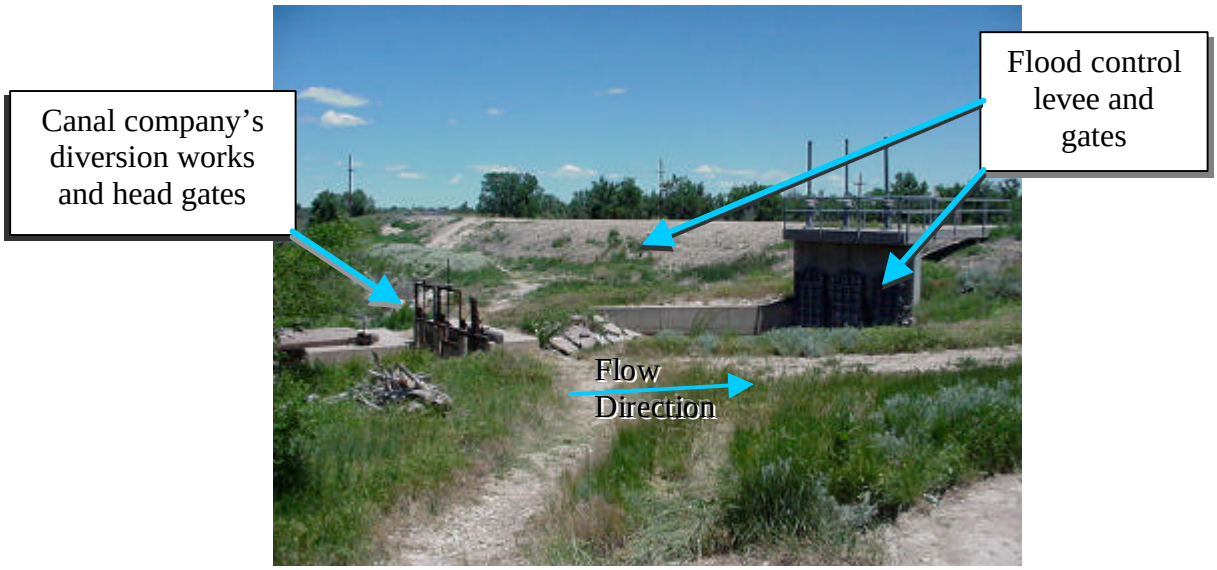
Rocky Ford Ditch, westbound bridge

4.2.7. Las Animas Consolidated Canal, CDOT Structure: L-23-C, Mile: 392.62.

The existing canal crossing structure is a single cell concrete box culvert constructed in 1958. The canal, formally known as the Jones Ditch, has a decreed flow of 135-cfs and a normal flow of approximately 75-cfs. Excel Energy, Denver, Colorado now owns 98% of the canal shares. There is a diversion works with head gates located approximately 500-ft upstream of the US 50 crossing site. The canal also flows through a flood control levee equipped with gates just downstream of the diversion works. The gates at the levee are employed in the event of a flood and are only used to shutoff flow through the levee. Between the levee and the US 50 crossing is a Parshall flume used by the Canal Company to measure canal flows. The flume and canal closely parallel the US 50 Right of Way (ROW). A smaller ditch called the Riverside Ditch diverges from the Las Animas Consolidated Canal just upstream (approximately 50-ft) of the US 50 crossing. A concrete structure and gate exist at the juncture of the Los Animas Consolidated Canal and Riverside Ditch and is located immediately adjacent to the US 50 ROW. There are no major issues with this canal or crossing site. Access from US 50 to the diversion works, head gates and levee will need to be maintained.

Las Animas Canal CBC outfall


Parshall flume located between levee and US 50 crossing
(photo taken from top of flood control levee)



Los Animas Canal diversion works, head gates and flood control levee

4.2.8. Lamar Canal, CDOT Structures: L-26-E;-BV, Mile: 434.78; 436.76.

The Lamar Canal crosses US 50 in two locations in or near the city of Lamar, Colorado. The decreed flow for the Lamar canal is 285.7-cfs, the design capacity of the canal at the crossing sites is 285-cfs and the normal flow is approximately 150-cfs. The first crossing is on the north end of town at mile 434.78 utilizing a 25-ft concrete slab bridge. A Parshall flume is located just downstream of this crossing which reduces the flow velocities and causes an accumulation of sediment beneath the US 50 bridge. The second crossing is just east of town through a concrete box culvert at mile 436.76. Immediately downstream of this crossing is an entrance to an inverted siphon where the Lamar Canal passes under the Willow Creek Drainage channel. Sediment routinely collects between the siphon entrance and CBC and within the CBC under US 50.

Lamar Canal, Structure L-26-E
Parshall flume directly downstream

Lamar Canal, CBC Structure L-26-BV
(photo taken from inverted siphon entrance)

4.2.9. Manvel Canal, Approximate Mile: 444.8.

The Manvel Canal crosses US 50 through a 60”x60” (estimated) concrete box culvert at approximate mile 444.8 east of the Roosevelt School site. The CBC is not on the CDOT Field Log of Structures. The Manvel Canal was purchased in 1995 by the Lower Arkansas Water Management Association (LAWMA) and is no longer active as an irrigation water supply facility. The decreed flow of 54-cfs is no longer routed through the canal. The canal’s primary purpose is to provide drainage for the adjoining agricultural fields. The easements on which the canal lies are being returned to the landowners and regular maintenance of the ditch no longer occurs.

Manvel Canal CBC entrance

4.2.10. X-Y Canal, Approximate Mile: 452.2.

The X-Y Canal crosses US 50 through a concrete box culvert at approximate mile 452.2 near the west end of Granada, Colorado. The CBC is not on the CDOT Field Log of Structures. Like the Manvel Canal, the X-Y Canal was purchased in 1996 by the Lower Arkansas Water Management Association and is no longer active as an irrigation water supply facility. The decreed flow of 69-cfs no longer flows through the canal. The canal’s primary purpose is to provide drainage for adjoining agricultural fields.

X-Y Canal CBC entrance

4.2.11. Other Irrigation Issues

4.2.11.1. Irrigation Ditches Immediately Adjacent to US 50

East of Manzanola and continuing to Rocky Ford, CO, from approximate mile: 361.5 to mile: 368, there are several locations where irrigation ditches are immediately adjacent to the US 50 roadway. In some locations the irrigation ditch inverts are higher than the adjoining roadway curb/profile. The close proximity of the ditches to the road causes issues with roadside drainage, occasional overflow of irrigation water onto the roadway, deposits of drifting snow onto the roadway, and safety issues due to the lack of a shoulder. In other locations irrigation ditches are immediately adjacent to US 50 but with inverts below the roadway curb/profile. In these particular locations, roadway shoulders are minimal and make for unsafe conditions, as vehicles are able to enter the ditch directly after leaving the roadway surface. The area also includes cross drains that can contribute to various drainage problems.

Irrigation ditches immediately adjacent to the US 50 roadway

4.2.11.2. Irrigation Drainage and Roadway Ditch Interaction

Throughout the corridor there exist locations where roadside ditches and irrigation ditches combine flows. With few exceptions the roadside ditches were sized for the additional irrigation drainage flows and during storm events are quickly overtopped. The additional flows from irrigation drainage also carry sediment that can quickly reduce the capacity of the roadside ditch exacerbating a lack of capacity. Siltation of roadside ditches combined with increased flows has caused additional vegetation to prosper and require significantly more maintenance. Future designs should require segregation of irrigation drainage flows from roadside drainage ditches. Separate systems should be considered to reduce combined flows and increased maintenance requirements for CDOT crews.

Combined roadside and irrigation drainage ditch

Silt accumulation at highway cross culvert due to combined roadside and irrigation drainage

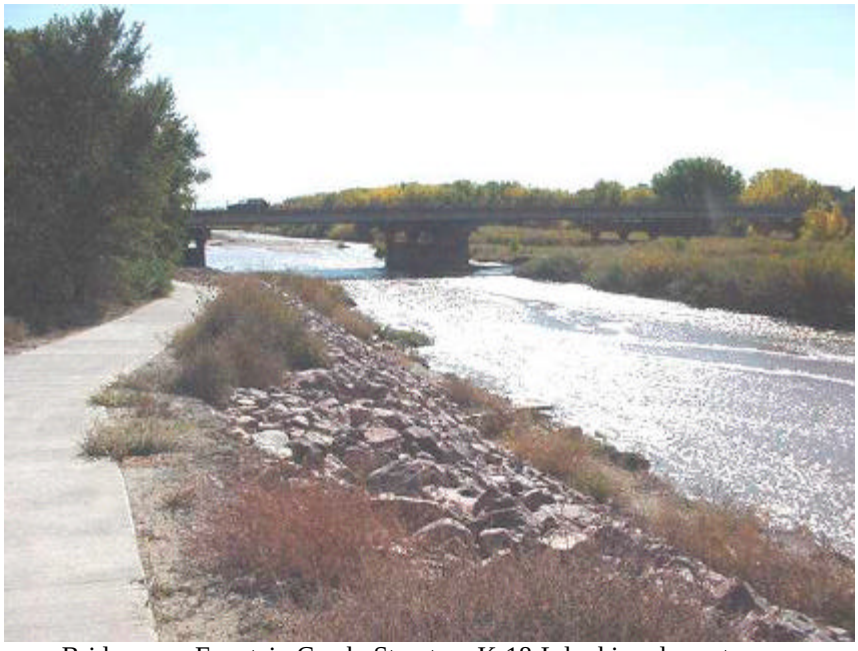
4.3. Recurrent Drainage Issues and Flood Histories

This section summarizes recurrent drainage issues that were identified by CDOT maintenance personnel during field visits and interviews. Examples of these recurrent issues include bridge pier scour, inadequate roadside ditches and culverts, inadequate ditch outfalls and locations were US 50 is often overtopped or inundated. This list of issues is extensive, but not necessarily all inclusive of the drainage issues that will need to be addressed in the future.

4.3.1 Pueblo to Nepesta Road

Below is a summary of issues relating to drainage, US Highway 50, Pueblo to Nepesta Road. A field visit was conducted on 17 October 2000 with Ken Wissel, Supervisor CDOT Pueblo Maintenance and Carl Valdez, CDOT Maintenance Technician.

4.3.1.1. Mile 314, Fountain Creek Bridge. Alignment of Fountain Creek through structure K-18-L continues to be an issue. During the Spring 1999 floods, Fountain Creek migrated to the west and was impinging upon the northwest abutment/approach of the US 50 bridge. Late in 1999 URS completed an analysis and design for counter measures to protect the abutment and help ensure proper alignment of Fountain Creek through the structure. The current alignment of Fountain Creek is adequate but channel migration is a continuous possibility during future flood events. Improvements should include construction of the URS designed guide banks and other counter measures as soon as possible.



Bridge over Fountain Creek, Structure K-18-L looking downstream

4.3.1.2. Mile 318, Dry Creek Bridge Scour and Erosion. Structures K-18-BZ, BY, and FG all show signs of significant pier and abutment scour. Numerous emergency repairs have been made to curtail erosion of the abutments and piers. The last major event causing damage was in 1999. Support piles beneath the US 50 bridge piers have already been exposed!

Concrete riprap repairs for abutment scour

Scour has exposed the support piles under the pier

Dry Creek Drainage looking upstream/north

4.3.1.3. Mile 319, Inadequate Underpass Drainage beneath BNSF Railroad Bridge. The US 50 roadway beneath the BNSF railroad tracks (structure K-18-W), east side of Pueblo, is flooded routinely. Two existing sump pumps transfer water from a sump on the south side of the road to a concrete lined ditch that drains generally south and parallel to the railroad ROW toward the Arkansas River. The two pumps were replaced approximately five years ago but are inadequate to handle any but the smallest events. Contributing surface flows converge on the underpass from the east and west along the US 50 roadway and from the northeast along the BNSF roadbed. High ground water can also influence the amount of water entering the pump sump.

K-18-W looking west, pump house on left near truck

K-18-W looking east

Possible corrective action at the BNSF Underpass should include:

a. Increased pump size/capacity.
b. Flow analysis and possible increase in the size of the concrete lined discharge ditch to handle any increased pump flows.
c. Review of local hydrology; significant development has occurred to the north and east.

4.3.1.4. Mile 329 – 330, Inadequate Cross Drainage, vicinity Arkansas River Floodplain. This area begins in the vicinity of the junction of US 50 and CO 96 and extends east approximately two miles along US 50 to the bridge over the Arkansas River (structure L-19-H). There are presently only two locations where cross drainage can occur, a single 72-inch CMP and at a collection of seven 36-inch CMPs located just west of the intersection of US 50 and the roads to Avondale and North Avondale.

72-inch Cross Culvert; looking west along US 50

Collection of seven 36-inch Cross Culverts (three shown)

The area is located within the floodplain of the Arkansas River; US 50 is often overtopped during flood events. Flood flows originate from the Arkansas River to the south, flow northeast towards US 50 paralleling the Arkansas River, then return to the river just north of the US 50 bridge. The road was last overtopped in 1999 by as much as 1-ft of water and was closed to traffic for over 14 hours. Improvements will likely require raising the US 50 roadway surface and installing additional cross culverts.

One of the seven 36-inch cross culverts inlets

4.3.1.5. Mile 332, Undersized Culvert near Intersection with Business 50.

Just west of the intersection of US 50 and Business 50 there is an existing 30-inch CMP beneath US 50. Flow through this culvert is a combination of overland storm runoff and irrigation drainage. During the summer irrigation season, the irrigation drainage ditches often flow at or near capacity and directly into the 30-inch CMP. During summer storms, the combination of stormwater and irrigation drainage flows quickly exceeds the capacity of the 30-inch culvert. Possible improvements include replacement of the CMP with a CBC capable of conveying the combined storm and irrigation drainage flows.


Irrigation ditch upstream of US 50 30-inch CMP


30-inch CMP outfall, northside of US 50

4.3.1.6. Mile 332 – 334, Inadequate Roadside and Cross Drainage.

This area extends just east of the intersection of US 50 and Business 50 (near 51st Lane) east to Asbury Lane, approximately one and one half miles. Irrigated fields exist on the south side of US 50 and un-irrigated areas lay on the north side. Irrigation drainage flows depart from the fields and flow into areas along the south side of US 50. There are few, if any, established drainage ditches to accommodate the irrigation flows. The lack of established roadside ditches is compounded by a scarcity of cross culverts and the absence of established drainages to the Arkansas River. Small roadway dips and low areas in US 50 are often overtopped during storms. Improvements would include raising US 50 in select locations, the establishment of engineered drainage ditches along the south side of US 50, and the installation of properly sized and located cross culverts.

(See photos on next page)

Roadside Drainage Ditches south side US50 vicinity mi. 333

4.3.1.7. Mile 335, Inadequate Drainage from Cross Culverts to the Arkansas River.

Near mile 335 there are two cross culverts beneath US 50 that lack established outfalls to the Arkansas River. One of the culverts is a CBC that drains water from a perennial spring. The existing CBC adequately conveys the spring flows, but north of the US 50 ROW there is not an established drainage to the Arkansas River. The drainage flows migrate across private land through a series of marshy areas. The lack of established drainage ditches connecting US 50 cross culverts and the Arkansas River is typical along this area east to the Huerfano River bridge (structure L-19-B).

CBC inlet, flow is from a perennial spring

CBC outfall looking toward Arkansas River

4.3.1.8. Mile 341, Low Area, Replace CMP with CBC.

US50 descends into a low area as it crosses Thompson Arroyo. Currently there is a single 72-inch CMP conveying flows beneath US50. The existing 72-inch CMP performs adequately for most flow events. During wet periods water can be retained upstream of the culvert and ponding can occur. There is a good outfall and established drainage north to the Arkansas River. Improvements would include possible replacement of the 72-inch CMP if required by updated hydrology.


Mi. 341 Low Area looking west


72-inch CMP inlet beneath US 50

4.3.1.9. Mile 343, Undersized CBC near Nepesta Road Intersection.

The existing CBC located just west of the Nepesta Road intersection is undersized and overtopped often. Flows to this CBC include roadside drainage and overland runoff for a substantial area to the south and west. The CBC outfall is a ditch that flows approximately 500-ft to and into the Rocky Ford Highline Canal. Upsizing of the CBC and improvements of the outfall ditch will be required.


Undersized CBC near Nepesta Road Intersection

4.3.2 Nepesta Road to La Junta.

Below is a summary of issues relating to drainage, US Highway 50, Nepesta Road to La Junta. A field visit was conducted on 11 October 2000 with Greg Wingard, Supervisor CDOT La Junta Maintenance patrol.

4.3.2.1. Mile 346, Low Area.

This area is accumulating silt and will be a long-term problem area. The existing small CBC is barely adequate. Will need to raise elevation of US 50 and increase capacity of the drainage structure.

Low area between mileposts 345 and 346

4.3.2.2. Mile 348.50, Box Culvert too Small.

This area is drained with a combination of a small CBC and buried clay tile pipes. Contributing flows are combined stormwater runoff and irrigation drainage. After crossing beneath US 50, there is no established drainage north of the BNSF Railroad embankment to the Arkansas River. Some of the clay tile pipes have probably failed as evident by the need for constant shoulder repairs near the CBC outfall. There is most likely a failed clay tile pipe directly beneath the existing CBC. This area will need a properly sized (increased capacity) structure and drainage established to the Arkansas River. The drainage may be diverted to the west between the BNSF ROW and US 50, and then to the Arkansas River, however an irrigation siphon may be a conflict.

(See photo on next page)

Undersized Box Culvert, Mile 348.5, looking northeast

4.3.2.3. Mile 350.4, (West side of Fowler) Roadside Ditch without an Outfall.

This area is directly across from the Fowler Golf Course on the southside of US 50. There is no cross culvert beneath US 50. Flows appear to be directed entirely to the east along the south side of US 50. However, there is no outfall for the ditch to the east, it just dead ends! Flooding of a private residence and a commercial storage facility occurs routinely. There is an irrigation siphon that crosses beneath the roadside ditch and flows north under US 50. If a cross culvert was installed, there is no established drainage north of the BNSF ROW or through the Golf Course. Walt Pachak, CDOT Pueblo has apparently done some design work to correct this problem; extent of design work is unknown at this time.

Irrigation Siphon under Roadside Ditch

Dead End Roadside Ditch, looking east

4.3.2.4. Mile 354.4, Erosion Problem, Roadside Ditch into Otero Canal.

This problem is immediately adjacent to CDOT Structure L-21-A, on the south side of US 50. As the roadside ditch outfalls into the Otero Canal there is significant erosion between the roadside ditch and shoulder of US 50. Timber cribbing placed along both sides of the roadside ditch is currently controlling the erosion.


Roadside Ditch Outfall into Otero Canal


Erosion at Outfall & Temporary Wood Cribbing

4.3.2.5. Mile 360, East side of Manzanola, Curb and Gutter Issues – Undersized Stormdrain Pipe.

This area has curb and gutter and 4 to 5 storm drain inlets along the southside of US 50. However the pipe connecting the inlets also receives irrigation drainage and silts up quickly. The pipe slope is too shallow causing the storm inlets to back up and water to spread across US 50. The stormdrain pipe crosses beneath the Catlin Canal just east of Manzanola and daylights approximately 500-ft east of the Catlin Canal's crossing under US 50. The stormdrain outfall is heavily silted and must be cleaned at least 3 times per year. A suggested solution is to connect the existing pipe directly to the Catlin Canal on the northside of US 50, where the canal parallels US 50 just east of Manzanola. Any new cross culvert/connections would flow north under US 50 and outfall directly into the Catlin Canal.


Storm Drain Irrigation Drain Inlets


Silted Storm Drain Outfal

4.3.2.6. Mile 366.5, Piggyback Culverts, Inadequate Drainage Ditch.

An irrigation ditch on the northside of US 50 drops into a culvert and discharges into a drainage ditch. The irrigation culvert is placed directly on top of a larger cross culvert that directs flow from the concrete roadside drainage ditch on the southside of US 50. The two culverts discharge into a common drainage ditch that then flows north and east to SH 71.

Piggyback Culverts

Cross Culvert Looking North Toward Drainage Ditch and Piggy Back Culvert Outfall

4.3.2.7. Mile 367, (West side of Rocky Ford) Intersection with Colorado Highway 71, Undersized Structure and Ditch, Intersection Floods Routinely.

The existing structure beneath US 50 is inadequate, as is the ditch that receives the water and flows north along SH 71 to the Arkansas River. This intersection floods routinely. The existing structure needs to be increased in size and the slopes increased to prevent silt accumulation. Road 18 intersects US 50 from the south and acts as a divide with all flows to the east of the Road 18 intersection flowing east to a different cross culvert. Flows from the west flow to the intersection and underneath US 50 through the existing structure.

Cross Culvert under US 50 Looking North

Silted Cross Culvert Entrance with Debris

4.3.2.8. Mile 371.5, Undersized Structures near Gravel Pit.

There are two 24-inch cross culverts beneath US 50 at this location, one directly north of the BNSF bridge structure and one approximately 500-ft to the east at the intersection with County Road 22. The BNSF structure has substantially more capacity than the two 24-inch cross culverts. The existing culverts must be upsized to better match the railroad structure. Flooding has occurred at this site with depths in excess of 3-ft in the eastbound lane.


One of two 24-inch Cross Culverts under US 50


Railroad Structure 50-ft upstream of 24-inch Cross Culvert

4.3.2.9. Mile 364.2, Patterson Hollow, 4 each 72-inch CMP's Scheduled for Replacement.

The existing structure has 4 each 72-inch CMP's. The structure was replaced during the summer of 2001.


Structure L-21-Q, Patterson Hollow, Replaced in 2001

4.3.2.10. Mile 374, Swink Underpass below BNSF Railroad.

Current sump pump configuration is adequate for most storms unless electrical power is lost. New pumps were installed approximately 4 years ago and work well. The pumps discharge can exceed the capacity of the discharge channel, but this has not been a problem. However, pump stations are still subject to failure and undesirable in rural locations. Improvements in this area should address reducing surface runoff that drains to the pump station and riddance of the need for a pump station (e.g. re-alignment of US 50 and elimination of the underpass).

Underpass for BNSF RR, Sump Pump House near WB Bridge

4.3.2.11. Mile 375, Vicinity New Wal-Mart Intersection, twin Culverts Have no Place to drain to.

Two 36-inch CMP culverts drain the area in and around the new Wal-Mart store. Culverts are adequately sized but there is no established drainage north of the BNSF Railroad embankment to the Arkansas River. Flows are currently ditched to the west along the northside of the railroad embankment to the King Ditch. Flows to this culvert come along the southside of US 50 from the King Ditch on the west, Wal-Mart store and surrounding area to the south and the KOA campground to the east. This area will require a new established ditch/outfall to the Arkansas River.

Twin 36-inch Cross Culverts with no place to drain

4.3.2.12. Mile 377 (est.), Vicinity Road 27 Intersection, Big R, Needs New Culvert Alignment under US 50.

The drainage from this point east to the low spot near Bent Ave and the McDonalds Restaurant is inadequate and floods often. Improvements will be required all along US 50 with new/improved cross culverts. Specifically at the Road 27 intersection a new cross culvert system is probably required. Flows currently converge on the west side of Road 27 from the south, west and from a median drain between the east and westbound lanes of US 50. The culvert connecting the median drain to the main ditch is currently closed to prevent water from discharging onto the westbound lanes during moderate to heavy flow events. The main cross culvert beneath US 50 is just east of the Road 27 intersection.


Road 27 Intersection Looking East


Road 27 Intersection Looking South

4.3.2.13. Mile 378 (est.), Vicinity Bent Ave., McDonalds, Inadequate Cross Culverts under US 50.

There are two existing 24-inch CMP culverts beneath US 50 which are too small to handle the ditch flows from the south side of US 50 and adjacent stormwater flows. Adjacent to US50 to the north are 6, 48-inch CMP culverts beneath the BNSF Railroad embankment. However, downstream (north) of the railroad grade there is no established drainage ditch to the Arkansas River which is approximately 200-ft to the north. A small ditch with an 18-inch culvert under a gravel access road currently takes the flow toward the Arkansas River but is barely adequate for anything but minor flows. Increased sized culverts beneath US 50, and an established drainage ditch to the Arkansas River, will be required for improvement.

(See photos next page)

24-inch Cross Culverts under US 50
6, 48-inch culverts under RR grade in the distance

Small Drainage Ditch looking toward the 18-inch culvert and Arkansas River

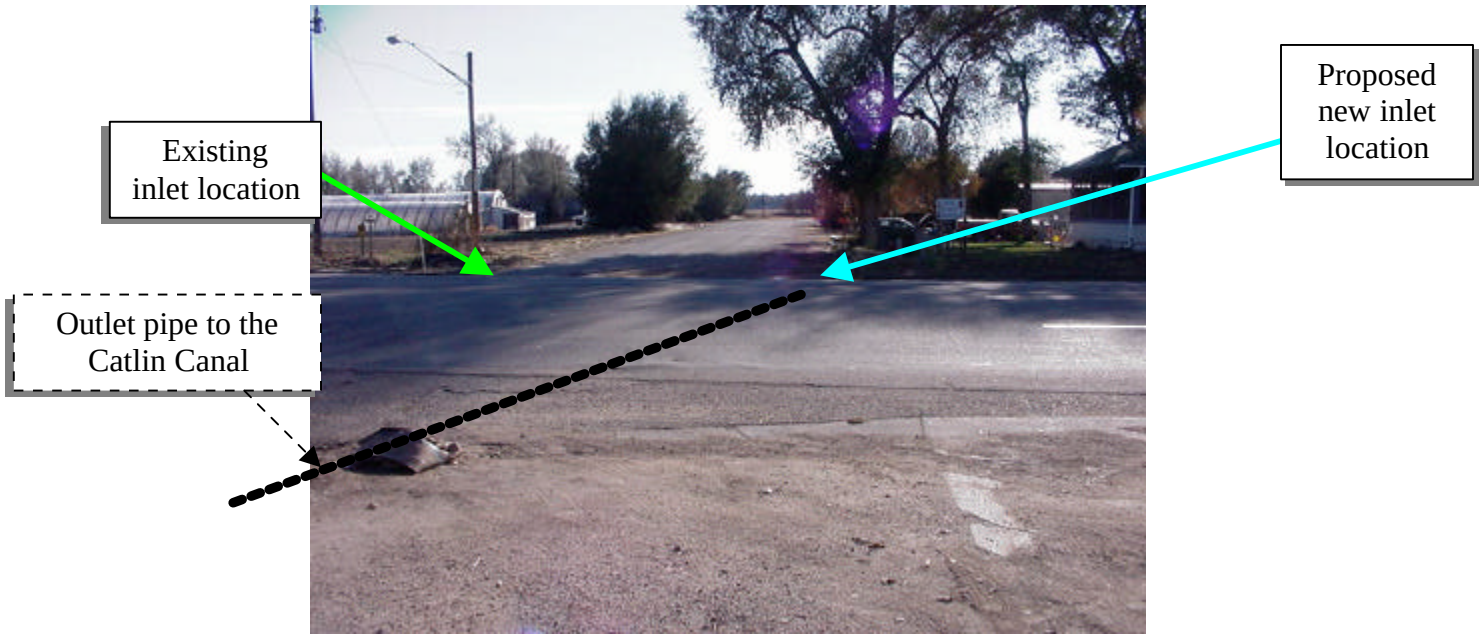
4.3.2.14. Mile 378.74, La Junta Underpass below BNSF Railroad.

As US 50 enters the western edge of La Junta, the highway passes beneath the BNSF railroad (CDOT Structure M-22-R). This underpass has been subject to frequent and deep flooding. Considerable improvements would be required to reduce or eliminate flooding and consequent road closures at this location.

BNSF Underpass, M-22-R looking west , westside of La Junta,

4.3.2.14. Follow up; Mile 360, East side of Manzanola, Curb and Gutter Issues – Undersized Stormdrain Pipe. (17 Nov 00)

On 16 Nov 00, a meeting with Mr. Elmer Bauman, Superintendent of the Catlin Canal Company and Mayor of Manzanola was held on site to discuss issues with the Catlin Canal (see separate report for US 50 Irrigation Canal Crossing Issues, 16 Nov 00). Mr. Bauman also discussed the problems with the curb and gutter at mile 360. Mr. Bauman suggests the addition of a new grated storm inlet on the southwest corner of the Washington Street and US 50 intersection. A pipe connecting the storm inlet could be connected directly to the Catlin Canal approximately 200-ft to the north. This corrective action would provide two separate locations for stormwater runoff to enter rather than relying on the single existing inlet on the southeast corner of the Washington Street/US 50 intersection. The city of Manzanola has completed initial concept design of this alternative and has received preliminary bids of approximately $10k to install the new inlet and connect to the Catlin Canal.



Intersection of Washington Street and US 50, Manzanola, CO, looking south. Existing inlet location shown on the left – proposed new inlet location on the right.

4.3.3. La Junta to McClave Junction

Below is a summary of issues relating to drainage, US Highway 50, La Junta to McClave Junction. A field visit was conducted on 9 April 2001 with Greg Wingard, Supervisor CDOT La Junta Maintenance.

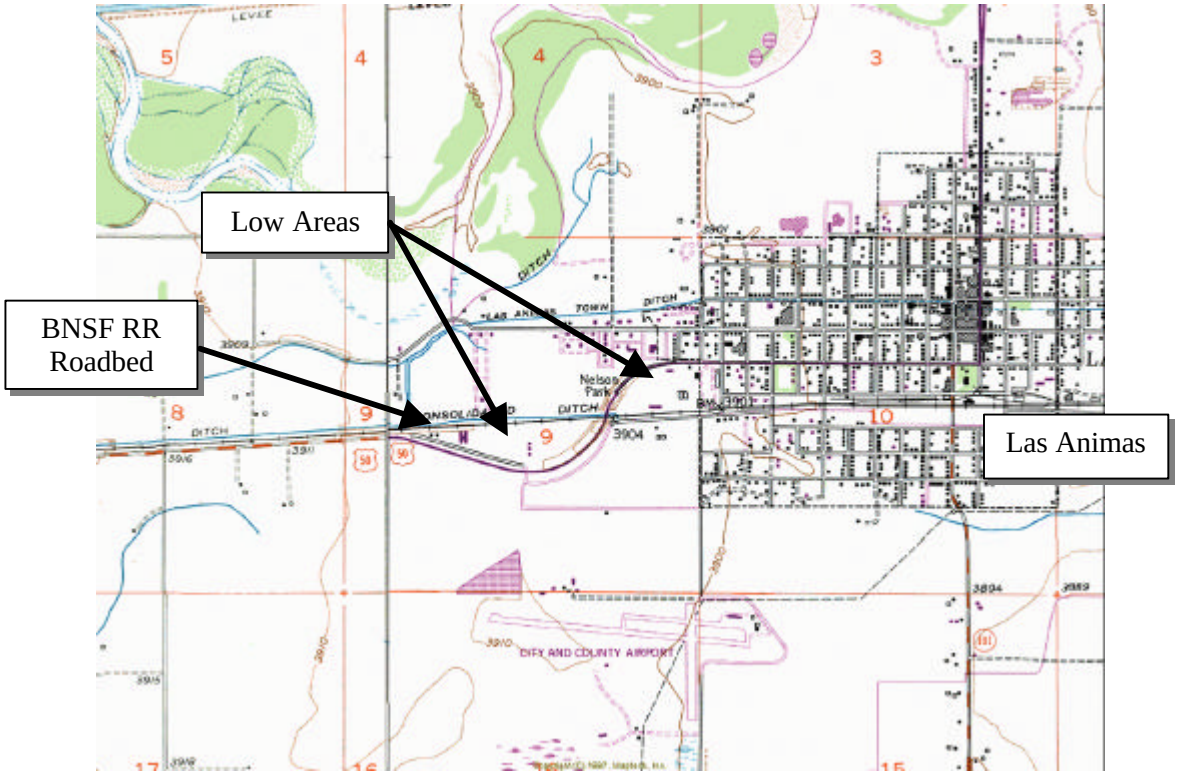
4.3.3.1. Mile 380.5, La Junta Stormwater system. A portion of the La Junta local stormwater system crosses US 50 near the intersection of US 50 (also known as First Street through La Junta) and Bradish Street. This particular area has experienced localized flooding and overtopping of US 50. A stormwater pump with an outfall to the Arkansas River was recently installed in 2000 to help reduce localized flooding.

La Junta Stormwater Pump Station located between US 50 and BNSF RR Yard

4.3.3.2. Mile 397.7, BNSF RR Overpass. A combination of the elevated BNSF Roadbed and the US 50 bridge approach embankments, on both sides of the bridge over the BNSF railroad tracks, isolates adjacent properties and contributes to reduced drainage. The properties lie between the US 50 ROW and the BNSF railroad tracks (see map). There are no cross culverts or established ditches to provide positive drainage.

Low area that lacks drainage, west of US 50

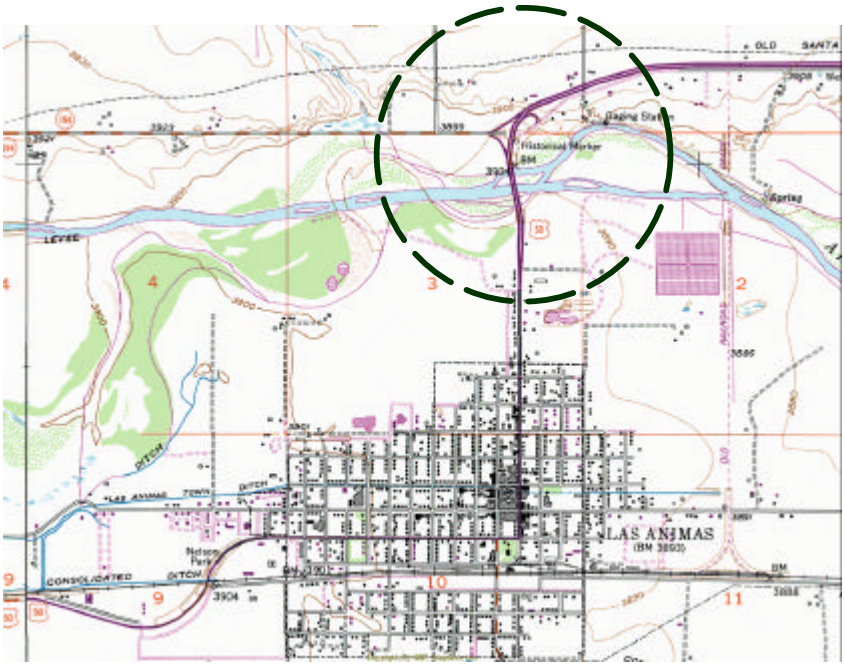
Low area near arena lacks drainage, east of US 50



Corrective action for this area will most likely include improvement of local drainage ditches along the BNSF railroad tracks and possible inclusion of cross culverts beneath the BNSF ROW.

4.3.3.3. Mile 400.1, Arkansas River Crossing and interchange with SH 194.

The Arkansas River flows between confining levees in the vicinity of the Town of Las Animas and the US 50 crossing. Immediately north of the US 50 crossing of the Arkansas River is the interchange between US 50 and SH 194 (CDOT structure L-24-B). Local drainage ditches flowing from the north must travel through gated culverts in order to pass through the levees and drain toward the Arkansas River. Gated culverts exist both west (upstream) and east (downstream) of the US 50 crossing site. As currently constructed, drainage through the gated culverts is inadequate and causes substantial ponding along the shoulders of SH 194 near the underpass for SH 194 below US 50. During periods of rain, SH 194 can be overtopped and was in fact closed during the most recent major storm event in April 1999. The gated culverts are normally operated in the "open" position and manually closed during periods of high flow in the Arkansas River. Aggradation of the bed of the Arkansas River is most likely exacerbating the condition with additional backwater affects through the culverts. Corrective action will possibly require modification/lowering of the inverts of the gated culverts, reestablishing drainage channels from the gated culverts to the Arkansas River low flow channel and raising of the SH 194 roadbed.



Map of the US 50 and SH 194 Interchange Area


US 50 bridge over SH 194, looking west


Low/wet area north of SH194 & east of US 50


Low/wet area south of SH194 & west of US 50


Culvert inlet and valve operator

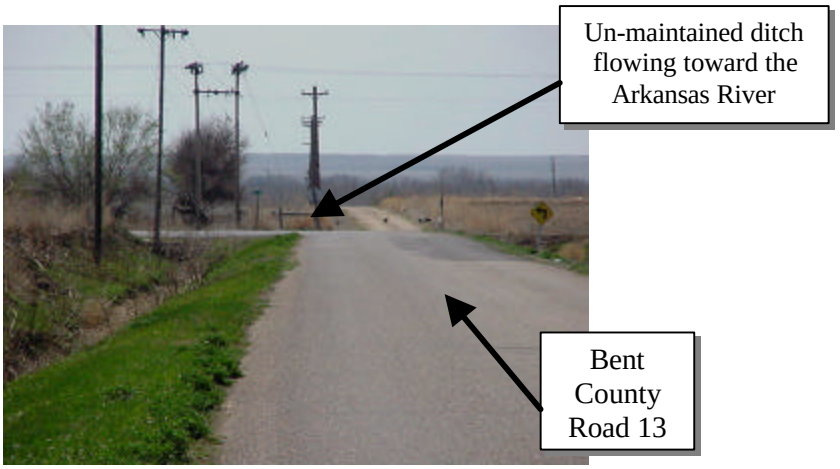
4.3.3.4. Vicinity mile 401, intersection of US 50 and Bent County Road 12. Localized drainage in and around the US 50 and CR 12 (also referred to as "Twelfth Lane") intersection generally flows from north to south. Several cross culverts direct drainage across CR 12 and south across US 50. Three culverts converge to a common culvert that flows south, underground, away from the road intersection to an outfall approximately 1000-ft south of US 50. The culvert outfalls into "Tree Top" ditch which flows for approximately 1-mile to the Arkansas River. CDOT currently maintains the culvert and ditch to ensure flow capacity.

Arrows depict approx. underground culvert network

Culvert outfall into the lined portion of "Tree Top" ditch

Head cut at downstream end of lined ditch

4.3.3.5. Vicinity mile 402, intersection of US 50 and Bent County Road 13. Localized drainage at this intersection flows south away from US 50. However, all drainage flows combine and must flow in a currently un-maintained ditch to the Arkansas River. Maintenance responsibility for the ditch is currently un-assigned resulting in an inefficient, overgrown ditch with reduced capacity that can cause flows to back up and flood the US 50 ROW and intersection.



County Road 13 looking south, away from the US 50 & CR 13 intersection

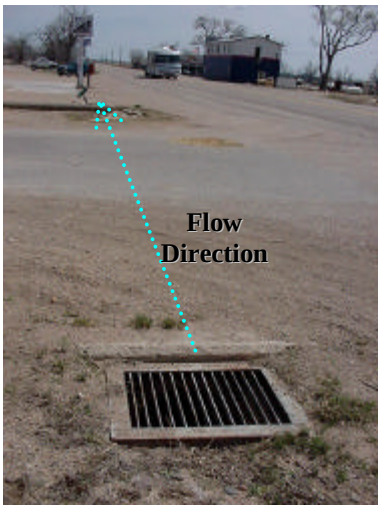
4.3.3.6. Vicinity mile 403, intersection of US 50 and Bent County Road 14.
Two undersized culverts beneath US 50 contribute to flooding along the northside of US 50. Analysis of the local hydrology and culvert hydraulics will be required to determine possible corrective actions. Current conditions contribute to flooding of the residence on the NW corner of the intersection.

Culvert outfalls at US 50 and CR 14, looking north

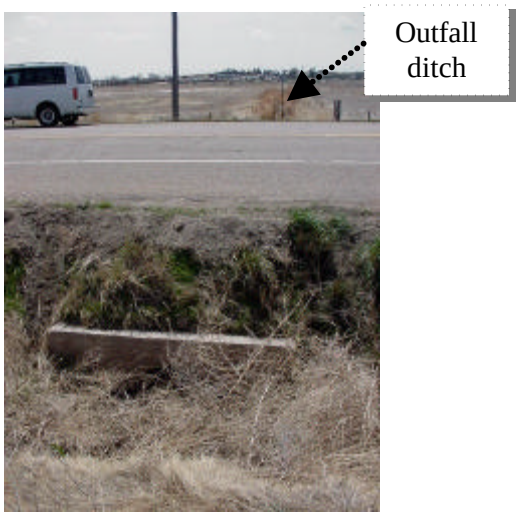
4.3.3.7. Vicinity mile 416 - 417, Hasty, CO. As the US 50 corridor passes through the settlement of Hasty, CO., the highway lays within a large localized depression. During periods of significant precipitation, drainage accumulates along the northside and overtops the US 50 ROW. Two cross culverts, just east and west of Hasty, direct flow beneath US 50 and into ditches that generally drain south and away from US 50. Bent County currently maintains the ditches. Within the settlement of Hasty, two drop inlets, on the northside of US 50, coupled with miscellaneous small berms direct drainage and protect residence and businesses in Hasty.

Cross culvert under US 50, west of Hasty

West cross culvert outfall ditch looking downstream



Drop inlet, northside of US 50, Hasty, CO



Cross culvert inlet under US 50, east of Hasty

4.3.4. McClave Junction to Kansas Border

Below is a summary of issues relating to drainage, US Highway 50, McClave Junction to the Kansas border. A field visit was conducted on 10 April 2001 with Dewey Norfleet, Supervisor CDOT Lamar Maintenance, and his Patrol Leaders.

4.3.4.1. Mile 420.8, Intersection of US 50 and SH 196, Undersized and Old Cross Culverts. Three culverts cross US 50 at this location. Two culverts are for irrigation and a third for roadside drainage. Approximately 100-ft north of the intersection, along the east side of SH 196, is an existing division box/structure for the irrigation culverts. Any improvements to this intersection will need to consider the location and hydraulics of the division box. All three culverts are very old (1920 – 30's). The existing 30-inch (estimated) roadside drainage culvert should be re-evaluated for size using current hydrology and hydraulic design methods.

Irrigation culvert US 50 & SH196 intersection

4.3.4.2. Mile 420.8 to 427, Undersized and Old Cross Culverts. Through out this section of US 50 numerous old cross culverts exist. All culverts should be re-evaluated for capacity, size, entrances and outfalls. Roadway improvements along this section will require that most cross culverts be lengthened as existing entrances and outfalls are immediately adjacent to the roadway.

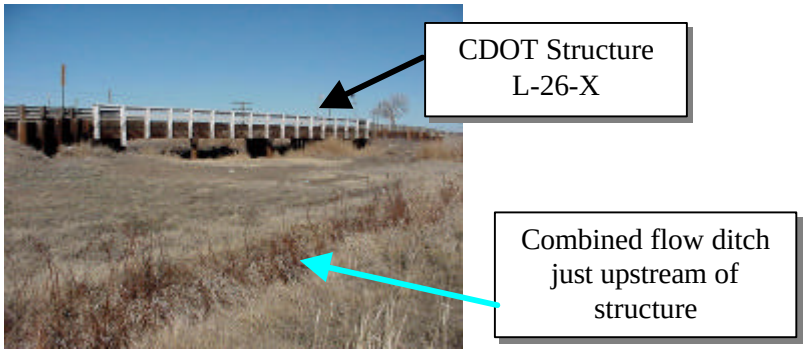
4.3.4.3. Mile 422.1, Undersized Irrigation Cross Culvert. This location typifies the numerous existing small irrigation crossings of US 50 just west of Lamar. Most crossings would benefit from re-evaluation of structure capacity and size.

Typical irrigation ditch cross culvert beneath US 50 west of Lamar, CO

4.3.4.4. Mile 436.5, Intersection of US 50 and Prowers County Road 9, Undersized Cross Culvert. This location is just east of the City of Lamar. The cross culvert beneath CR 9 is inadequate for most major storm events. Sediment has accumulated in the culvert and has reduced flow capacity. The outfall ditch from the culvert to the Lamar Canal has very little slope and is an area prone to saturation. Hydrology for this area and local drainage should be re-evaluated and flow capacity of the cross culvert and outfall ditch improved.

4.3.4.5. Vicinity mile 438 to 439.5, Combined Flows - Drainage and Irrigation tailwater. This southside ditch of US 50 receives combined roadside drainage and irrigation tailwater flows. Flows in this ditch travel east along the US 50 ROW and are discharged into the Willow Creek Overflow channel, immediately upstream of the US 50 structure L-26-X. For most storms the ditch capacity is adequate. However, during larger storms, water accumulates and ponds alongside US 50.

(See photo next page)



4.3.4.6. Vicinity mile 440.2 to 442, Morrios Bottoms, Low Area. The ground water level in this area is directly influenced by the stage of the Arkansas River. Ditch maintenance is problematic in this area as the ground water level is often near the inverts of the ditches. The Morrios Bottoms is a designated wetland area therefore limiting maintenance operations. Several cross culverts in the area are aged and in need of replacement. Culvert capacity and hydraulics should be re-evaluated prior to replacement.

Morrios Bottoms area and wetlands along US 50

4.3.4.7. Vicinity mile 443, Roosevelt School, Drainage Overtops US 50. At this location, water has overtopped US 50 twice within ten years. The drainage ditch along the south shoulder of US 50 has combined flows of stormwater and irrigation tailwater. During larger storm events, capacity of the ditch is exceeded and overtopping of US 50 results. A single small CBC is the only cross structure which causes backwater

to accumulate along the south shoulder. Additional driveway culverts and an enlarged cross culvert will most likely be required.

Roosevelt School area and new entrance to CBC under US 50

4.3.4.8. Mile 452.5, Granada, CO. There is no established stormwater system within the settlement of Granada other than a very basic system of disjointed curbs and gutters. There are no stormwater inlets or conduits. Existing conditions require stormwater to slowly migrate east through the center of Granada before entering roadside ditches on the eastern end of town. Improvements in this area should consider an underground system of inlets and conduits to remove stormwater runoff from US 50.

Granada, CO, US 50 looking east

Granada, CO, US 50 looking west

4.3.4.9. Vicinity mile 458 to 460, Aged Seep Ditch and Culvert Crossing. For two miles along the US 50 ROW, this seep ditch parallels the highway along the south shoulder from mile 458 to 459 where it crosses beneath US 50 in a very old CMP. After crossing under US 50 the ditch continues to flow along the north shoulder to mile 460 at which the ditch alignment diverges away from US 50. This ditch was originally constructed to gather seep water from the surrounding agricultural fields. The ditch is relatively deep (8 to 10-ft) making for a hazardous area immediately adjacent to the US 50 ROW. In many locations the agricultural fields are no longer used or irrigated and therefore flows are a fraction of the original ditch design capacity. CDOT does not maintain this ditch since it is outside of the ROW. Improvements to this portion of US 50 will be constrained by the proximity of the ditch to CDOT ROW.


Seep ditch along US 50 ROW


Seep ditch cross culvert under US 50

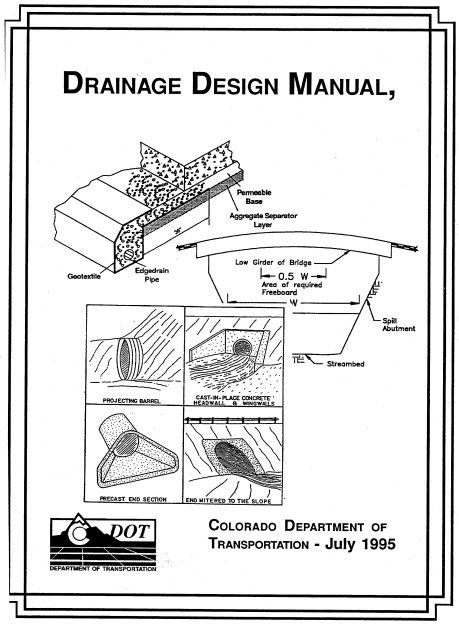
4.3.4.10. Mile 462.5, Holly, CO., Low Intersection. The intersection of US 50 and South 10th Street in the town of Holly accumulates water and does not drain efficiently. The intersection is in a localized low spot and water is forced to pond to a depth of approximately 3-inches before draining south along the west curb line of South 10th Street. There are no existing storm drain inlets or system. Stormwater routinely accumulates in the intersection from the north and is deepest in the westbound travel lane of US 50. Improvements should consider a system of inlets and pipes to properly drain the intersection.


South 10th Street looking north across US 50 intersection


US 50 & South 10th Street intersection

5. HYDRAULIC DESIGN CRITERIA

It has been assumed that all drainage design work associated with this US Highway 50 corridor will be performed in compliance with the current Colorado Department of Transportation (CDOT) Drainage Design Manual. The current manual is dated 1995.



It is anticipated that the design will be for a multi-lane roadway with a divided median for the whole corridor length except in municipalities. Most of the corridor length is in rural farming areas. Therefore the cross drainage will be designed for the **50-year** design frequency except in the urban areas where the **100-year** frequency will be used. The urban areas are defined as those areas eligible for Federal-Aid Highway Funds. This is anticipated in only a small part of the corridor. Side drains for County Roads will be designed for the **10-year** frequency. All other side drains will be minimum size unless justified for a larger size. Any drainage structure will have a higher design frequency if overtopping from that structure affects SH 50 roadway lanes.

Culverts designed for this corridor will use the allowable headwater per CDOT standards. This allows for a headwater to culvert depth (rise) ratio (HW/D) ranging from 2.0 for culverts less than 36 inches depth to 1.0 for culvert depths 120 inches or greater. Minimum culvert flow velocity will be 2.5 fps to maintain sediment transport in the culvert. Because of the flat terrain, maximum velocities are not anticipated. If outlet velocities exceed 10 fps for design discharges greater than 50 cfs, outlet protection should be used. Outlet protection should be considered when there is continuous (including

irrigation, if outlet velocities are increased above normal channel velocity) or for long durations of flow.

Minimum culvert size will adhere to the diameters presented in the CDOT Drainage Manual. The minimum size is 15 inches for median and storm drain inlets outfalling to cross culverts and trunk lines, 18 inches for side drains, median drain outlets, storm drain trunk lines and 24 inches for cross culverts. *{Input from CDOT Maintenance personnel recommend using 18 inches as a minimum for all pipes. 15 inch pipes are difficult to maintain, repair and purchase}* Culvert end treatments will follow recommendations in the CDOT Drainage Manual. End sections will be use for all small culverts to blend with the embankment slopes, to improve hydraulic efficiency and to keep weed growth away from the entrance except for irrigation and areas of blowing dirt. Culverts 42 inches and larger will have Type "S" headwalls to reduce inlet buoyancy and potential problems with outlet scour. Full headwalls and wingwalls will be use on culverts 96 inches or larger.

For curb and gutter areas where storm drains are necessary, the design will comply with the CDOT Drainage Manual for both the minor and the major storm requirements. For an arterial highway, the allowable gutter spread width during the minor storm event is limited to the highway shoulder area. For the major storm, the depth of water at the crown of the road can not exceed 6 inches deep to allow the movement of emergency vehicles.

Irrigation crossing openings should closely match the existing ditch to reduce backwater to a maximum of 0.2 feet. Small culverts will be extended to ROW to reduce maintenance and access on CDOT ROW. Minimum freeboard of 1 foot should be provided to allow passage of floating debris, maintain hydraulic efficiency and account for small waves.

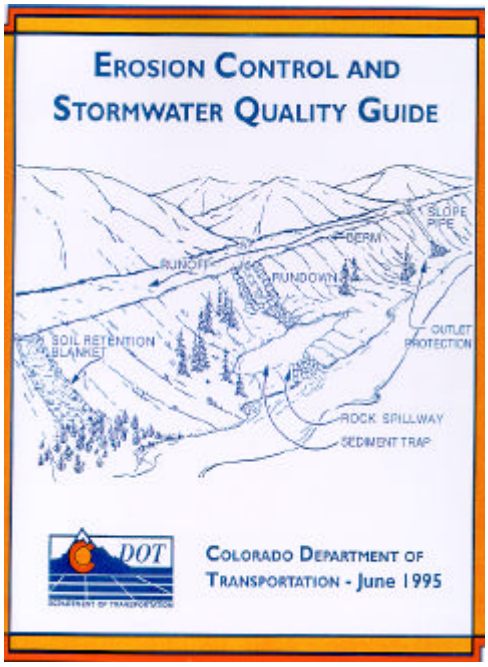
Throughout most of the US 50 corridor, soil eroded from cultivated areas presents a constant maintenance problem as it accumulates in ditches and culverts. There may be merit in adding additional freeboard to ditches and moderately increasing culvert sizes to reduce maintenance frequency and improve the ability of crews and equipment to clean.

The following table summarizes the drainage criteria to be used on this corridor.

DESIGN FEATURE	DESIGN CRITERIA	COMMENT
Design Frequency		
Cross-Drainage Urban	100 year	Areas Eligible for Urban Highway Funds
Cross-Drainage Rural	50 year	
Side Drainage County Roads	10 year	With No Highway Overtopping
Storm Drain	2 year	Unless damages warrant a higher frequency
Culvert Ponding Depth (HW/D)		
Less than 36”	2.0	Except for Detention Ponds
36” – 60”	1.7	“
60”+ - less than 84”	1.5	
84” – less than 120”	1.2	
120” or larger	1.0	
Minimum Culvert Size		
Curb and median drain laterals	15”	Tying to cross culverts or storm drains
Side drains, trunk lines, median	18”	
Cross culverts	24”	
End Treatment		
Culverts less than 42”	End sections	Except for irrigation or areas of blowing dirt
42” to less than 96”	Type S headwalls	
96” or larger	Full headwall	Wingwalls normally would be used
Minimum pipe velocity	2.5 fps	To reduce deposition
Storm Drains		
Minor Storm	Spread in shoulder	
Major Storm	6” depth @ crown	To allow emergency vehicles to pass
Stock Passes	6’X 7’ CBC	
	84” pipe	Requires headers to retain 6” dirt over invert
Irrigation		
Freeboard	1’ minimum	
Backwater	0.2’ maximum	Structure opening close to ditch size; W<T

6. WATER QUALITY ISSUES

It is assumed that all drainage design and construction work associated with this US Highway 50 corridor will be performed in compliance with the current Colorado Department of Transportation (CDOT) Erosion Control and Stormwater Quality Guide. The current manual is dated June 1995. Water quality requirements of the National Pollutant Discharge Elimination System (NPDES) Phase II will also require consideration when designing and evaluating improvements to the US 50 corridor.



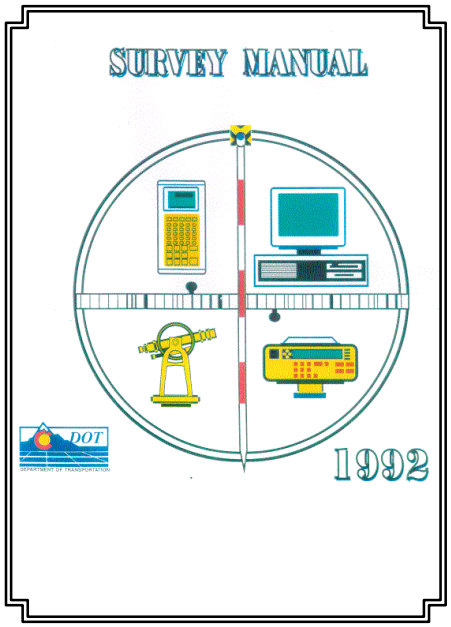
Engineering designs will be accomplished to minimize erosion and the discharge of pollutants to receiving waters to include irrigation waters both during and after construction. Best Management Practices (BMP's) will be specified to control erosion and sediment discharge and to properly manage stormwater quality. It is anticipated that for most construction projects within the US 50 corridor a Stormwater Management Plan (SWMP) will be prepared and include appropriate BMP's that meet the following CDOT goals:

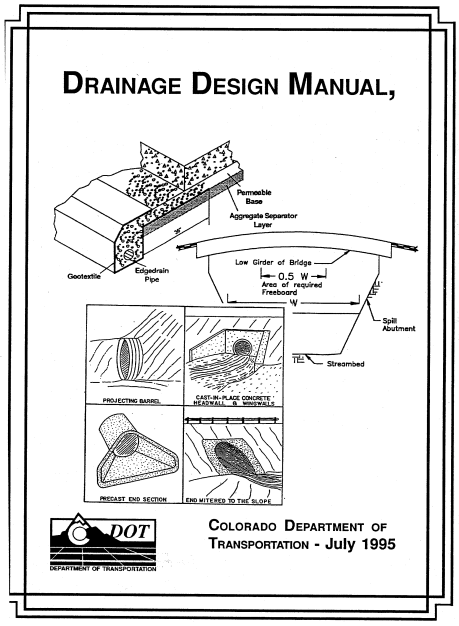
1. Control and minimize erosion and sedimentation during and after the construction phase of a project.
2. Minimize the pollution of stormwater and receiving waters to include irrigation water during construction activities.
3. Reduce pollutants in stormwater runoff.

SWMP's and BMP's will be developed during the design phases and will be specific to each project in order to achieve the goals listed above.

7. SURVEY REQUIREMENTS

It is anticipated that all survey work relating to the drainage design work, associated with the US Highway 50 corridor, Pueblo to the Kansas border, will be performed in accordance with the current Colorado Department of Transportation (CDOT) Survey and Drainage Design Manuals. The current manuals are dated 1992 and 1995 respectively.





Below is a summary of generic survey data required for each crossing/structure, irrigation canal and structure and storm drains. Site specific requirements will be determined at a later time:

7.1. Bridges and Concrete Box Culverts (CBC)

A. Structure number.
B. Structure type.
C. Curb to curb width and sidewalk widths.
D. Number of spans.
E. Span lengths.
F. Wingwall lengths.
G. Angles of skew of abutment and piers.
H. Utilities present.
I. Large Bridges ($Q_{design} \geq$ 20,000cfs or spans greater than 250-ft).
   1.) Develop site specific requirements.
   2.) Aerial survey should be considered.

J. Large Culverts/Medium Bridges (20,000cfs > Q_{design} ≤ 2,000 cfs or spans less than 250-ft and larger than 20-ft x 10-ft CBC).
   1.) Topographic survey should extend at least 1200-ft upstream and downstream from the existing road centerline. To include cross sections and Thalweg profile.
   2.) Additional survey data must be taken near the upstream and downstream edges of the existing structure to include the abutments and piers.
   3.) Elevations of the existing structure lowest girders or clearance.
   4.) Width of survey to be determined for each individual site.

K. Medium to Large Culverts (2,000 cfs > Q_{design} ≤ 200 cfs or 72-inch Pipe to 20-ft x 10-ft CBC).
   1.) Topographic survey should extend at least 500-ft upstream and downstream from the existing road centerline. To include cross sections and Thalweg profile. Also see 5.C. below.
   2.) Additional survey data must be taken near the upstream and downstream edges of the existing structure to include the abutments and piers.
   3.) Width of survey to be determined for each individual site.

L. Small Culverts (200cfs > Q_{design} or pipes smaller than 72-inch).
   1.) Topographic survey should extend at least 100-ft upstream and downstream from the existing road centerline. To include cross sections and Thalweg profile. Width of survey should slightly exceed required ROW width.
   2.) Survey data must also be taken at each end of the culvert to determine structure centerline, depth of sediments, headwall dimensions, type of end section if any, type of flow vegetation, and soil type of banks and bottom.
   3.) Complete CDOT Form 283 for each culvert.

7.2 Irrigation Structures

A. Detailed drawing/sketch of the structure with dimensions and elevations.
B. Name of ditch and owner.
C. Direction of flow.

7.3 Irrigation Canals and Ditches

A. Water surface profile at 100-ft intervals measured to plus or minus 0.05-ft.
B. Channel invert (may require canal to be dry).
C. Topographic survey shall extend at least 1000-ft upstream and 2000-ft downstream from the existing road centerline.
D. Date, time and discharge water surface profile was recorded.
E. Name and address of ditch/canal owner.
F. Location of easements and or Right of Way boundaries
G. Identify and detail any irrigation control structures within the survey limits.
H. Locations of siphons and crossings.

7.4 Storm Drains

A. Profile grade and gutter flow line elevations of main roadway. The survey must include all areas of the roadway that contribute drainage.
B. Profile grade and gutter flow line elevations of all cross street or road approaches. The survey shall extend at least 500-ft up the road approach or to the highest point whichever is less.
C. Location of all curbs, gutters, inlets, culverts, and manholes.
D. Indicate inlet and pipe depths and sizes to include rim and invert elevations and direction of flow.
E. Location of all utilities. Indicate utility type, size and depth.

7.5 Additional Requirements

A. Location and elevation of railroad embankments adjacent to or in the vicinity of any US 50 highway drainage structure.
B. Drainage structure information (see 1. above) for railroad structures adjacent to or in the vicinity of any US 50 highway drainage structure (e.g. railroad culverts or bridges upstream/downstream of a highway drainage structure).
C. For most locations, topographic survey will need to extend downstream along the drainage course to its respective confluence with the Arkansas River.
D. Locations of irrigation

8. REFERENCES

Colorado Department of Transportation. *Drainage Design Manual*, 1995.

Colorado Department of Transportation. *Erosion Control and Stormwater Quality Guide*, 1995.

Colorado Department of Transportation. *Field Log of Structures*, 2001

Colorado Department of Transportation. *Survey Manual*, 1992.

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U.S. Army Corps of Engineers, Albuquerque District. *Channel Capacity and Riparian Habitat Planning Study – Arkansas River from John Martin Reservoir to the Colorado-Kansas State Line*, 1999.

U.S. Army Corps of Engineers, Albuquerque District. *Channel Capacity and Riparian Habitat Planning Study – Arkansas River from Otero/Pueblo County Line to John Martin Reservoir*, 2001.

9. CONSOLIDATED DRAINAGE ISSUE SUMMARY
US 50 Corridor, Pueblo to Kansas Border
Preliminary Drainage Assessment Report

Mile	Nearest Town	Structure ID	Water Course	Issue	Report para
316	Pueblo	K-18-L	Fountain Creek	Fountain Creek attacked western approach in 1999. I-25/US 50 Interchange located within 500-yr floodplain	4.1.2.1. & 4.3.1.1.
318.1	Pueblo	K-18-BZ, BY	Dry Creek	Significant per and abutment scour	4.3.1.2.
319.1	Pueblo	K-18-W	BNSF RR	Stormwater flooding problems at RR underpass	4.3.1.3.
328	Devine	NA	Excelsior Ditch	Irrigation ditch flows combined with stormwater can cause flooding	4.2.1.
329	Avondale	NA	Arkansas River	Inadequate surface drainage during high flows in the Arkansas River cause flooding in this area. (mi.: 329-330)	4.3.1.4.
329.3	Avondale	NA	Arkansas River	Roadway located in Arkansas River floodplain	4.1.1.1.
332	Avondale	NA	Irrigation ditches	Undersized culverts near intersection of US 50 with Business Route 50	4.3.1.5.
332.5	Avondale	NA	Irrigation ditches	Inadequate roadside and cross drainage (mi.: 332-334)	4.3.1.6.
335	Avondale	NA	Surface drainage	Inadequate surface drainage from cross culverts to the Arkansas River	4.3.1.7.
335.8	Avondale	L-29-B	Huerfano River	Dense vegetation and debris may cause flooding	4.1.3.
341	Nepesta	NA	Surface drainage	Low area, replace CMP with CBC	4.3.1.8.
343	Nepesta	NA	Surface drainage	Undersized CBC near Nepesta Road intersection	4.3.1.9.
344.6	Nepesta	L-20-B	Rocky Ford Highline Canal	No major issues. Improvements to US 50 may require structure modifications or replacement.	4.2.2.
346	Nepesta	NA	Surface drainage	Poor drainage and silting culverts in low area, between miles 345 & 346,	4.3.2.1.
347	Nepesta	L-20-C	Farmers Oxford Ditch	Improvements to US 50 may require structure modifications or replacement. Poor condition of the existing structure will require replacement in the near future	4.2.3.
347.5	Fowler	L-20-AN	Chicosa Creek & Arkansas River	Roadway ROW adjoins Arkansas River floodplain	4.1.1.2. & 4.1.4.
348.5	Fowler	NA	Surface drainage	Undersized CBC and poor site drainage to the Arkansas River	4.3.2.2.
350.4	Fowler	NA	Surface drainage	Roadside ditch lacks proper outfall	4.3.2.3.
351	Fowler	NA	Arkansas River	Future aggradation of the Arkansas River could result in flooding of US 50	4.1.1.3.
352.5	Fowler	L-21-W	Hungerford Hollow	Possible floodplain impacts	4.1.5.
354.4	Manzanola	L-21-A	Otero Ditch	Irrigation ditch access needs improvement, some erosion issues	4.2.4.1. & 4.3.2.4.
355.1	Manzanola	L-21-G, DA	Apishapa River	US 50 located within the Apishapa River floodplain	4.1.6.
355.1	Manzanola	L-21-I	Otero Ditch	Improvements to US 50 may require structure modifications or replacement.	4.2.4.2.
356.4	Manzanola	L-21-b	Otero Ditch	Marginal existing capacity. Improvements to US 50 may require structure modifications or replacement.	4.2.4.3.
360	Manzanola	NA	Surface drainage	Curb and Gutter issues, undersized stormdrain	4.3.2.5.
360.2	Manzanola	L-21-K	Catlin Canal	No major issues. Improvements to US 50 may require structure modifications or replacement.	4.2.5.
362	Manzanola to Rocky Ford	NA	Misc. irrigation ditches	Irrigation ditches located immediately adjacent to US 50.	4.2.11.1.
364.1	Rocky Ford	L-21-Q	Patterson Hollow	Structure replaced in 2001, previous culverts were inadequate	4.1.7.
366.5	Rocky Ford	NA	Surface drainage	Inadequate drainage ditch	4.3.2.6.
367	Rocky Ford	NA	Surface drainage	Inadequate drainage ditch, intersection floods	4.3.2.7.

9. CONSOLIDATED DRAINAGE ISSUE SUMMARY
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Preliminary Drainage Assessment Report

Mile	Nearest Town	Structure ID	Water Course	Issue	Report para
368.5	Rocky Ford	L-22-I	Rocky Ford Ditch	No major issues. Improvements to US 50 may require structure modifications or replacement.	4.2.6.
370.4	Rocky Ford	NA	Arkansas River	Roadway ROW in very close proximity to Arkansas River floodplain	4.1.1.4.
371.5	Rocky Ford	NA	Surface drainage	Undersized culverts	4.3.2.8.
373.6	Swink	L-22-AL	Timpas Creek	US 50 located in Timpas Creek/Arkansas River floodplain	4.1.8.
374.1	Swink	L-22-R, H	Surface drainage	RR Underpass floods	4.3.2.10.
375	La Junta	NA	Surface drainage	Inadequate surface drainage from cross culverts to the Arkansas River	4.3.2.11.
376.9	La Junta	M-22-K, A	Crooked Arroyo & Arkansas River	Roadway ROW in very close proximity to Arkansas River floodplain	4.1.1.5. & 4.1.9.
377	La Junta	NA	Surface drainage	Intersection requires new culverts/drainage plans	4.3.2.12.
378	La Junta	NA	Arkansas River	US 50 through La Junta is within the 100-yr floodplain	4.1.1.6. & 4.1.10. & 4.1.11.
378	La Junta	NA	Surface drainage	Inadequate cross culverts under US 50	4.3.2.13.
379.1	La Junta	M-22-M	Anderson Arroyo	50-yr event and greater overtop US 50 structure	4.1.10.
380.5	La Junta	M-22-X	King Arroyo	US 50 located in King Arroyo/Arkansas River floodplain	4.1.11.
380.5	La Junta	NA	Surface drainage	Local surface drainage requires pumping	4.3.3.1.
385.4	La Junta	L-23-S, J	Vandiver Arroyo	US 50 located in Vandiver Arroyo/Arkansas River floodplain	4.1.12.
388.1	La Junta	L-23-K	Robinson Arroyo & Arkansas River	Roadway ROW in close proximity to Arkansas River floodplain	4.1.1.7.
389	La Junta	NA	Un-named Creeks & Arkansas River	US 50 located in Arkansas River floodplain	4.1.13.
392.6	Riverdale	L-23-C	Las Animas Consolidated Canal	No major issues. Improvements to US 50 may require structure modifications or replacement.	4.2.7.
394	Riverdale	NA	Arkansas River	Roadway ROW in close proximity to Arkansas River floodplain	4.1.1.8.
397.7	Las Animas	L-24-AB	BNSF RR & Surface drainage	Area lacks cross culverts and needs drainage improvements	4.3.3.2.
399.9	Las Animas	L-24-A, D	Arkansas River	US 50 protected by levee (mi.: 391-400)	4.1.1.9.
400.1	Las Animas	L-24-B	Arkansas River	Surface drainage degraded due to aggradation of the Arkansas River at the SH 194 interchange.	4.3.3.3.
401	Las Animas	NA	Surface drainage	Intersection of US 50 and Bent County Road 12, culvert outfall needs improvement.	4.3.3.4.
402	Las Animas	NA	Surface drainage	Intersection of US 50 and Bent County Road 13, drainage ditch outfall needs improvement.	4.3.3.5.
403	Las Animas	NA	Surface drainage	Intersection of US 50 and Bent County Road 14, cross culverts need improvement/upsizing.	4.3.3.6.
408.1	Las Animas	L-24-M	Gageby Creek	US 50 located in Gageby Creek floodplain	4.1.14.
416	Hasty	NA	Surface drainage	Inadequate cross culverts and outfall ditches cause flooding of US 50	4.3.3.7.
416.3	Hasty	L-25-L	Prowers Arroyo	US 50 located in Prowers Arroyo floodplain	4.1.15.
419.6	McClave	L-25-N	Limestone Creek	US 50 located in Limestone Creek floodplain	4.1.16.
420.8	McClave	NA	Surface drainage & Irrigation	Intersection of US 50 and SH 196, cross culverts for drainage and irrigation need improvement/upsizing.	4.3.4.1.
422.1	McClave	NA	Surface drainage & Irrigation	Undersized irrigation cross culvert	4.3.4.3.
423	McClave	NA	Surface drainage & Irrigation	Cross culverts for surface drainage and irrigation require analysis & improvements (mi.: 420.8-427)	4.3.4.2.
423.3	McClave	L-25-C	Graveyard Creek	US 50 located in Graveyard Creek floodplain	4.1.17.

9. CONSOLIDATED DRAINAGE ISSUE SUMMARY
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Preliminary Drainage Assessment Report

Mile	Nearest Town	Structure ID	Water Course	Issue	Report para
434.1	Lamar	L-26-H, BW	Arkansas River	US 50 through Lamar is within the 100-yr floodplain	4.1.1.10.
434.7	Lamar	L-26-E	Lamar Canal	Some sediment deposition occurs at this location. No other major issues. Improvements to US 50 may require structure modifications or replacement.	4.2.8.
436.5	Lamar	NA	Surface drainage	Intersection of US 50 and Prowers County Road 9, undersized cross culvert	4.3.4.4.
436.7	Lamar	L-26-BV	Lamar Canal	Some sediment deposition occurs at this location. No other major issues. Improvements to US 50 may require structure modifications or replacement.	4.2.8.
437.7	Lamar	L-26-M	Willow Creek	US 50 located in Willow Creek floodplain	4.1.19.
438	Lamar	L-26-X	Surface drainage	Inadequate roadside ditch for combined stormwater and irrigation flows. (mi.: 438-439.5)	4.3.4.5.
440.2	Lamar	L-26-F	Clay Creek & Arkansas River	US 50 located in Clay Creek/Arkansas River floodplain	4.1.1.11. & 4.1.18.
441	Lamar	NA	Surface drainage	Morrios Bottoms area, culvert capacities and hydraulics require updated analysis. (mi.: 440.2-442)	4.3.4.6.
443	Lamar - Roosevelt School	NA	Surface drainage	Roadside ditch occasionally overtops US 50.	4.3.4.7.
444.8	Lamar - Roosevelt School	NA	Manval Canal	No major issues. Improvements to US 50 may require structure modifications or replacement. Ditch is no longer used to supply water, primary use is now drainage of agricultural fields.	4.2.9.
445.2	Lamar - Roosevelt School	L-27-AM	Smith Arroyo	US 50 located in Smith Arroyo floodplain	4.1.20.
451.3	Granada	L-27-B	Wolf Creek & Arkansas River	US 50 located in Wolf Creek/Arkansas River floodplain	4.1.1.12.
452.2	Granada	NA	X-Y Canal	No major issues. Improvements to US 50 may require structure modifications or replacement. Ditch is no longer used to supply water, primary use is now drainage of agricultural fields.	4.2.10.
452.5	Granada	NA	Surface drainage	Area lacks stormwater conveyance system.	4.3.4.8.
457.4	Granada	L-28-AQ	Arkansas River	US 50 located in Arkansas River floodplain	4.1.1.13.
458	Granada	NA	Surface drainage	Large, deep roadside ditch is hazardous, capacity may be reduced. (mi.: 458-460)	4.3.4.9.
462.5	Holly	NA	Surface drainage	Intersection of US 50 and South 10th Street is low and requires drainage improvements. Area lacks stormwater conveyance system.	4.3.4.10.
467.3	Holly	L-28-E	Cheyenne Creek	US 50 located in Cheyenne Creek floodplain	4.1.21.