

Monument Creek Study

PREPARED FOR

THE CITY OF COLORADO SPRINGS, COLORADO

BY

G. J. WEISS AND ASSOCIATES

CONSULTING ENGINEERS

COLORADO SPRINGS, COLORADO

MARCH 1974

THE FURN WITHIN 2 WEEKS TO: CITY OF COLORADO SPRINGS SUBDIVISION ENGINEERING 30 SOUTH NEVADA AVE., SUITE 702 COLORADO SPRINGS, CO 80903 (719) 865-5679 1815 North Tejon

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March 22, 1974

Mr. Dewitt Miller, Director of Public Works P. O. Box 1575 Colorado Springs, Colorado 80901

Dear Mr. Miller:

I am submitting, herewith, my engineering study and report for the rehabilitation of Monument Creek; referred to as the MONUMENT CREEK STUDY.

The study extends along Fountain Creek, from the south Nevada Avenue Bridge to Cimarron Bridge and along Monument Creek, from Cimarron Bridge to Fillmore Street Bridge. The emphasis of the study has been placed on that portion of the creek lying between Cimarron Street and the Rock Island Rail-road Bridge, north of the City Service Center. This section of the creek has been stabilized along the banks, for the majority of its length.

I remain available to answer questions or provide additional information relative to this study.

Sincerely,

G. J. WEISS AND ASSOCIATES

Mun. G. J. Weiles P.E.- L.S. 4124

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LETTER OF TRANSMITTAL

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I. INTRODUCTION

This study was initiated at the request of the Public Works Department of the City of Colorado Springs. It is the purpose of the study to determine the condition of the channel and structures through the study area, make recommendations for any required rehabilitation, prepare cost estimates for recommended repairs and set up a program for annual construction to stay within the limits of budget allocation.

Monument Creek has its headwaters at Monument, Colorado and flows southerly along the front range to its confluence with Fountain Creek at a point adjacent to the Cimarron Street Bridge in Colorado Springs. This study covers that section of Monument Creek, from Fillmore Street Bridge to Cimarron Street and that section of Fountain Creek, from Cimarron Street to the South Nevada Avenue Bridge.

The creeks have stream flow continuously with the flow being low during the winter months and much higher during the spring snow melting run-off and summer rain storms. Most of the flood producing storms occur during the months from May through August and the valley has a long history of flooding. The May 30, 1935 storm produced a stream flow greater than that predicted for the 100 year storm. The flooding from this storm destroyed most of the bridges across Monument Creek, causing damages in the millions of dollars and loss of life.

Since the major flood in 1935, a portion of Monument Valley has been channelized and stabilized along the banks with concrete and rock lining. Subsequent storms have eroded, undercut and damaged this lining and other structures along the channel and has also deposited silt and sediment in various locations. This report will study and analyze these conditions.

The Corps of Engineers has prepared two studies during the past few years, providing Flood Plain information along Monument and Fountain Creeks. These studies were used as reference information in this report and the flood plain, as determined by their study has been plotted on the topographical map in this report.

II. EXISTING CONDITIONS

A detailed on-site inspection was made along the entire length of this project. Notation was made of infringements, obstructions, erosion, seepage, silting, drainage inflows and condition of all structures.

A stationing system was set up, with Station 0 + 00 starting at the South Nevada Avenue Bridge and continuing upstream to Station 261 + 00 at the Fillmore Street Bridge, for a distance of about 5 miles. A topographical map at a scale of 1" = 200' and contour intervals of 5' is used as base map for this report and a topographical map at a scale of 1" = 40' and contours intervals of 1' is used as a reference map. The stationing referred to on this base map is determined by scaled dimension along the approximate centerline of the channel and is not intended to be to the accuracy of a surveyed traverse line. However, it can be used for identification and estimating purposes.

The stream bed has an elevation of 5892 feet above sea level under the South Nevada Avenue Bridge and rises to an elevation of 6069 feet above sea level, under the Fillmore Street Bridge. This provides an average slope of 0.67 feet/100 feet or about 36 feet of fall per mile. The slope varies from grades of 0.2% up to 2.0%.

A velocity of less than 2 f.p.s. will deposit silt and a velocity of over 4 f.p.s. will cause erosion. Both of these conditions are met at various points along this section at different depths of flow. A velocity of 15.7 f.p.s. could be expected in the main channel during the 100 year storm and would cause serious erosion of the channel and banks, where it is not stabilized by a solid lining.

It should be noted here that the inspection revealed a general lowering of the stream bed flow line of about 4'-6' below that at the time the bridges and other structures were constructed. A comparison of the topographical maps flown in 1970 and 1973 indicates a lowering of the stream bed flow line about 2'-3' during this period for the section between the South Nevada Avenue Bridge and the Cimarron Bridge. This erosion factor must be corrected to protect the stability of the lining and structures. The results of the inspection are listed by numerical stationing.

O + OO NEVADA AVENUE BRIDGE

The structure was in good condition with the center abutments showing an indication of stream bed erosion, which has lowered the channel 3'-4' below that of the ground during original construction. The 100 year flood plain, as shown in the Corps of Engineers Study, dated March 1973, is 1.8' below the low steel of the bridge.

2 + 30 24" STORM SEWER INFLOW FROM NORTH

Structure is in good condition, but silting at the outlet of the pipe has greatly reduced its capacity.

6 + OO TEJON STREET BRIDGE

Structure is in good condition with the center abutments indicating channel erosion 2'-3' below that from original construction. An 8" C.I.P. suspended under the bridge was broken and was leaking raw sewage. The Sewer Department was notified of the leak. The 100 year flood plain, as shown in the Corps of Engineers Study, dated March 1973, is 2.2' below the low steel of the bridge.

6 + 40 36" STORM SEWER INFLOW FROM NORTH

Outlet is plugged with trash.

6 + 70 115 K.V. STEEL TOWER

Channel erosion has lowered stream bed about 3' exposing caissons for tower. The Electric Division has been notified of this problem.

11 + OO VERTICAL RETAINING WALL ON SOUTH

Stream flow is adjacent to wall and there is erosion of the channel. This wall is constructed from Station 1 + 20 to 24 + 20 and does contain the 100 year storm within its bank.

13 + 80 24" STORM SEWER INFLOW FROM NORTH

Pipe has silted almost full, leaving only 10% of capacity for storm flow.

24 + 20 VERTICAL RETAINING WALL ON SOUTH

The gabions protecting the end of the wall have collapsed leaving the wall subject to being washed out during heavy storm flow.

26 + OO NORTH BANK

A number of old, dead trees are lying along the bank which produce a plugging hazard downstream, if they are washed away during a heavy storm.

27 + 50 NORTH BANK

The property owner has been dumping trash, debris and dirt in this area, reclaiming some of the low land. There is some encroachment into the channel.

28 + 30 24" STORM SEWER INFLOW FROM SOUTH

The end section of this pipe needs grouted and the outflow has silted to reduce the capacity.

29 + 50 NORTH BANK

The stream is undercutting the north bank, which is an unstable trash land fill.

25 + OO to 32 + OO CENTER OF CHANNEL

A large amount of silt has been deposited, leaving a sand-bar through this area.

34 + 40 30" STORM SEWER INFLOW FROM SOUTH

The channel has eroded where the pipe enters. Rip-rap should be placed here to prevent further undercutting of the outlet.

35 + 00 18" STORM SEWER INFLOW FROM MILL STREET

The outlet is plugged or covered with debris.

35 + 70 SOUTH BANK

The alignment of the gabions protecting the 115 K.V. Steel Tower is poor. It protrudes into the channel, causing the creek to move to the north bank, rather than letting it continue in a smooth flow.

38 + 80 18" STORM SEWER INFLOW FROM SOUTH

The outlet has silted, causing a reduction in capacity of the pipe.

39 + 00 to 41 + 00 NORTH BANK

This area has a large amount of loose fill from the power plant. This would be very erosive during any high stream flow.

41 + 30 24" STORM SEWER INFLOW FROM SOUTH

The outlet of the pipe has silted and the edge of the main channel has eroded badly, where this flow enters.

44 + OO SOUTH BANK

The gabions protecting the 115 K.V. Steel Tower have deteriorated and need repair. The alignment of the gabion is poor, causing an obstruction to flow. The Electric Division has been notified of this item.

47 + 80 BEAR CREEK DRAINAGE INFLOW FROM WEST

There has been a considerable amount of erosion at the outlet of the box culvert and around the base of the steel pole. The stream bed is now 3' below the level from when the pole was installed. The Electric Division has been notified of this problem.

49 + OO WEST BANK

Some of the rip-rap protecting the pole anchor structure has been undercut and washed away. The stream bed through this area is 3' below that from when the poles were installed.

52 + 00 and 54 + 20 WEST BANK

The rip-rap protecting the pole structures has been undercut due to channel erosion.

54 + 00 to 66 + 00 EAST BANK

This area has been filled over the years and has a fairly solid earth bank along the creek. It does not have enough rip-rap or vegetation growing in it to be very resistant to erosion during a flood flow.

64 + 60 8" S.S. AERIAL LINE

The lowering of the channel has caused erosion around the piers supporting the pipe. The Sewer Division has been notified of this problem.

67 + 00 CIMARRON BRIDGE

The structure appears to be in good condition, but channel erosion has lowered the stream bed below the solid piers, exposing about 4' of the caissons. The 100 year flood plain level is 2.0' below the low steel of the bridge, as shown in the Corps of Engineers Study, dated March 1973.

67 + 80 CENTER OF CHANNEL

Some old posts are protruding and collect trash, causing obstruction to flow. This general area has a lot of trash and old pipes in the channel.

68 + 40 24" S.S. ENCASED PIPE

The area just downstream from the concrete encasement has been eroded to a depth of 4', leaving the effect of a check dam. The west portion of the 24" pipe has not been encased and channel erosion has exposed the pipe. The Sewer Division has been notified of this problem.

71 + 00 to 78 + 50 EAST BANK

Some encroachment has been made by filling this area over the years with rubble, dirt, trash and wasting fresh concrete. The bank is more stable than an earth bank, but would still be subject to erosion at high flows.

79 + 10 DENVER AND RIO GRANDE R. R. BRIDGE

There is some evidence of channel erosion around the abutments. The 100 year flood plain, as shown in the Corps of Engineers Study, dated May 1971, indicates that the low steel under the bridge is 2.7' below the high water line. This indicates that the bridge will obstruct the flow during this storm.

79 + 20 CHANNEL LINING

The walls of the channel have been improved from this point northward for a distance of nearly three miles with a concrete retaining wall and grouted rock slope wall combination. The lining has been omitted in several sections and these will be noted.

79 + 90 BOX CULVERT INFLOW FROM EAST

A dimension on this box culvert could not be obtained, since it is silted 95% closed. The maintenance crew should dig this out prior to spring rains if it is to be of any value for drainage.

81 + 70 36" STORM SEWER INFLOW FROM WEST

The outlet on this pipe needs some patching.

82 + 30 EAST BANK

An old abandoned wooden structure exists on the bank. It appears to have been used for sand screening and storage at some previous time. This should be removed, since it presents an obstruction to flow.

83 + 10 15" STORM SEWER INFLOW FROM WEST

The outlet joint needs to be grouted.

86 + 90 COLORADO AVENUE BRIDGE

The underside of the bridge shows some damage from the use of salt in ice removal on the deck. A 30" storm sewer from the west enters at the north side of the bridge. Silting at the outlet has reduced the flow capacity and the maintenance crew should clean this out. The rock slope lining has sunk in the area above this storm sewer and needs to be repaired. A 24" storm sewer from the east enters at the north side of the bridge. A vertical wall at this point leans toward the channel by about 6" and the rock slope lining has sunk in this area.

The 100 year flood plain, as shown in the Corps of Engineers study, dated May 1971, indicates that the low steel under the bridge is 8.2' above the high water level.

99 + 50 2.5' x 3.0' BOX CULVERT INFLOW FROM WEST

The outlet of this box is about 90% submerged in silt and needs to be cleaned out, if it is to function properly.

102 + 20 15" STORM SEWER INFLOW FROM WEST

The outlet section on this pipe needs to be repaired or replaced.

104 + 60 BIJOU BRIDGE

The underside of the bridge is caked with salt and shows some deterioration. The south walk on the bridge is spalling very badly. The concrete base on one of the light posts has broken and is being held only by the rebar.

The flood plain for the 100 year storm, as shown in the Corps of Engineers study, dated May 1971, indicates that the low steel under the bridge is 18.6 above the high water level.

104 + 60 to 110 + 60 CHANNEL

The channel has an 80° change of direction flowing between these two points. A vertical concrete wall exists on the west (outside) bank of the curve with erosion evident along the bottom of the wall. The east bank (inside of curve) has not been lined and is stabilized only by a few sections of broken concrete in the fill. A large section of the washed out bridge abutment lies in the channel, in this area and causes an obstruction to flow during large runoff.

110 + 60 DENVER AND RIO GRANDE R. R. BRIDGE

There has been a large amount of erosion and undercutting around the center piers of the bridge.

The low steel on the bridge is 0.4' below the high water elevation for the 100 year storm and will cause an obstruction to the flow.

118 + 60 CHANNEL

An old concrete wall exists across the channel and acts as a check dam. The stream bed drops about two feet on the downstream side of the wall. This check dam is on an angle and forces the stream flow to the east banking, causing erosion.

121 + 90 18" STORM SEWER INFLOW FROM EAST

The outlet needs to be repaired in the sloping wall.

129 + 00 CHANNEL

There is evidence of seepage along the west side. This point falls opposite the outlet from one of the lakes in Monument Valley Park.

141 + 35 CACHE LA POUDRE BRIDGE

The stream bed around center piers of the bridge have been eroded to a lower depth. The piers have painted elevations on them, from 14 foot high at low steel down to zero mark. The channel has eroded 3.5' below the zero mark.

The low steel on the bridge is 9.5' above the high water elevation for the 100 year storm, as shown in the Corps of Engineers study, dated March 1971.

The vertical retaining wall along the east bank, south of the bridge, is leaning and the rock slope lining has settled at this point.

The rock slope lining on the east bank, north of the bridge. has a small section that has settled.

143 + 20 18" STORM SEWER INFLOW FROM EAST

The outlet on the pipe needs repair.

145 + 80 20" WATER MAIN

The water main is encased in concrete, with about 100° of length being exposed and acts as a check dam. The flow line of the creek drops about 1° on the downstream side of the pipe.

148 + 30 4.5' x 9.0' BOX CULVERT INFLOW FROM WEST

The walls and bottom section of the box culvert are spalling with the rebar being exposed. The flow line of the channel drops about 4' vertically at the outlet and has caused serious soil erosion.

148 + 80 36" STORM SEWER INFLOW FROM WEST

The channel has eroded at the pipe outlet.

150 + 20 CHANNEL

A shale outcropping appears in the channel bottom and acts as a natural check dam. The flow line of the creek drops about two feet on the downstream side of the shale.

156 + 00 CHANNEL

Seepage appears along the bottom, on the east side of the channel.

159 + 85 UINTAH BRIDGE

The bridge appears to be in good condition, with some indication of channel erosion in the stream bed.

The slope lining along the east bank needs repair on both the north and south side of the bridge. A 3.5' x 5.0' box culvert inflow from the west, on the south side of the bridge, has been partially plugged, due to silting.

The low steel on the bridge is 5.6' above the high water elevation for the 100 year storm. The 30" water main, hanging under the bridge, is at an elevation nearly 2' lower than the low steel, which leaves the main 3.6' above the high water elevation.

169 + 15 12" WATER MAIN

An abandoned 12" water main is visible at this point. The line was concrete encased, which formed a check dam. The center 70' of the line has been washed away, permitting the channel stream bed to lower about 1' in elevation.

175 + 50 WEST BANK

The vertical wall is being undercut, due to the stream flowing adjacent to it.

182 + 20 to 184 + 00 EAST BANK

The vertical retaining wall is being undercut by the stream flow and portions of the concrete wall are spalling with the rebar being visible.

185 + 00 _ 24" WATER MAIN

This pipe is encased in concrete, with the encasement being exposed for about 70' of length. The encased pipe acts as a check dam, with the flow line of the stream dropping about 4' on the downstream side of the pipe. The pipe crosses at an angle and forces the stream flow to the east bank, causing erosion.

190 + 80 to 212 + 50 WEST BANK

The concrete retaining wall and sloped rock lining has not been installed through this section. The bank is covered with a growth of grass, brush and trees and has fair stability.

The stream flow is crowding the west bank from Station 200 + 00 to 203 + 00, causing some erosion. A rail, wire and rock wall stabilization has been installed from Station 200 + 00 to 201 + 90. to protect this and it is also being undercut.

198 + 20 24" STORM SEWER INFLOW FROM WEST

There is erosion of the dirt bank where the pipe enters.

202 + 50 to 208 + 50 EAST BANK

The vertical wall along the east bank has been undercut during some previous storms and about 100' of wall has completely collapsed and washed downstream, leaving an earth dike. Another 500' of vertical wall is leaning and the rock slope lining behind it has sunken adjacent to the vertical wall. This section of lining is on the outside curve of the channel and is very susceptible to further serious damage until such time as it is repaired.

207 + 00 18" STORM SEWER INFLOW FROM WEST

The outlet is partially plugged with oily rags and the earth bank beneath the outlet has eroded very badly.

209 + 30 24" STORM SEWER INFLOW FROM WEST

The earth bank has been eroded beneath the pipe outlet.

212 + 50 to 222 + 20 WEST BANK

A vertical rock wall, about 7' high, has been constructed to protect the west bank through this section. The wall has been undercut by the stream flow at Station 213 + 00 and needs repair.

218 + 70 EAST BANK

The vertical wall and grouted rock slope line begins at this point and is continuous along this bank, going downstream to Station 79 + 20, except for a small section just north of Bijou Bridge.

221 + 00 to 223 + 00 EAST BANK

The dirt bank through this area is quite steep and has experienced serious erosion along the bottom, over the years. The owner of the property has dumped large amounts of broken concrete, brush and grass along the top of the bank.

This section is subject to serious erosion and undercutting during a large stream flow, due to it being just downstream from a sharp curve and on the outside of the curve.

223 + 50 CITY UTILITIES BRIDGE

This bridge is in good condition, with no apparent erosion problems around the piers. The low steel on the bridge is 11.1' above the high water elevation for the 100 year storm.

224 + 10 ROCK ISLAND R. R. BRIDGE

The abutments and center piers on this bridge have experienced serious erosion and undercutting over the years. The flow line of the channel is about 6' below that when it was first installed. The entrance to the north side of the bridge, from the west, had been stabilized some years ago, with rail posts being driven into the ground, covered with wire and filled in behind with rock. This area has been undermined and any major channel flow now, would collapse this rip-rap section. The channel has about a 70 curve, as it enters the bridge.

The low steel on the bridge is 8.6' above the high water elevation for the 100 year storm.

230 + 00 to 234 + 00 WEST BANK

This area has been filled to depths of 20' with trash, rubble and concrete sections, as the owner has reclaimed the low land. There is some infringement of the channel.

237 + 20 18" S.S. BRIDGE

There is erosion around the piers and the concrete shows some deterioration. A drainage channel enters from the west at a point just north of the structure and this area is also eroded.

247 + OO POLK STREET BRIDGE

This bridge is in poor condition. The west abutment has been undercut and the concrete shows deterioration. The east abutment is on a caisson, but the slope protecting it is not very stable. The bridge opening is not wide enough to permit adequate flow during flood stage. The low steel is 5.4' below the elevation of high water in the 100 year storm, so it can be seen that the bridge is a major restriction to flow during flood stage.

252 + 00 to 261 + 00 EAST BANK

This area has been filled over the past years to where it is above the flood plain, but the banks are not stable enough to withstand the high velocities of a flood flow.

261 + 00 FILLMORE BRIDGE

The structure is in good condition, but the channel has lowered several feet since the original construction. The caissons have been exposed several feet below the solid piers.

The base map in this report shows the size and location of all storm sewer inflows and utility lines that fall within the channel. Access to the creek bottom is feasible at stations 66 + 00, 77 + 00, 108 + 00, 194 + 00 and 211 + 00. If additional access is required, earth ramps will need to be constructed up the slope to provide this at the required access locations.

The improved lining consists of a vertical concrete wall at the bottom of the slope, which varies in height from 3' to 11'. The vertical wall holds the bottom of the slope improvement in place. It sets on a shale bottom. The slope has been improved with concrete or rock grouted in place, with the slope ranging from 1 1/2 to 1, down to 1 to 1.

The flow line of the channel is about one to two feet above the shale, but in some locations, even the shale bottom has been eroded. This is evident in the areas where the vertical wall has been undercut.

III. FLOOD PLAIN

The flood plain has been drawn on the base topographical map used in this report. The map indicates that a very wide area is inundated in the area between Fillmore Bridge and the Rock Island Bridge. The section between the Rock Island Bridge and Cimarron Bridge is confined to the main channel, although erosion would damage some areas where the banks are not stable. The section between Cimarron Bridge and Nevada Avenue Bridge does not have bank lining along most of its length and the 100 year storm inundates portions of the Martin Drake Power Plant property, as well as a large section of business district, along Las Vegas Street. Interstate 25 is above the flood plain, but most of the electric poles and steel towers fall within it.

The Corps of Engineers report indicates that the 100 year storm would produce 32,000 c.f.s. of flow in Monument Creek and that the improved channel between the Rock Island Bridge and Cimarron Bridge would have a capacity of about 50,000 c.f.s. The combined flow of Fountain Creek and Monument Creek below this point would have a 100 year flow of 42,200 c.f.s.

IV. CONCLUSIONS AND RECOMMENDATIONS

The improved channel is in good condition except for the areas shown to be repaired. These areas must be repaired to prevent further damage.

The channel meanders considerably throughout its entire length. It was noted that in several locations, a utility line or a rock outcropping crossed the channel at an angle, rather than straight across. These obstructions act as check dams to prevent further channel bottom erosion, but because of their angle, they force the flow to the outside of the channel, rather than directing it downstream, in the center. This has caused serious undercutting and vertical wall damage in these locations.

The vertical walls at the toe of the improved slopes were intended to be protection for the slope, rather than acting as retaining walls. They do not have footings under them, the reinforcing is small and they are not anchored against the force of the slope. Therefore, it is essential that they have embankment on the stream side of the wall to prevent them from leaning and collapsing into the channel.

It is recommended that check dams be installed at selected locations along the channel. A V-type check dam is recommended in this wide channel. The greater height of check dam at the outside will protect the vertical wall and retain the depth of embankment. The short height of the check dam at the center of the channel will retain the capacity of the section and in addition, will tend to keep the stream flow in the center. This should alleviate the problem of undercutting along the outside walls. The check dams will also prevent further deepening of the channel and undercutting the bridge piers.

There is a surplus of dirt in a few locations and these are indicated on the cross sections. It is not recommended that any major earth removal project be initiated, but rather use the surplus as embankment along the eroded vertical walls, after the check dams are installed. Consideration should be given to regrassing the excavated and filled areas to maintain the aesthetics of Monument Valley Park.

There was evidence of alkalai soil along the entire length of the study. It is recommended that Type II L.A. cement be used in any concrete poured in the channel. This would also preclude the use of CaCl in the concrete mix if it were to be poured in cold weather.

The rehabilitation of Monument Creek is recommended to be accomplished using the following priorities:

- 1. Repair damaged sections.
- 2. Install protection for existing structures.
- 3. Install protection to prevent further channel erosion.
- 4. Install lining in vulnerable locations.

Polk Street Bridge is in poor condition and presents an obstruction to flow in the 100 year storm. However, it will not be included in the cost estimate for this project, since it is proposed to be replaced by the Public Works Department in their five year Capital Improvement Program.

V. COST ESTIMATE		PHASE
CMATTON D . OO +- 10 . OO		
STATION 7 + 00 to 12 + 00	•	
3' x 3' Gabions along south wall	$500' \times $30.00 = $15,000.00$	3
STATION 21 + 00 to 23 + 00		
3' x 3' Gabions along south wall	$300' \times $30.00 = $9,000.00$	3
STATION 24 + 50		
3' x 3' Gabions 12' high at end of wall	50' x \$120.00 = \$ 6,000.00	1
STATION 47 + 80		
Bear Creek Bridge Outlet 3' x 3' Gabions	20' x \$ 30.00 = \$ 600.00	2
<u>STATION 53 + 00</u> *		
Earthwork Check Dam Gabions Downstream	400 c.y. x \$ 1.50 = \$ 600.00 47 c.y. x 285.00 = 13,400.00 60 ft. x 30.00 = 1.800.00 \$15,800.00	1
STATION 66 + 50		
Earthwork Check Dam Gabions Downstream	200 c.y. x \$ 1.50 = \$ 350.00 50 c.y. x 285.00 = 14,250.00 70 ft. x 30.00 = 2.100.00 \$16,700.00	2
STATION 80 + 00		
Earthwork Check Dam Gabions Downstream	400 c.y. x \$ 1.50 = \$ 600.00 23 c.y. x 285.00 = 6,555.00 40 ft. x 30.00 = 1,200.00 \$ 8,355.00	3
STATION 81 + 70		
Repair 36" Pipe Outlet	\$ 100.00	3

This location is downstream from point where new 42" s.s. will cross the channel at an angle.

STATION 82 + 30				PHASE
Remove Wooden Chute		\$	500.00	3
STATION 83 + 10				
Repair 15" Pipe Outlet	· V	\$	100.00	.3
STATION 86 + 90				
Repair Sunken Slope Lining		\$	1,000.00	3
STATION 88 + 40				
Earthwork Check Dam Gabions Downstream	1000 c.y. x \$ 1.50 = 30 c.y. x 285.00 = 40 ft. x 30.00 =	= =	8,550.00	2
STATION 95 + 00				
Earthwork Check Dam Gabions Downstream	1000 c.y. x \$ 1.50 = 25 c.y. x 285.00 = 40 ft. x 30.00 =	=	7,125.00	2
STATION 102 + 20				
Repair Outlet of 15" Pipe		\$	100.00	3
<u>STATION 103 + 00</u>				
Earthwork Check Dam Gabions Downstream	200 c.y. x \$ 1.50 = 29 c.y. x 285.00 = 40 ft. x 30.00 =	=		2
STATION 104 + 00 to 108 + 00				
3' x 3' Gabion Along West Wall	400 ft. x \$ 30.00 =	= \$]	L2,000.00	3
<u>STATION 110 + 30</u>				
Earthwork Check Dam Gabions Downstream	200 c.y. x \$ 1.50 = 42.1 c.y. x 285.00 = 40 ft. x 30.00 =	s [3

<u>STATION 117 + 00</u>					-	PHASE
Earthwork Check Dam Gabion Downstream	400 c.y. x 28.1 c.y. x 40 ft. x	ζ,	285.00	=	8,000.00	2
STATION 121 + 90						
Repair Outlet on 18" Pipe				\$	100.00	3
<u>STATION 133 + 00</u>						
Earthwork Check Dam Gabion Downstream	400 c.y. 2 21.05 c.y. 2 40 ft. 2	X.	285.00	=	6,000.00 1,200.00	2
<u>STATION 137 + 00</u>						
Earthwork Check Dam Gabion Downstream	28.07 c.y. 2	X.	285.00	=	300.00 8,000.00 1,200.00 9,500.00	2
STATION 141 + 30					-	
Repair East Wall				\$	500.00	2
STATION 143 + 20						
Repair Outlet On 18" Pipe				\$	100.00	3
<u>STATION 145 + 00</u>						
Install Gabions To Correct Bad Angle On 20" Water Main	100 ft.	x \$	30.00	= \$	3,000.00	3
<u>STATION 148 + 00</u>						
Repair Outlet On Concrete Box				\$	1,000.00	3
<u>STATION 160 + 00</u>						
Repair East Lining				\$	500.00	. 3

<u>STATION 174 + 00</u>				PHASE
Earthwork Check Dam Gabion Downstream	15 c.y.	x \$ 1.50 = x 285.00 = x 30.00 =	4.275.00	1
STATION 178 + 00	- -			
Earthwork Check Dam Gabion Downstream		x \$ 1.50 = x 285.00 = x 30.00 =		2
<u>STATION 183 + 00</u>			•	
Earthwork Check Dam Gabion Downstream		x \$ 1.50 = x 285.00 = x 30.00 =		_
STATION 183 + 20 to 184 + 20			\$ 7,700.00	1
Pour New Wall Along East Bank	22.22 c.y.	x \$225.00 =	\$ 5,000.00	1
STATION 190 + 00 to 203 + 00		·		
Protection For West Unlined Bank		x \$ 60.00 = x \$ 60.00 =		3 4
STATION 204 + 00 to 205 + 50				
Replace East Wall Replace Rock Slope Lining Slope Backfill Grout Voids Where Wall	354.00 sq. ft.	x \$225.00 = x 3.25 = x 7.00 =	1,150.00 2,100.00	
Is Leaning			1,000.00 \$16,750.00	1
<u>STATION 205 + 00</u>				
Earthwork Check Dam Gabion Downstream	25.00 c.v.	x \$ 1.50 = x 285.00 = x 30.00 =	7.125.00	1

STATION 207 + 00		PHASE
Earthwork Check Dam Gabions Downstream	400 c.y. x \$ 1.50 = \$ 600.00 22.10 c.y. x 285.00 = 6,300.00 40 ft. x 30.00 = 1,200.00 \$ 8,100.00	1
STATION 209 + 00		
Earthwork Check Dam Gabions Downstream	400 c.y. x \$ 1.50 = \$ 600.00 26.00 c.y. x 285.00 = 7,410.00 40 ft. x 30.00 = 1,200.00 \$ 9,210.00	1
<u>STATION 212 + 60</u>		
Earthwork Check Dam Gabions Downstream	600 c.y. x \$ 1.50 = \$ 900.00 20 c.y. x 285.00 = 5,700.00 40 ft. x 30.00 = 1,200.00 \$ 7,800.00	2
STATION 217 + 50 to 223 + 50		
Stabilize East Bank With Gabions STATION 224 + 30	500 ft. x \$ 60.00 = \$30,000.00	4
	17.78 c.y. x \$225.00 = \$ 4,000.00 22.80 c.y. x 285.00 = 6,500.00 50 ft. x 30.00 = 1,500.00 \$12,000.00	1
PHASE 2 \$91,140.00 x 1.0 PHASE 3 \$86,555.00 x 1.1	00 cost increase = \$ 96,460.00 05 cost increase = \$ 95,697.00 10 cost increase = \$ 95,210.50 15 cost increase = \$ 98.670.00	

TOTAL ESTIMATED CONSTRUCTION COST \$386,03

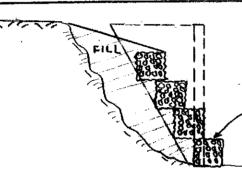
\$386,037.50

TYPICAL REPAIRS

VERTICAL WALL BEING UNDERCUT

3'x3' Gabion

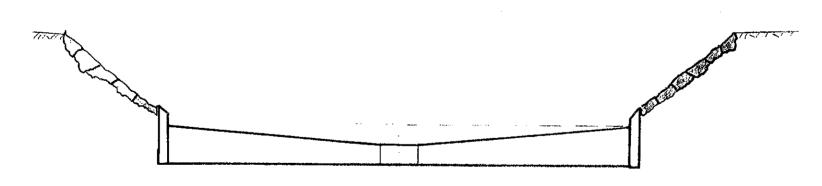
STATIONS 7+00 to 12+00
21+00 to 23+00
104+00 to 108+00



PROTECT END SECTION OF VERTICAL RETAINING WALL

S'X3' GABIONS

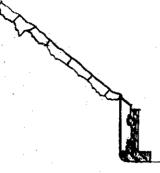
STATION 24+50 to 25+00



CHECK DAM

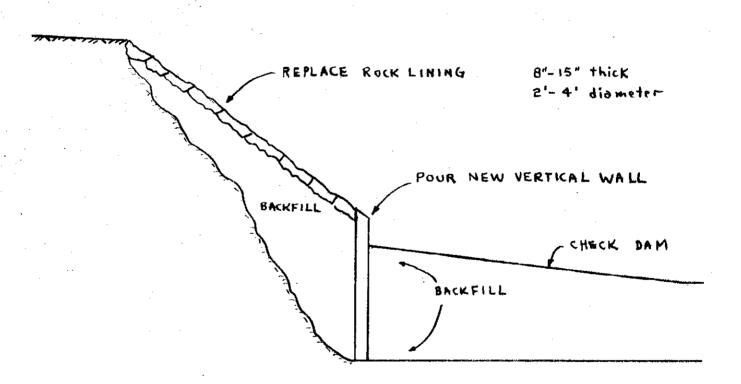
CHECK DAM - 2010 3'X3' GABION

TYPICAL REPAIRS



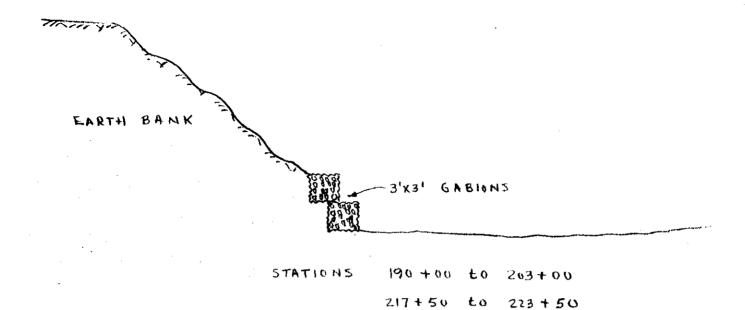
POUR NEW WALL IN FRONT OF DETERIORATED WALL

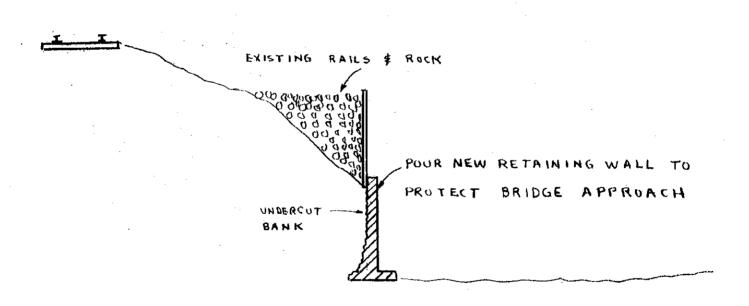
STATION 183+ 20 to 184+ 20



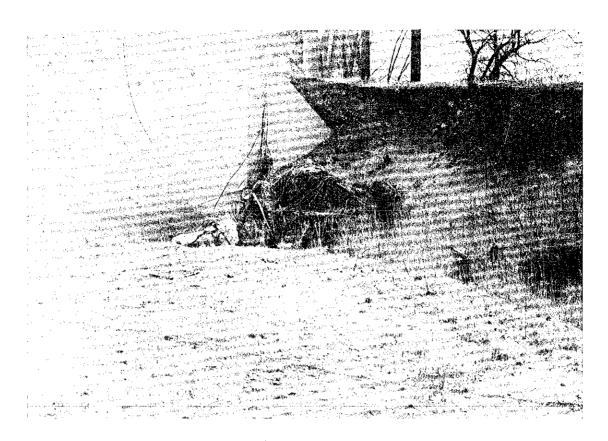
STATION 204+00 to 205 + 50

TYPICAL REPAIRS





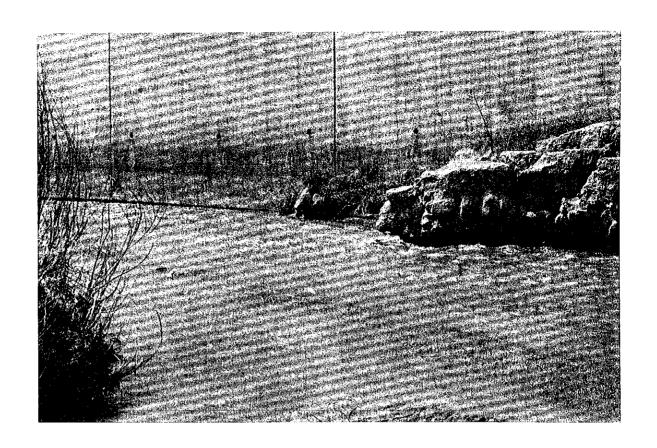
OF + PSS NOITATE



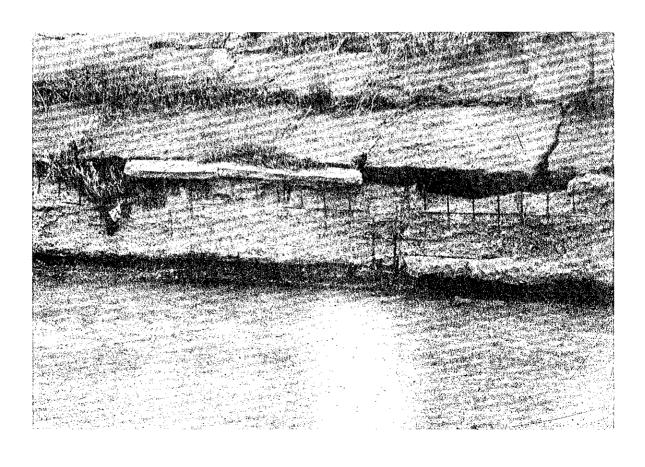
STATION 24 + 20 EXPOSED END OF RETAINING WALL



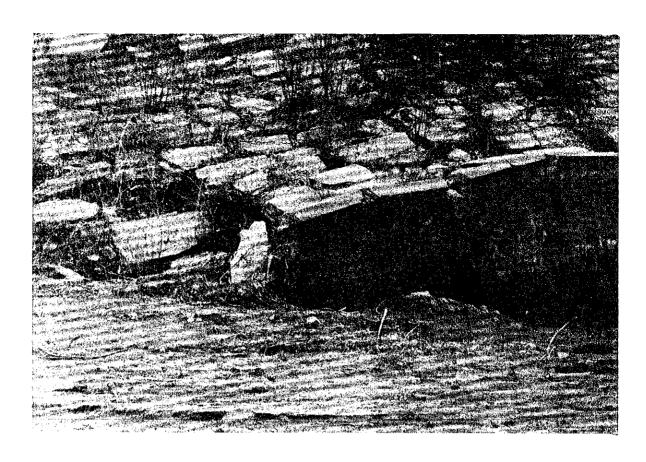
STATION 67 + 00 EXPOSED CAISSONS AT CIMARRON



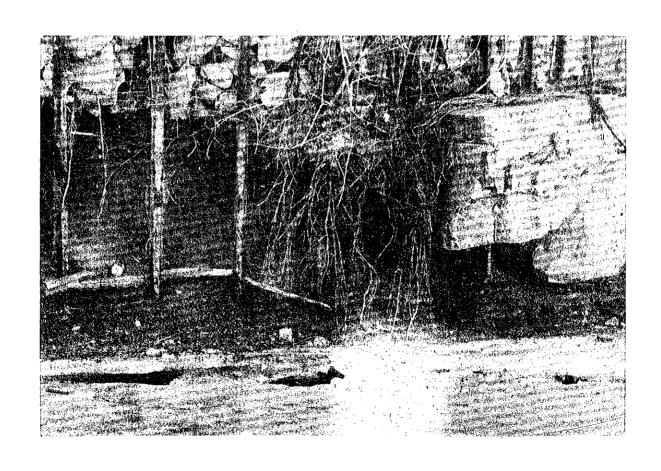
STATION 109 + OO EROSION ALONG WALL AT BIJOU



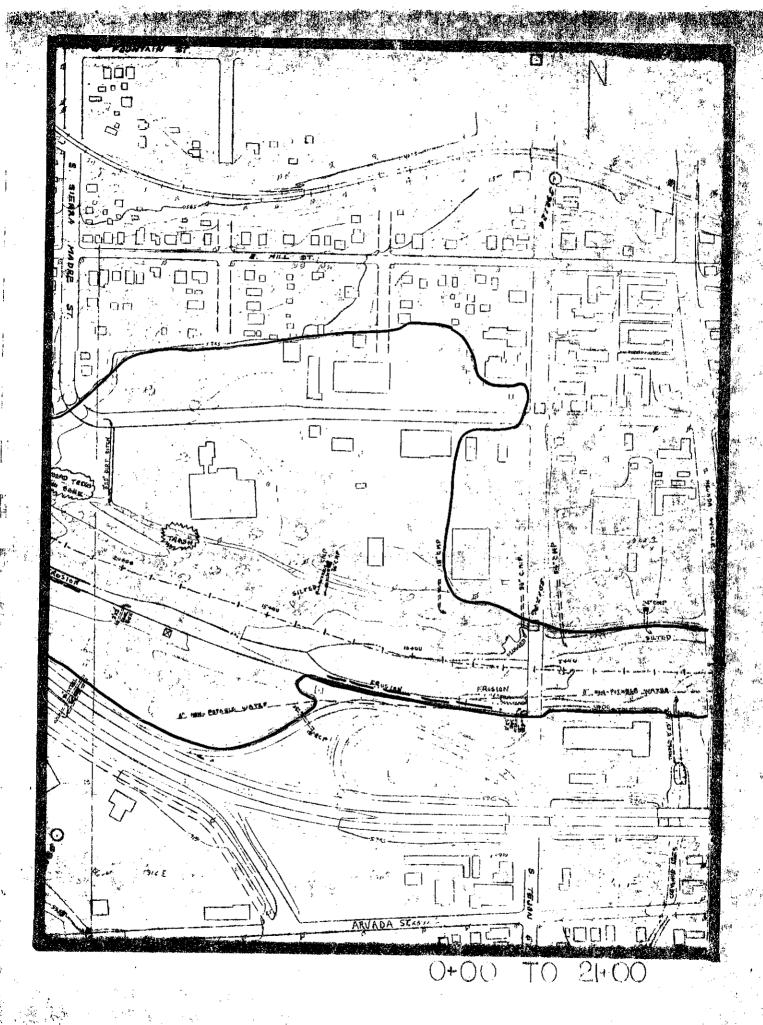
STATION 183 + OO DETERIORATION OF EAST WALL

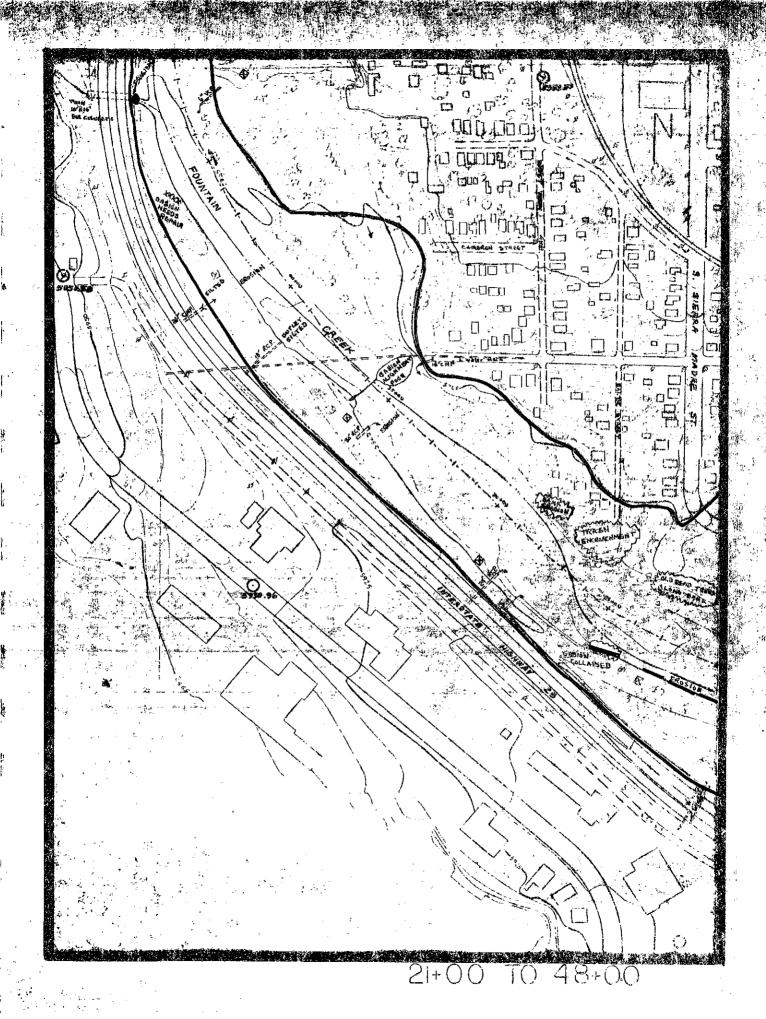


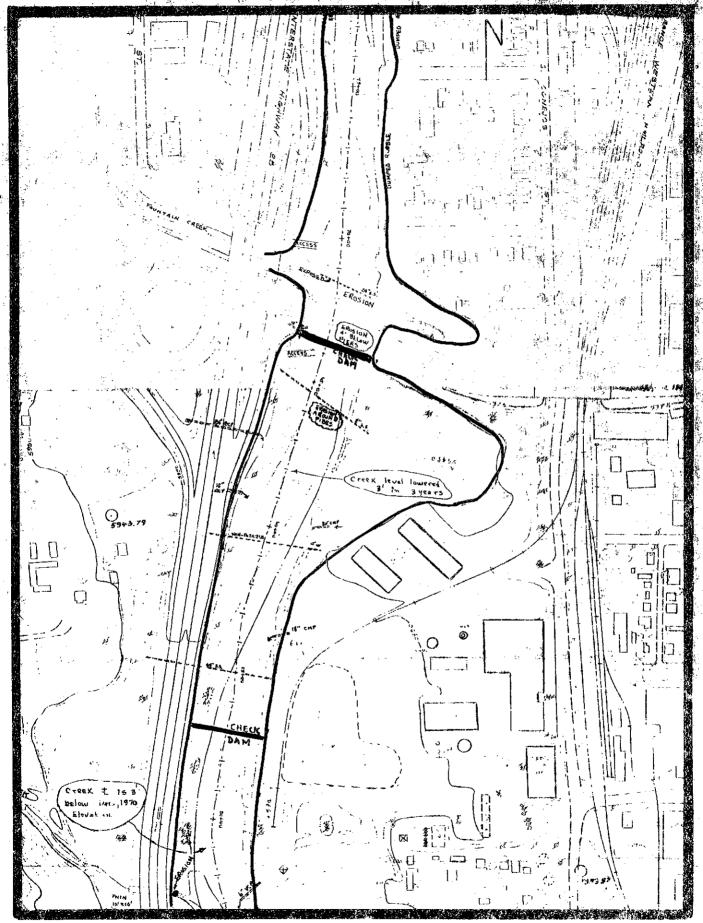
STATION 202 + 50 FAILURE OF EAST BANK



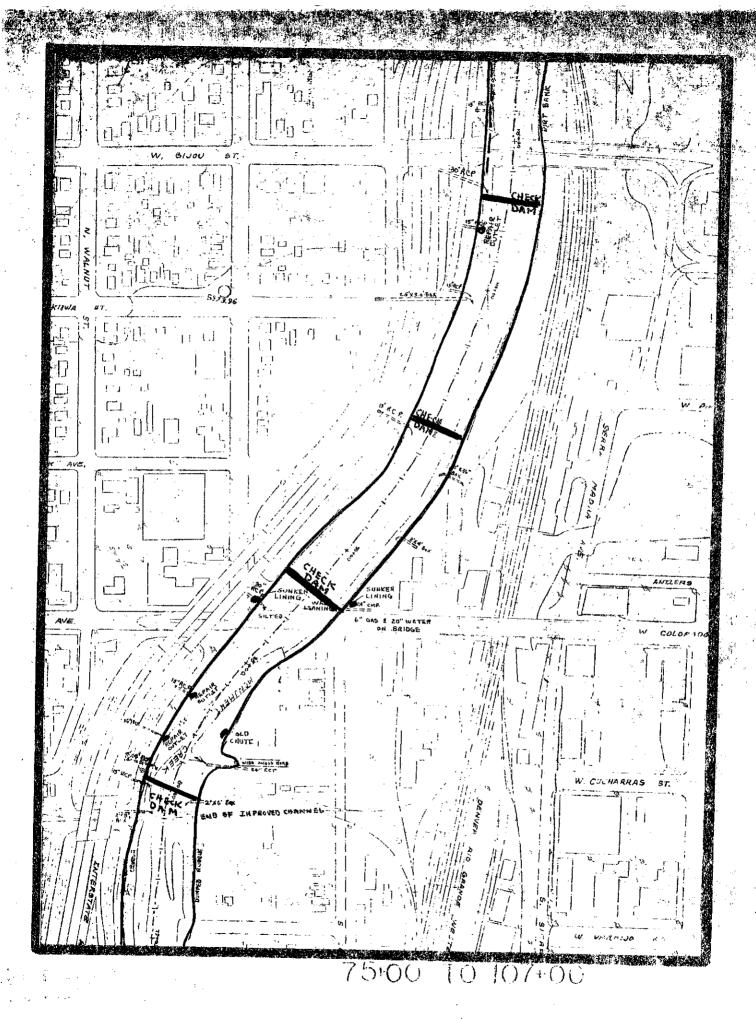
STATION 224 + 10 UNDERCUT APPROACH TO R.R. BRIDGE

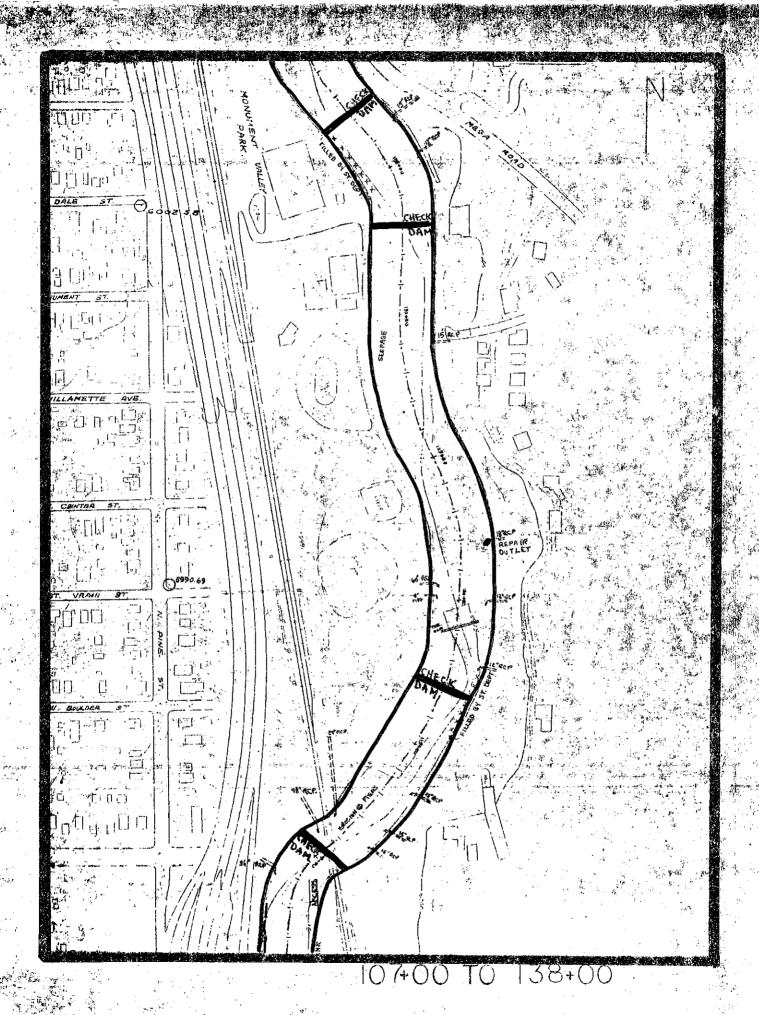


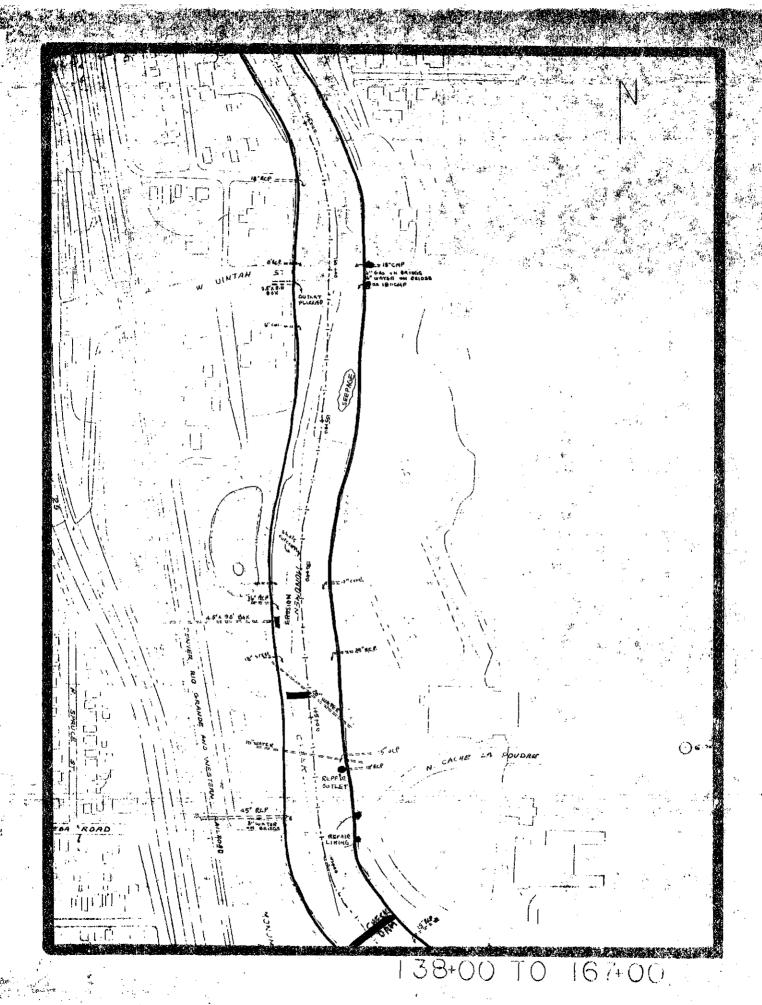


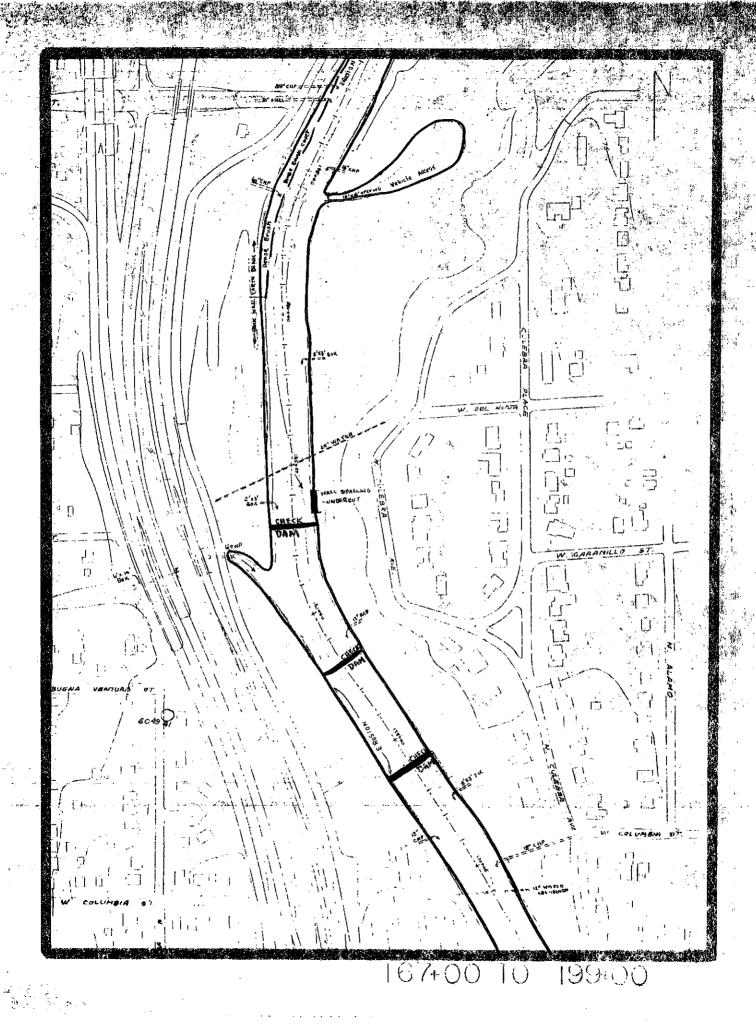


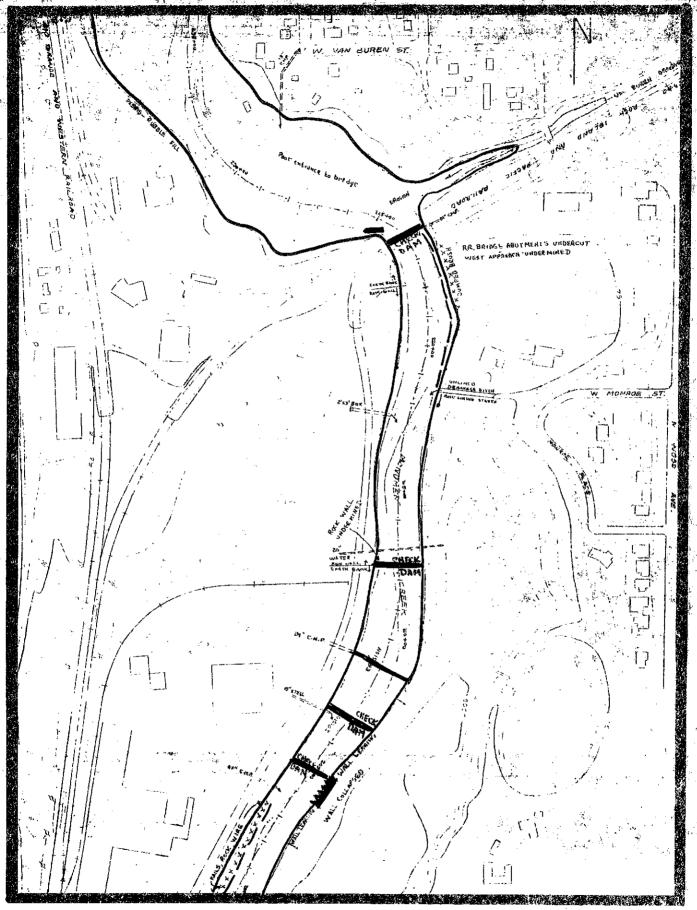
48.00 TO 75+00



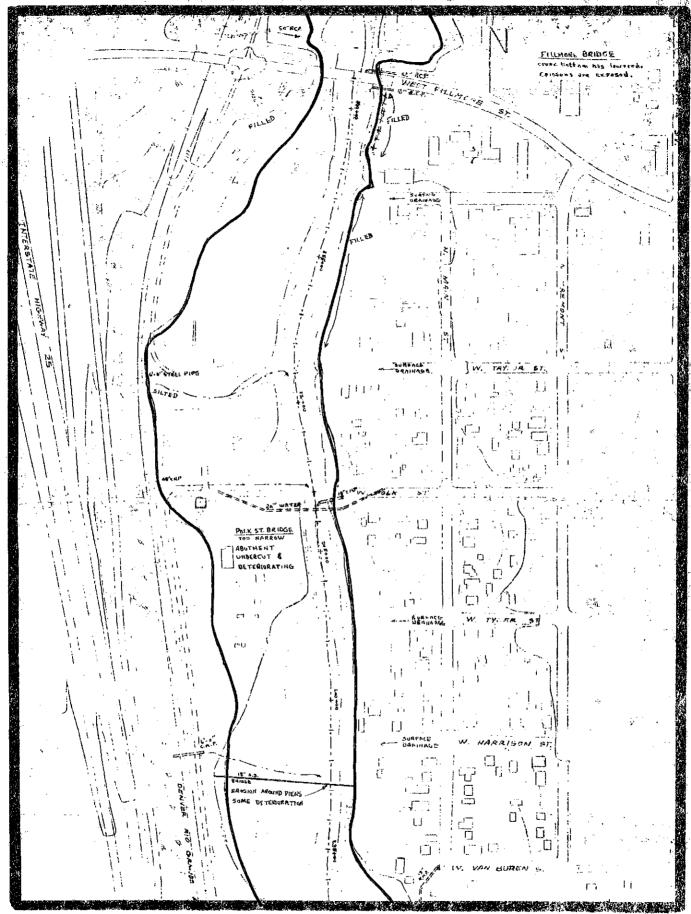








199+00 TO 235+00



235+00 TO 261+00

