State of Colorado

COLORADO WATER CONSERVATION BOARD

Clifford H. Stone, Director

Preliminary Examination Report

FLOOD CONTROL INVESTIGATION

PIERCE, COLORADO AND VICINITY

Weld County, Colorado

June 1939

CLIFFORD H. STONE
DIRECTOR AND SECRETARY

STATE OF COLORADO

COLORADO WATER CONSERVATION BOARD

DENVER
JUNE
28
1939

Colorado Water Conservation Board,
Mr. Clifford H. Stone, Director,
Denver, Colorado.

Gentlemen:

In compliance with previous instructions of the Board, we have made a preliminary examination of the flood control problems in the vicinity of Pierce, Weld County, Colorado.

Attached will be found our preliminary report, with recommendation that copies of said report, subject to approval by the local flood protection committee, be submitted to Federal Agencies that are interested in and concerned with flood control problems.

Respectfully submitted,

CLP:ds

C. L. Patterson, Chief Engineer

Preliminary Examination Report
FLOOD CONTROL INVESTIGATION
PIERCE, COLORADO AND VICINITY
Weld County, Colorado

INDEX

1. INTRODUCTION

During recent years a series of floods have occurred in the vicinity of Pierce, Weld County, Colorado. Copy of a map of the vicinity is hereto attached, marked Exhibit 1. Shortly after the most recent flood of September, 1938, a meeting of property owners in the vicinity was held at Pierce to discuss the flood situation. Various opinions were advanced as to the causes of floods and numerous suggestions were made as to remedies for the prevention of flood damages. These opinions and suggestions were divergent and in some respects were conflicting so that no definite plan of procedure could then be adopted.

One of the functions of the Colorado Water Conservation Board is to aid citizens of the state in the solution of such problems. The authority of the Colorado Water Conservation Board with respect to the prevention of flood damages is set forth in attached Exhibit No. 2.

Through its Director, Clifford H. Stone, the services of the Colorado Water Conservation Board were offered to the property owners of the Pierce vicinity. The Engineering Department of the Board was instructed to make a preliminary examination and report for the assistance of a local flood protection committee consisting of:

Moses Smith	Ault, Colorado, Chairman
J. A. Turner	Nunn, Colorado
Emil Smith	Pierce, Colorado
Jacob Hasbrouck	Ault, Colorado
F. A. Griffen	Nunn, Colorado

2. QUESTIONNAIRES

At a meeting of the flood protection committee with representatives of the Board, held November 4, 1938, a questionnaire-form was adopted, copy of which is hereto attached as Exhibit No. 3.

At a second similar meeting November 22, 1938, arrangements were made for the circulation of questionnaires among local property owners. The local flood protection committee furnished the names of approximately 75 property owners to whom the Board mailed questionnaires.

As of December 9, 1938, approximately 30 of the questionnaires had been filled out and returned. The names of the owners and operators reporting flood damages are indicated on tabulation marked Exhibit 4. The names of those to whom questionnaires had been mailed but from whom no replies had been received, together numbering about forty, were furnished to each member of the local flood protection committee under date of December 13, 1938. In the meantime a field inspection had been made of the area. Within a few weeks thereafter, no additional reports of flood damages having been received, tabulations were prepared of the flood damage statements as submitted, copies of which are hereto attached.

3. SUMMARY OF FLOOD DAMAGE REPORTS

Exhibit 4 shows the names of owners and operators from whom reports of flood damages were received. The locations of the properties are described by section, township and range. By means of letters these properties are further grouped according to their locations, whether within or outside of the drainage basin of Spring Creek. Those

properties within Spring Creek basin are grouped according to their locations above or below the various canals and ditches that cross the Spring Creek drainage basin.

The map, Exhibit 1, was prepared from U. S. Geological Survey topographic maps. It shows the locations of the several properties concerning which flood damage reports were received and tabulated. It also shows the location of Spring Creek and its drainage basin with respect to adjoining water sheds, as well as locations of the towns of the vicinity and of the several ditches that cross the Spring Creek Valley.

The flood damage statements of local property owners and operators appearing in the signed questionnaires, have been augmented by reports received from the State Highway Department and the Union Pacific Railroad Company, showing the damages to their properties resulting from floods in the Pierce vicinity.

Exhibit 5 shows the amounts of the reported damages to crops, ditches, buildings, highways and railroad properties, and other damages including livestock, lands, bridges, fences and implements and machinery for the years 1917 to 1935.

Exhibit 6 is a similar summary of the reported flood damages for the years 1936 to 1938 inclusive.

During the 22 year period, 1917-1938, the total reported flood damages were $91,631.00. During the 18-year period, 1917-1934, the reported damages totaled only $2,600.00. The balance of the reported damages, namely, $89,031.00 occurred during the four year period, 1935-1938. Of this amount, 3 reports for the year 1935 covered

properties that are located outside of the Spring Creek Drainage Basin These three properties reported damages totaling $9,550.00, as indicated on Exhibit 5.

Limiting the consideration to properties within the Spring Creek Drainage Basin and to the four year period, 1935-1938, the total reported damages were $79,481.00 as shown by Exhibit 7.

Exclusive of damages to highways and railroads, the four year, 1935-1938 flood damages totaled $49,518.00 of which $27,313.00 was reported as damages to crops; $2,560.00 damages to ditches; $8,845.00 damages to buildings; and $10,800.00 in the form of other damages, consisting of $650.00 loss of livestock; $1,325.00 damages to fences; $2,475.00 damages to equipment, machinery, et cetera; and $6,350.00 damages to lands caused by erosion and deposition. No estimates are included covering the depreciated land values resulting from flood hazards.

4. LOCATION OF FLOOD DAMAGES

During the four year period, 1935-1938, the major share of the reported flood damages to farm property was located in area (B) east of the Town of Ault, above the Eaton Ditch and below the Collins lateral. (See Map, Exhibit 1, and tabulation, Exhibit 4).

Damage to highways and railroads were largely concentrated in the section between the Towns of Nunn and Pierce, that is in area (D) below the Laramie-Poudre Canal and above the Pierce Lateral. Assigning all the reported highway and railroad damages to this area (D) the following summary will indicate the location of flood damages during the 1935-1938 period within the Spring Creek Drainage Basin.

Section - Area	Reported Damages Total 1935-1938	Average Per Yr.	Percent of Total
A - Below Eaton Ditch	$ 4,425	$ 1,106	5.6 %
B - Eaton Ditch to Collins Lateral	29,275	7,319	36.8
C - Collins Lateral to Pierce Lateral	13,893	3,473	17.5
D - Pierce Lateral to Laramie-Poudre	30,263 (a)	7,566	38.1
E - Above Laramie-Poudre Canal	1,625 (b)	406	2.0
Totals	$79,481	$19,870	100 %

(a) Includes highway and railroad damages.

(b) Probably does not include sheet or gully erosion over the watershed of Spring Creek.

Considering the incompleteness of the returned questionnaires and based upon the scattered locations of the properties reporting flood damages, it appears that a detailed investigation of the entire area, to include all forms of damages, might disclose a larger total and a larger average annual damage than is shown in the above table.

5. FLOOD PREVENTION MEASURES AS SUGGESTED BY QUESTIONNAIRE STATEMENTS

A total of twenty-seven suggestions were made by residents of the Pierce area as to measures for the prevention of flood damages. Seventeen of these involved the Laramie-Poudre Canal. Nine residents suggested enlarging the Laramie-Poudre Ditch throughout its length to the McGrew Reservoir in order to carry the flood water of Spring Creek completely away from the valley and from the vicinity of Pierce. Seven persons suggested using the Laramie-Poudre Ditch with Spillways constructed in its lower banks at all natural water courses in order to avoid concentration of flood flows. One suggested cleaning and enlarging the Laramie-Poudre Ditch as far as Lone Tree Creek.

Two persons suggested enlarging the Pierce Lateral and the Collins Lateral in addition to enlarging the Laramie-Poudre Ditch. One suggested the construction of spillways at natural water courses through the Eaton Ditch. Two persons suggested the construction of a flood ditch along highway No. 85 in order to prevent the flood waters from over-flowing the fields adjacent to the highway. Two suggestions include the straightening and enlarging the channel of Lone Tree Creek. One resident suggested the construction of a system of collection and detention ditches over the drainage basin of Spring Creek above the Laramie-Poudre Canal. Two residents suggested checking the water above the Laramie-Poudre Ditch by means of dams across the Spring Creek Valley, although both admitted that some enlargement of the Laramie-Poudre Ditch might also be required.

6. FIELD INVESTIGATION OF DECEMBER 1938

Beginning December 5, 1938, a field investigation was made which required 5 days. Part of this time was involved in the collection of questionnaires that had been distributed among residents of the flood area. A search was made for additional rainfall records and information concerning the intensity and duration of storms which resulted in damage. Cross-sections and levels were taken in the Laramie-Poudre Canal from its crossing of Spring Creek to Lone Tree Creek. An inspection was made of the lower portion of the basin of Lone Tree Creek below the Junction of Owl Creek and Spring Creek. An investigation was also made of the bridges and culverts crossing the highway and railroad between the towns of Nunn and Pierce.

7. PRECIPITATION DATA

There are no precipitation records published by the U. S. Weather Bureau for stations within the area under investigation. The nearest point for which records have been published are at Greeley, about 15 miles South of Pierce, and at Grover, about 30 miles Northeast of Pierce.

However, a record of rainfall at Nunn, Colorado, for the year 1925-1938 was compiled and furnished by Mr. J. A. Turner. Records were also obtained from the Great Western Sugar Company stations at Eaton, Colorado and at a farm 2-1/2 miles East and one mile South of Pierce, Colorado. A rain gage is also being maintained by the Town of Ault, observations being made by the Town Clerk. Copies of these several records were made for the years 1934-1938. Exhibit 8 (a) is a description of the several rain gages above mentioned. Exhibit 8 (b) is a precipitation record at Pierce and Eaton for 1934; Exhibit 8 (c) is the record at Nunn, Pierce, Ault and Eaton for the year 1935, with certain daily values during the month of May; Exhibit 8 (d) relates to the year 1936; 8 (e) to the year 1937; and 8 (f) to the year 1938, with daily values for portions of the month of September.

No reliable observations or records of intensity of rainfall could be obtained. The greatest amount of rainfall observed in any one day of 1935 occurred May 30, 1935, when 4.62 inches was reported at the Nunn Station. On this same day the record at Pierce shows 0.38 inches and at Ault 0.25 inches, indicating a wide variation in rainfall intensities over relatively short distances.

During the flood of September 1 and 2, 1938, the rainfall at Nunn totaled 5.00 inches, while during the same days 3.20 inches fell at Pierce and 1.23 inches at Ault.

These figures are here repeated in order to confirm the impressions of some of the local residents that the two major floods in the Pierce vicinity during recent years (May 30, 1935 and September 2, 1938) have been caused by intense rainfalls over the drainage area of Spring Creek above the Town of Nunn and above the Laramie-Poudre Canal.

8. SPRING CREEK DRAINAGE BASIN

Spring Creek is an intermittent stream having a drainage area of 71 square miles above the Laramie-Poudre Canal, of which 12.5 square miles is located in Northeast Larimer County near the Wyoming line, and the balance is in Weld County. An additional 10 square miles of drainage area is located West of the Union Pacific railroad tracks along a tributary of Spring Creek which arrives at the Laramie-Poudre Canal in the vicinity of the Town of Nunn. The total drainage area above the Laramie-Poudre Canal is thus 81 square miles.

This water shed totaling 81 square miles is approximately 24 miles long and is, therefore, about 3-1/2 miles in average width. In its upper reaches in Larimer County, the drainage basin is approximately 1-1/2 miles wide. Its maximum width in Weld County is approximately 6 miles (see Map Exhibit 1).

The head waters of Spring Creek are at elevation approximately 6300 feet and the Laramie-Poudre Canal is at elevation approximately 5180 feet. On the average the fall along the floor of the drainage

basin is about 45 feet per mile.

The Westerly side of the watershed consists of steep barren bluffs. Along the Easterly portion (including the ten square miles draining into the town of Nunn) there is a low flat ridge marking the divide between Spring Creek and Lone Tree Creek.

A considerable portion of the water shed is of a topography adapted to cultivation. During past years some of the natural sod has been removed and the lands have been plowed to the extent of approximately 50% of the area above the Laramie-Poudre Canal up to the county line between Larimer County and Weld County. Above that point there has been little land cultivated. Below the Laramie-Poudre Canal down to the Town of Pierce, approximately 80% of the land has been plowed. From the testimony of local residents and from observations in the field, it appears that the principal flood producing area is located above the Laramie-Poudre Canal, having a total area of 60-70 square miles in Weld County.

9. LARAMIE-POUDRE CANAL

From the time of its construction (about 1910) the Laramie-Poudre Canal appears to have functioned as an intercepting drain and to have carried the flood waters away from the drainage basin of Spring Creek into the territory East of the Town of Nunn. The Laramie-Poudre Canal was constructed or intended to be completed to a length of about 17 miles East of the Town of Nunn, to empty into the McGrew Reservoir. However, the construction, if it was ever completed, was not of sufficient capacity to handle all of the flood flows. There has not been an available supply of water to allow the Laramie-Poudre

Canal to be used continuously for irrigation purposes East of the Town of Nunn. However, the ditch seems to have served a useful purpose in relieving the area West of Nunn from the flood water there accumulating. Since its construction the ditch has become badly silted and its capacity has been reduced.

During May 1935, heavy rains occurred throughout Northeastern Colorado. Abnormal flows occurred in practically all stream channels at that time. The Laramie-Poudre Canal was unable to carry away the flood waters accumulating above the Town of Nunn. The water backed up behind the ditch to such an extent that the lower canal banks were broken by residents in order to allow accumulated water to drain away. These breaks were made at the Spring Creek crossing, and also at the tributary draw which passes through the Town of Nunn. At other points along the ditch, the water appears to have obtained such height as to break out at the lower bank of the ditch. The channel of Lone Tree Creek was out or washed through the Laramie-Poudre Canal.

10. HIGHWAY AND RAILROAD CROSSINGS

As a result of the breaks in the lower bank of the Laramie-Poudre Canal at the Town of Nunn and at the Spring Creek crossing, all of the water from the 81 square miles of drainage above the canal was released to flow down to the Town of Pierce. From the break at the draw through the Town of Nunn, the water flowed toward Highway 85, being intercepted by the road embankment just South of the Town of Nunn. Between this point and the Town of Pierce there are three culverts or bridges for drains across the highway and railroad. The first of these is one mile North of the Town of Pierce, so that for a distance of 2-1/2

miles the flood water flowed alongside the highway. A channel was eroded to a width of 20 to 40 feet and to a depth of 8 or 10 feet, in some places dangerously close to the road pavement.

The first opening under the highway and railroad to the South of Nunn crosses almost at right angles to the direction of flow. The clearance under the highway bridge at the present time is only one foot. This inadequate capacity forces the flood waters to continue along the highway or to spread out over the fields to the west as the flow continues Southward toward the town of Pierce.

The second bridge South of the Town of Nunn, about 1/2 mile North of the Town of Pierce, is that of the Pierce lateral. At this point a culvert four feet wide passes under the railroad, which is too small to take care of much of the runoff arriving at the Pierce Lateral.

A third bridge, on the North border of the Town of Pierce, is located at a point where the flow along the highway joins with the discharge of Spring Creek. The bridges at the highway and railroad crossings have clearance areas of not more than 80 square feet. Spring Creek channel through the Town of Pierce has been excavated to some extent, but on account of the small capacity of the bridges the water will spread through the town before draining away to the flat lands Southeast of Pierce.

Arriving at the Eaton Ditch, where there is insufficient cross-drainage capacity, the flood waters spread along the roads and farm lands of the vicinity. Submergence continues for considerable periods, whenever high water occurs, before draining away.

11. ESTIMATED MAXIMUM FLOOD FLOWS

During the field investigation of December 1938, efforts were made to estimate the maximum flood flows from observed high water marks and from cross sections and slope measurements. One such estimation made at a point approximately one mile North of the Town of Pierce indicated that the crest flow during the 1935 floods may have approximated 2000 to 2500 cubic feet per second. At the same point the maximum runoff during the 1938 flood appears to have been approximately 600 to 700 second feet.

Similar estimations were made at a point 3 miles North of Pierce where the maximum flow during 1935 appears to have been 1000 to 1200 cubic feet, and in September 1938 to have approximated 500 second feet.

Using the Berkli-Ziegler formula for the Spring Creek watershed above the Laramie-Poudre Canal, and assuming a drainage area of 67 square miles and a rainfall intensity of two inches per hour, the runoff that might be expected at the Laramie-Poudre Canal would approximate 2350 cubic feet per second.

Such estimated rates of flow do not appear to have occurred prior to the year 1935. It appears probable that such flood crests might be greatly reduced by adequate watershed treatment.

12. DISCUSSION OF FLOOD PREVENTION

The suggestion of enlarging the Laramie-Poudre Canal to a capacity sufficient to carry the flood waters originating above that canal through the 17 miles of ditch to the McGrew Reservoir would be an ideal solution of the flood problem, except from the standpoint of cost. In 1935 a Works Progress Administration project was initiated

for that purpose. The plan as advanced by Mr. L. L. Stimson, County Surveyor for Weld County, was to enlarge the Laramie-Poudre Canal to a width of 40 feet, with a lower bank 13 feet high, designed to carry water to a depth of 10 feet. Under this plan each inflowing natural stream valley would become atemporary storage reservoir to the extent that the raised ditch bank would cause water to back up-stream. It was calculated that the canal so constructed would carry 2800 second feet of water and that this capacity would be sufficient to relieve the flood conditions in all the tributary stream basins crossed by the ditch.

Work on this project was commenced at the Mc-Grew Reservoir and was continued for a distance of 17,000 feet, nearly to Eastman Creek crossing. However, the bottom was not enlarged to the full forty feet wide for the whole of this distance. Approximately 120,000 cubic yards of excavation was made at an approximate cost of $25,000, of which $15,350 was for labor and the remainder was for equipment.

This project was abandoned on account of the shortage of funds. In its present condition, with banks broken and washed out in several places, the Laramie-Poudre Canal will not convey more than 50 to 75 second feet of flood waters away from the vicinity of the Town of Nunn. With excavation at a few points along the ditch between Nunn and Lone Tree Creek (to eliminate a few high places), and with widening of the ditch bottom to approximately 20 feet, the carrying capacity would be increased to 300 or 400 cubic feet per second of time, assuming the broken banks and breaks at Nunn Draw and Lone Tree Creek be repaired.

Adequate spillways might be installed at the Nunn Draw and then at points East of Nunn where natural drainage enters the ditch.

At present there is a 75 foot spillway constructed below the Lone Tree Creek to take care of excessive flows at that crossing. Near the Little Owl Creek crossing the Laramie-Poudre Canal has been more or less wholly destroyed for a length of approximately 1/2 mile. The lands on which the waters discharge are mostly waste.

13. CONCLUSIONS

From the information available, it is apparent that before a definite plan of flood prevention can be intelligently formulated, a detailed investigation of the entire area is necessary. Such an investigation would probably indicate (1) that soil conservation, water runoff retardation and related facilities constructed in the drainage area of Spring Creek above the Laramie-Poudre Canal would materially reduce the flood flows from that area; (2) that the flood flows which remained after such treatment over the catchment area could be handled by the rehabilitation of portions of the Laramie-Poudre Canal, including adequate spillways for ditch protection at various places; and (3) that the water released from the Laramie-Poudre Canal in the drainage basin of the Lone Tree Creek might thereafter be carried off providing proper crossings are constructed at the various ditches and providing surface drainage channels are constructed at a few points along the course of Lone Tree Creek.

A detailed investigation to determine the cost and feasibility of a plan such as above outlined might be undertaken by the War Department, through its U. S. Corps of Engineers, or through some of the agencies of the Department of Agriculture that are interested in flood prevention work; or by both of these Federal groups working in cooperation.

14. RECOMMENDATIONS

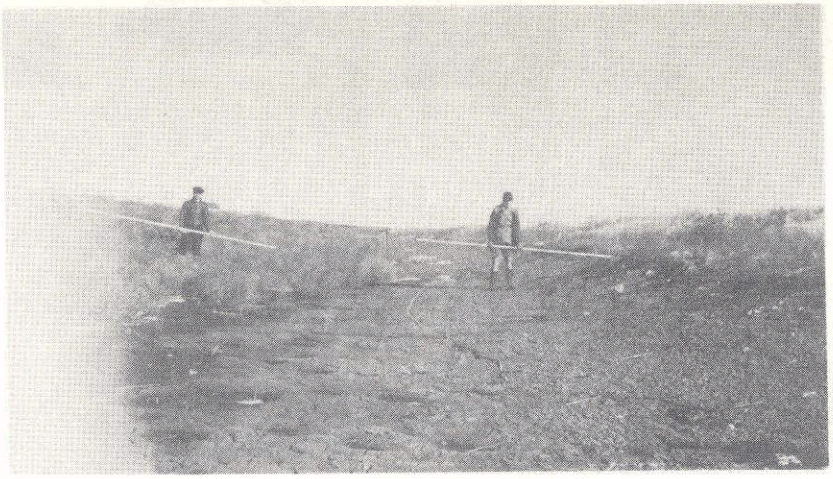
It is recommended that copies of this preliminary report be submitted to the Pierce flood protection committee, and, subject to their approval, copies of said report be submitted to the various Federal Agencies that are interested in or concerned with flood control problems, to the end that the advice of such Federal Agencies may be obtained as to the next and subsequent steps to be taken by the Water Conservation Board and the flood protection committee.

Respectfully submitted,

Colorado Water Conservation Board

By C. L. Patterson, Chief Engineer

CLP:ds

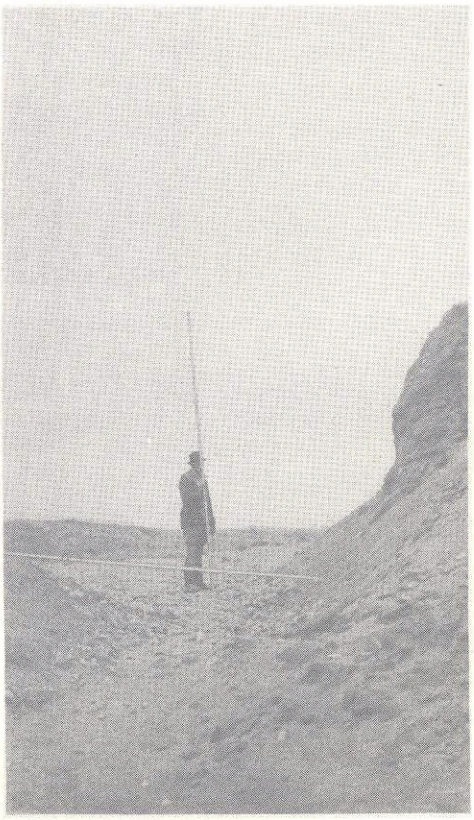


38132

Looking east down Laramie-Poudre Ditch about 1/4 mile east of Nunn. Shows weeds in ditch bottom. Bottom width 20 feet.

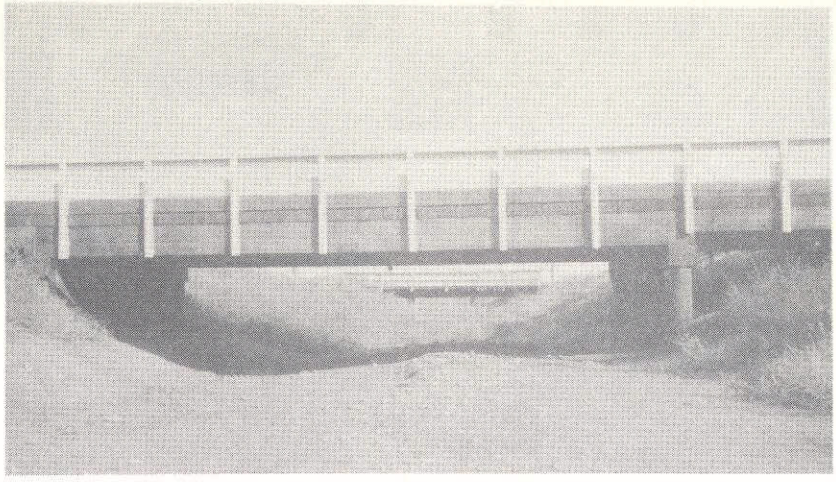
38135

Bridge over Laramie-Poudre Ditch about 1-3/4 miles east of Nunn. Important critical section owing to small area and weeds.



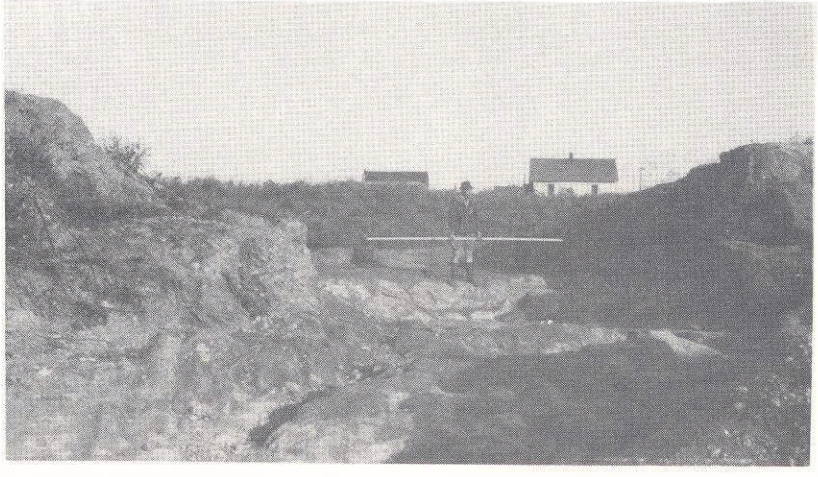
38136

Break in bank of Laramie-Poudre Ditch at Long Tree Creek. Crest 75 feet wide, 6 feet above ditch bottom.



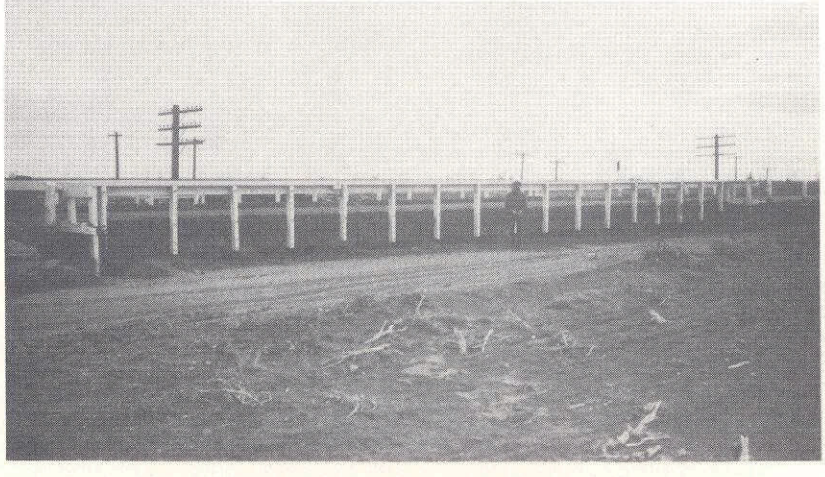
38151

Looking east at bridge on Highway 85 over Laramie-Poudre Ditch at Nunn. Railroad bridge in background.



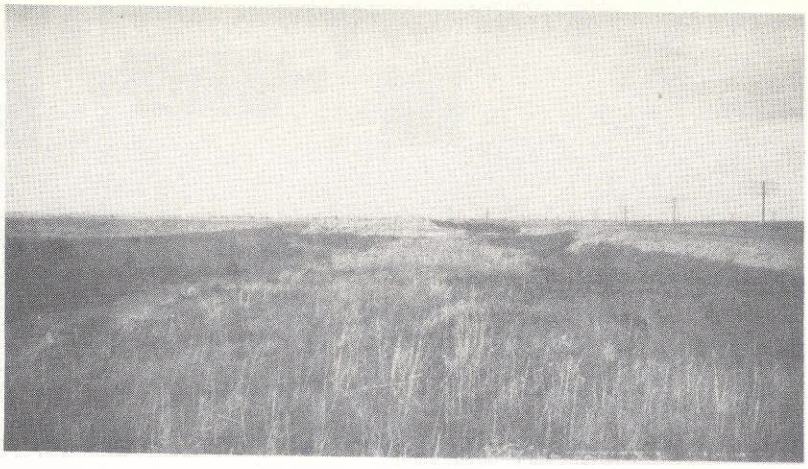
38140

Break in the lower bank of the Laramie-Poudre Ditch at Nunn. 35 feet wide and 8 feet deep.



38142

First bridge south of Nunn on Highway 85, looking east. Shows heavily silted condition and small area. This bridge is the first to get flood waters from the west side of the highway, south of Nunn. It is 3-1/2 miles south of Nunn, 1 mile North of Pierce.

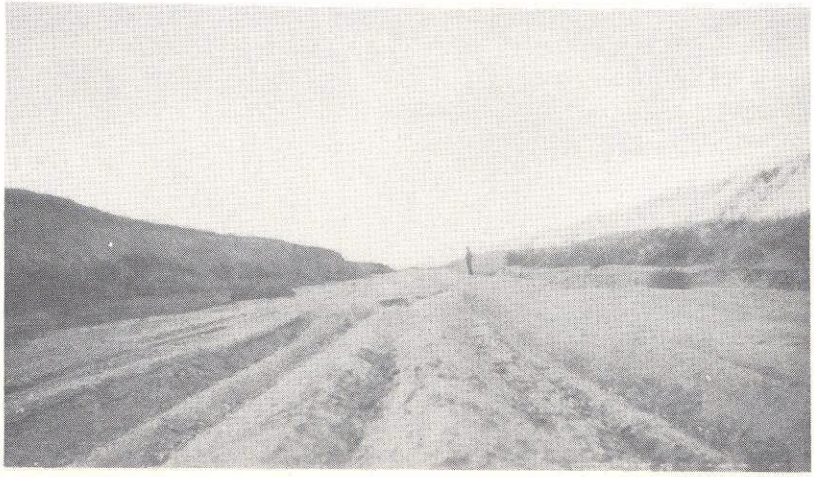


38150

Looking north along west side of Highway 85 at wash made by flood of 1935, (right side) and channel made by Highway Department (left side) to protect road. The two channels meet in center of picture. Average depth 8 feet. About 3 miles north of Pierce.

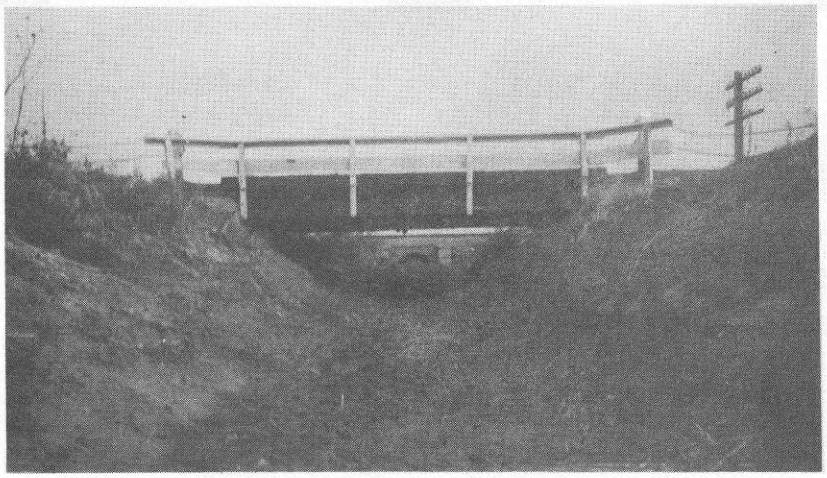
38149

Looking north in wash along west side of Highway 85 about 2-1/2 miles north of Pierce. Length of wash 1500 feet, depth about 9 feet.



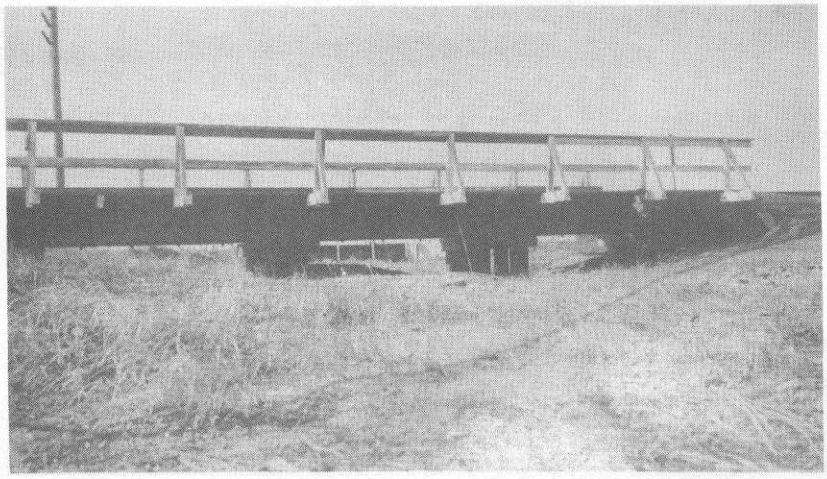
38148

Looking north in wash along west side of Highway 85 about 1 mile north of Pierce. Length of wash is over 1/2 mile, depth averages 8 feet. Just above bridge.



38143

Second bridge south of Nunn over Highway 85, looking east at railroad bridge down Pierce Lateral. Ditch bottom 6 feet wide. Bridge is 1/2 mile north of Pierce.



38145

First railroad bridge north of Pierce, looking west and upstream. Highway bridge in background. High sand bar between the bridges.

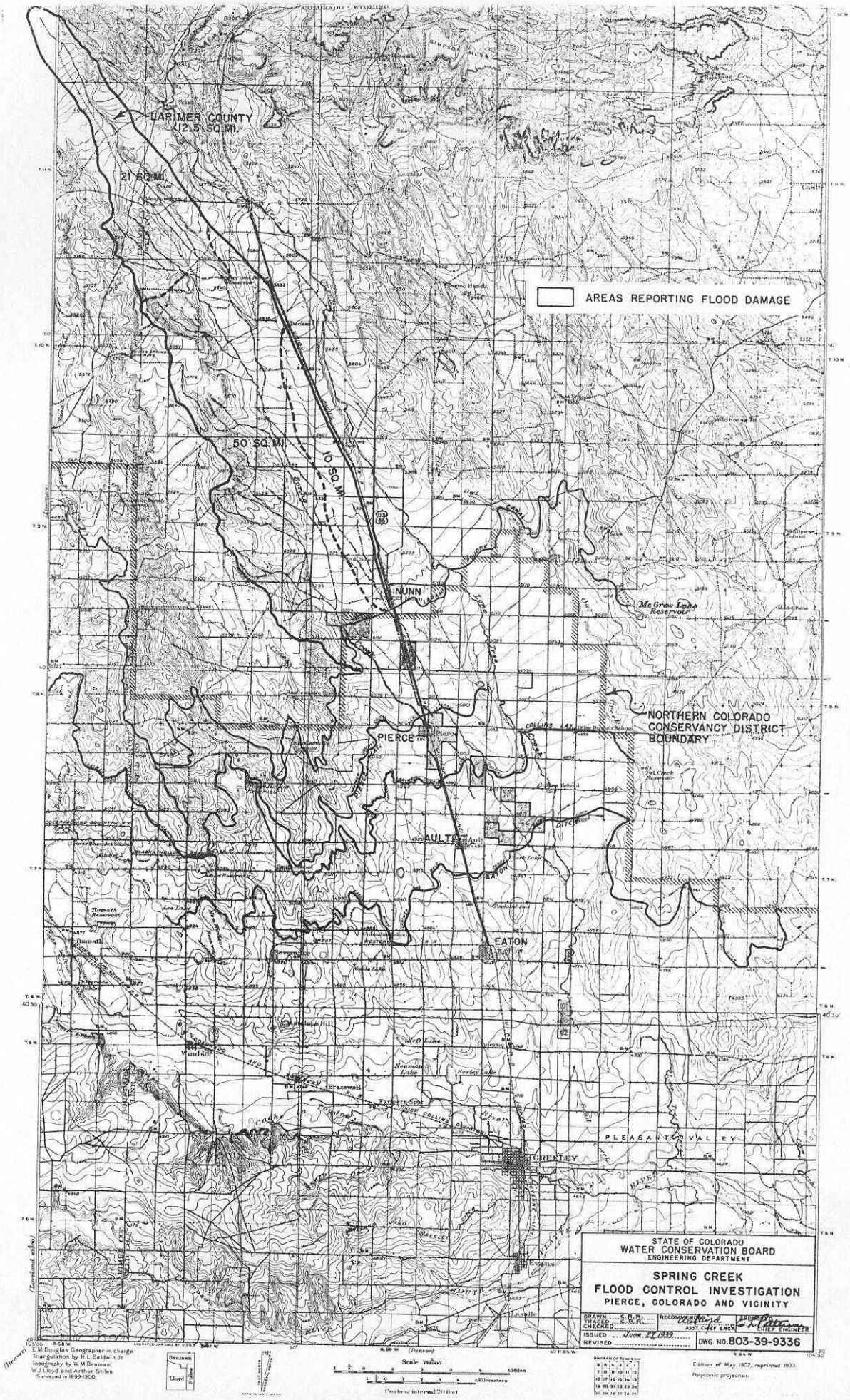

LARIMER COUNTY
(12.5 SQ.MI.)
21 SQ.MI.
50 SQ.MI.
10 SQ.MI.
AREAS REPORTING FLOOD DAMAGE
NUNN
PIERCE
AULT
EATON
GREELEY
McGrew Lake Reservoir
NORTHERN COLORADO CONSERVANCY DISTRICT BOUNDARY
PLEASANT VALLEY
STATE OF COLORADO
WATER CONSERVATION BOARD
ENGINEERING DEPARTMENT
SPRING CREEK
FLOOD CONTROL INVESTIGATION
PIERCE, COLORADO AND VICINITY
DRAWN S.R.R.
TRACED S.R.R.
CHECKED
ISSUED June 27, 1939
REVISED
DWG. NO. 803-39-9336
E.M. Douglas Geographer in charge
Triangulation by H.L. Baldwin Jr.
Topography by W.M. Beaman,
W.J. Lloyd and Arthur Stiles
Surveyed in 1899-1900
Edition of May 1902, reprinted 1933.
Polyconic projection.
Contour interval 20 feet

EXHIBIT NO.

EXHIBIT 2

AUTHORITY

COLORADO WATER CONSERVATION BOARD

FLOOD CONTROL AND FLOOD PREVENTION PROJECTS

IN THE STATE OF COLORADO

Chapter 265 Session Laws of 1937 created the Colorado Water Conservation Board for the general purpose of aiding in the protection and development of the water resources of the State of Colorado, and, with respect to flood control and flood prevention projects, the Board is directed:

Sec. 11: "To promote the conservation of the waters of the State of Colorado in order to secure the greatest utilization of such waters and the utmost prevention of floods; and in particular, and without limiting the general character of this section, the Board shall have power and it shall be its duty:"

(a) "To foster and encourage irrigation districts (associations, companies, etc.) and any other agencies - - -;"

(b) "To assist such agencies in their financing, but not to lend or pledge the credit or faith of the State of Colorado in aid thereof - - -;"

(c) "To devise and formulate methods, means and plans for bringing about - - - the prevention of flood damages - - -;"

(d) "To gather data and information looking toward - - - the prevention of floods and for this purpose to make investigations and surveys;"

(e) "To cooperate with the United States and the agencies thereof and with other States for the purpose of bringing about - - - the prevention of flood damages;"

(f) "To cooperate with the United States or any of the agencies thereof, in the making of preliminary surveys, and sharing the expense thereof when necessary, respecting the engineering and economic feasibility of any proposed - - - flood control project within the State of Colorado - - -;"

(g) "To formulate and prepare drafts of legislation, state and federal, designed to assist in securing - - - protection from flood damages;" and

(j) "In general, to take such action and have such powers as may be incidental to the foregoing specific provisions and to the general purposes of this Act - - -."

092-38-9132

COLORADO WATER CONSERVATION BOARD
Engineering Department
FLOOD DAMAGE SURVEY

EXHIBIT 3

Stream _____ County _____

Location of Farm or Ranch _____ S _____ T _____ R _____
(Give subdivision of Section)

Size of Farm _____ Acres. Occupied By _____

How long so occupied _____ years. Owner of Farm _____

YEARS DURING WHICH FLOODS HAVE OCCURRED

MONTH	YEAR	DURATION OF FLOOD	APPROXIMATE DEPTH OF WATER ON FLOODED AREA

AREA OF FARM SUBJECT TO FLOODING

USE	ACRES	PRESENT VALUE PER ACRE	VALUE PER ACRE IF PROTECTED FROM FLOODING
Irrigated		$	$
Cultivated		$	$
Pasture		$	$
Other		$	$

Value of buildings and other improvements in flooded area $ _____

FLOOD DAMAGE IN DOLLARS

YEAR	LIVESTOCK	CROPS	DITCHES	BUILDINGS & IMPROVEMENTS	TOTAL

Flood damages or losses other than those above. (Give year, amount and nature of loss _____

Remarks or Suggested Remedies. (Use back of sheet if necessary)

Date Signed

EXHIBIT NO. 4

COLORADO WATER CONSERVATION BOARD
Engineering Department - C. L. Patterson, Chief Engineer

SUMMARY OF FLOOD DAMAGE REPORTS

PIERCE, COLORADO and VICINITY

No.	Owner	Operator	Location of Properties Subd.	Sec.	Twp.	Rge.	Acres	Notes	
1	W.R.Clark	L.C.Molander	NW	8	7	65	160	(B)	
2	J.B.Cozzens)	Fred Cozzens		9	6	65	290	(A)	
	(a)J.B.Cozzens)	Fred Cozzens		16	6	65	168	(A)	
3	W.E.Gould	M.E.Giffen	25 &	36	9	67	1220	(E)	
4	L.N.Priddy	Troy Jones	SW	23	8	66	150	(C)	
5	S.Dundas	A.Wahlquist	W-SW	5	7	65	80	(B)	See 8(a)
6	J.Hasbrouck	J.Hasbrouck, Jr.		7	7	65	160	(B)	
7	C.F.Mauser	F.Hoffner	NE	6	7	65	160	(B)	
	(a)C.F.Mauser	F.Hoffner	S[illegible]	5	7	65	160	(B)	See 5
8	J.G.Newman	Carl Olson	SE	7	7	65	160	(B)	
	(a)J.G.Newman	C.Johnson	SW	3	7	66	160	(X)	
9	O.Salberg	O.Salberg	NE	8	7	65	120	(B)	
10	J.E.Fisk	J.E.Fisk	SW	26	8	66	134	(C)	
11	O.W.Venoble	V.Duncan	NW	26	8	66	60	(C)	
12	F.Batman	F.Batman	NE	26	8	66	160	(C)	
13	A.Anderson	F.Kerbs	NW	35	8	66	160	(C)	
14	G.A.Turner	(Foreman)	E	36	8	66	320	(B)	& (C)-19
15	Pierce Elev.Co.	E.Smith	In Town of Pierce					(C)	
16	R.Carroll	C.Duff	NW	17	8	65	134	(X)	
17	F.Campbell	S.Franklin	NW	34	7	66	164	(X)	
18	W.D.Kay	W.D.Kay	E-SE	33	7	65	80	(A)	
19	A.Petersen	A.Petersen	SE	36	8	66	160	(B)	See 14
20	E.C.Phillips		In Town of Pierce					(C)	
21	C.Markham	C.Markham	NE	6	8	66	145	(E)	
22	W.A.Hart	A.Brinkman	SW	10	8	66	132	(D)	
23	Chas.Cozad	C.Cozad	NW	10	8	66	160	(D)	
24	W.N.Kuykendall			5	8	66	572	(D-E)	
25	L.I.Harr (Reports cover five sections of land)							(X)	
26	A.B.Stewart	B.G.Page	S-NW	7	7	65	86	(B)	

Notes:
(A) Below Eaton ditch and junction Spring Creek with Lone Tree Creek.
(B) Above Eaton ditch, below Collins Lateral of Larimer County Canal.
(C) Above Collins Lateral, below Pierce Lateral.
(D) Above Pierce Lateral, below Laramie-Poudre Canal.
(E) Above Laramie-Poudre Canal.
(X) Outside of Spring Creek drainage basin.

EXHIBIT NO. 5

COLORADO WATER CONSERVATION BOARD
Engineering Department - C. L. Patterson, Chief Engineer

SUMMARY OF REPORTED FLOOD DAMAGES

YEARS 1917 - 1935

PROPERTIES WITHIN SPRING CREEK DRAINAGE

Year	Report No.	Crops	Ditches	Buildings	Others	Totals
1917	1	$ 700	$ 300	$ 500	$ 100 (1)	$ 1,600
1933	2		200	500	300 (2)	1,000
1935	1	500	250	400		1,150
	2	500	200	1,000	1,025 (3)	2,725
	(a)	500	200	200	300 (3)	1,200
	3	1,000	-	-	-	1,000
	4	1,500	100	-	-	1,600
	5	200	-	250	-	450
	6	1,500	200	-	2,000 (4)	3,700
	7	100	-	500	200 (1)	800
	(a)	300	-	600	300 (1)	1,200
	8	300	150	-	-	450
	9	1,500	100	100	-	1,700
	10	648	50	110	-	808
	11	1,500	250	100	1,500 (4)	3,350
	12	1,000	-	-	1,000 (4)	2,000*
	13	275	-	-	-	275
	14	-	-	500	-	500
	15	-	-	-	2,000 (5)	2,000
	18	-	-	200	300 (4)	500*
1935	Sums	$11,323	$1,500	$3,960	$8,625	$25,408
1935	State Highway Department					19,723
1935	Union Pacific Railroad Company					6,125
1935	Total Reported Damages - Spring Creek Basin					$51,256

DAMAGES TO PROPERTIES OUTSIDE OF SPRING CREEK BASIN

1935	8 (a)	$3,000	$ 150	$ -	$ -	$ 3,150
	16	500	-	-	2,000 (4)	2,500
	17	-	-	1,500 (5)	2,400 (4)	3,900
	Sums	$3,500	$ 150	$1,500	$4,400	$ 9,550

* Total as reported - segregations are estimated.
(1) Livestock; (2) Bridges; (3) Fences, etc.; (4) Lands;
(5) Implements and Machinery.

EXHIBIT NO. 6

COLORADO WATER CONSERVATION BOARD
Engineering Department - C. L. Patterson, Chief Engineer

SUMMARY OF REPORTED FLOOD DAMAGES

YEARS 1936-1938

PROPERTIES WITHIN SPRING CREEK DRAINAGE

Year	Report No.	Crops	Ditches	Buildings	Others	Totals
1936	19	$1,500	$ 50	$ 150	$ -	$ 1,700
	20	-	-	50	50 (1)	100
1936	Sums	$1,500	$ 50	$ 200	$ 50	$ 1,800
1936	State Highway Department					$ 588
				Total		$ 2,388
1937	1	$1,600	$ 250	$ 600	$ 75 (1)	$ 2,525
	19	100	-	-	-	100
1937	Sums	$1,700	$ 250	$ 600	$ 75	$ 2,625
1937	State Highway Department					634
				Total		$ 3,259
1938	1	$2,000	$ 200	$1,500	$ -	$ 3,700
	3	400	-	-	-	400
	4	300	-	-	-	300
	5	1,100	-	300	-	1,400
	6	1,000	150	-	1,000 (4)	2,150
	7	1,000	-	800	-	1,800
	(a)	2,000	-	1,000	-	3,000
	8	250	50	-	-	300
	9	1,500	100	100	-	1,700
	10	840	60	35	-	935
	11	500	100	100	300 (4)	1,000
	12	250	-	-	250 (4)	500*
	13	125	-	-	-	125
	15	75	-	-	75 (5)	150*
	19	1,000	50	150	-	1,200
	20	-	-	100	400 (5)	500
	21	200	-	-	25 (1)	225
	22	250	50	-	-	300
1938	Sums	$12,790	$ 760	$4,085	$2,050	$19,685
1938	State Highway Department					723
1938	Union Pacific Railroad Co.					2,170
1938				Total		$22,578

Exhibit No. 7

COLORADO WATER CONSERVATION BOARD

Engineering Department - C. L. Patterson, Chief Engineer

SUMMARY OF REPORTED FLOOD DAMAGES

Years 1935 - 1938

PROPERTIES WITHIN SPRING CREEK DRAINAGE

REPORTED DAMAGES TO:	1935	1936	1937	1938	Totals
CROPS	$11,323	$1,500	$1,700	$12,790	$27,313
DITCHES	1,500	50	250	760	2,560
BUILDINGS	3,960	200	600	4,085	8,845
OTHERS (Below)	8,625	50	75	2,050	10,800
(1) Livestock	500	50	75	25	650
(2) Bridges	-	-	-	-	-
(3) Fences, etc.	1,325	-	-	-	1,325
(4) Lands	4,800	-	-	1,550	6,350
(5) Equip. Mach.	2,000	-	-	475	2,475
SUMS	$25,408	$1,800	$2,625	$19,685	$49,518
A (Below Eaton D)	4,425	-	-	-	4,425
B (Collins L-Eaton D)	9,700	1,700	2,625	15,250	29,275
C (Pierce L-Collins L)	10,283	100	-	3,510	13,893
D (L-P Canal-Pierce L)	-	-	-	300	300
E (Above L-P Canal)	1,000	-	-	625	1,625
STATE HYW. DEPT.	$19,723	$ 588	$ 634	$ 723	$21,668
U.P. RAILROAD	6,125	-	-	2,170	8,295
TOTALS	$51,256	$2,388	$3,259	$22,578	$79,481

Exhibit 8 (a)

Colorado Water Conservation Board

FLOOD CONTROL INVESTIGATION

Pierce, Colorado and Vicinity

- - - -

Description of Rain Gages At

Nunn, Pierce, Ault and Eaton, Colorado

At Nunn	Gage is 2 lb lard can - setup away from buildings. Measuring stick is ordinary rule. Observed by J. A. Turner.
At Pierce	2-1/2 miles east and 1 mile south of Pierce. Home-made gage constructed to standard specifications with 10.1 ratio (galvanized metal). Set up about 10 feet above the ground. Maintained by Great Western Sugar Company of Eaton. Observed by farmer at the location.
At Ault	Standard U.S. Weather Bureau rain gage owned by town of Ault and read by Town Clerk, Mr. Smith. Length of record 6 or 7 years.
At Eaton	Standard U.S. Weather Bureau rain gage located at the Eaton sugar factory and read by them. Gage set above the ground (about 8 feet). Length of record about 18 years.
At Stage	3-1/2 miles east of highway #85.

Exhibit 8 (b)

Colorado Water Conservation Board

FLOOD CONTROL INVESTIGATION

Pierce, Colorado and Vicinity

- - - -

Precipitation for Year 1934

Inches of Rain

MONTH	PIERCE	EATON	REMARKS
January	0	0	
February	.34	1.01	
March	.06	.39	
April	1.00	1.08	
May	1.27	1.60	
June	2.07	1.85	
July	.72	1.75	
August	.27	.14	
September	.43	.68	
October	0	0	
November	.01	0	
December	0	0	
Total	6.17	8.50	

Exhibit 8 (c)

Colorado Water Conservation Board
FLOOD CONTROL INVESTIGATION
Pierce, Colorado and Vicinity

Precipitation for year 1935
Inches of Precipitation

Month	Nunn	Pierce	Ault	Eaton	Remarks	
Total January	0	.02	NR	.05		
Total February	0	.35	NR	.51		
Total March	0	.07	NR	.28		
Total April	.25	.67	NR	.78	Nunn, April 23- (Snow)	.25"
May 1	0	.12	0			
5	.38	.01	0			
7	0	.12	0			
8	0	.11	0			
11	.50	.50	0			
12	0	.14	0			
13	.25	.06	0			
14	0	.05	0			
17	0	.52	.21			
18	0	1.32	1.02		Eaton, May 18-	1.86"
19)	2.50	.16	.75			
20)		.36	.50			
21	0	0	.05			
22	0	.54	.25			
23	.75	0	.30			
25	0	0	.08			
27	.75	.32	.10		Eaton - Rain May 27 to 31,	
28	.12	.15	.12		amount ranging	
29	0	.26	0		between .38" and .51" each	
30	4.62	.38	.25		day. Average .42"	
31	0	.10	.23			
Total May	9.87	5.22	3.86	6.91		
Total June	1.88	.61	.80	1.04	Nunn, June 10-	1.38"
Total July	.75	.48	.32	.61	Nunn, July 22-	.75"
Total August	0	.46	.11	.34		
Total September	2.88	2.24	2.33	2.29	Nunn, Sept. 7-	1.0"
					Ault, Sept. 8-	1.59"
Total October	0	.31	.10	.34		
Total November	.38	.42	NR	.55	Nunn, Nov. 3-	.38"
Total December	0	0	NR	0		
Total For Year	16.01	10.85 PR	7.52	13.70		

NR = No Record
PR = Partial Record at Ault

Exhibit 8 (d)

Colorado Water Conservation Board

FLOOD CONTROL INVESTIGATION

Pierce, Colorado and Vicinity

- - - -

Precipitation for year 1936

Inches of Precipitation

Month	Nunn	Pierce	Ault	Eaton	Remarks
January	0	0	NR	0	
February	0	NR	NR	.29	
March	0	NR	NR	.59	
April	.38	.29	.33	1.00	
May	1.75	2.25	2.40	2.63	
June	2.25	1.12	1.36	1.17	Nunn-2 days rain
July	0	.81	.80	.95	
August	.50	.38	.41	.69	
September	0	.54	.41	.77	
October	.88	NR	.26	1.11	
November	0	NR	NR	.08	
December	.25	NR	NR	.25	
Total for Year	6.01 PR	5.39 PR	5.97	9.53	

NR = No Record

PR = Partial Record at Pierce and Ault.

Exhibit 8 (e)

Colorado Water Conservation Board

FLOOD CONTROL INVESTIGATION

Pierce, Colorado and Vicinity

- - - - -

Precipitation for Year 1937

Inches of Precipitation

Month	Nunn	Pierce	Ault	Eaton	Remarks
January	.12	NR	NR	.21	
February	.25	NR	NR	.16	
March	.50	NR	NR	1.16	
April	1.25	1.07	.43	.97	
May	.50	1.37	.92	1.20	
June	1.50	2.96	1.74	3.09	
July	.75	2.85	.68	1.08	
August	.25	.27	.10	.41	
September	.50	.65	.33	1.19	
October	0	.46	.10	.03	
November	.38	NR	NR	.32	
December	1.38	NR	NR	1.50	
Total for Year	7.38 PR	9.63 PR	4.30	11.32	

NR = No Record

PR = Partial Record at Pierce and Ault.

Exhibit 8 (f)

Colorado Water Conservation Board

FLOOD CONTROL INVESTIGATION

Pierce, Colorado and Vicinity

- - - -

Precipitation Record for 1938

Inches of Precipitation

Month	Nunn	Pierce	Ault	Eaton	Remarks	
Total January	.25	NR	NR	.18		
Total February	.12	NR	NR	.17		
Total March	.75	.61	NR	.68		
Total April	2.00	1.98	1.18	1.52		
Total May	2.88	2.16	2.00	2.12	Nunn-May 20-	1.25"
Total June	.75	2.82	1.95	.81	Nunn-June 25-	.75"
					Ault-June 19-	1.47"
Total July	1.50	1.04	.34	.45	Ault-July 13-	.34"
Total August	0	.19	.15	.57	Ault-Aug. 31-	.15"
September 1	2.75	1.70	.22		Stage-Sept. 1-	1.50"
					Galeton-Sept. 1-	.30"
2	2.25	1.50	1.01			
3	.50	.48	1.94			
4	0	0	.01			
7	0	.09	0			
10	.75	.31	0			
11	.50	.53	.68			
12	.50	.54	.84			
Total September	7.25	5.15	4.70	4.34		
Total October	.25	NR	.11	.23	Ault-Oct. 8-	.11"
Total November	.50 PR	NR	NR	.42	Nunn, Nov. 2-	.50"
Total to Nov. 1	15.75 PR	13.95 PR	10.43	11.07		

NR = No Record

PR = Partial Record at Pierce and Ault.
Also at Nunn for Total November precipitation.