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5-1143

DEPARTMENT OF THE INTERIOR

UNITED STATES INDIAN IRRIGATION SERVICE

SUPERINTENDENT OF IRRIGATION

Ganado, Arizona,

August 29th, 1916.

Mr. H. F. Robinson,

Superintendent of Irrigation,

Albuquerque, N. M.

Dear Sir:-

I submit the following report, plans, estimates, and bills of material for the " Extension of Work on the Ganado Project."

The present system consists of the diversion works on the Rio Pueblo Colorado, a supply ditch leading from the diversion to the reservoir, a low earth storage dam forming a reservoir and about 4.2 miles of ditch conveying water from the reservoir to the irrigable lands in the valley of the Rio Pueblo Colorado.

The structures on the latter ditch line embrace the following:- 6 flumes and 3 culverts to care for the cross drainage; 2 bridges and 8 small 8" turnouts or distributary outlets tubes for the use of the Indians. Besides the above, there is a small reservoir and some more outlets belonging to Mr. J. L. Hubbell and used by him in irrigating his own lands. About 480 acres of irrigable land is under the ditch as at present constructed.

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A proposed extension has been surveyed from the end of the present ditch on the south side of the valley. This survey has been carried for about three and one-half miles further down the valley. The first mile and a half of the proposed extension would cover about 360 acres and the next two miles about 400 to 500 acres in addition to the above.

From the profile of the above survey, the extension would involve the excavation of about 18,000 cubic yards and require the following structures:- One 60 Ft. flume; one 32 ft. flume; two 10 ft. drops; two 2 ft. drops; one chute to drop the water about 23 feet; two single barrel culverts; two double barrel culverts and one triple barrel culvert. Besides the above, some turnouts or lateral headings would be required.

The present report will only consider the alterations and repairs to the present system. The work to be done will be discussed under the following heads:

Storage Dam

Supply Ditch

Diversion Dam

Alterations to Flumes

Storm water diversion ditches

Protection from floods in the Rio Pueblo

Repairs at Flume No. 3

New Structures.

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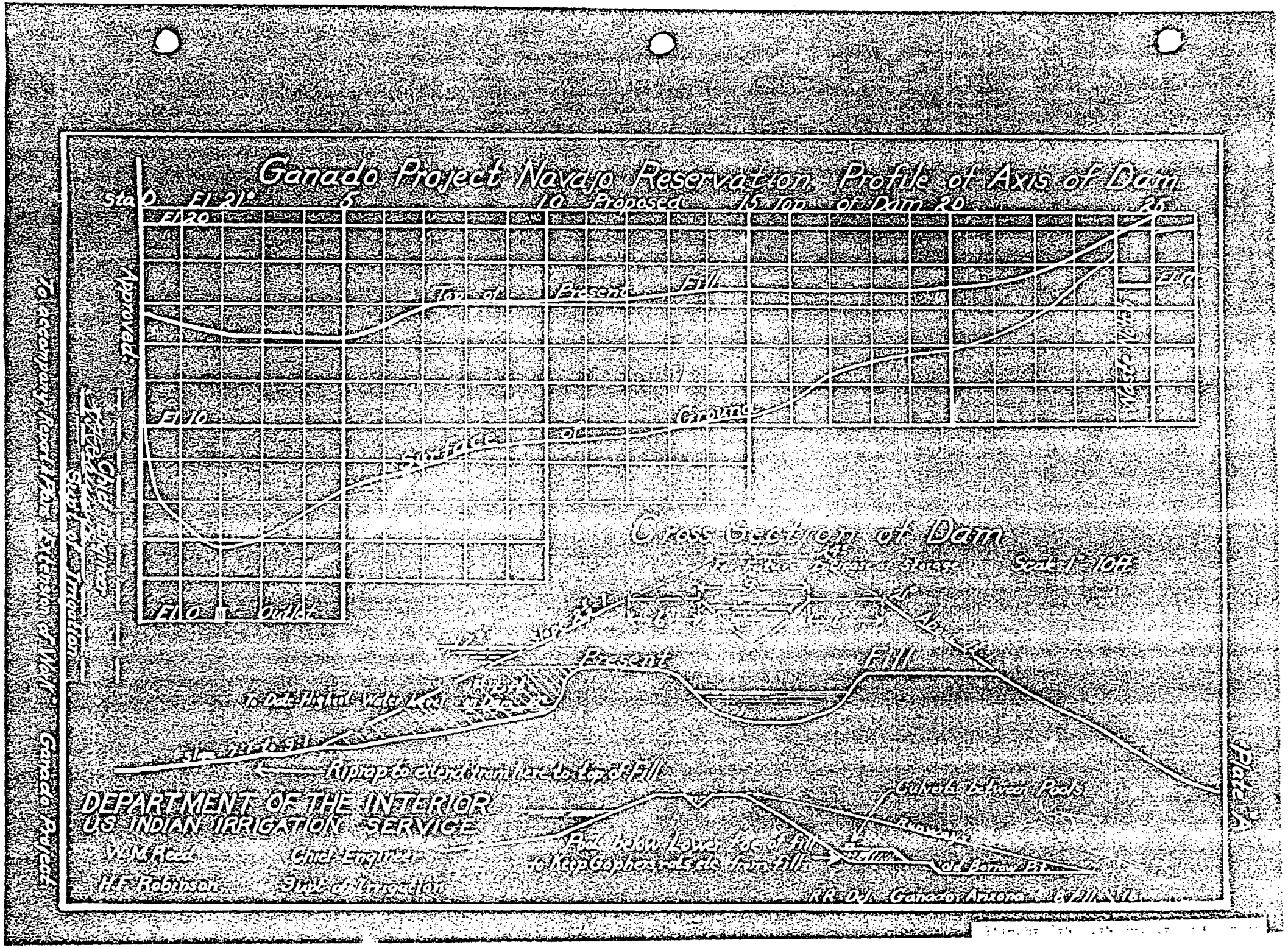

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STORAGE DAM

This is an earth fill dam over half a mile long and at present twelve or fourteen feet in maximum height. Plate " A " shows the profile and cross-section of this dam. The original fill, or rather two parallel fills with a puddle ditch between, was constructed with both slopes about 1-1/2 to 1 and no riprap was placed on the water face.

The wave action from the waters stored in the reservoir eroded the upstream fill leaving it with a slope of from 7 to 1 to 9 to 1 below the water line and with vertical caving banks above. Twelve feet of water were stored in the reservoir last winter--about 1900 acre feet.

The proposed work contemplates raising the fill to the 21 foot gauge and riprapping the water face.(See Plate "A" for details) Water can then be stored to the 17 ft. gauge height im pounding about 3300 acre feet. The top of the fill at the 21 foot height will be wide enough to raise the banks three feet more should additional storage be needed at some future time, giving an ultimate capacity of about 4200 acre feet.

Water will be kept in the puddle ditch in the center of the fill and also in a series of pools along the lower or downstream toe of the fill. The main object of the water is to keep the banks wet and discourage all burrowing animals, the latter being a very real menace to the safety of banks in

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this locality. The series of pools along the toe will also serve another purpose. During the times the flow of the Rio Pueblo Colorado is muddy and silt laden, a part of the flow can be diverted into the supply ditch and passed through the pools to the irrigating ditch without entering the reservoir. Only the clear water flow will be impounded in the reservoir.

The drainage area tributary to the reservoir is small, being roughly estimated at from six to eight dquare miles. Unless there is a cloudburst on this water shed, with the reservoir full, the possibility of the dam ever being overtopped, is remote. But to provide against such a contingency, a spillway or wasteway notch will be left as shown on the profile. This gap will be where the fill is low and will also be provided with a flanking dike to prevent any escaping water from flowing down the toe of the fill. It will be riprapped. A long continued outflow would cut this notch back, but even this is much more desirable than having the fill overtopped. Any other spillway outlet involves a large amount of excavation and it is doubtful if the spillway will ever be needed.

Since the water has been stored in the lake, it is only possible to borrow the dirt from one side of the dam. There is a sandy layer below the top soil, which is heavy adobe. The borrow pits for the raising the fill will be kept at some distance from the dam, and this sandy layer will not be exposed.

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The estimated cost of completion made upon resuming work here this summer was:

24,000 Cu. yds fill @	33-1/3¢	$8,000.00
8,000 sq. yds riprap	40¢	3,200.00
Total		$ 11,200.00

No materials or supplies beyond those now on hand or ordered, are considered necessary. The lumber for the culverts and the approach to the outlet tower, is on hand or will be old stuff that has been used for forms, etc.

The only work done here since resuming operations has been the raising of the fill and the riprapping of the slope. The cross-section on Plate "A" shows this first lift in the raising of the dam.

SUPPLY DITCH

The extraordinary flood of July 30th, 1916, damaged the headworks and the supply ditch. This flood has been reported previously. This flood overtopped the headgate and afterwards washed away the fills on the upper side of the same and filled the supply ditch. The volume of water carried by the latter was sufficient to raise the reservoir level one foot in three hours. This is about equivalent to 800 acre feet or more, so the supply ditch at one time carried from 800 to 900 second feet of water.

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The ditch, being intended to carry only a small fraction of this amount, was considerably damaged. The profile of Plate "B" shows the debris deposited by the flood.

The ditch must be cleaned out which will involve about 1200 cu. yards of excavation. The banks need some repairs and the riprap and dry wall below the drop at station 12 and around the headgate, must be replaced. There is about 35 cu. yards of this riprap that must be renewed.

In addition to the above, the present sluice gate should be repaired, the present outlet bring about 6" higher than the inlet. The turnout near station 10 should be supplied with an adequate gate lift and otherwise put in shape. This turnout is used to fill the puddle trench in constructing the dam and will be used to bypass the muddy water into the main irrigating ditch as commented upon above.

Another sluice gate should be provided at about Station 6. These structures will follow the plans given on Plate "C". All three will have the 24" gate lifts connected with the 24" corrugated culverts for outlet tubes.

Masonry and not concrete is contemplated in these and similar structures for several reasons:- Gravel suitable for concrete work is scarce, while sand for mortar is comparatively plentiful. Good hard sandstone that works up in

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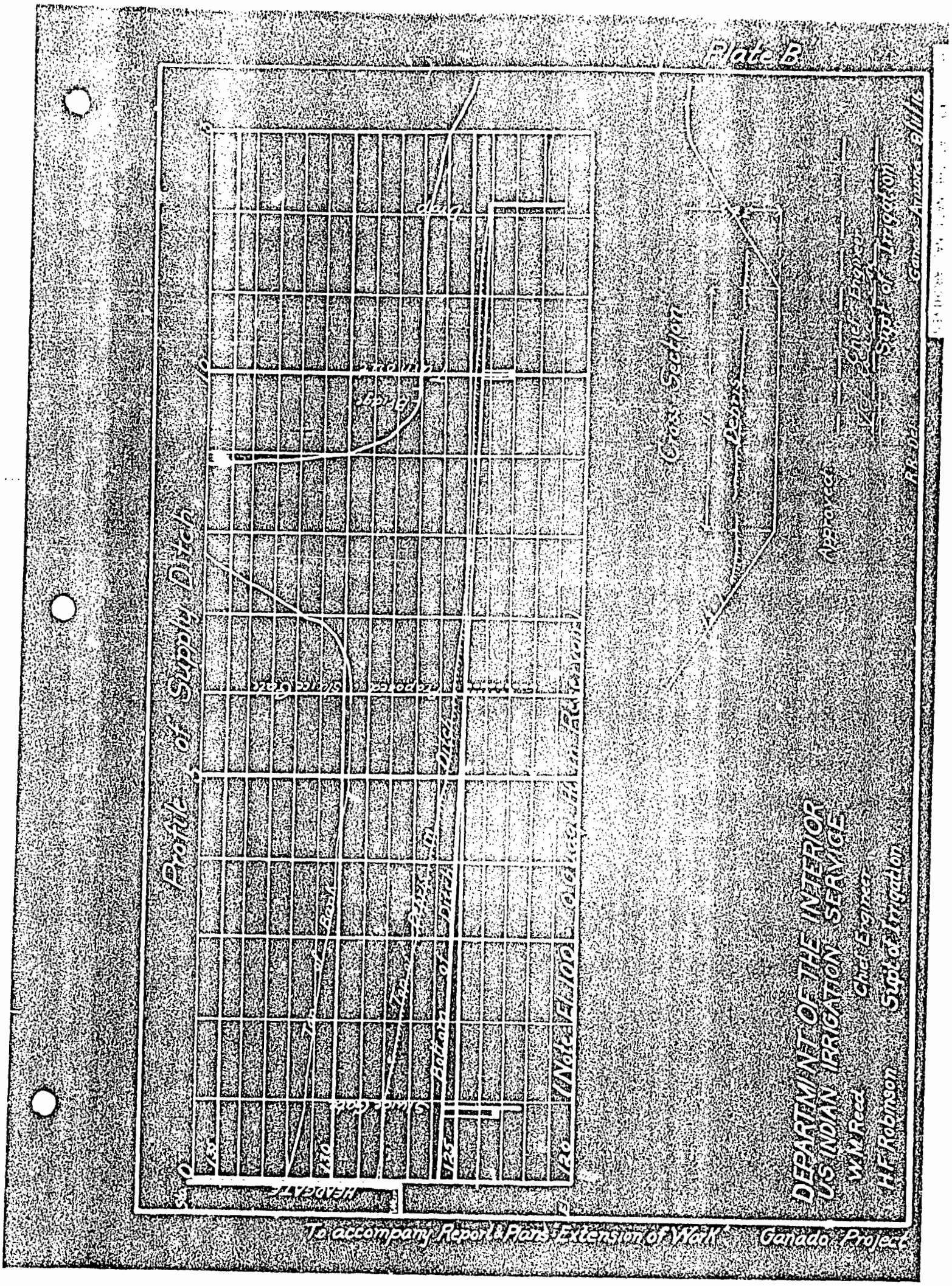
Plate B
Profile of Supply Ditch
Cross Section
Approved
DEPARTMENT OF THE INTERIOR
US INDIAN IRRIGATION SERVICE
W.M. Reed
Chief Engineer
H.F. Robinson
Supt. of Irrigation
To accompany Report & Plans "Extension of Work"
Ganado Project

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excellent manner is abundant. Such rock can in most places be procured within a few hundred yards of the structures. The masonry walls must be heavier in section than concrete ones but the masonry work will only require about 1-1/4 sacks of cement per cubic yard as compared with from 5 to 5-1/2 for the concrete. Cement is very high this distance from the railroad. While masons are high priced laborers, the saving in the form work and lumber will offset this charge. A good workman can lay from 2 to 4 cubic yards per day under adequate supervision and given plenty of low priced helpers to handle the stone, mortar, etc.

Each 24" sluice structure will require about 15 cubic yards of masonry and about 5 cubic yards of dry wall. The 24" turnouts will each require 11 cubic yards of masonry and 3 cubic yards of dry wall, while a 12" turnout would take about 9 cubic yards of masonry and about 2 cubic yards of dry wall.(See Plate "C" for details of proposed sluice gates)

The estimated cost of the work on this supply ditch is:

Repairs made necessary by the flood:

1200 cu. yards excavation	@	35¢	$420.00
35 " " Riprap	"	1.20	42.00
Total			$462 .00

New Structures:

3-24" Gate lifts			$ 75.00
38 feet 24" corrugated culvert pipe			65.00
40 cu. yards masonry	@	$7.50	300.00
14 cu. " dry wall	@	1.50	21.00
			$ 461.00

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It is believed these and similar repairs made necessary by the flood are properly an item against the maintenance and operation instead of against the " Extension of Work."

The total estimated cost for this feature then is $923.00.

Materials and supplies needed.

3-24" gate lifts with stems 8 ft. long and fitted to be connected to the 24" corrugated culverts.

2 pieces of 24" currugated Ingot Iron Culvert each 16' long made of 16 gauge metal.

60 sacks cement.

Rock, Sand, etc. will be procured in the vicinity.

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DIVERSION DAM.

Plate "I" shows the existing conditions and the proposed alterations to the diversion works. The flood of July 30th piled up on the west or headgate side submerging the latter and was just on the verge of overflowing the crib dam. The effective width of the spillway opening is not over 80 feet. The main depth of water was nine feet or more during this flood, the cross sectional area being about 720 square feet.

It may be added here that running the weir obliquely to the direction of the flow does not increase the effective length of the weir.

The present dimensions of the spillway opening proved entirely inadequate for the flood in question. Larger floods than this have been observed at Ganado in times past. Cross-sections were taken at Ganado of the area of this flood and of the highest observed flow. The areas were 630 and 1060 square feet respectively. These figures are surprisingly small when the area at the diversion dam was 720 square feet. The explanation is that during the height of the flood, the bottom of the wash was scoured out much deeper than when the sections were taken. As the flood subsided the bottom was built up again. At Ganado hard soil is found

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at a depth of about four feet below the present sandy bed of the arroyo and it is estimated that the area should be increased by 140 square feet at least. This would make the two water prism areas 760 and 1200 square feet respectively, or the last flood in question was about 60 per cent of the record flow.

These plans of procedure are possible in making the repairs to the diversion works:

1. Only repair the damage caused by the last flood and not increase the spillway capacity as a flood equal to or exceeding the one in question only occurs at rare intervals.

2. To raise the side walls of the spillway opening four feet on the headgate side and three feet on the crib dam side. This would increase the capacity one-third.

3. Move the headgate back to the line F-G-H, on Plate "I", which would double the capacity. The east wall and dam would not be raised in this plan. This is the safest and also the most expensive solution. The new headgate is to be the same height as the present one.

As the record flow has only been observed once in many years, the second plan has been worked out most in detail as it will handle all but the very largest floods. An estimate was also made for plan No. 3. It is a matter of record that the present walls have been raised three

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feet higher than when the structure was first built.

Plan No. 2.

This plan not only contemplates raising the east wall but extending it both up and down stream. It is to be extended up stream to permit the placing of a wider earth fill in front of crib dam, and down stream to reduce the back wash from the water pouring around the lower end of the wall. This backlash in the last flood washed out a considerable portion of the fill under the subsidiary crib, endangering the structure. The plan includes driving piling under this crib and filling the washed out portion with riprap. (See cross-section of the crib dam on Plate "I") . The piling is to be in two rows 6 feet apart and 6 feet c-c. The exposed crib will be drift bolted to these piles for the sake of security and to retain the riprap. There is a pile hammer, trigger and headblock here belonging to Mr. Hubbell and a few parts of the old frame used on this project but it will be necessary to practically construct a new frame. The crib dam and the dike will be raised three feet to cut off all flow around the east of the dam as occurred during the last flood, which in time would destroy the whole structure.

The weir lip is to be rebuilt on the old alignment but with a heavier section and anchored to the rock ledge with dowel pins.

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The wings of the headgate do not follow the old alignment, but flare out so as not to choke the flow following about the line C-D-E. The walls to be raised four feet on this side and to be reinforced as indicated. At present the only reinforcement is in the floor slab or the operating platform of the headgate.

The use of reinfofced concrete here is thought desirable in spite of its high cost and the difficulty of procuring suitable aggregate. All walls to be anchored to the rock with dowels as shown and connected to the old work with anchor bolts through the old walls.

The estimates cost of this feature follows:

Raising Headgate as shown on plan		
42 cu. yards concrete	@ 15.00	$630.00
Raising east side wall		
28 cu. yards concrete		420.00
New Weir		
8 cu. yards concrete	@ 12.50	100.00
50 cu. yards dry wall	@ 2.50	125.00
		1275.00

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Brought forward		$1275.00
Repairing wooden gates and lenghtening stems		50.00
Raising crib dam 3 feet(50 ft. long)		
20-16 Ft. logs	$40.00	
Rock fill 25 cu. yards	50.00	
Labor and supplies for crib	90.00	
Planking upper face of dam 800 sq. Feet	250.00	430.00
Repairs below Dam		
15 piles	30.00	
Driving piles	75.00	
New driver frame	80.00	
Riprap 160 cu. yards	320.00	505.00
Widening fill and extending dike at Dam 2800 cu. yards @35¢	980.00	
Riprapping upper face of Dam 250 sq. yards @ 40¢	100.00	1,080.00
Estimated cost of work		$ 3,340.00

Materials and supplies needed for the above.

400 sacks cement
2400 lineal feet or 2500# 5/8" round iron for reinforcing bars dowels, anchor bolts, drift pins, etc.
100 5/8 nuts
75 4" X 4" X 1/4" plates
200 5/8" Washers
100# 20d Nails
100# 40d "

Lumber for forms, planking face dam, building pile driver frame, gates, etc.

130 pieces 2" X 12"X 16'
50 " 4" X 6" X 16"
6 " 8" X 8" X 16"
50 " 2" X 6" X 16'

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Plan No. 3.

This contemplates moving the headgates back about 80 feet, extending the east side wall down stream, strenghtening but not raising the dam, planking the upper face of the same, extending the dike to the east and repairing the downstream toe of the dam as in the previous plan.

The rock ledge is apparently an isolated mass of rock and does not extend any distance to the west of the present sluice gate which is behind the present headgates. Therefore the wing walls must be longer if the gates are moved back to prevent any floods from ever cutting around behind the gate structure. These walls will be 9 feet high 12 inches on top and 24 inches on the bottom. They will be reinforced and anchored with dowels the same as the higher walls shown on the plan.

The headgate structure to be practically similar to the present one but reinforced.

The estimate for this plan is as follows:

Headgate structure:		
40 cu. yards concrete	@ 15.00	$600.00
Wing wall and side wall		
50 cu. yards concrete	15.00	750.00
Wrecking old headgates		100.00
Stripping rock ledge for widening spillway 1600 cu. yards	.40	640.00
Dry walls 60cu. yards	2.50	150.00

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New Weir lip		
20 cu. yards	@ 12.50	$250.00
Planking face pf Dam		
800 sq. feet		250.00
Repairs below dam as in scheme 2 above		505.00
Fill to widen earth dam and build dike		
1600 cu. yards	@ 35¢	560.00
Riprapping dam		
150 sq. yards	@ 40¢	60.00
		$3,865.00

The materials and supplies needed will not be changed except 600 sacks of cement will be needed instead of 400 as in plan No. 2 and the logs for raising the crib in the latter will not be necessary in Plan No. 3.

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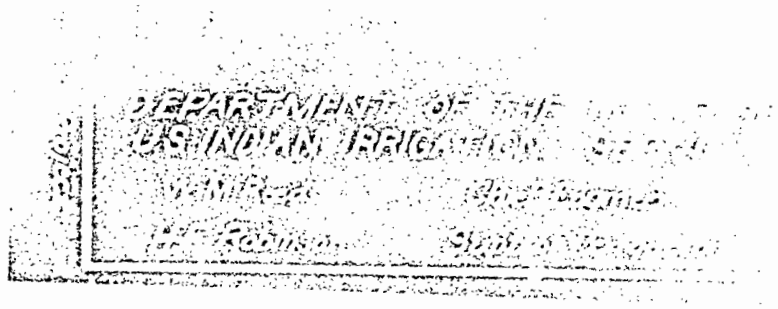
ALTERATIONS TO FLUMES:

The ends of all of the flumes except No. 3 are located in soft sandy soil. Once the least leak starts around the end, the approach is washed out and much damage may be done the whole structure. The inlets and outlets have caused much trouble in thepast. The manner of joining the flumes to the ditch heretofore is indicated on Plate "G".

It is proposed to lengthen Flume 1, 2, and 6, the end connections to be put in as shown on Plate "G". For such an inlet and outlet, about 12 cubic yards of masonry will be required for each flume.

Flume No. 6 had the inlet destroyed in the manner mentioned above, and the caving bank damaged the entire wooden truss. This damage was caused by one of the rain storms of the present month. In repairing this flume, the truss will have to be extensively altered, the flume lenghtened and end connections built as outlined above.

The stringers used in supporting the simple spans are 4" X 6" and put in without any knee braces. In the proposed changes the 4" X 6" stringers will b removed and 6" X 8" substituted. A collar is to be bolted around all the pedestals piers and 6" X 6" knee brakes placed on this collar and under the stringers. While theoretically the 4" X 6" stringers are strong enough to support the No. 60 flumes, the lumber that



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can be procured here is of poor wuality and the strongers deflect excessively. This causes a bad sag in the flume making the use of thick shims necessary. The sag increases all the time, making continual adjustments necessary. Another point to which exception is taken is that some of these stringers are spliced near the middle of the span at the point of greatest bending moment,-- the result can be readily imagined.

The wooden trusses supporting Flume No. 5 needs to be jacked up to grade, the members strenghtened, the connections tightened and put in to shape generally.

Only minor repairs are considered necessary to Flume No.4 as the storm water diversion,spillway and sluiceway should lessen and danger of this flume being damaged.

Repairs to Flume No. 3 will be discussed under a separate heading.

Estimated cost of the Alterations :

New inlets and outlets to Flume 1,2,6		
Excavation, backfill 350 cu. yards	@ 40¢	$100.00
36 cu. yards masonry	7.50	270.00
120 ft. new metallic waterway		200.00
Lumber for stringers and repairs to trusses, etc.		
2500 ft. B.M. delivered	@ 40.00	100.00
Bolts, nuts, etc.		20.00
Labor on replacements and repairs		350.00
Total		$1,040.00

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Materials needed:

60 sacks cement
120 lineal feet Hess flume No. 60, 22 gauge metal

Lumber needed

20 pieces 6" X 8" X 16'
10 " 6" X 6" X 16'
30 " 3" X 6" X 16'

100# 40d Nails
50-1/2" nuts,
100-1/2" Washers
100 lineal feet or 85 pounds 1/2" round iron
50 Iron plates 4" X 6" X 1/4"

Rocks, sand, etc., to be obtained locally.

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STORM WATER DIVERSION DITCHES.

At several places along the ditch line the cross drainage enters the ditch in large volume and causes considerable damage every time a storm occurs. The worst place is just below Flume 3 where a large arroyo overflows the present inadequate protective dikes and chokes up the ditch with silt. There is always the danger of the excess waters damaging Flume 4 a short distance below.

The existing conditions are shown on Plate "F" and the proposed protective ditch is also indicated thereon.

The borrow pits for the protective dikes are to be put on the high side or the one away from the ditch for obvious reasons. The ditches are to be located so that the borrow pits will have a fall of at least one percent. By this means the water will cut back from the outlets of the diversion and enlarge the carrying capacity of the diversion as times goes on.

It is estimated the average excavation will be about 1-1/2 cubic yards per lineal foot of dike. About 1200 feet of such dike are required nearFlume 3; 400 near Flume 4, and about 1200 near Flume 5.

The total yardage will then be about 3500 and the estimated cost about $1,100.00. No materials or supplies are necessary for this work.

These diversions, while expensive, are one of the most

necessary provisions for the safety of the ditch.

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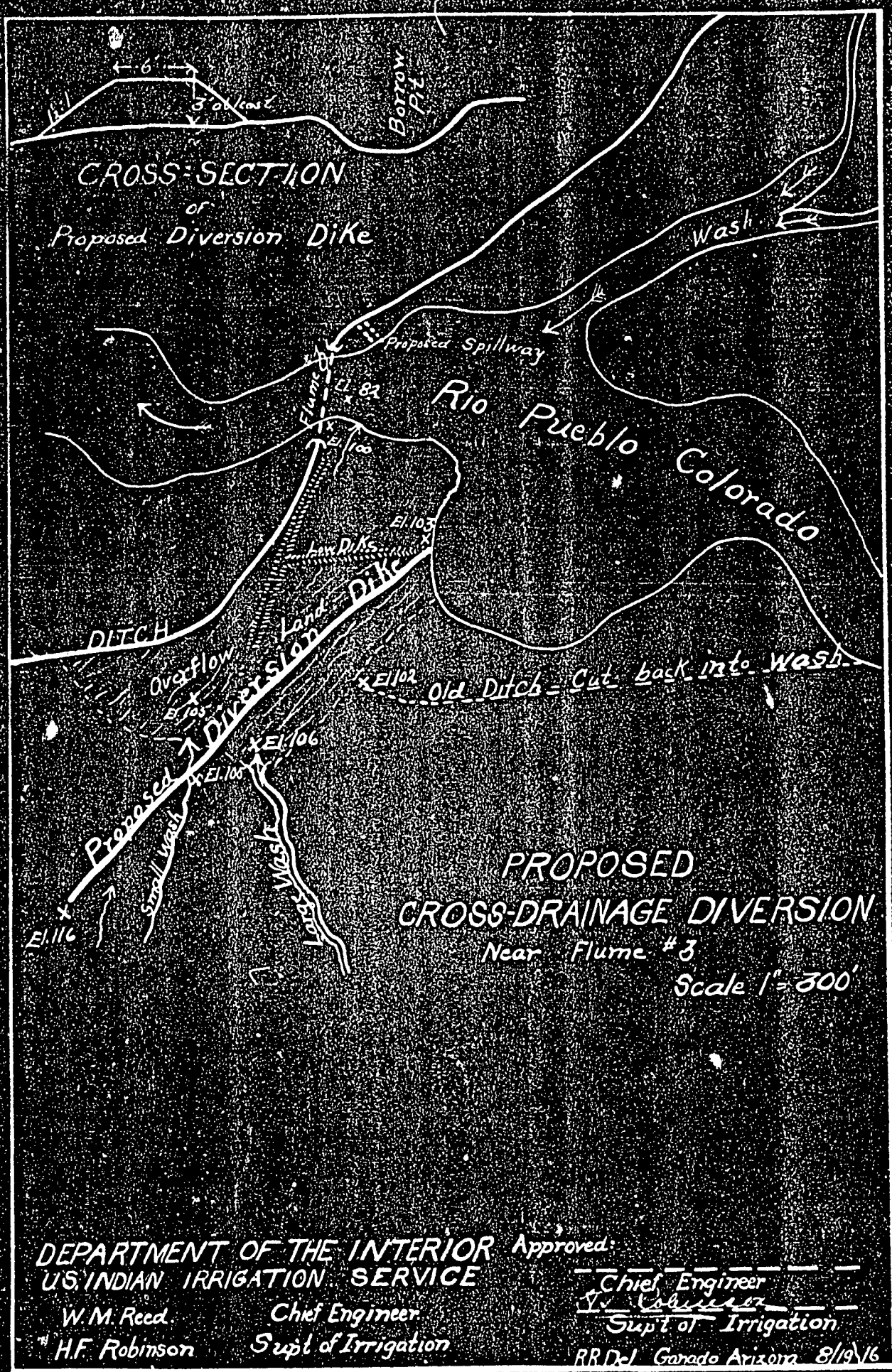
Plate "F"



To accompany Report Plans etc. "Extension of Work - Ganado Project"

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PROTECTION FROM FLOODS IN THE RIO PUEBLO COLORADO.

The ditch line closely approaches the channel of the Rio Pueblo Colorado in several places before the line crosses the channel to the south side of the valley by means of Flume No. 3. Several of these places may cause trouble but only one place is the danger regarded as imminent. That is near Station 15.

The conditions at this point and the proposed protection work are shown on Plate "D". Here the whole force of the arroyo is directed against the bank. The latter has been eroded until the bank is now close to the ditch line. It is not practicable to move the ditch back from the arroyo as the line follows the base of a high steep mesa.

The ditch here is in a variegated shale and hardpan formation. The erosion of the arroyo and the soaking from the ~~river~~ water in the ditch causes the slips and slides shown.

As the arroyo bed here is full of sandstone fragments large and small, it is hardly feasible to drive piling for the protection work. The rock and brush mattress seems the solution.

Vertical posts will be driven into the arroyo as far as possible then the brush and rock interwoven among these posts, the whole to be bound together with barbed wire. Afterwards the backfill will be placed as indicated.

The estimated cost of the work is:

225 cu. yards riprap	@ $2.00	$450.00
200 cu. yards backfill	@ .40	80.00
		$530.00

The only supplies needed except the rock and brush which are nearby, is 300 pounds of barbed wire.

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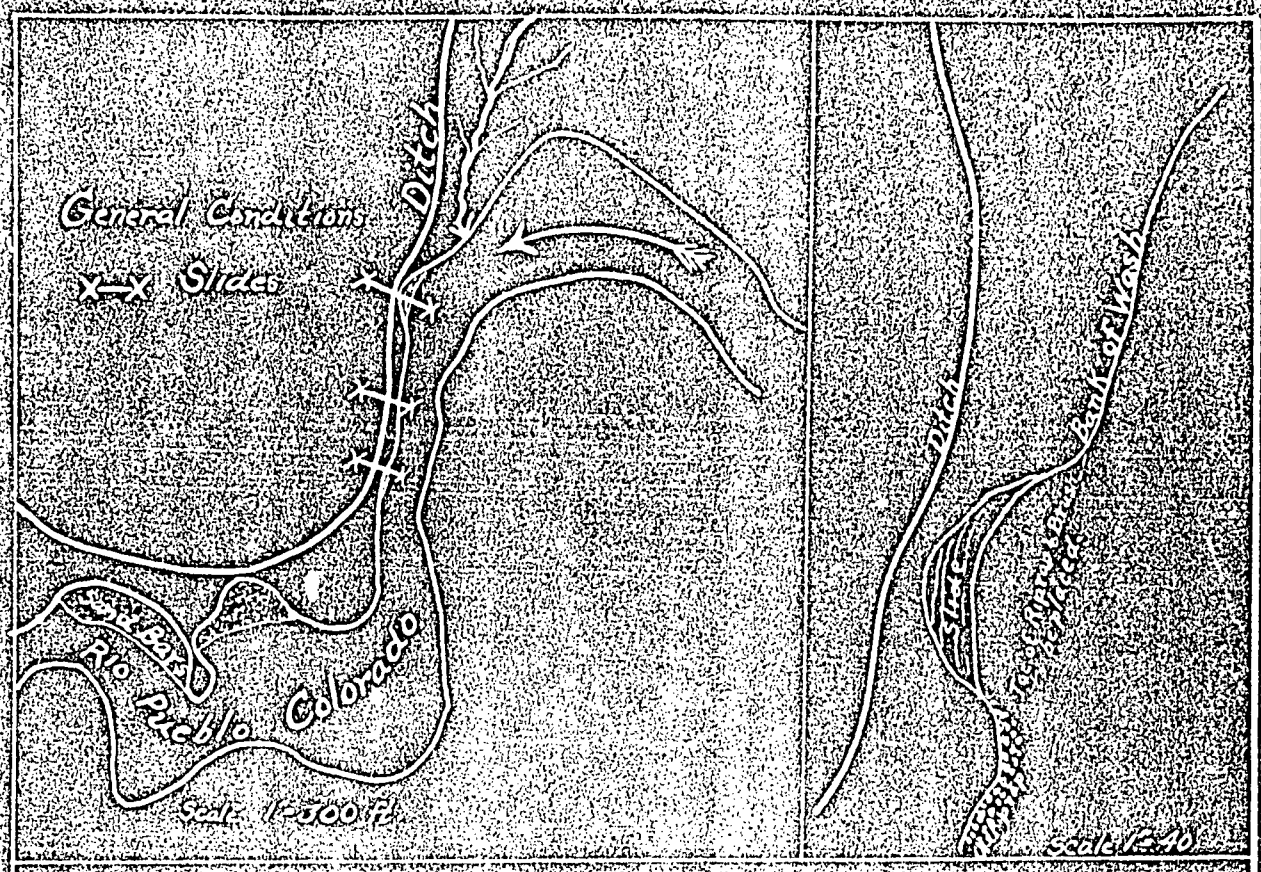
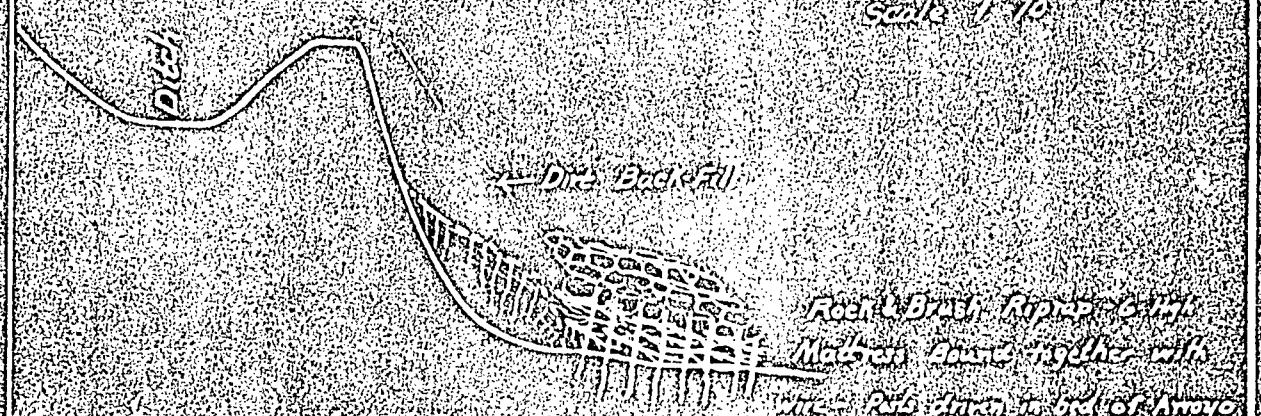
Plate D



CROSS-SECTION AT SIDE

Scale 1"=10



PROPOSED RIPRAP
FOR PROTECTING
THE GANADO DITCH

DEPARTMENT OF THE INTERIOR
U.S. INDIAN IRRIGATION SERVICE

W.M. Reed — Chief Engineer
H.F. Robinson — Supt. of Irrigation

Approved:
Chief Engineer
Supt. of Irrigation

R.R.D.I. Ganado Arizona 8/16/16

To accompany Report, Plans etc. Extension of Work Ganado Project

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REPAIR TO FLUME NO. 3.

Plate "H" shows the conditions at Flume No. 3 and indicates the proposed remedies. The flood of July 30th 1916 scoured out the bottom of the arroyo several feet deeper. It also washed away the fender crib encircling the lower piers that support the steel truss. Many large logs are brought down by the extreme floods. The current is such that most of the logs and drift tend to batter against the piers in question.

Some sort of protection is needed but it is thought best not to have the fender crib touch the piers lest the shock of impact be transmitted to the latter. The proposed arrangement will be found on Plate "H".

The footing of the piers is thought to be somewhat unsafe. The shale on which the pier is founded could carry a much greater weight than borne now, but erosion should be prevented if possible. It is proposed to encircle the present footing with a concrete collar as shown, this collar to extend at least three feet below the present bottom of the footing. This collar is not designed to carry any weight but simply to prevent undermining.

The remarks as to the stringers in Flumes No. 1 and 2 apply to Flume No. 3. It is proposed to substitute larger stringers as in the former case, and add the knee braces.

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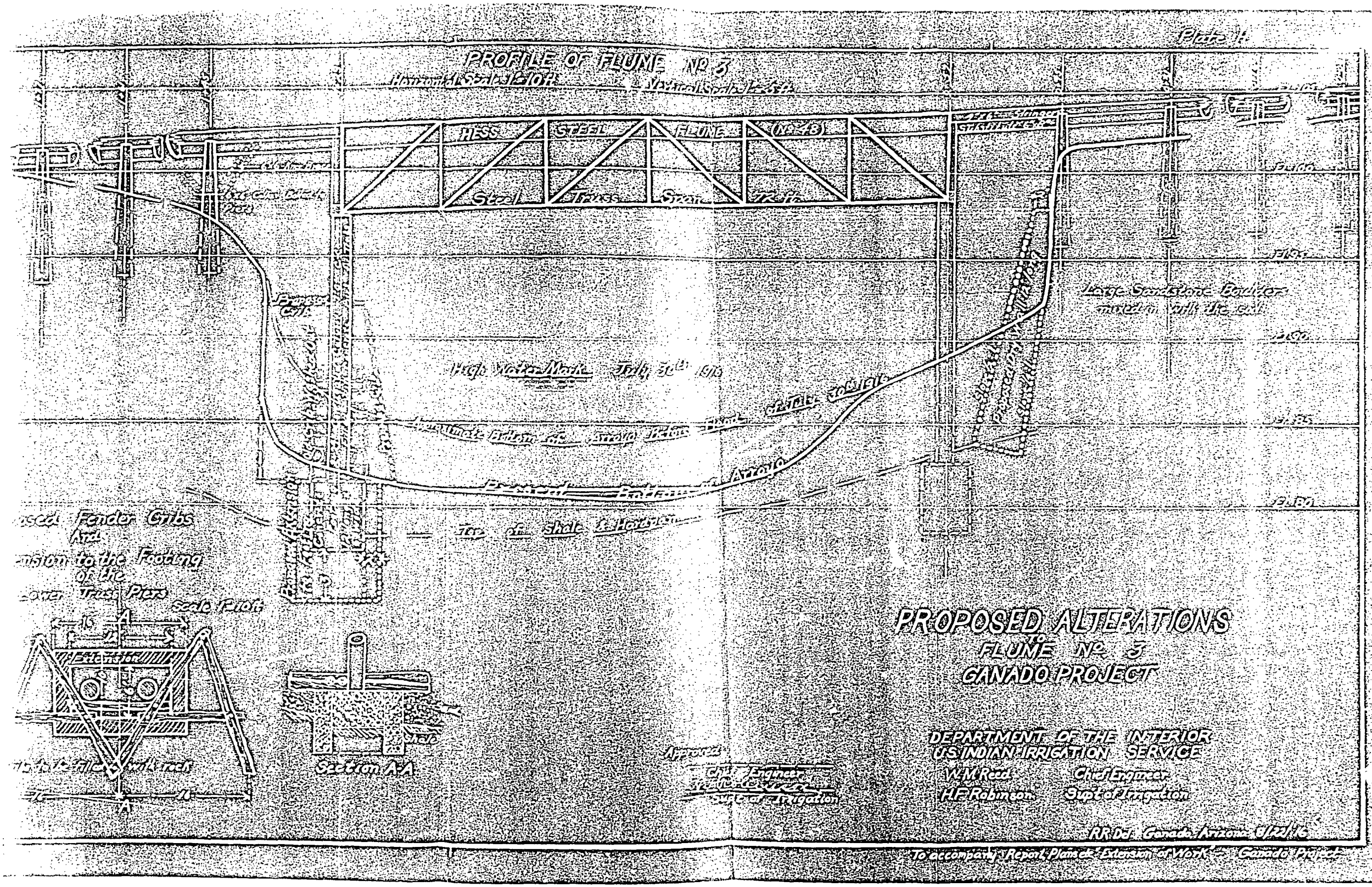

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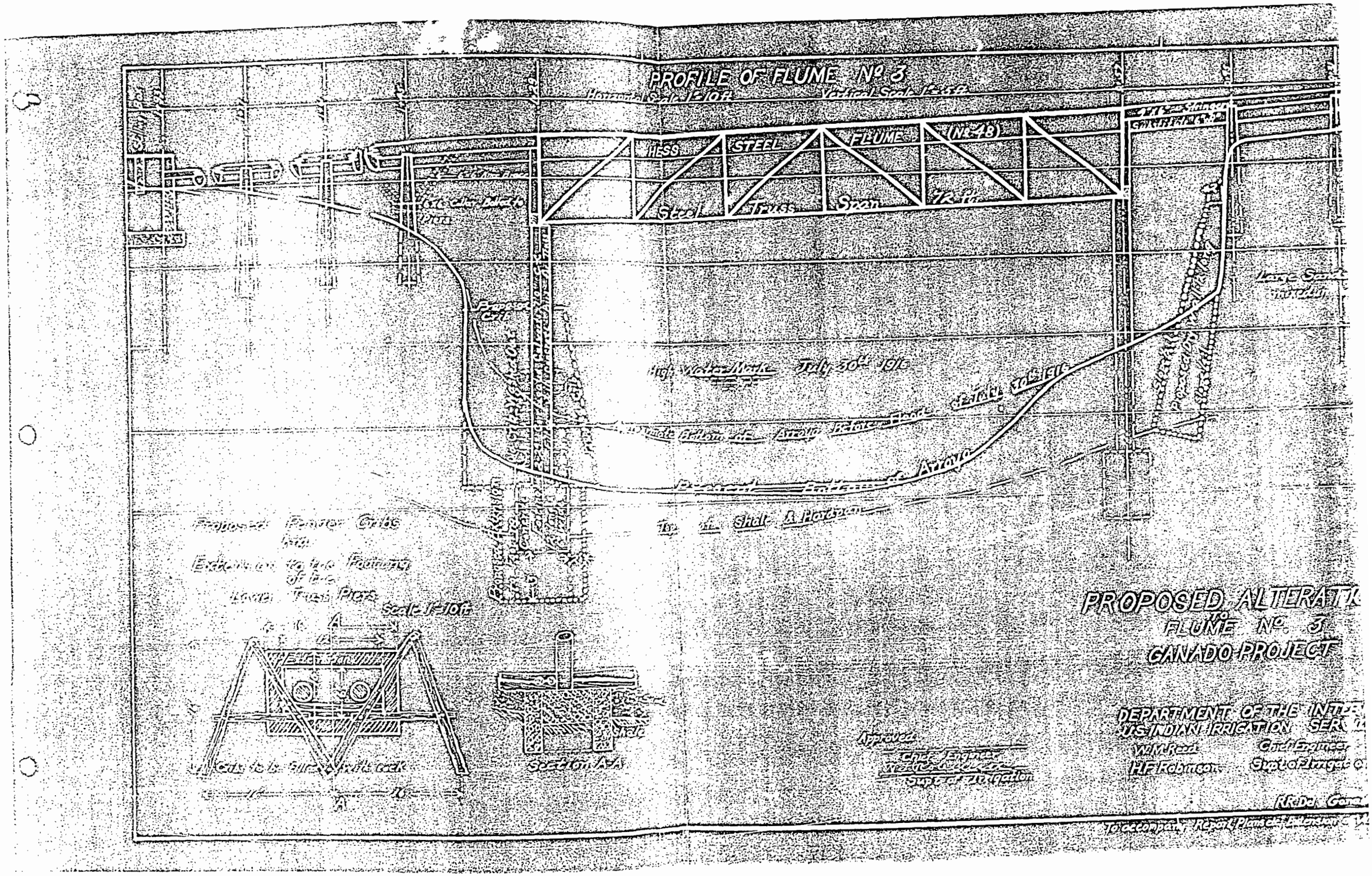
PROFILE OF FLUME No 3
Horizontal Scale 1"=10 ft.
Vertical Scale 1"=5 ft.
HESS STEEL FLUME (No 48)
Steel Truss Span 72 ft.
Large Sand
High Water Mark July 30th 1916
Proposed Bottom of Arroyo Before Flood of July 30th 1916
Proposed Bottom of Arroyo
Top of Shale & Hardpan
Proposed Pender Cribs
Extension to the Footing of the Lower Trust Piers
Scale 1"=10 ft.
Section A-A
Approved
Chief Engineer
Supt. of Irrigation
PROPOSED ALTERATI
TO
FLUME No. 3
GANADO PROJECT
DEPARTMENT OF THE INTE
U.S. INDIAN IRRIGATION SER
W.M. Reed
Chief Engineer
H.F. Robinson
Supt. of Irrigation
RR Dep. Gana
To accompany Report, Plans &c. Extension

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The pedestal piers just above the upper end of the steel truss are practically exposed for their entire depth. It is,proposed here to build a dry retaining wall against the vertical dirt bank to prevent any erosion by wind, rain or frost. Such erosion might undermine the pier.

The stilling box at the outlet needs some alterations. The baffle wall is to be removed as it causes a standing wave when a large head is turned into the flume. This wave backs up into the flume and over the sides of the waterway endangering the structure. It is proposed to build a masonry continuation to the box to prevent washing the banks of the ditch.

The estimated cost of the work is as follows:

Dry wall upper end truss 30 Cu. yards	@ $2.50	$ 75.00
Concrete collar at Lower pier Footing 20 cu. yards	@ 15.00	300.00
Fehder crib at lower piers 90 logs		180.00
100 cu. yards rock filling		200.00
Altering the flume supports 2000 Ft. B. M. Lumber		80.00
Nails, nuts, etc		20.00
Labor changing		150.00
Stilling box 10 Cu. yards masonry	@ 8.00	80.00
Total		$1,085.00

CV-6417-201 NN007711

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Materials and supplies needed:

120 sacks cement
50 logs 18 ft. long and 40 12 ft. long
(These will be obtained from the mountains, cut and hauled by the Indians)

Lumber:

16 pieces 6" X 8" X 16'
16 " 6" X 6" X 16'
8 " 3" X 6" X 16'

144 lineal ft, or 150# 5/8" round iron for drift bolts
48 feet or 40# 1/2" round iron for bolts, etc.
30-1/2" nuts and 60-1/2# Washers
30 Iron plates 4" X 6" X 1/2"
100# 40d Nails

Rock, sand and gravel to be obtained in the vicinity. Old lumber to be used for the necessary sheeting, bracing, and forms.

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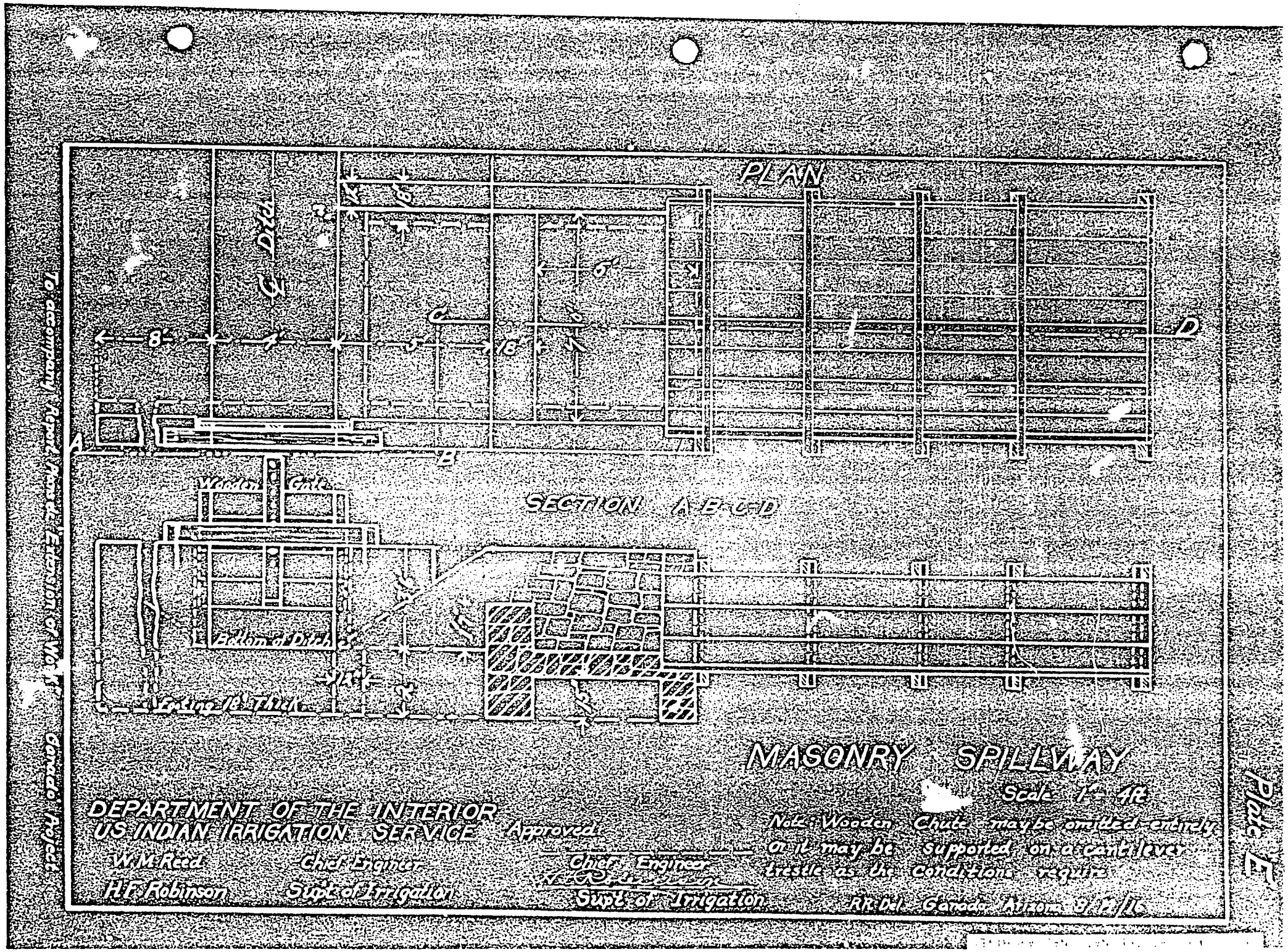
NEW STRUCTURES:

It is believed highly advisable to provide spillways immediately above Flumes 3, 4, and 6. Each spillway will require about 12 cubic yards of masonry, 600 feet B.M. of rough and 80 feet B. M. of surfaced lumber. The plan of the structure will be found on Plate "E".

A sluice gate at each of the above points would be of great benefit. Such a gate has been mentioned previously and is shown on Plate "C". Each gate calls for about 15 cubic yards of masonry the 24" gate lift and the 24" outlet tube of corrugated pipe.

In the spillway structure the gate can be adjusted so as to always keep the normal flow up to the level of the spillway lip thus any excess wouldcause an overflow and any large amounts of water , to a great extent, be prevented from damaging the flumes in question. The ability to shut off the entire flow quickly at the spillway and to open the sluice gate in case of a break in the ditch below needs no comment to demonstrate its advantages. Such control is now entirely lacking in the four miles of ditch.

Below Flume No. 2 is a lined ditch used in taking up excess fall. This section needs about three masonry cutoff walls to sto the tendency of the water towards working behind the dry laid riprap and undermining and damaging the sides.



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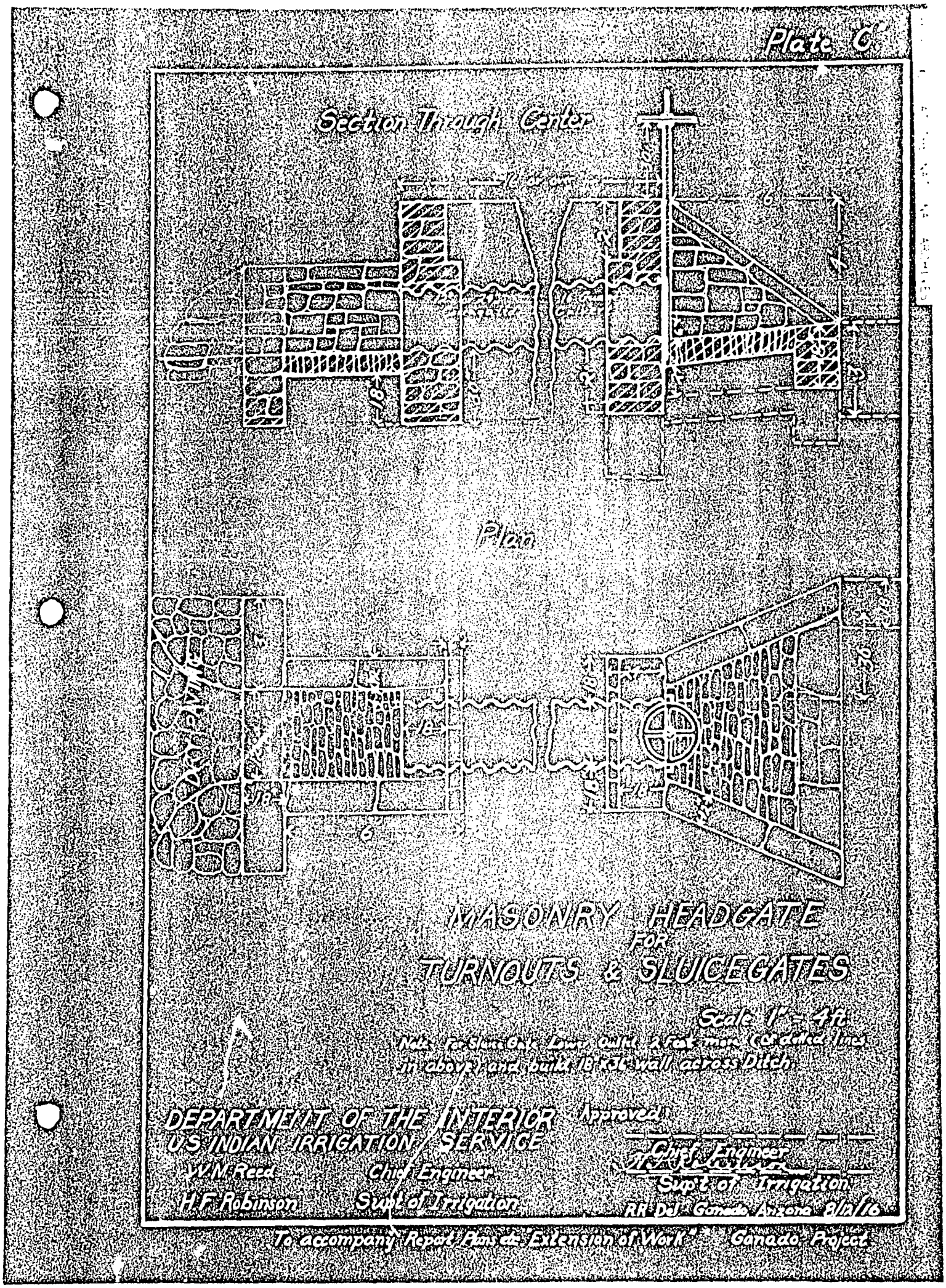
Plate "C"
Section Through Center
Plan
MASONRY HEADGATE
FOR
TURNOUTS & SLUICEGATES
Scale 1" = 4 ft.
Note: For Sluice Gate Lower Outlet 2 Feet more (Cr dotted lines in above) and build 18"x36" wall across Ditch.
DEPARTMENT OF THE INTERIOR
U.S. INDIAN IRRIGATION SERVICE
W.M. Reed
Chief Engineer
H.F. Robinson
Supt. of Irrigation
Approved
Chief Engineer
Supt. of Irrigation
RR Del. Ganado Arizona 8/12/16
To accompany Report Plans etc. "Extension of Work" Ganado Project

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The upper end of this lined section should be lowered to give more fall to Flume No. 2. About 12 cubic yards of masonry will be required for these cutoffs.

Eight small turnouts have been installed for the use of the Navajos. Four more are on hand that have not yet been placed. These are 8" turnouts of corrugated pipe and equipped with a swinging shear gate. They are only four feet long which prevents the ditch bank being rebuilt to the proper height over these outlets. Each should be lenghtened by attaching 12 foot length of the 8" corrugated pipe. The inlet end should be imbedded in masonry, about one cubic yard would be ample for each. By this means the ditch bank can be rebuilt properly and the turnout will be a permanent structure.

Estimated cost of the new structure.

Spillways

36 cu. yards masonry	@ $7.50	$270.00
2200 ft. B.M. Lumber		88.00
Labor installing outlet flume of lumber		240.00
		$ 598.00

Sluice Gates.

45 cu. yards masonry	@ $7.50	337.50
15 " " dry wall	2.50	37.50
Gate Lifts 24"		75.00
Outlet tubes of currugated iron 24"		100.00
		$550.00

Paved Ditch,

12 cu. yards masonry	@ $7.50	90.00

Turnouts.

12 cu. yards masonry	90.00
12 pieces 8" pipe each 12 long	75.00
	$ 1403.00

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Materials and supplies needed.

160 sacks cement

Lumber.

45 pieces	2" X 12"	X 16'	rough	
30 "	2" X 6"	X 16'	"	
3 "	6" X 6"	X 16'	"	
15 "	2" X 12"	X 16'	surfaced 4 sides	
10 "	2" X 6"	X 16'	"	" "

150 lbs. 20d Nails
50 " 40d "

3-24" gate lift stems 8ft. long and fitted to connect with the 24" corrugated pipe culvert.

3 pieces 24" corrugated pipe each 16' long with 16 gauge metal
12 " 8" " " " 12' " " " " "
to couple on to 8" turnouts.

Sand, rock, etc, to be procured in the vicinity.

Recapitulation of estimated costs of the different features.

Feature	Cost	Percentage of whole Estimate.
Storage Dam	$ 11,200.00	54
Supply Ditch	923.00	4
Diversion Dam, etc	3,340.00	16
Alterations to Flumes	1,040.00	5
Storm water diversion Ditches	1,100.00	6
Protective riprap along arroyo	530.00	3
Repairs to Flume No. 3	1,085.00	5
New Structures	1,403.00	7
	$20,621.00	100

Reports, plans, etc.
Extension of Work.
Ganado Project.

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No estimate for equipment has been included in the above but it is hoped that but little will be required. A list will be submitted after finding what of the tools, etc, used in the work at Captain Tom's Wash can be sent here.

There are a number of running repairs, such as strenghhening the banks here and there, repairing some of the riprap, no one item of which will amount to much, that are thought to be properly maintenance work.

It is believed the repairs to the Supply Ditch, Repairs to Flume No. 3 and the riprapping or protective mattrees are items properly chargeable to Maintenance. The sum of these features is $2,538.00, the balance of the work amounting to approximately $18,000.00.

If theplans and estimates are approved, the appropriation will be practically exhausted without opening up much new ditch. Though some money will probably be available for extending the line below Flume No. 6, or building a small lateral on the north side of the valley, this latter would take out the main ditch just above Flume No. 3 and cover a small flat containing some very desirable land.

As but little land under the present ditch has been used by the Navajos, the plea is made to put the present system in the best shape possible. All work to be done in the most substantial and workmanlike manner and no makeshifts allowed. Only by this means will the continuous and successful operation of the ditch be assured.

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The Indians can be more readily induced to take up the land after several seasons of successful operation of the system.

To paraphrase a well known advertising slogan. These improvements must be done eventually----Why Not Now ?

No requisitions for supplies can be made until the plans and estimates herein have been passed upon, but it should be noted all materials and supplies should be freighted out here as soon as the rainy season ends. As a rule the last part of September, October and November are marked by settled weather and are well adapted for hauling freight. After then the roads are practically impassible.

Plates "A" ~~and~~ to "I" are included and are a part of this report.

Respectfully Submitted,

Rollin Ritter

Engineer.