HYDROLOGY E18/D25 FOUR PLANS

E18/D25

4 PLANS

CITY OF ALBUQUERQUE, NEW MEXICO
PUBLIC WORKS DEPARTMENT

RECEIVED
NOV 29 1978
CITY ENGINEERS

MEMORANDUM -- November 27, 1978

TO: File

FROM: H. R. Orr, Jr., Acting Director of Public Works

SUBJECT: RUTHERFORD DEVELOPMENT AT SAN MATEO AND THE BEAR ARROYO

A meeting was held this morning with Mr. Rutherford, Rich Leonard, Bob Sheppard, Flatow Structural Engineer and me to discuss subject development and the drawings previously submitted by Flatow for drainage review.

Mr. Sheppard said that two drawings, C-1 and C-2, were submitted for review at the same time, although from the comments resulting only the drawing C-1 was reviewed. He left a copy of C-2 which I have given to Bruno.

It appears that there is a separately owned parcel immediately east of the Rutherford property, perhaps 300 feet in the east-west direction, which Mr. Rutherford believes is owned by Mr. Wylie. He will contact Mr. Wylie either for permissionfor construction of the transition or for possible inclusion of channel improvement through the Wylie tract.

Drawing C-1 will be expanded to include a cross section and details of the entrance transition structure and various other notes will be added to drawing C-1. Fencing of some type will be indicated at least for the deeper 2/3 of the transition structure.

Mr. Rutherford proposes to address a letter to the City wherein he will assume responsibility for improvements on the west side of San Mateo which he will accomplish after concurrence and, if possible, participation of the property owners and/or others.

A structural partition to block upstream and downstream unused barrels will be designed except that the barrel north of the permanent four barrels and the barrel south of the four barrels may be used by either property owners or the City in accordance with subsequent drainage plans or designs. Bob Sheppard suggested that a wall be extended from the north edge of the north temporary barrel and the south edge of the south temporary barrel and designed to serve as the support for an eight-foot wide double tee beam upon which the west sidewalk and hand rail would be placed. The beam and sidewalk and hand rail to be provided by way of the assessment district. He will convey this suggestion to Hans Coucheron-Aamot of Molzen-Corbin & Associates.

Mr. Rutherford is desirous of immediate release to permit construction of 350 feet of the box culvert beginning from the east side of San Mateo. We suggested that he prepare a letter for approval of the Acting Public Works Director, the State Highway Department, and the AMAFCA.

HRO:rs
cc: Mr. R. S. Heller, City Engineer
Mr. Richard E. Leonard, Executive Engineer, AMAFCA
Mr. Bruno Conegliano, Assistant City Engineer-Hydrology
Mr. C. D. Sheppard, Acting City Engineer

NOV 27 1978

GEORGE A. RUTHERFORD, INC.

GENERAL CONTRACTORS
ALBUQUERQUE, NEW MEXICO

Telephone 842-8240
900 Hazeldine Ave., SE
P. O. Box 309 Zip Code 87103

November 27, 1978

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NOV 27 1978
CITY ENGINEERS

City of Albuquerque
400 Marquette, N.W.
Albuquerque, New Mexico
Attn: Mr. Rip ey Orr
Director of Public Works

Re: Channelization of Bear Canyon Arroyo from San Mateo East approximately 1100 feet.

Dear Sir:

The need to complete the first 350' of channel east of San Mateo is quite urgent; we, therefore, respectfully request permission to commence work on that part immediately. Recognizing that there are a few unanswered questions relative to the east end of the project and also that portion west of San Mateo; we hereby agree to address ourselves to the expeditious resolution of these questions.

Very truly yours,

GEORGE A. RUTHERFORD, INC.

cc: Dwayne Bruno ✓

George A. Rutherford, President

Approved: Harold R. Grife Date 11/29/78
For City Engineer, City of Altuquerque, N.M.

Approved: _____ Date _____
Executive Engineer A.M.A.F.C.A.

Approved: _____ Date _____
N.M. State Highway Department

flatow
moore
bryan &
associates

william jette
leon ross
rusty shaffer
wayne andrews

ARCHITECTS
ENGINEERS
PLANNERS

5608 zuni s.e.
p.o. box 8266
uquerque, n.m. 87108
phone 505/268-6783

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CITY ENGINEERS

November 10, 1978

Mr. Bruno Conegliano
Assistant City Engineer - Hydrology
City of Albuquerque
P. O. Box 1293
Albuquerque, New Mexico 87103

Dear Sir:

As you requested in your letter of October 24, 1978, we have prepared a Flow Evaluation study for the Bear Canyon Arroyo channelization across the George Rutherford property. Please review the enclosed study and plans. Let me know if you have any questions.

Very truly yours,

Bob Sheppard

Bob Sheppard

BS/mm

Encl.

cc: Richard Leonard, A.M.A.F.C.A.
Dr. Richard Heggen, U.N.M.
Harry Apodaca, Dist. Engineer, Hwy. Dept.
George Rutherford

FLOW EVALUATION REPORT

FOR

CHANNELIZATION & REALIGNMENT
OF BEAR CANYON ARROYO

ACROSS

GEORGE RUTHERFORD PROPERTY

NOVEMBER 10, 1978

NEW MEXICO

STATE HIGHWAY DEPARTMENT

COMMISSION

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CHAIRMAN, HOBBS

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VICE CHAIRMAN, MESILLA

JAMES W. CHANEY
SECRETARY, MORIARTY

JULIAN GARCIA
MEMBER, ALBUQUERQUE

ALBERT N. SANCHEZ
MEMBER, SANTA ROSA

P. O. Box 1149
SANTA FE, NEW MEXICO
87503

FRED L. O'CHESKEY
CHIEF HIGHWAY ADMINISTRATOR

Copy in letter receiver
original in Wood & Prop. File

M - Drainage

October 2, 1978

Albuquerque Metropolitan Arroyo
Flood Control Authority
P. O. Box 25851
Albuquerque, N. M. 87125

RECEIVED
OCT 05 1978
CITY ENGINEERS

Attn: Richard Leonard

Gentlemen:

Subject: Arroyo del Oso

Plans prepared by Flatow Moore Bryan & Associates for channelizing the water on the Arroyo del Oso into the New Mexico State Highway Department's structure, are acceptable to the State Highway Department.

However, structural plans within the right of way will need to be submitted prior to a permit being issued for said construction.

Very truly yours,

H. V. Parr
Drainage Engineer

HVP:jc
cc: John Whitman
C. E. Serna
R. L. Russell
H. Tachau
✓City of Albuquerque - Engineering
Harry Apodaca

City of Albuquerque
P.O. BOX 1293 ALBUQUERQUE, NEW MEXICO 87103

October 24, 1978

Mr. Bob Sheppard
Flatow, Moore, Bryan & Assoc.
5608 Zuni S.E.
Albuquerque, New Mexico 87108

RE: BEAR CANYON ARROYO DESIGN

Dear Mr. Sheppard:

I have received a copy of the drawing indicating the facilities that you recommend be built to replace the existing natural channel, crossing the Rutherford property.

The proposal submitted indicates a rather complex hydraulic structure that will have to be investigated under at least two flow conditions, namely 500 cfs and 1290 cfs. A forewater analysis will have to be performed (see for instance U.S.C.E. E.M. 1110-2-1601 Plate 8) to establish the maximum velocity attained by the flows. The type, magnitude and location of the hydraulic jump that will occur at the grade change needs to be established. It is also necessary that the formation of standing waves be prevented in order to avoid dynamic loading on the walls and impede the proper functioning of the box culvert. Regarding the mode of operation of the double box, the head water elevation indicated on the standard tables of the Bureau of Public Roads results from the necessity of accelerating the flow upstream of the culverts. If the channel configuration and velocity upstream from the entrance is comparable to the conditions within the box, little variation in the water surface profile would be observed.

Please review the functions discussed above, and supply the requested hydraulic computations together with water surface profiles and hydraulic grade lines to allow the verification of the validity of the design.

Very truly yours,

Bruno Conegliano
Asst. City Engineer-Hydrolog

BC/gw

cc: C. D. Sheppard, Acting City Engineer
Richard Leonard, AMAFCA
Drainage File

Sept. 19, 1978

To: Richard E. Leonard, AMAFCA

From: Richard J. Heggen, P.E.

Subject: Technical Review of Box Culverts
Subsequent to Open Channel Revision

The following findings result from my telephone conversation with Bob Sheppard of Flatow, Moore, Bryan and Associates in which we discussed alterations to the culvert design.

1. The redesigned culvert system (open channel to Sta. 3 + 69, transition to 2 - 14.8 x 5 ft. box culverts having at least 10 ft. of entrance head) will transmit roughly 1750 cfs, approximately 33 percent over 100 year design flood criteria.

2. Backwater from the inlet pool will extend approximately 400 feet across the eastern property line. The pool will be contained within present arroyo banks.

3. Approximately 300 cfs would be expected to spill from the inlet pool should a 100 year storm occur before Del Oso Dam is reconstructed.

4. Tentative parking lot grading does not protect the San Mateo - Academy intersection from inlet pool spill. Two options should be considered:

a. Construct a berm or elevate peripheral parking lot elevation to route the entire pool spill to one or two 4 x 10 ft. inlets to San Mateo culverts.

b. Design parking lot drainage for local runoff only and let pool spill enter the street intersection.

5. I find the redesigned culvert system hydraulically adequate to transmit the 1297 cfs design flow. I would personally prefer option "a." in item 4 above, but recognize that this option provides flood protection above that required for the 100 year storm.

City of Albuquerque
P.O. BOX 1293 ALBUQUERQUE, NEW MEXICO 87103

May 17, 1978

Bob Sheppard
Flatow Moore Bryan & Associates Inc.
5608 Zuni SE
Albuquerque, New Mexico

RE: Design of the structure under the Woolco property for the Bear Canyon Arroyo

Dear Mr. Sheppard:

I am very concerned with the potential for destructiveness of large flows travelling at high velocity as are those indicated for the Bear Canyon Arroyo, in the master plan for drainage, Northeast Heights.

The flow of 1297 cfs. travels in the concrete lined channel @ 18.6 feet per second at a depth of 2.73 ft. with a Frounde number of 2.0. The top width of the flow should be 31.0 ft. and the velocity head 5.4 ft. Due to the necessity of preserving the flow conditions with a minimum disturbance, it is my suggestion that the flow be carried under Woolco store site through 4 - 6' x 4' box culverts. Standing waves will be generated at the entrance if great care is not exercised in designing the transition from the channel to the box culverts. A high velocity inlet will have to be constructed to prevent a hydraulic jump and overflow of the banks into the property.

Typical design methods are reported in chapter 11, section 6 of the Ven Te Chow textbook 'Open Channel Hydraulics.' Similar care will have to be adopted for the exit transition, given the short length of the reach between the end of the

property and the box culverts under San Mateo. It is my understanding that the Corps of Engineers has developed design methods for high velocity inlets that do not require model studies and I would recommend that you get in contact with Mr. Elias Quintana, who may be able to assist you in this endeavor.

Very truly yours,

Bruno Conegliano
Asst. City Engineer-Hydrology

BC/gm

cc; V.M. Kimmick
Jim Smith
Drainage file

FLOW EVALUATION REPORT

FOR

CHANNELIZATION & REALIGNMENT
OF BEAR CANYON ARROYO

ACROSS

GEORGE RUTHERFORD PROPERTY

NOVEMBER 10, 1978

flatow
moore
bryan &
associates

william jr.tte
leon ross
rusty shaffer
wayne andrews

ARCHITECTS
ENGINEERS
PLANNERS

5608 zuni s.e.
p.o. box 8265
albuquerque, n.m. 87108
telephone 505/268-6783

RECEIVED
NOV 13 1978
CITY ENGINEERS

November 10, 1978

Mr. Bruno Conegliano
Assistant City Engineer - Hydrology
City of Albuquerque
P. O. Box 1293
Albuquerque, New Mexico 87103

Dear Sir:

As you requested in your letter of October 24, 1978, we have prepared a Flow Evaluation study for the Bear Canyon Arroyo channelization across the George Rutherford property. Please review the enclosed study and plans. Let me know if you have any questions.

Very truly yours,

Bob Sheppard

Bob Sheppard

BS/mm

Encl.

cc: Richard Leonard, A.M.A.F.C.A.
Dr. Richard Heggen, U.N.M.
Harry Apodaca, Dist. Engineer, Hwy. Dept.
George Rutherford

TO: Bob Sheppard, FMB & A

FROM: Richard J. Heggen, P.E.

DATE: November 9, 1978

SUBJECT: Hydraulic Aspects of Rutherford Culvert

An increase in radius of curvature to 400 ft. for the initial culvert curve will substantially reduce cross wave generation caused by supercritical flow in nonlinear alignment, I estimate at Q = 1297 cfs, cross waves due to channel bending will a depth of:

$$\Delta D_M = \frac{V^2\ b}{gr} = \frac{16^2\ (30)}{32.2\ (400)} = 0.6 \text{ ft.}$$

I would expect to see a crest at an angular displacement of:

$$\theta = \arctan \left[\frac{b}{(r + b/2)\ \tan\ (\arcsin\ (1/F))} \right]$$

$$= \arctan \left[\frac{30}{415\ \tan\ (\arcsin\ (1/1.33))} \right] = 6.3°$$

from the beginning of the bend. This crest would occur on alternate channel sides each 44 ft. around the curve and will dissipate once the channel straightens.

A similar set of cross waves will occur at the culvert's other two curves. Noting that b and r vary, ΔD_M at the middle curve will be 0.4 ft. and ΔD_M at the last curve will be 0.3 ft. As the closed channel has 1.7 ft. of freeboard at design flow, I anticipate no cross-wave caused problems.

The change in slope at the initial transition bottom introduces a second non-uniform flow condition. In that channel slope remains steep (F goes from 4.27 to 1.83), an S3-type gradually varied surface profile will occur. Mean depth will increase from 1.5 ft. to 2.6 ft approximately 130 ft. below the grade change. Due to the simultaneous channel curvature and change of slope, this increase in flow

elevation will occur obliquely at an angle somewhat more than 40° to the channel tangent.

A third non-uniform flow condition will be encountered in the inlet. Because the transition is nonprismatic, cross waves will develop in supercritical conditions. These cross waves will cancel at the transition's bottom. A single ridge-like wave will occur in the transition's center at approximately Sta. 0 + 90. I would not expect downstream disturbances due to this transition to exceed 0.4 ft. in vertical magnitude.

A worst-case estimation of downstream wave conditions caused by all three non-uniform flow factors is obtained by assuming throughs and then crests from all three factors might coincide. Thus depth might vary from 0.5 to 2.5 ft. at the grade change, and from 1.6 to 3.8 ft. further down the channel. As the location of a maximized wave will vary with discharge, I suggest that the channel's side walls be adequate to withstand a dynamic 2 ft. surcharge traveling at:

$$V = 16.8 + \sqrt{gd} = 16.8 + \sqrt{32.2 \times 2.6} = 25 \text{ fps.}$$

Depths, velocities and Froude numbers are indicated on the following table for points along the culvert system for Q's of 1297 and 500 cfs. As indicated by the F's, flow is in similar supercritical state in both cases. A wave pattern similar to that discussed for 1297 cfs will occur at 500 cfs, but as depths and velocities will be less, wave magnitudes will decrease.

At both Q's the max. d/d_c ratio occurs within the boxed culverts. As these ratios are significantly below 1.0, flow will remain stable. The rule-of-thumb that d/d_c should not be in the 0.7 - 1.3 range is satisfied to my satisfaction. Local disturbances (say stemming from a rolling rock in the culvert) will be undular; as the grade (0.0075) is 3 times the critical slope (.0027), flow will return to normal supercritical depth.

	*TOP OF INLET	*BOTTOM OF INLET	OPEN CHANNEL	CULVERT	BOTTOM OF TRANSITION	SAN MATEO CULVERT
Depth of Flow (ft.)	0.90 0.51	1.47 0.82	2.58 1.41	2.80 1.50	2.15 1.19	1.95 1.03
Vel. (fps)	22.17 15.08	29.41 20.32	16.75 11.82	15.79 11.36	14.74 10.24	16.62 12.13
Crit. Depth (ft.)	2.31 1.22	3.87 2.05	3.87 2.05	3.93 2.08	3.14 1.66	3.19 1.69
F	4.11 3.72	4.27 3.95	1.83 1.75	1.66 1.63	1.76 1.65	2.10 2.10
d/d_c	.38 .41	.37 .40	.66 .68	.71 .72	.68 .71	.61 .61

Upper number Q = 1297 cfs

Lower number Q = 500 cfs

*Inlet flow approximated by normal depths. Control location subject to proposed upstream concrete channel.

Theoretically, the channel should transmit design flow with a free water surface at all points. Because the wave pattern is complex and because flow pulses and local disturbances could be expected, I forsee that waves might at times contact the closed culvert top. Should this occur, the entrance to the closed culvert would submerge and the system would behave in an inlet controlled manner. An 8 ft. head would develop at the entrance to the boxed culverts.

STRUCTURAL ELEVALUATION OF MAXIMUM WAVE IMPACT

Maximum wave height = 2' on outer wall
Velocity = 25 fps

Impact effect on 1' strip of channel wall:

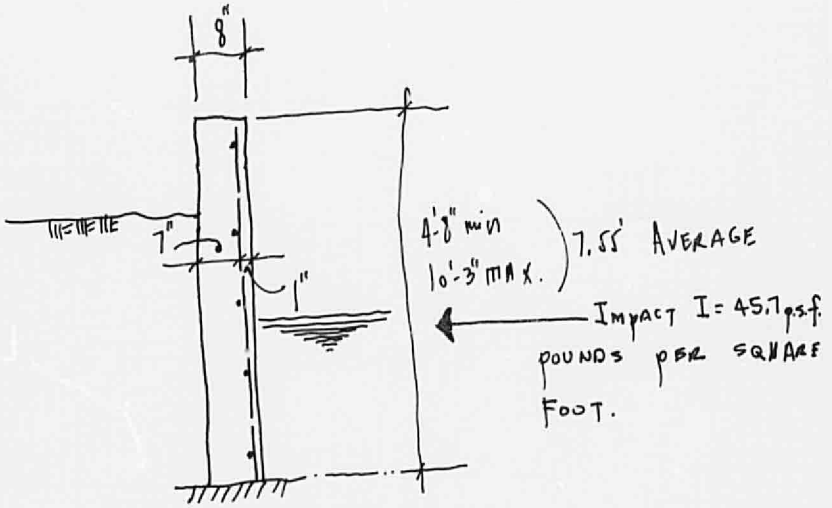
Assume the wave will assume a triangular shape across the channel.

$$\text{Impact} = I = \frac{M V^2}{R} \quad \text{where } M = \text{mass in slugs.}$$

$$M = \frac{\left(\frac{2+0}{2}\right)(30)(62.4)}{32.2} = 58.5 \text{ slugs.}$$

$$I = \frac{58.5 \times 25^2}{400} = 91.4 \text{ surcharge lbs.}$$

$$I = \frac{91.4}{2} = 45.7 \text{ psf}$$



WALL SECTION

$$H\ av. = \frac{4.8' + 10.3'}{2} = 7.55'$$

$$\text{At Base } M = 45.7\ \#/\square' \times \frac{(7.55')^2}{2} \times 12 = 15{,}630\ \text{"-\#/ft.}$$

$$Mc = 240\ \text{p.s.i.} \times (7)^2 \times 12'' = 141{,}120\ \text{"-\#/ft.}$$ OK

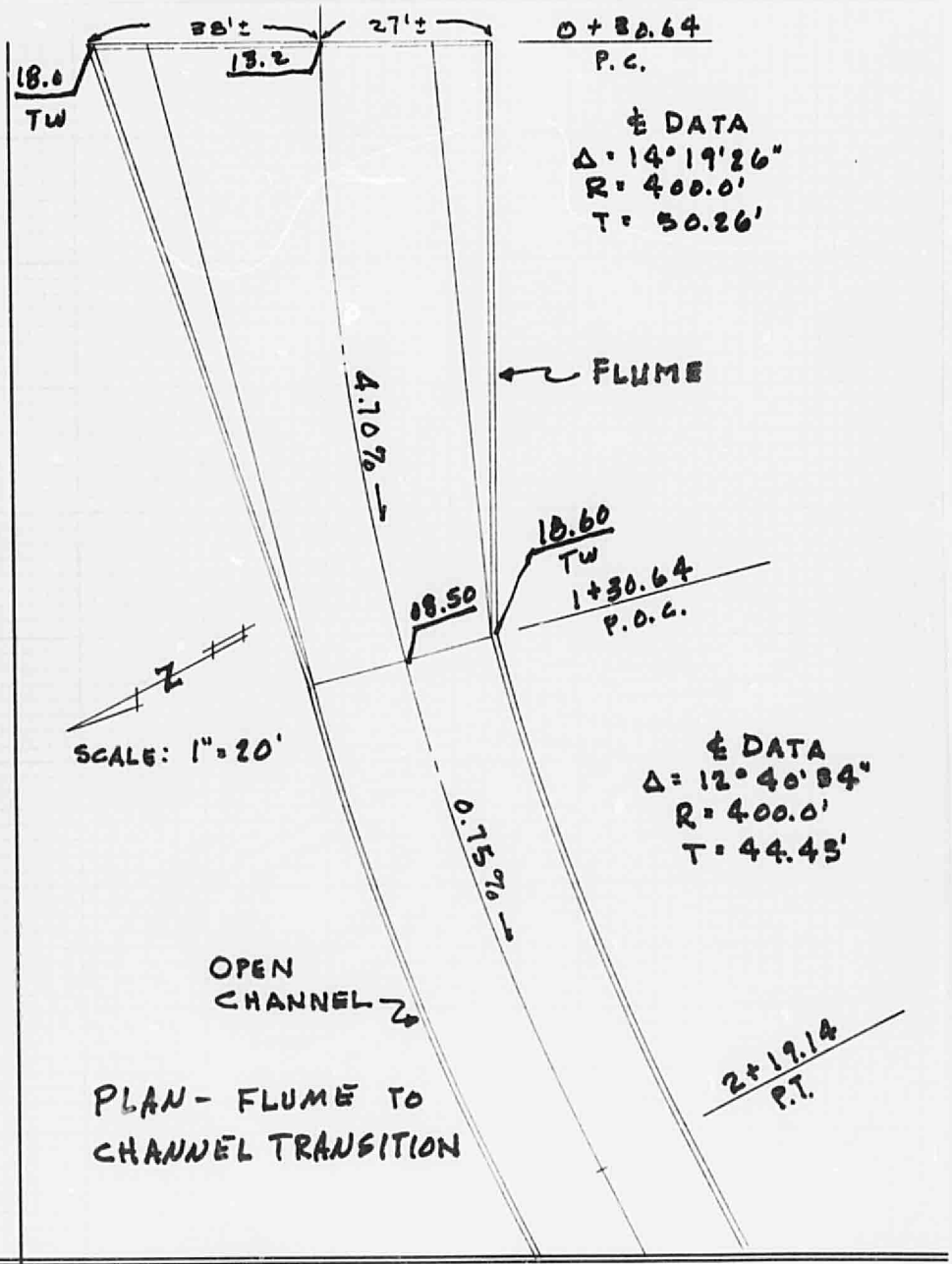
$$As = \frac{15{,}630\ \text{"-\#}}{24{,}000\ \text{p.s.i.} \times .867 \times 7''} = 0.107\ \square''/\text{ft.}$$ OK

Note: The structural system is found sound and stable for I = 45.7 p.s.f. The horizontal impact load is absorbed by the permanent horizontal soil retaining pressure applied on the opposite side of the conc. wall. Soil W = 201 p.s.f. > 45.7 p.s.f. OK

SCHEMATIC OF SURFACE PROFILES

fmb
fisher moore bryan & associates

project _____ no. _____
client _____
by _____ date _____ page 6



PLAN - FLUME TO CHANNEL TRANSITION

flatow moore bryan & associates

project _____ no. _____

client _____

by _____ date _____ page 7

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