

Note: See drawings that accompany this report

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STUDY
of
ARCADIA - ARIZONA CANAL
STORM DRAIN CHANNEL
64th STREET TO 56th STREET

Prepared
for
City of Phoenix



by
COE & VAN LOO
Consulting Engineers, Inc.
4831 North 11th Street
Phoenix, Arizona 85014

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INDEX

INTRODUCTION	1
CONCLUSIONS & RECOMMENDATIONS	2 & 3
RUNOFF DETERMINATION	3 - 6
EXISTING DRAINAGEWAY	6 & 7
PROPOSED CHANNEL DESIGN	7 - 11
COST ESTIMATE	11 - 13
POSSIBLE ADVERSE EFFECTS OF CHANNEL	13
FURTHER REFINEMENTS	14 & 15
ALTERNATES	15
MISCELLANEOUS REQUIREMENTS PRIOR TO CONSTRUCTION OF CHANNEL	15 & 16
DRAWINGS AND CHARTS	

1. INTRODUCTION

This report concerns the feasibility of developing the alley north of the Arizona Canal between 56th Street and 64th Street into a drainage channel. A channel is desirable because something over 2,000 acres of land drains into this alley and the property to the north. Because the alley is nearly on the contour, the existing drainage is poor and significant quantities of water will not flow out until the water has built up. For major storms residences along the canal may be flooded and in some cases those on the north side of the first street north of the canal are also flooded.

This report is not concerned with the volumes of storm water anticipated. An accurate analysis of the rate of runoff would be very difficult to make. Hence, this report is largely limited to what could be done with the alley and what problems might be anticipated. However, the runoff is discussed in general terms.

The suggested design is based on surveys by the City of Phoenix made in 1967 and 1968. Some supplemental surveys were made for this report where it appeared necessary, and a few additional may be needed if the drawings are finalized.

2. Conclusions and Recommendations

(1.) The area along the canal receives drainage from about 2,000 acres.

(2.) The alley on the north side of and parallel to the Arizona Canal can be converted to a drainageway.

(3.) It is doubtful if the drainageway which is feasible under present conditions will eliminate all possibility of flooding of adjoining property.

(4.) A channel which would handle 200 c.f.s. or more would cost approximately \$128,000.

(5.) That channel, if carrying 200 c.f.s. from 64th Street to 60th Street and 300 c.f.s. downstream, would have a water surface about level with the floors of adjoining homes for which data is available.

(6.) A channel about one foot deeper would cost about \$6,000 more.

(7.) The deeper channel would provide a greater margin of safety to the adjoining homes but would increase the possibility of flooding south of Indian School Road and 56th Street in the event of major storms. It seems doubtful if the design can be made to provide the greatest margin of safety along the canal and at the same time not contribute to flooding south of Indian School Road.

(8.) The Arizona Canal will receive water at a higher rate, either through the canal inlet or at the 56th Street Bridge, from any modification than it presently does, and approval of the Salt River Project will be needed for any modification.

(9.) Some further refinements of the preliminary design will be needed. Floor elevations of all houses along the canal and front curb elevations should be obtained.

(10.) An alternate deeper channel can be constructed with provisions to reduce the capacity temporarily in the event more discharge capacity would someday be feasible.

(11.) Right of way requirements, alley use, closing of fence gates, and probably other matters must be clarified and probably resolved with the property owners.

3. Runoff Determination

Determination of the quantity of water which reaches the Arizona Canal would require a very complex analysis. Among other things, there are a number of storage areas in the contributing area such as along the west side of Scottsdale Road and along the north side of the Arizona

Canal in the reach north and east of 68th Street. Large amounts of water are temporarily accumulated in these depressions. While the total volume which eventually finds its way into the canal is not changed, the rate is slowed substantially. In addition to the complexities of runoff rates, the determination of storage volume available along the Arizona Canal would require much detail for accurate determination.

A few years ago the writer prepared a study of the runoff to 68th Street and the Arizona Canal. At that location the total runoff was estimated to approximate 180 c.f.s. for a 25 year storm. While to our knowledge there have been no quantitative measurements, the elevations for flood flows reached since that time approximate those computed.

The remaining 1,500 acres plus which contribute to the area between 68th Street and 56th Street have little storage area and a relatively high runoff rate. Consequently it is not too difficult to conclude that construction of a channel of sufficient size to carry the water off as rapidly as it reaches the canal without substantial raising of the water surface is of doubtful feasibility. Hopefully, however, the

water level can be kept sufficiently low from most storms to avoid flooding of homes in the area under study.

The contributing area is shown on the attached map marked Figure 1. This map was taken from USGS quadrangle sheets for the area.

4. Existing Drainageway

The existing alley along the north side of the Arizona Canal serves as a channel conveying water to a drainage inlet east of 56th Street. This inlet consists of a horizontal grate over a 7 foot x 15 foot concrete box. Water entering the inlet flows out through a 48 inch diameter concrete pipe line some 500 feet long which empties into the Arizona Canal.

The grate usually is covered with debris during storms, and it is doubtful if it will pass enough water to fill the 48 inch pipe throughout the runoff period. However, the volume of water entering the pipe line does not have any significant effect on the hydraulic gradient upstream. Water not entering the inlet flows west, over or around the inlet. When it reaches 56th Street, some of it crosses the bridge to the south and some runs into the canal..

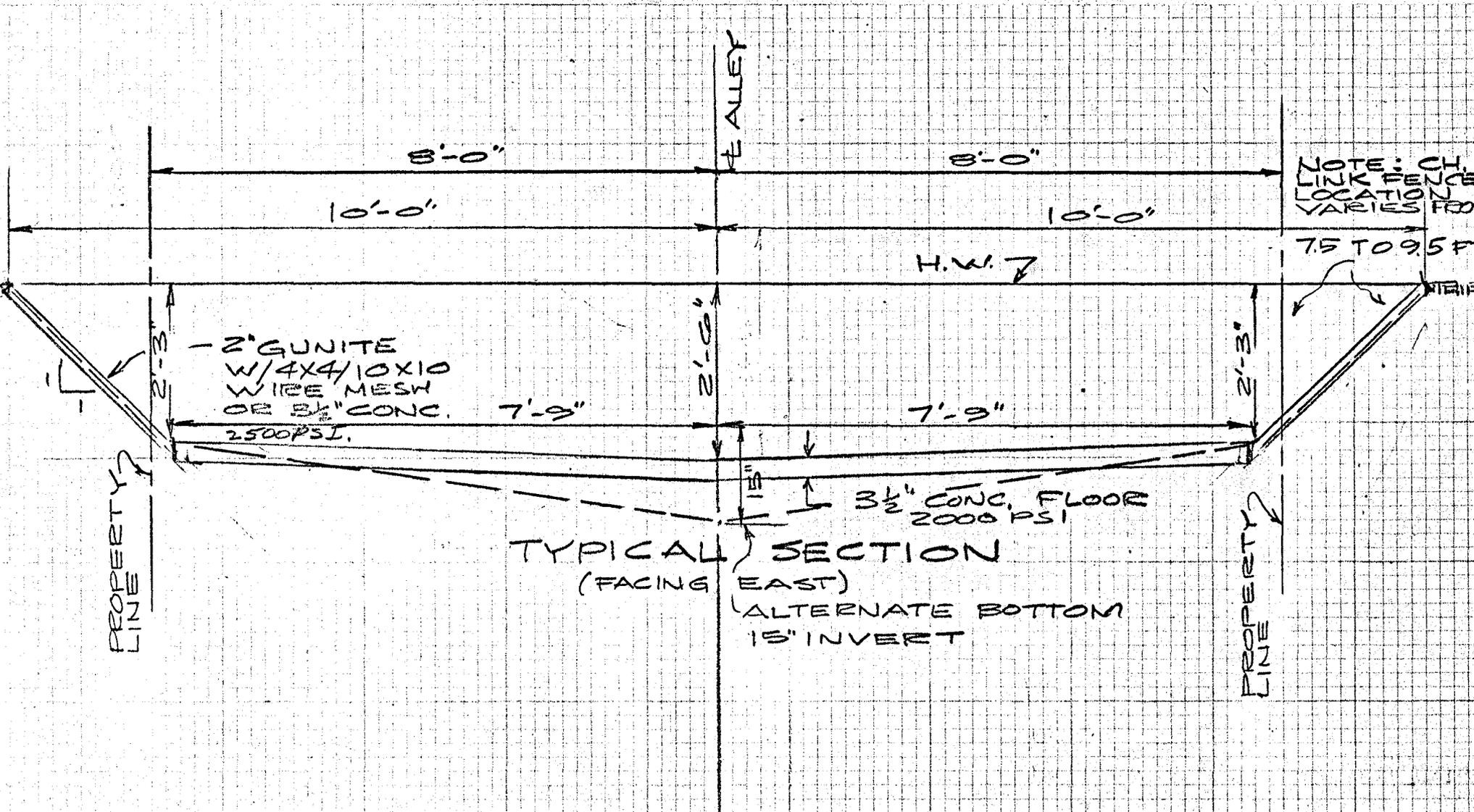
The alley which presently serves as a conduit is mostly paved. It would have a fairly good capacity except it is very flat. Much of it slopes only 0.1 feet per hundred or less.

5. Proposed Channel Design

To make a channel as large as feasible, the existing fences along the north side of the alley are proposed to be treated as if they were property line. This will require some variation on how the side slope is handled so the fences do not lose their footing support but will not interfere with the use of the property inside the fence. The south side of the channel is limited by the north bank of the Arizona Canal. The typical section is shown on Figure 2. The side slopes are proposed to be either of 2" Gunitite on a 1 to 1 slope reinforced with 4"x4" 10 guage wire mesh or of 3 1/2" concrete similarly reinforced. The bottom is proposed to be 3 1/2" unreinforced concrete. The center is inverted 3" to provide a channel for nuisance water and could be increased to 12" or more to increase capacity slightly. The typical section is shown on Figure 1.

The capacity of the full channel proposed is 130-150 c.f.s. immediately west of 64th Street. This rate is computed with water to the top of the

FIGURE 2



NOTE: SECTION VARIES
SEE ALLEY SECTIONS

NOTE: CH.
LINK FENCE
LOCATION
VARIES FROM

7.5 TO 9.5 FT

TYPICAL SECTION
(FACING EAST)
(ALTERNATE BOTTOM
15" INVERT)

concrete side slope and assumes the flow further downstream is not so large as to raise the water surface at 64th Street. Capacities for the individual reaches computed to the top of the lining without regard to backwater curves are shown on Figure 3. This table serves only to reflect comparative sizes and capacities for the various sections.

Another analysis was run to reflect a flow of 300 c.f.s. west of 60th Street. The water surface elevations from that computation are indicated on the general plan of the channel which also shows a few elevations furnished for floor elevations of some adjoining houses and curb elevations in front of those houses. The analysis computes only the flow in the limits of the channel whether it is surcharged or not and ignores water which may be flowing through the yards. With the flows indicated the water level would be at or slightly above the adjoining floors.

From the profiles and sections attached, it will be noted the channel is not carried through to 64th Street. This was done so that flow from outside the city is not increased. In effect, it retains the storage created by deeper water east of 64th Street.

CHANNEL CAPACITY*

STATION	AREA (SF)	PERM. (FT)	HYD. RAD.	(HYD. RAD) ^{2/3}	DEPTH AT z	n	$\frac{1.486}{n}$	SLOPE	$S^{1/2}$	Q (CFS) CAPACITY
49+60 30+0	41.95	22	1.9	1.53	2.50	0.013	114.2	0.00075	0.0275	200 ⁽¹⁾
30+0 20+0	49.30	22.4	2.2	1.69	3.0			"	"	261
20+0 10+0	43.6	20.3	2.15	1.67	3.0			"	"	228 ⁽²⁾
10+0 8+0	44.6	22.5	1.97	1.57	2.83 A.G.			0.00175	0.042	336
8+0 6+0	43.8	22	1.99	1.58	2.63 A.G.			0.00450	0.067	530
6+0 4+0	43.8	22	1.99	1.58	2.50			0.0145	0.120	947
4+0 0+0	43.8	22	1.99	1.58	2.50			0.0040	0.063	496
0+0 -1+60	43.8	22	1.99	1.58	2.50			0.00875	0.093	732

(1) CAPACITY DECREASES FROM STATION 42+0 TO 49+60 DUE TO ZERO GRADE LINING TOP

(2) STA 18+0 AT 3.00' DEPTH
AT STAS 0+0 TO 18+0 ACTUAL CAPACITY IS GREATER BY USING NORTH SLOPE OF ARIZONA CANAL BANK AT LEVEL TO TOP OF CONCRETE SWALE AT NORTH SIDE OF ALLEY.

* MANNING EQUATION

$$Q = A \frac{1.486}{n} (R^{2/3}) (S^{1/2})$$

ALL CHANNEL CAPACITIES ARE COMPUTED TO TOP OF CHANNEL WITHOUT REGARD TO BACKWATER CURVES, AND SHOULD NOT BE REGARDED AS OTHER THAN COMPARATIVE SIZES AND CAPACITIES FOR DIFFERENT SECTIONS.

FISURE 3

The culvert inlet near 56th Street has been moved west about 200 feet to decrease the length of pipe as much as possible. About 200 feet of the existing culvert would have to be removed. The drop inlet would also be removed to reduce the probability of plugging. The culvert inlet would be changed to a sloped inlet with a bar grate. This increases the hydraulic slope available and also places the bar grate in a position where it might be cleaned. While under normal operation with normal water surface there is ample head available between the water surface in the canal and the water surface at the inlet, in flood stage the canal runs much fuller and the culvert outlet is submerged. Then about six feet is all that is available. Under this condition 2 - 48" culverts would carry about 280 c.f.s. Once that flow is reached, excess flow would pass around the culverts.

6. Cost Estimate

Excavation	5,200 c.y. @	.70	\$ 3,640
Concrete Channel Side Walls (alternates concrete or gunite)	36,600 s.f. @	.60	21,960
Concrete in Channel Bottom	800 c.y. @	55.00	44,000
Wire Mesh	17,000# @	.30	5,100

Remove Existing Culvert Inlet Lump Sum		\$ 800
Remove 48" dia. Concrete Pipe 190 l.f. @ 15.00		2,850
Furnish and Place 48" dia. Reinf. Concrete Pipe Type III 231 l.f. @ 30.00		6,930
Place 48" Concrete Pipe 190 l.f. @ 20.00		3,800
Miscellaneous Items for Drainage Inlet		700
Move Chain Link Fence 3,475 l.f. @ 3.00		10,425
Adjust Manholes to Grade 14 ea. @ 150.00		2,100
Furnish and Place Barricades 100 l.f. @ 5.00		500
Total Construction		<u>\$102,805</u>
Contingencies 10%		10,000
Engineering & Inspection		<u>15,000</u>
TOTAL COST		\$127,805

The excavation estimate assumes all material will have to be hauled out by truck. Concrete items are based on the belief that the contractor will be allowed to work off the canal bank. The existing 48" pipe to be removed is to be reused. Some care will be required in removal and the trench backfilled and compacted.

The chain link fence to be relocated is an existing fence apparently built by private parties along the canal, probably to keep children away

from the canal. The legal requirement to move the fence seems doubtful. Also its moving would place it further into the canal right of way. The manholes to be adjusted to grade will require major rebuilding since the crown on each will have to be lowered.

7. Possible Adverse Effects of Channel

So far as the Arcadia area and strip along the canal is concerned, the channel can have nothing but benefits. In the event of floods exceeding the capacity of the inlet, the channel will allow the water to move downstream to 56th Street much more quickly than it does now. From that point some of it would drop into the canal, but much of it would move across Indian School Road possibly creating flooding problems to the South. There is a possibility such an event could be construed as creating a liability for which someone might be awarded damages. While the water might reach the same location without this project, the construction of this channel will increase the speed and probably the volume.

The more rapid evacuation of water also will increase the rate of contribution to the Arizona Canal. This would have to be relieved by added capacity in the Old Cross Cut Canal. Means of increasing that channel capacity are under study.

8. Further Refinements

Before a final design is made, the general views of the Salt River Project will be needed to ascertain whether that agency is in agreement with the general criteria.

After the final review of the preliminary drawings, it was considered advisable to eliminate some of the grade fluctuations along the downstream end. Those had been established by attempting to create a generally uniform depth, but there are too many grade fluctuations for high flows. This will not change the basic concept or have material effect on quantities.

We are not satisfied with the treatment near 64th Street. As mentioned earlier this channel had not been extended to 64th Street so that its benefits would be within the city, and it could not be used to provide relief elsewhere. While relief east of 64th Street is desirable, if it is provided by this channel, the benefits west of 64th Street will be reduced. We may need to effect a compromise, i.e., extend the channel closer to 64th Street but not the entire distance. The depth of that section will need to be increased also.

Before a final design is made, it would be desirable to make further surveys to obtain floor elevations adjoining the alley for its full length together with adjoining curb elevations. Alignment and detail surveys will also be needed at the downstream end to the canal inlet.

9. Alternates

The only practical alternate to the design suggested, aside from the earlier suggestions of minor changes in vertical alignment and length, is to construct the channel deeper. A channel one foot deeper would cost about \$6,000 more. There is a limit to how deep the channel can and should be, however, because of the increased rate of discharge and the possible flooding south of Indian School Road.

Possibly a deep channel could be built on the basis that provision would someday be made for discharging its full capacity. Such a channel would have to be provided with a series of weirs to minimize its present capacity. A major problem with these weirs would be the handling of channel maintenance, for equipment could not then travel down the channel.

10. Miscellaneous Requirements Prior to Construction of Channel

There are a number of additional steps which

must be taken. The most obvious is approval of the property owners for abandoning use of the alley for normal alley purposes. In addition, there are a number of short alleys connecting to the main alley which will either need to be abandoned, to be no longer used for refuse pickup, or to have refuse collection with the trucks backing into those sections.

Also for safety considerations all gates from private residences will need to be closed in some manner. This item has not been included in the estimate, but barricading of the short alleys is included.

It may be necessary to secure from each property owner an easement over that portion of the lot outside the fence and also to barricade the gates into the alley. If so, it would be desirable if the easement could be kept in general terms so that it would not be necessary to determine the specific location of each fence and the detailed description of the easement. Location of each lot line would take considerable surveying. This is a matter for legal determination.