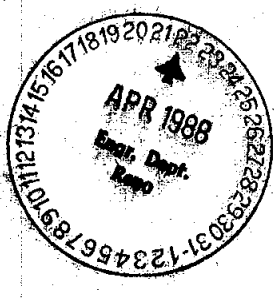
FLOOD STUDY

FOR

DONNER SPRINGS SUBDIVISIONS

RENO, NEVADA



Reno/Sparks, Nevada
Las Vegas, Nevada
Phoenix, Arizona

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CONSULTING ENGINEERS

SEA incorporated

Consulting Engineers

950 INDUSTRIAL WAY
SPARKS, NEVADA 89431-6092
(702) 358-6931

October 25, 1976
Project No. 76400 A

ROBERT L. HELMS CONSTRUCTION COMPANY
Post Office Drawer 608
Sparks, Nevada 89431

Gentlemen:

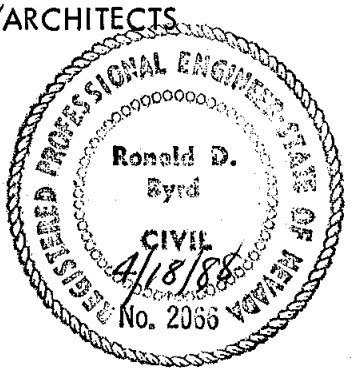
We are submitting herewith the Flood Study and Drainage Master Plan for the Greater Donner Springs Subdivision.

This report has been prepared subsequent to other flood reports by S E A, Inc., and is intended to modify and augment those previous studies. It is recommended that the criteria contained herein be used for the design of developments in the Donner Springs area.

Respectfully submitted,

S E A ENGINEERS/PLANNERS/ARCHITECTS

Ronald D. Byrd - P.E.
Registered Professional Engineer
R.E. No. 2066



RDB/MJD/fap
Enclosure

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FLOOD STUDY OF DONNER SPRINGS

SCOPE AND OBJECTIVES

The initial objective of this investigation was to identify major flood factors in and near the Donner Springs residential development. Potential storm flows in the Dry Creek drainage area were studied to determine the effect of high water on the residential area, which lies in the floodway's path. Of major importance was the computation of discharges for individual regions near the development and the associated water surface elevations. These flood characteristics were analyzed for historic, current and projected future use of the land.

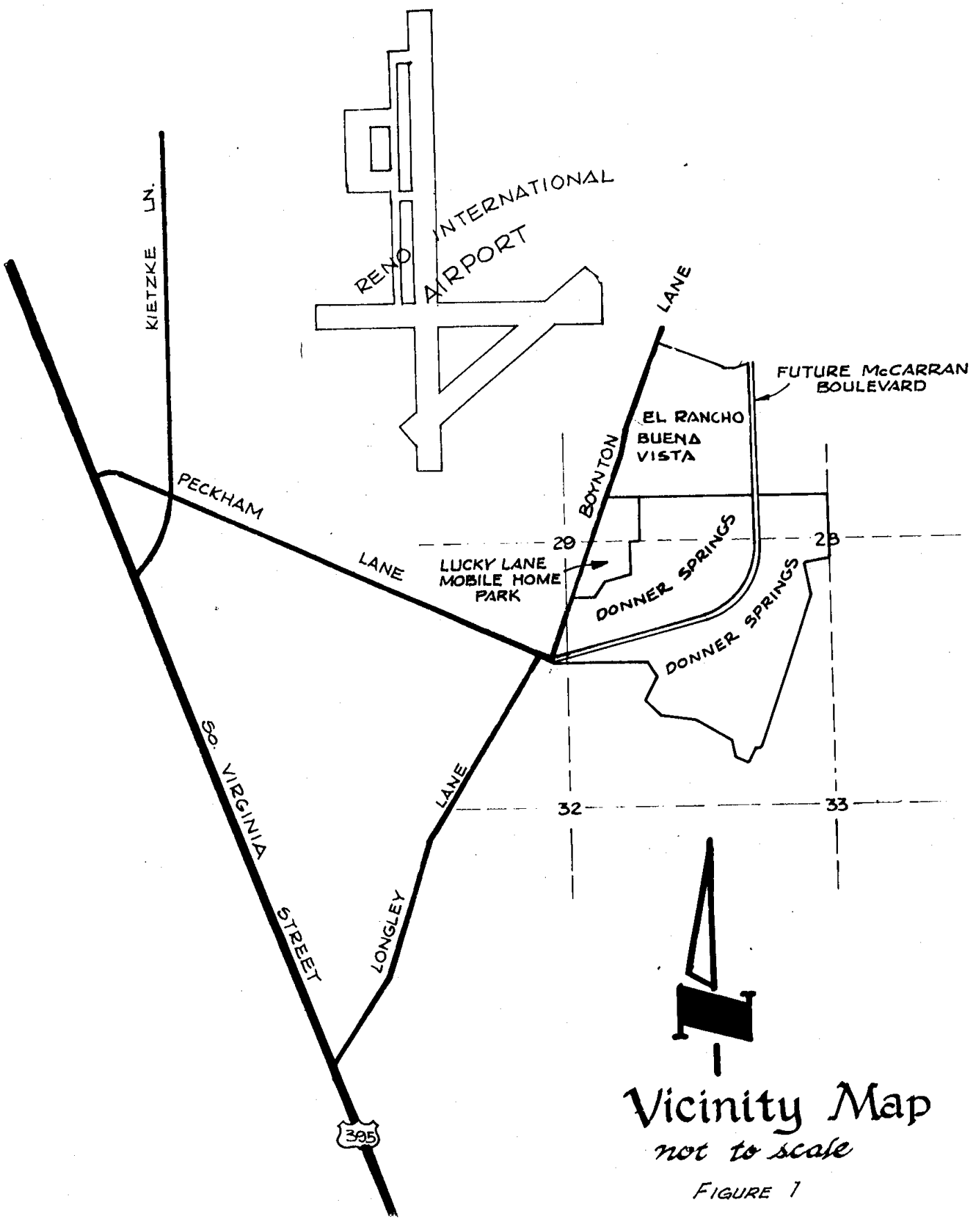
Based on the flood analyses, suggestions for the possible routing are presented. In addition, recommendations are given for the prevention or alleviation of potentially serious flood problems in this region.

STUDY AREA

Donner Springs comprises an area of about 400 acres, and lies in Section 29 of Township 19 North, Range 20 East, near Reno. The area is bounded on the south by Rattlesnake Mountain and on the west by Boynton Lane. To the north it borders on "Lucky Lane" Mobile Home Park and El Rancho Buena Vista. The development is divided into five (5) main sections, the first of which, Donner Springs Unit 1, is completed. Work has begun on the development of the remaining units. A map showing the location of Donner Springs and the adjacent areas is presented in Figure 1.

HYDROLOGY ABOVE DONNER SPRINGS

Donner Springs is situated in the flood region of the Dry Creek watershed, a twenty-



Vicinity Map

not to scale

FIGURE 1

four (24) square mile basin that drains from Mt. Rose. Evans Creek, a tributary to Dry Creek above Donner Springs development, augments the flood discharges affecting the study area.

With the intent of being conservative, only storm flows with a 100-year return period were analyzed. The peak discharge at East Peckham Lane from the Dry Creek and Evans Creek drainages for a 100-year storm is 4,400 c.f.s[1] Because of the considerable size of this flow, the Dry Creek channel is unable to carry all of the flood water and a major portion is transported as sheet flow on the stream's banks. Plate 10 of "Flood Plain Information, Truckee River, Reno-Sparks-Truckee Meadows, Nevada"[2] (herein referred to as the Flood Plain Report), illustrates that this overbank flow covers a large region, spanning a width of close to 3,500 feet where it crosses Peckham Lane.

HISTORIC FLOOD SITUATION

At the time of preparation of the Flood Plain Report (1970), the 100-year storm flows from Dry Creek were routed in a somewhat different manner than would occur today or in the future. In 1970, Donner Springs Unit 1 did not exist, and a large fraction of the 100-year peak flow traveled between Rattlesnake Mountain and a small hill 1,000 feet to the north of the mountain. In addition, the flow across the current location of "Lucky Lane" Mobile Home Park was not impeded by Donner Springs or the mobile home park, and thus was probably larger than it would be currently.

During 1970, there were four (4) routes by which the flood waters were transported through and beyond the current location of Donner Springs (Plates 8 and 10, Flood Plain Report). Attempts were made to determine the discharge quantities that passed through each area based on information in the Flood Plain Report. The first approximation

was made by assuming the flows were proportional to the relative widths of the constricted parts of the four floodways. This method was not very accurate, however, because it did not reflect the variation in channel dimensions, slopes and velocities between routes.

A second approach to the determination of historical flood quantities was based on Manning's equation calculations. Channel factors were derived from maps prepared by S E A Engineers and the Nevada State Highway Department (NSHD), while water depths were estimated based on information in the Flood Plain Report. This method resulted in reasonable answers for the Dry Creek channel and the region that crosses the current location of "Lucky Lane" Mobile Home Park. However, no calculation was made for the westernmost route near the Reno Airport because of insufficient data. In the region between Rattlesnake Mountain and the hill to the north of it, Manning's Equation produced values close to and in excess of the full 100-year peak flow from the entire Dry Creek drainage basin. It is highly improbable that the discharge in this area could be so large and therefore, none of the computed values here were trusted.

One possible explanation for the errant calculations near Rattlesnake lies in the apparent discrepancy between the topographic information given in the Flood Plain Report and that used in maps prepared by S E A Engineers and the NSHD. In some areas, such as this one, the Flood Plain Report shows contours to be, on the average, two feet (2') higher than the S E A elevations. This discrepancy makes overland flood waters appear quite deep because surface water elevations are estimated from the report and land topography is drawn from S E A and NSHD maps.

Another problem that could lead to unreasonable flow computations in some regions

is the apparent variation between sources in the predicted peak discharge for Dry Creek. The 4,400 c.f.s. value used in this study was determined subsequent to the publication of the Flood Plain Report, and consequently seems to differ from values given in the report. Although the calculated discharges from both sources were prepared by the Army Corps of Engineers, it is possible that different criteria were used in the most recent determinations. The Flood Plain Report lists 100-year peak discharges of 6,100 c.f.s. and 3,050 c.f.s. for Dry Creek and Evans Creek, respectively, at Last Chance Ditch, an irrigation canal approximately 3.5 miles upstream from Peckham Lane. If these flows are the result of concurrent storms centered over each of the two basins, it is unlikely that the routing of both flows downstream to Peckham Lane would result in an attenuated combined flow of 4,400 c.f.s.

In addition to the aforementioned difficulties in computing flow quantities, another problem arose in choosing proper areas for application of the Manning's equation. This procedure was relatively accurate only when used in floodways that carried uniform or gradually varied flow. Many flood regions in which the equation was applied apparently did not meet this criteria, for several of the computations yielded far from reasonable results. Among the factors which contributed to the non-uniform conditions were: 1) roads that traversed the floodways, 2) irrigation and other ditches that traversed the overland flow regions, 3) rapidly varied channel geometries, and 4) rapidly varied bed slopes.

Taking into account all of the problems in determining historical flood quantities, a final estimation of the flows in each path was made using a combination of techniques. A discharge of 1000 c.f.s. was computed for the Dry Creek channel approximately 700 feet upstream from the Boynton Lane crossing (Cross-section 1, Figure 2) using Manning's

formulation (Pages A-1 and A-2, Appendix A). The other three routes were considered to be primarily overland flow paths, and the amount of water carried by each was assumed to be proportional to the width of the constricted part of the floodway. Using this procedure, the location of the routes and their calculated discharges were:

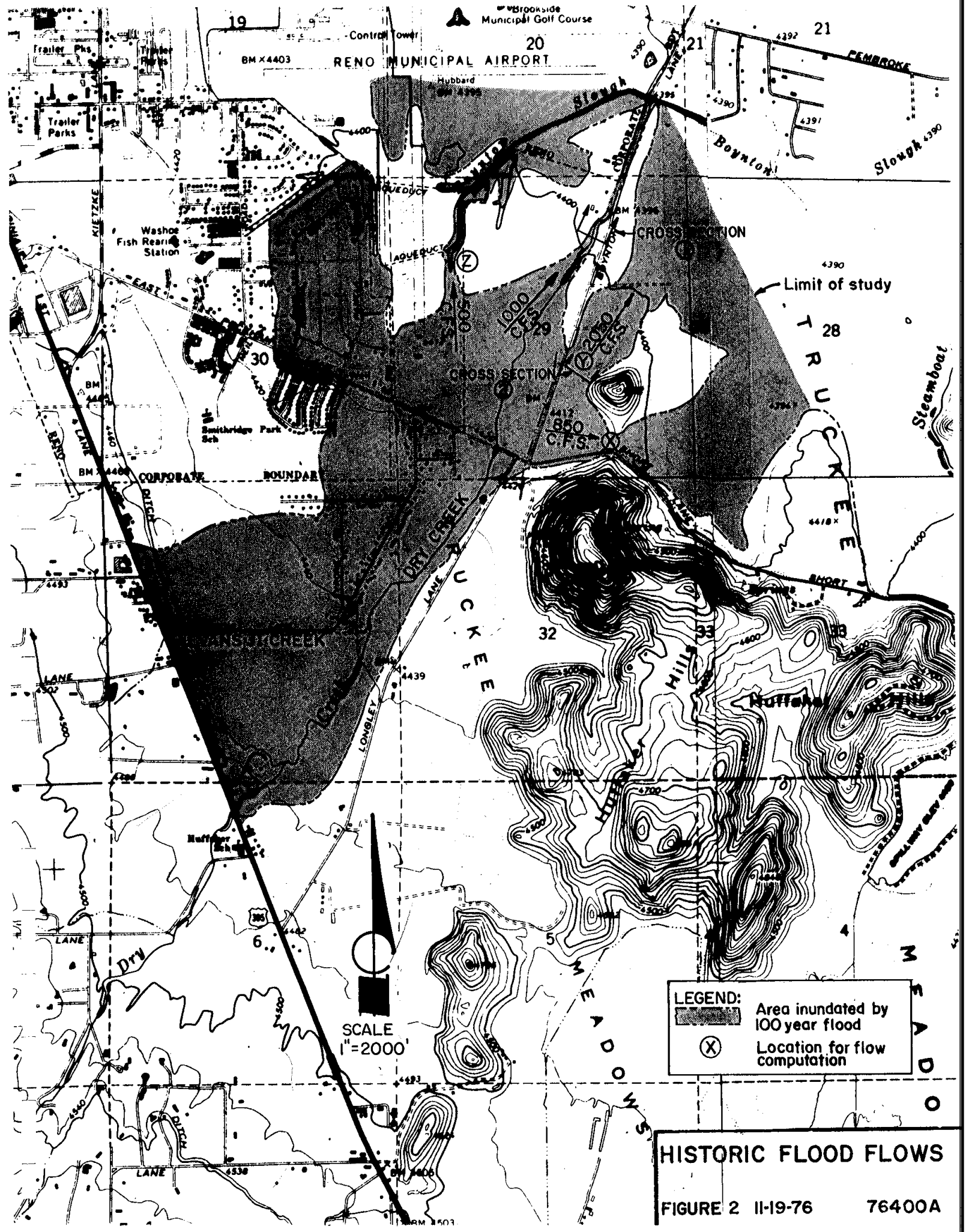
1. Between Rattlesnake Mountain and the hill 1,000 feet to the north (Location X, Figure 2) - 850 c.f.s.
2. Across the current location of "Lucky Lane" Mobile Home Park and the parcel of land adjacent to its northern border (Location Y, Figure 2) - 2,050 c.f.s.
3. Westernmost outlet to Boynton Slough, approximately 0.5 miles west Boynton Lane and close to the eastern boundary of the Reno Airport (Location Z, Figure 2) - 500 c.f.s.

The flows determined by this process were the final values used for the historic analysis.

A Manning's equation computation at the current loaction of the mobile home park gives partial corroboration to the estimate of 2,050 c.f.s across this region. The location of the cross-section used for this supportive calculation, Cross-section 2, is shown on Figure 2. The cross-section and calculations for that area are found on Pages A-3, A-4, and A-5, Appendix A. No concrete support or criticism can be given to the computed quantity of 500 c.f.s in the drain close to the airport due to the lack of data. It is possible, however, that this value is low because the flow here appears to be more channelized than overland.

CURRENT FLOOD SITUATION

As mentioned before, the quantities and direction of flow passing the north slopes of Rattlesnake Mountain have probably been altered by the development of Donner


Brookside Municipal Golf Course
Control Tower
RENO MUNICIPAL AIRPORT
BM X4403
Hubbard
Slough
Trailer Parks
Washoe Fish Rearing Station
Smithridge Park Sch
CORPORATE BOUNDARY
Bowlon
Pembroke
Steamboat
CROSS SECTION
Limit of study
1000 CFS
2000 CFS
850 C.F.S.
DRY CREEK
LONGLEY
Huffaker Hills
Huffaker Sch
Dry Ditch
MEADOWS
SCALE
1"=2000'
LEGEND:
Area inundated by 100 year flood
Location for flow computation
HISTORIC FLOOD FLOWS
FIGURE 2 11-19-76 76400A

Springs Unit 1. This residential area has been elevated three to five feet (3-5') above original ground and thus is no longer expected to be inundated by 100-year storm flows. However, it is probable that the remaining area between Donner Springs Unit 1 and Rattlesnake Mountain will be flooded. For identification purposes, this route is labeled Drainage Way 1.

In the remaining flooded region immediately below Peckham Lane, the 100-year discharge appears to flow over a single yet very wide flood path. No individual routes are distinguishable here. However, for purposes of analyzing those flows that could potentially cross Boynton Lane and reach Donner Springs, this region is considered as two drainage ways. These two routes are separated by a slightly elevated region about 500 feet west of and parallel to Boynton Lane. Although this high area is probably inundated by a 100-year peak discharge, it does likely impede water from being transferred from one floodway to the other for some 2000 feet below Peckham Lane. One of the routes consists of the Dry Creek channel and the overbank area to the west of it and is designated Drainage Way 3. The other path, Drainage Way 2, is located between Donner Springs Unit 1 and the elevated area previously discussed. This latter route is considered to be the source of water that overflows Boynton Lane and crosses "Lucky Lane" Mobile Home Park. The respective locations of Drainage Ways 1, 2, and 3 are given in Plate 1.

The amount of water passing through Drainage Way 1 in a 100-year storm could not be accurately determined for several reasons. This area is constantly being altered by ongoing construction and at several points updated topographic information is not available. However, even in regions where relatively accurate cross-sections were determined, Manning's equation yielded flows on the order of 50% of the full 100-year peak flow at Peckham Lane. These flows were rejected as being too large for reasons elucidated in

the historic flood section. In addition, the historic water surface elevations here also could not be used.

Another approximation of Drainage Way 1 discharge was arrived at by assuming the flow was proportional to the relative width of the flow path at Peckham Lane. Using this method, 5% of 4,400 c.f.s., or 220 c.f.s., was estimated to pass through this area. Once again, however, this result seemed dubious and far from trustworthy.

The final discharge used for routing through Drainage Way 1 was 850 c.f.s., the same flow estimated to pass by the north slope of Rattlesnake Mountain historically. This value is probably conservative because Donner Springs Unit 1 has eliminated much of the floodway through which the historic flow passed. Several cross-sections were analyzed superficially in this region using this discharge and the resultant water surface elevations wer calculated.

Because Drainage Way 1 quantities could not be accurately determined, the amount of water carried by Drainage Ways 2 and 3 was conservatively assumed to be the full 4,400 c.f.s. The calculated flows in each path were one again based on proportional widths of the routes. As a result, Drainage Way 2 was estimated to carry 14% of the 100-year peak discharge. However, in the interest of being even more conservative, a full 25% of the 4,400 c.f.s., or 1100 c.f.s., was considered to pass through this route. The remaining 3300 c.f.s. was allocated to Drainage Way 3.

Manning's equation was applied to several cross-sections in Drainage Way 2 to determine what surface elevations would result from a flow of 1100 c.f.s through here. At those points where relatively uniform flow seemed to exist, the computed flood water elevations were found to jibe fairly well with those estimated from the Flood Plain Report.

Flood depths between uniform flow sites were approximated.

Because Donner Springs Unit 1 cuts off a major historic flood route to "Lucky Lane" Mobile Home Park, it is doubtful that 2050 c.f.s. still crosses this area. Most of the 100-year flow here today would come from Drainage Way 2 water crossing Boynton Lane in the mobile home park. Currently, as in the past, an irrigation ditch located on the west side of Boynton flows into a pipe under the road near the "Lucky Lane" entrance. The limited capacity of this pipe and the existence of a few elevated areas in this vicinity probably help to create a backwater effect. This in turn enlarges the quantities of water that overflow Boynton Lane.

The percentage of Drainage Way 2 discharge that crosses over into "Lucky Lane" was determined indirectly by estimating the amount of water that gets by the high area just north of where the irrigation ditch turns into Boynton (Cross-Section 3, Figure 3). This was done through a combination of techniques. In the region within 150 feet of Boynton Lane, the high area was assumed to act much like a broad-crested weir. A formula for this kind of situation was applied based on an assumed water depth and a flow was calculated. In another region, about 500 feet west of Boynton, uniform flow appeared probable and Manning's equation was applied (Pages A-6 and A-7). This combined approach showed a flow of 300 c.f.s. bypassing this area. Therefore, under the assumption that Drainage Way 2 carries 1100 c.f.s. into this area, 800 c.f.s. is crossing over the road to the mobile home park. This value is probably conservative, but it was used for routing purposes.

Once the flow across the mobile home park had been determined, the associated water surface elevations were calculated. This was done for "Lucky Lane" and the parcel of land on its north side under the assumption that the 800 c.f.s. was divided evenly

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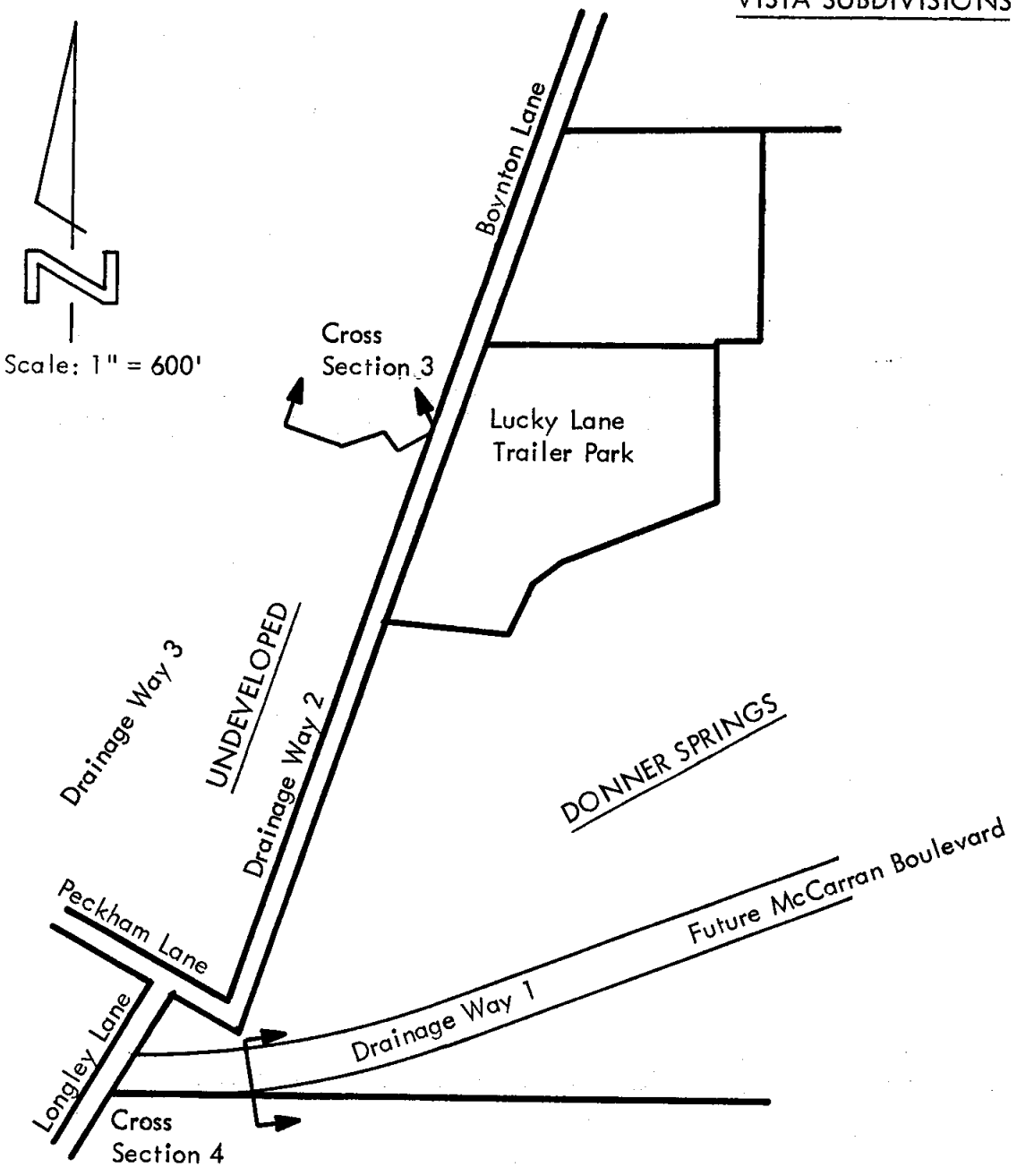

LOCATIONS OF CROSS-SECTIONS USED FOR CURRENT AND FUTURE FLOOD FLOWS

FORM 110

between the two pieces of land. The general direction of flow was estimated based on the current land use and topography of the region.

FUTURE FLOOD SITUATION

Because it is impractical to predict all land development in this area, only two changes in land use were considered in this analysis. The construction of McCarran Boulevard in the region of Drainage Way 1 represented one potential change in flood routing. Secondly, the effect of development in the land north of "Lucky Lane" was also examined.

Tentative information from the Nevada State Highway Department was used to compute storm flows along McCarran Boulevard. A cross-section was constructed for the road approximately 50 feet east of the southwest corner of Donner Springs Unit 1 and using Manning's equation, a 100-year discharge of 700 c.f.s. was determined (Pages A-8 and A-9, Appendix A). This represents the flow that would pass between Donner Springs Unit 1 and Rattlesnake Mountain in the future (Plate 1). The location of the cross-section used for this calculation (Cross-section 4) is displayed on the map in Figure 3.

It is difficult to tell how the parcel of land immediately north of the mobile home park will eventually be used. However, it is not impractical to assume that the surface elevations will remain close to what they currently are, and that streets constructed here will also carry water towards Donner Springs Unit 2. Based on these assumptions, the flow estimated to cross the land after development was considered to be the same as that estimated for the current situation. Plate 1 shows these flows.

COMPARISONS WITH PREVIOUS STUDIES

In an earlier investigation of the flood flows in this region, S E A Engineers based the 100-year peak discharges upon the published information that was available at that

time. This report was prepared using the latest available information including the Corps of Engineers report "Flood Plain Information Southwest Foothills Streams, Reno Nevada"[3] and letter to Douglas W. Hopkins[1]. The previous reports had indicated flows near the intersection of Boynton and Peckham Lanes to be around 7,000 c.f.s., while the latest estimate from the Corps of Engineers indicates 4,400 c.f.s.[1] for the 100-year return period flood. According to the letter from the Corps of Engineers to Douglas W. Hopkins[1] the 4,400 c.f.s. represents the routing of runoff from Dry and Evans Creeks to East Peckham Lane.

Because a total combined flow of 4400 c.f.s. was used in this report, the resulting flows routed through each of the individual drainage ways also differ from previous S E A estimates. Only those values used for historic flows across "Lucky Lane" are close in magnitude. An earlier S E A study estimated the peak discharge over this path to be approximately 2500 c.f.s., while this report shows 2050 c.f.s.

DURATION OF CRITICAL FLOOD PERIODS

The length of time over which the 100-year peak flood flows would threaten the study area is not directly determinable. However, information presented in previous studies indicates relatively short critical periods.

The Flood Plain Report shows a duration of critical stage (i.e. the period of overbank flow) of two hours for Dry Creek at Virginia Street (page 56, Flood Plain Report). Similarly, Evans Creek at Virginia Street is also reported as having a critical stage period of two hours. It is doubtful, however, that Dry Creek at the study site would also maintain a flood stage for such a short period of time for at least three reasons:

1. Dry Creek and Evans Creek combine their flows above the study area.
2. Flood path geometries change between Virginia Street and the study area.
3. As a flood wave is routed downstream the flow volume is usually spread out over a larger time span.

Regardless of these factors, based on the given information, it is not unreasonable to assume that Dry Creek near Donner Springs would not overflow its banks for a period longer than eight hours.

An additional Corps of Engineers publication entitled "Flood Plain Information, Southwest Foothill Streams, Reno, Nevada"[3] (Herein referred to as the Southwest Foothill Streams Report), also gives information by which relative time durations of 100-year flood flows can be estimated. This study was published subsequently to the determination of a peak discharge of 4400 c.f.s. at Peckham Lane. Therefore, the peak flows of 4300 c.f.s. and 2600 c.f.s., listed in the report for Dry Creek and Evans Creek at Virginia Street, respectively, were probably routed downstream to produce the 4400 c.f.s. value. Under this assumption, it appears that the peak flows from Dry and Evans Creeks do not arrive at the streams' confluence at the same time. Also evident is the fact that the 100-year storm flow of Dry Creek increases little between Virginia Street and Peckham Lane.

The Southwest Foothill Streams Report includes stage hydrographs for Dry Creek and Evans Creek at locations in the proximity of Virginia Street. These visual representations of flood depths are also shown in this report on pages A-10 and A-11 of Appendix A. From the hydrographs it can be seen that the critical stage duration for Dry Creek is approximately three hours while that for Evans Creek is close to four hours. Using this

information and the assumption that Evans Creek exerts minimal influence on Dry Creek discharges, the critical stage duration in the study area can reasonably and conservatively be estimated to vary between four and eight hours.

DESIGN TO ACCOMODATE FLOOD FLOWS

The Donner Springs residential development has been designed to carry those 100-year flood flows that are estimated to enter the development for the future flood situation. A map showing the flows and how they are routed through the subdivision units is presented in Plate 1. Typical cross-sections of the channels and streets used as flood escapeways are also shown on the plate. It is highly desirable that the current floodways not be altered in any way that would result in peak flows through Donner Springs that would exceed those given here. Failure to do this would almost certainly result in damaging effects on the area in the event of a 100-year flood.

RECOMMENDATIONS

Several recommendations can be given as a result of this and other studies in the interest of avoiding serious flood problems in this region in the future. All of the alternatives suggested here apply only to areas outside of the Donner Springs residential development. Firstly, it is strongly suggested that Recommendation No. 11 found in "An Addendum Report on Storm Drainage"[4] for the City of Reno be followed. This alternative would allow for the construction of a flood detention reservoir on Steamboat Creek near Huffaker Hills, diversion of Dry Creek into this reservoir, and downstream channel improvements on Steamboat Creek. If this program could not be followed, the following alternatives are also recommended:

1. Control the development of land upstream from the study area to prevent the

current 100-year peak storm flows from increasing.

2. Provide adequate floodways to carry 100-year storm discharges by and beyond the study area. If necessary, the Dry Creek channel could be enlarged to achieve this effect.

3. Minimize the problems associated with obstructions to flood flow. Steps that could be taken to reach this goal include increasing the carrying capacities of existing bridges and culverts.

4. Limit the diversion of storm discharges from adjacent stream basins into the Dry Creek flood plain. If additional water is brought in from outside the Dry Creek drainage area, provide means of controlling the extra burden placed on the watershed.

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MIRA LOMA DRIVE

BLVD.

COMMERCIAL AREA

2B

2C-1

2A

2C

1

4

3A

3B

5

LUCKY LANE TRAILER PARK

UNDEVELOPED

DRAINAGE WAY 3

DRAINAGE WAY 2

DRAINAGE WAY 1

BOYNTON LANE

PECKHAM LANE

LONGLEY LANE

MC CARRAN

POSSIBLE ESCAPE WAY

FUTURE

400 CFS

1100 CFS

700 CFS

3700 CFS

4400 CFS

60'±

100'±

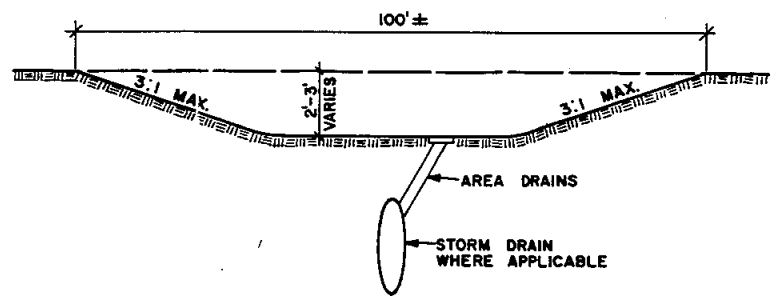
+1%-5

SCALE: 1"= 600'

RATTLESNAKE HILL

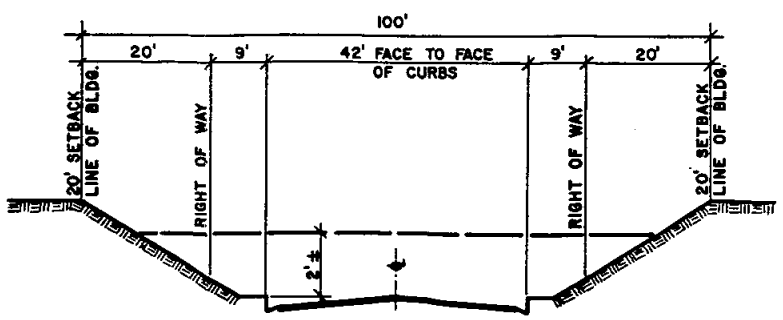
LEGEND

- PROPOSED DRAINAGE WAY AND DESIGN WIDTH AND CAPACITY
- PROPOSED INTERCEPTOR STORM DRAIN CONDUITS
- APPROXIMATE DIKE LOCATION
- PROPOSED LAKE AND DETENTION POND
- 2C-1 DONNER SPRINGS SUBDIVISION UNIT NUMBERS



TYPICAL SECTION A—A

SCALE: HORIZ. 1"=30' VERT. 1"=6'



TYPICAL SECTION B—B

SCALE: HORIZ. 1"=30' VERT. 1"=6'

MASTER PLAN OF DRAINAGE
DONNER SPRINGS SUBDIVISIONS

SPARKS, NEVADA
LAS VEGAS, NEVADA
SEATTLE, WASHINGTON
ENGINEERS/PLANNERS ARCHITECTS

JOB NO. 76400

REFERENCES

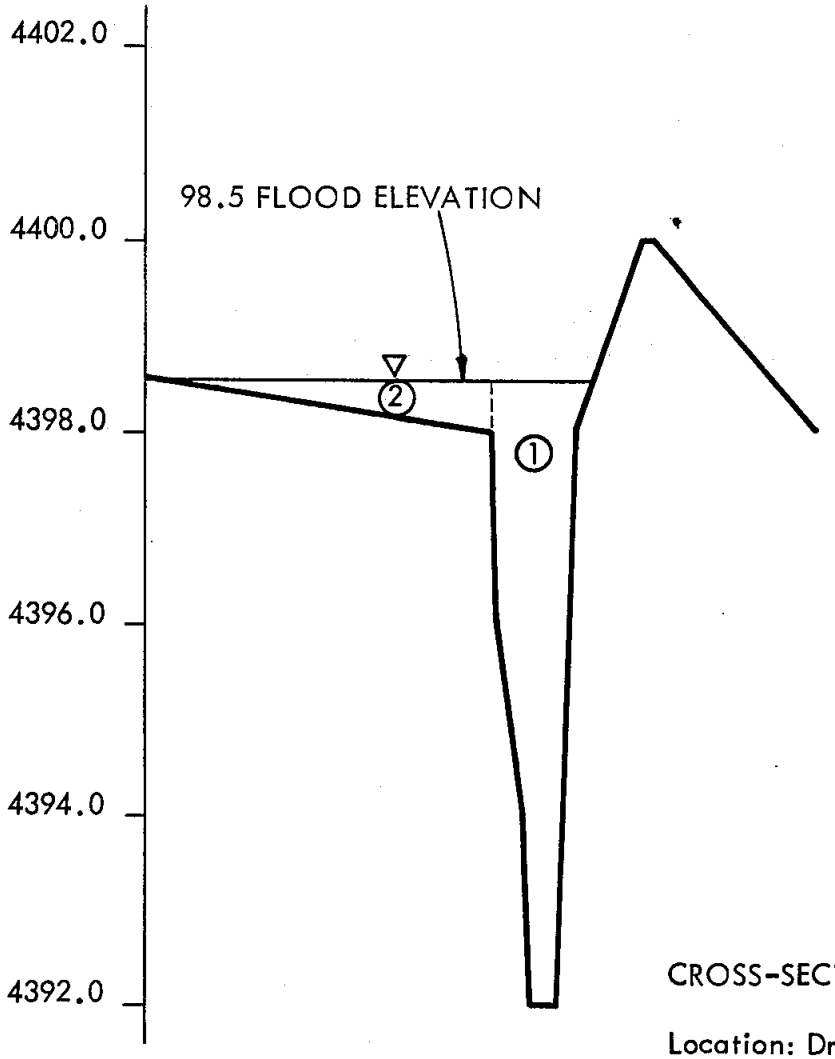
1. Letter to Douglas W. Hopkins, Assistant Washoe County Engineer, from A. W. Zimmerman on behalf of George C. Weddell, Chief of Engineering Division, Sacramento District Corps of Engineers; March 6, 1974.

2. Department of the Army, Sacramento District Corps of Engineers; "Flood Plain Information, Truckee River, Reno-Sparks-Truckee Meadows, Nevada"; October, 1970.

3. Department of the Army, Sacramento District Corps of Engineers; "Flood Plain Information, Southwest Foothill Streams, Reno, Nevada"; June, 1974.

4. Department of Engineering, City of Reno, and Kennedy Engineers; "An Addendum Report on Storm Drainage", Prepared as a Supplement to the Storm Drainage Section of the Master Plan Report on Storm Drainage and Sanitary Sewerage of October 1957; August, 1963.

APPENDIX A



CROSS-SECTION 1

Location: Dry Creek channel approximately 650' upstream from bridge where Boynton Lane crosses the creek. (Figure 2)

Scale: Horiz. 1" = 50'
Vert. 1" = 2'

Calculations for Cross-Section 1 at 4398.5' Elevation:

1. Section 1

$A = 96.8 \text{ ft.}^2$

$P = 27.5 \text{ ft.}$

$R = 3.52$

$n = 0.028$

$s = 0.0066$

$$V = \frac{1.486}{n} S^{1/2}R^{2/3} = \frac{1.486}{0.028} (0.0066)^{1/2}(3.52)^{2/3}$$

$= 10.0 \text{ f.p.s.}$

$Q = VA = (10 \text{ f.p.s.})(96.8 \text{ ft.}^2) = 968 \text{ c.f.s.}$

2. Section 2

$A = 22.5 \text{ ft.}^2$

$P = 90 \text{ ft}$

$R = 0.25$

$n = 0.030$

$s = 0.003$

$V = 1.3 \text{ f.p.s.}$

$Q = (1.3 \text{ f.p.s.})(22.5 \text{ ft.}^2) = 29 \text{ c.f.s.}$

Total $Q = 968 + 29 = 997 \text{ c.f.s.}$

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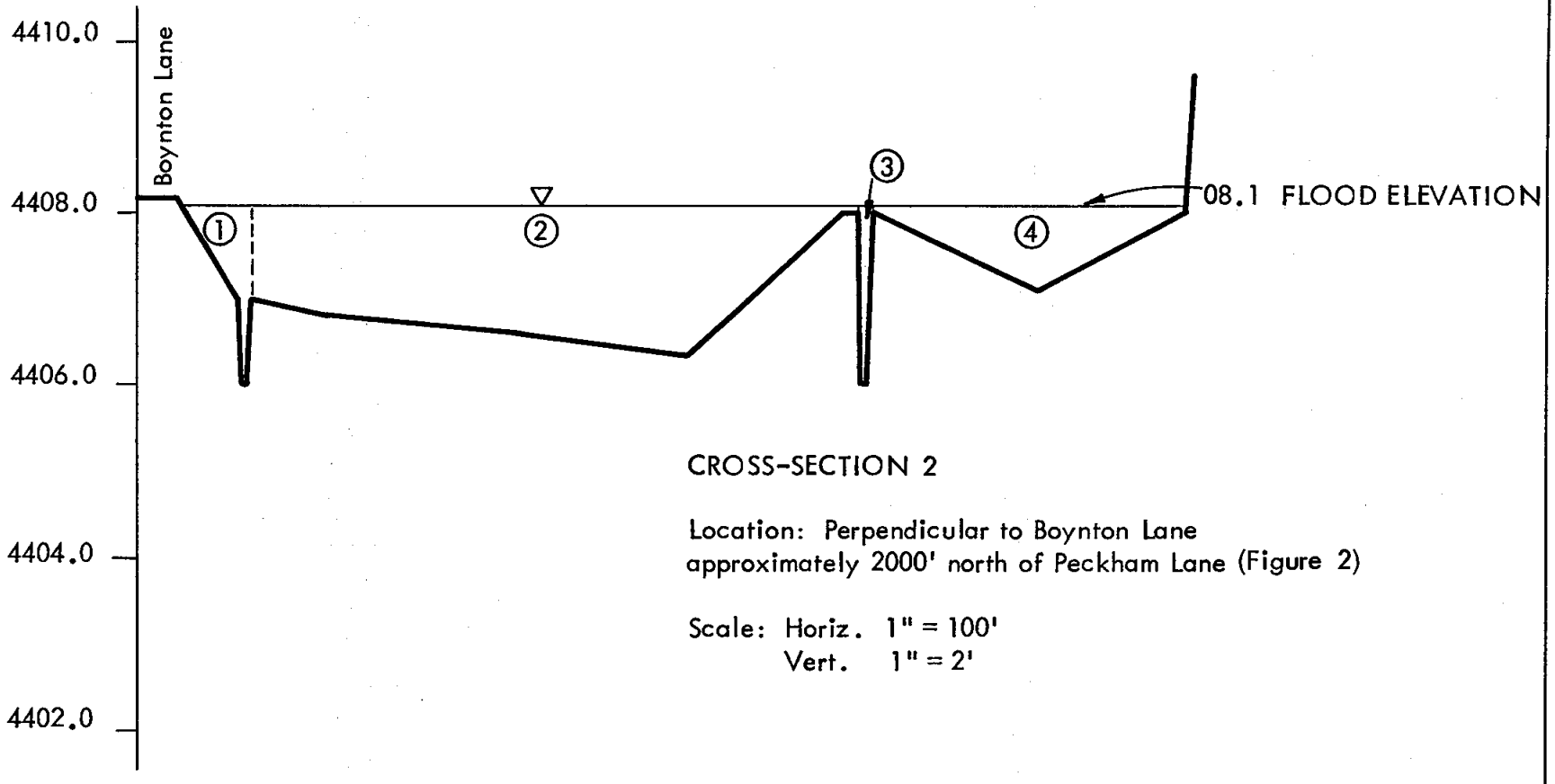

CROSS-SECTION 2

Location: Perpendicular to Boynton Lane approximately 2000' north of Peckham Lane (Figure 2)

Scale: Horiz. 1" = 100'
Vert. 1" = 2'

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PLATE A-3

Calculations for Cross-Section 2 at 4408.1' Elevation

1. Section 1

$A = 45 \quad ft.^2$
$P = 47 \quad ft.$
$R = 0.96$
$n = 0.030$
$s = 0.004$

$$V = \frac{1.486}{n} S^{1/2} R^{2/3} = \frac{1.486}{0.030} (0.004)^{1/2} (0.96)^{2/3}$$

$= 3.0$ f.p.s.

$Q = VA = (3.0)(45) = 135$ c.f.s.

2. Section 2

$A = 412 \quad ft.^2$
$P = 370 \quad ft.$
$R = 1.11$
$n = 0.030$
$s = 0.005$

$$V = \frac{1.486}{0.030} (0.005)^{1/2} (1.11)^{2/3}$$

$= 3.75$ f.p.s.

$Q = VA = (3.75)(412) = 1545$ c.f.s.

3. Section 3

$A = 15 \quad ft.^2$
$P = 12 \quad ft.$
$R = 1.25$
$n = 0.030$
$s = 0.005$

$$V = \frac{1.486}{0.030} (0.004)^{1/2} (1.25)^{2/3}$$

$= 3.5$ f.p.s.

$Q = VA = (3.5)(15) = 52$ c.f.s.

4. Section 4

$A = 105 \quad ft.^2$
$P = 175 \quad ft.$
$R = 0.60$
$n = 0.030$
$s = 0.005$

$$V = \frac{1.486}{0.030} (0.005)^{1/2} (0.60)^{2/3}$$

$= 2.5$ f.p.s.

$Q = VA = (2.5)(105) = 262$ c.f.s.

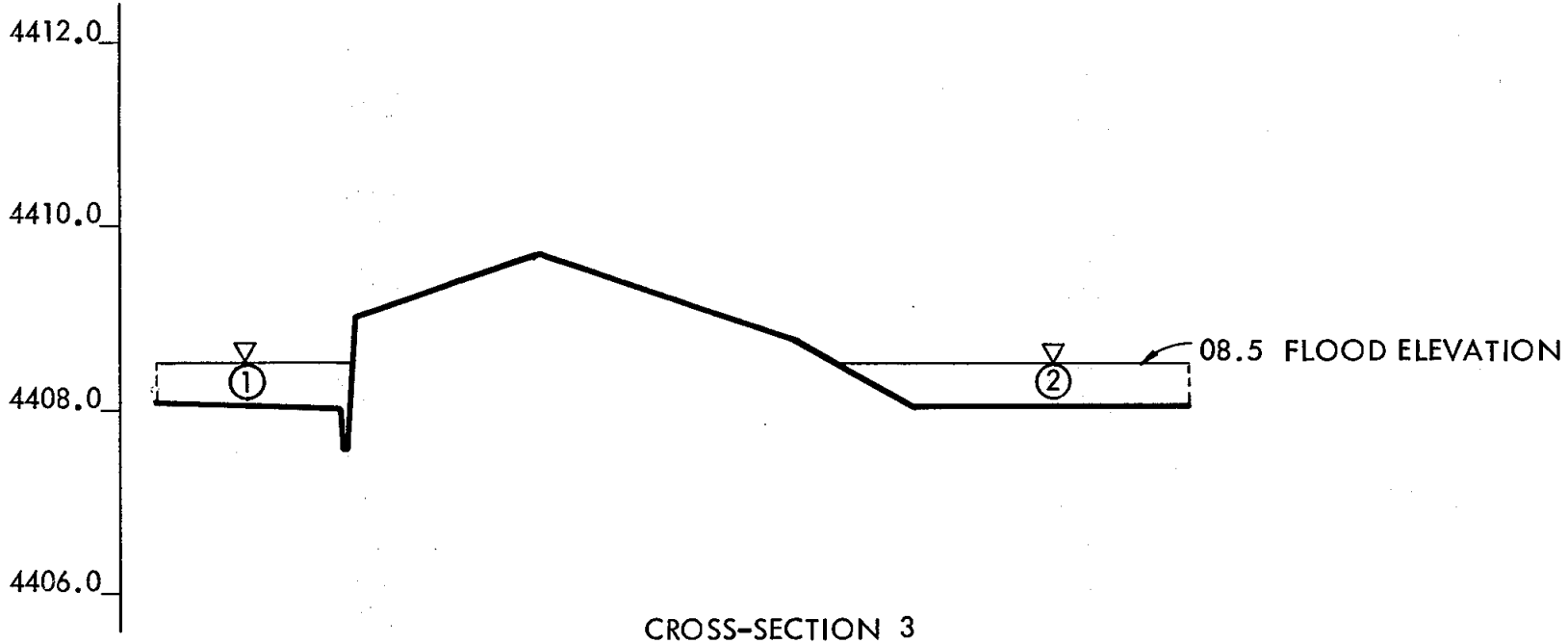
5. Assume an additional 100 c.f.s. from the following two sources:

   a. Pipe under Boynton Lane from ditch on west side of Boynton - 50 c.f.s.

   b. Flow over Boynton in the area where pipe crosses under the road - 50 c.f.s.

Total: Q = 2095 c.f.s.

FORM 110



CROSS-SECTION 3

Location: Generally perpendicular to Boynton Lane approximately 650' north of north boundary of Donner Springs Unit 1. Part of the cross-section follows high elevation points while the remainder is perpendicular to an overland flow path. (Figure 3)

Scale: Horiz. 1" = 100'
Vert. 1" = 100'

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PLATE A-6

Calculations for Cross-Section 3 at 4398.5' Elevation

1. Section 1

$A = 51 \text{ ft.}^2$

$P = 108 \text{ ft.}$

$R = 0.47$

$n = 0.030$

$s = 0.006$

$$V = \frac{1.486}{n} (S)^{1/2} (R)^{2/3} = \frac{1.486}{0.030} (0.006)^{1/2} (0.47)^{2/3}$$

$= 2.3 \text{ f.p.s.}$

$Q = VA = (2.3)(51) = 117 \text{ c.f.s.}$

2. Section 2

This section behaves much like a broad-crested weir. Therefore, the formula used is:

$$Q = C\ L\ d^{1.5}$$

where Q = discharge in c.f.s.

C = coefficient of discharge

L = length of the weir crest in ft.

d = depth of flow over the weir in ft.

In this problem C is assumed to be 3.0 and:

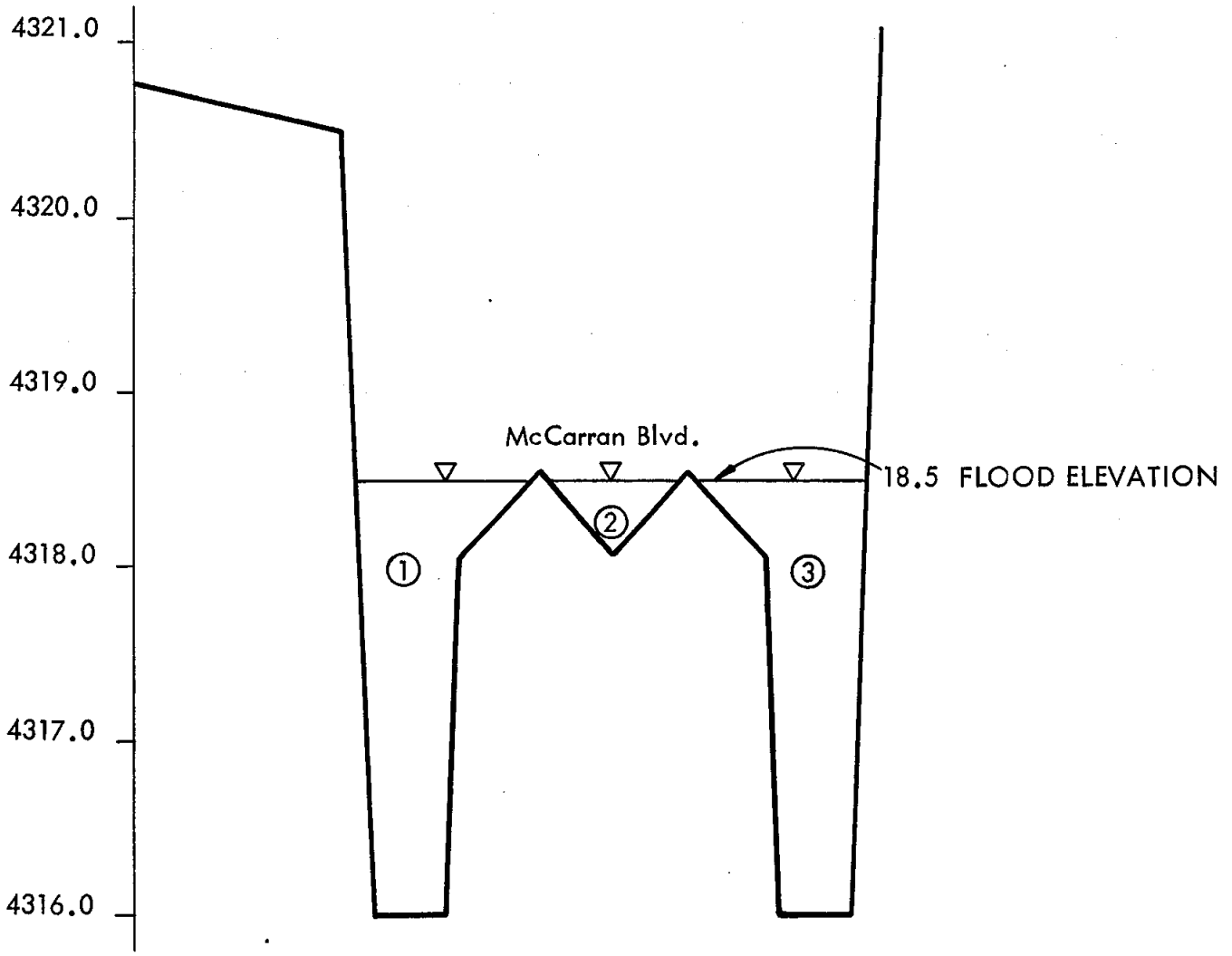
$L = 170 \text{ ft}$

$d = 0.5 \text{ ft (assumption)}$

$$Q = C\ L\ d^{1.5} = (3.0)(170)(0.5)^{1.5}$$

$= 180 \text{ c.f.s.}$

Total $Q = 297 \text{ c.f.s.}$



CROSS-SECTION 4

Location: Perpendicular to southern boundary of Donner Springs Unit 1 and proposed McCarran Blvd., approximately 50' east of southwest corner of Donner Springs Unit 1. (Figure 3)

Scale: Horiz. 1" = 50'
Vert. 1" = 1'

Calculations for Cross-Section 4 at 4418.5' Elevation

1. Section 1

$A = 70\ Ft^2$

$P = 50\ Ft$

$R = 1.40$

$n = 0.030$

$s = 0.0059$

$$V = \frac{1.486}{n} (S)^{1/2} (1.40)^{2/3} = \frac{1.486}{0.030} (0.0059)^{1/2} (1.40)^{2/3}$$

$= 4.8$ f.p.s.

$Q = VA = (4.8)(70) = 336$ c.f.s.

2. Section 2

$A = 8.5$ ft.^{2}

$P = 38$ ft.

$R = 0.22$

$n = 0.015$

$s = 0.0059$

$$V = \frac{1.486}{0.015} (0.0059)^{1/2} (0.22)^{2/3}$$

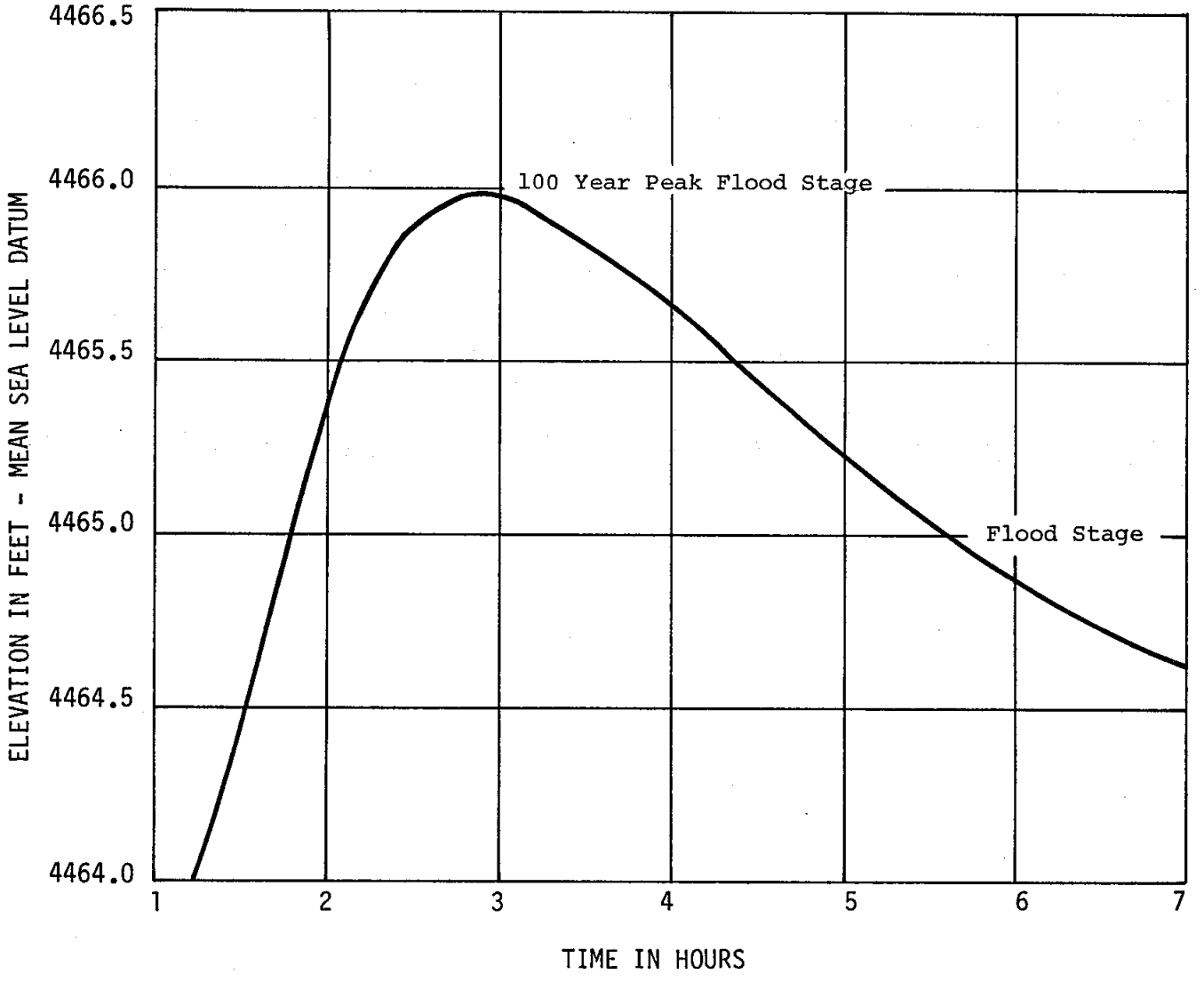
$= 2.7$ f.p.s.

$Q = VA = (2.7)(8.5) = 23$ c.f.s.

3. Section 3

Same as Section 1 $Q = 336$ c.f.s.

Total: $Q = 695$ c.f.s.



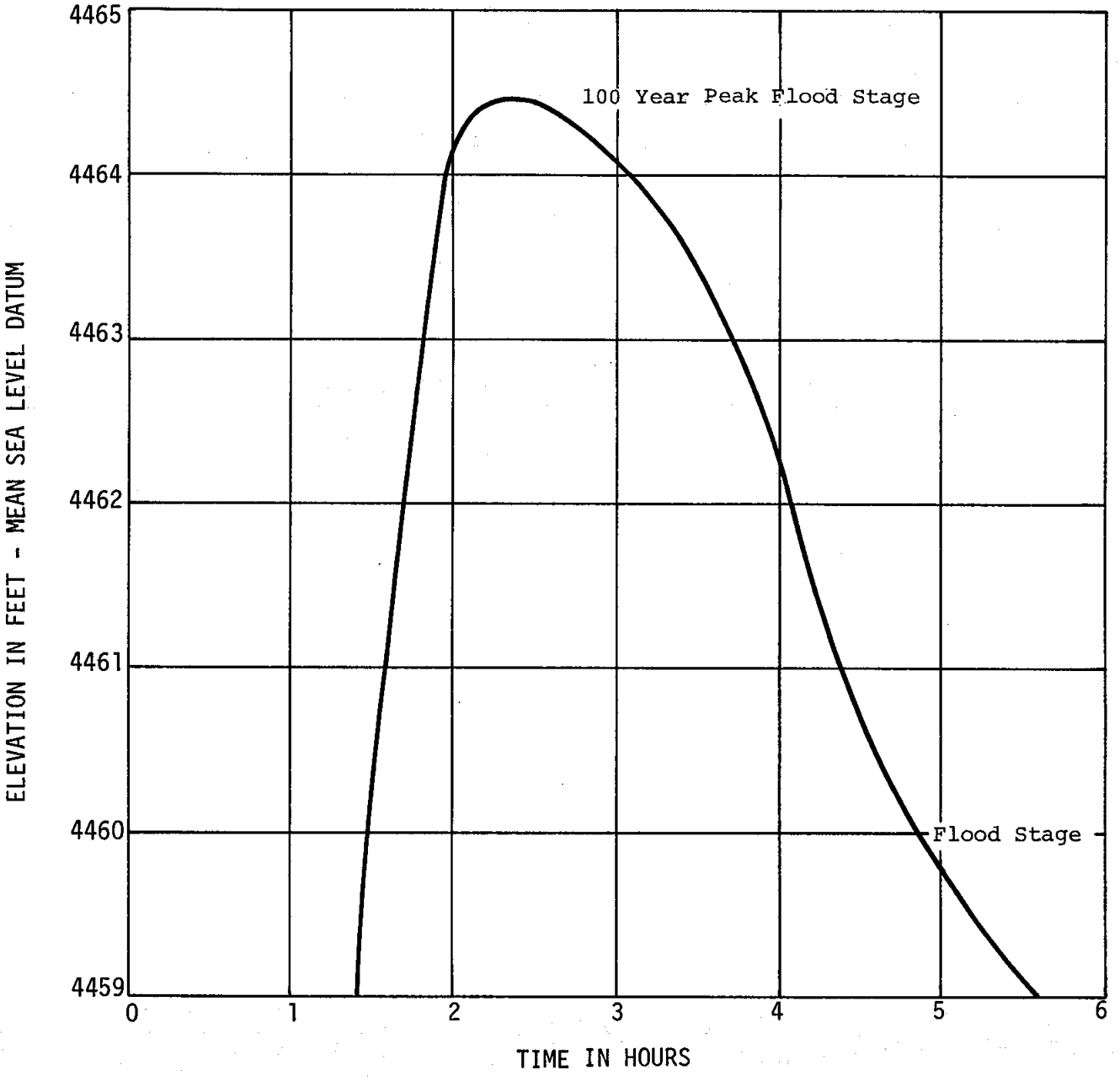
FLOOD STAGE HYDROGRAPH - EVANS CREEK

Location: Approximately 0.15 miles upstream from Virginia Street.

NOTES:

Flood Stage represents beginning of overbank flow.

Reprinted from "Flood Plain Information, Southwest Foothill Streams, Reno, Nevada;" June 1974.



FLOOD STAGE HYDROGRAPH - DRY CREEK

Location: Approximately 0.02 miles upstream from Virginia Street

NOTES:

Flood Stage represents beginning of overbank flow.

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