CPM - File

HYDROLOGIC ANALYSIS

Thomas Creek, Dry Creek, and Evans Creek
Washoe County, Nevada

Prepared for:

Federal Emergency Management Agency
Contract #EMW-89-C-2841

AUGUST 1990
NIMBUS JOB #8901

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1.0 INTRODUCTION

In 1989, Nimbus Engineers was authorized by the Federal Emergency Management Agency (FEMA) under Contract No. EMW-89-C-2841 to conduct a flood insurance restudy for Thomas and Dry Creeks in Washoe County and the City of Reno (see figure 1 for vicinity map). As specified in the scope of work, Nimbus evaluated other hydrology studies completed for the Dry and Thomas Creek watersheds. Rainfall-runoff models using the U.S. Army Corps of Engineers (COE) HEC-1 computer program were also developed for these watersheds. The purpose of these models was to provide a comparative analysis to better evaluate the current FEMA discharges and the COE's 1980 discharges. In 1990, FEMA authorized Nimbus to develop a hydrologic model for Evans Creek and combine it with the Dry Creek model. This model of Evans Creek was necessary to determine the 100-year discharge of Dry Creek at its confluence with Evans Creek.

This report will include the following:

-The methodology used to develop rainfall-runoff models for Thomas, Dry, and Evans Creek.

-A physical description of the watersheds.

-The results of evaluating existing hydrology studies for Thomas, Dry, and Evans Creeks (FEMA's and the COE's studies).

-The assumptions used to determine the 100-year peak discharge of Dry Creek at its confluence with Evans Creek.

-The results of the rainfall-runoff models with an explanation of why these results will be used in the restudy instead of the discharges from FEMA's and the COE's studies.

2.0 METHODOLOGY FOR THE RAINFALL-RUNOFF MODELS

To assess the COE's and the original Flood Insurance Study's (FIS) hydrology, Nimbus conducted a hydrologic analysis using the SCS methods option in the COE's HEC-1 computer model (Reference 1). The discharges from this analysis are in Table 7. One model was developed for the Dry Creek watershed and one model for the Thomas Creek watershed. A third model was developed which combines the Evans Creek watershed with the Dry Creek watershed.

The models used the following parameters to calculate runoff:

1) Basin area in square miles.

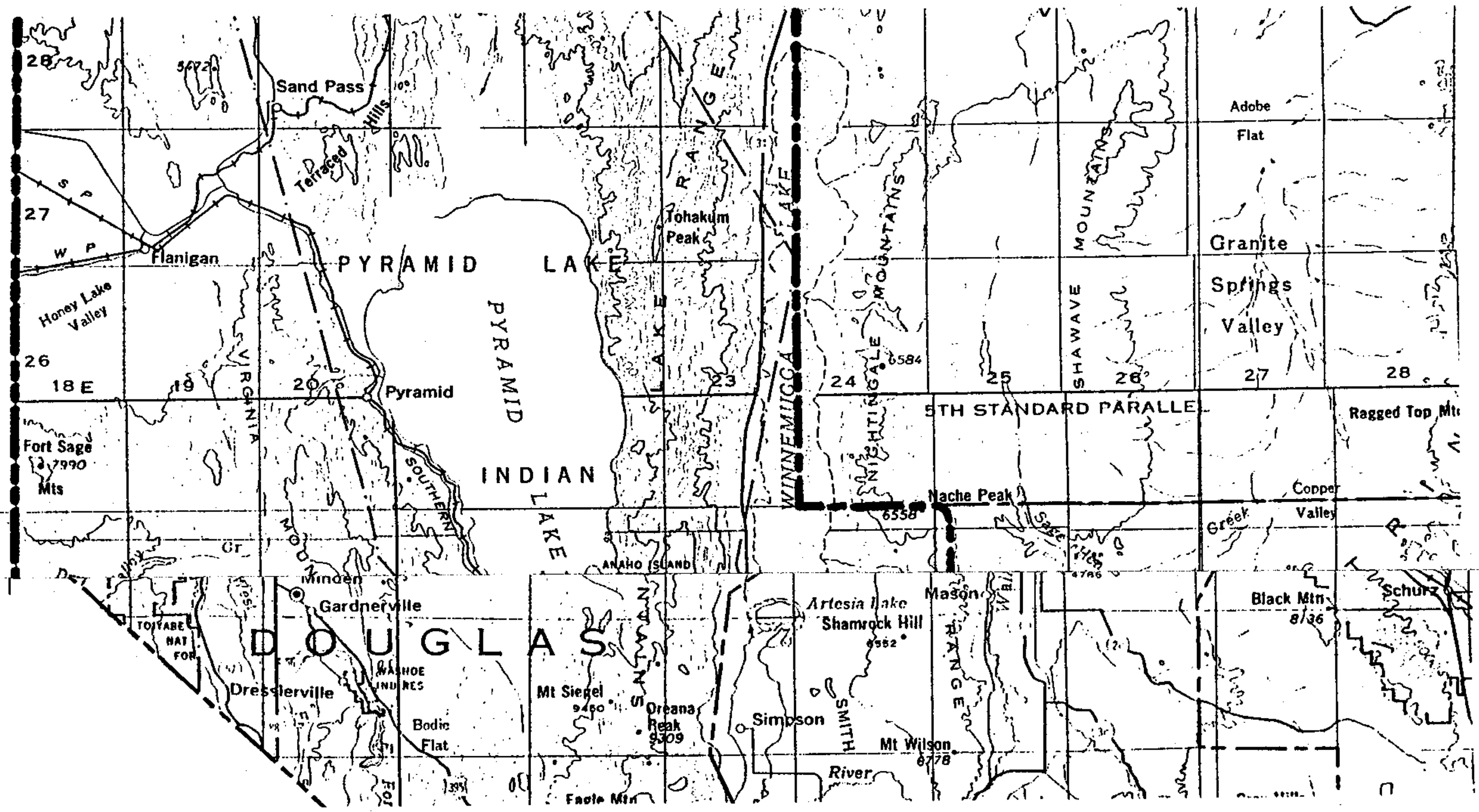

FIGURE 1

Vicinity Map

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2) Runoff curve number, which estimates how much rainfall will become runoff for a given basin. This number is selected based upon soil type, relative soil moisture content, vegetation type, and vegetation cover density.

3) Percentage of the drainage area that is impervious.

4) Basin lag time, which is defined as the time from the center of mass of rainfall excess to the peak discharge, expressed in hours.

5) Rainfall depth, duration, and distribution.

The watershed boundaries were identified using USGS 7.5 minute quadrangle maps (Reference 2) and field inspection. The area of each contributing drainage area was measured from the USGS quad maps.

The first step to estimating runoff curve number is identification of soil types for each individual drainage area. In the cases where the soil type had more than one possible hydrologic soil group, the soil group was selected based upon field inspection or use of the more conservative possibility. Soils are classified by the SCS into four hydrologic soil groups, type A, B, C and D. Type A soils have a rapid infiltration rate and include very porous soils such as sandy soils. Type D soils have a very slow infiltration rate which results in a larger percentage of the rainfall expressed as runoff. Soil types and hydrologic soil groups were identified using the SCS Soil Survey for Washoe County (Reference 3).

Relative soil moisture content is described in the SCS methodology by a term identified as "antecedent moisture condition" (AMC). Three different relative conditions are described by the SCS: AMC I, II and III. AMC I is an extremely dry condition where soil moisture has been depleted and infiltration rates for the soil are near their maximum. AMC II is an average condition. AMC II is the standard condition used for hydrologic analysis in the western states. AMC III is a saturated condition which represents the condition where the soils infiltration rate is near its lowest level. The AMC II soil moisture condition was used in selecting the appropriate table of curve numbers.

Vegetation and cover density for the drainage areas were determined from field inspection and aerial photos. Using the identified hydrologic soil groups and vegetation information, curve numbers used in the HEC-1 models were selected using the SCS TR-55 handbook and SCS NEH-4 as a guide (References 4 and 5).

The Upland Method in NEH-4 was used for subbasins less than 2000 acres (3.12 square miles). All the subbasins in the models with exception of the upper basin of Evans Creek were less than 2000 acres. The Upland Method estimates flow velocity based on channel slope and ground cover. Due to the variability of the channel slope within these basins, a reach by reach analysis was performed. The resulting travel time is multiplied by the empirical factor of 0.6 (NEH-4) to obtain the watershed lag time estimate.

In the method described in TR-55, the travel time is determined by dividing the hydraulic length into three reaches: one reach for sheet, one reach for shallow concentrated, and one reach for channel flow. The hydraulic length is the length from the hydraulic most distant point in the basin to its outlet. For a more detailed explanation on how the travel times for the reaches are calculated see Chapter 3 in the TR-55 manual. For the upper basin of Evans Creek, the lag time was developed using the procedure described in TR-55. Travel time through the channel reaches were estimated from hydraulic calculations of cross sections taken from the USGS 7.5 minute quadrangles and field notes.

Channel routing was performed with the Muskingum method of channel routing. The parameters for the reaches modeled with the Muskingum method were estimated using channel and overbank characteristics, lengths, slopes and typical roughness. The guidelines set forth in the HEC-1 manual were used to estimate values for k,t, and x (Reference 1).

The Modified Puls routing method was used to route the flow under I-580 at two locations: a reinforced concrete box (RCB) for Evans Creek, and a 66 inch culvert located between the Evans Creek RCB and the Dry Creek RCB. No storage routing was required for the Dry Creek crossing under the interstate because the flow is confined in the channel. The stage-discharge relationships at the culverts were calculated using the methods and equations in the Federal Highway Administration report "Hydraulic Design of Highway Culverts" (Reference 12). The stage-storage relationship for each culvert was developed using a 1 inch = 400 feet scale topographic map (4 foot contour interval) developed by Kenney Aerial Mapping, Inc. (Reference 13). A topographic map, 1" =100' scale (2 foot contour interval), from the Nevada Department of Transportation (NDOT) was used to supplement the Kenney map (Reference 14).

The rainfall distribution used in this model is a hypothetical distribution similar to the SCS Type I and II but uses data specific to the watershed. The depths for 5 and 15 minute, 1, 2, 3, 6, 12, and 24-hour values are entered into the HEC-1 model using the PH record. A rainfall mass curve is generated by HEC-1 by rearrangement of the depths for each duration so that the central 5 minute period of the 24-hour distribution contains the 5 minute depth specified and the central 15 minute period contains the 15 minute depth, etc. This same procedure was used by the SCS in generating the Type 1, 1A, II, and III dimensionless temporal distributions. The SCS distributions are based on regional averages. The use of a PH record produces a hypothetical pattern based upon site specific data.

Rainfall depths to be used in the HEC-1 model for each drainage area were derived according to NOAA Atlas 2, Volume VII - Nevada (Reference 6). Rainfall depths for each duration and return period were developed for the centroid of each subbasin. A considerable amount of uncertainty exists regarding the nature of extreme storm events for the study area. Due to lack of recorded data on depths and temporal distributions, a technically superior method was not available.

3.0 PHYSICAL DESCRIPTION OF AREA

The Thomas, Dry, and Evans Creek watersheds are located in Washoe County and the City of Reno. These watersheds originate in the Carson Range of the Sierra Nevada and drain through a combination of rural, residential and commercial areas. Dry Creek empties into the Boynton Slough, a man-made channel that conveys flow from South McCarran Boulevard to Steamboat Creek. The majority of the flow from Evans Creek combines with Dry Creek 3600 feet upstream of South McCarran Boulevard. Some flow will leave the Evans Creek watershed and drain north along Lakeside Drive. The majority of the flow from the Thomas Creek watershed empties into the upper Truckee Meadows above Huffaker Narrows. The remaining flow drains into Alexander Ditch.

Thomas Creek

D.S. end of T6A? Alluvial Fan note consistent standard techniques

The drainage area of Thomas Creek above the apex of its fan is 8.5 square miles (Figure 2). The total drainage area of Thomas Creek above Virginia Street is 11.6 square miles. The watershed ranges in elevation from 4500 feet to 9800 feet yielding an average slope of 9.5%. The Thomas Creek watershed was divided into subbasins according to differences in rainfall depths, soil types, and vegetation types. Vegetation in the subbasins above 6000 feet (T1-T4) is comprised mainly of pine trees with a very thick understory. The percent ground cover for these upper areas is close to 90%. The soils are a mixture of type C and D. Due to the change in elevation, the 100-year 24 hour rainfall varies from 5.5 inches in the highest subbasin to 2.8 inches in the lowest subbasin.

The vegetation type for subbasins T5 and T6A is mainly a mixture of sagebrush and mahogany with some pine and aspens scattered throughout the watershed. The average ground cover for this portion of the watershed is approximately 25%. Over 80% of the soil in these basins is a type C. The subbasin below the apex of Thomas Creeks fan (T6B) is a mixture of irrigated pastures and low density residential areas. This area has a fairly even distribution of type B, C, and D soils.

Flow from the Thomas Creek watershed will be contained in the channel from the headwaters of the watershed to the apex of its fan. The velocities in the channel, as reflected in the Muskingum routing parameters, are high. The velocities range from 10 to over 15 ft/sec for some reaches. Below the apex, the 100 year flows will not be contained in a well-defined channel. The average velocities for this reach range between 3 and 6 ft/sec. Table 1 lists parameters used in the Thomas Creek HEC-1 model.

THIS SPREADING OUT OF FLOWS AT THE THOMAS CREEK FAN APEX WILL HAVE TO BE CAREFULLY EVALUATED IN REGARD TO FUTURE DETENTION CONSIDERATIONS

CONFLUENCE OF THOMAS CREEK FLOWS @ I-580 & So. VIRGINIA ST. IMPROVEMENTS ~ FLOWS WILL SPLIT w/ SIGNIFICANT Q OVERLAND DOWN VIRGINIA ST.

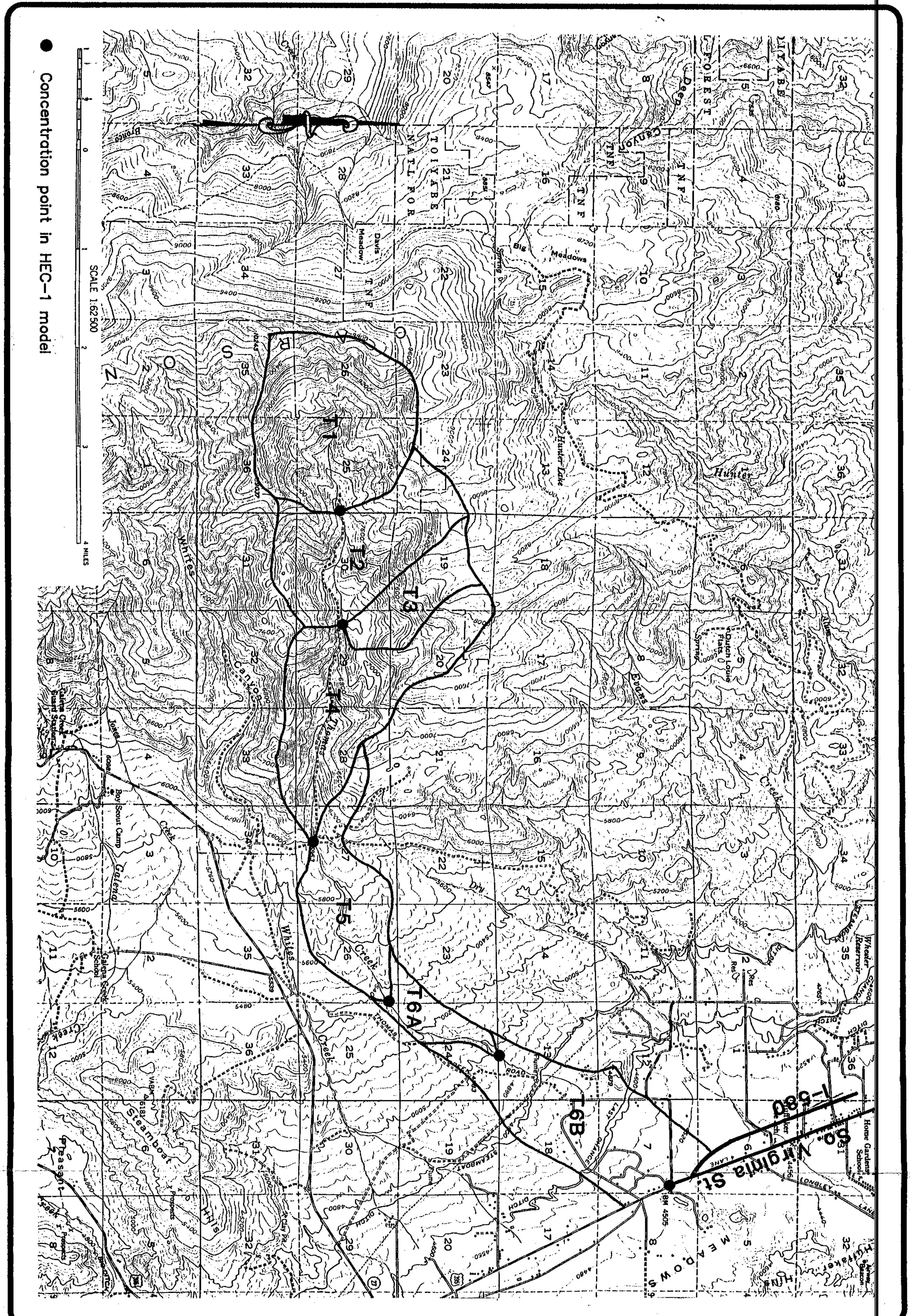

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FIGURE 2

Thomas Creek Watershed Map

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TABLE 1
WATERSHED PARAMETERS FOR THOMAS CREEK

SUBBASIN	BASIN AREA sq. mi.	CURVE NUMBER	HYDRAULIC LENGTH ft.	LAG TIME hr.	100 Yr., 24 Hr. RAINFALL in.	AVERAGE VELOCITY for entire hydraulic length ft/sec
T1	2.50	69	12,200	0.35	5.44	5.8
T2	1.82	58	11,400	0.29	4.92	6.6
T3	0.82	59	8,000	0.30	4.73	4.4
T4	2.16	58	18,450	0.54	4.20	5.7
T5	1.19	71	16,000	0.49	3.40	5.4
T6A	0.65	75	8,700	0.21	2.80	6.9
T6B	2.50	75	16,400	0.66	2.80	4.1

Dry Creek

The drainage area of Dry Creek above I-580 is 13 square miles (Figure 3). This watershed ranges in elevation from 4460 feet to 7800 feet (an average slope of approximately 9%). The watershed was divided into 14 basins. These subdivisions were made for two reasons: 1) to account for the differences in rainfall depths, soil types, and vegetation types within the watershed and 2) to provide concentration points at key locations in the watershed for the hydraulic analysis, such as confluences of tributaries.

The 100-year 24-hour precipitation ranges from 4.0 inches for the upper subbasins of the watershed to 2.8 inches for the lower subbasins. The predominant vegetation type for the entire watershed is sagebrush. The watershed above Steamboat Ditch (approximately 10 square miles) contains mainly a mixture of mahogany and sagebrush with a percent ground cover between 30 and 50. The soil types for the watershed above Steamboat Ditch are mainly type D soils with small areas of type C soils. The area below Steamboat Ditch is rural with few impervious areas, and a majority of this area is developed for pasture. The soil survey maps also indicate that this area is primarily a type D soil.

Channel velocities for the routing reaches for the entire watershed range between 6 and 10 ft/sec. Table 2 lists input parameters used in the Dry Creek model.

Evans Creek

The watershed of Evans Creek above its confluence with Dry Creek is approximately 10 square miles (Figure 4). The watershed was divided into three subbasins. The upper subbasin is the area above Lakeside Drive, the middle subbasin is between Lakeside Drive and I-580 and the lower subbasin is between I-580 and the confluence of Evans and Dry Creeks.

The drainage area above Lakeside Drive, the upper subbasin, is approximately 8.5 square miles. The watershed ranges in elevation from 4600 to 9100 feet. The average slope of this basin is 10%. Vegetation for the area above 6000 feet consists of pine and aspen trees on the north-facing slopes and along the creek. The south-facing slope consists of Mountain Mahogany, sagebrush, and some pine trees. The ground cover for the area above 6000 feet averages 50%. The drainage area below 6000 feet and above Lakeside Drive is comprised mainly of sage brush with an average ground cover of 50%. The soils for the entire subbasin are a mixture of type C and D soils. The 100-year 24-hour rainfall averages 4.2 inches for this subbasin.

As stated in Section 2.0 of this report, the lag time for the upper subbasin was calculated by the procedures described in TR-55. The channel reach portion of the hydraulic length has an average slope of 10% but is choked with vegetation. The flow velocities for the channel reach range between 8 and 11 feet/second. The average velocity for the entire hydraulic length is 6.9 feet/second.

TABLE 1
WATERSHED PARAMETERS FOR THOMAS CREEK

SUBBASIN	BASIN AREA sq. mi.	CURVE NUMBER	HYDRAULIC LENGTH ft.	LAG TIME hr.	100 Yr., 24 Hr. RAINFALL in.	AVERAGE VELOCITY for entire hydraulic length ft/sec
T1	2.50	69	12,200	0.35	5.44	5.8
T2	1.82	58	11,400	0.29	4.92	6.6
T3	0.82	59	8,000	0.30	4.73	4.4
T4	2.16	58	18,450	0.54	4.20	5.7
T5	1.19	71	16,000	0.49	3.40	5.4
T6A	0.65	75	8,700	0.21	2.80	6.9
T6B	2.50	75	16,400	0.66	2.80	4.1

Dry Creek

The drainage area of Dry Creek above I-580 is 13 square miles (Figure 3). This watershed ranges in elevation from 4460 feet to 7800 feet (an average slope of approximately 9%). The watershed was divided into 14 basins. These subdivisions were made for two reasons: 1) to account for the differences in rainfall depths, soil types, and vegetation types within the watershed and 2) to provide concentration points at key locations in the watershed for the hydraulic analysis, such as confluences of tributaries.

The 100-year 24-hour precipitation ranges from 4.0 inches for the upper subbasins of the watershed to 2.8 inches for the lower subbasins. The predominant vegetation type for the entire watershed is sagebrush. The watershed above Steamboat Ditch (approximately 10 square miles) contains mainly a mixture of mahogany and sagebrush with a percent ground cover between 30 and 50. The soil types for the watershed above Steamboat Ditch are mainly type D soils with small areas of type C soils. The area below Steamboat Ditch is rural with few impervious areas, and a majority of this area is developed for pasture. The soil survey maps also indicate that this area is primarily a type D soil.

Channel velocities for the routing reaches for the entire watershed range between 6 and 10 ft/sec. Table 2 lists input parameters used in the Dry Creek model.

Evans Creek

The watershed of Evans Creek above its confluence with Dry Creek is approximately 10 square miles (Figure 4). The watershed was divided into three subbasins. The upper subbasin is the area above Lakeside Drive, the middle subbasin is between Lakeside Drive and I-580 and the lower subbasin is between I-580 and the confluence of Evans and Dry Creeks.

The drainage area above Lakeside Drive, the upper subbasin, is approximately 8.5 square miles. The watershed ranges in elevation from 4600 to 9100 feet. The average slope of this basin is 10%. Vegetation for the area above 6000 feet consists of pine and aspen trees on the north-facing slopes and along the creek. The south-facing slope consists of Mountain Mahogany, sagebrush, and some pine trees. The ground cover for the area above 6000 feet averages 50%. The drainage area below 6000 feet and above Lakeside Drive is comprised mainly of sage brush with an average ground cover of 50%. The soils for the entire subbasin are a mixture of type C and D soils. The 100-year 24-hour rainfall averages 4.2 inches for this subbasin.

As stated in Section 2.0 of this report, the lag time for the upper subbasin was calculated by the procedures described in TR-55. The channel reach portion of the hydraulic length has an average slope of 10% but is choked with vegetation. The flow velocities for the channel reach range between 8 and 11 feet/second. The average velocity for the entire hydraulic length is 6.9 feet/second.

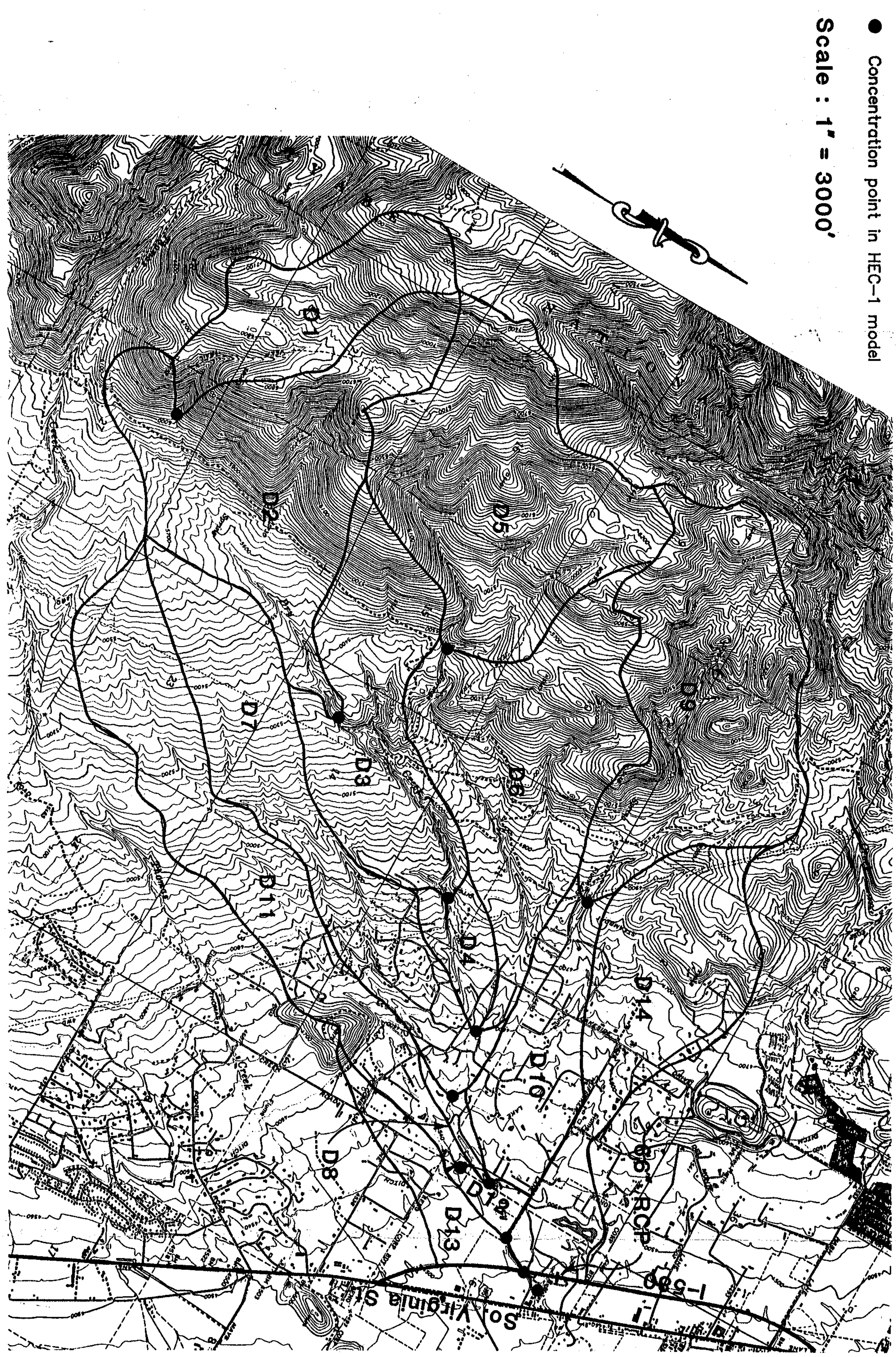

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FIGURE 3

Dry Creek Watershed Map

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TABLE 2
WATERSHED PARAMETERS FOR DRY CREEK

SUBBASIN	BASIN AREA sq. mi.	CURVE NUMBER	HYDRAULIC LENGTH ft.	LAG TIME hr.	100 Yr., 24 Hr. RAINFALL in.	AVERAGE VELOCITY for entire hydraulic length ft/sec
D1	0.78	65	9,900	0.29	4.0	5.7
D2	1.66	77	16,400	0.43	3.7	6.4
D3	1.10	79	12,400	0.38	3.2	5.4
D4	0.19	76	4,900	0.25	2.9	3.3
D5	1.70	75	11,300	0.31	3.7	6.1
D6	1.60	80	17,200	0.57	3.1	5.0
D7	1.20	80	19,800	0.85	3.1	3.9
D8	0.07	80	4,000	.33	2.8	2.0
D9	1.53	77	15,200	.45	3.1	5.6
D10	0.63	78	9,000	.45	2.8	3.3
D11	1.40	80	20,800	.85	3.0	4.1
D12	0.08	80	2,800	.23	2.8	2.0
D13	0.03	80	7,700	.78	2.8	1.7
D14	1.20	80	13,400	.74	2.8	3.0

● Concentration Point in HEC-1 model

SCALE 1:62500

0 1 2 3 4 MILES

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FIGURE 4
Dry and Evans Creek
Watershed Map

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The middle subbasin is mainly pastures and rural dwellings with some residential developments within the basin. The average curve number determined for this basin is 78. The hydraulic length of this subbasin does not contain a defined channel; therefore, the Upland Method was used to calculate the lag time. The lag time for this subbasin is .74hours. The average velocity for the hydraulic length is 2.5 feet/second. The 100-year 24-hour rainfall for this basin averages 2.8 inches.

The lower subbasin is a mixture of pastures, residential and commercial developments. The average curve number for this subbasin is 76. As in the middle basin, the Upland Method was used to calculate the lag time (.74 hours). The 100-year 24-hour rainfall for this subbasin is the same as the middle basin (2.8 inches). Table 3 lists input parameters for Evans Creek in the Evans/Dry Creek model.

4.0 ASSUMPTIONS USED TO DETERMINE DRY CREEK'S DISCHARGE BELOW EVANS CREEK IN THE RAINFALL RUNOFF MODELS

Prior. Alluvial Fan designation Lewis Lakeside

In the rainfall-runoff model of Evans Creek that was developed by Nimbus, the 100-year discharge for Evans Creek at Lakeside Drive is 1988 cfs. The flow is not contained in the channel. Approximately 470 cfs will overtop the north bank and drain down Lakeside Drive. An existing hydraulic model (HEC-2) was used to estimate how much flow would be lost down Lakeside Drive at this location (Reference 15). The remaining flow in Evans Creek, 1521 cfs, was routed down to I-580. The capacity of the culvert under the interstate is approximately 1000 cfs. Any flow over 1000 cfs was assumed to flow under the interstate on Del Monte Lane and return to Evans Creek.

The Evans Creek hydrologic model was combined with the Dry Creek model to determine the 100-year discharge at the confluence of Evans and Dry Creek. The aerial reduction factor for rainfall (the variable found in the second field of the PH record in the HEC-1 model) was adjusted to match the combined drainage area of both watersheds, 24 square miles. The 100-year discharge at the confluence of Dry and Evans Creek was calculated at 4891 cfs.

5.0 OTHER STUDIES

Tudor Study for FEMA

The original flood insurance study for Washoe County and the City of Reno was completed by Tudor Engineering in July 1979 (Reference 16 and 17). Part of that study developed hydrology for Evans, Dry, and Thomas Creeks. Discharges of Evans, Dry, and Thomas Creek from this study are in Table 4. To develop the hydrology for these creeks, Tudor Engineering used a regional analysis based on 306 flood peaks in 18 moderate sized, natural drainage basins in the Truckee and Carson River Watersheds. The equation is a function of mean annual precipitation and drainage area.

TABLE 3
WATERSHED PARAMETERS FOR EVANS CREEK

SUBBASIN	BASIN AREA sq. mi.	CURVE NUMBER	HYDRAULIC LENGTH ft.	LAG TIME hr.	100 Yr., 24 Hr. RAINFALL in.	AVERAGE VELOCITY for entire hydraulic length ft/sec
EV1	8.60	72	43,300	1.04	4.2	6.9
EV2	1.10	78	5,800	0.74	2.8	3.6
EV3	0.52	76	5,600	0.70	2.8	3.7

TABLE 4
100-YEAR DISCHARGES (cfs)
from the rainfall runoff model and previous studies

MAJOR CONCENTRATION POINTS	CURRENT FEMA VALUES (Ref. 16 and 17)	COE 1974 STUDY (Ref. 10)	COE 1980 STUDY (Ref. 8)	SCS 1980 STUDY (Ref. 11)	NIMBUS VALUES 1990 STUDY
Dry Creek					
@ Steamboat Ditch	------	------	1180	------	1348
@ I-580	1000	4300	4900	6550	4018
below confluence w/Evans	1880	------	------	------	4891
Evans Creek					
@ Steamboat Ditch	------	2600	2200	------	------
@ Lakeside Drive	------	------	------	------	1988
@ I-580	980	2600	------	1666	------
Thomas Creek					
@ Apex of its fan	1500	------	------	------	2638
@ Steamboat Ditch	------	3500	2500	------	------
@ HWY 395	------	3900	------	3400	2554

In their analysis (Reference 7), Tudor indicated that the regional equation approach was the most appropriate "because it is based on frequency of actual observed floods and all the diverse characteristics of rainfall-runoff and snowmelt relations are included in this methodology." Tudor indicated that the hydrologic computer models (such as HEC-1), on the other hand, are based on methods that must assume or ignore many hydrologic characteristics. The discharges developed by the Tudor study, however, were much lower than the COE's 1980 report and previous studies completed by the COE and the SCS. The COE and local officials had objections to the lower discharges developed in the Tudor study.

The COE 1980 Report

In 1980, the Sacramento District of the Corps of Engineers published a report titled, Truckee River, California and Nevada, Hydrology (Reference 8). In this report, 100-year discharges were determined for Dry, Thomas, and Evans Creeks using a hydrologic model (HEC-1) combined with the results of a statistical analysis. A more detailed explanation regarding how this hydrology is developed can be found in the COE's report. Discharges for Dry, Thomas, and Evans Creeks from this study are presented in Table 4. These discharges are significantly higher than the corresponding discharges in the original FEMA study.

The COE addresses the difference between the Tudor study and their study in a January 28, 1980 letter to FEMA (Reference 9). In this letter the COE expressed concern in Tudor's regional equation that was developed for estimating floodflows on Steamboat, Thomas, Evans, and Dry Creeks. Their major concerns were that only three of the 18 stream gages used to develop the regional relationship were representative of the study area and that this method does not recognize cloudburst potential because the mean annual precipitation is used instead of a short duration precipitation parameter. Specifically, this letter expressed concern regarding the low values of Dry Creek in comparison to the COE report. The COE stated that the flood potential estimated using the regional equation is understated, and they would not revise their discharges for Dry Creek.

Other Studies By Agencies

In 1974, the COE published a floodplain information study that included discharges for Evans, Dry and Thomas Creeks (Reference 10). These discharges were higher than the discharges in the COE's 1980 report. The 1980 report superceded the previous COE's studies for these watersheds. In 1980, the SCS conducted a study on Dry and Thomas Creeks (Reference 11). Their discharges were up to 33% higher than the COE's values.

6.0 RATIONALE FOR USING THE RAINFALL-RUNOFF MODEL DEVELOPED BY NIMBUS IN THE RESTUDY

The 100-year discharges developed by Nimbus Engineers for the restudy are within 20% of the COE's values for Dry Creek and within 6% for Thomas Creek, and 10% for Evans Creek. The hydrology by Nimbus Engineers provides more concentration points than the COE study. For example, between Panorama Drive and Holcomb Lane, two major branches of Dry Creek join. The COE hydrology does not have concentration points at this and other confluences within the watershed. Because the 100-year discharges from the Nimbus model and the COE hydrology are close and the Nimbus model provides more concentration points within the watersheds, the discharges from the Nimbus model are used for the hydraulic analyses of Dry and Thomas Creeks. See Table 7 for discharges at key concentration points from the Nimbus Models.

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APPENDIX

APPENDIX

HEC-1 MODELS

THOM02.901	-	Thomas Creek 2-year, 24-hour
THOM10.901	-	Thomas Creek 10-year, 24-hour
THOM100.901	-	Thomas Creek 100-year, 24-hour
DRYCR.901	-	Dry Creek 100-year, 24 hour
DREV.901	-	Evans Creek combined with Dry Creek 100-year, 24-hour

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*                                    *                    *                                    *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1) *                   *  U.S. ARMY CORPS OF ENGINEERS      *
*           FEBRUARY 1981            *                    * THE HYDROLOGIC ENGINEERING CENTER  *
*         REVISED 01 JUN 88          *                    *        609 SECOND STREET           *
*                                    *                    *     DAVIS, CALIFORNIA 95616        *
* RUN DATE  08/20/1990  TIME  12:16:33 *                  *          (916) 551-1748            *
*                                    *                    *                                    *
**************************************                    **************************************
```

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X               X
XXXXXXX  XXXX     X       XXXXX   X
X     X  X        X               X
X     X  X        X     X         X
X     X  XXXXXXX   XXXXX         XXX
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THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM
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```
1                                        HEC-1 INPUT                                        PAGE  1

       LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

                    *DIAGRAM
         1          ID  ********************************************************************************
         2          ID     FILENAME : THOM02.301
         3          ID
         4          ID     FEMA FLOOD INSURANCE STUDY                   THOMAS CREEK, WASHOE COUNTY,NV
         5          ID     FINAL RUN AUGUST 1990   BY: NIMBUS ENGINEERS   CONTRACT NO. EMW-89-C-2841
         6          ID                                                    NIMBUS JOB NUMBER 8901
         7          ID
         8          ID  THIS MODEL IS BASED ON DATA GENERATED BY NIMBUS ENGINEERS DURRING SUMMER 1989
         9          ID  THE PARAMETERS FOR THIS MODEL ARE BASED ON THE 2 YEAR RAIN FALL PATTERN OF
        10          ID  THE NOAA 2 ATLAS. LOSSES ARE BASED ON THE SCS CURVE NUMBER METHOD OUTLINED IN
        11          ID  NEH-4 AND TR-55. THE MUSKINGHAM METHOD IS USED FOR ROUTING. THE UPLAND
        12          ID  METHOD IS USED FOR THE DETERMINATION OF LAG TIME.
        13          ID  -CURVE NUMBERS ESTIMATED FROM USFS PHOTOGRAPHS
        14          ID    (AERIAL REDUCTION FOR TOTAL AREA OF THOMAS CREEK)
        15          ID
        16          ID  ********************************************************************************
        17          IT       5                      289
        18          IO       5       1

        19          KK      T1   THOMAS CREEK WATERSHED T1
        20          BA     2.5
        21          PH      50   11.64     .16     .31     .55     .76     .96    1.42    2.05    2.67
        22          LS               69
        23          UD     .35
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 24           KK   RT1-B   ROUTE T1 TO CONCENTRATION POINT B
 25           RM       1  .20115      .4

 26           KK      T2   THOMAS CREEK WATERSHED T2
 27           BA    1.82
 28           PH      50  11.64     .15     .29     .51     .69     .87    1.27    1.82    2.36
 29           LS              58
 30           UD     .29

 31           KK      T3   THOMAS CREEK WATERSHED T3
 32           BA     .82
 33           PH      50  11.64     .15      .3     .53     .71     .87    1.26    1.73    2.19
 34           LS              59
 35           UD      .3

 36           KK    CP-B   COMBINE ROUTED WATERSHED T1 W/ T2 AND T3 AT CONCCENTRATION PT B
 37           HC       3

 38           KK   RCP-C   ROUTE COMBINED T1-T3 TO CONCENTRATION PT C
 39           RM       4  .34962      .4

 40           KK      T4   THOMAS CREEK WATERSHED T4
 41           BA    2.16
 42           PH      50  11.64     .16     .31     .55     .72     .88    1.25    1.65    2.05
 43           LS              58
 44           UD     .54
1                                          HEC-1 INPUT                                          PAGE  2

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 45           KK    CP-C   COMBINE ROUTED T1-T3 W/ T4
 46           HC       2

 47           KK   RCP-D   ROUTE COMBINED T1-T4 TO CONCENTRATION PT D
 48           RM       4   .3492      .4

 49           KK      T5   THOMAS CREEK WATERSHED T5
 50           BA    1.19
 51           PH      50  11.64     .13     .25     .44     .57     .69     .98    1.30    1.70
 52           LS              71       0
 53           UD     .49

 54           KK    CP-D   COMBINE ROUTED T1-T4 W/ T5
 55           HC       2
 56           KO       1

 57           KK   RAPEX   ROUTE COMBINED T1-T5 TO APEX
 58           RM       4     .37      .4

 59           KK     T6A   THOMAS CREEK WATERSHED T6 @ fan APEX
 60           BA     .65
 61           PH      50  11.64     .13     .26     .46     .56     .66     .88    1.09     1.3
 62           LS              75
 63           UD     .21

 64           KK   APEX1   COMBINE FLOWS AT APEX
 65           HC       2
 66           KO                                      22

 67           KK  RT-395   ROUTE FLOWS FROM APEX TO 395
 68           RM       5    1.02      .2

 69           KK     T6B   THOMAS CREEK WATERSHED T6 FROM APEX TO 395
 70           BA     2.5
```

```
            71          PH     50  11.64    .13    .26    .46    .56    .66    .88   1.09    1.3
            72          LS            75
            73          UD    .66

            74          KK  T6A&B   COMBINE ALL FLOWS
            75          HC      2
            76          ZZ
1
                SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE     (V) ROUTING         (--->) DIVERSION OR PUMP FLOW

   NO.     (.) CONNECTOR       (<---) RETURN OF DIVERTED OR PUMPED FLOW

    19        T1
              V
              V
    24     RT1-B
              .
              .
    26        .           T2
              .           .
              .           .
    31        .           .           T3
              .           .           .
              .           .           .
    36      CP-B.......................
              V
              V
    38     RCP-C
              .
              .
    40        .           T4
              .           .
              .           .
    45      CP-C...........
              V
              V
    47     RCP-D
              .
              .
    49        .           T5
              .           .
              .           .
    54      CP-D...........
              V
              V
    57     RAPEX
              .
              .
    59        .          T6A
              .           .
              .           .
    64     APEX1...........
              V
              V
    67    RT-395
              .
              .
    69        .          T6B
              .           .
              .           .
    74     T6A&B ...........

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1*****************************************                              *****************************************
```

```
*                                       *                    *                                     *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)    *                    *  U.S. ARMY CORPS OF ENGINEERS       *
*           FEBRUARY 1981               *                    * THE HYDROLOGIC ENGINEERING CENTER   *
*         REVISED 01 JUN 88             *                    *        609 SECOND STREET            *
*                                       *                    *     DAVIS, CALIFORNIA 95616         *
* RUN DATE  08/20/1990  TIME  12:16:33  *                    *         (916) 551-1748              *
*                                       *                    *                                     *
*****************************************                    ***************************************


                 *****************************************************************************
                   FILENAME : THOM02.901

                   FEMA FLOOD INSURANCE STUDY                    THOMAS CREEK, WASHOE COUNTY,NV
                   FINAL RUN AUGUST 1990   BY: NIMBUS ENGINEERS   CONTRACT NO. EMW-89-C-2841
                                                                   NIMBUS JOB NUMBER 8901

                 THIS MODEL IS BASED ON DATA GENERATED BY NIMBUS ENGINEERS DURRING SUMMER 1989
                 THE PARAMETERS FOR THIS MODEL ARE BASED ON THE 2 YEAR RAIN FALL PATTERN OF
                 THE NOAA 2 ATLAS. LOSSES ARE BASED ON THE SCS CURVE NUMBER METHOD OUTLINED IN
                 NEH-4 AND TR-55. THE MUSKINGHAM METHOD IS USED FOR ROUTING. THE UPLAND
                 METHOD IS USED FOR THE DETERMINATION OF LAG TIME.
                 -CURVE NUMBERS ESTIMATED FROM USFS PHOTOGRAPHS
                   (AERIAL REDUCTION FOR TOTAL AREA OF THOMAS CREEK)

                 *****************************************************************************

 18 IO         OUTPUT CONTROL VARIABLES
                     IPRNT          5  PRINT CONTROL
                     IPLOT          1  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE

    IT         HYDROGRAPH TIME DATA
                      NMIN          5  MINUTES IN COMPUTATION INTERVAL
                     IDATE      1   0  STARTING DATE
                     ITIME       0000  STARTING TIME
                        NQ        289  NUMBER OF HYDROGRAPH ORDINATES
                    NDDATE      2   0  ENDING DATE
                    NDTIME       0000  ENDING TIME
                     ICENT         19  CENTURY MARK

                 COMPUTATION INTERVAL    .08 HOURS
                      TOTAL TIME BASE  24.00 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
               PRECIPITATION DEPTH   INCHES
               LENGTH, ELEVATION     FEET
               FLOW                  CUBIC FEET PER SECOND
               STORAGE VOLUME        ACRE-FEET
               SURFACE AREA          ACRES
               TEMPERATURE           DEGREES FAHRENHEIT


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              ***************
              *             *
 54 KK        *     CP-D    *       COMBINE ROUTED T1-T4 W/ T5
              *             *
              ***************
```

56 KO OUTPUT CONTROL VARIABLES

IPRNT 1 PRINT CONTROL

IPLOT 1 PLOT CONTROL

QSCAL 0. HYDROGRAPH PLOT SCALE

55 HC HYDROGRAPH COMBINATION

ICOMP 2 NUMBER OF HYDROGRAPHS TO COMBINE

***

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HYDROGRAPH AT STATION CP-D

SUM OF 2 HYDROGRAPHS

****

DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	*	1		0605	74	0.	*	1		1210	147	0.	*	1		1815	220	66.
1		0005	2	0.	*	1		0610	75	0.	*	1		1215	148	0.	*	1		1820	221	66.
1		0010	3	0.	*	1		0615	76	0.	*	1		1220	149	0.	*	1		1825	222	66.
1		0015	4	0.	*	1		0620	77	0.	*	1		1225	150	1.	*	1		1830	223	66.
1		0020	5	0.	*	1		0625	78	0.	*	1		1230	151	2.	*	1		1835	224	66.
1		0025	6	0.	*	1		0630	79	0.	*	1		1235	152	3.	*	1		1840	225	66.
1		0030	7	0.	*	1		0635	80	0.	*	1		1240	153	5.	*	1		1845	226	66.
1		0035	8	0.	*	1		0640	81	0.	*	1		1245	154	8.	*	1		1850	227	65.
1		0040	9	0.	*	1		0645	82	0.	*	1		1250	155	13.	*	1		1855	228	65.
1		0045	10	0.	*	1		0650	83	0.	*	1		1255	156	24.	*	1		1900	229	63.
1		0050	11	0.	*	1		0655	84	0.	*	1		1300	157	40.	*	1		1905	230	62.
1		0055	12	0.	*	1		0700	85	0.	*	1		1305	158	60.	*	1		1910	231	60.
1		0100	13	0.	*	1		0705	86	0.	*	1		1310	159	78.	*	1		1915	232	58.
1		0105	14	0.	*	1		0710	87	0.	*	1		1315	160	92.	*	1		1920	233	56.
1		0110	15	0.	*	1		0715	88	0.	*	1		1320	161	100.	*	1		1925	234	54.
1		0115	16	0.	*	1		0720	89	0.	*	1		1325	162	101.	*	1		1930	235	52.
1		0120	17	0.	*	1		0725	90	0.	*	1		1330	163	98.	*	1		1935	236	51.
1		0125	18	0.	*	1		0730	91	0.	*	1		1335	164	93.	*	1		1940	237	50.
1		0130	19	0.	*	1		0735	92	0.	*	1		1340	165	88.	*	1		1945	238	50.
1		0135	20	0.	*	1		0740	93	0.	*	1		1345	166	83.	*	1		1950	239	49.
1		0140	21	0.	*	1		0745	94	0.	*	1		1350	167	79.	*	1		1955	240	49.
1		0145	22	0.	*	1		0750	95	0.	*	1		1355	168	76.	*	1		2000	241	48.
1		0150	23	0.	*	1		0755	96	0.	*	1		1400	169	74.	*	1		2005	242	48.
1		0155	24	0.	*	1		0800	97	0.	*	1		1405	170	72.	*	1		2010	243	48.
1		0200	25	0.	*	1		0805	98	0.	*	1		1410	171	71.	*	1		2015	244	47.
1		0205	26	0.	*	1		0810	99	0.	*	1		1415	172	71.	*	1		2020	245	47.
1		0210	27	0.	*	1		0815	100	0.	*	1		1420	173	71.	*	1		2025	246	47.
1		0215	28	0.	*	1		0820	101	0.	*	1		1425	174	71.	*	1		2030	247	47.
1		0220	29	0.	*	1		0825	102	0.	*	1		1430	175	71.	*	1		2035	248	47.
1		0225	30	0.	*	1		0830	103	0.	*	1		1435	176	71.	*	1		2040	249	47.
1		0230	31	0.	*	1		0835	104	0.	*	1		1440	177	71.	*	1		2045	250	46.
1		0235	32	0.	*	1		0840	105	0.	*	1		1445	178	70.	*	1		2050	251	46.
1		0240	33	0.	*	1		0845	106	0.	*	1		1450	179	70.	*	1		2055	252	46.
1		0245	34	0.	*	1		0850	107	0.	*	1		1455	180	70.	*	1		2100	253	46.
1		0250	35	0.	*	1		0855	108	0.	*	1		1500	181	69.	*	1		2105	254	46.
1		0255	36	0.	*	1		0900	109	0.	*	1		1505	182	69.	*	1		2110	255	46.
1		0300	37	0.	*	1		0905	110	0.	*	1		1510	183	69.	*	1		2115	256	46.
1		0305	38	0.	*	1		0910	111	0.	*	1		1515	184	69.	*	1		2120	257	46.
1		0310	39	0.	*	1		0915	112	0.	*	1		1520	185	69.	*	1		2125	258	45.
1		0315	40	0.	*	1		0920	113	0.	*	1		1525	186	69.	*	1		2130	259	45.
1		0320	41	0.	*	1		0925	114	0.	*	1		1530	187	69.	*	1		2135	260	45.
1		0325	42	0.	*	1		0930	115	0.	*	1		1535	188	69.	*	1		2140	261	45.
1		0330	43	0.	*	1		0935	116	0.	*	1		1540	189	69.	*	1		2145	262	45.
1		0335	44	0.	*	1		0940	117	0.	*	1		1545	190	69.	*	1		2150	263	45.
1		0340	45	0.	*	1		0945	118	0.	*	1		1550	191	69.	*	1		2155	264	45.
1		0345	46	0.	*	1		0950	119	0.	*	1		1555	192	68.	*	1		2200	265	45.

1	0350	47	0.	*	1	0955	120	0.	*	1	1600	193	68.	*	1	2205	266	44.
1	0355	48	0.	*	1	1000	121	0.	*	1	1605	194	68.	*	1	2210	267	44.
1	0400	49	0.	*	1	1005	122	0.	*	1	1610	195	68.	*	1	2215	268	44.
1	0405	50	0.	*	1	1010	123	0.	*	1	1615	196	67.	*	1	2220	269	44.
1	0410	51	0.	*	1	1015	124	0.	*	1	1620	197	67.	*	1	2225	270	44.
1	0415	52	0.	*	1	1020	125	0.	*	1	1625	198	66.	*	1	2230	271	44.
1	0420	53	0.	*	1	1025	126	0.	*	1	1630	199	66.	*	1	2235	272	44.
1	0425	54	0.	*	1	1030	127	0.	*	1	1635	200	66.	*	1	2240	273	44.
1	0430	55	0.	*	1	1035	128	0.	*	1	1640	201	66.	*	1	2245	274	44.
1	0435	56	0.	*	1	1040	129	0.	*	1	1645	202	66.	*	1	2250	275	43.
1	0440	57	0.	*	1	1045	130	0.	*	1	1650	203	66.	*	1	2255	276	43.
1	0445	58	0.	*	1	1050	131	0.	*	1	1655	204	66.	*	1	2300	277	43.
1	0450	59	0.	*	1	1055	132	0.	*	1	1700	205	66.	*	1	2305	278	43.
1	0455	60	0.	*	1	1100	133	0.	*	1	1705	206	66.	*	1	2310	279	43.
1	0500	61	0.	*	1	1105	134	0.	*	1	1710	207	66.	*	1	2315	280	43.
1	0505	62	0.	*	1	1110	135	0.	*	1	1715	208	66.	*	1	2320	281	43.
1	0510	63	0.	*	1	1115	136	0.	*	1	1720	209	66.	*	1	2325	282	43.
1	0515	64	0.	*	1	1120	137	0.	*	1	1725	210	66.	*	1	2330	283	43.
1	0520	65	0.	*	1	1125	138	0.	*	1	1730	211	66.	*	1	2335	284	43.
1	0525	66	0.	*	1	1130	139	0.	*	1	1735	212	66.	*	1	2340	285	43.
1	0530	67	0.	*	1	1135	140	0.	*	1	1740	213	66.	*	1	2345	286	42.
1	0535	68	0.	*	1	1140	141	0.	*	1	1745	214	66.	*	1	2350	287	42.
1	0540	69	0.	*	1	1145	142	0.	*	1	1750	215	66.	*	1	2355	288	42.
1	0545	70	0.	*	1	1150	143	0.	*	1	1755	216	66.	*	2	0000	289	42.
1	0550	71	0.	*	1	1155	144	0.	*	1	1800	217	66.	*				
1	0555	72	0.	*	1	1200	145	0.	*	1	1805	218	66.	*				
1	0600	73	0.	*	1	1205	146	0.	*	1	1810	219	66.	*				
				*					*					*				

****

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	24.00-HR
+ (CFS)	(HR)					
		(CFS)				
+ 101.	13.42		70.	28.	28.	28.
		(INCHES)	.077	.121	.121	.121
		(AC-FT)	35.	55.	55.	55.

CUMULATIVE AREA = 8.49 SQ MI

*** ***

```
           **************
           *            *
 64 KK     *    APEX1   *       COMBINE FLOWS AT APEX
           *            *
           **************

 66 KO        OUTPUT CONTROL VARIABLES
                   IPRNT          5  PRINT CONTROL
                   IPLOT          1  PLOT CONTROL
                   QSCAL         0.  HYDROGRAPH PLOT SCALE
                   IPNCH          0  PUNCH COMPUTED HYDROGRAPH
                    IOUT         22  SAVE HYDROGRAPH ON THIS UNIT
                   ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                   ISAV2        289  LAST ORDINATE PUNCHED OR SAVED
                  TIMINT       .083  TIME INTERVAL IN HOURS
```

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	T1	107.	12.50	59.	22.	22.	2.50		
+	ROUTED TO	RT1-B	101.	12.67	59.	22.	22.	2.50		
+	HYDROGRAPH AT	T2	7.	18.08	6.	2.	2.	1.82		
+	HYDROGRAPH AT	T3	2.	18.08	2.	1.	1.	.82		
+	3 COMBINED AT	CP-B	101.	12.67	63.	25.	25.	5.14		
+	ROUTED TO	RCP-C	98.	13.00	63.	25.	25.	5.14		
+	HYDROGRAPH AT	T4	3.	24.00	3.	1.	1.	2.16		
+	2 COMBINED AT	CP-C	98.	13.00	64.	25.	25.	7.30		
+	ROUTED TO	RCP-D	95.	13.42	64.	25.	25.	7.30		
+	HYDROGRAPH AT	T5	8.	15.08	7.	3.	3.	1.19		
+	2 COMBINED AT	CP-D	101.	13.42	70.	28.	28.	8.49		
+	ROUTED TO	RAPEX	98.	13.75	70.	27.	27.	8.49		
+	HYDROGRAPH AT	T6A	3.	14.25	3.	1.	1.	.65		
+	2 COMBINED AT	APEX1	102.	13.75	73.	28.	28.	9.14		
+	ROUTED TO	RT-395	83.	15.00	71.	26.	26.	9.14		
+	HYDROGRAPH AT	T6B	13.	15.08	10.	4.	4.	2.50		
+	2 COMBINED AT	T6A&B	96.	15.00	80.	30.	30.	11.64		

*** NORMAL END OF HEC-1 ***

Thomas Creek 10-Year

```
 ***************************************                  ***************************************
 *                                     *                  *                                     *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                 *   U.S. ARMY CORPS OF ENGINEERS      *
 *             FEBRUARY 1981           *                  *  THE HYDROLOGIC ENGINEERING CENTER  *
 *           REVISED 01 JUN 88         *                  *          609 SECOND STREET          *
 *                                     *                  *       DAVIS, CALIFORNIA 95616       *
 *  RUN DATE  08/20/1990  TIME  12:17:18 *                *           (916) 551-1748            *
 *                                     *                  *                                     *
 ***************************************                  ***************************************


                    X     X  XXXXXXX   XXXXX          X
                    X     X  X        X     X        XX
                    X     X  X        X               X
                    XXXXXXX  XXXX     X       XXXXX   X
                    X     X  X        X               X
                    X     X  X        X     X         X
                    X     X  XXXXXXX   XXXXX         XXX


     THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

     THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
     THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
     NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
     DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
     KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


1                                            HEC-1 INPUT                                             PAGE  1

       LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

                    *DIAGRAM
         1          ID  *************************************************************************
         2          ID     FILENAME : THOM10.301
         3          ID
         4          ID     FEMA FLOOD INSURANCE STUDY                   THOMAS CREEK, WASHOE COUNTY,NV
         5          ID     FINAL RUN AUGUST 1990   BY: NIMBUS ENGINEERS   CONTRACT NO. EMW-89-C-2841
         6          ID                                                  NIMBUS JOB NUMBER 8901
         7          ID
         8          ID  THIS MODEL IS BASED ON DATA GENERATED BY NIMBUS ENGINEERS DURRING SUMMER 1989
         9          ID  THE PARAMETERS FOR THIS MODEL ARE BASED ON THE 10 YEAR RAIN FALL PATTERN OF
        10          ID  THE NOAA 2 ATLAS. LOSSES ARE BASED ON THE SCS CURVE NUMBER METHOD OUTLINED IN
        11          ID  NEH-4 AND TR-55. THE MUSKINGHAM METHOD IS USED FOR ROUTING. THE UPLAND
        12          ID  METHOD IS USED FOR THE DETERMINATION OF LAG TIME.
        13          ID  -CURVE NUMBERS ESTIMATED FROM USFS PHOTOGRAPHS
        14          ID    (AERIAL REDUCTION FOR TOTAL AREA OF THOMAS CREEK)
        15          ID
        16          ID  *************************************************************************
        17          IT       5                     289
        18          IO       5       1

        19          KK      T1    THOMAS CREEK WATERSHED T1
        20          BA     2.5
        21          PH      10   11.64     .26     .51     .90    1.23    1.50    2.12    2.73    3.35
        22          LS              69
        23          UD     .35
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24          KK  RT1-B  ROUTE T1 TO CONCENTRATION POINT B
25          RM      1  .13025     .4

26          KK     T2  THOMAS CREEK WATERSHED T2
27          BA   1.82
28          PH     10  11.64    .28    .54    .95   1.19   1.42   1.95   2.69   3.42
29          LS             58
30          UD    .29

31          KK     T3  THOMAS CREEK WATERSHED T3
32          BA    .82
33          PH     10  11.64    .26    .51    .89   1.13   1.35   1.88   2.56   3.24
34          LS             59
35          UD     .3

36          KK   CP-B  COMBINE ROUTED WATERSHED T1 W/ T2 AND T3 AT CONCCENTRATION PT B
37          HC      3

38          KK  RCP-C  ROUTE COMBINED T1-T3 TO CONCENTRATION PT C
39          RM      2  .20487     .4

40          KK     T4  THOMAS CREEK WATERSHED T4
41          BA   2.16
42          PH     10  11.64    .26    .50    .88   1.09   1.29   1.75   2.35   2.94
43          LS             58
44          UD    .54
```



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LINE        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

45          KK   CP-C  COMBINE ROUTED T1-T3 W/ T4
46          HC      2

47          KK  RCP-D  ROUTE COMBINED T1-T4 TO CONCENTRATION PT D
48          RM      2  .19881     .4

49          KK     T5  THOMAS CREEK WATERSHED T5
50          BA   1.19
51          PH     10  11.64    .22    .43    .75    .95   1.15   1.40   1.90   2.40
52          LS             71      0
53          UD    .49

54          KK   CP-D  COMBINE ROUTED T1-T4 W/ T5
55          HC      2
56          KO      1

57          KK  RAPEX  ROUTE COMBINED T1-T5 TO APEX
58          RM      3   0.23     .4

59          KK    T6A  THOMAS CREEK WATERSHED T6 @ fan APEX
60          BA    .65
61          PH     10  11.64    .26    .51    .90   1.00   1.10   1.25    1.6   1.95
62          LS             75
63          UD    .21

64          KK  APEX1  COMBINE FLOWS AT APEX
65          HC      2
66          KO                                    22

67          KK RT-395  ROUTE FLOWS FROM APEX TO 395
68          RM      5   0.88     .2

69          KK    T6B  THOMAS CREEK WATERSHED T6 FROM APEX TO 395
70          BA    2.5
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          71         PH     10  11.64    .26    .51    .80   1.00   1.10   1.25    1.6    1.9
          72         LS            75
          73         UD    .66

          74         KK  T6A&B   COMBINE ALL FLOWS
          75         KC      2
          76         ZZ
1
               SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING         (--->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR       (<---) RETURN OF DIVERTED OR PUMPED FLOW

    19         T1
               V
               V
    24      RT1-B
               .
               .
    26         .         T2
               .         .
               .         .
    31         .         .         T3
               .         .         .
               .         .         .
    36       CP-B.......................
               V
               V
    38      RCP-C
               .
               .
    40         .         T4
               .         .
               .         .
    45       CP-C...........
               V
               V
    47      RCP-D
               .
               .
    49         .         T5
               .         .
               .         .
    54       CP-D...........
               V
               V
    57      RAPEX
               .
               .
    59         .        T6A
               .         .
               .         .
    64      APEX1...........
               V
               V
    67     RT-395
               .
               .
    69         .        T6B
               .         .
               .         .
    74     T6A&B ...........

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1*****************************************                            *****************************************
```

```
*                                     *                                         *                                     *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                                         *  U.S. ARMY CORPS OF ENGINEERS       *
*           FEBRUARY 1981             *                                         * THE HYDROLOGIC ENGINEERING CENTER   *
*         REVISED 01 JUN 88           *                                         *       609 SECOND STREET             *
*                                     *                                         *     DAVIS, CALIFORNIA 95616         *
* RUN DATE  08/20/1990  TIME  12:17:18 *                                        *       (916) 551-1748                *
*                                     *                                         *                                     *
***************************************                                         ***************************************



                     ***********************************************************************
                        FILENAME : THOM10.301

                        FEMA FLOOD INSURANCE STUDY                 THOMAS CREEK, WASHOE COUNTY,NV
                        FINAL RUN AUGUST 1990   BY: NIMBUS ENGINEERS   CONTRACT NO. EMW-89-C-2841
                                                                       NIMBUS JOB NUMBER 8901

                     THIS MODEL IS BASED ON DATA GENERATED BY NIMBUS ENGINEERS DURRING SUMMER 1989
                     THE PARAMETERS FOR THIS MODEL ARE BASED ON THE 10 YEAR RAIN FALL PATTERN OF
                     THE NOAA 2 ATLAS. LOSSES ARE BASED ON THE SCS CURVE NUMBER METHOD OUTLINED IN
                     NEH-4 AND TR-55. THE MUSKINGHAM METHOD IS USED FOR ROUTING. THE UPLAND
                     METHOD IS USED FOR THE DETERMINATION OF LAG TIME.
                     -CURVE NUMBERS ESTIMATED FROM USFS PHOTOGRAPHS
                       (AERIAL REDUCTION FOR TOTAL AREA OF THOMAS CREEK)

                     ***********************************************************************

 18 IO         OUTPUT CONTROL VARIABLES
                     IPRNT          5  PRINT CONTROL
                     IPLOT          1  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE

    IT         HYDROGRAPH TIME DATA
                      NMIN          5  MINUTES IN COMPUTATION INTERVAL
                     IDATE     1    0  STARTING DATE
                     ITIME       0000  STARTING TIME
                        NQ        289  NUMBER OF HYDROGRAPH ORDINATES
                    NDDATE     2    0  ENDING DATE
                    NDTIME       0000  ENDING TIME
                     ICENT         19  CENTURY MARK

                 COMPUTATION INTERVAL    .08 HOURS
                      TOTAL TIME BASE  24.00 HOURS

        ENGLISH UNITS
             DRAINAGE AREA         SQUARE MILES
             PRECIPITATION DEPTH   INCHES
             LENGTH, ELEVATION     FEET
             FLOW                  CUBIC FEET PER SECOND
             STORAGE VOLUME        ACRE-FEET
             SURFACE AREA          ACRES
             TEMPERATURE           DEGREES FAHRENHEIT


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


            **************
            *            *
 54 KK      *    CP-D    *       COMBINE ROUTED T1-T4 W/ T5
            *            *
            **************
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56 KO        OUTPUT CONTROL VARIABLES
                  IPRNT          1  PRINT CONTROL
                  IPLOT          1  PLOT CONTROL
                  QSCAL         0.  HYDROGRAPH PLOT SCALE

55 HC        HYDROGRAPH COMBINATION
                  ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE
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HYDROGRAPH AT STATION CP-D
SUM OF 2 HYDROGRAPHS

****

DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	*	1		0605	74	0.	*	1		1210	147	64.	*	1		1815	220	184.
1		0005	2	0.	*	1		0610	75	0.	*	1		1215	148	88.	*	1		1820	221	182.
1		0010	3	0.	*	1		0615	76	0.	*	1		1220	149	118.	*	1		1825	222	180.
1		0015	4	0.	*	1		0620	77	0.	*	1		1225	150	158.	*	1		1830	223	178.
1		0020	5	0.	*	1		0625	78	0.	*	1		1230	151	220.	*	1		1835	224	174.
1		0025	6	0.	*	1		0630	79	0.	*	1		1235	152	315.	*	1		1840	225	169.
1		0030	7	0.	*	1		0635	80	0.	*	1		1240	153	434.	*	1		1845	226	163.
1		0035	8	0.	*	1		0640	81	0.	*	1		1245	154	554.	*	1		1850	227	157.
1		0040	9	0.	*	1		0645	82	0.	*	1		1250	155	642.	*	1		1855	228	152.
1		0045	10	0.	*	1		0650	83	0.	*	1		1255	156	684.	*	1		1900	229	147.
1		0050	11	0.	*	1		0655	84	0.	*	1		1300	157	682.	*	1		1905	230	143.
1		0055	12	0.	*	1		0700	85	0.	*	1		1305	158	647.	*	1		1910	231	140.
1		0100	13	0.	*	1		0705	86	0.	*	1		1310	159	597.	*	1		1915	232	138.
1		0105	14	0.	*	1		0710	87	0.	*	1		1315	160	545.	*	1		1920	233	136.
1		0110	15	0.	*	1		0715	88	0.	*	1		1320	161	500.	*	1		1925	234	134.
1		0115	16	0.	*	1		0720	89	0.	*	1		1325	162	462.	*	1		1930	235	133.
1		0120	17	0.	*	1		0725	90	0.	*	1		1330	163	433.	*	1		1935	236	131.
1		0125	18	0.	*	1		0730	91	0.	*	1		1335	164	410.	*	1		1940	237	130.
1		0130	19	0.	*	1		0735	92	0.	*	1		1340	165	393.	*	1		1945	238	129.
1		0135	20	0.	*	1		0740	93	0.	*	1		1345	166	379.	*	1		1950	239	128.
1		0140	21	0.	*	1		0745	94	0.	*	1		1350	167	367.	*	1		1955	240	127.
1		0145	22	0.	*	1		0750	95	0.	*	1		1355	168	357.	*	1		2000	241	127.
1		0150	23	0.	*	1		0755	96	0.	*	1		1400	169	348.	*	1		2005	242	126.
1		0155	24	0.	*	1		0800	97	0.	*	1		1405	170	339.	*	1		2010	243	125.
1		0200	25	0.	*	1		0805	98	0.	*	1		1410	171	332.	*	1		2015	244	124.
1		0205	26	0.	*	1		0810	99	0.	*	1		1415	172	325.	*	1		2020	245	123.
1		0210	27	0.	*	1		0815	100	0.	*	1		1420	173	319.	*	1		2025	246	123.
1		0215	28	0.	*	1		0820	101	0.	*	1		1425	174	313.	*	1		2030	247	122.
1		0220	29	0.	*	1		0825	102	0.	*	1		1430	175	307.	*	1		2035	248	121.
1		0225	30	0.	*	1		0830	103	0.	*	1		1435	176	303.	*	1		2040	249	121.
1		0230	31	0.	*	1		0835	104	0.	*	1		1440	177	298.	*	1		2045	250	120.
1		0235	32	0.	*	1		0840	105	0.	*	1		1445	178	294.	*	1		2050	251	119.
1		0240	33	0.	*	1		0845	106	0.	*	1		1450	179	290.	*	1		2055	252	119.
1		0245	34	0.	*	1		0850	107	0.	*	1		1455	180	286.	*	1		2100	253	118.
1		0250	35	0.	*	1		0855	108	0.	*	1		1500	181	283.	*	1		2105	254	118.
1		0255	36	0.	*	1		0900	109	0.	*	1		1505	182	279.	*	1		2110	255	117.
1		0300	37	0.	*	1		0905	110	0.	*	1		1510	183	276.	*	1		2115	256	116.
1		0305	38	0.	*	1		0910	111	0.	*	1		1515	184	274.	*	1		2120	257	116.
1		0310	39	0.	*	1		0915	112	0.	*	1		1520	185	272.	*	1		2125	258	115.
1		0315	40	0.	*	1		0920	113	0.	*	1		1525	186	270.	*	1		2130	259	115.
1		0320	41	0.	*	1		0925	114	0.	*	1		1530	187	268.	*	1		2135	260	114.
1		0325	42	0.	*	1		0930	115	0.	*	1		1535	188	266.	*	1		2140	261	114.
1		0330	43	0.	*	1		0935	116	0.	*	1		1540	189	263.	*	1		2145	262	113.
1		0335	44	0.	*	1		0940	117	0.	*	1		1545	190	258.	*	1		2150	263	113.
1		0340	45	0.	*	1		0945	118	0.	*	1		1550	191	251.	*	1		2155	264	112.
1		0345	46	0.	*	1		0950	119	0.	*	1		1555	192	244.	*	1		2200	265	112.

1	0350	47	0.	*	1	0955	120	0.	*	1	1600	193	238.	*	1	2205	266	111.
1	0355	48	0.	*	1	1000	121	0.	*	1	1605	194	232.	*	1	2210	267	111.
1	0400	49	0.	*	1	1005	122	0.	*	1	1610	195	227.	*	1	2215	268	110.
1	0405	50	0.	*	1	1010	123	0.	*	1	1615	196	223.	*	1	2220	269	110.
1	0410	51	0.	*	1	1015	124	0.	*	1	1620	197	219.	*	1	2225	270	109.
1	0415	52	0.	*	1	1020	125	0.	*	1	1625	198	216.	*	1	2230	271	109.
1	0420	53	0.	*	1	1025	126	0.	*	1	1630	199	214.	*	1	2235	272	108.
1	0425	54	0.	*	1	1030	127	0.	*	1	1635	200	211.	*	1	2240	273	108.
1	0430	55	0.	*	1	1035	128	0.	*	1	1640	201	209.	*	1	2245	274	107.
1	0435	56	0.	*	1	1040	129	0.	*	1	1645	202	207.	*	1	2250	275	107.
1	0440	57	0.	*	1	1045	130	0.	*	1	1650	203	206.	*	1	2255	276	106.
1	0445	58	0.	*	1	1050	131	0.	*	1	1655	204	204.	*	1	2300	277	106.
1	0450	59	0.	*	1	1055	132	0.	*	1	1700	205	202.	*	1	2305	278	105.
1	0455	60	0.	*	1	1100	133	0.	*	1	1705	206	201.	*	1	2310	279	105.
1	0500	61	0.	*	1	1105	134	0.	*	1	1710	207	199.	*	1	2315	280	105.
1	0505	62	0.	*	1	1110	135	1.	*	1	1715	208	198.	*	1	2320	281	104.
1	0510	63	0.	*	1	1115	136	1.	*	1	1720	209	197.	*	1	2325	282	104.
1	0515	64	0.	*	1	1120	137	3.	*	1	1725	210	195.	*	1	2330	283	103.
1	0520	65	0.	*	1	1125	138	5.	*	1	1730	211	194.	*	1	2335	284	103.
1	0525	66	0.	*	1	1130	139	7.	*	1	1735	212	193.	*	1	2340	285	103.
1	0530	67	0.	*	1	1135	140	10.	*	1	1740	213	192.	*	1	2345	286	102.
1	0535	68	0.	*	1	1140	141	13.	*	1	1745	214	191.	*	1	2350	287	102.
1	0540	69	0.	*	1	1145	142	17.	*	1	1750	215	189.	*	1	2355	288	101.
1	0545	70	0.	*	1	1150	143	22.	*	1	1755	216	188.	*	2	0000	289	101.
1	0550	71	0.	*	1	1155	144	28.	*	1	1800	217	187.	*				
1	0555	72	0.	*	1	1200	145	35.	*	1	1805	218	186.	*				
1	0600	73	0.	*	1	1205	146	47.	*	1	1810	219	185.	*				
				*					*					*				

****

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	24.00-HR
+ (CFS)	(HR)					
		(CFS)				
+ 684.	12.92		300.	105.	105.	105.
		(INCHES)	.329	.461	.461	.461
		(AC-FT)	149.	209.	209.	209.

CUMULATIVE AREA = 8.49 SQ MI

*** ***

```
              **************
              *            *
   64 KK      *    APEX1   *        COMBINE FLOWS AT APEX
              *            *
              **************

   66 KO           OUTPUT CONTROL VARIABLES
                        IPRNT           5  PRINT CONTROL
                        IPLOT           1  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE
                        IPNCH           0  PUNCH COMPUTED HYDROGRAPH
                         IOUT          22  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1           1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2         289  LAST ORDINATE PUNCHED OR SAVED
                       TIMINT        .083  TIME INTERVAL IN HOURS
```

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD			BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
				6-HOUR	24-HOUR	72-HOUR			
+ HYDROGRAPH AT	T1	480.	12.42	162.	54.	54.	2.50		
+ ROUTED TO	RT1-B	469.	12.58	162.	54.	54.	2.50		
+ HYDROGRAPH AT	T2	103.	12.50	50.	19.	19.	1.82		
+ HYDROGRAPH AT	T3	40.	12.50	21.	8.	8.	.82		
+ 3 COMBINED AT	CP-B	602.	12.58	233.	81.	81.	5.14		
+ ROUTED TO	RCP-C	591.	12.75	232.	80.	80.	5.14		
+ HYDROGRAPH AT	T4	39.	13.00	34.	13.	13.	2.16		
+ 2 COMBINED AT	CP-C	626.	12.75	266.	93.	93.	7.30		
+ ROUTED TO	RCP-D	611.	13.00	265.	92.	92.	7.30		
+ HYDROGRAPH AT	T5	94.	12.67	37.	13.	13.	1.19		
+ 2 COMBINED AT	CP-D	684.	12.92	300.	105.	105.	8.49		
+ ROUTED TO	RAPEX	677.	13.17	300.	104.	104.	8.49		
+ HYDROGRAPH AT	T6A	96.	12.33	17.	6.	6.	.65		
+ 2 COMBINED AT	APEX1	693.	13.17	311.	110.	110.	9.14		
+ ROUTED TO	RT-395	559.	14.08	309.	106.	106.	9.14		
+ HYDROGRAPH AT	T6B	186.	12.92	62.	20.	20.	2.50		
+ 2 COMBINED AT	T6A&B	620.	14.08	355.	126.	126.	11.64		

*** NORMAL END OF HEC-1 ***

Thomas Creek 100-Year

```
****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*            FEBRUARY 1981             *
*           REVISED 01 JUN 88          *
*                                      *
* RUN DATE  08/20/1990  TIME  12:18:01 *
*                                      *
****************************************
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****************************************
*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*  THE HYDROLOGIC ENGINEERING CENTER   *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*           (916) 551-1748             *
*                                      *
****************************************
```

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X               X
XXXXXXX  XXXX     X       XXXXX   X
X     X  X        X               X
X     X  X        X     X         X
X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

```
1                               HEC-1 INPUT                                       PAGE  1

 LINE      ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

           *DIAGRAM
   1       ID  ***************************************************************************
   2       ID     FILENAME : THOM100.901
   3       ID    FEMA FLOOD INSURANCE STUDY       THOMAS CREEK, WASHOE COUNTY, NEVADA
   4       ID    FINAL RUN AUGUST 1990   BY: NIMBUS ENGINEERS  CONTRACT NO. EMW-89-C-2841
   5       ID                                                  NIMBUS JOB NO. 8901
   6       ID
   7       ID  THIS MODEL IS BASED ON DATA GENERATED BY NIMBUS ENGINEERS DURRING SUMMER 1989
   8       ID  THE PARAMETERS FOR THIS MODEL ARE BASED ON THE 100 YEAR RAIN FALL PATTERN OF
   9       ID  THE NOAA 2 ATLAS. LOSSES ARE BASED ON THE SCS CURVE NUMBER METHOD OUTLINED IN
  10       ID  NEH-4 AND TR-55. THE MUSKINGHAM METHOD IS USED FOR ROUTING. THE UPLAND
  11       ID  METHOD IS USED FOR THE DETERMINATION OF LAG TIME.
  12       ID  -CURVE NUMBERS ESTIMATED FROM USFS PHOTOGRAPHS
  13       ID    (AERIAL REDUCTION FOR TOTAL AREA OF THOMAS CREEK)
  14       ID
  15       ID  ***************************************************************************
  16       IT       5                   289
  17       IO       5       1

  18       KK      T1   THOMAS CREEK WATERSHED T1
  19       BA     2.5
  20       PH       1   11.64     .42     .33    1.45    1.87    2.26    3.18    4.31    5.44
  21       LS               69
  22       UD     .35
```

```
 23         KK   RT1-B  ROUTE T1 TO CONCENTRATION POINT B
 24         RM       1  .09568     .4

 25         KK      T2  THOMAS CREEK WATERSHED T2
 26         BA    1.82
 27         PH       1  11.64      .4    .79   1.39   1.75    2.1    2.9   3.31   4.92
 28         LS             58
 29         UD     .29

 30         KK      T3  THOMAS CREEK WATERSHED T3
 31         BA     .82
 32         PH       1  11.64     .41     .8    1.4   1.73   2.04   2.76   3.75   4.73
 33         LS             59
 34         UD      .3

 35         KK    CP-B  COMBINE ROUTED WATERSHED T1 W/ T2 AND T3 AT CONCCENTRATION PT B
 36         HC       3

 37         KK   RCP-C  ROUTE COMBINED T1-T3 TO CONCENTRATION PT C
 38         RM       2  .14576     .4

 39         KK      T4  THOMAS CREEK WATERSHED T4
 40         BA    2.16
 41         PH       1  11.64     .39    .77   1.35   1.64   1.91   2.55   3.38    4.2
 42         LS             58
 43         UD     .54
1                                   HEC-1 INPUT                                      PAGE  2

LINE        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 44         KK    CP-C  COMBINE ROUTED T1-T3 W/ T4
 45         HC       2

 46         KK   RCP-D  ROUTE COMBINED T1-T4 TO CONCENTRATION PT D
 47         RM       2  .1408      .4

 48         KK      T5  THOMAS CREEK WATERSHED T5
 49         BA    1.19
 50         PH      1.  11.64     .35    .68    1.2    1.4   1.59   2.04   2.75    3.4
 51         LS             71      0
 52         UD     .49

 53         KK    CP-D  COMBINE ROUTED T1-T4 W/ T5
 54         HC       2
 55         KO       1

 56         KK   RAPEX  ROUTE COMBINED T1-T5 TO APEX
 57         RM       2    .18      .4

 58         KK     T6A  THOMAS CREEK WATERSHED T6 @ fan APEX
 59         BA     .65
 60         PH       1  11.64     .35    .69   1.21   1.34   1.48    1.8    2.3    2.8
 61         LS             75
 62         UD     .21

 63         KK   APEX1  COMBINE FLOWS AT APEX
 64         HC       2
 65         KO                                 22

 66         KK  RT-395  ROUTE FLOWS FROM APEX TO 395
 67         RM       3   .462      .2

 68         KK     T6B  THOMAS CREEK WATERSHED T6 FROM APEX TO 395
 69         BA     2.5
 70         PH       1  11.64     .35    .69   1.21   1.34   1.48    1.8    2.3    2.8
```

```
              71          [illegible]            75
              72          UD     .66

              73          KK  T6A&B   COMBINE ALL FLOWS
              74          KC      2
              75          ZZ
1
                 SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT
 LINE     (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.     (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

   18         T1
              V
              V
   23      RT1-B
              .
              .
   25         .           T2
              .           .
              .           .
   30         .           .           T3
              .           .           .
              .           .           .
   35       CP-B.......................
              V
              V
   37      RCP-C
              .
              .
   39         .           T4
              .           .
              .           .
   44       CP-C............
              V
              V
   46      RCP-D
              .
              .
   48         .           T5
              .           .
              .           .
   53       CP-D............
              V
              V
   56       RAPEX
              .
              .
   58         .           T6A
              .           .
              .           .
   63       APEX1............
              V
              V
   66      RT-395
              .
              .
   68         .           T6B
              .           .
              .           .
   73      T6A&B ............

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1****************************************                          ****************************************
*                                       *                          *                                      *
```

```
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                              *   U.S. ARMY CORPS OF ENGINEERS     *
*          FEBRUARY 1981                *                              *  THE HYDROLOGIC ENGINEERING CENTER *
*        REVISED 01 JUN 88              *                              *        609 SECOND STREET           *
*                                       *                              *     DAVIS, CALIFORNIA 95616        *
*  RUN DATE  08/20/1990  TIME  12:18:01 *                              *        (916) 551-1748              *
*                                       *                              *                                    *
*****************************************                              **************************************


              ***************************************************************************
                FILENAME : THOM100.301
               FEMA FLOOD INSURANCE STUDY      THOMAS CREEK, WASHOE COUNTY, NEVADA
               FINAL RUN AUGUST 1990   BY: NIMBUS ENGINEERS  CONTRACT NO. EMW-89-C-2841
                                                             NIMBUS JOB NO. 8901

              THIS MODEL IS BASED ON DATA GENERATED BY NIMBUS ENGINEERS DURRING SUMMER 1989
              THE PARAMETERS FOR THIS MODEL ARE BASED ON THE 100 YEAR RAIN FALL PATTERN OF
              THE NOAA 2 ATLAS. LOSSES ARE BASED ON THE SCS CURVE NUMBER METHOD OUTLINED IN
              NEH-4 AND TR-55. THE MUSKINGHAM METHOD IS USED FOR ROUTING. THE UPLAND
              METHOD IS USED FOR THE DETERMINATION OF LAG TIME.
              -CURVE NUMBERS ESTIMATED FROM USFS PHOTOGRAPHS
                (AERIAL REDUCTION FOR TOTAL AREA OF THOMAS CREEK)

              ***************************************************************************

  17 IO         OUTPUT CONTROL VARIABLES
                      IPRNT          5  PRINT CONTROL
                      IPLOT          1  PLOT CONTROL
                      QSCAL         0.  HYDROGRAPH PLOT SCALE

     IT         HYDROGRAPH TIME DATA
                       NMIN          5  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1   0  STARTING DATE
                      ITIME       0000  STARTING TIME
                         NQ        289  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      2   0  ENDING DATE
                     NDTIME       0000  ENDING TIME
                      ICENT         19  CENTURY MARK

                  COMPUTATION INTERVAL     .08 HOURS
                       TOTAL TIME BASE   24.00 HOURS

          ENGLISH UNITS
              DRAINAGE AREA           SQUARE MILES
              PRECIPITATION DEPTH     INCHES
              LENGTH, ELEVATION       FEET
              FLOW                    CUBIC FEET PER SECOND
              STORAGE VOLUME          ACRE-FEET
              SURFACE AREA            ACRES
              TEMPERATURE             DEGREES FAHRENHEIT


 *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
   53 KK    *     CP-D   *       COMBINE ROUTED T1-T4 W/ T5
            *            *
            **************

   55 KO         OUTPUT CONTROL VARIABLES
```

IPRNT [illegible] PRINT CONTROL
IPLOT 1 PLOT CONTROL
QSCAL 0. HYDROGRAPH PLOT SCALE

54 HC HYDROGRAPH COMBINATION
ICOMP 2 NUMBER OF HYDROGRAPHS TO COMBINE

***

****

HYDROGRAPH AT STATION CP-D
SUM OF 2 HYDROGRAPHS

****

DA MON	HRMN	ORD	FLOW	*	DA MON	HRMN	ORD	FLOW	*	DA MON	HRMN	ORD	FLOW	*	DA MON	HRMN	ORD	FLOW
1	0000	1	0.	*	1	0605	74	0.	*	1	1210	147	463.	*	1	1815	220	427.
1	0005	2	0.	*	1	0610	75	0.	*	1	1215	148	617.	*	1	1820	221	422.
1	0010	3	0.	*	1	0615	76	0.	*	1	1220	149	863.	*	1	1825	222	415.
1	0015	4	0.	*	1	0620	77	0.	*	1	1225	150	1228.	*	1	1830	223	405.
1	0020	5	0.	*	1	0625	78	0.	*	1	1230	151	1696.	*	1	1835	224	391.
1	0025	6	0.	*	1	0630	79	0.	*	1	1235	152	2169.	*	1	1840	225	376.
1	0030	7	0.	*	1	0635	80	0.	*	1	1240	153	2512.	*	1	1845	226	360.
1	0035	8	0.	*	1	0640	81	0.	*	1	1245	154	2644.	*	1	1850	227	346.
1	0040	9	0.	*	1	0645	82	0.	*	1	1250	155	2568.	*	1	1855	228	335.
1	0045	10	0.	*	1	0650	83	0.	*	1	1255	156	2356.	*	1	1900	229	325.
1	0050	11	0.	*	1	0655	84	0.	*	1	1300	157	2086.	*	1	1905	230	318.
1	0055	12	0.	*	1	0700	85	0.	*	1	1305	158	1814.	*	1	1910	231	312.
1	0100	13	0.	*	1	0705	86	0.	*	1	1310	159	1580.	*	1	1915	232	307.
1	0105	14	0.	*	1	0710	87	0.	*	1	1315	160	1389.	*	1	1920	233	303.
1	0110	15	0.	*	1	0715	88	0.	*	1	1320	161	1236.	*	1	1925	234	300.
1	0115	16	0.	*	1	0720	89	0.	*	1	1325	162	1117.	*	1	1930	235	297.
1	0120	17	0.	*	1	0725	90	0.	*	1	1330	163	1027.	*	1	1935	236	294.
1	0125	18	0.	*	1	0730	91	0.	*	1	1335	164	964.	*	1	1940	237	291.
1	0130	19	0.	*	1	0735	92	0.	*	1	1340	165	919.	*	1	1945	238	289.
1	0135	20	0.	*	1	0740	93	0.	*	1	1345	166	886.	*	1	1950	239	287.
1	0140	21	0.	*	1	0745	94	0.	*	1	1350	167	860.	*	1	1955	240	285.
1	0145	22	0.	*	1	0750	95	0.	*	1	1355	168	838.	*	1	2000	241	283.
1	0150	23	0.	*	1	0755	96	0.	*	1	1400	169	818.	*	1	2005	242	281.
1	0155	24	0.	*	1	0800	97	0.	*	1	1405	170	800.	*	1	2010	243	279.
1	0200	25	0.	*	1	0805	98	0.	*	1	1410	171	784.	*	1	2015	244	277.
1	0205	26	0.	*	1	0810	99	0.	*	1	1415	172	770.	*	1	2020	245	275.
1	0210	27	0.	*	1	0815	100	0.	*	1	1420	173	756.	*	1	2025	246	274.
1	0215	28	0.	*	1	0820	101	0.	*	1	1425	174	742.	*	1	2030	247	272.
1	0220	29	0.	*	1	0825	102	0.	*	1	1430	175	730.	*	1	2035	248	270.
1	0225	30	0.	*	1	0830	103	0.	*	1	1435	176	717.	*	1	2040	249	269.
1	0230	31	0.	*	1	0835	104	1.	*	1	1440	177	705.	*	1	2045	250	267.
1	0235	32	0.	*	1	0840	105	2.	*	1	1445	178	693.	*	1	2050	251	266.
1	0240	33	0.	*	1	0845	106	3.	*	1	1450	179	682.	*	1	2055	252	264.
1	0245	34	0.	*	1	0850	107	5.	*	1	1455	180	672.	*	1	2100	253	262.
1	0250	35	0.	*	1	0855	108	6.	*	1	1500	181	661.	*	1	2105	254	261.
1	0255	36	0.	*	1	0900	109	8.	*	1	1505	182	652.	*	1	2110	255	260.
1	0300	37	0.	*	1	0905	110	11.	*	1	1510	183	643.	*	1	2115	256	258.
1	0305	38	0.	*	1	0910	111	13.	*	1	1515	184	634.	*	1	2120	257	257.
1	0310	39	0.	*	1	0915	112	15.	*	1	1520	185	626.	*	1	2125	258	255.
1	0315	40	0.	*	1	0920	113	18.	*	1	1525	186	618.	*	1	2130	259	254.
1	0320	41	0.	*	1	0925	114	21.	*	1	1530	187	610.	*	1	2135	260	253.
1	0325	42	0.	*	1	0930	115	24.	*	1	1535	188	599.	*	1	2140	261	251.
1	0330	43	0.	*	1	0935	116	27.	*	1	1540	189	588.	*	1	2145	262	250.
1	0335	44	0.	*	1	0940	117	31.	*	1	1545	190	576.	*	1	2150	263	249.
1	0340	45	0.	*	1	0945	118	35.	*	1	1550	191	564.	*	1	2155	264	247.
1	0345	46	0.	*	1	0950	119	39.	*	1	1555	192	554.	*	1	2200	265	246.
1	0350	47	0.	*	1	0955	120	44.	*	1	1600	193	545.	*	1	2205	266	245.
1	0355	48	0.	*	1	1000	121	48.	*	1	1605	194	537.	*	1	2210	267	244.
1	[illegible]	[illegible]	[illegible]	*	1	[illegible]	[illegible]	[illegible]	*	1	[illegible]	[illegible]	[illegible]	*	1	[illegible]	[illegible]	[illegible]

1	0400	49	0.	*	1	1005	122	52.	*	1	1610	195	530.	*	1	2215	268	242.
1	0405	50	0.	*	1	1010	123	57.	*	1	1615	196	523.	*	1	2220	269	241.
1	0410	51	0.	*	1	1015	124	62.	*	1	1620	197	517.	*	1	2225	270	240.
1	0415	52	0.	*	1	1020	125	67.	*	1	1625	198	511.	*	1	2230	271	239.
1	0420	53	0.	*	1	1025	126	72.	*	1	1630	199	506.	*	1	2235	272	238.
1	0425	54	0.	*	1	1030	127	78.	*	1	1635	200	501.	*	1	2240	273	237.
1	0430	55	0.	*	1	1035	128	84.	*	1	1640	201	496.	*	1	2245	274	236.
1	0435	56	0.	*	1	1040	129	90.	*	1	1645	202	492.	*	1	2250	275	234.
1	0440	57	0.	*	1	1045	130	97.	*	1	1650	203	487.	*	1	2255	276	233.
1	0445	58	0.	*	1	1050	131	104.	*	1	1655	204	483.	*	1	2300	277	232.
1	0450	59	0.	*	1	1055	132	111.	*	1	1700	205	479.	*	1	2305	278	231.
1	0455	60	0.	*	1	1100	133	119.	*	1	1705	206	475.	*	1	2310	279	230.
1	0500	61	0.	*	1	1105	134	127.	*	1	1710	207	471.	*	1	2315	280	229.
1	0505	62	0.	*	1	1110	135	136.	*	1	1715	208	467.	*	1	2320	281	228.
1	0510	63	0.	*	1	1115	136	146.	*	1	1720	209	463.	*	1	2325	282	227.
1	0515	64	0.	*	1	1120	137	157.	*	1	1725	210	460.	*	1	2330	283	226.
1	0520	65	0.	*	1	1125	138	169.	*	1	1730	211	456.	*	1	2335	284	225.
1	0525	66	0.	*	1	1130	139	182.	*	1	1735	212	453.	*	1	2340	285	224.
1	0530	67	0.	*	1	1135	140	194.	*	1	1740	213	450.	*	1	2345	286	223.
1	0535	68	0.	*	1	1140	141	206.	*	1	1745	214	446.	*	1	2350	287	222.
1	0540	69	0.	*	1	1145	142	221.	*	1	1750	215	443.	*	1	2355	288	221.
1	0545	70	0.	*	1	1150	143	239.	*	1	1755	216	440.	*	2	0000	289	220.
1	0550	71	0.	*	1	1155	144	265.	*	1	1800	217	437.	*				
1	0555	72	0.	*	1	1200	145	304.	*	1	1805	218	434.	*				
1	0600	73	0.	*	1	1205	146	366.	*	1	1810	219	431.	*				
				*					*					*				

```
*****************************************************************************************************

 PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR       72-HR      24.00-HR
+   (CFS)       (HR)
                           (CFS)
+   2644.       12.75                840.        292.        292.        292.
                         (INCHES)    .920       1.280       1.280       1.280
                          (AC-FT)    417.        579.        579.        579.

                         CUMULATIVE AREA =     8.49 SQ MI




*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


              **************
              *            *
  63 KK       *    APEX1   *     COMBINE FLOWS AT APEX
              *            *
              **************

  65 KO           OUTPUT CONTROL VARIABLES
                        IPRNT          5  PRINT CONTROL
                        IPLOT          1  PLOT CONTROL
                        QSCAL         0.  HYDROGRAPH PLOT SCALE
                        IPNCH          0  PUNCH COMPUTED HYDROGRAPH
                        IOUT          22  SAVE HYDROGRAPH ON THIS UNIT
                        ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                        ISAV2        289  LAST ORDINATE PUNCHED OR SAVED
                        TIMINT      .083  TIME INTERVAL IN HOURS

1
                                          RUNOFF SUMMARY
                                    FLOW IN CUBIC FEET PER SECOND
                                  TIME IN HOURS,  AREA IN SQUARE MILES

                                 PEAK   TIME OF    AVERAGE FLOW FOR MAXIMUM PERIOD      BASIN    MAXIMUM    TIME OF
        OPERATION     STATION    FLOW    PEAK                                           AREA      STAGE    MAX STAGE
```

+	OPERATION	STATION	FLOW	PEAK	6-HOUR	24-HOUR	72-HOUR	AREA	STAGE	MAX STAGE
+	HYDROGRAPH AT	T1	1471.	12.42	415.	148.	148.	2.50		
+	ROUTED TO	RT1-B	1451.	12.50	415.	147.	147.	2.50		
+	HYDROGRAPH AT	T2	507.	12.42	152.	52.	52.	1.82		
+	HYDROGRAPH AT	T3	229.	12.42	66.	23.	23.	.82		
+	3 COMBINED AT	CP-B	2121.	12.50	631.	223.	223.	5.14		
+	ROUTED TO	RCP-C	2091.	12.58	631.	222.	222.	5.14		
+	HYDROGRAPH AT	T4	290.	12.75	113.	41.	41.	2.16		
+	2 COMBINED AT	CP-C	2365.	12.67	750.	263.	263.	7.30		
+	ROUTED TO	RCP-D	2359.	12.75	750.	262.	262.	7.30		
+	HYDROGRAPH AT	T5	309.	12.58	92.	30.	30.	1.19		
+	2 COMBINED AT	CP-D	2644.	12.75	840.	292.	292.	8.49		
+	ROUTED TO	RAPEX	2589.	12.92	840.	290.	290.	8.49		
+	HYDROGRAPH AT	T6A	263.	12.25	44.	14.	14.	.65		
+	2 COMBINED AT	APEX1	2638.	12.92	879.	304.	304.	9.14		
+	ROUTED TO	RT-395	2267.	13.42	875.	300.	300.	9.14		
+	HYDROGRAPH AT	T6B	541.	12.83	165.	53.	53.	2.50		
+	2 COMBINED AT	T6A&B	2554.	13.33	1033.	353.	353.	11.64		

*** NORMAL END OF HEC-1 ***

Dry Creek

```
*************************************                    *************************************
*                                   *                    *                                   *
*   FLOOD HYDROGRAPH PACKAGE (HEC-1) *                   *  U.S. ARMY CORPS OF ENGINEERS     *
*          FEBRUARY 1981            *                    * THE HYDROLOGIC ENGINEERING CENTER *
*        REVISED 01 JUN 88          *                    *         609 SECOND STREET         *
*                                   *                    *      DAVIS, CALIFORNIA 95616      *
* RUN DATE  08/20/1990  TIME  08:29:11 *                 *          (916) 551-1748           *
*                                   *                    *                                   *
*************************************                    *************************************


                    X     X  XXXXXXX   XXXXX          X
                    X     X  X        X     X        XX
                    X     X  X        X               X
                    XXXXXXX  XXXX     X       XXXXX   X
                    X     X  X        X               X
                    X     X  X        X     X         X
                    X     X  XXXXXXX   XXXXX         XXX


THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                    HEC-1 INPUT                                  PAGE  1

 LINE        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

             *DIAGRAM
   1         ID   *****************************************************************************
   2         ID
   3         ID   FEMA FLOOD INSURANCE STUDY  -  DRY CREEK, WASHOE COUNTY, NEVADA
   4         ID   APRIL 1990
   5         ID
   6         ID   BY:  NIMBUS ENGINEERS, RENO, NEVADA                    FILE NAME: DRYCR.901
   7         ID   NIMBUS JOB NO. 8901   WASHOE CO & CITY OF RENO     CONTRACT NO. EMW-89-2841
   8         ID
   9         ID   RAINFALL DATA FROM NOAA ATLAS 2, VOLUME VII
  10         ID   RAINFALL DISTRIBUTION: 24 HOUR HYPOTHETICAL STORM USING AERIAL REDUCTION
  11         ID   FOR THE ENTIRE WATERSHED
  12         ID
  13         ID   LAG TIME COMPUTED WITH UPLAND METHOD
  14         ID   CURVE NUMBER FROM TR-55 AND NEH-4
  15         ID   ROUTING PERFORMED WITH MUSKINGUM METHOD
  16         ID
  17         ID   ========================  100 YEAR, 24 HOUR EVENT ========================
  18         ID
  19         ID       1989 MODEL REVISED TO REFLECT KEY CONCENTRATION POINTS
  20         ID                               (APRIL 1989)
  21         ID   *****************************************************************************
  22         IT       5                     300
  23         IO       5       0
```

```
 24         KK     D1     RUNOFF FROM DRAINAGE AREA D1
 25         BA    .78
 26         PH      1   13.44     .27     .53    1.27    1.55    1.82    2.45    3.23    4.00
 27         LS      0     65       0
 28         UD    .29

 29         KK  RT PTA    ROUTE FLOW FROM DRAINAGE AREA D1 TO OUTLET OF DRAINAGE AREA D2
 30         RM      3    .26     .40

 31         KK     D2     RUNOFF FROM DRAINAGE AREA D2
 32         BA   1.66
 33         PH      1   13.44     .36     .70    1.23    1.46    1.68    2.19    2.83    3.70
 34         LS      0     77       0
 35         UD    .43

 36         KK    PTA     COMBINE RUNOFF FROM D1 & D2 AT OUTLET OF D2
 37         HC      2

 38         KK  RT PTB    ROUTE COMBINED FLOW FROM DRAINAGE AREAS D1 AND D2 TO OUTLET OF D3
 39         RM      1    .10     .40

 40         KK     D3     RUNOFF FROM DRAINAGE AREA D3
 41         BA   1.10
 42         PH      1   13.44     .35     .70    1.20    1.37    1.56    2.00    2.65    3.20
 43         LS      0     79       0
 44         UD    .38
1                                       HEC-1 INPUT                                       PAGE  2

LINE        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 45         KK  D  PTB    COMBINE FLOWS FROM DRAINAGE AREAS D1,D2 & D3 AT STEAMBOAT DITCH
 46         HC      2

 47         KK  RT PTC    ROUTE FLOWS FROM STEAMBOAT DITCH TO POINT C
 48         RM      1    .11     .40

 49         KK     D4     DRAINAGE AREA D4
 50         BA    .19
 51         PH      1   13.44     .35     .70    1.20    1.36    1.50     1.8    2.35     2.9
 52         LS            76
 53         UD    .25

 54         KK    PTC     COMBINE D4 AND ROUTED FLOWS FROM D3
 55         HC      2

 56         KK     D5     RUNOFF FROM DRAINAGE AREA D5
 57         BA    1.7
 58         PH      1   13.44     .35     .70    1.22    1.47    1.70    2.25    2.90    3.70
 59         LS      0     75       0
 60         UD    .31

 61         KK  RTPT C    ROUTE COMBINED FLOWS FROM D5 TO OUTLET OF D6 (STEAMBOAT DITCH)
 62         RM      3    .25     .40

 63         KK     D6     RUNOFF FROM DRAINAGE AREA D6
 64         BA   1.60
 65         PH      1   13.44     .34     .67    1.17    1.37    1.56    2.00    2.55    3.10
 66         LS      0     80       0
 67         UD    .57

 68         KK   PT C   COMBINE ROUTED D5 AND D6
 69         HC      2

 70         KK    PTC     COMBINE ALL FLOWS ABOVE THIS CONCENTRATION POINT
 71         HC      2
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 72          KK  RT PTD   ROUTE FLOW TO LAKE DITCH
 73          RM      1      .1      .3

 74          KK      D7  RUNOFF FROM DRAINAGE AREA D7
 75          BA    1.20
 76          PH      1  13.44     .34     .67    1.17    1.37    1.56     2.0    2.55    3.10
 77          LS              80
 78          UD     .85

 79          KK     PTD    COMBINE FLOW AT LAKE DITCH
 80          HC       2

 81          KK  RT PTE    ROUTE FLOW TO PANORMA DRIVE (POINT E)
 82          RM       1      .1      .3
1                                         HEC-1 INPUT                                         PAGE  3

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 83          KK      D8    DRAINAGE AREA D8
 84          BA     .07
 85          PH       1  13.44     .32     .70    1.10    1.30    1.43    1.80    2.30     2.8
 86          LS              80
 87          UD     .33

 88          KK      D9    DRAINAGE AREA 9
 89          BA    1.53
 90          PH       1  13.44     .34     .67    1.17    1.37    1.56     2.0    2.55     3.1
 91          LS              77
 92          UD     .45

 93          KK     RTE    ROUTE FLOWS TO PANORAMA DRIVE (POINT E)
 94          RM       3     .32      .2

 95          KK     D10    DRAINAGE AREA 10
 96          BA     .63
 97          PH       1  13.44     .32     .70    1.10    1.30    1.43    1.80    2.30     2.8
 98          LS              78
 99          UD     .45

100          KK     PTE    COMBINE D9 AND D10
101          HC       2

102          KK     PTE    COMBINE HYDROGRAPHS JUST BELOW PANORAMA DRIVE
103          HC       3

104          KK  RT PTF    ROUTE FLOW TO F
105          RM       1      .1      .3

106          KK     D11    RUNOFF FROM DRAINAGE AREA D11
107          BA    1.40
108          PH       1  13.44     .35     .70    1.22    1.38    1.54    1.90    2.50    3.00
109          LS       0      80       0
110          UD     .85

111          KK  RT PTF    ROUTE FLOW TO POINT F
112          RM       1      .1      .4

113          KK     D12    DRAINAGE AREA D12
114          BA     .08
115          PH       1  13.44     .32      .7    1.10    1.30    1.43     1.8    2.30     2.8
116          LS              80
117          UD     .23

118          KK     PTF    COMBINE HYDROGRAPHS AT POINT F
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```
        119          HC      3

        120          KK  RT PTG    ROUTE FLOW TO POINT G
        121          RM      1    .08     .4
1                                         HEC-1 INPUT                                         PAGE 4

        LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


        122          KK     D13    DRAINAGE AREA 13
        123          BA      .3
        124          PH       1  13.44    .32     .7   1.10   1.30   1.43    1.8   2.30    2.8
        125          LS              80
        126          UD     .78

        127          KK     PTG    COMBINE HYDROGRAPHS AT FREEWAY
        128          HC       2

        129          KK  RT PTH    ROUTE FLOW TO INTERSECTION WITH PIPE
        130          RM       1   .08     .4

        131          KK     D14    RUNOFF FROM DRAINAGE AREA D14 (DRAINS THROUGH  66" PIPE UNDER I-580
        132          KM     PIPE LOCATED NORTH OF DRY CREEK CROSSING @ FREEWAY
        133          BA    1.20
        134          PH       1  13.44    .32     .7   1.10   1.30   1.43    1.8   2.30    2.8
        135          LS              80
        136          UD    .740

        137          KK   RES2  ROUTE FLOWS THROUGH 60 INCH CULVERT UNDER FREEWAY
        138          RS       1    STOR     -1
        139          SV       0     1.4    4.4     23     55    170    389
        140          SE  4462.5    4466   4468   4470   4472   4476   4480
        141          SQ       0      50     80    100    200    300    380

        142          KK     PTH  COMBINE FLOWS AT POINT H, JUST BELOW THE FREEWAY
        143          HC       2
        144          ZZ
1
              SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT
 LINE     (V) ROUTING         (--->) DIVERSION OR PUMP FLOW

  NO.     (.) CONNECTOR       (<---) RETURN OF DIVERTED OR PUMPED FLOW

   24         D1
              V
              V
   29     RT PTA
              .
              .
   31         .         D2
              .          .
              .          .
   36        PTA.........
              V
              V
   38     RT PTB
              .
              .
   40         .         D3
              .          .
              .          .
   45     D  PTB.........
              V
              V
   47     RT PTC
```

```
                .
                .
49              .        D4
                .         .
                .         .
54             PTC..........
                .
                .
56              .        D5
                .         V
                .         V
61              .      RTPT C
                .         .
                .         .
63              .         .         D6
                .         .          .
                .         .          .
68              .       PT C..........
                .         .
                .         .
70             PTC..........
                V
                V
72           RT PTD
                .
                .
74              .         D7
                .          .
                .          .
79             PTD..........
                V
                V
81           RT PTE
                .
                .
83              .         D8
                .          .
                .          .
88              .          .         D9
                .          .          V
                .          .          V
93              .          .         RTE
                .          .          .
                .          .          .
95              .          .          .         D10
                .          .          .           .
                .          .          .           .
100             .          .        PTE ...........
                .          .          .
                .          .          .
102            PTE ....................
                 V
                 V
104           RT PTF
                 .
                 .
106              .        D11
                 .          V
                 .          V
111              .      RT PTF
                 .          .
                 .          .
113              .          .         D12
                 .          .          .
                 .          .          .
118             PTF.....................
```

```
               V
               V
 120     RT PTG
               .
               .
 122           .          D13
               .            .
               .            .
 127         PTG............
               V
               V
 129     RT PTH
               .
               .
 131           .          D14
               .            V
               .            V
 137           .         RES2
               .            .
               .            .
 142         PTH............

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
```

```
***************************************            ***************************************
*                                     *            *                                     *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1) *            *   U.S. ARMY CORPS OF ENGINEERS      *
*          FEBRUARY 1981              *            * THE HYDROLOGIC ENGINEERING CENTER   *
*        REVISED 01 JUN 88            *            *         609 SECOND STREET           *
*                                     *            *       DAVIS, CALIFORNIA 95616       *
* RUN DATE  08/20/1990  TIME  08:29:11 *           *          (916) 551-1748             *
*                                     *            *                                     *
***************************************            ***************************************
```

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*************************************************************************

FEMA FLOOD INSURANCE STUDY  -  DRY CREEK, WASHOE COUNTY, NEVADA
APRIL 1990

BY:  NIMBUS ENGINEERS, RENO, NEVADA                    FILE NAME: DRYCR.901
NIMBUS JOB NO. 8901   WASHOE CO & CITY OF RENO      CONTRACT NO. EMW-89-2841

RAINFALL DATA FROM NOAA ATLAS 2, VOLUME VII
RAINFALL DISTRIBUTION: 24 HOUR HYPOTHETICAL STORM USING AERIAL REDUCTION
FOR THE ENTIRE WATERSHED

LAG TIME COMPUTED WITH UPLAND METHOD
CURVE NUMBER FROM TR-55 AND NEH-4
ROUTING PERFORMED WITH MUSKINGUM METHOD

=======================  100 YEAR, 24 HOUR EVENT =======================

    1989 MODEL REVISED TO RELFECT KEY CONCENTRATION POINTS
                        (APRIL 1989)
*************************************************************************
```

```
 23 IO          OUTPUT CONTROL VARIABLES
                      IPRNT          5  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL         0.  HYDROGRAPH PLOT SCALE

    IT          HYDROGRAPH TIME DATA
                      NMIN           5  MINUTES IN COMPUTATION INTERVAL
```

```
IDATE      1    0  STARTING DATE
ITIME        0000  STARTING TIME
NQ            300  NUMBER OF HYDROGRAPH ORDINATES
NDDATE     2    0  ENDING DATE
NDTIME       0055  ENDING TIME
ICENT          19  CENTURY MARK

COMPUTATION INTERVAL    .08 HOURS
TOTAL TIME BASE   24.92 HOURS

ENGLISH UNITS
    DRAINAGE AREA          SQUARE MILES
    PRECIPITATION DEPTH    INCHES
    LENGTH, ELEVATION      FEET
    FLOW                   CUBIC FEET PER SECOND
    STORAGE VOLUME         ACRE-FEET
    SURFACE AREA           ACRES
    TEMPERATURE            DEGREES FAHRENHEIT
```

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	D1	205.	12.42	61.	21.	20.	.78		
+	ROUTED TO	RT PTA	200.	12.67	61.	21.	20.	.78		
+	HYDROGRAPH AT	D2	740.	12.50	191.	68.	66.	1.66		
+	2 COMBINED AT	PTA	911.	12.58	251.	89.	86.	2.44		
+	ROUTED TO	RT PTB	906.	12.67	251.	89.	86.	2.44		
+	HYDROGRAPH AT	D3	496.	12.42	116.	38.	37.	1.10		
+	2 COMBINED AT	D PTB	1348.	12.58	367.	128.	123.	3.54		
+	ROUTED TO	RT PTC	1329.	12.67	367.	127.	123.	3.54		
+	HYDROGRAPH AT	D4	80.	12.33	14.	5.	5.	.19		
+	2 COMBINED AT	PTC	1369.	12.67	381.	132.	127.	3.73		
+	HYDROGRAPH AT	D5	800.	12.42	183.	64.	62.	1.70		
+	ROUTED TO	RTPT C	777.	12.67	183.	64.	62.	1.70		
+	HYDROGRAPH AT	D6	575.	12.67	167.	55.	53.	1.60		

	2 COMBINED AT								
+		PT C	1351.	12.67	351.	119.	115.	3.30
	2 COMBINED AT								
+		PTC	2721.	12.67	732.	251.	242.	7.03
	ROUTED TO								
+		RT PTD	2667.	12.75	731.	251.	242.	7.03
	HYDROGRAPH AT								
+		D7	333.	13.00	125.	41.	40.	1.20
	2 COMBINED AT								
+		PTD	2973.	12.75	856.	292.	282.	8.23
	ROUTED TO								
+		RT PTE	2910.	12.92	856.	292.	281.	8.23
	HYDROGRAPH AT								
+		D8	30.	12.42	6.	2.	2.	.07
	HYDROGRAPH AT								
+		D9	526.	12.58	139.	45.	44.	1.53
	ROUTED TO								
+		RTE	483.	12.83	138.	45.	44.	1.53
	HYDROGRAPH AT								
+		D10	199.	12.50	50.	16.	16.	.63
	2 COMBINED AT								
+		PTE	626.	12.83	188.	62.	59.	2.16
	3 COMBINED AT								
+		PTE	3548.	12.83	1050.	356.	343.	10.46
	ROUTED TO								
+		RT PTF	3495.	13.00	1049.	355.	342.	10.46
	HYDROGRAPH AT								
+		D11	387.	13.00	139.	45.	44.	1.40
	ROUTED TO								
+		RT PTF	386.	13.08	139.	45.	44.	1.40
	HYDROGRAPH AT								
+		D12	41.	12.33	7.	2.	2.	.08
	3 COMBINED AT								
+		PTF	3887.	13.00	1194.	403.	388.	11.94
	ROUTED TO								
+		RT PTG	3869.	13.08	1194.	402.	387.	11.94
	HYDROGRAPH AT								
+		D13	76.	12.92	26.	9.	8.	.30
	2 COMBINED AT								
+		PTG	3941.	13.08	1220.	411.	396.	12.24
	ROUTED TO								
+		RT PTH	3923.	13.17	1220.	410.	395.	12.24
	HYDROGRAPH AT								
+		D14	315.	12.83	105.	34.	33.	1.20

	ROUTED TO									
+		RES2	97.	14.17	91.	34.	33.	1.20		
+									4469.68	14.17
	2 COMBINED AT									
+		PTH	4014.	13.17	1310.	444.	428.	13.44		

*** NORMAL END OF HEC-1 ***

Dry and Evans Creek

```
****************************************                    ****************************************
*                                      *                    *                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *                    *  U.S. ARMY CORPS OF ENGINEERS        *
*          FEBRUARY 1981               *                    * THE HYDROLOGIC ENGINEERING CENTER    *
*          REVISED 01 JUN 88           *                    *       609 SECOND STREET              *
*                                      *                    *     DAVIS, CALIFORNIA 95616          *
* RUN DATE  08/20/1990  TIME  08:30:39 *                    *       (916) 551-1748                 *
*                                      *                    *                                      *
****************************************                    ****************************************


                    X     X  XXXXXXX   XXXXX         X
                    X     X  X        X     X       XX
                    X     X  X        X              X
                    XXXXXXX  XXXX     X      XXXXX   X
                    X     X  X        X              X
                    X     X  X        X     X        X
                    X     X  XXXXXXX   XXXXX        XXX


THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


1                                        HEC-1 INPUT                                        PAGE  1

          LINE        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

                      *DIAGRAM
            1         ID    ****************************************************************************
            2         ID
            3         ID    FEMA FLOOD INSURANCE STUDY  -  DRY AND EVANS CREEKS, WASHOE COUNTY, NEVADA
            4         ID    JULY  1990
            5         ID
            6         ID    BY:  NIMBUS ENGINEERS, RENO, NEVADA                  FILE NAME: DREV.901
            7         ID    NIMBUS JOB NO. 8901   WASHOE CO & CITY OF RENO      CONTRACT NO. EMW-89-2841
            8         ID
            9         ID    RAINFALL DATA FROM NOAA ATLAS 2, VOLUME VII
           10         ID    RAINFALL DISTRIBUTION: 24 HOUR HYPOTHETICAL STORM AERIAL REDUCTION
           11         ID    WAS ESTIMATED FOR 100-YEAR STORM OCCURING OVER THE EVANS AND DRY CREEKS
           12         ID    WATERSHEDS AT THE SAME TIME (24 SQ. MILES)
           13         ID
           14         ID    LAG TIME COMPUTED WITH UPLAND METHOD AND THE PROCEDURES DESCRIBED IN TR-55
           15         ID    CURVE NUMBER FROM TR-55 AND NEH-4
           16         ID    ROUTING PERFORMED WITH MUSKINGUM METHOD AND MODIFIED PULS
           17         ID
           18         ID    ======================== 100 YEAR, 24 HOUR EVENT ========================
           19         ID
           20         ID        1989 MODEL REVISED TO RELFECT KEY CONCENTRATION POINTS
           21         ID                             (APRIL AND JULY 1990)
           22         ID    ****************************************************************************
           23         IT     5               300
           24         IO     5      0
```

```
 25          KK  EV 1   EVANS CREEK WATERSHED NO.1
 26          BA    8.60
 27          PH     1      24     .4      .7     1.3     1.6     1.9     2.6     3.4     4.2
 28          LS            72
 29          UD   1.04

 30          KK   EVOUT
 31          DT     OUT
 32          DI       0    1521    1988    2200
 33          DQ       0      00     467     475

 34          KK    PTE1 ROUTE FLOWS FROM LAKESIDE ROAD TO I-395
 35          RM       5     .43     .20

 36          KK  EV 2   EVANS CREEK WATERSHED NO.2
 37          BA    1.10
 38          PH     1      24     .32     .7    1.10    1.30    1.43     1.8    2.30     2.8
 39          LS            78
 40          UD     .74

 41          KK    PTE2  COMBINE WATERSHEDS AT FREEWAY
 42          HC       2

 43          KK   RESE2  STORAGE AT I-395
 44          KM   FLOWS THAT DO NOT GO UNDER THE FREEWAY WILL ASSUME GO UNDER FREEWAY
 45          KM   AT DEL MONTE
 46          RS       1    STOR      -1
 47          SV       0     .01     .02       3      11      16     21.      27
 48          SE    4467    4468    4474    4476    4478    4479   4480.   4481.
1                                           HEC-1 INPUT                                           PAGE  2

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 49          SQ       0      80     700     900     950     975    1000   2000.

 50          KK   RTPTI  ROUTE FLOWS IN CULVERT THRU CONCRETE CHANNEL TO DRY CREEK CONFLUENCE
 51          RM       1      .1      .4

 52          KK     D14     RUNOFF FROM DRAINAGE AREA D14 (DRAINS THROUGH  66" PIPE UNDER I-580
 53          KM     PIPE LOCATED NORTH OF DRY CREEK CROSSING @ FREEWAY
 54          BA    1.20
 55          PH     1      24     .32     .7    1.10    1.30    1.43     1.8    2.30     2.8
 56          LS            80
 57          UD    .740
 58          KO                                  30

 59          KK    RES2  ROUTE FLOWS THROUGH 60 INCH CULVERT UNDER FREEWAY
 60          RS       1    STOR      -1
 61          SV       0     1.4     4.4      23      55     170     389
 62          SE  4462.5    4466    4468    4470    4472    4476    4480
 63          SQ       0      50      80     100     200     300     380
 64          KO                                  31

 65          KK      D1     RUNOFF FROM DRAINAGE AREA D1
 66          BA     .78
 67          PH     1      24     .27     .53    1.27    1.55    1.82    2.45    3.23    4.00
 68          LS       0      65       0
 69          UD     .29

 70          KK  RT PTA     ROUTE FLOW FROM DRAINAGE AREA D1 TO OUTLET OF DRAINAGE AREA D2
 71          RM       3     .26     .40

 72          KK      D2     RUNOFF FROM DRAINAGE AREA D2
 73          BA    1.66
 74          PH     1      24     .36     .70    1.23    1.46    1.68    2.19    2.83    3.70
```

```
  75          LS       0     77       0
  76          UD     .43

  77          KK     PTA    COMBINE RUNOFF FROM D1 & D2 AT OUTLET OF D2
  78          HC       2

  79          KK  RT PTB    ROUTE COMBINED FLOW FROM DRAINAGE AREAS D1 AND D2 TO OUTLET OF D3
  80          RM       1    .10     .40

  81          KK      D3    RUNOFF FROM DRAINAGE AREA D3
  82          BA    1.10
  83          PH       1     24     .35     .70    1.20    1.37    1.56    2.00    2.65    3.20
  84          LS       0     79       0
  85          UD     .38

  86          KK  D  PTB    COMBINE FLOWS FROM DRAINAGE AREAS D1,D2 & D3 AT STEAMBOAT DITCH
  87          HC       2
1                                         HEC-1 INPUT                                        PAGE  3

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


  88          KK  RT PTC    ROUTE FLOWS FROM STEAMBOAT DITCH TO POINT C
  89          RM       1    .11     .40

  90          KK      D4    DRAINAGE AREA D4
  91          BA     .19
  92          PH       1     24     .35     .70    1.20    1.36    1.50     1.8    2.35     2.9
  93          LS             76
  94          UD     .25

  95          KK     PTC    COMBINE D4 AND ROUTED FLOWS FROM D3
  96          HC       2

  97          KK      D5    RUNOFF FROM DRAINAGE AREA D5
  98          BA     1.7
  99          PH       1     24     .35     .70    1.22    1.47    1.70    2.25    2.90    3.70
 100          LS       0     75       0
 101          UD     .31

 102          KK  RTPT C    ROUTE COMBINED FLOWS FROM D5 TO OUTLET OF D6 (STEAMBOAT DITCH)
 103          RM       3    .25     .40

 104          KK      D6    RUNOFF FROM DRAINAGE AREA D6
 105          BA    1.60
 106          PH       1     24     .34     .67    1.17    1.37    1.56    2.00    2.55    3.10
 107          LS       0     80       0
 108          UD     .57

 109          KK    PT C  COMBINE ROUTED D5 AND D6
 110          HC       2

 111          KK     PTC    COMBINE ALL FLOWS ABOVE THIS CONCENTRATION POINT
 112          HC       2

 113          KK  RT PTD  ROUTE FLOW TO LAKE DITCH
 114          RM       1      .1      .3

 115          KK      D7  RUNOFF FROM DRAINAGE AREA D7
 116          BA    1.20
 117          PH       1     24     .34     .67    1.17    1.37    1.56     2.0    2.55    3.10
 118          LS             80
 119          UD     .85

 120          KK     PTD    COMBINE FLOW AT LAKE DITCH
 121          HC       2
```

```
122          KK  RT PTE    ROUTE FLOW TO PANORMA DRIVE (POINT E)
123          RM       1     .1     .3

124          KK      D8    DRAINAGE AREA D8
125          BA     .07
126          PH       1     24     .32     .70    1.10    1.30    1.43    1.80    2.30     2.8
127          LS             80
128          UD     .33
1                                    HEC-1 INPUT                                        PAGE  4

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


129          KK      D9    DRAINAGE AREA 9
130          BA    1.53
131          PH       1     24     .34     .67    1.17    1.37    1.56     2.0    2.55     3.1
132          LS             77
133          UD     .45

134          KK     RTE    ROUTE FLOWS TO PANORAMA DRIVE (POINT E)
135          RM       3    .32     .2

136          KK     D10    DRAINAGE AREA 10
137          BA     .63
138          PH       1     24     .32     .70    1.10    1.30    1.43    1.80    2.30     2.8
139          LS             78
140          UD     .45

141          KK     PTE    COMBINE D9 AND D10
142          HC       2

143          KK     PTE    COMBINE HYDROGRAPHS JUST BELOW PANORAMA DRIVE
144          HC       3

145          KK  RT PTF    ROUTE FLOW TO F
146          RM       1     .1     .3

147          KK     D11    RUNOFF FROM DRAINAGE AREA D11
148          BA    1.40
149          PH       1     24     .35     .70    1.22    1.38    1.54    1.90    2.50    3.00
150          LS       0     80       0
151          UD     .85

152          KK  RT PTF    ROUTE FLOW TO POINT F
153          RM       1     .1      .4

154          KK     D12    DRAINAGE AREA D12
155          BA     .08
156          PH       1     24     .32      .7    1.10    1.30    1.43     1.8    2.30     2.8
157          LS             80
158          UD     .23

159          KK     PTF    COMBINE HYDROGRAPHS AT POINT F
160          HC       3

161          KK  RT PTG    ROUTE FLOW TO POINT G
162          RM       1    .08      .4

163          KK     D13    DRAINAGE AREA 13
164          BA      .3
165          PH       1     24     .32      .7    1.10    1.30    1.43     1.8    2.30     2.8
166          LS             80
167          UD     .78
1                                    HEC-1 INPUT                                        PAGE  5
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LINE        ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 168        KK     PTG     COMBINE HYDROGRAPHS AT FREEWAY
 169        HC       2

 170        KK  RT PTH     ROUTE FLOW TO INTERSECTION WITH PIPE
 171        RM       1   .08     .4

 172        KK     PTH  COMBINE FLOWS AT POINT H,'JUST BELOW  FREEWAY
 173        HC       2
 174        KO                              32.

 175        KK   RTPTI   ROUTE FLOWS TO CONFLUENCE WITH EVANS CREEK
 176        RM       1  .15      .2

 177        KK     EV3  EVANS CREEK WATERSHED NO. 3
 178        BA     .52
 179        PH       1     24.    .32      .7   1.1     1.3   1.43      1.8   2.3    2.8
 180        LS             76.     8.
 181        UD      .7

 182        KK     PTI  CONFLUENCE OF EVANS CREEK AND DRY CREEK
 183        HC       3
 184        ZZ
1
               SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT
 LINE     (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

  NO.     (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

  25      EV 1
             .
             .
  31         .------->     OUT
  30       EVOUT
             V
             V
  34        PTE1
             .
             .
  35         .        EV 2
             .           .
             .           .
  41        PTE2............
             V
             V
  43       RESE2
             V
             V
  50       RTPTI
             .
             .
  52         .          D14
             .            V
             .            V
  59         .        RES2
             .           .
             .           .
  65         .           .          D1
             .           .           V
             .           .           V
  70         .           .      RT PTA
             .           .           .
             .           .           .
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```
72          .          .          .         D2
            .          .          .          .
            .          .          .          .
77          .          .        PTA...........
            .          .          V
            .          .          V
79          .          .     RT PTB
            .          .          .
            .          .          .
81          .          .          .         D3
            .          .          .          .
            .          .          .          .
86          .          .     D  PTB...........
            .          .          V
            .          .          V
88          .          .     RT PTC
            .          .          .
            .          .          .
90          .          .          .         D4
            .          .          .          .
            .          .          .          .
95          .          .        PTC...........
            .          .          .
            .          .          .
97          .          .          .         D5
            .          .          .          V
            .          .          .          V
102         .          .          .     RTPT C
            .          .          .          .
            .          .          .          .
104         .          .          .          .         D6
            .          .          .          .          .
            .          .          .          .          .
109         .          .          .       PT C...........
            .          .          .          .
            .          .          .          .
111         .          .        PTC...........
            .          .          V
            .          .          V
113         .          .     RT PTD
            .          .          .
            .          .          .
115         .          .          .         D7
            .          .          .          .
            .          .          .          .
120         .          .        PTD...........
            .          .          V
            .          .          V
122         .          .     RT PTE
            .          .          .
            .          .          .
124         .          .          .         D8
            .          .          .          .
            .          .          .          .
129         .          .          .          .         D9
            .          .          .          .          V
            .          .          .          .          V
134         .          .          .          .        RTE
            .          .          .          .          .
            .          .          .          .          .
136         .          .          .          .          .        D10
            .          .          .          .          .          .
            .          .          .          .          .          .
141         .          .          .          .       PTE ...........
            .          .          .          .          .
            .          .          .          .          .
```

```
143        .         .       PTE....................
           .         .         V
           .         .         V
145        .         .     RT PTF
           .         .         .
           .         .         .
147        .         .         .       D11
           .         .         .         V
           .         .         .         V
152        .         .         .    RT PTF
           .         .         .         .
           .         .         .         .
154        .         .         .         .       D12
           .         .         .         .         .
           .         .         .         .         .
159        .         .       PTF....................
           .         .         V
           .         .         V
161        .         .     RT PTG
           .         .         .
           .         .         .
163        .         .         .       D13
           .         .         .         .
           .         .         .         .
168        .         .       PTG..........
           .         .         V
           .         .         V
170        .         .     RT PTH
           .         .         .
           .         .         .
172        .       PTH..........
           .         V
           .         V
175        .     RTPTI
           .         .
           .         .
177        .         .       EV3
           .         .         .
           .         .         .
182      PTI....................

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1*****************************************
 *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
 *             FEBRUARY 1981             *
 *           REVISED 01 JUN 88           *
 *                                       *
 * RUN DATE  08/20/1990  TIME  08:30:39  *
 *                                       *
 *****************************************

*****************************************
*                                       *
*   U.S. ARMY CORPS OF ENGINEERS        *
*  THE HYDROLOGIC ENGINEERING CENTER    *
*         609 SECOND STREET             *
*      DAVIS, CALIFORNIA 95616          *
*         (916) 551-1748                *
*                                       *
*****************************************


***************************************************************************

FEMA FLOOD INSURANCE STUDY  -  DRY AND EVANS CREEKS, WASHOE COUNTY, NEVADA
JULY  1990

BY:  NIMBUS ENGINEERS, RENO, NEVADA                   FILE NAME: DREV.901
NIMBUS JOB NO. 8901   WASHOE CO & CITY OF RENO     CONTRACT NO. EMW-89-2841

RAINFALL DATA FROM NOAA ATLAS 2, VOLUME VII
RAINFALL DISTRIBUTION: 24 HOUR HYPOTHETICAL STORM AERIAL REDUCTION
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                    WAS ESTIMATED FOR 100-YEAR STORM OCCURING OVER THE EVANS AND DRY CREEKS
                    WATERSHEDS AT THE SAME TIME (24 SQ. MILES)

                    LAG TIME COMPUTED WITH UPLAND METHOD AND THE PROCEDURES DESCRIBED IN TR-55
                    CURVE NUMBER FROM TR-55 AND NEH-4
                    ROUTING PERFORMED WITH MUSKINGUM METHOD AND MODIFIED PULS

                    ======================== 100 YEAR, 24 HOUR EVENT ========================

                         1989 MODEL REVISED TO RELFECT KEY CONCENTRATION POINTS
                                        (APRIL AND JULY 1990)
                    **************************************************************************

  24 IO        OUTPUT CONTROL VARIABLES
                     IPRNT         5  PRINT CONTROL
                     IPLOT         0  PLOT CONTROL
                     QSCAL        0.  HYDROGRAPH PLOT SCALE

    IT         HYDROGRAPH TIME DATA
                      NMIN         5  MINUTES IN COMPUTATION INTERVAL
                     IDATE     1   0  STARTING DATE
                     ITIME      0000  STARTING TIME
                        NQ       300  NUMBER OF HYDROGRAPH ORDINATES
                    NDDATE     2   0  ENDING DATE
                    NDTIME      0055  ENDING TIME
                    ICENT         19  CENTURY MARK

                 COMPUTATION INTERVAL     .08 HOURS
                      TOTAL TIME BASE   24.92 HOURS

         ENGLISH UNITS
              DRAINAGE AREA         SQUARE MILES
              PRECIPITATION DEPTH   INCHES
              LENGTH, ELEVATION     FEET
              FLOW                  CUBIC FEET PER SECOND
              STORAGE VOLUME        ACRE-FEET
              SURFACE AREA          ACRES
              TEMPERATURE           DEGREES FAHRENHEIT


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
  52 KK    *     D14    *         RUNOFF FROM DRAINAGE AREA D14 (DRAINS THROUGH  66" PIPE UNDER I-580
           *            *
           **************

  58 KO        OUTPUT CONTROL VARIABLES
                     IPRNT         5  PRINT CONTROL
                     IPLOT         0  PLOT CONTROL
                     QSCAL        0.  HYDROGRAPH PLOT SCALE
                     IPNCH         0  PUNCH COMPUTED HYDROGRAPH
                      IOUT        30  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1         1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2       300  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT      .083  TIME INTERVAL IN HOURS


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
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          **************
          *            *
  59 KK   *    RES2    *     ROUTE FLOWS THROUGH 60 INCH CULVERT UNDER FREEWAY
          *            *
          **************

  64 KO        OUTPUT CONTROL VARIABLES
                     IPRNT          5  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE
                     IPNCH          0  PUNCH COMPUTED HYDROGRAPH
                      IOUT         31  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2        300  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT       .083  TIME INTERVAL IN HOURS


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
 172 KK   *     PTH    *      COMBINE FLOWS AT POINT H, JUST BELOW  FREEWAY
          *            *
          **************

 174 KO        OUTPUT CONTROL VARIABLES
                     IPRNT          5  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE
                     IPNCH          0  PUNCH COMPUTED HYDROGRAPH
                      IOUT         32  SAVE HYDROGRAPH ON THIS UNIT
                     ISAV1          1  FIRST ORDINATE PUNCHED OR SAVED
                     ISAV2        300  LAST ORDINATE PUNCHED OR SAVED
                    TIMINT       .083  TIME INTERVAL IN HOURS

1
```

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD			BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+					6-HOUR	24-HOUR	72-HOUR			
	HYDROGRAPH AT									
+		EV 1	1988.	13.17	999.	347.	334.	8.60		
	DIVERSION TO									
+		OUT	467.	13.17	55.	14.	13.	8.60		
	HYDROGRAPH AT									
+		EVOUT	1521.	13.17	944.	333.	321.	8.60		
	ROUTED TO									
+		PTE1	1521.	13.92	942.	330.	317.	8.60		
	HYDROGRAPH AT									
+		EV 2	239.	12.83	63.	28.	27.	1.10		
	2 COMBINED AT									
+		PTE2	1666.	13.33	1021.	357.	344.	9.70		
	ROUTED TO									

+		RESK2	1649.	13.58	1021.	357.	344.	9.70		
+									4480.65	13.58
	ROUTED TO									
+		RTPTI	1645.	13.75	1021.	356.	343.	9.70		
	HYDROGRAPH AT									
+		D14	298.	12.83	102.	34.	32.	1.20		
	ROUTED TO									
+		RES2	95.	14.17	90.	33.	32.	1.20		
+									4469.55	14.17
	HYDROGRAPH AT									
+		D1	189.	12.42	59.	20.	20.	.78		
	ROUTED TO									
+		RT PTA	185.	12.67	59.	20.	20.	.78		
	HYDROGRAPH AT									
+		D2	693.	12.50	185.	67.	65.	1.66		
	2 COMBINED AT									
+		PTA	852.	12.58	243.	87.	84.	2.44		
	ROUTED TO									
+		RT PTB	848.	12.67	243.	87.	84.	2.44		
	HYDROGRAPH AT									
+		D3	464.	12.50	113.	38.	36.	1.10		
	2 COMBINED AT									
+		D PTB	1263.	12.58	356.	125.	120.	3.54		
	ROUTED TO									
+		RT PTC	1245.	12.67	356.	125.	120.	3.54		
	HYDROGRAPH AT									
+		D4	74.	12.33	14.	5.	4.	.19		
	2 COMBINED AT									
+		PTC	1284.	12.67	370.	129.	125.	3.73		
	HYDROGRAPH AT									
+		D5	745.	12.42	178.	63.	60.	1.70		
	ROUTED TO									
+		RTPT C	724.	12.67	178.	63.	60.	1.70		
	HYDROGRAPH AT									
+		D6	541.	12.67	163.	54.	52.	1.60		
	2 COMBINED AT									
+		PT C	1265.	12.67	341.	117.	113.	3.30		
	2 COMBINED AT									
+		PTC	2549.	12.67	710.	246.	237.	7.03		
	ROUTED TO									
+		RT PTD	2500.	12.75	710.	246.	237.	7.03		
	HYDROGRAPH AT									
+		D7	316.	13.00	121.	40.	39.	1.20		
	2 COMBINED AT									
+		PTD	2790.	12.75	831.	286.	276.	8.23		

	ROUTED TO							
+		RT PTE	2736.	12.92	881.	286.	276.	8.23
	HYDROGRAPH AT							
+		D8	28.	12.42	6.	2.	2.	.07
	HYDROGRAPH AT							
+		D9	492.	12.58	134.	44.	43.	1.53
	ROUTED TO							
+		RTE	453.	12.92	134.	44.	43.	1.53
	HYDROGRAPH AT							
+		D10	186.	12.58	48.	16.	15.	.63
	2 COMBINED AT							
+		PTE	589.	12.83	182.	60.	58.	2.16
	3 COMBINED AT							
+		PTE	3333.	12.83	1019.	348.	336.	10.46
	ROUTED TO							
+		RT PTF	3289.	13.00	1019.	348.	335.	10.46
	HYDROGRAPH AT							
+		D11	367.	13.00	135.	44.	43.	1.40
	ROUTED TO							
+		RT PTF	366.	13.08	135.	44.	43.	1.40
	HYDROGRAPH AT							
+		D12	38.	12.33	7.	2.	2.	.08
	3 COMBINED AT							
+		PTF	3660.	13.00	1160.	394.	380.	11.94
	ROUTED TO							
+		RT PTG	3644.	13.08	1160.	394.	379.	11.94
	HYDROGRAPH AT							
+		D13	72.	12.92	25.	8.	8.	.30
	2 COMBINED AT							
+		PTG	3712.	13.08	1185.	402.	388.	12.24
	ROUTED TO							
+		RT PTH	3696.	13.17	1185.	402.	387.	12.24
	2 COMBINED AT							
+		PTH	3786.	13.17	1274.	435.	419.	13.44
	ROUTED TO							
+		RTPTI	3638.	13.25	1273.	434.	418.	13.44
	HYDROGRAPH AT							
+		EV3	118.	12.83	39.	14.	13.	.52
	3 COMBINED AT							
+		PTI	4891.	13.50	2330.	804.	774.	23.66

*** NORMAL END OF HEC-1 ***

Nimbus Engineers
3710 Grant Dr., Suite D • Reno, NV 89509
Mail: P.O. Box 10220 • Reno, NV 89510
(702) 689-8630

August 22, 1990

Mr. Steve Varela
City of Reno, City Engineer
City Hall Annex
P.O. Box 1900
Reno, Nevada 89502

RE: Hydrologic Analyses for Thomas, Dry, and Evans Creek
(Nimbus Job #8901)

Dear Mr. Varela:

Presently, Nimbus Engineers is performing a flood insurance study for portions of Washoe County and the City of Reno under FEMA Contract #EMW-89-C-2841. Enclosed is a copy of a hydrology report prepared by Nimbus Engineers for this study. The results of this report will be used in the hydraulic analyses to delineate flood hazards within the watersheds that were studied. This report is submitted to you for review and comments at the request of Les Sakumoto of FEMA Region IX.

We respectfully request that this report be reviewed by your office and comments be provided by September 7, 1990. Should you have any questions during your review, please do not hesitate to call John Schmeltzer or me.

Sincerely,
Nimbus Engineers

John Schmeltzer for
Margaret (Peggy) Bowker, P.E.
Principal

Encl.

xc: Les Sakumoto, FEMA Region IX

City of Reno

Inter-Office Memo

Date: September 10, 1990

To: Steve Varela, City Engineer

From: Glen Daily, Associate Civil Engineer

Re: **FEMA Hydrologic Analysis for Thomas Creek, Dry Creek, and Evans Creek**

Regarding the attached Hydrologic Analysis prepared by Nimbus Engineers, I offer the following comments:

1. The routing of the 100-year Thomas Creek flows below the fan apex and existing channel capacity will have to be carefully evaluated in regard to considerations for future detention facilities. The effectiveness of such detention would obviously be severely limited in the event flows split between more than one channel above the detention facility.

2. The confluence of Thomas Creek flows resulting from a 100-year storm event at the Interstate 580/So. Virginia St. Interchange will far exceed the capacity of the existing drainage improvements and detention facility which are designed for a 10-year event. This dictates the effectiveness of planned improvements within the Huffaker Subdivision area to that which is effectively piped or channelized from the detention outlet with added local flow accumulations. The excess flows during a 100-year storm event will sheet overland with a significant portion flowing down Virginia St.

3. As a general comment the usefulness of this flood study would be enhanced by providing more detailed information regarding the adequacy of existing drainage improvements through developed areas to the eventual terminus of the various watersheds.

GBD:gd
cc: Bob Gottsacker

Kennedy/Jenks/Chilton

6 September 1990

MEMORANDUM

To: File

From: Mark Forest

Subject: Washoe County Flood Control Master Plan
FEMA Flood Insurance Study for Thomas and Dry Creeks
K/J/C Job No.: 897043.01

Kennedy/Jenks/Chilton has received a copy of a report prepared by Nimbus Engineers titled "Hydrologic Analysis, Thomas Creek, Dry Creek and Evans Creek, Washoe County, Nevada" dated August 1990. This report was prepared by Nimbus as partial satisfaction of their contract with FEMA to prepare a Flood Insurance Re-Study (FIS) of Thomas Creek and Dry Creek within Washoe County and the City of Reno. This study has been in progress for the last two years. According to the cover letter that transmitted the report to the City of Reno, FEMA has requested Nimbus to send the hydrology report for the FIS to the communities for review.

Kennedy/Jenks/Chilton has reviewed the report as a technical document that is important to the Washoe County Flood Control Master Plan. Flood Insurance Studies result in a set of Flood Insurance Rate Maps that FEMA will require the communities to use for flood plain management and regulatory purposes.

The following items are the most critical concerns with the conclusions identified in the report.

1) On page 4 the report indicates that the Dry Creek channel and box culvert under Interstate 580, have sufficient capacity to convey the discharges estimated by Nimbus (4018 cfs). Based upon field surveys conducted by Kennedy/Jenks/Chilton and the plans for I-580, under optimal conditions (inlet control governing) the culvert would not be able to achieve the needed headwater depth at the inlet of the culvert without overtopping the north bank of the Dry Creek channel. In addition, the culvert and channel conditions downstream of the box culvert will likely cause significant backwater influences that will further reduce the capacity of the I-580 culvert.

   Flow which overtops the north bank of the channel will interact with the overflow from Evans Creek. The interaction of Evans Creek and Dry Creek upstream of I-580 is a very dynamic process that will require careful analysis to properly identify the extent of the flooding hazard in this area.

2) In the discussion of the Evans Creek contribution to the Dry Creek peak flows, the report indicates (page 12 and Dry and Evans Creek HEC-1 model element RESE2) that Evans Creek flows are impounded by I-580 and the overflow will exit the pool through the Del Monte underpass. The model indicates that the maximum pool elevation resulting in this overflow is 4480.65. This elevation will result in a pool that interacts with Dry Creek and also spills through the Longley Lane underpass. This elevation is also well above the low point in I-580 at the north end of the sound wall just south of Del Monte Lane.

   The computed pool elevation also exceeds the computed pool elevation at model element D14 and RES2 by over 10 feet. The flow from D14 also interacts with the overflow from Evans Creek. As mentioned in item 1, the Dry Creek interaction with this overflow from Evans Creek is neglected in the report discussion and hydrologic analysis.

3) The estimated discharges for Dry Creek computed by Nimbus differ considerably with the Corps of Engineers estimate. The difference between the two studies is not specifically addressed.

4) Previous studies have indicated that a portion of flows from extreme events on Thomas Creek proceed north and interact with Dry Creek. The Nimbus report neglects any Thomas Creek contribution to the peak flows in Dry Creek.

5) In the report discussion Thomas Creek (pg. 5) is referred to as an alluvial fan. The appendix also contains a 2 and 10 year hydrologic model for Thomas Creek that would be needed to prepare an alluvial fan model. Although the report does not directly state that the alluvial fan model will be applied to Thomas Creek, it is very strongly implied. As stated by Kennedy/Jenks/Chilton in the Thomas Creek detention basin study, Kennedy/Jenks/Chilton has taken the position the [That] Thomas Creek does not exhibit the characteristics of an active alluvial fan and therefore, the assumptions inherent to the FEMA alluvial fan model would not be valid for Thomas Creek. The result would be a floodplain delineation that would underpredict the flooding hazards in several critical areas and overpredict flooding hazards in other areas.

These items will be significant to the flood plain mapping effort that Nimbus is in the process of preparing. If these issues are not properly addressed before the completion of the study, it may be necessary for the community to prepare an appeal during the formal appeals period.

MF/kls

cc: Shelly Gordon