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Colorado Springs
Denver

Engineering
Planning
Surveying

September 4, 1992

City of Colorado Springs
Engineering Division
30 South Nevada Avenue, Suite 403
Colorado Springs, CO 80903

ATTN: Mr. Bob Adamczyk

RETURN WITHIN 2 WEEKS TO:
CITY OF COLORADO SPRINGS
STORM WATER & SUBDIVISION
101 W. COSTILLA, SUITE 113
COLORADO SPRINGS, CO 80903
(719) 385-5979

RE: Dry Creek MDDP

Dear Bob:

JR Engineering, Ltd. is currently revising the Dry Creek Master Development Drainage Plan (MDDP) within the Peregrine area. During the course of updating the Dry Creek MDDP, it has been noticed that the peak runoff predicted by the TR-20 computer model seems to be greater than field observations would support.

JR Engineering, Ltd. and Peregrine Joint Venture have over six years of involvement with this portion of the Dry Creek Basin. During this time we have made periodic investigations to evaluate storm water discharge. Field observations consist of the presence of high water marks within existing ponds and natural channel conditions after high intensity rainfalls. Attempts to observe significant discharge in the lower portions of Dry Creek in the vicinity of Peregrine's easterly boundary have been unsuccessful. Existing ponds have no high water mark indicating no consistent appreciable ponding as predicted in the TR-20 model. Field reconnaissance of the main channel of Dry Creek, after particularly intense storms, reveal signs of runoff, i.e., vegetation pushed over and leaf litter along the high water mark, but as we follow the channel downstream these signs decrease, indicating a high degree of infiltration in the main channel.

As we continue to collect additional empirical evidence, it is obvious that we need to somehow "calibrate" the computer model to be more consistent with the observable data.

We have returned to the original input file to see if there are any erroneous or overly conservative data that can be adjusted.

TR-20 utilizes Soil Conservation Service calculations to determine storm water discharge. Parameters we revisited which affect runoff include: 1) rainfall depth, 2) runoff curve number (CN), 3) time of concentration (TC), and 4) the selected design storm.

Rainfall Depth (Exhibit 'C')
Rainfall depth is interpolated from NOAA Atlas 2, Volume III. These maps show isopuvials for the 10-year and 100-year 24-hour storms. The 10-year 24-hour precipitation of 3.0" utilized in the original MDDP input file appears to be a correct interpolation. The 100-year 24-hour precipitation was originally input as 4.5"; we propose to revise this to 4.4". This revised value is consistent with recent SCS drainage analysis performed in the Peregrine area, and is a more accurate interpolation from the 100-year 24-hour NOAA Atlas.

Basin Parameters (CN & TC)
CN's are determined by three factors: hydrologic soil group, ground cover and the hydrologic condition of the cover. The hydrologic soil group is based upon the existing soil complex and is determined directly from soils maps published by the SCS. Ground cover and hydrologic condition are determined from U.S.G.S. topographic data and site specific knowledge. The original Dry Creek MDDP computer model assumed that all existing ground cover had a hydrologic condition of "fair". We conducted field investigations to determine if this was an appropriate assumption. It appears that a hydrologic condition of "good" would be more accurate for the existing forest and range CN's used in the model. "Good" forest cover (as defined in SCS, NEH-4) is noted as "protected from grazing, litter and shrubs cover the soil". The forest in this area meets these requirements. The existing range would also meet the hydrologic condition of "good" as defined in NEH-4; "lightly grazed, has plant cover on more than 75% of the area".

Time of concentration for individual sub-basin typically involve two types of calculations; an overland travel time plus channel travel time. Overland travel times as calculated in the original Dry Creek MDDP appeared to be accurate. Channel travel time was calculated by Mannigs Velocity Equation. The roughness coefficient was assumed to be n=0.050 (clean bottom, brush on sides). Field investigations found the natural channels within upper Dry Creek to have many natural drops, large boulders, deadfalls, significant vegetation and an appreciable degree of meandering. The natural channels gradually transition to wide, gently rolling valleys with the main channels poorly defined and densely covered with native grasses. Utilizing Table 10-1 from the City Drainage Criteria Manual, these factors produce a roughness coefficient averaging closer to n=0.100, increasing the time of concentration of the overall Dry Creek Basin within Peregrine.

Selected Design Storm

Another proposed revision would include using a Type II storm distribution as opposed to the Type IIA utilized in the original computer model. Current City criteria allows the Type II storm to be used for basins above 8,000 feet. Approximately 35% (mainly offsite Pike National Forest land) of the entire study area is above 8,000 feet. If the basin is run utilizing current City criteria (Type II above 8,000 feet, IIA below 8,000 feet), the resulting outflow hydrograph produces two distinct peaks; one occurring approximately six hours after the beginning of the storm (Type IIA) and another peak occurring approximately twelve hours after the storm begins (Type II). We feel it would be more accurate and consistent to utilize the Type II storm through the entire basin so that the resultant discharge hydrograph would contain one peak.

Current SCS criteria (SCS TR-55, June, 1986) no longer includes the Type IIA storm distribution (see Exhibit 'D'). The Type II storm is the recommended design storm for all of Colorado. Discussions with Mr. Glade Wilkes of the Soil Conservation Service provided some history of the origins for the IIA storm. The IIA storm was developed in New Mexico and adopted later for Colorado in the SCS publication "Procedures For Determining Peak Flows In Colorado, March, 1984". Subsequently, SCS revised their criteria (TR-55, June, 1986). SCS concluded that the Type II storm yielded accurate peak flow determinations and did not update the Colorado specific criteria. Mr. Wilkes also concurred that the Type II storm would yield accurate peak flows within the Peregrine Dry Creek Basin, as described to him.

In conclusion, after a number of years monitoring runoff within the Peregrine Dry Creek Basin, we feel a need to review the basin parameters which affect storm runoff. Runoff curve numbers and time of concentration were revised to better reflect actual field conditions. The Type IIA storm distribution utilized within the entire basin is overly conservative under current City criteria. We are requesting to use the Type II in order to align the peaks of the contributing subbasins into a hydrograph which will provide one defined peak. We have provided an exhibit which compares the differences between the original model and the proposed model revisions.

Significant runoff is still evident at all Design Points. We feel that these revisions generate peak flows that are better supported by the observable evidence.

Please review the enclosed information and contact us with your comments.

Very truly yours,

Timothy E. Marshall
Project Manager
For and on Behalf of
JR Engineering, Ltd.

Joseph W. DesJardin, P.E.
Director or Engineering
For and on Behalf of
JR Engineering, Ltd.

Enclosures

/cdr

EXHIBIT 'A'

REVISED BASIN PARAMETERS

EXHIBIT 'A'

SHEET 1 OF 2

JR ENGINEERING, LTD.

CLIENT Peregrine JOB NO. 8030.61

PROJECT Dry Creek MDDP BY WO DATE 2/7/89

SUBJECT Existing Condition - Basin Parameters SHEET NO. 1 OF 15

ORIGINAL BASIN PARAMETERS

RAINFALL PARAMETERS

10Yr - 24Hr = 3.0" (From "NOAA Atlas 2 - Volume III" and Colorado Springs/El Paso County "Drainage Criteria Manual")

100Yr - 24Hr = 4.5" *

Standard SCS 24 Hr Type IIA Rainfall Distribution *

GENERAL PARAMETERS

TR-20 Main Time Increment = 0.05 Hr *

Antecendent Moisture Condition II

CN - From Colorado Springs/El Paso County "Drainage Criteria Manual" *

$T_c = t_1 + t_t$ *

t_1 = Overland Flow Time - From Colorado Springs / El Paso County "Drainage Criteria Manual"

t_t - Travel Time - Manning's Equation for appropriate channel type *

C_{10} - From Colorado Springs / El Paso County "Drainage Criteria Manual"

Routing Parameters - From TR-20 User Manual

For Triangular Cross-Sections - $X = \left(\frac{0.94}{n}\right) \frac{S^{1/2}}{Z^{1/3}}$ and $m = 1.33$

$Z = (0.5) \frac{TW}{d}$

Roughness Coefficients - From Chow's "Open Channel Hydraulics" and Colorado Springs / El Paso County "Drainage Criteria Manual"

n = 0.016 (roadway)

n = 0.013 (RCP or concrete channel)

n = 0.030 (natural plain stream - clean, straight, with no rifts or deep pools) *

n = 0.050 (natural mountain stream - brush along banks, bottom with cobbles and boulders) *

*** INDICATES PROPOSED PARAMETERS TO BE REVISED SEE SHT. 2**

RAINFALL PARAMETERS

	ORIGINAL MDDP	PROPOSED REVISION
100-YR 24-HR PRECIP.	4.5"	4.4"
SCS RAINFALL DISTRIBUTION	II A	II

GENERAL PARAMETERS

TR-20 MAIN TIME INCREM.	0.05 HR	0.09 HR
CN - HYDROLG. CONDITION	FAIR	GOOD
ROUGNESS COEFFICIENTS (NATURAL CHANNELS)	0.030 - 0.050	0.100

TRAVEL TIME IN NATURAL CHANNELS DUE TO PROPOSED REVISION OF ROUGHNESS COEFFICIENTS.

EXHIBIT 'B'

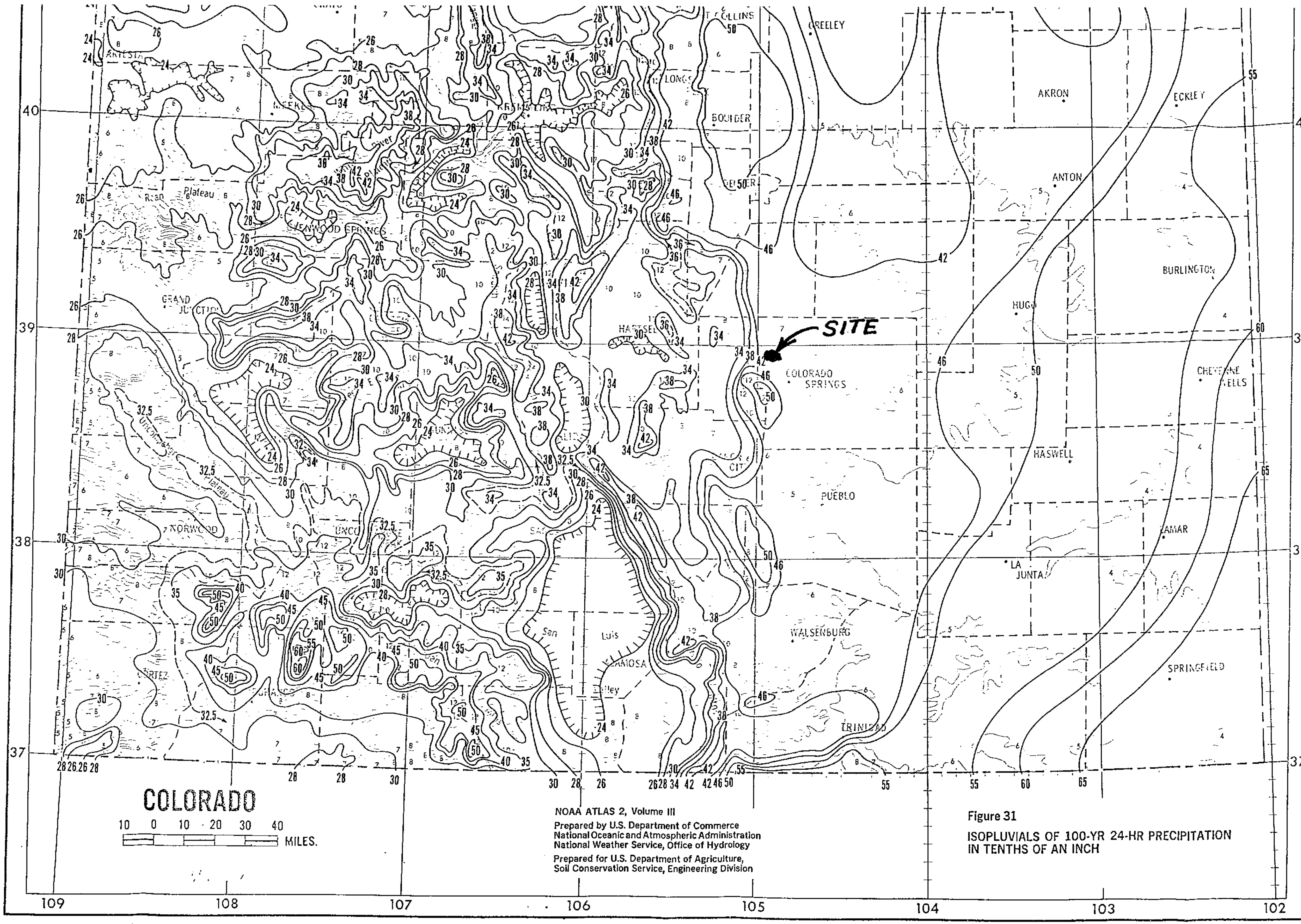
PEAK DISCHARGE SUMMARY

PEAK DISCHARGE SUMMARY FOR
PROPOSED REVISIONS TO DRY CREEK MDDP

	MDDP Report-March 1989		Revised w/Type IIA Storm		Revised with Type II Storm	
Design Point	10-Year Peak Discharge (cfs) (24 - Hour)	100-Year Peak Discharge (cfs) (24 - Hour)	10-Year Peak Discharge w/Revised Tc's & Cn's	100-Year Peak Discharge w/Revised Tc's & Cn's	10-Year Peak Discharge w/Revised Tc's & Cn's	100-Year Peak Discharge w/Revised Tc's & Cn's
1	216	441	152	322	132	271
2	271	591	170	397	146	324
3	278	629	171	417	148	342
5	210	442	185	392	159	327
6	252	558	207	471	179	397
8	532	1180	378	887	327	735
9	542	1232	362	890	317	748
10	234	480	180	378	156	320
12	263	620	176	428	152	369
15	542	1243	386	927	338	784
16	246	522	178	389	157	332
17	550	1265	387	938	340	793
18	575	1342	401	992	351	839
20	584	1390	408	1015	359	859
21	582	1480	421	1069	376	930
22	26	59	19	47	16	40
24	74	182	59	153	52	130
25	19	39	14	30	11	25
26	573	1486	420	1074	380	950
31	71	190	52	156	43	127
32	621	1642	443	1162	402	1036

EXHIBIT 'C'

NOAA 100-YEAR 24-HOUR PRECIPITATION



NOAA ATLAS 2, Volume III
Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology
Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

Figure 31
ISOPLUVIALS OF 100-YR 24-HR PRECIPITATION
IN TENTHS OF AN INCH

EXHIBIT 'C'
SHEET 1 OF 1

EXHIBIT 'D'

SCS RAINFALL DISTRIBUTIONS

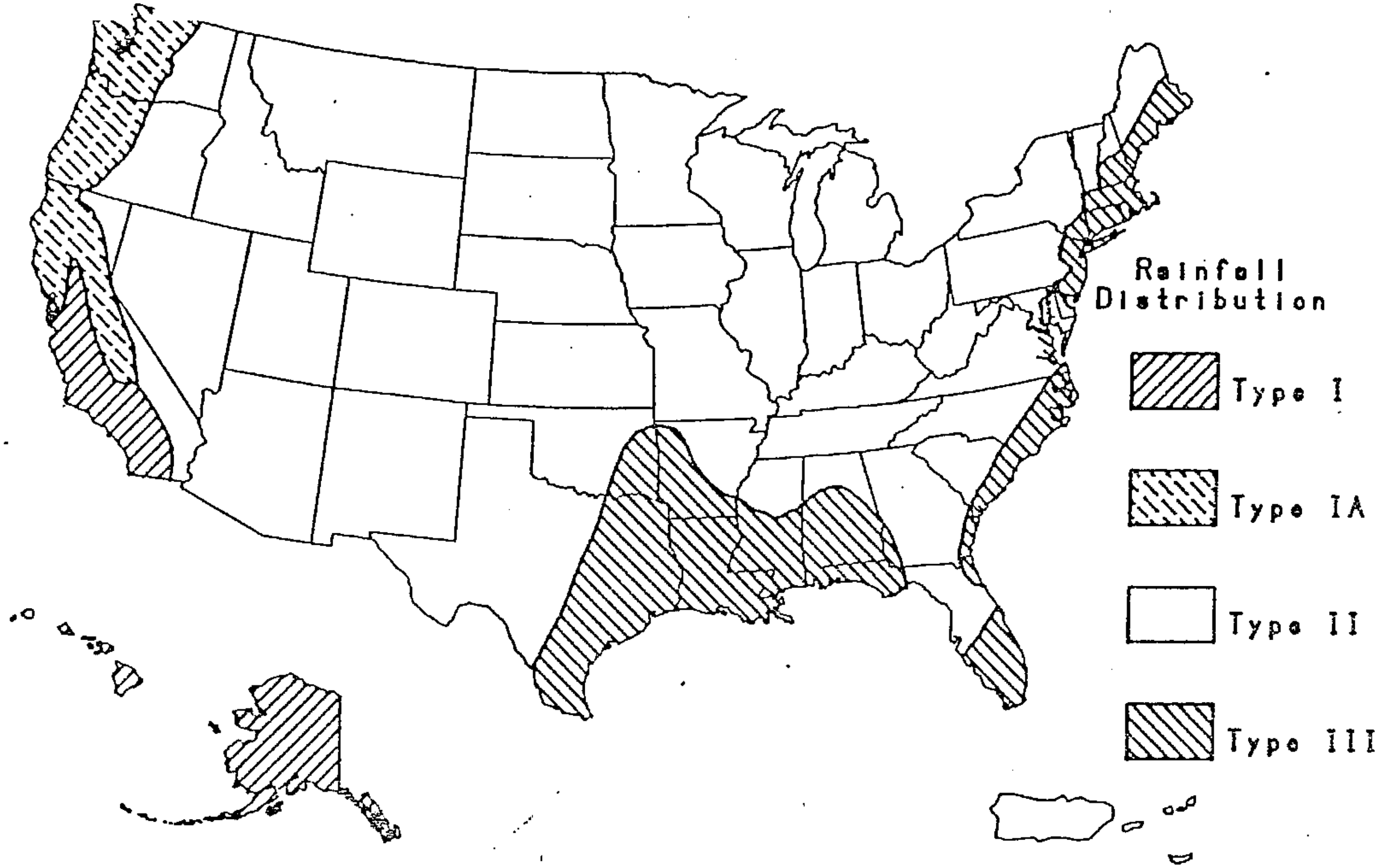


Figure B-2.—Approximate geographic boundaries for SCS rainfall distributions.

EXHIBIT 'D'
SHEET 1 OF 1