

TEXAS

**ENGINEERING  
TECHNICAL NOTE**

**Subject : *HYDROLOGY***

**No. : *210-18-TX1 (SUPPLEMENT NO.1)***

**Reference : *EMERGENCY SPILLWAY AND FREEBOARD  
HYDROGRAPH DEVELOPMENT***

**Date : *DECEMBER 1989***



**SOIL CONSERVATION SERVICE  
U.S. DEPARTMENT OF AGRICULTURE**

TEXAS ENGINEERING TECHNICAL NOTE

SUBJECT: HYDROLOGY

NO.: 210-18-TX1  
SUPPLEMENT No. 1

EMERGENCY SPILLWAY AND FREEBOARD HYDROGRAPH DEVELOPMENT

INTRODUCTION

This supplement provides a procedure to incorporate the minimum hydrologic criteria for dams and reservoirs according to Texas Water Commission (TWC) Permanent Rules, Texas Administration Code 31, Chapter 299. Minimum spillway flood hydrograph according to these rules shall be compared to the SCS emergency spillway freeboard hydrograph. SCS minimum hydrologic criteria will equal or exceed the criteria from the TWC rules. This procedure is only applicable to dams that are under the TR60 design criteria.

TWC - HYDROLOGIC CRITERIA FOR DAMS

The TWC's classification for size is based on overall height of the dam or total reservoir storage at the top of the dam. The appropriate size is the largest category determined by either storage or height. The classification size shall be in accordance with Table 1.

TABLE 1 - Size Classification

<u>Category</u>	<u>Total Storage (Ac-Ft)</u>	<u>Overall Height (Ft)</u>
Small	Less than 1000	Less than 40
Intermediate	Equal to or Greater than 1000 and Less than 50,000	Equal to or Greater than 40 & Less than 100
Large	Equal to or Greater than 50,000	Equal to or Greater than 100

The TWC's minimum spillway flood hydrograph is based on hazard classification and dam size. The TWC's hydrologic criteria for dams is shown on Table 2.

TABLE 2 - Hydrologic Criteria for Dams

CLASSIFICATION

<u>Hazard</u>	<u>Size</u>	<u>Minimum Flood Hydrograph</u>
(a) - Low	Small	1/4 PMF
	Intermediate	1/4 PMF to 1/2 PMF
	Large	PMF
(b) - Significant	Small	1/4 PMF to 1/2 PMF
	Intermediate	1/2 PMF to PMF
	Large	PMF
(c) - High	Small	PMF
	Intermediate	PMF
	Large	PMF

Figures 1, 2 and 3 show Table 2 in graphical form.

PMF is the probable maximum flood which is computed using the probable maximum precipitation (PMP). The definition of a percent PMF is not specifically defined by TWC's permanent rules. The definition of percent PMF is generally accepted in terms of percent of runoff volume resulting from the PMF. The following example illustrates this definition.

Given: PMP = 30 inches

RCN = 65

Determine: 50% of PMF

Solution: Runoff volume (PMF based on PMP) = 24.38 inches

50% Runoff Volume of PMF =  $(.5)(24.38) = 12.19$  inches

The runoff volume from the SCS emergency spillway freeboard storm shall equal or exceed the runoff volume as computed by the percent PMF based on hazard class and dam size. The following steps summarize the computational procedures to verify that the design meets minimum hydrologic criteria as specified by TWC.

Determine dam size based on overall height or total storage from Table 1. Determine the one that controls the minimum hydrologic criteria from Table 2 and Figures 1, 2, and 3 based on dam size and hazard class.

- Determine runoff volume from PMF which is based on PMP with areal adjustment and average condition RCN. The PMP and RCN should have previously been computed.

3. Determine percent PMF based on TWC's procedures for hazard class and dam size. Use Figures 1, 2, and 3 for this determination.
4. Multiply percent from step 3 by PMF runoff volume from step 2.
5. Compare the runoff volume from step 4 to the runoff volume from the SCS freeboard storm.
6. If the runoff volume from the SCS freeboard storm is equal to or greater than the runoff volume from step 4, then no further computations are needed. If the runoff volume from the SCS freeboard storm is less than the runoff volume from step 4, then proceed with step 7.
7. Determine the rainfall required to equal the runoff volume from step 3 using the runoff curve number for the freeboard storm.
8. Determine the top of dam (Freeboard Storm) by using the rainfall depth computed in step 7.

The following example demonstrates the computational steps. This example is a continuation of the example given in Technical Note No. 210-18-TX1, pages 1-3 thru 1-5.

Example No. 1:

- Given:** Floodwater structure in Lubbock County, Texas drainage area = 21.85 sq mi  
 antecedent moisture condition II, RCN = 75  
 hazard class (a)  
 product of storage and effective height > 30,000  
 dam overall height = 39 ft  
 total storage = 5,000 ac-ft  
 P100 = 5.0 inches  
 PMP = 26.0 inches  
 areal adjustment (100 yr) = 0.91  
 areal adjustment (PMP) = 0.94  
 $P100 \text{ (areal)} = (0.91)(5.0) = 4.55 \text{ inches}$   
 $PMP \text{ (areal)} = (0.94)(26.0) = 24.44 \text{ inches}$   
 freeboard rainfall =  $P100 + 0.26 (PMP - P100) = 9.72 \text{ inches}$   
 average condition RCN = 60  
 dry freeboard RCN =  $60 + 3 = 63$
- Determine:** Freeboard storm rainfall depth to meet or exceed TWC's minimum hydrologic criteria.
- Solution:** 1. From Table 1 the dam size is small based on overall height and intermediate based on total storage. Total storage will control TWC's hydrologic criteria.

2. Runoff volume from PMF is:

$$RCN = 60$$

$$PMP = 24.44 \text{ inches}$$

$$\text{runoff volume} = 17.93 \text{ inches}$$

3. From Figure 3, based on a low hazard dam and total storage of 5,000 ac-ft, 27 percent of the PMF is required to be passed.

4. The runoff volume from 27% of PMF is:

$$\text{runoff volume} = (.27)(17.93) = 4.84 \text{ inches}$$

5. The runoff volume from the SCS freeboard storm is:

$$\text{rainfall} = 9.72 \text{ inches}$$

$$RCN = 63$$

$$\text{runoff volume} = 5.07 \text{ inches}$$

6. The runoff volume from step 5 is greater than the runoff volume from 27% of PMF. Therefore, no additional computations are required.

EXAMPLE No. 2:

Given: Same as example No. 1, except overall height of the dam is 60 ft.

Determine: Freeboard storm rainfall depth to meet or exceed TWC's minimum hydrologic criteria.

Solution: 1. From Table 1 the dam size is intermediate based on both overall height and total storage. From Figures 1 and 3 based on intermediate size and a low hazard class, the overall dam height will control the TWC's minimum hydrologic criteria.

2. The runoff volume from PMF is:

$$RCN = 60$$

$$PMP = 24.44 \text{ inches}$$

$$\text{runoff volume} = 17.93 \text{ inches}$$

3. From Figure 1 based on a low hazard dam and overall height of 60 feet, the percent PMF required to be passed is 33.

4. The runoff volume for 33% of PMF is:

$$\text{runoff volume} = (.33)(17.93) = 5.92 \text{ inches}$$

5. The runoff volume from the SCS freeboard storm is:

$$\text{rainfall} = 9.72 \text{ inches}$$

$$\text{RCN} = 63$$

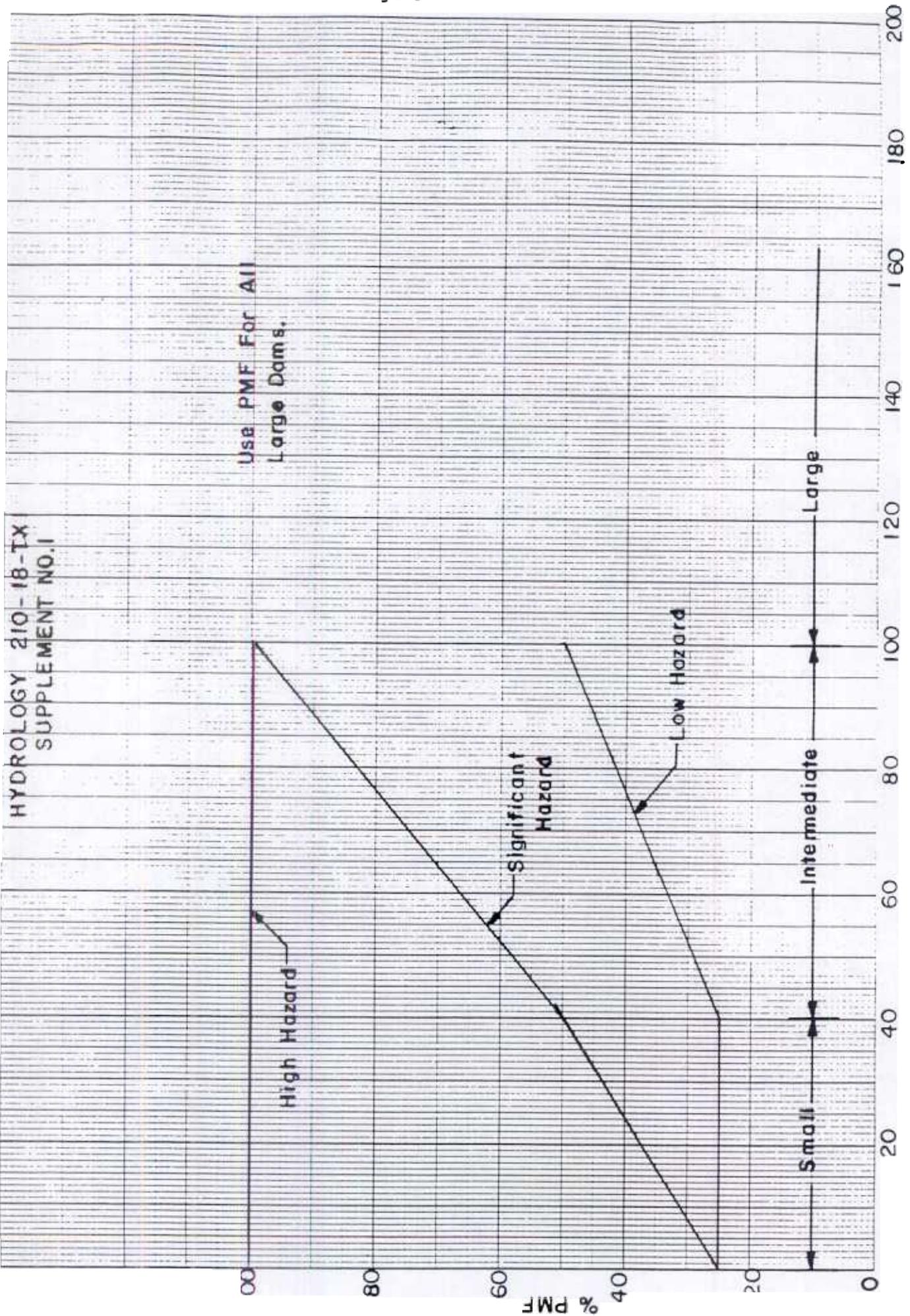
$$\text{runoff volume} = 5.07 \text{ inches}$$

6. The runoff volume in step No. 5 is less than the runoff volume from 33% of the PMF.

7. Based on RCN equal to 63, a rainfall depth of 10.72 inches will produce a runoff volume of 5.92 inches.

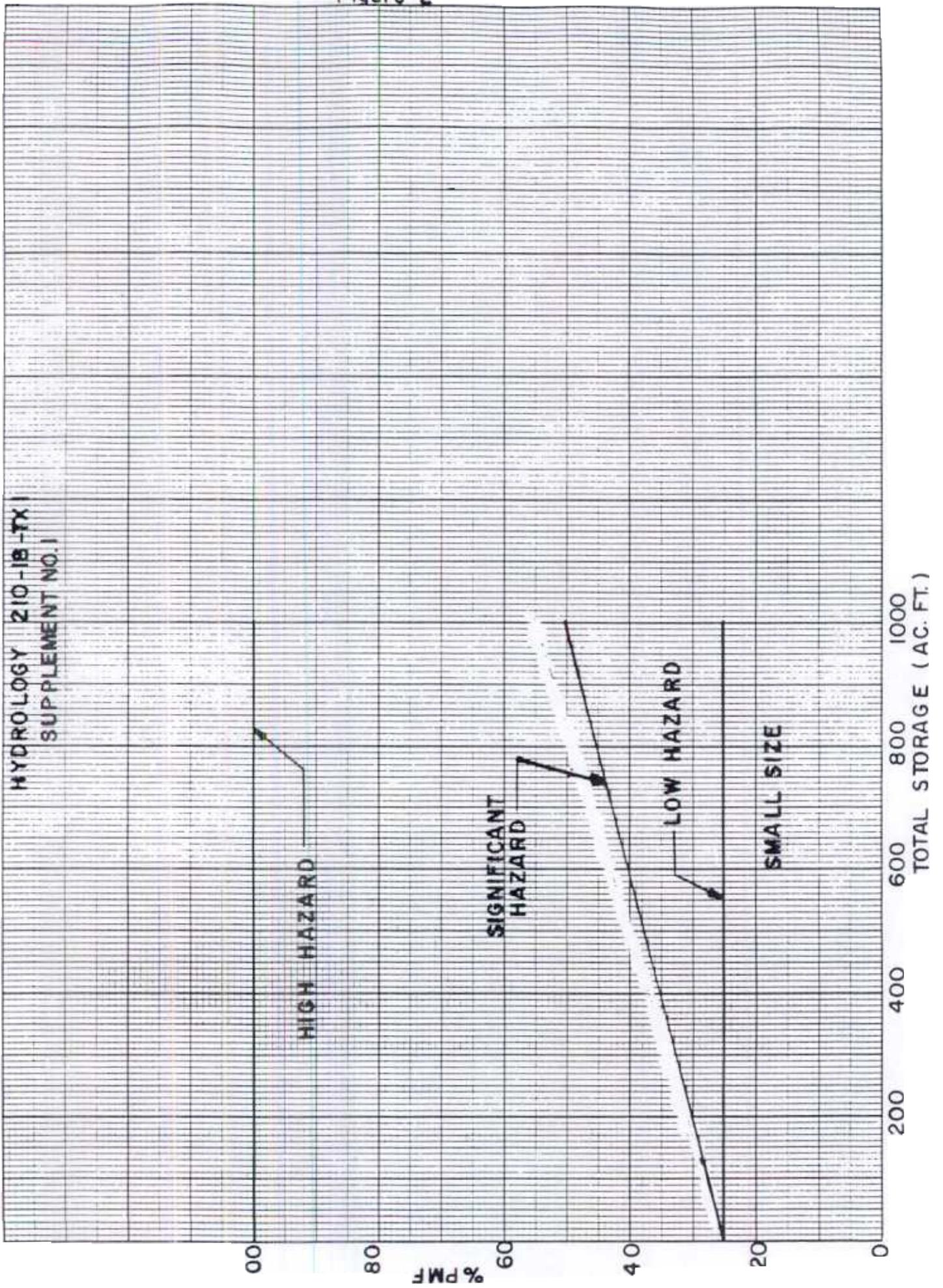
8. Therefore, use a RCN of 63 and a rainfall depth of 10.72 inches for the freeboard storm to set the minimum top of dam.

HYDROLOGY 210-18-TX  
SUPPLEMENT NO.1



Figure

Figure 2



HYDROLOGY 210-18-TX1  
SUPPLEMENT NO. 1

Figure 3

