11.12.010

of crown for all class roads shall be two percent.

F. Superelevation Rate. The minimum superelevation rate for all class roads shall be 0.02 foot per one foot.

G. Side Slope Ratio. The side slope (fill) for all class roads shall be no steeper than 2:1.

H. Back Slope Ratio. The back slope (cut) ratio for all class roads shall be no steeper than 1 1/2:1. A designed back slope ratio may be modified with the approval of the county engineer depending upon the materials encountered. The modified back slope shall not be steeper than 1/2:1.

I. Side Slope Ratio-Ditch. The side slope ratio for all roadside ditches shall not be steeper than 3:1 for unpaved ditches, and 6:1 for paved ditches with dikes.

J. Ditch Depth. Unpaved ditches shall be no more than one foot deep with the inclusion of appropriate bed material and paved ditches with dikes shall be no less than four inches deep.

K. Stopping Sight Distance. The stopping sight distance shall be based upon the posted speed limit or the minimum design speed, whichever is greater. The minimum design speed shall be thirty-five mph for arterial and collector roads and twenty-five mph for all other roads.

L. Alignments. Alignment for horizontal curves shall be based upon the posted speed limit or minimum design speed, whichever is greater, and shall be no smaller than a fifty-foot interior curve radius with a minimum taper length of fifty feet. Vertical curves shall provide for a sight distance consistent with the posted speed limit or the minimum design speed, whichever is greater, and shall have a minimum length of one hundred feet.

M. Drainage. Roadside drainage facilities shall be located outside of the traveled way. Culverts and/or down drains shall be three-hundred feet apart or as necessary to protect the roadway unless satisfactory drainage calculations are submitted to demonstrate roadside drainage may be carried further. Cross-culverts shall be no less than eighteen inches in diameter. Culverts with a diameter of twenty-four inches or more shall have appropriate inlet and outlet protection. (Ord. 2765 § 4 (part), 2007; Ord. 2579 § 11, 2004; Ord. 1875 § 2 (part), 1991; Ord. 1559 §1 (part), 1987).

11.12.020 Structural design standards.

A. The structural section of the road surface shall be designed based on a twenty-year design life and using stabilometer "R" values, which are not less than those indicated below, and the expected traffic index. In no event shall the structural section of a road include less than the following compacted depths of asphalt concrete and aggregate base:

Road Designation	Asphalt Concrete	Aggregate Base	Traffic Index
Major arterial****			
Minor arterial****			
Major collector		3"	8"8
Minor collector		2"	6"6
Local road	2"**	4"	4
Driveway	***	4"	n/a*

* Structural design is not required.

** Not required for final maps with minimum parcel size of five or more acres, or for parcel maps with minimum parcel size of two or more acres.

*** As required by Section 11.12.060.

**** Structural section shall be based on criteria developed for the specific project.

B. All road structures shall be capable of supporting a 40,000 pound axle load and shall be constructed to carry at least the maximum load and provide the minimum vertical clearance as required by Vehicle Code Sections 35550, 35750 and 35250. (Ord. 1875 § 2 (part), 1991; Ord. 1559 § 1 (part), 1987).

11.12.030 Profiles. The minimum and maximum gradients for all class roads shall be as follows:

A. The minimum gradient shall be one percent;

B. The maximum gradient for local roads below the three thousand foot elevation shall be sixteen percent;

C. The maximum gradient for local roads above the three thousand foot elevation shall be twelve percent;

D. The maximum gradient for arterial and collector roads shall be as shown below:

Design Speed (mph) Type of Terrain	20	30	40	50	60	70
Level	7	7	7	6	5	4
Rolling	10	9	8	7	6	5
Mountainous	12	10	10	9	8	6

(Ord. 1875 § 2 (part), 1991; Ord. 1559 § 1

11.04.050

and side slope ratios' crown and superelevation rates, base thickness and class, slope easements, legend and scales.

C. Layout Sheet. The layout sheets shall contain thereon the entire subdivision unit on one sheet, a skeleton layout of the entire subdivision unit and the location of proposed water and/or sewer system, including appurtenances. The plotting scale as indicated as desirable in Section 11.04.040 for the above sheet may be modified for compliance with the above requirements.

D. Plan and Profile Sheets. Standard plan and profile sheets shall be used. The plan for each road shall be delineated within the plan block in the upper half of the sheet. The corresponding profile shall be plotted in the graphical block directly under the road plan. The plan shall contain thereon the right-of-way widths, catch points, cuts (solid line), fills (dashed line), cut and fill easements, culverts and structures, radii and central angles, curves lengths and scales. The profile shall contain thereon the culverts and structures, percent grade and vertical curve length elevations shown at twenty-five-foot intervals throughout the vertical curve. Scales shall clearly show the existing and proposed profiles of all roads. Stationing on plan and profile shall read from left to right unless otherwise authorized by the director.

E. Drainage Study and Contour Sheet. The drainage study and contour sheet shall contain thereon the contours of the subdivision unit and immediate vicinity sufficient to indicate the perimeter of the upland areas to be drained by each structure and associated outlet protection. Section 11.04.010 requires the submittal of computations with improvement plans at the time such plans are submitted for approval. It is required that the consulting engineer prepare and submit calculations to support the design of the drainage structures and that such be shown of the drainage study and contour sheet.

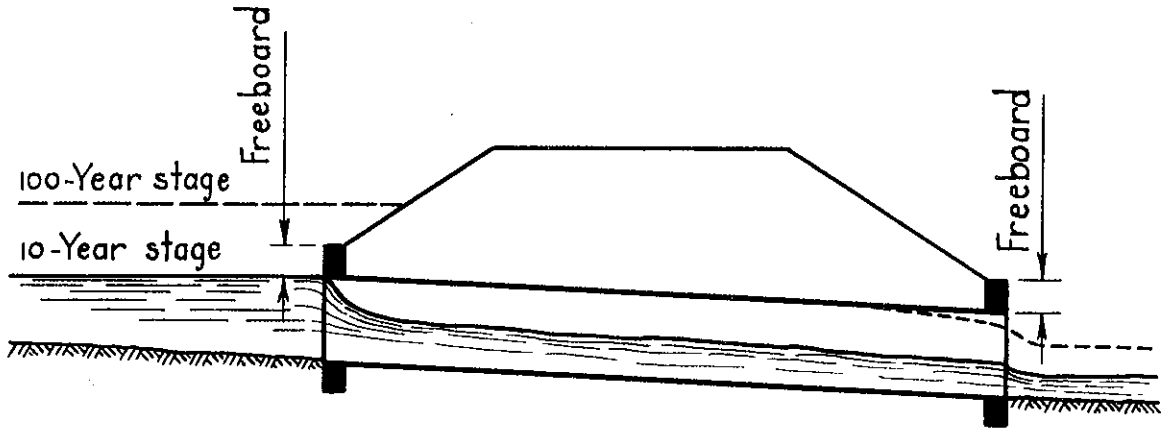
The basis for culvert design shall be "Design Flood" estimates from the California culvert practices which employs the general rules:

1. That a culvert pass a ten year flood without static head on the crown of the culvert at its entrance:

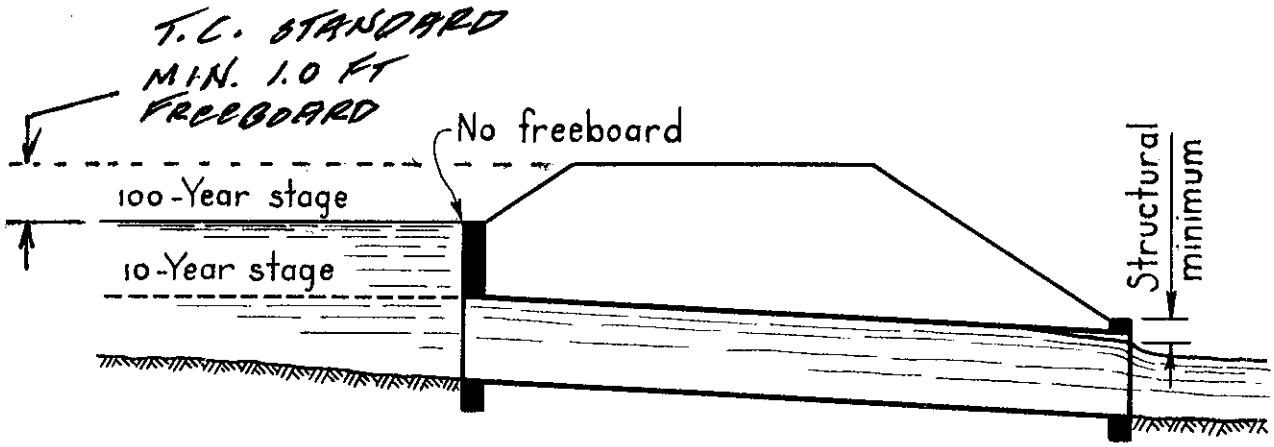
2. That design of the culvert and appurtenances be balanced to avoid serious damage from head and velocity obtained in a one-hundred-year flood. Bridges shall be designed for the one-hundred-year flood. Minimum diameter for pipes shall be eighteen inches in diameter.

F. Construction Detail Sheets. Construction detail sheet shall contain thereon details of all structures such as bridges, box culverts, drop inlets, headwalls, wingwalls, and temporary and permanent erosion control structures. A typical drainage pipe section shall be shown on the map(s).

G. Cross-Section. Cross-sections shall be included in the plans where determined necessary by the director. (Ord. 2902 §1, 2008; Ord. 2765 § 1 & 2 (part), 2007; Ord. 1559 § 1 (part), 1987).



(a.) Current Practice: Frequent flood just fills the entrance; equal freeboards, insufficient at entrance, excessive at outlet.



(b.) Balanced Design: Infrequent flood submerges entrance; appurtenances fit this stage without freeboard.

FIGURE 101. Comparison of controls for current practice and balanced design for free-outlet culvert on supercritical slope.

boxes from entrance to outlet. For various reasons progress ended with experimental installations.

BALANCED DESIGN

As one step in the improvement of this practice, the committee proposed the second rule. Instead of constructing headwalls, endwalls and other facilities to arbitrary freeboards, the combination of culvert barrel and all appurtenances should barely satisfy for the 100-yr flood (limiting flood) without any freeboard (Fig. 101b).

The limiting flood has been designated the "design discharge" and has been given an approximate frequency of once in 100 years. It is an "ultimate capacity" of the system, beyond which there may occur still greater floods which will damage all parts of the system—perhaps destructively.

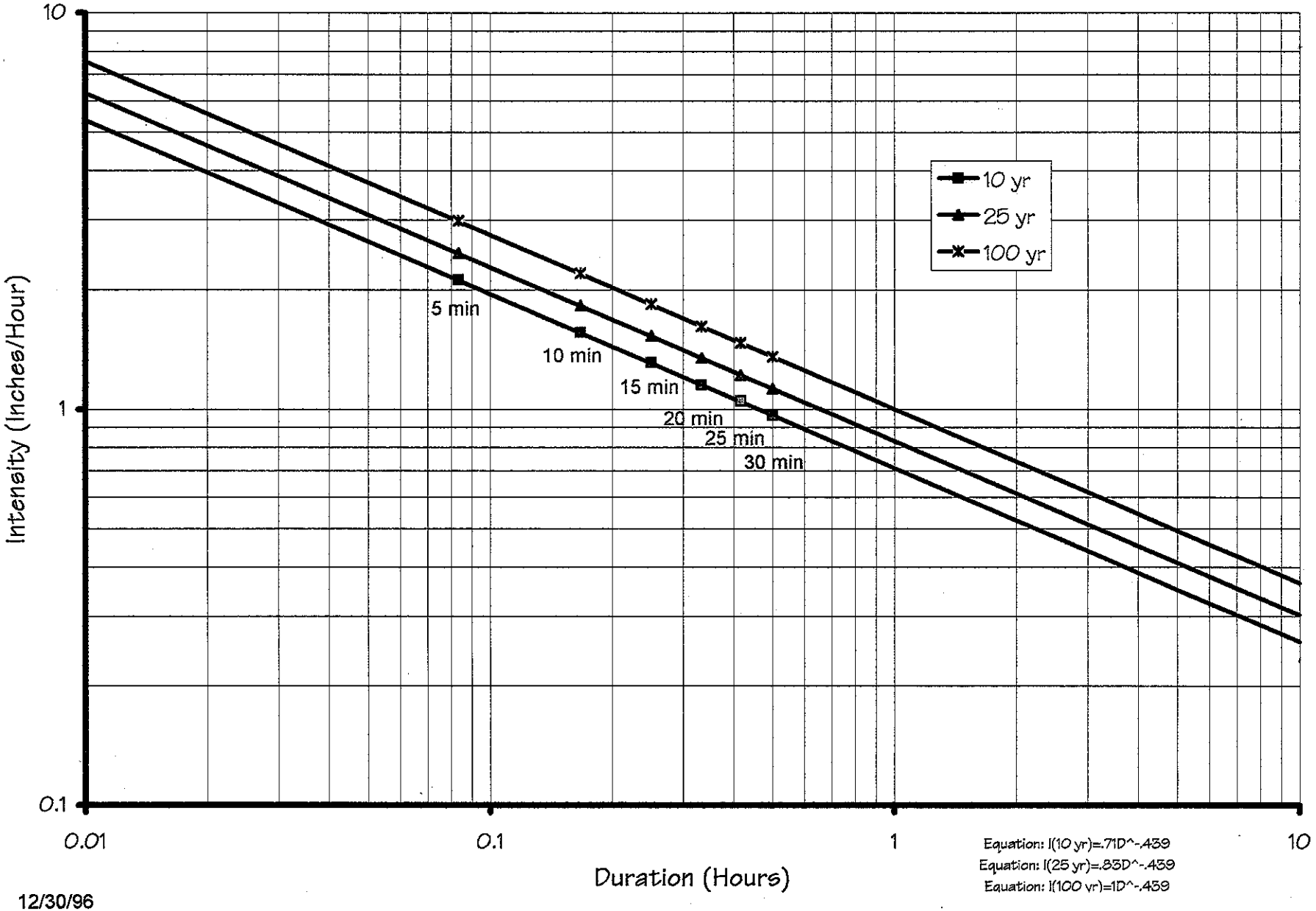
To be specific, balanced design is defined as that combination of conduit section, shape, texture and gradient with entrance and outlet appurtenances which will just pass a 100-yr flood without interruption of traffic and without serious damage to structure, embankment or abutting property.

To obtain such balance, the designer must know the stages and velocities at critical points of a trial layout and the durability of structure,

Intensity-Duration-Frequency Curves for Melones Dam

Elevation = 900 feet

Years of Record: 1978-1991

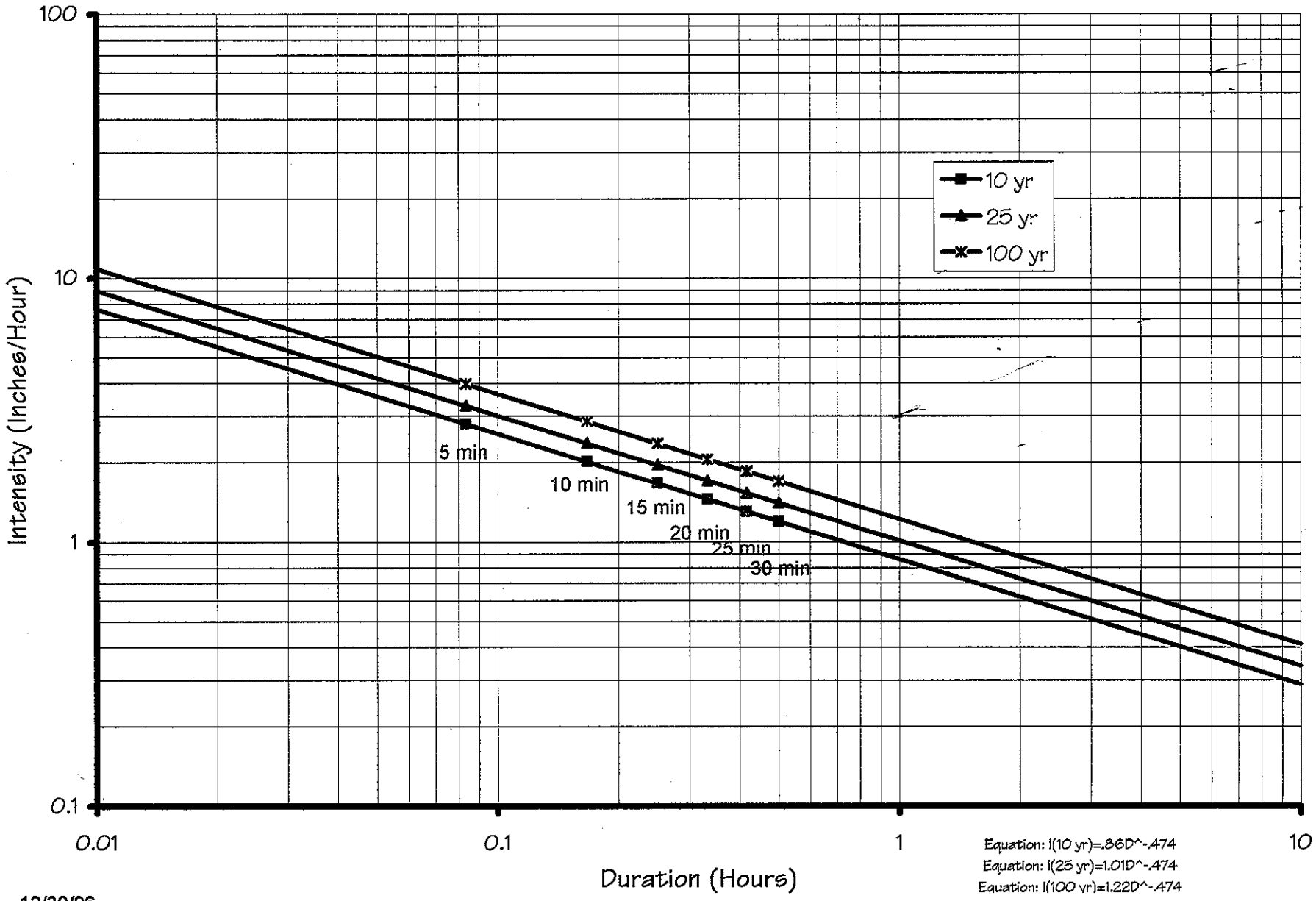


12/30/96

Intensity-Duration-Frequency Curves for Groveland

Elevation = 2825 feet

Years of Record: 1941-1993



Equation: i(10 yr)=.86D^-.474

Equation: i(25 yr)=1.01D^-.474

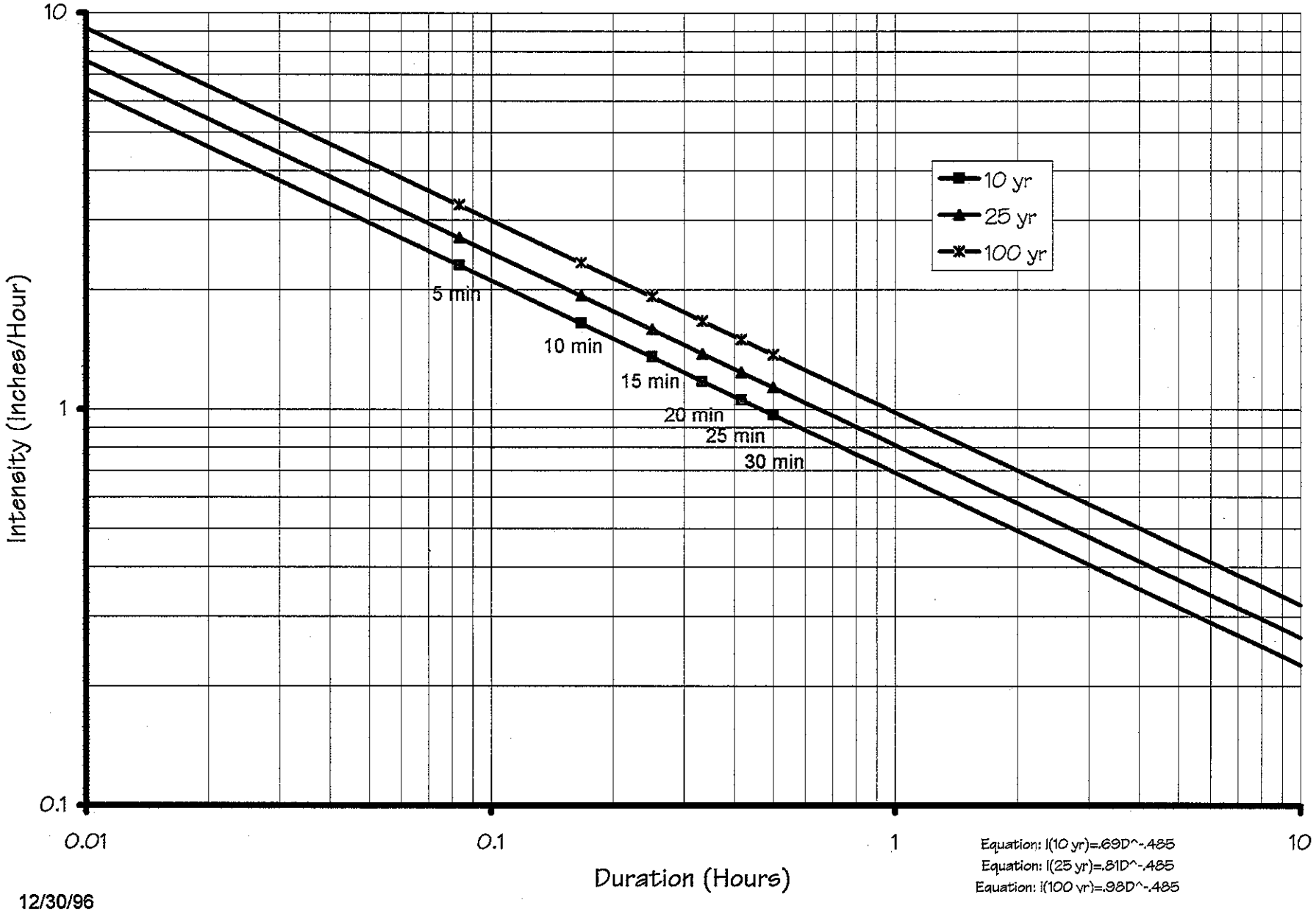
Equation: i(100 yr)=1.22D^-.474

12/30/96

Intensity-Duration-Frequency Curves for Hetch Hetchy

Elevation = 3870 feet

Years of Record: 1940-1993



Equation: I(10 yr)=.69D^-.485

Equation: I(25 yr)=.81D^-.485

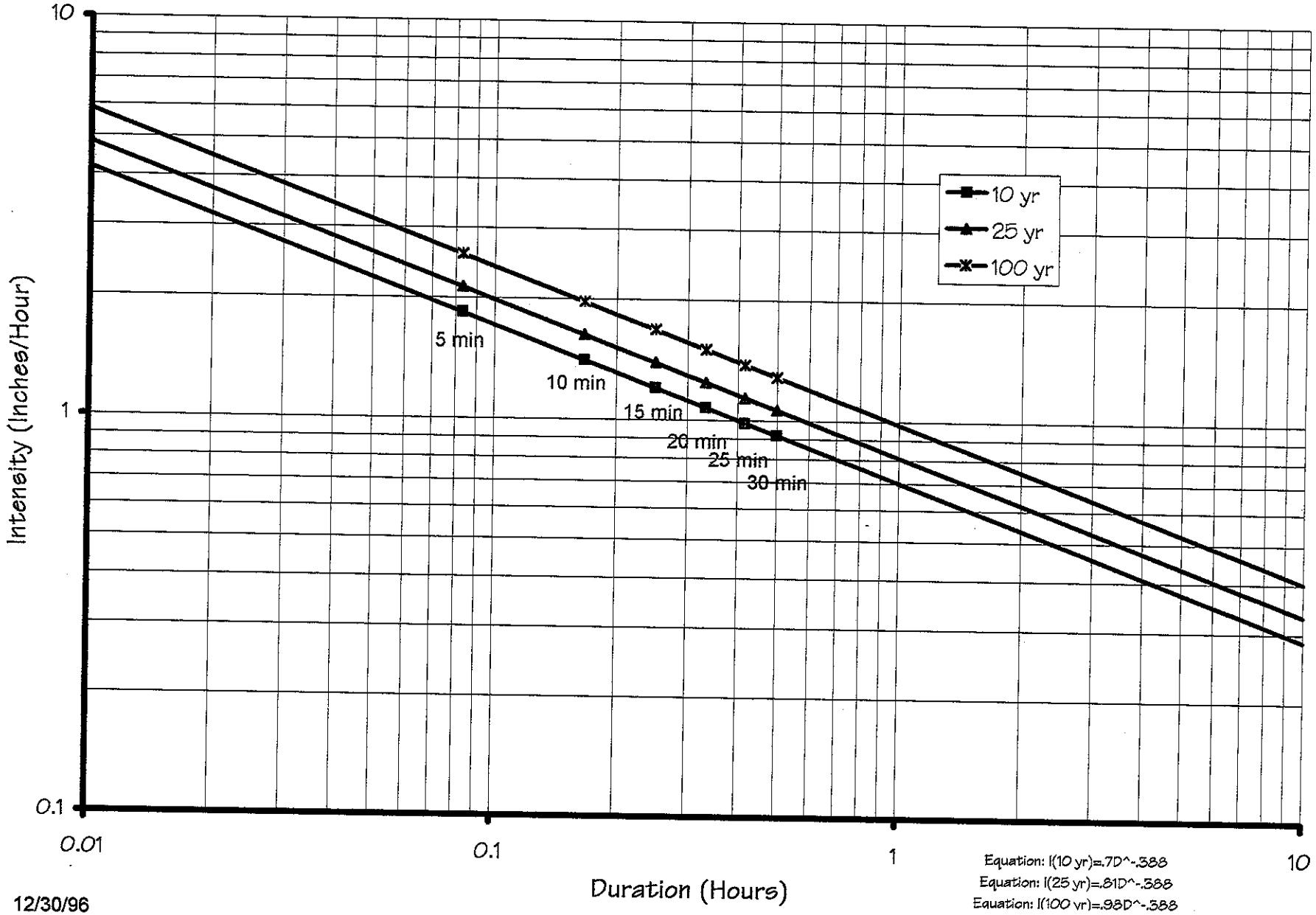
Equation: I(100 yr)=.98D^-.485

12/30/96

Intensity-Duration-Frequency Curves for Long Barn

Elevation = 4963 feet

Years of Record: 1941-1963



Equation: I(10 yr)=.7D^-.388

Equation: I(25 yr)=.81D^-.388

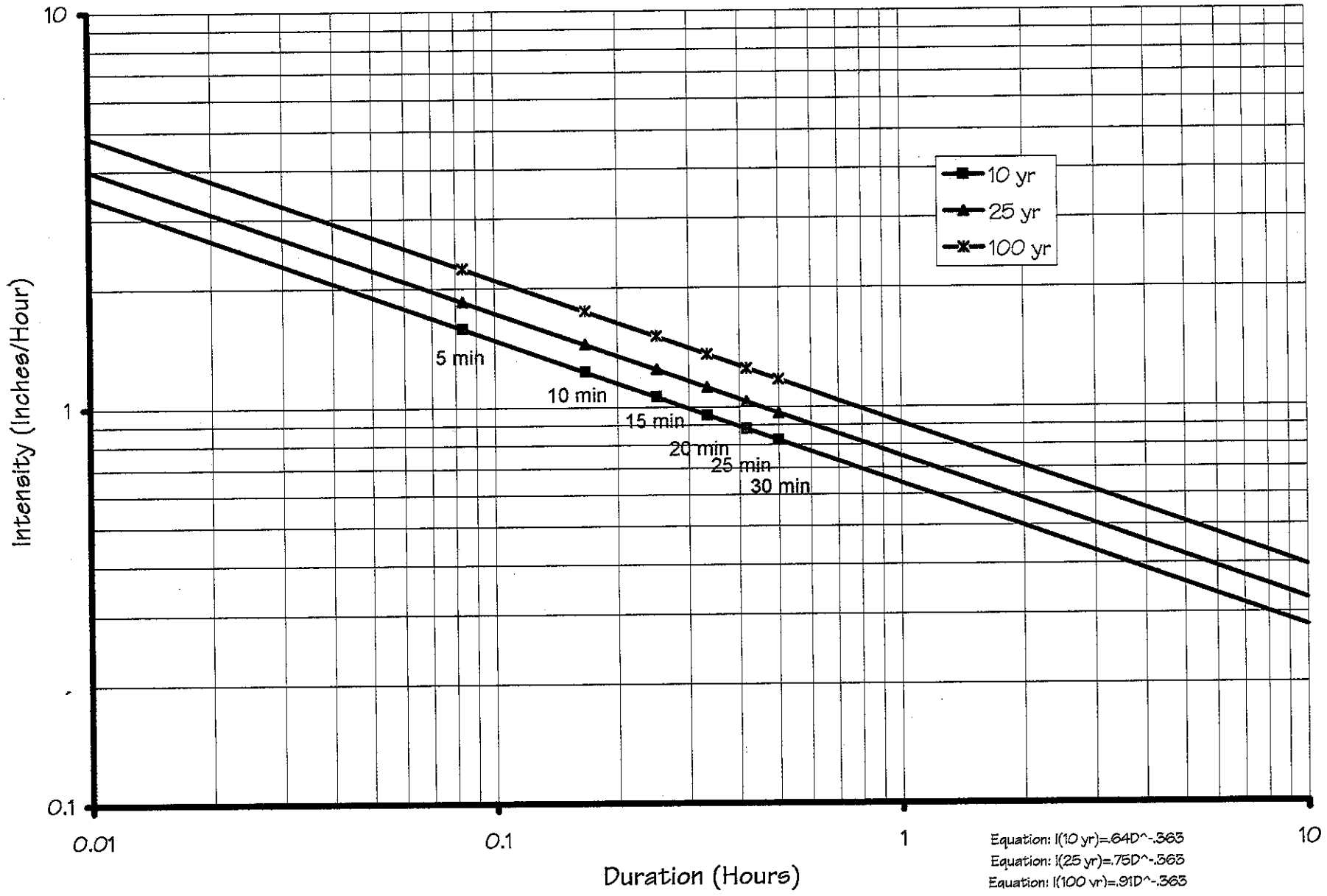
Equation: I(100 yr)=.98D^-.388

12/30/96

Intensity-Duration-Frequency Curves for Pinecrest Summit

Elevation = 5600 feet

Years of Record: 1964-1993



Equation: I(10 yr)=.64D^-.363

Equation: I(25 yr)=.75D^-.363

Equation: I(100 yr)=.91D^-.363

12/30/96

Runoff Coefficients for Undeveloped Areas

Watershed Types

	Extreme	High	Normal	Low
Relief	.28-.35 Steep, rugged terrain with average slopes above 30%	.20-.28 Hilly, with average slopes of 10 to 30%	.14-.20 Rolling, with average slopes of 5 to 10%	.08-.14 Relatively flat land, with average slopes of 0 to 5%
Soil Infiltration	.12-.16 No effective soil cover, either rock or thin soil mantle of negligible Infiltration capacity	.08-.12 Slow to take up water, clay or shallow loam soils of low infiltration capacity, imperfectly or poorly drained	.06-.08 Normal; well drained light or medium textured soils, sandy loams, silt and silt loams	.04-.06 High; deep sand or other soil that takes up water readily, very light well drained soils
Vegetal Cover	.12-.16 No effective plant cover, bare or very sparse cover	.08-.12 Poor to fair; clean cultivation crops, or poor natural cover, less that 20% of drainage area over good cover	.06-.08 Fair to good; about 50% of area in good grassland or woodland, not more than 50% of area in cultivated crops	.04-.06 Good to excellent; about 90% of drainage area in good grassland, woodland or equivalent cover
Surface Storage	.10-.12 Negligible surface depression few and shallow; drainageways steep and small, no marshes	.08-.10 Low; well defined system of small drainageways; no ponds or marshes	.06-.08 Normal; considerable surface depression storage; lakes and pond marshes	.04-.06 High; surface storage, high; drainage system not sharply defined; large flood plain storage or large number of ponds or marshes

Given: An undeveloped watershed consisting of; 1) rolling terrain with average slopes of 5%, 2) clay type soils, 3) good grassland area, and 4) normal surface depressions.

Find: The runoff coefficient, C, for the above watershed.

Solution:

Relief	0.14
Soil Infiltration	0.08
Vegetal Cover	0.04
Surface Storage	0.06
C =	0.32

Figure 819.2A