Appendix 10
RISK

This appendix describes the recommended procedures for estimating the risk incurred when a location is occupied for a period of years. As used in this guide, risk is defined as the probability that one or more events will exceed a given flood magnitude within a specified period of years.

Two basic approaches may be used to compute risk, nonparametric methods [(e.g., (19)] and parametric methods [(e.g., (20)]. Parametric methods which use the binomial distribution require assuming that the annual exceedance frequency is exactly known. The difference between methods is not great, particularly in the range of usual interest; consequently, use of the binomial distribution is recommended because of ease of comprehension and application.

The binomial expression for estimating risk is:

$$R_I = \frac{N!}{I! \, (N-I)!} P^I \, (1-P)^{N-I} \qquad (10-1)$$

in which R_I is the estimated risk of obtaining in N years exactly I number of flood events exceeding a flood magnitude with annual exceedance probability P.

When I equals 0 equation 10-1 reduces to:

$$R_0 = (1-P)^N \qquad (10-2)$$

in which R_0 is the estimated probability of nonexceedance of the selected flood magnitude in N years. From this the risk R of one or more exceedance becomes

$$R \text{ (1 or more)} = 1 - (1-P)^N \qquad (10-3)$$

Risk of 2 or more exceedances, R (2 or more), is

$$R(2 \text{ or more}) = R - R_1 = R - NP \, (1-P)^{N-1} \qquad (10-4)$$

� Some solutions are illustrated by the following table and figure ✱ 10-1.

BINOMIAL RISK TABLE

TIME	** RISK (PERCENT) ** P=0.100			** RISK (PERCENT) ** P=0.050		
	NONE	ONE OR MORE	TWO OR MORE	NONE	ONE OR MORE	TWO OR MORE
10	35	65	26	60	40	9
20	12	88	61	36	64	26
30	4	96	82	21	79	45
40	1	99	92	13	87	60
50	1	99	97	8	92	72
60	0	100	99	5	95	81
70	0	100	99	3	97	87
80	0	100	100	2	98	91
90	0	100	100	1	99	94
100	0	100	100	1	99	96
110	0	100	100	0	100	98
120	0	100	100	0	100	98
150	0	100	100	0	100	100
200	0	100	100	0	100	100

TIME	** RISK (PERCENT) ** P=0.040			** RISK (PERCENT) ** P=0.020		
	NONE	ONE OR MORE	TWO OR MORE	NONE	ONE OR MORE	TWO OR MORE
10	66	34	6	82	18	2
20	44	56	19	67	33	6
30	29	71	34	55	45	12
40	20	80	48	45	55	19
50	13	87	60	36	64	26
60	9	91	70	30	70	34
70	6	94	78	24	76	41
80	4	96	83	20	80	48
90	3	97	88	16	84	54
100	2	98	91	13	87	60
110	1	99	94	11	89	65
120	1	99	96	9	91	69
150	0	100	98	5	95	80
200	0	100	100	2	98	91

NOTE: TABLE VALUES ARE ROUNDED TO NEAREST PERCENT

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BINOMIAL RISK TABLE

TIME	** RISK (PERCENT) ** P=0.010			** RISK (PERCENT) ** P=0.005		
	NONE	ONE OR MORE	TWO OR MORE	NONE	ONE OR MORE	TWO OR MORE
10	90	10	0	95	5	0
20	82	18	2	90	10	0
30	74	26	4	86	14	1
40	67	33	6	82	18	2
50	61	39	9	78	22	3
60	55	45	12	74	26	4
70	49	51	16	70	30	5
80	45	55	19	67	33	6
90	40	60	23	64	36	8
100	37	63	26	61	39	9
110	33	67	30	58	42	11
120	30	70	34	55	45	12
150	22	78	44	47	53	17
200	13	87	60	37	63	26

TIME	** RISK (PERCENT) ** P=0.002			** RISK (PERCENT) ** P=0.001		
	NONE	ONE OR MORE	TWO OR MORE	NONE	ONE OR MORE	TWO OR MORE
10	98	2	0	99	1	0
20	96	4	0	98	2	0
30	94	6	0	97	3	0
40	92	8	0	96	4	0
50	90	10	0	95	5	0
60	89	11	1	94	6	0
70	87	13	1	93	7	0
80	85	15	1	92	8	0
90	84	16	1	91	9	0
100	82	18	2	90	10	0
110	80	20	2	90	10	1
120	79	21	2	89	11	1
150	74	26	4	86	14	1
200	67	33	6	82	18	2

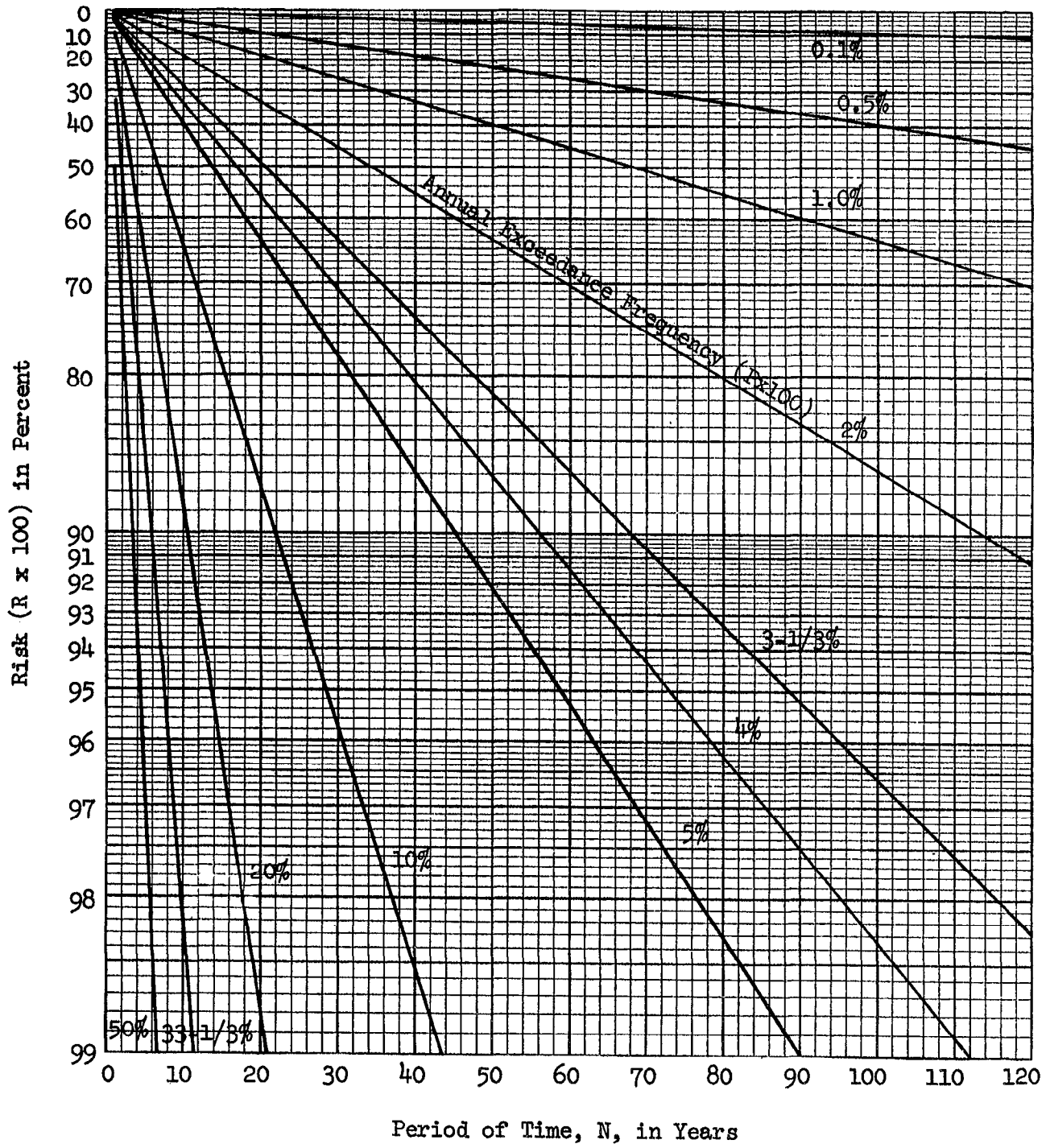NOTE: TABLE VALUES ARE ROUNDED TO NEAREST PERCENT

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Figure 10-1. RISK OF ONE OR MORE FLOOD EVENTS EXCEEDING
A FLOOD OF GIVEN ANNUAL EXCEEDANCE FREQUENCY WITHIN A PERIOD OF YEARS