Flood Control & Water Conservation DISTRICT

Alameda County Hydrology & Hydraulics Manual

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Alameda County Flood Control & Water Conservation District
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Disclaimer

The design criteria and the hydrologic computation techniques described in this manual have been developed based upon the hydrologic and meteorological data from Alameda County and surrounding areas.

The guidelines in this manual represent minimum design requirements and do not replace sound engineering judgment for site-specific conditions that require more conservative assumptions and/or more rigorous analytic techniques.

The guidelines and the hydrologic computation techniques in this manual are applicable for hydrologic and hydraulic studies and design beginning January 1994 for the District's large open-channel projects, and for all projects effective October 2016. Studies and designs before these dates were subject to the usage and guidelines set forth in previous hydrologic and hydraulic criteria summary reports.

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ABBREVIATIONS AND ACRONYMS

ac	acre
BMP	best management practice
CASQA	California Stormwater Quality Association
CFR	Code of Federal Regulations
cfs	cubic feet per second
DCIA	directly connected impervious areas, or hydraulically effective impervious areas
DSOD	California Division of Safety of Dams
DWR	California Department of Water Resources
EGL	Energy Grade Line
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
ft	feet
ft^2	square feet
GIS	geographical information system
HEC-1	Hydrologic Engineering Center Flood Hydrograph Package software program
HEC-HMS	Hydrologic Engineering Center Hydrologic Modeling System software program
HGL	hydraulic grade line
hr	hour
MHHW	mean higher high water
m	meters
mi	mile
mi^2	square miles
min	minute
MLLW	mean lower low water
NAVD	North America Vertical Datum
NCIA	non-directly connected impervious areas
NFIP	National Flood Insurance Program
NGVD	National Geodetic Vertical Datum
NPDES	National Pollutant Discharge Elimination System
NRC	National Research Council
NRCS	Natural Resource Conservation Service
RWQCB	California Regional Water Quality Control Board
SCS	Soil Conservation Service
sec	second
sf	square foot
SF	San Francisco
SPF	standard project flood
USACE	U.S. Army Corps of Engineers
USWRC	U.S. Water Resources Council
V_{no}	Vedernikov number
WS	water surface
yr	year
Zone AH	FEMA Special Flood Hazard Area: areas subject to inundation by 100-year (1-percent annual chance) shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet.

LIST OF VARIABLES

A	drainage area or flow area
A_1	cross sectional area of pipe 1
A_2	cross sectional area of pipe 2
A_a	increase in flow area attributable to air entrainment
A_i	decimal fraction of non-directly connected impervious areas
A_j	incremental area defined by watercourse profile
b	channel width of water surface
C	basic runoff coefficient
C'	district's runoff coefficient
C_i	rainfall intensity factor
C_p	basin peaking factor
C_s	ground slope adjustment factor
CV	coefficient of variation
D	pipe diameter
D_1	upstream pipe diameter
D_2	downstream pipe diameter
Δ_y	change in hydraulic grade line
Δh	rise in water surface
D_{ij}	design rainfall depth for recurrence interval j and storm duration i
g	gravitational acceleration
H_b	energy loss due to bend or pipe curvature
H_{bc}	energy loss due to change in flow direction and pipe contraction
H_{be}	energy loss due to change in flow direction and pipe expansion
H_c	energy loss due to pipe contraction
H_e	energy loss due to pipe expansion
H_j	energy loss in junction manhole
H_{jb}	energy loss in junction manhole with deflected mainline
H_{mh}	energy loss in manhole
H_{tm}	energy loss in most upstream terminal manhole
i	rainfall intensity
i_{ij}	rainfall intensity for recurrence interval j and storm duration i
K	distance factor
K	energy loss coefficient
K_b	energy loss coefficient due to bend
K_c	energy loss coefficient due to contraction
K_e	energy loss coefficient due to expansion
K_j	frequency factor for recurrence interval j
K_n	energy loss coefficient due to curvature
L	initial loss or loss rate
L	length
$\bar{L}$	adjusted loss or adjusted loss rate

L_c	length along longest watercourse measured from the point of concentration to a point opposite the watershed centroid
L_o	overland flow length
L_g	gutter flow length
N	basin roughness factor
n	Manning's roughness coefficient
n_{adj}	adjusted roughness coefficient
$\overline{P}$	mean annual precipitation
Q	discharge
Q_1	discharge in pipe 1
Q_2	discharge in pipe 2
Q_3	discharge in pipe 3
R	hydraulic radius
r	radius of curvature
S	slope
S_o	average watershed slope or channel slope
T_c	time of concentration
t_{cond}	conduit time
t_d	storm duration
t_i	consecutive time
t_L	lag time
t_o	roof-to-gutter and/or overland time of concentration
t_{rg}	roof-to-gutter time
V	flow velocity
V_1	flow velocity in upstream pipe
V_2	flow velocity in downstream pipe
V_3	flow velocity in tributary pipe
V_g	gutter flow velocity
V_{no}	Vedernikov Number
V_o	overland flow velocity
V_w	volume of water to be stored

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Introduction

This manual defines current Alameda County Flood Control and Water Conservation District (District) practice in the hydrologic and hydraulic design of flood control facilities in Alameda County. It is a guide for District engineers and engineers who perform work for District review.

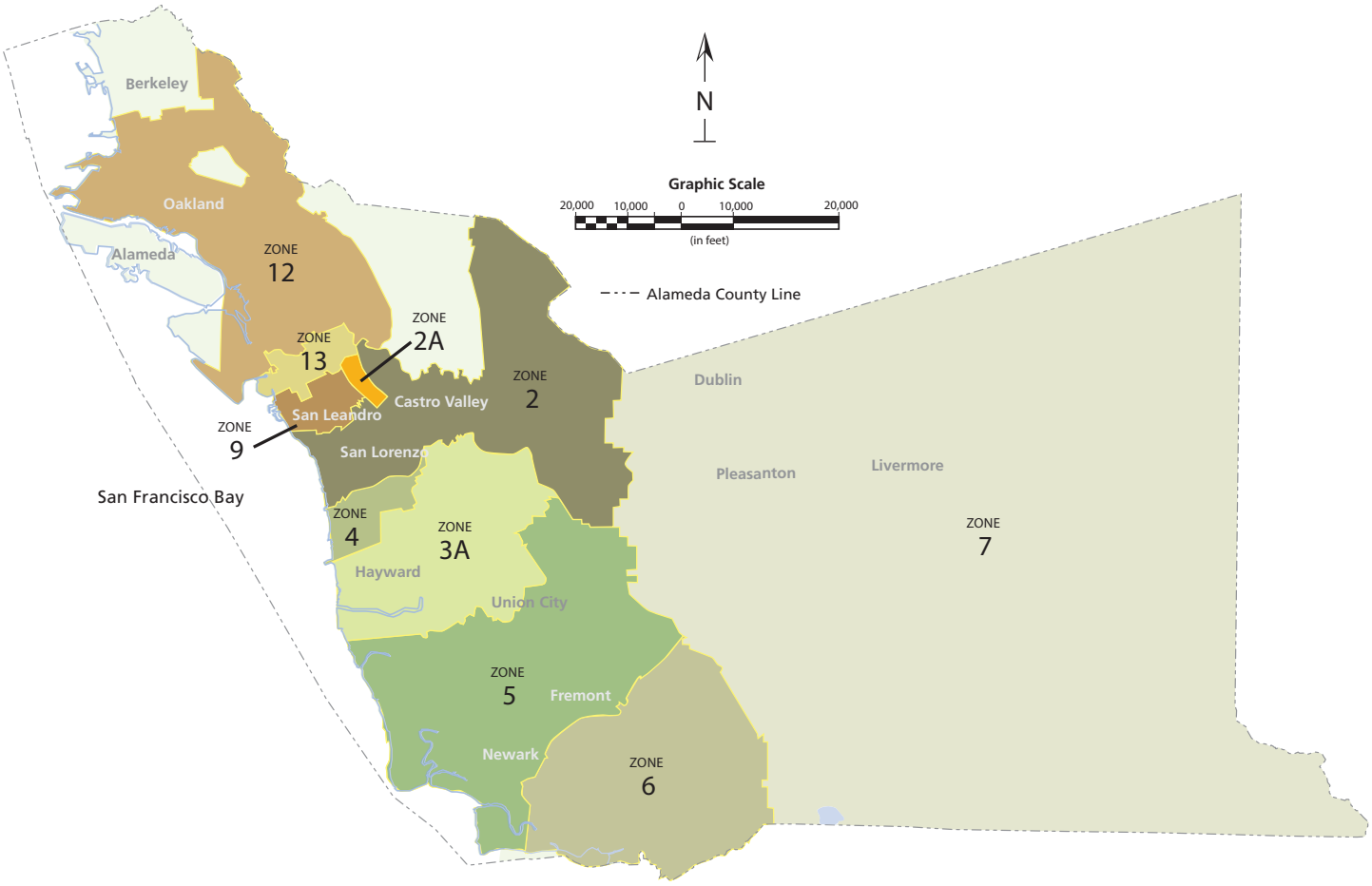
This manual is intended for use by engineers familiar with generally accepted hydrologic and hydraulic engineering design practice. The guidelines in this manual represent minimum design requirements and do not replace sound engineering judgment for site-specific conditions that require more conservative assumptions and/or more rigorous analytical techniques. Criteria not specifically detailed herein should be determined in accordance with sound engineering practice. Contact the District Hydrologist with any questions regarding site-specific design considerations.

This manual applies to Alameda County, California, as shown in ***Figure 1***. For application of the methodologies in this manual to projects in eastern Alameda County (Flood Control Zone 7), contact the Zone 7 offices located at 100 North Canyons Parkway, Livermore, CA 94551, telephone (925) 454-5000.

The procedures summarized here may be updated as appropriate to reflect changes in District practice. The revision date of the manual is shown on the front cover. Please make sure you are using the current edition of the manual.

The manual is available online at ***www.acfloodcontrol.org*** and may be downloaded free of charge. Detailed data for mean annual precipitation, slope, and hydrologic soil group are also on this website. You may download these data and use them with geographical information system (GIS) software to perform hydrologic overlay computations.

FIGURE 1 **DISTRICT ZONES**



Note: Graphic for illustration purposes only. (District 2009)

CHAPTER ONE

Background

Gradual changes in hydrologic conditions and continued development throughout Alameda County produces an increased amount of stormwater runoff, increasing the risk of flooding. As more rainfall and runoff data are collected, the ability to assess this risk improves. The District has performed drainage studies using the best available information, and has developed a representative hydrologic model for Alameda County. This model is intended to be used to assess the potential hazards associated with the existing system, and to provide a standardized means for new facility design.

The procedures in this manual should be used to design flood control and/or drainage facilities that are subject to District approval. Using these procedures in no way obviates or replaces the individual design engineer's adherence to the profession's "standard of care" in design.

The procedures described in this manual apply to the design of typical facilities. Where unusual circumstances result in requirements beyond the scope of this manual, contact the District Hydrologist for additional guidance and with any questions regarding site-specific design considerations. Criteria not specifically detailed herein shall be determined in accordance with sound engineering practices.

This manual provides:

- Computational techniques and criteria for evaluating exiting facilities and determining design runoff for new storm facilities
- Criteria and acceptable methodology for calculating water surface profiles and hydraulic grade lines associated with design runoff in conveyance elements (pipes and channels)
- Procedures to determine required storage volume detention and retention basin design

FREQUENCY DEFINITIONS

Hydrology relies heavily on probability and statistics. This manual uses two complementary terminologies to describe the frequency of floods and precipitation:

1. The first is the "recurrence interval" (sometimes called "return period") terminology. This terminology uses a number of years to specify a flood event. For example, a "10-year peak discharge" would be the discharge that would be expected to be equaled or exceeded once every ten years, on average. Note that this terminology is a statistical value and does not mean that a 100-year event will happen regularly every 100 years, or that it will only happen once in 100 years.
2. The second is the "annual exceedance probability" terminology. The annual exceedance probability is the chance or probability of a natural hazard event (rainfall or flood) occurring annually and is usually expressed as a percentage. For example, a "10-percent peak discharge" for a particular location on a

creek, river, or channel would be the discharge that is expected to have a 10-percent probability (chance) of being equaled or exceeded during any water year at that location.

These two terminologies are related in that one is the reciprocal of the other. For example, the 10-year event is the 10-percent event (0.10 in probability terms) because the reciprocal of 0.10 is 10. Similarly, the 100-year event is the 1-percent event (0.01 in probability terms).

Of special note is that the rainfall and the peak discharge annual exceedance probability (or recurrence interval) are not necessarily consistent with each other.

One challenge in hydrologic engineering is predicting runoff resulting from various rainfall frequencies. Depending on soil moisture content prior to a rainfall event, for example, a 100-year rainfall event may produce a 50-year runoff if the soil moisture content is low, or a 200-year runoff if the soil moisture content is high.

The District's procedures to relate rainfall return frequency to runoff return frequencies, as reflected in this manual, are based on physical and statistical calibration of gauged watersheds and years of hydrologic data.

An accurate representation of runoff, as outlined in this manual, is accomplished by using a historically and statistically appropriate soil moisture content and design storm temporal distribution. By following the guidelines set forth in this manual, a 10-year or 100-year rainfall event is more likely to produce a corresponding 10-year or 100-year estimate of runoff.

FLOOD CONTROL FACILITY CATEGORIES

Design procedures depend on the location and type of facility and tributary area. The District considers three categories of flood control facilities based on tributary area:

1. Major Facilities. These have drainage areas of 25 square miles or more at their upstream reach. Only Alameda Creek, San Lorenzo Creek, and San Leandro Creek fall into this category.
2. Primary Facilities. These have drainage areas greater than or equal to fifty acres and less than 25 square miles.
3. Secondary Facilities. These have drainage areas less than fifty acres and are generally maintained by a local jurisdiction.

Minimum setback criteria for flood control facilities in Alameda County are presented in ***Attachment 1***, although these criteria do no supersede other applicable agency requirements.

ELEVATION DATUM

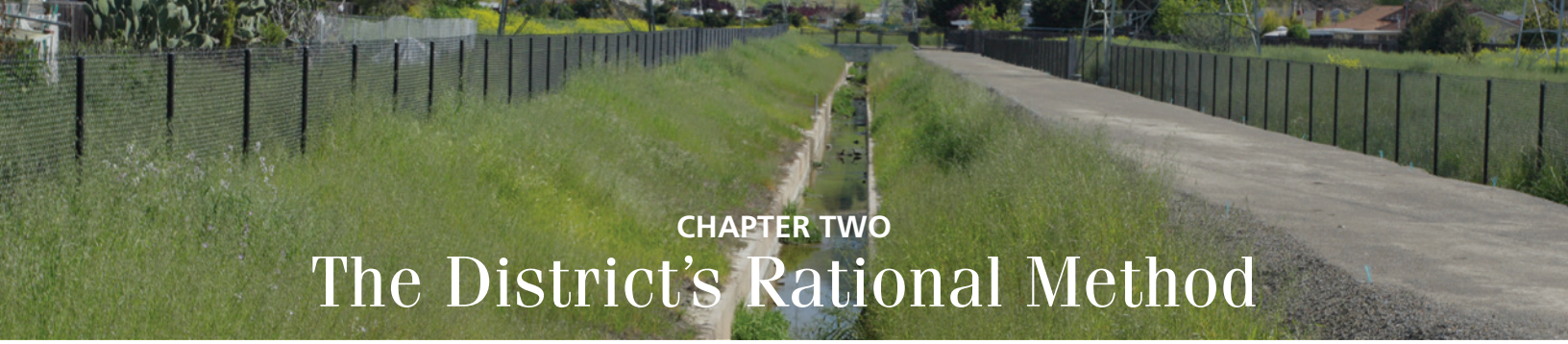
Currently, a number of different vertical datum systems are used in the San Francisco Bay area. These include Mean Lower Low Water (MLLW), National Geodetic Vertical Datum of 1929 (NGVD 29), and North American Vertical Datum of 1988 (NAVD 88), as well as local city datum systems. **Be certain that all elevations used for tides, cross-sections, tailwater elevations, and bridge or culvert geometry are on the same vertical datum systems.**

RUNOFF DETERMINATION METHOD

Due to a wide variety of land development practices and drainage area sizes in Alameda County, two hydrologic computation techniques are used to determine runoff:

1. The District's Rational Method should be used for design of new drainage systems for land development projects and for drainage areas up to 0.5 square miles (320 acres).
2. A Synthetic Unit Hydrograph Method is used for drainage areas greater than 0.5 square miles. However, for evaluation of existing District facilities, for detention basin design, and for situations where a hydrograph is required, this methodology can also be used for drainage areas less than 0.5 square miles.

These methods are described in ***Chapters Two*** and ***Three***, respectively.



CHAPTER TWO

The District's Rational Method

The District uses a modified form of the Rational Method to determine the peak discharge of a watershed for areas up to 0.5 square miles (320 acres). Calculations for the District's Rational Method can be made using ***Attachment 2*** or an equivalent method for design of drainage facilities for urban development and roadway crossings.

To use this method, the overall watershed should be broken down into smaller areas that contribute to hydraulically significant points of concentration. The subcatchment boundaries should be established based on topographic boundaries such as ridges, streets, drainage systems, etc., using good engineering judgment. The peak design discharge or flow rate should be calculated using ***Equation 1***, the District's Rational Formula.

EQUATION 1 DISTRICT'S RATIONAL FORMULA

$$Q = C'iA \tag{1}$$

where:

Q = *discharge (cfs)*
C' = *District's runoff coefficient (from **Equation 7**)*
i = *rainfall intensity (inches/hr from **Equation 5**)*
A = *drainage area (acres)*

(District 1989)

When using the District's Rational Method, it is critical to compare the peak discharge rate of a tributary area to the peak discharge in the main stem downstream of the tributary and use the greater of the two flow rates for the downstream drainage system.

TIME OF CONCENTRATION

The time of concentration (T_c) is the time required for the runoff from the most remote region of the watershed to reach the point of interest at which the flow is to be calculated. Calculate T_c using ***Equation 2.***

EQUATION 2 TIME OF CONCENTRATION

$$T_c = t_o + t_{cond} \tag{2}$$

where:

T_c = *time of concentration (min)*
t_o = *roof-to-gutter and/or overland time of concentration (min, from **Equation 3** or **4**)*
t_{cond} = *conduit time (min)*

(District 2015)

To design a drainage system, use a minimum time of concentration based on hydraulic conditions that maximize flow velocities.

Overland Time of Concentration

The overland time of concentration (t_o) is that time required for runoff to travel from the most remote point in the drainage area to the first point of concentration. Often, this first point of concentration is the furthest upstream inlet of the stormwater system or the upstream end of a defined ditch or swale. This time is seldom less than three minutes or more than 20 minutes. The overland time of concentration (t_o) depends on the surface conditions, i.e., whether the watershed is rural (undeveloped) or urban (developed).

For undeveloped watersheds, use ***Equation 3*** to determine t_o.

EQUATION 3 OVERLAND TIME OF CONCENTRATION — UNDEVELOPED WATERSHEDS

$$t_o = \frac{L_o}{60V_o} \tag{3}$$

where:

t_o = *roof-to-gutter and/or overland time of concentration (min)*
L_o = *overland flow length (ft)*
V_o = *overland flow velocity (ft/sec from **Attachment 3**)*

(NRCS 1986)

For urbanized watersheds, the t_o is "roof-to-gutter" time, plus the time required for the water to flow from the street gutter at the uppermost part of the drainage basin to the furthest upstream inlet of the stormwater system. For developed watersheds, use ***Equation 4*** to determine t_o.

EQUATION 4 OVERLAND TIME OF CONCENTRATION — DEVELOPED WATERSHEDS

$$t_o = t_{rg} + \frac{L_g}{60V_g} \tag{4}$$

where:

t_o = *roof-to-gutter and/or overland time of concentration (min)*
t_{rg} = *roof-to-gutter time (min from **Attachment 4**)*
L_g = *gutter flow length (ft)*
V_g = *gutter flow velocity (ft/sec from **Attachment 5**)*

(District 1989)

Roof-to-street gutter time is a function of ground slope and type of drainage facility, as determined from ***Attachment 4***. Use sound engineering practices for other-than-typical residential areas. Then, estimate the time for the water to flow from the upstream end of the gutter to the first inlet based on the gutter flow velocity in ***Attachment 5***. In other-than-typical residential situations, use Manning's equation (***Equation 15***) to estimate

velocity and travel time, or reference other charts, such as those for flow in small conduits or gullies.

Conduit Time

Conduit time (t_{cond}) is the length of time required for the water to flow from one point of concentration, or inlet, to the next. The calculated average velocity, or weighted incremental velocities, must accurately reflect the hydraulic conditions (i.e. closed conduit or open channel) within the stormwater system. Where the flow takes place in natural streams, channels, or closed conduits, use Manning's Equation to calculate the conduit time. For conduits under pressure, divide the discharge (Q) by the conduit cross-sectional area to determine the average flow velocity and conduit time.

RAINFALL INTENSITY AND DEPTH

Compute rainfall intensity for the appropriate time of concentration and storm recurrence interval using *Equation 5*:

EQUATION 5 RAINFALL INTENSITY

$$i_{ij} = \frac{D_{ij}}{t_d} \tag{5}$$

where:

i_{ij} = *rainfall intensity (inches/hr) for recurrence interval* j *and storm duration* i

D_{ij} = *design rainfall depth (inches) for recurrence interval* j *and storm duration* i *(from* ***Equation 6****)*

t_d = *storm duration (hr)* $= T_c/60$

T_c = *time of concentration (min)*

(District 2015)

Alternatively, in lieu of using *Equation 5*, rainfall intensity (i) may be determined from the tables in *Attachment 7*. Select the proper chart depending on recurrence interval, then use the time of concentration (T_c) and mean annual precipitation $(\overline{P})$ to select the rainfall intensity value from the chart.

EQUATION 6 RAINFALL DEPTH

$$D_{ij} = (0.32665 + 0.091144\overline{P})(1 + K_j CV)t_i^{0.43287} \quad (6)$$

where:

D_{ij} = *design rainfall depth (inches) for recurrence interval j and storm duration i*

$\overline{P}$ = *mean annual precipitation (inches)*

K_j = *frequency factor for recurrence interval j (from **Table 1** for storm durations up to 24 hours or **Attachment 12** for storm durations greater than 24 hours)*

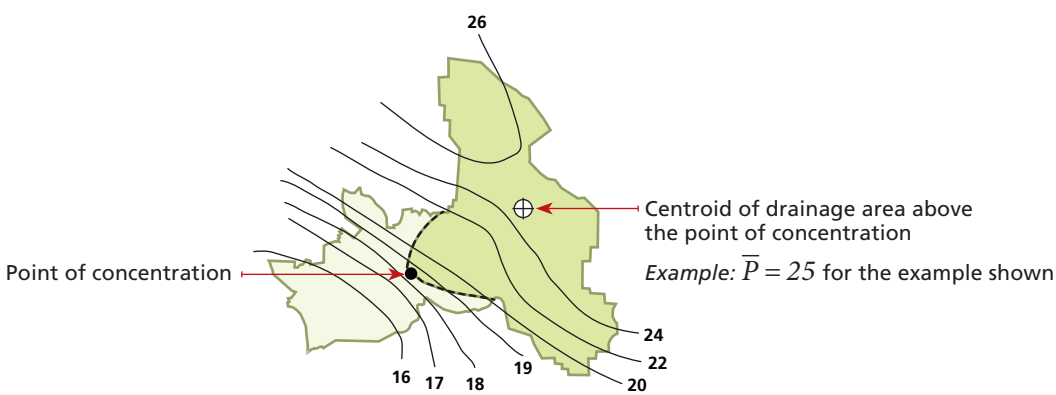
CV = *coefficient of variation (from **Attachment 12**)*

t_i = *consecutive time (days)*

(District 2015)

Determine the mean annual precipitation ($\overline{P}$) of a drainage area using the District's isohyetal map ***Attachment 6***. The $\overline{P}$ to be used is located at the centroid of the drainage area above the point of concentration at which the flow rate is being determined, as shown in ***Figure 2***.

FIGURE 2 DETERMINING MEAN ANNUAL PRECIPITATION



Note: Graphic for illustration purposes only.

TABLE 1 FREQUENCY FACTORS FOR SELECT RECURRENCE INTERVALS*

Recurrence interval *(yrs)*	2	5	10	15	25	100	200	500	1000
Frequency Factor, K_j	-0.210	0.719	1.339	1.684	2.108	3.211	3.745	4.417	4.955

*Table 1 presents frequency factors (K_j) for storm durations (t_d) up to 24 hours. See ***Attachment 12*** for storm durations greater than 24 hours.

(District 2015)

Alternatively, in lieu of using ***Equation 6***, design rainfall depth (D_{ij}) may be determined from the tables in ***Attachment 8***. Select the proper chart depending on recurrence interval, then use the mean annual precipitation ($\overline{P}$) and storm duration (t_d) to select the rainfall depth from the chart.

RUNOFF COEFFICIENT

The District requires the use of the District's runoff coefficient (C') for design of flood control facilities. Calculate the runoff coefficient using ***Equation 7***. Each of the components that comprise C' is described below.

EQUATION 7 DISTRICT'S RUNOFF COEFFICIENT

$$C' = C + C_s + C_i \tag{7}$$

where:

C' = *District's runoff coefficient*
C = *basic runoff coefficient (from **Table 2**)*
C_s = *ground slope adjustment factor (from **Equation 8**)*
C_i = *rainfall intensity factor (from **Equation 9**)*

(District 1989)

Basic Runoff Coefficient

To design conveyance elements, choose the basic runoff coefficient (C) to reflect the proposed or ultimate development of the drainage area. Ultimate development is normally based on City/County general plans. If general plans are not available, make a reasonable estimate of ultimate land use.

The basic runoff coefficient (C) is a function of the percent of the watershed that is impervious and the hydrologic soil group. The percent impervious is normally based on land use category; however, it may be measured. To determine the appropriate C for any given drainage area, overlay the applicable land use onto the soil group maps provided in ***Attachment 9***. Using the area of each land use category within each soil group, determine an area-weighted average C using the information provided in ***Table 2***.

Table 2 applies to typical land use situations. For conditions not covered by ***Table 2***, calculate an appropriate runoff coefficient based on impervious area, to be determined using aerial photographs and site plans. Calculate the runoff coefficient based on an area-weighted average using $C = 0.9$ for all impervious areas, and the appropriate pervious area C value for soil groups present from the first row of ***Table 2***.

TABLE 2 BASIC RUNOFF COEFFICIENTS FOR PARTICULAR LAND USE AND SOIL TYPE

Land Use Description	Hydrologic Soil Group			
	A	B	C	D
Undeveloped land, parks, and golf courses	0.10	0.15	0.20	0.25
Rural Residential (larger than 1 ac lot)	0.13	0.18	0.23	0.28
Residential 10,000 - 1 ac lot	0.20	0.25	0.30	0.35
Residential 1/4 ac (8,000 - 10,000 sf lot)	0.25	0.30	0.35	0.40
Residential 1/8 ac (5,000 - 8,000 sf lot)	0.27	0.32	0.37	0.42
Residential (3600 - 5000 sf lot)	0.28	0.33	0.38	0.43
Residential (2700 - 3600 sf lot)	0.29	0.34	0.39	0.44
Zero Lot Line Residential & Less than 2700 sf	0.34	0.39	0.44	0.49
Townhouse	0.44	0.49	0.54	0.59
Condominium	0.51	0.56	0.61	0.66
Industrials	0.58	0.63	0.68	0.73
Apartment	0.65	0.70	0.75	0.80
Commercial	0.69	0.74	0.79	0.84
Freeway*	0.72	0.77	0.82	0.87
Mobile Home Park*	0.34	0.39	0.44	0.49
School (large open space)	0.24	0.29	0.34	0.39
School (small open space)	0.44	0.49	0.54	0.59

* For freeways, use aerial imagery to estimate percent impervious area.
** For mobile home parks, a minimum of 50% of the NCIA roof area should be counted as DCIA; for example, DCIA = 17+(37/2) = 35.5

(District 2015)

HYDROLOGIC SOIL GROUPS

Attachment 9 provides a map that shows the areas of hydrologic soil groups A, B, C, and D based on Natural Resource Conservation Service (NRCS – formerly Soil Conservation Service, SCS) mapping.

Soil Type A: Sand, loamy sand, or sandy loam. Low runoff potential and high infiltration rate even when thoroughly wetted. Primarily deep, well- to excessively-drained sand or gravel that has a high rate of water transmission.

Soil Type B: Silt loam or loam. Moderately low runoff potential and moderate infiltration rate when thoroughly wetted. Moderately deep to deep, moderately well- to well-drained soil with moderately fine to moderately coarse texture.

Soil Type C: Sandy clay loam. Moderately high runoff potential and low infiltration rate when thoroughly wetted that impedes downward movement of water. Soil with moderately fine to fine structure.

Soil Type D: Clay loam, silty clay loam, sandy clay, silty clay, or clay. High runoff potential and very low infiltration rate when thoroughly wetted. Consists chiefly of clay soil with a high swelling potential, soil with a permanent high water table, soil with a claypan or clay layer at or near the surface, and shallow soil over nearly impervious material.

Ground Slope Adjustment Factor

The ground slope adjustment factor (C_s) is used to adjust for increases in runoff as the average slope of the incremental drainage area increases. Use an area-weighted average slope (S) from the slope map provided in ***Attachment 10*** as a basis for determining C_s.

Rainfall Intensity Factor

The rainfall intensity factor (C_i) is used to account for the decrease in soil permeability that can be expected with an increase in ground slope and rainfall intensity.

EQUATION 8 GROUND SLOPE ADJUSTMENT FACTOR

$$C_s = \frac{(0.8 - C)[ln(S-1)]S^{0.5}}{56} \tag{8}$$

$$C_s = 0 \text{ for } C \geq 0.8$$

where:

C_s = *ground slope adjustment factor*
C = *basic runoff coefficient*
S = *slope (percent from **Attachment 10**)*

(District 1989)

EQUATION 9 RAINFALL INTENSITY FACTOR

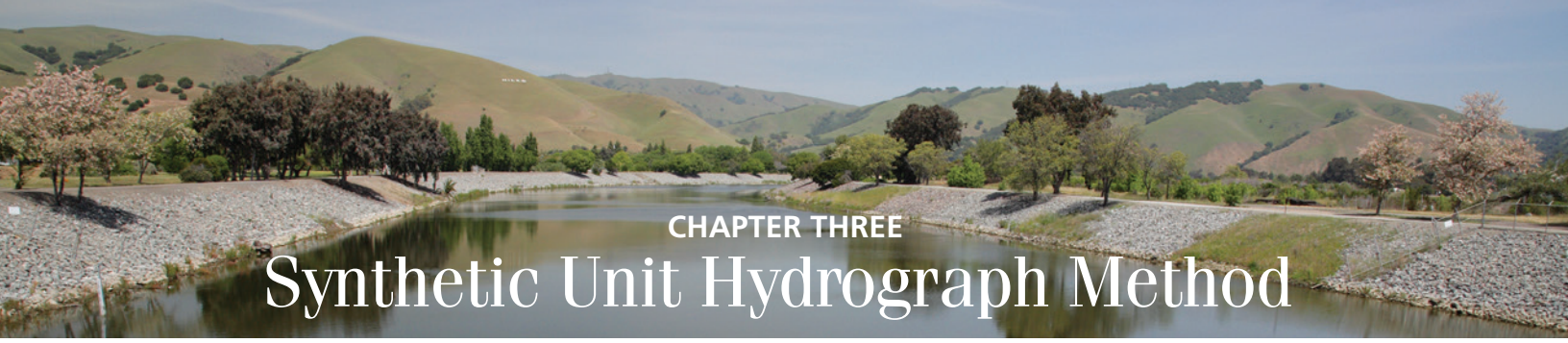
$$C_i = 0.8 - (C + C_s)\left(1 - \frac{1}{\frac{1}{e^i} + ln(i+1)}\right) \tag{9}$$

$$C_i = 0 \text{ for } C + C_s \geq 0.8$$

where:

C_i = *rainfall intensity factor*
C = *basic runoff coefficient*
C_s = *ground slope adjustment factor*
i = *rainfall intensity (inches / hr from **Equation 5** or **Attachment 7**)*

(District 1989)



CHAPTER THREE

Synthetic Unit Hydrograph Method

Synthetic Unit Hydrograph Method is used to determine the peak discharge and runoff volume of a watershed for areas greater than 25 acres. The methodology can be used for runoff volume evaluation of watersheds less than 25 acres as well. The Synthetic Unit Hydrograph Method is also used to design detention facilities as presented in ***Chapter 5***. A Synthetic Unit Hydrograph Method transforms a hypothetical rainfall distribution and design rainfall depth into a design runoff hydrograph. The District has adopted a modified Snyder Unit Hydrograph Method as its preferred method, mainly because the Snyder Unit Hydrograph Method has the flexibility needed for calibration.

The District has been using the procedures presented in this chapter for purposes of hydraulic analysis and design since publication of its ***Hydrologic Modeling Summary Report for Alameda County, California*** (District 1994) in 1994; however, some equations and values have been modified since District 1994 was published. All analyses and design procedures presented herein are now in effect. The U.S. Army Corps of Engineers flood hydrograph computer programs HEC-1 or HEC-HMS are used for all rainfall-to-runoff transformations. This manual does not cover detailed procedures for using HEC-1 or HEC-HMS.

APPLICATION

The District has adopted a 6-hour storm duration for calculating the peak discharges for watersheds with drainage areas up to 25 square miles, unless a detention pond routing analysis necessitates the use of a 24-hour storm. A 24-hour storm should be used for drainage watersheds larger than 25 square miles and for use in detention basin design.

For rainfall temporal distribution, use ***Table 3*** (6-hour design storm) or ***Table 4*** (24-hour design storm).

TABLE 3 RAINFALL DISTRIBUTION FOR 6-HOUR DESIGN STORM

Time *(hr)*	Rainfall Fraction	Time *(hr)*	Rainfall Fraction	Time *(hr)*	Rainfall Fraction
0.25	0.0179	2.25	0.2014	4.25	0.8359
0.50	0.0372	2.50	0.2372	4.50	0.8662
0.75	0.0566	2.75	0.2869	4.75	0.8938
1.00	0.0759	3.00	0.3724	5.00	0.9186
1.25	0.0966	3.25	0.4938	5.25	0.9407
1.50	0.1186	3.50	0.6234	5.50	0.9628
1.75	0.1434	3.75	0.7338	5.75	0.9821
2.00	0.1710	4.00	0.7945	6.00	1.0000

(District 2015)

TABLE 4 RAINFALL DISTRIBUTION FOR 24-HOUR DESIGN STORM

Time *(hr)*	Rainfall Fraction	Time *(hr)*	Rainfall Fraction	Time *(hr)*	Rainfall Fraction
0.25	0.0045	8.25	0.1906	16.25	0.8139
0.50	0.0091	8.50	0.1997	16.50	0.8230
0.75	0.0136	8.75	0.2088	16.75	0.8306
1.00	0.0182	9.00	0.2179	17.00	0.8381
1.25	0.0227	9.25	0.2269	17.25	0.8457
1.50	0.0272	9.50	0.2375	17.50	0.8533
1.75	0.0318	9.75	0.2481	17.75	0.8608
2.00	0.0363	10.00	0.2587	18.00	0.8684
2.25	0.0408	10.25	0.2700	18.25	0.8759
2.50	0.0454	10.50	0.2821	18.50	0.8820
2.75	0.0499	10.75	0.2958	18.75	0.8880
3.00	0.0545	11.00	0.3109	19.00	0.8941
3.25	0.0590	11.25	0.3275	19.25	0.9002
3.50	0.0651	11.50	0.3472	19.50	0.9062
3.75	0.0711	11.75	0.3744	19.75	0.9123
4.00	0.0722	12.00	0.4213	20.00	0.9183
4.25	0.0832	12.25	0.4879	20.25	0.9244
4.50	0.0893	12.50	0.5590	20.50	0.9304
4.75	0.0953	12.75	0.6195	20.75	0.9365
5.00	0.1014	13.00	0.6528	21.00	0.9425
5.25	0.1074	13.25	0.6755	21.25	0.9486
5.50	0.1135	13.50	0.6921	21.50	0.9546
5.75	0.1195	13.75	0.7073	21.75	0.9592
6.00	0.1256	14.00	0.7209	22.00	0.9637
6.25	0.1316	14.25	0.7330	22.25	0.9682
6.50	0.1377	14.50	0.7443	22.50	0.9728
6.75	0.1452	14.75	0.7549	22.75	0.9773
7.00	0.1528	15.00	0.7655	23.00	0.9818
7.25	0.1604	15.25	0.7761	23.25	0.9864
7.50	0.1679	15.50	0.7867	23.50	0.9909
7.75	0.1755	15.75	0.7958	23.75	0.9955
8.00	0.1831	16.00	0.8048	24.00	1.0000

(District 2015)

LOSS RATES

Rainfall that does not result in runoff is accounted for by estimating losses. Losses occur due to surface ponding and infiltration. Appropriate selection of loss rates is critical in determining design discharges. The District has adopted the Initial Loss and Uniform Loss Rate methods for design runoff calculations. Losses are applicable only to pervious portions of the drainage area. Use the following procedures to determine initial and uniform loss rates, as well as the impervious area as a function of land use.

Initial Losses

In order to produce corresponding runoff frequencies from a given rainfall intensity, the initial loss values were calibrated based on discharge frequency data from long-term streamflow gage records in Alameda County and its vicinity. ***Table 5*** provides the appropriate value for initial loss, depending on the design storm durations. (***Note:*** The values in Table 5 are applicable for runoff events of 5 to 500 years, but should not be used for events less than 5 years. For intervals of less than 5 years, contact the District.)

TABLE 5 INITIAL LOSS

Design Storm *(hr)*	Initial Loss *(inches)*
6	0.8
24	1.0

(District 1994)

Uniform Loss Rate

Uniform loss (constant infiltration) rate is a function of the hydrologic soil group and soil cover within the drainage area. The type of vegetation or general soil cover in a watershed also significantly affects the rate of infiltration. Infiltration rates for well-established urban landscaping are higher than for new urban landscaping. The District uses a lower uniform loss rate for new urban landscaping to account for the potentially higher flow rates that could be experienced before the new landscaping becomes well established. The District has adopted the following three categories of vegetation and soil coverage:

1. Rural Coverage: Consisting of all rural areas with undisturbed soil cover and natural rural vegetation growth.
2. New Urban Coverage: Consisting of pervious areas of newly developed urban areas with less than 5 years of vegetation growth (e.g., lawn, golf course, landscaped areas), unless low impact development techniques are integrated into the landscaping, in which case the developer may submit an alternative uniform loss rate for the District Hydrologist's consideration, on a case-by-case basis.
3. Existing Urban Coverage: Consisting of areas of existing urban development with more than 5 years of vegetation growth (e.g., lawn, golf course, landscaped areas).

Table 6 tabulates uniform loss rates for use in applying the Synthetic Unit Hydrograph Method, based on the hydraulic soil group (as described in ***Chapter 2***) and the type of soil coverage.

TABLE 6 UNIFORM LOSS RATES

Hydrologic Soil Group	Rural Coverage	New Urban Coverage	Existing Urban Coverage
A	0.45	0.45	0.45
B	0.35	0.37	0.40
C	0.14	0.19	0.25
D	0.05	0.07	0.09

All loss rates in inches/hour. (District 1994)

To compute the uniform loss rate for a particular catchment, superimpose the hydrologic soil map of the area on the soil cover map and the drainage area map. Develop a composite map, and assign the proper loss rates based on *Table 6* to each area. Finally, compute an area-weighted average of the uniform loss rate, based upon the type of coverage, hydraulic soil group, and the area sizes on the composite map. *Figure 3* illustrates this process.

FIGURE 3 SIMPLIFIED UNIFORM LOSS RATE USING A COMPOSITE MAP

Note: Graphic for illustration purposes only.

EFFECT OF URBAN DEVELOPMENT AND IMPERVIOUS AREAS

An important factor that affects infiltration rates in a watershed is the level of urbanization and the percentage of directly connected impervious areas (DCIAs). DCIAs, also referred to as "hydraulically effective impervious areas," are those impervious areas where runoff flows directly into the storm drain system (i.e. gutters, ditches, catch basins) without passing over significant pervious areas.

Non-directly connected impervious areas (NCIAs) are those impervious areas that drain to a pervious area and then flow to the storm drain system. An example of runoff from an NCIA is a roof that drains into yard landscaping and flows across pervious lawn areas before entering the storm drain system. To a limited degree, the runoff rate from NCIAs is similar to that for pervious areas.

For the pervious and non-directly connected impervious areas, the initial and uniform loss rates are based on *Tables 5* and *6*, without any further adjustment. If more than 50

percent of the sum of the pervious plus the NCIAs are impervious, the initial and uniform loss rates are adjusted, based on the relationship shown in ***Equation 10***. This adjustment limits the percentage of the non-effective impervious areas.

EQUATION 10 ADJUSTED INITIAL LOSS AND UNIFORM LOSS RATES

$$\overline{L} = 2L\left(1 - A_i\right) \tag{10}$$

where:

$\overline{L}$ = *adjusted loss or adjusted loss rate (inches or inches/hr)*

L = *initial loss or loss rate for pervious area (inches or inches/hr)*

A_i = *decimal fraction of non-directly connected impervious area*

(District 1994)

Table 7 shows the adopted values of DCIAs and NCIAs for typical land uses in Alameda County. If the land use condition of the watershed does not match with the general assumptions in *Table 7*, determine the percentage imperviousness using aerial imagery.

TABLE 7 ADOPTED VALUES OF PERVIOUSNESS/IMPERVIOUSNESS

Land Use Type	Impervious Area *(%)*		Pervious Area *(%)*
	Directly Connected (DCIA)	Non-Directly Connected (NCIA)	
Undeveloped Land, parks, open space, golf courses	0	0	100
Rural Residential (larger than 1 ac lot)	4	6	90
Residential 10,000 - 1 ac lot	15	12	73
Residential 1/4 ac (8,000 - 10,000 sf lot)	22	18	60
Residential 1/8 ac (5,000 - 8,000 sf lot)	24	26	50
Residential (3600 - 5000 sf lot)	26	28	46
Residential (2700 - 3600 sf lot)	28	32	40
Zero Lot Line Residential & Less than 2700 sf	35	0	65
Townhouse	50	30	20
Condominium	60	25	15
Industrial	70	20	10
Apartment	80	10	10
Commercial	85	5	10
Freeway *	90	0	10
Mobile Home Park **	17	37	46
School (large open space)	15 - 20	0	80-85
School (small open space)	40 - 50	0	50-60

* For freeways, use aerial imagery to estimate percent impervious area.

** For mobile home parks, a minimum of 50% of the NCIA roof area should be counted as DCIA; for example, DCIA = 17 + (37/2) = 35.5

(District 2015)

Rural Residential: This category is applicable to areas that have mostly dirt sidewalks and a large green/dirt area surrounding the house.

Residential 1/8 & 1/4 Acre: Only applicable if most of the roofs are NCIAs. For new development where gutters drain directly to the street, use the sum of DCIAs and NCIAs as the total effective impervious area. For older neighborhoods, perform field inspections of representative areas or used gauged data to calibrate the representative DCIA.

Zero Lot Line, Duplexes, Triplexes, Townhouses, and Condominiums: Roofs are considered to be DCIAs unless proven otherwise by calibrations or other physical evidence. This category can be used if there is more than 30 percent pervious area throughout the complex. Otherwise, use "Commercial," as described below.

Low- and Medium-Rise Apartments, Townhouses, and Condominiums: Use when there is less than 15 percent green area and roofs are DCIAs.

Commercial: Includes stores, churches, and libraries. This cover type may also be used for townhouses if the roofs are DCIAs and green areas are less than 15 percent. Small green areas can be left under this classification as long as the total green area does not exceed 15 percent of the total land area. Any large green areas within commercial areas should be removed and treated separately as "Open Space." "Industrial" may fall under this classification unless the area surrounding buildings is dirt/gravel.

Freeway: Includes main freeways and highways. All other roadways are included in their land use category.

SYNTHETIC UNIT HYDROGRAPH

The Snyder Unit Hydrograph Method in HEC-1 or HEC-HMS is formulated with two input parameters:

1. Basin lag time
2. Basin peaking factor

The District has adopted procedures for calculating these parameters based on regionally calibrated equations (District 1994). Therefore, these procedures do not necessarily reflect Snyder Unit Hydrograph Method procedures described in other references or guidance documents.

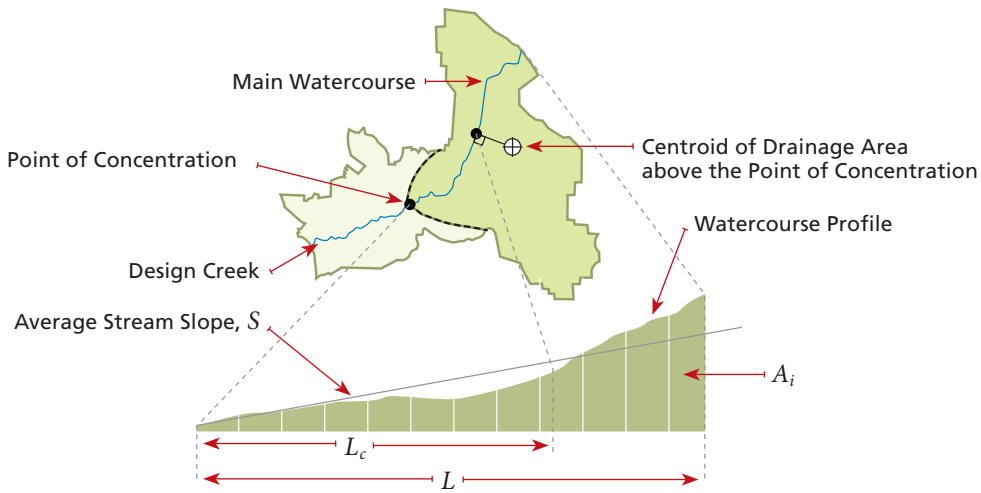
Basin Lag Time

Basin lag time is an important parameter in the determination of runoff hydrograph peaks. Basin lag time is a measure of the time elapsed between the occurrence of unit rainfall and the occurrence of unit runoff. The basic procedure (as illustrated in ***Figure 4***) for determining basin lag time is as follows:

1. Delineate the drainage basin's main watercourse or main drainage network.
2. Determine the centroid of the drainage area above the point of concentration.
3. Measure the main watercourse length (L) and the length of the watercourse from the point of concentration to a point adjacent to the centroid along the watercourse length (L_c) on a scale map.

4. Calculate average watercourse slope (S) upstream of the point of concentration using ***Equation 11***.
5. Estimate basin roughness factor (N) using ***Table 8*** for rural watersheds and ***Equation 12*** for urban watersheds.
6. Calculate basin lag time using ***Equation 13***.

FIGURE 4 PARAMETERS IN CALCULATING BASIN LAG TIME



Note: Graphic for illustration purposes only.

EQUATION 11 AVERAGE STREAM SLOPE

$$S = 5{,}280 \frac{2\left(\sum_{i=1}^{n} A_i\right)}{L^2} \tag{11}$$

where:

S = *average stream slope (ft/mi)*

A_i = *incremental area defined by the watercourse profile, summed between the outfall and the most remote point upstream* (L), *ft² (see **Figure 4**)*

L = *total length along the centerline of the main channel (ft)*

(District 1994)

To determine an appropriate basin roughness factor (N) the basin should be classified as either rural or urban. If more than 80 percent of the subject watershed has natural pervious coverage, the basin is considered rural, and the basin roughness factor (N) can be determined from ***Table 8***.

If the basin is urban, use ***Equation 12*** to calculate N using Manning's roughness coefficient (n) values of the main drainage network from ***Table 9***. If a field survey of the main drainage reach has been performed, compute a weighted average N using the length and the corresponding N of each drainage reach. It is also possible to use a combination of aerial photos for the upstream and natural reaches and field reconnaissance for the downstream urban reaches of the main drainage watercourse to estimate N.

If the basin is mixed rural and urban, a combined, weighted average N should be calculated based on ***Table 9*** and ***Equation 11***.

TABLE 8 BASIN ROUGHNESS FACTORS FOR RURAL WATERSHEDS

Basin Type	Basin Roughness Factor (N)
1. Rural watersheds with generally clear stream bed and minimal vegetation growth in the drainage reaches.	0.05
2. Rural watersheds with moderate to high levels of vegetation growth, or rock and boulder deposits within the main drainage reaches.	0.07
3. Rural watersheds with dense vegetation or high levels of boulder deposits within the main drainage reaches.	0.08

(District 2015)

EQUATION 12 BASIN ROUGHNESS FACTOR FOR URBAN WATERSHEDS

$$N = 0.52\,n^{0.79} \tag{12}$$

where:

N = *basin roughness factor*

n = *Manning's roughness coefficient (from **Table 9**)*

(District 2015)

TABLE 9 MANNING'S ROUGHNESS COEFFICIENT

Type of Facility	n
Reinforced Concrete Pipe	
Conduit > 36″ diameter	0.012
Conduit ≤ 36″ diameter	0.014
Corrugated Metal Pipe	
Annular	0.021
Helical	0.018
Concrete-Lined Channels	
Smooth-troweled	0.015
District Simulated Stone	0.017
Reinforced Concrete Box	
Cast-in-Place	0.015
Pre-Cast	0.014
Earth Channels	
Smooth Geometric	0.030 – 0.035
Irregular or Natural	0.045 – 0.050

(Chow 1959, District 1989)

EQUATION 13 BASIN LAG TIME

$$t_L = K \cdot N \left(\frac{L \cdot L_c}{\sqrt{S}} \right)^{0.38} \tag{13}$$

where:

t_L = *lag time (hr)*

K = *distance factor*
for $L > 1.7$ *mi,* $K = 24$
for $L \leq 1.7$ *mi,* $K = 15.22 + 2.15L + 8.7/L$
if calculated value of K *is greater than* 40*, use* $K=40$

N = *basin roughness factor (from **Table 8**, rural watershed or **Equation 12**, urban watershed)*

L = *length of longest watercourse (mi) (see **Figure 4**)*

L_c = *length along longest watercourse measured from the point of concentration to a point opposite the watershed centroid (see **Figure 4**)*

S = *average stream slope (ft / mi from **Equation 11**)*

(District 1994)

Transition structures include various forms of contractions, expansions, bridges, culvert crossings, junctions, bends, manholes, and inlets. Use the lower end of the range of applicable N for drainage reaches with fewer transition structures (less than two). Use the higher values of applicable N for drainage reaches with more structures.

Basin Peaking Factor

The basin peaking factor (C_p) parameter used in the Snyder Unit Hydrograph method affects the shape of the runoff hydrograph. The peaking factor is a function of overland basin storage. Large areas with flat slopes are associated with relatively high amounts of overland basin storage. Conversely, water that falls on steeply sloped areas will run off quickly, with little overland basin storage. The lower the basin storage, the higher the corresponding peaking factor.

The peaking factor can be determined as follows:

1. Locate the study watershed and delineate its boundary on slope maps provided in ***Attachment 10***.
2. If the watershed is within a flat urban area with less than 5 percent average slope, use $C_p = 0.6$.
3. If the watershed is within a steeply sloped area, using the overland slope maps in ***Attachment 10***, calculate a weighted average slope for the study drainage area.
4. Calculate the basin peaking factor for the study watershed using ***Equation 14***.

EQUATION 14 BASIN PEAKING FACTOR

$$C_p = 0.6e^{0.06(S_o/A)} \tag{14}$$

where:

C_p = *basin peaking factor* $(C_p \leq 0.85)$

S_o = *average watershed slope (percent from* ***Attachment 10****)*
For $S_o \leq 5\%$, $C_p = 0.6$

A = *drainage area (*mi^2*; if* $A < 5mi^2$, *use* $A = 5mi^2$*)*

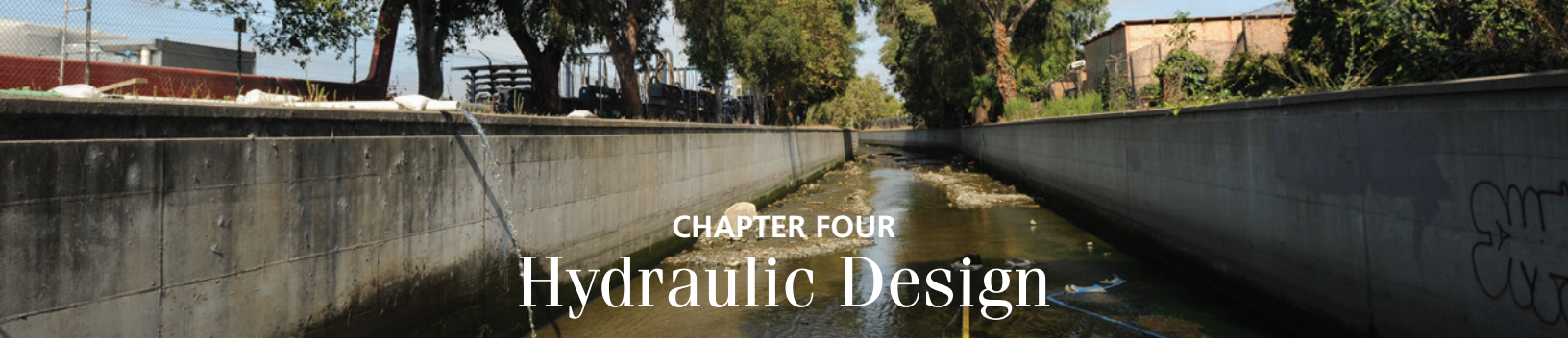
(District 1994)

BASE FLOW

If a considerable base flow exists due to high water table, reservoir releases, or other circumstances, then it should be considered as an addition to the design flood hydrograph. Base flow is also to be used when designing or sizing stormwater detention basins, as outlined in ***Chapter 5***.

PEAK DISCHARGE

Using the values of the variables calculated in this chapter, determine the peak design discharge (Q) using HEC-1 or HEC-HMS.



CHAPTER FOUR

Hydraulic Design

This chapter describes the design level of protection, which provides the minimum discharge (***Q***) and the level of flooding to be used for analysis and design. This chapter also describes the methods and procedures for calculating the hydraulic grade line (HGL). From a hydrologic standpoint, the required level of protection is related to the recurrence interval to be used for design. The level of protection is then used to calculate the discharge (also called the design flow rate). The method used to calculate the design discharge depends on the area tributary to the subject flood control facility. The recurrence interval for which the facility is to be designed also depends on the tributary area, as well as other factors. The design discharge is then used to size facilities and determine the HGL.

Although some guidance on the design of drainage facilities for major waterways is included here, this manual is mainly focused on primary and secondary facilities. The District Hydrologist establishes the design criteria for major facilities on a case-by-case basis. ***Chapters 2*** and ***3*** described how the total discharge (***Q***) is estimated or calculated for drainage facilities in Alameda County.

The minimum design level of flood protection in Alameda County is based on various factors, including:

- Category of flood control facility (major, primary or secondary as defined in Chapter 1)
- District zone
- Whether or not the facility was constructed and/or is maintained by the U.S. Army Corps of Engineers (USACE)
- Whether or not the facility is considered in the National Flood Insurance Program (NFIP)
- Whether or not the facility is tidally influenced

There are instances where facilities require more than one design level of protection. All criteria must be considered. The minimum design levels of protection are described in ***Table 10***. 100-year tidal elevations and MHHW elevations are reflected in ***Attachments 11A*** and ***11B***.

TABLE 10 MINIMUM DESIGN LEVEL OF PROTECTION

Type of Facility	Design Discharge	Design Tailwater		Design Freeboard or Clearance	
		Tidally Influenced	Non-Tidally Influenced	Leveed	Non-Leveed
MAJOR: Watershed Area > 25 sq. mi.					
All Facilities	100-year	MHHW	*	44 CFR 65.10	1.0 ft
All Facilities	5-year	100-year	*	44 CFR 65.10	1.0 ft
Alameda Creek	SPF	MHHW	*	1.0 ft	1.0 ft
San Lorenzo Creek	SPF	MHHW	*	1.0 ft	1.0 ft
San Leandro Creek	2,800 cfs	MHHW	*	1.0 ft	1.0 ft
PRIMARY Watershed Area > 50 ac but < 25 sq. mi.					
In NFIP Area	100-year	MHHW	**	44 CFR 65.10	1.0 ft
In NFIP Area	5-year	100-year	**	44 CFR 65.10	1.0 ft
All zones except Zone 12	15-year	MHHW	**	1.0 ft	1.0 ft
Zone 12	25-year	MHHW	**	1.0 ft	1.0 ft
SECONDARY: Watershed Area < 50 ac					
All	10-year	100-year	***	0.0 ft	0.0 ft
All zones except Zone 12	10-year	15-year	***	NA	1.25 ft
Zone 12	10-year	25-year	***	NA	1.25 ft

SPF Standard Project Flood.
* SPF - Standard Project Flood. Use closest known downstream water surface for the required design discharge. If the water surface in the facility is not known, it should be calculated beginning at the nearest point of hydraulic control, or at the Bay.
** Use closest known downstream water surface for the required design discharge. If the water surface in the facility is not known, it should be calculated beginning at the nearest point of hydraulic control, or at the Bay. If draining to a major facility, use major facility design water surface.
*** If draining to a major or primary facility, use major or primary facility design water surface.

(District 2015)

44 CFR 65.10(B) CHAPTER I FREEBOARD REQUIREMENTS

The District follows FEMA requirements for freeboard within leveed waterways, as specified in *Code of Federal Regulations, Title 44, Section 65.10(b) Chapter I* (10–1–2002 edition). Pertinent excerpts from this requirement are as follows:

(1) Freeboard.

(i) Riverine levees must provide a minimum freeboard of three feet above the water-surface level of the base flood. An additional one foot above the minimum is required within 100 feet in either side of structures (such as bridges) riverward of the levee or wherever the flow is constricted. An additional one-half foot above the minimum at the upstream end of the levee, tapering to not less than the minimum at the downstream end of the levee, is also required.

(ii) Occasionally, exceptions to the minimum riverine freeboard requirement described in paragraph (b)(1)(i) of this section, may be approved. Appropriate engineering analyses demonstrating adequate protection with a lesser freeboard must be submitted to support a request for such an exception. The material presented must evaluate the uncertainty

in the estimated base flood elevation profile and include, but not necessarily be limited to an assessment of statistical confidence limits of the 100-year discharge; changes in stage-discharge relationships; and the sources, potential, and magnitude of debris, sediment, and ice accumulation. It must also be shown that the levee will remain structurally stable during the base flood when such additional loading considerations are imposed. Under no circumstances will freeboard of less than two feet be accepted.

(iii) For coastal levees, the freeboard must be established at one foot above the height of the one percent wave or the maximum wave runup (whichever is greater) associated with the 100-year stillwater surge elevation at the site.

(iv) Occasionally, exceptions to the minimum coastal levee freeboard requirement, described in paragraph (b)(1)(iii) of this section, may be approved. Appropriate engineering analyses demonstrating adequate protection with a lesser freeboard must be submitted to support a request for such an exception. The material presented must evaluate the uncertainty in the estimated base flood loading conditions. Particular emphasis must be placed on the effects of wave attack and overtopping on the stability of the levee. Under no circumstances, however, will a freeboard of less than two feet above the 100-year stillwater surge elevation be accepted.

LEVEL OF PROTECTION - MAJOR FACILITIES

Major facilities are flood control facilities serving drainage areas 25 square miles or greater. There are only three major facilities in Alameda County: Alameda Creek, San Lorenzo Creek, and San Leandro Creek. Each major facility is an open channel.

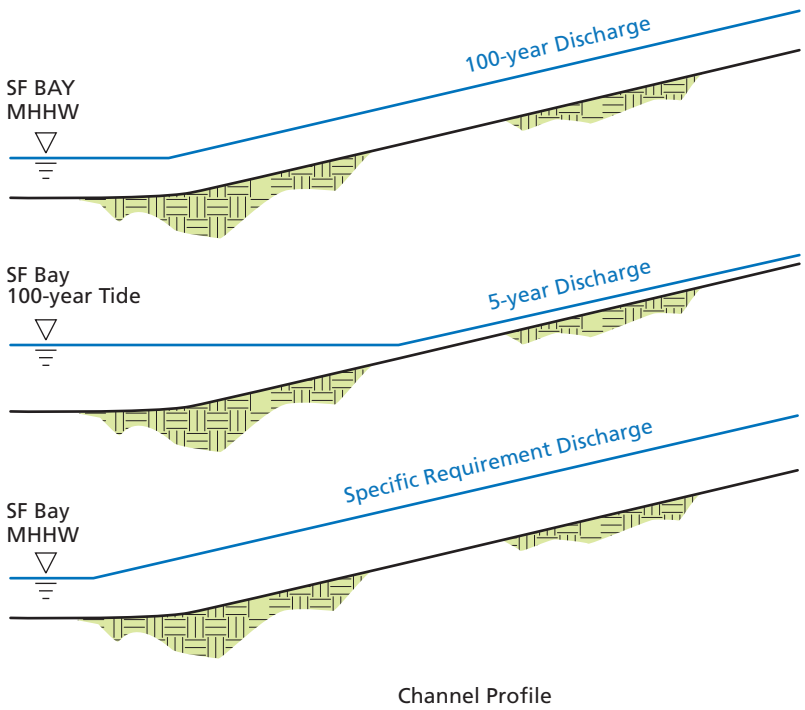
Minimum Design Discharge, Hydraulic Profile, and Freeboard

Tidally Influenced Major Facilities (*Figure 5)* - The design hydraulic profile for reaches of major facilities that are tidally influenced and are protective of urbanized or developed areas must include consideration of:

1. The 100-year (1-percent-annual-chance) discharge using mean higher high water (MHHW) as a tailwater surface elevation at the Bay, with the freeboard requirements of *44 CFR 65.10* (these requirements are included on p. 24-25).
2. The 5-year (20-percent-annual-chance) discharge using the 100-year (1-percent-annual chance) tide elevation as a tailwater at the Bay, with the freeboard requirements of *44 CFR 65.10.*
3. The specific requirement discharge (described below) using MHHW as a tailwater surface elevation at the Bay, with one (1) foot of freeboard. The specific requirement discharge:
    - Alameda Creek – Standard Project Flood discharge
    - San Lorenzo Creek (San Francisco Bay to Cull Creek) – Standard Project Flood discharge
    - San Leandro Creek – 2,800 cfs

These requirements are not applicable to reaches protective of marshlands or restoration areas.

FIGURE 5 **LEVEL OF PROTECTION FOR TIDALLY INFLUENCED MAJOR FACILITIES**



Note: Graphic for illustration purposes only. (District 2015)

Not Tidally Influenced Major Facilities - The design hydraulic profile for reaches of major facilities that are not tidally influenced must include consideration of:

1. The 100-year (1-percent-annual-chance) discharge using the closest downstream water surface for the 100-year discharge as a tailwater, with the freeboard requirements of *44 CFR 65.10*.
2. The specific design requirement (noted above) using the closest downstream water surface for the specific design discharge (noted above) as a tailwater, with one (1) foot of freeboard.

LEVEL OF PROTECTION - PRIMARY FACILITIES

Primary facilities are flood control facilities serving drainage areas greater than 50 acres, but less than 25 square miles. Facilities in this category are both open channels and closed conduit pipes.

Minimum Design Discharge, Hydraulic Profile, and Freeboard

Tidally Influenced Primary Facilities *(Figure 6)* - The design hydraulic profile for reaches of primary facilities that are tidally influenced must include consideration of:

1. For facilities considered in the NFIP, the 100-year (1-percent-annual-chance) discharge using mean higher high water (MHHW) as a tailwater surface elevation at the San Francisco Bay, with the freeboard requirements of

44 CFR 65.10 for leveed open channel reaches and one foot of freeboard for non-leveed open channel reaches.

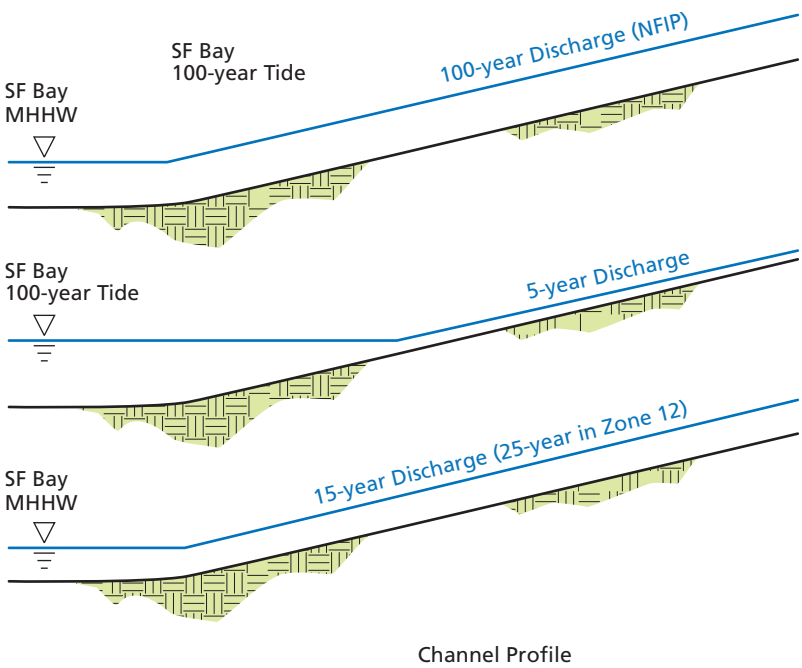
2. The 5-year (20-percent-annual-chance) discharge using the 100-year (1-percent-annual-chance) tide elevation as a tailwater at the San Francisco Bay, with the freeboard requirements of *44 CFR 65.10* for leveed open channel reaches and one foot of freeboard for non-leveed open channel reaches.

3. The 15-year (6.7-percent-annual-chance) discharge in all zones except Zone 12 using mean higher high water (MHHW) as a tailwater surface elevation at the Bay; with one foot of freeboard for all open channel reaches.

   The 25-year (4-percent-annual-chance) discharge in Zone 12 using mean higher high water (MHHW) as a tailwater surface elevation at the San Francisco Bay; with one foot of freeboard for all open channel reaches.

4. Primary facilities should provide design flood hydraulic grade line that is adequate for the positive drainage of secondary facilities, using the secondary facility design discharges.

FIGURE 6 **LEVEL OF PROTECTION FOR TIDALLY INFLUENCED PRIMARY FACILITIES**



Note: Graphic for illustration purposes only. (District 2015)

Not Tidally Influenced Primary Facilities - The design hydraulic profile for reaches of primary facilities that are not tidally influenced must include consideration of:

1. For facilities considered in the NFIP, the 100-year (1-percent-annual-chance) discharge using the closest downstream water surface for the 100-year (1-percent-annual-chance) discharge as a tailwater, with the freeboard requirements of *44 CFR 65.10* for leveed open channel reaches, and one (1) foot of freeboard for non-leveed open channel reaches.

2. The 15-year (6.7-percent-annual-chance) discharge in all zones except Zone 12. The 25-year (4-percent-annual-chance) discharge in Zone 12. Both should use the closest known downstream water surface for the required design discharge. If the water surface in the facility is not known, it should be calculated beginning at the nearest point of hydraulic control, or at the Bay. If draining to a major facility, use major facility design water surface with one foot of freeboard for all open channel reaches.

3. Primary facilites should provide a design flood hydraulic grade line that is adequate for the positive drainage of secondary facilities, using the secondary facility design discharges.

LEVEL OF PROTECTION - SECONDARY FACILITIES

Secondary facilities are flood control facilities serving drainage areas less than 50 acres. Facilities in this category within western Alameda County are typically closed conduit pipes.

Design Hydraulic Profile

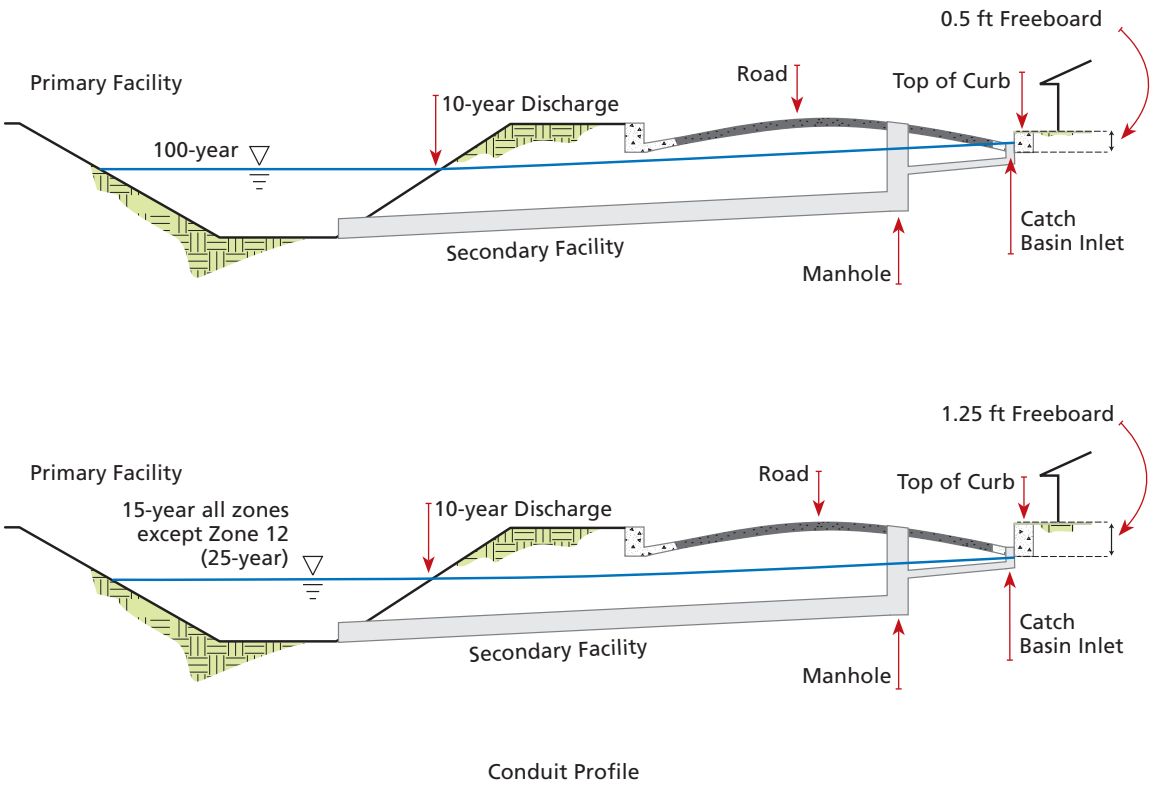
Tidally or Not Tidally Influenced (*Figure 7)* - The design hydraulic profile of secondary facilities must include consideration of:

1. The 10-year (10-percent-annual-chance) discharge with the 100-year (1-percent-annual-chance) design HGL as a tailwater in the primary facility, with 0.5 feet freeboard to the top of curb.

2. The 10-year (10-percent-annual-chance) discharge with the 15-year (6.7-percent-annual-chance) design HGL as a tailwater in the primary facility in all zones except Zone 12; with 1.25 feet of freeboard to the top of curb.

3. The 10-year (10-percent-annual-chance) discharge with the 25-year (4-percent-annual-chance) discharge in the primary facility as a tailwater in Zone 12; with 1.25 feet of freeboard to the top of curb.

FIGURE 7 **LEVEL OF PROTECTION FOR SECONDARY FACILITIES**



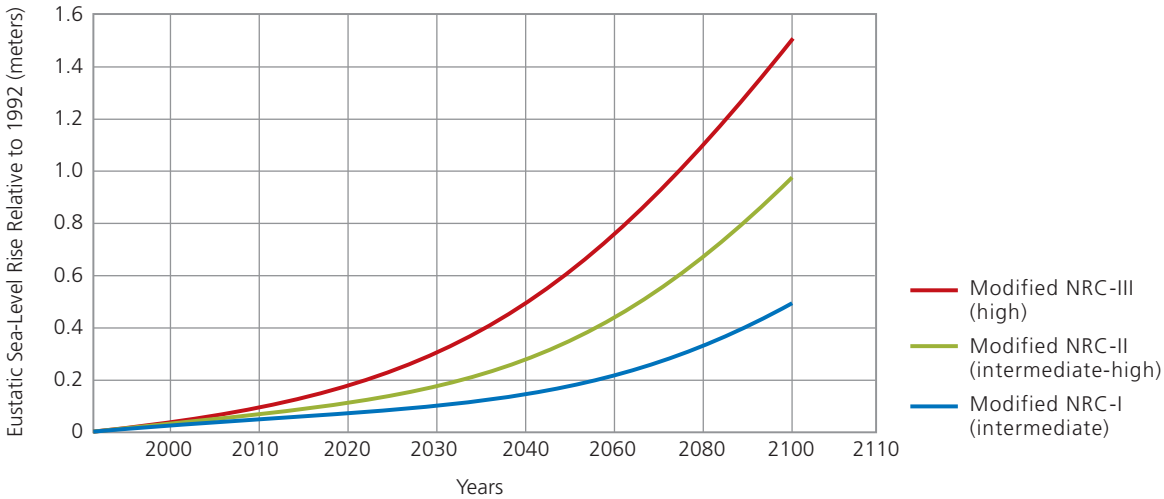
Note: Graphic for illustration purposes only. (District 2015)

SEA LEVEL RISE

Planning studies and engineering designs for proposed near-shore projects should consider alternatives that are formulated and evaluated for sea level rise over the project life cycle.

The USACE has defined a range of possible future rates of sea level change, as represented by three scenarios of "intermediate," "intermediate-high," and "high" sea level change as shown in *Figure 8*. Level of protection within areas that may be vulnerable to sea level rise will be considered by the District Hydrologist on a case-by-case basis.

FIGURE 8 **PROJECTED MEAN SEA LEVEL CHANGE**



Note: Historic (low) not shown. (USACE 2011)

HYDRAULIC PROFILE: FRICTION LOSSES

The District generally uses Manning's Equation to calculate friction losses to determine water surface profiles and HGLs. Use Manning's Equation (***Equation 15***) to calculate hydraulic profiles.

EQUATION 15 MANNING'S EQUATION

$$Q = \frac{1.49 R^{2/3} S_o^{1/2} A}{n} \tag{15}$$

where:

Q = *discharge (cfs)*
R = *hydraulic radius (ft)*
S_o = *channel slope (ft / ft)*
A = *flow area (ft²)*
n = *Manning's roughness coefficient (ft² from **Table 9**)*

(Brater and King 1976)

Typical roughness coefficient values are shown in ***Table 9***. For open channels and closed conduits, the roughness coefficient may vary depending on construction methods, maintenance procedures, and the materials involved. Roughness coefficient values are subject to variation, and that variation can cause changes in computed water surface elevations far in excess of those resulting from poor accuracy of cross-sections (USACE 1986).

When roughness coefficient values are used in channel or closed conduit design, they should be varied by plus or minus one-third of the design roughness coefficient value

to test the sensitivity of the design. Use the lowest roughness coefficient value to test for potential scour. Use the highest roughness coefficient value to test that the HGL or water surface elevation does not exceed the project's freeboard.

For curved open channels increase the roughness coefficient value (n_{adj}) according to *Equation 16*. For closed conduits, bend losses should be calculated as a minor loss, curved pipe.

EQUATION 16 ROUGHNESS COEFFICIENT ADJUSTMENT

$$n_{adj} = n + \frac{0.29}{r} \tag{16}$$

where:

n_{adj} = *adjusted roughness coefficient*
n = *Manning's roughness coefficient*
r = *radius of curvature at centerline (ft)*

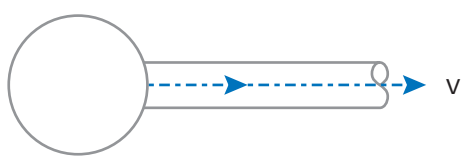
(District 1989)

HYDRAULIC PROFILE: MINOR LOSSES

Energy losses resulting from a rapid change in the direction or magnitude of flow velocity are called minor losses.

Upstream Terminal Manhole Loss

Use *Equation 17* to calculate the approximate estimate of energy loss in an upstream terminal manhole (H_{tm}) at the point where flow leaves the manhole and enters the pipe.



EQUATION 17 ENERGY LOSS IN UPSTREAM TERMINAL MANHOLE

$$H_{tm} = K\frac{V^2}{2g} \tag{17}$$

where:

H_{tm} = *energy loss in most upstream terminal manhole (ft)*
K = *energy loss coefficient (from **Table 11**)*
V = *flow velocity in pipe (ft/sec)*
g = *gravitational acceleration (32.2 ft/sec^2)*

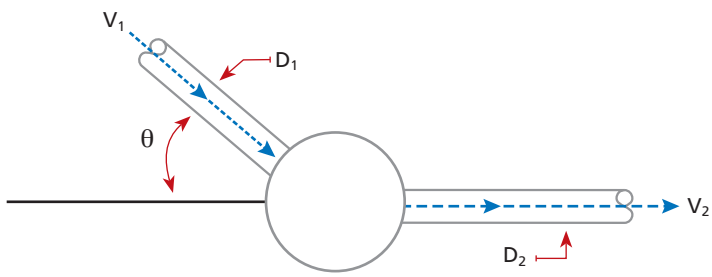
(Brater and King 1976)

TABLE 11 ENERGY LOSS COEFFICIENT AT MANHOLES			
Type of entrance	K	K_c	K_e
Square-cornered entrance flush with wall	0.5	0.5	0.7
Shaped	0.1	0.2	0.3

(Brater and King 1976) and (District 2015)

Manhole Loss with No Change in Pipe Size; with Straight-through Flow and with Change in Flow Direction

Use *Equation 18* to calculate the approximate estimate of energy loss through a manhole (H_{mh}) where the pipe is straight through the manhole ($\theta = 180°$) or if the pipe has a bend ($\theta \neq 180°$) that causes a change in flow direction.



EQUATION 18 ENERGY LOSS IN TO MANHOLE WITH STRAIGHT-THROUGH FLOW AND WITH CHANGE IN FLOW DIRECTION

$$H_{mh} = K_b \frac{V^2}{2g} \tag{18}$$

where:

H_{mh} = *energy loss in manhole due to change in flow direction (ft)*
K_b = *energy loss coefficient due to bend (from **Table 12** or **Figure 9**)*
V = *flow velocity in pipe (ft/sec)*
g = *gravitational acceleration (32.2 ft/sec²)*

$$D_1 = D_2$$

where:

D_1 = *upstream pipe diameter (ft)*
D_2 = *downstream pipe diameter (ft)*

For all manholes and junctions, verify that the total loss is not less than 0.05$(V_1^2/2g)$ or greater than $V_1^2/2g$ + 0.5$(V_2^2/2g)$.

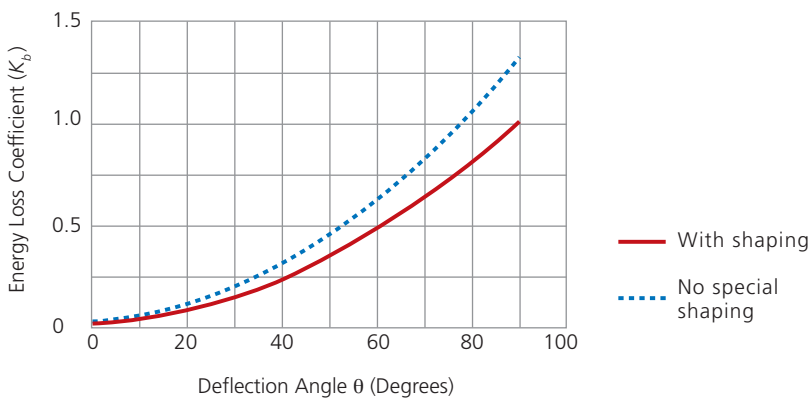
(District 2015)

TABLE 12 ENERGY LOSS COEFFICIENTS DUE TO FLOW DIRECTION CHANGE THROUGH MANHOLE

Structure Configuration	K_b shaped	K_b not shaped
Manhole straight run, $\theta = 0°$	0.05	0.08
Manhole $\theta = 30°$	0.15	0.21
Manhole $\theta = 45°$	0.29	0.39
Manhole $\theta = 60°$	0.48	0.63
Manhole $\theta = 90°$	1.02	1.33

(District 2015)

FIGURE 9 BEND LOSS COEFFICIENT IN MANHOLE



(District 2015)

Manhole Loss with Shaped Invert

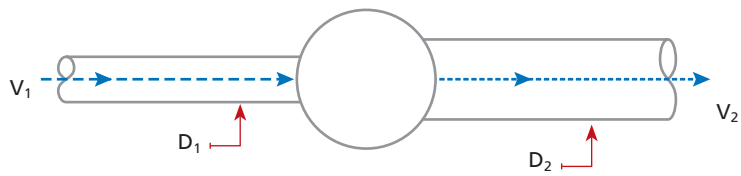
In order to minimize the head loss in a manhole, the inverts of the upstream and downstream pipes should be connected with a smooth transitional structure inside the manhole. The transitional structure should be shaped with a dimension of at least half of the pipe diameter. For manholes with shaped inverts, use *Table 12*, column 2 to select the appropriate energy loss coefficient, K_b.

Manhole Loss without Shaped Invert

Older manholes sometimes do not contain a transitional structure. In such cases, use *Table 12*, column 3 to select the appropriate energy loss coefficient, K_b.

Manhole Loss with Pipe Size Expansion and Straight-through Flow

Use ***Equation 19*** to calculate the approximation of energy loss (H_e) through a manhole where the pipe is straight through the manhole and the pipe size increases (a flow expansion).



EQUATION 19 ENERGY LOSS IN MANHOLE FROM PIPE EXPANSION, STRAIGHT-THROUGH FLOW

$$H_e = K_e \left(\frac{V_1^2}{2g} - \frac{V_2^2}{2g} \right) \tag{19}$$

where:

H_e = *energy loss due to pipe expansion (ft)*
K_e = *energy loss coefficient due to expansion (from **Table 11**)*
V_1 = *flow velocity in upstream pipe (ft/sec)*
V_2 = *flow velocity in downstream pipe (ft/sec)*
g = *gravitational acceleration (32.2 ft/sec²)*

$$D_1 < D_2$$

where:

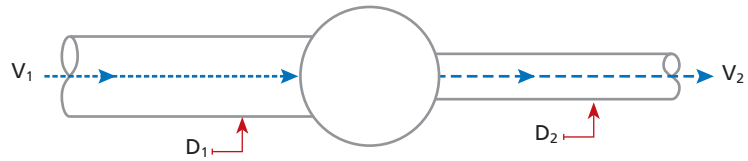
D_1 = *upstream pipe diameter (ft)*
D_2 = *downstream pipe diameter (ft)*

For all manholes and junctions, verify that the total loss is not less than 0.05$(V_1^2/2g)$ or greater than $V_1^2/2g$ + 0.5$(V_2^2/2g)$.

(District 2015)

Manhole Loss with Pipe Size Contraction and Straight-through Flow

Use ***Equation 20*** to calculate the approximation of energy loss (H_c) through a manhole where the pipe is straight through the manhole and the pipe size reduces (a flow contraction).



EQUATION 20 ENERGY LOSS IN MANHOLE FROM PIPE CONTRACTION, STRAIGHT-THROUGH FLOW

$$H_c = K_c \left(\frac{V_2^2}{2g} - \frac{V_1^2}{2g} \right) \tag{20}$$

where:

H_c = *energy loss due to pipe contraction (ft)*
K_c = *energy loss coefficient due to contraction (from **Table 11**)*
V_1 = *flow velocity in upstream pipe (ft/sec)*
V_2 = *flow velocity in downstream pipe (ft/sec)*
g = *gravitational acceleration (32.2 ft/sec²)*

$$D_1 > D_2$$

where:

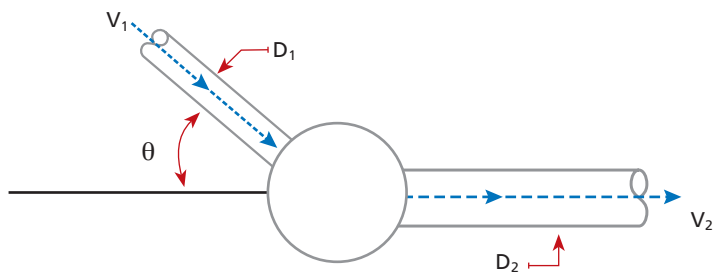
D_1 = *upstream pipe diameter (ft)*
D_2 = *downstream pipe diameter (ft)*

For all manholes and junctions, verify that the total loss is not less than 0.05$(V_2^2/2g)$ or greater than $V_1^2/2g$ + 0.5$(V_2^2/2g)$.

(District 2015)

Manhole Loss with Pipe Size Expansion, Change in Flow Direction

Use ***Equation 21*** to calculate the approximation of energy loss (H_{be}) through a manhole where the pipe size increases (a flow expansion) and the pipe has a bend ($\theta \neq 180°$) that causes a change in flow direction.



EQUATION 21 ENERGY LOSS IN MANHOLE FROM PIPE EXPANSION, CHANGE IN FLOW DIRECTION

$$H_{be} = K_b \left(\frac{V_1^2}{2g} \right) + H_e \tag{21}$$

where:

H_{be} = *energy loss due to change in flow direction and pipe expansion (ft)*
K_b = *energy loss coefficient due to bend (from **Table 12** or **Figure 9**)*
V_1 = *flow velocity in upstream pipe (ft/sec)*
g = *gravitational acceleration (32.2 ft/sec²)*
H_e = *energy loss due to pipe expansion (ft) (from **Equation 19**)*

$$D_1 < D_2$$

where:

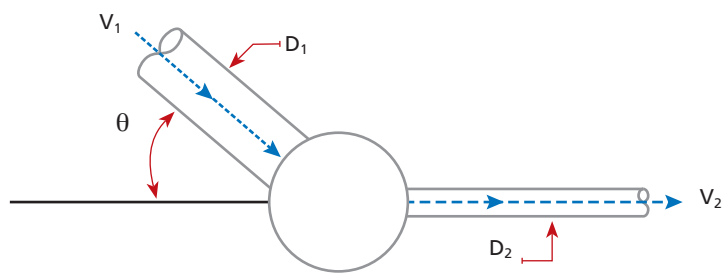
D_1 = *upstream pipe diameter (ft)*
D_2 = *downstream pipe diameter (ft)*

For all manholes and junctions, verify that the total loss is not less than 0.05$(V_1^2/2g)$ or greater than $V_1^2/2g$ + 0.5$(V_2^2/2g)$.

(District 2015)

Manhole Loss with Pipe Size Contraction, Change in Flow Direction

Use ***Equation 22*** to calculate the approximation of energy loss (H_{bc}) through a manhole where the pipe size decreases (a flow contraction) and the pipe has a bend ($\theta \neq 180°$) that causes a change in flow direction.



EQUATION 22 ENERGY LOSS IN A MANHOLE FROM PIPE CONTRACTION, CHANGE IN FLOW DIRECTION

$$H_{bc} = K_b \left(\frac{V_1^2}{2g} \right) + H_c \tag{22}$$

where:

H_{bc} = *energy loss due to change in flow direction and pipe contraction (ft)*
K_b = *energy loss coefficient due to bend (from **Table 12** or **Figure 9**)*
V_1 = *flow velocity in upstream pipe (ft/sec)*
H_c = *energy loss due to pipe contraction (ft) (from **Equation 20**)*
g = *gravitational acceleration (32.2 ft/sec²)*

$$D_1 > D_2$$

where:

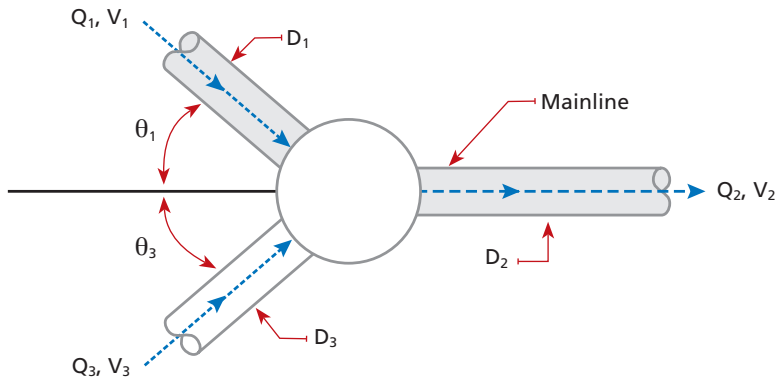
D_1 = *upstream pipe diameter (ft)*
D_2 = *downstream pipe diameter (ft)*

For all manholes and junctions, verify that the total loss is not less than 0.05$(V_2^2/2g)$ or greater than $V_1^2/2g$ + 0.5$(V_2^2/2g)$.

(District 2015)

Junction Loss with Manhole

Use *Equation 23* or *24* depending on the deflection angle of the mainline to calculate the energy loss (H_j or H_{jb}) in a junction manhole where flow enters the manhole from two pipes.



EQUATION 23 ENERGY LOSS AT JUNCTION WITH TWO UPSTREAM PIPES, STRAIGHT-THROUGH MAINLINE $(\theta_1=0)$

$$H_j = \Delta_y + \frac{V_1^2}{2g} - \frac{V_2^2}{2g} \tag{23}$$

where:

H_j = *energy loss in junction manhole (ft)*
Δ_y = *change in hydraulic grade line (ft) (from **Equation 25**)*
V_1 = *flow velocity in upstream mainline pipe 1 (ft/sec)*
V_2 = *flow velocity in downstream mainline pipe 2 (ft/sec)*
g = *gravitational acceleration (32.2 ft/sec²)*

For all manholes and junctions, verify that the total loss is not less than 0.1$(V_2^2/2g)$ or greater than $V_1^2/2g$ + 0.5$(V_2^2/2g)$.

(District 2015)

EQUATION 24 ENERGY LOSS AT JUNCTION WITH TWO UPSTREAM PIPES, DEFLECTED MAINLINE $(\theta_1>0)$

$$H_{jb} = H_j + H_b \tag{24}$$

where:

H_{jb} = *energy loss in junction manhole with deflected mainline (ft)*
H_j = *energy loss in junction manhole (ft) (from **Equation 23**)*
H_b = *energy loss due to bend (from **Equation 26**)*

(District 2015)

EQUATION 25 CHANGE IN HYDRAULIC GRADE LINE

$$\Delta_y = \frac{Q_2V_2 - Q_1V_1 - Q_3V_3\cos\theta_3}{g\left(\frac{A_1 + A_2}{2}\right)} \tag{25}$$

where:

Δ_y = *change in hydraulic grade line (ft)*
Q_1 = *discharge in upstream mainline pipe 1 (ft^3/sec)*
Q_2 = *discharge in downstream mainline pipe 2 (ft^3/sec)*
Q_3 = *discharge in upstream tributary pipe 3 (ft^3/sec)*
V_1 = *flow velocity in upstream mainline pipe 1 (ft/sec)*
V_2 = *flow velocity in downstream mainline pipe 2 (ft/sec)*
V_3 = *flow velocity in tributary upstream pipe 3 (ft/sec)*
A_1 = *cross sectional area of pipe 1 (ft^2)*
A_2 = *cross sectional area of pipe 2 (ft^2)*
g = *gravitational acceleration (32.2 ft/sec^2)*

(District 2015)

EQUATION 26 ENERGY LOSS DUE TO BEND IN JUNCTION MANHOLE

$$H_b = K_b\left(\frac{V_1^2}{2g}\right) \tag{26}$$

where:

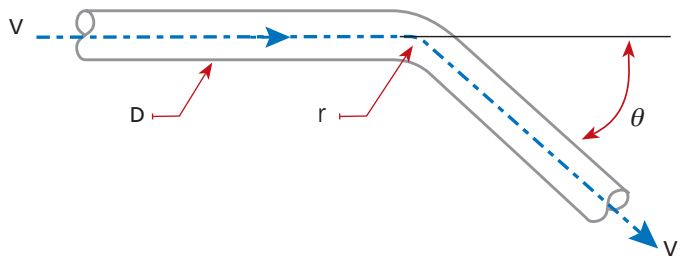
H_b = *energy loss due to bend (ft)*
K_b = *energy loss in coefficient due to bend (from **Table 12** or **Figure 9**)*
V_1 = *flow velocity in mainline upstream pipe 1 (ft/sec)*
g = *gravitational acceleration (32.2 ft/sec^2)*

For all manholes and junctions, verify that the total loss is not less than 0.1$(V_2^2/2g)$ or greater than $V_1^2/2g$ + 0.5$(V_2^2/2g)$.

(District 2015)

Curved Pipes, No Manhole

Use *Equation 27* to calculate the energy loss (H_b) in a curved pipe with no manhole.



EQUATION 27 ENERGY LOSS DUE TO PIPE BEND, NO MANHOLE

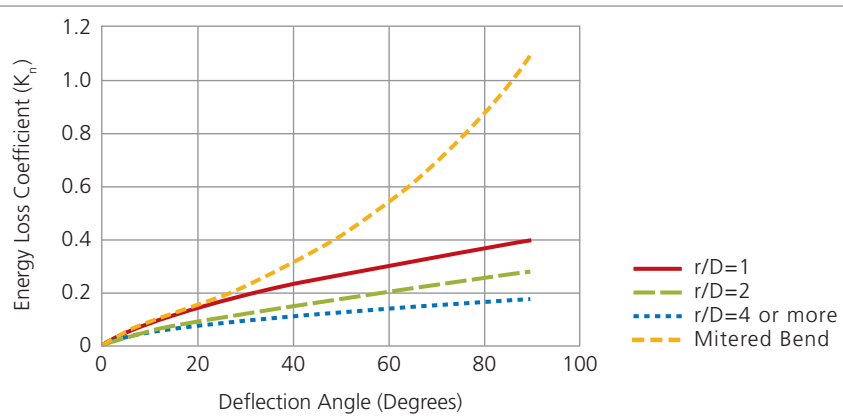
$$H_b = K_n \frac{V^2}{2g} \tag{27}$$

where:

H_b = *energy loss due to pipe curvature (ft)*
K_n = *energy loss coefficient due to curvature without a manhole or junction (from **Figure 10**)*
V = *flow velocity in pipe (ft/sec)*
θ = *pipe deflection angle (degrees)*
D = *pipe diameter (ft)*
r = *radius of curvature (ft)*
g = *gravitational acceleration (32.2 ft/sec^2)*

(Brater and King 1976)

FIGURE 10 CURVED PIPE LOSS COEFFICIENT



(District 2015)

HYDRAULIC PROFILE: HYDRAULIC JUMPS IN OPEN CHANNELS

Hydraulic jumps are a case of rapidly varied flow that occur in open channels when the depth of flow changes rapidly from a low stage to a high stage. Where hydraulic jumps are likely to occur—such as where the slope or cross-section of the facility changes from super-critical to sub-critical flow—their location and energy losses should be determined and considered in the design (Chow 1959, pp. 393–434).

LIMITING VELOCITIES AND MINIMUM INVERT SLOPE

The District has established minimum velocities to minimize siltation in open channels or closed conduits, along with maximum velocities to prevent excessive erosion or scour, as shown in *Table 13*. Where velocities are greater than 14 feet per second, the District Hydrologist establishes special criteria on a case-by-case basis to account for scouring, maintenance, or uneven flow conditions.

TABLE 13 LIMITING VELOCITIES AND MINIMUM INVERT SLOPE

Facility	Minimum Velocity (ft/sec)	Maximum Velocity (ft/sec)	Minimum Slope (ft/ft)
Earth Channels	2.0	6.0	0.0007
Concrete-Lined Channels	2.0	14.0	0.0007
Closed Conduits	3.0	14.0	0.0007

(District 2015) and (Chow 1959)

HIGH-VELOCITY FLOWS

Roll waves and pulsating (slug) flows should be considered when designing for high-velocity flows in open channels or closed conduits that result from facilities on steep slopes. Roll waves are created when the normal depth of flow is within ten percent of the critical depth for the section. This condition should be avoided.

Slug flow is a pulsating flow of waves that tend to amplify. The Vedernikov Number (V_{no}) is a measure of the tendency for super-critical flow stability. Where V_{no} is greater than unity, any wave created in the facility will tend to amplify up to a maximum height of 1.65 times normal depth, given a suitable length of run. Where this condition cannot be avoided, size closed conduits so that normal depth does not exceed half the depth of the conduit. For open channels, consider at least 1.70 times normal depth to establish free-board requirements (Chow 1959, pp. 210-211).

EFFECTS OF CURVATURE IN OPEN CHANNELS

In open channels with curvature, the rise in the water surface due to super-elevation and cross waves should be considered. Super-elevation is the rise in water surface around the outer edge of a bend in a channel resulting from centrifugal force. *Equation 28* shows the rise (Δh) in water surface. Cross waves occur in super-critical flow and should be considered in design (see Chow 1959, p 448).

EQUATION 28 EFFECTS OF CURVATURE

$$\Delta h = \frac{V^2 b}{gr} \tag{28}$$

where:

Δh = *rise in water surface (ft)*
V = *flow velocity (ft/s)*
b = *channel width at the water surface (ft)*
g = *gravitational acceleration (32.2 ft/sec²)*
r = *radius of channel centerline's curvature (ft)*

(Chow 1959)

AIR ENTRAINMENT IN OPEN CHANNELS

Velocities greater than 14 ft/sec entrain air. An increased water depth may result, with this depth relating directly to the increase in the volume of water. Use ***Equation 2***9 to estimate the increase in flow area (A_a) caused by air entrainment.

EQUATION 29 EFFECTS OF AIR ENTRAINMENT

$$A_a = 10\left(\frac{0.2V^2}{gR} - 1\right)^{0.5} \tag{29}$$

where:

A_a = *increase in flow area attributable to air entrainment (percent)*
V = *flow velocity at normal depth (ft/sec)*
g = *gravitational acceleration (32.2 ft/sec²)*
R = *hydraulic radius without air entrainment (ft)*

(Chow 1959)

MISCELLANEOUS SPECIFICATIONS AND STANDARDS

Where applicable, follow District specifications and standards for backfill, concrete products, and pipes, as well as District design guidelines. ***Table 14*** addresses minimums not covered elsewhere in this manual. ***Table 15*** addresses maximums not covered elsewhere in this manual.

TABLE 14 DISTRICT MINIMUMS	
Minimum pipe size	18 inches in diameter
Minimum reinforced concrete box height	7 feet, where grades permit
Minimum bottom width for open channels and boxes	4 feet for earth sections and 6 feet for concrete, whenever possible

(District 1989, 2015)

TABLE 15 DISTRICT MAXIMUMS	
Maximum EGL elevation	Below the top of bank in channels and below ground in closed conduit systems, wherever possible. The EGL should take super-elevation into account, if applicable.
Manhole spacing for underground conduits	Must not exceed 400 feet on center.
Side drain spacing for open channels	A minimum 2 percent slope must be maintained between grade break and side drain inlet (never greater than 400 feet).
Ratio of side slope for earth channels	No steeper than two and one half ($2^1/_2$) horizontal units to one (1) vertical unit unless District's approved protection measures are implemented.

(District 1989) and (District 2015)

Debris, Sediment Basins and Trash Racks

The design of certain flood control facilities may require debris and sediment basins and/or trash racks. The District Hydrologist determines the need for such structures on a site-by-site basis.

Channel Crossings

Any proposed or new crossings of District open channels shall be either clear-span or shall not adversely increase the water surface elevation for any cross-section of the channel upstream of the crossing for the appropriate design storm.

Undergrounding of Existing District Open Channels

Undergrounding of existing District open channels is strongly discouraged. However, if Undergrounding is unavoidable, the conduit should not adversely increase the water surface elevation for any cross-section of the channel upstream for the appropriate design storm.

Cast-in-Place Concrete Pipe

Precast reinforced concrete pipe is the accepted material for concrete culverts. The District Hydrologist may approve cast-in-place pipe on a case-by-case basis.

Pipe Sizes

Pipes shall not decrease in area or diameter in the downstream direction. Pipelines with area and/or diameter reductions in the downstream direction are treated as detention basins (see *Chapter 5*).

CHAPTER FIVE

Stormwater Holding Facilities Design

Stormwater holding facilities (for either retention or detention) are typically required for new development projects because the post-development increase in impervious area (streets, sidewalks, driveways, and roofs, for example) generates higher runoff rates. If not controlled, the higher runoff could cause downstream flooding.

A stormwater holding facility is designed to receive runoff from an upstream watershed and hold or release it downstream at a reduced rate to lessen the risk of downstream flooding. Within Alameda County, all new development projects discharging to District facilities will require a stormwater holding facility. The District may consider exceptions on a case-by-case basis, for example, if the project is near points of outfall to the San Francisco Bay, or if the timing of releases from the holding facility could adversely impact downstream flows.

Retention facilities are generally smaller below-ground facilities designed to retain runoff from urban development or infill projects. Detention facilities are generally used for larger development projects. Both are designed to store runoff for a short or temporary period of time.

The stormwater holding facilities described in this chapter are specifically intended for flood control purposes. The holding facility designs do not necessarily address requirements for improved water quality from new developments. Specifically, the San Francisco Bay Regional Water Quality Control Board stipulates that pollutants in stormwater be reduced to the maximum extent practicable (RWQCB 2015). More about water quality requirements is presented in ***Chapter 6***.

RETENTION FACILITIES

Retention facilities are designed to contain approximately 20 percent of the mean annual precipitation, regardless of the design storm frequency of the drainage facilities entering the retention facility. Retention facilities do not have surface outflow but rely instead on pumping to discharge the excess runoff.

Retention facilities should be designed with an optimized volume and enough pumping capacity to enable the facility to drain within 24 hours after it reaches its maximum capacity. The volume of stormwater (V_w) that the retention facility should be designed to store is calculated per ***Equation 30***.

EQUATION 30 DESIGN VOLUME OF STORMWATER FOR RETENTION BASINS

$$V_w = 0.021\overline{P}A \tag{30}$$

where:

V_w = *volume of water to be stored (acre-feet)*
$\overline{P}$ = *mean annual precipitation (inches)*
A = *drainage area (acres)*

(District 1989)

The mean annual precipitation ($\overline{P}$) is estimated at the centroid of the drainage area above the point of concentration at which the retention facility is being designed, as shown in ***Figure 2.*** The retention facilities must be designed with at least one foot of freeboard and must include a designated spillway to discharge stormwater to a District facility.

DETENTION FACILITIES

Several types of detention facilities are acceptable to the District for onsite control of additional runoff caused by development:

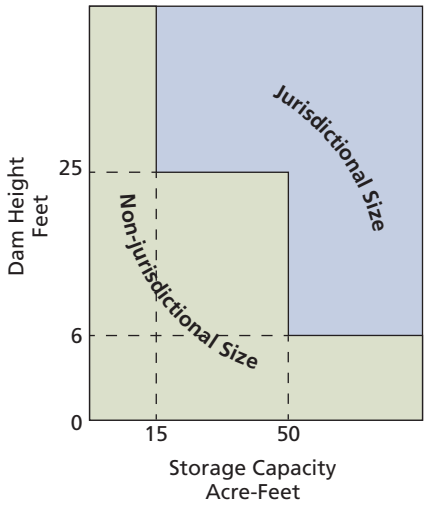
- Ponds or swales built for the express purpose of stormwater detention.
- Parking lot detention for industrial/business development. A notice must be filed that the area is subject to stormwater ponding. Pedestrian access should be provided through the ponded areas. The depth of ponding should not exceed 4 inches during a 100-year event.
- Conduit storage by oversizing the below-ground drainage facilities. The design must account for problems associated with siltation and long-term maintenance.
- Multipurpose facilities such as parks, tennis courts, parking areas, existing ponds and wetland areas, and landscaped areas may be used as detention facilities. A notice must be posted that the area is subject to stormwater ponding and escape routes must be clearly identified.

Dry Ponds versus Wet Ponds: A dry pond is designed such that the pond outlet is positioned at or below the lowest elevation in the pond. Dry ponds drain completely between storm events. A wet pond is designed such that the lowest outlet is at an elevation above the pond bottom. Water remains in the pond during dry-weather periods between storm events, and is depleted by evaporation and/or infiltration into the soil. For wet ponds, the local or regional mosquito abatement district must be consulted, and appropriate integrated pest management measures should be considered.

Above-ground versus Below-ground Detention: Above-ground detention facilities typically consist of depressed or excavated areas in the land surface or can be constructed using embankments or earthen dams. The District requires that above-ground detention facilities be used for new development projects, when FEMA floodplains may be impacted, or when long-term maintenance of the detention facility is to be managed by a public authority.

All above-ground detention facilities must comply with California Department of Water Resources' Division of Safety of Dams requirements, if within the jurisdictional parameters shown in ***Figure 11***. Neither the height nor the storage capacity of an earthen dam can exceed the maximum allowable limit for a non-jurisdictional dam.

FIGURE 11 **CALIFORNIA WATER CODE JURISDICTION OVER DAMS AND RESERVOIRS**

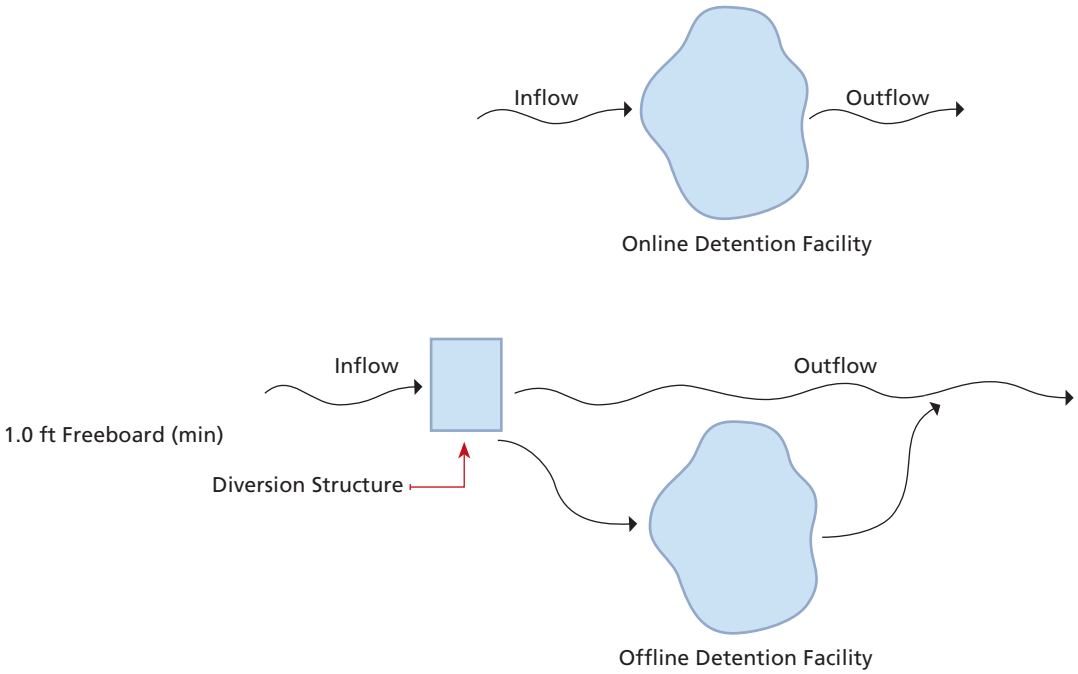


(DSOD 2015)

Below-ground detention facilities may be allowed for smaller development projects where space is limited and detention facility maintenance will not be managed by a public authority. Below-ground detention can consist of a series of appropriately sized pipes or concrete chambers manufactured specifically for below-ground detention. Long-term maintenance to account for siltation must be considered in the design.

Online versus Offline Detention: As shown in ***Figure 12***, an online detention facility is positioned along the alignment of the main stormwater drainage path and operates during all storm events. An offline detention facility is located away from the main drainage path, and operates only when the runoff exceeds certain pre-determined amounts. Depending on site conditions and downstream restrictions, either one—or a combination of both—may be used.

FIGURE 12 ONLINE AND OFFLINE DETENTION FACILITIES

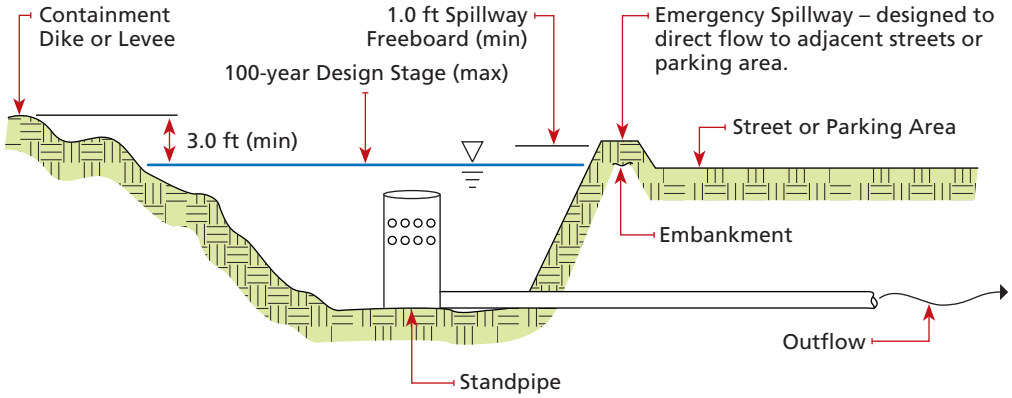


Note: Graphic for illustration purposes only.

COMPONENTS OF A DETENTION POND

Detention ponds are one of the most common types of detention facilities used in Alameda County. *Figure 13* illustrates the main engineered components of a typical detention pond design. Other configurations are possible, pursuant to the District's approval.

FIGURE 13 TYPICAL DETENTION POND CONFIGURATION



Note: Graphic for illustration purposes only.

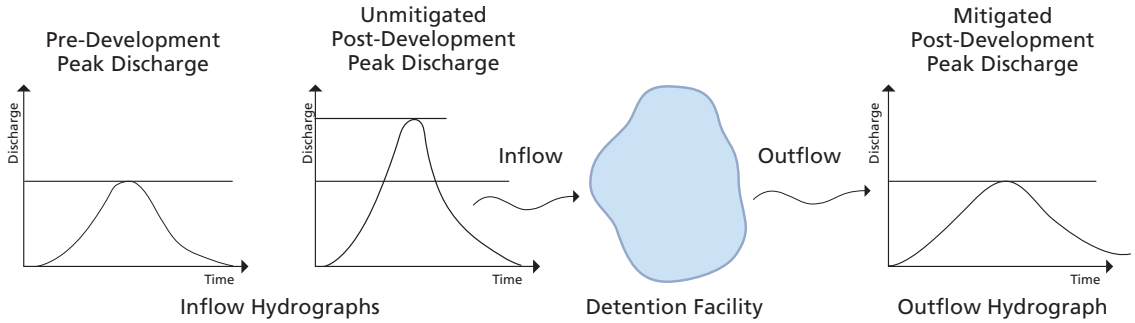
Any embankment or containment dike design for a detention pond should conform to acceptable geotechnical engineering practice, and must provide a minimum of three feet of freeboard from the 100-year flood stage for a levee or dike, or two feet of freeboard for top of natural ground. Appropriate geotechnical analyses must also be performed to ensure adequate stability of all detention pond side slopes.

The emergency outflow spillway must be designed in such a way to convey discharge safely to a outfall point when the detention pond storage capacity is exceeded during a 500-year event. The emergency spillway and other outlet structures must be protected using concrete, rock, riprap, or other appropriate materials to prevent excessive erosion during normal and high flow conditions.

DETENTION FACILITY DESIGN PROCEDURE

Figure 14 illustrates the basic concepts for detention facility hydrologic analysis. Runoff (as depicted in a hydrograph from one or more contributing areas) is directed toward a detention facility. Water is released from the facility in a regulated manner through an outlet structure. The District requires that detention facilities be designed with adequate storage volume and hydraulic capacity of associated inlet and outlet structures so that the peak discharge from the detention facility is less than or equal to the peak discharge prior to development for all recurrence intervals, including 5-, 15-, 25, and 100-year events. Alternatively, the discharge rate may be based on other criteria as specified or authorized by the District.

FIGURE 14 DETENTION FACILITY HYDRAULICS



Note: Graphic for illustration purposes only.

At a minimum, detention facilities must be designed to accommodate flows from the District's 24-hour hypothetical design storm, as presented in *Table 4*. The Synthetic Unit Hydrograph Method, as presented in *Chapter 3*, should be used to generate pre- and post-development hydrographs for the project. Any generally accepted hydrologic model—such as HEC-1 or HEC-HMS—can be used to perform runoff generation and hydrologic routing calculations. Consult with the District if planning to use any other hydrologic model.

Pre-Development Peak Discharge: Before beginning the design process, contact the District for the appropriate design guidelines for the project site. To establish the pre-development

peak discharge, an analysis of pre-development conditions is based on an assessment of the existing land use, land cover, stormwater holding facilities (including cattle ponds and naturally occurring ponding areas), and onsite conveyance systems. To generate the pre-development peak discharge hydrograph:

1. Select an appropriate uniform loss rate from ***Table 6***, "Existing Urban Coverage" (column 4) based on hydrologic soil group.
2. Determine the DCIA value for pre-development conditions from ***Table 7***. Use a value of zero if no DCIA is present.
3. Calculate the pre-development basin roughness factor from ***Equation 12***.
4. Calculate the pre-development catchment lag time using ***Equation 13*** and the basin roughness factor from step 3.
5. Use a basin peaking factor $C_p = 0.6$ for pre-development conditions.

Post-Development Peak Discharge: To generate the post-development peak discharge hydrograph:

1. Select an appropriate uniform loss rate from ***Table 6***, "New Urban Coverage" (column 3) based on hydrologic soil group.
2. Determine the DCIA value for post-development conditions from ***Table 7***. If more than 50 percent of the combined pervious and NCIA is impervious, adjust the initial loss and uniform loss rates based on ***Equation 10***.
3. Calculate the post-development basin roughness factor from ***Equation 12.***
4. Calculate the post-development catchment lag time using ***Equation 13*** and the basin roughness factor from step 3.
5. Use a basin peaking factor $C_p = 0.7$ for the post-development conditions.

Detention Facility Volume and Outlet Structure Requirements: Once the runoff analysis has been approved by the District, design the required detention facility volume and the outlets structure so that post-development peak runoff does not exceed pre-development peak runoff for the 5-, 15-, 25-, and 100-year recurrence interval storm events using a 24-hour design storm. Refer to the appropriate District-approved hydrologic master plan guidelines for meeting 2-year continuous runoff restrictions.

An exception to this requirement pertains to smaller development projects with post-development runoff of less than 5 cfs for the 100-year event. For these cases, the detention facilities need only be designed for a 15-year event. All emergency spillway designs must be based on a 100-year discharge, however.

The water elevation within the pond must return to its initial level within 24 hours. If constrictions are present in the downstream flood control infrastructure, the District may require a comparison of the downstream design capacity and the pre-development peak runoff. Use the lower of the two values to establish the maximum allowable peak discharge for the stormwater detention design.

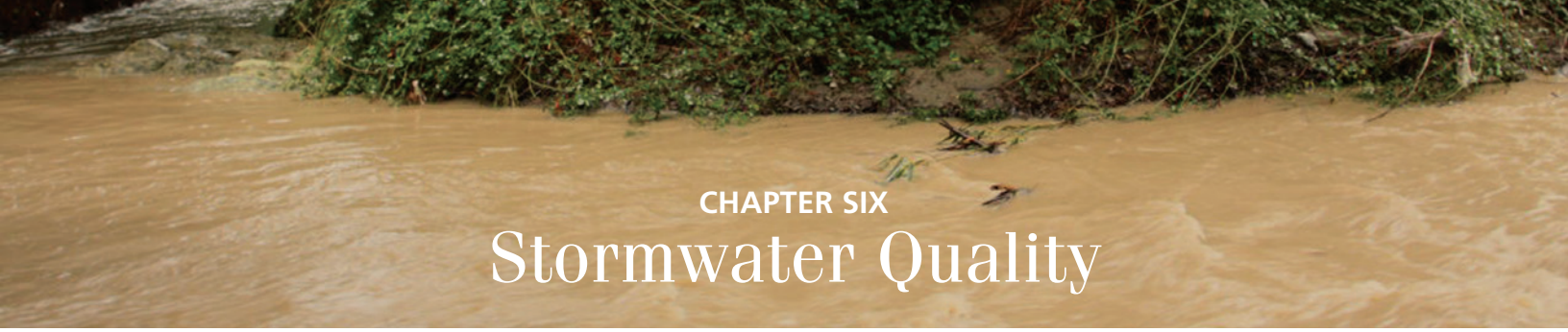
For storms greater than the 100-year event, the emergency spillway must be designed so that the overflow can reach a drainage facility without generating water depths greater

than 6 inches over the entire flow path. A minimum of 1 foot of freeboard from the 100 year peak water level to the emergency spillway elevation must be included. The pond containment dikes must be designed with a minimum of 2 feet above the 100-year peak water level.

Depending on the size of a development project, the District may also require that the detention facility and its associated outlet structures be designed in a manner that the timing of the outflow from the pond will not cause an increase to the downstream flood stage.

For projects located within a FEMA-designated Zone AH (meaning areas subject to inundation by 1-percent-annual-chance of shallow flooding with average depths between one and three feet), the reduction to pre-development flood storage capacity caused by development will need to be mitigated.

The detention facility design procedures in this section do not necessarily reflect hydromodification management that may be required as part of the Municipal Regional Stormwater NPDES Permit (RWQCB 2015). Those requirements must be evaluated and met as well.



CHAPTER SIX

Stormwater Quality

NPDES PERMIT

As of November 2015, the 17 Alameda County agencies are included as co-permittees with 60 other regional agencies regulated by the new joint *Municipal Regional Stormwater Permit* (RWQCB 2015), issued under the National Pollutant Discharge Elimination System (NPDES). NPDES *Permit No. CAS612008* mandates pollution control standards for stormwater runoff to San Francisco Bay, consistent with the goals of the federal Clean Water Act.

NPDES permit *Provision C.3* pertains to the quality of runoff from new development and redevelopment. It stipulates that pollutants in stormwater be reduced to the maximum extent practicable.

Among other things, *Provision C.3* requires that certain new development and redevelopment projects incorporate post-construction stormwater management measures —including stormwater treatment measures, stormwater site design measures, and source control measures—to reduce stormwater pollution. These requirements are *in addition to* standard best management practices required during construction.

COMPLIANCE

In general, the Municipal Regional Stormwater Permit stipulates a preference that stormwater pollution be prevented at the source. A second-tiered approach would be to decrease the amount of runoff from a site so that stormwater pollutants do not reach downstream waterways. A third-tiered approach would be to treat the stormwater prior to discharging it.

Any agency, organization, or person involved in the design of stormwater facilities should obtain a copy of the latest version of the *Municipal Regional Stormwater Permit* and must understand and comply with the requirements therein. Additional useful guidance can be found in the California Stormwater Quality Association's (CASQA's) *Stormwater Best Management Practice* (BMP) handbooks, and in other similar references.

Acknowledgements and References

ACKNOWLEDGEMENTS

This *Hydrology & Hydraulics Manual* was prepared under the direction of Daniel Woldesenbet, PhD., P.E., General Manager of the Alameda County Flood Control & Water Conservation District, and under the supervision of Henry E. "Hank" Ackerman, P.E., Principal Civil Engineer and Flood Control Program Manager.

Rohin Saleh, P.E., Supervising Civil Engineer in the Flood Control Planning Section, led the development and verification of the main technical content. The Modified Rational Method technical content and parts of the District's general policies are based on the District's *Hydrology and Hydraulics Criteria Summary* manual dated August 7, 1989.

Assisting in the analyses were Frank Codd, P.E., Manny Canivel, P.E., and Ramses Manalo, all with the District. Daniel Matthies, P.E., C.F.M. with Wood-Rodgers, Inc. provided peer review. Sybil Hatch, P.E. with Convey, Inc. and her staff produced the manual.

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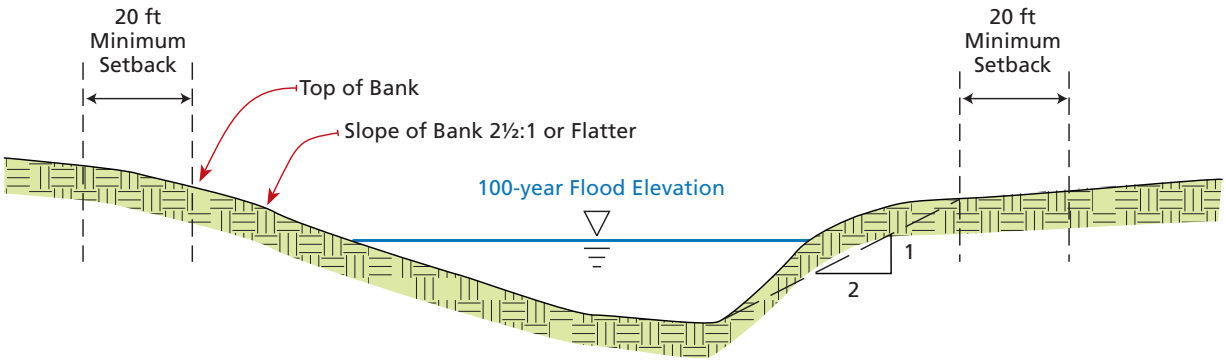
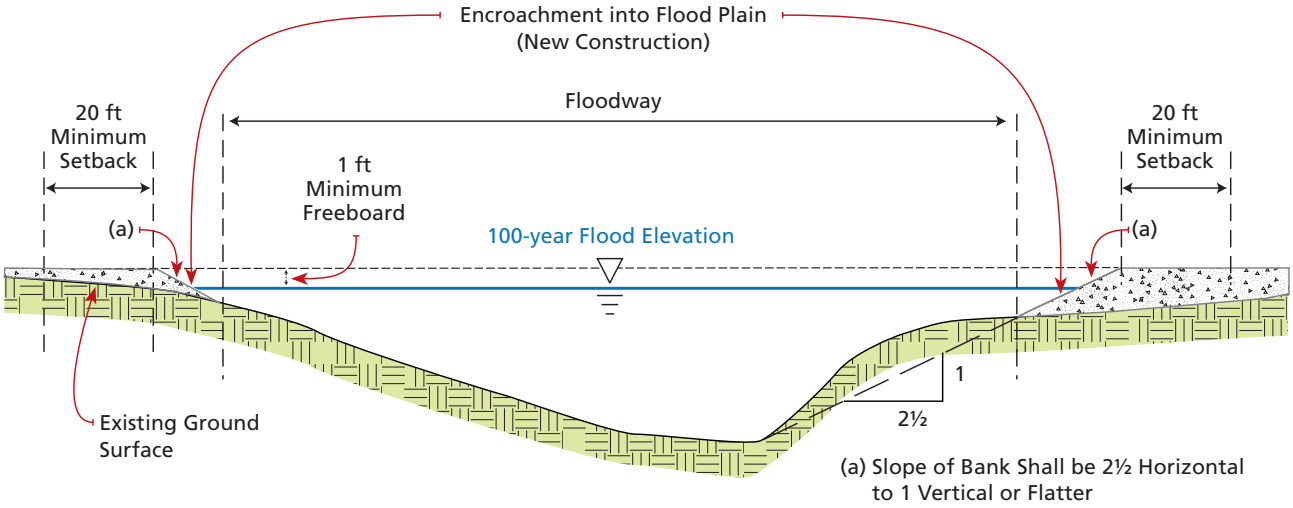
Attachments



Section A: Applies when 100-year storm is contained within existing facility



Section B: Applies when the existing facility is large enough to accommodate side encroachment

Alameda County
Flood Control & Water Conservation District
399 Elmhurst Street, Hayward, CA 94544
(510) 670-5480

Flood Zone: _____ Drainage Line: _____ Page: _____

Prepared by: _____ Date: _____

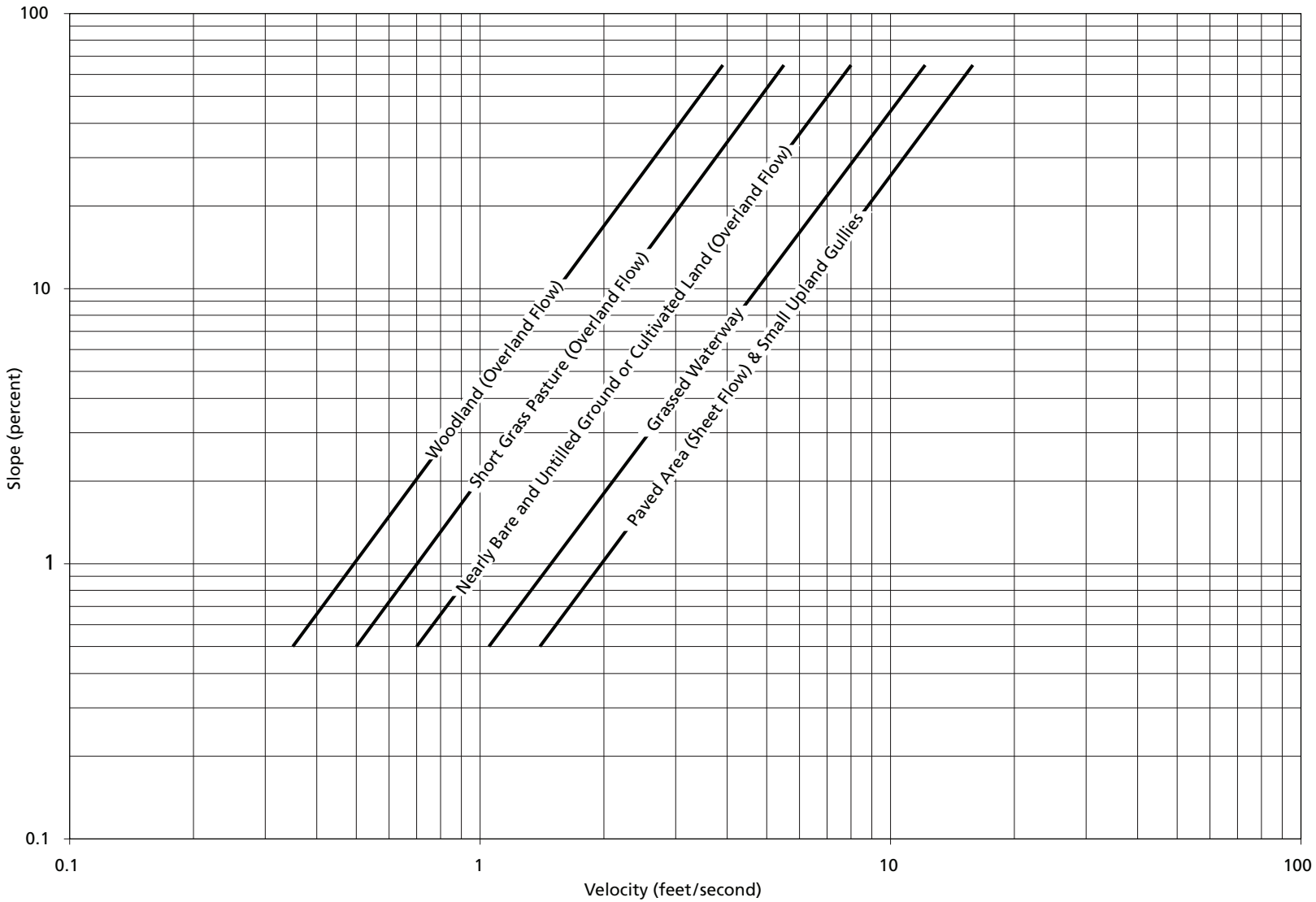
Checked by: _____ Date: _____

INDIVIDUAL DRAINAGE AREA						COMBINED DRAINAGE AREA						RUNOFF	PARAMETERS of ROUTING CONDUIT*								
		Average	Runoff Coefficient			Concentration								Channel Cross-Section							
Id.	Area (acres)	Average Land Slope (percent)	Standard C	Modified C'	Area x C'	Pt.	Σ Area (acres)	Time (min)	Mean Annual Precipitation (in)	Rainfall Intensity, i (in/hr)	Σ(Area x C')	Flow Rate, Q i Σ(Area x C') (cfs)	Pipe Diameter (in)	Base (ft)	Side Slope (ft/ft)	Slope (ft/ft)	Length (ft)	Manning's *n*	Normal Depth (ft)	Velocity (ft/s)	Conduit Time (min)
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
													*Use only one uniformly sized conduit type (pipe or channel) per row.								
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22

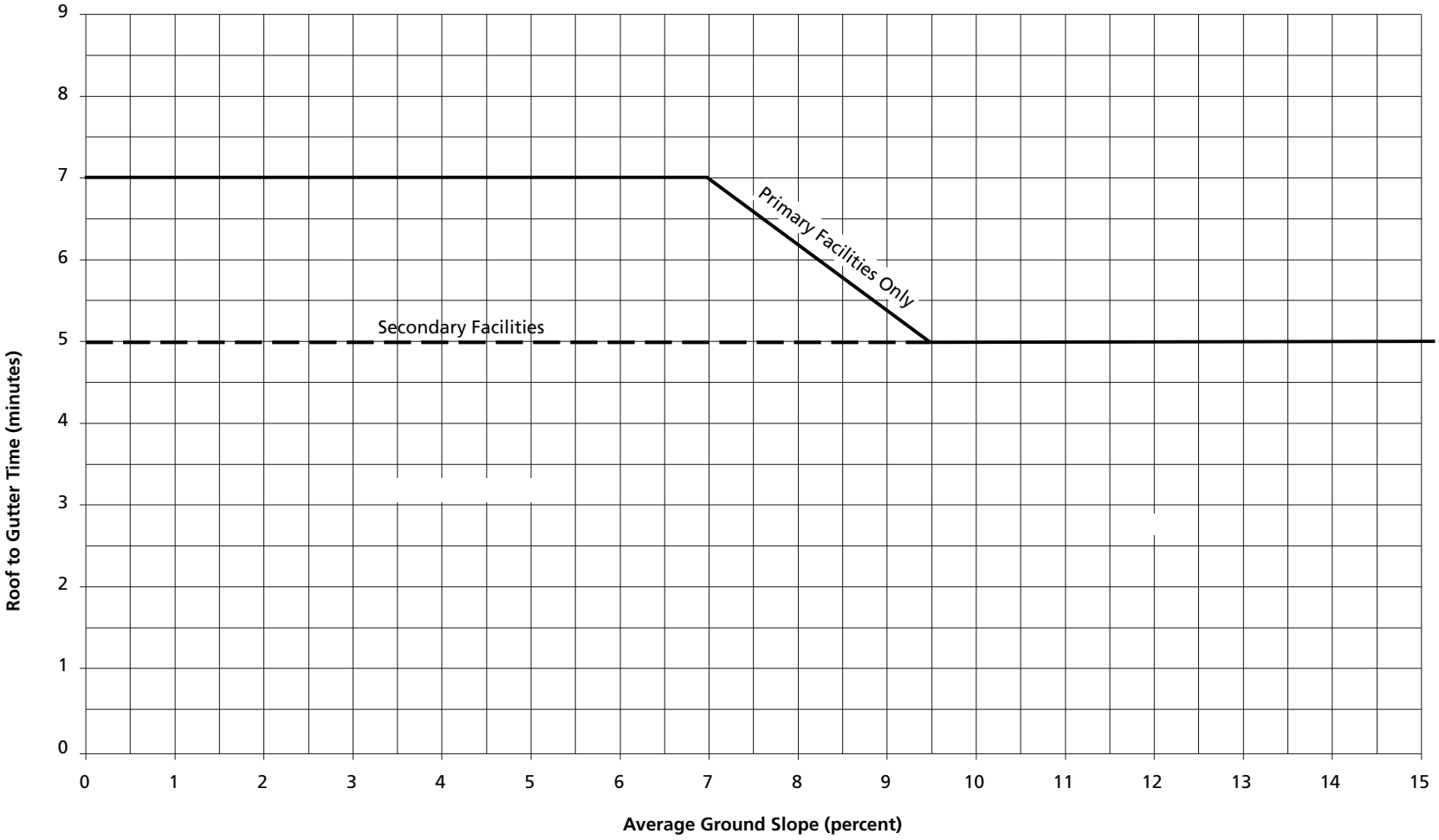
Notes: _____

Attachment 2 available for download in Microsoft Excel format from the Alameda County Flood Control District website.

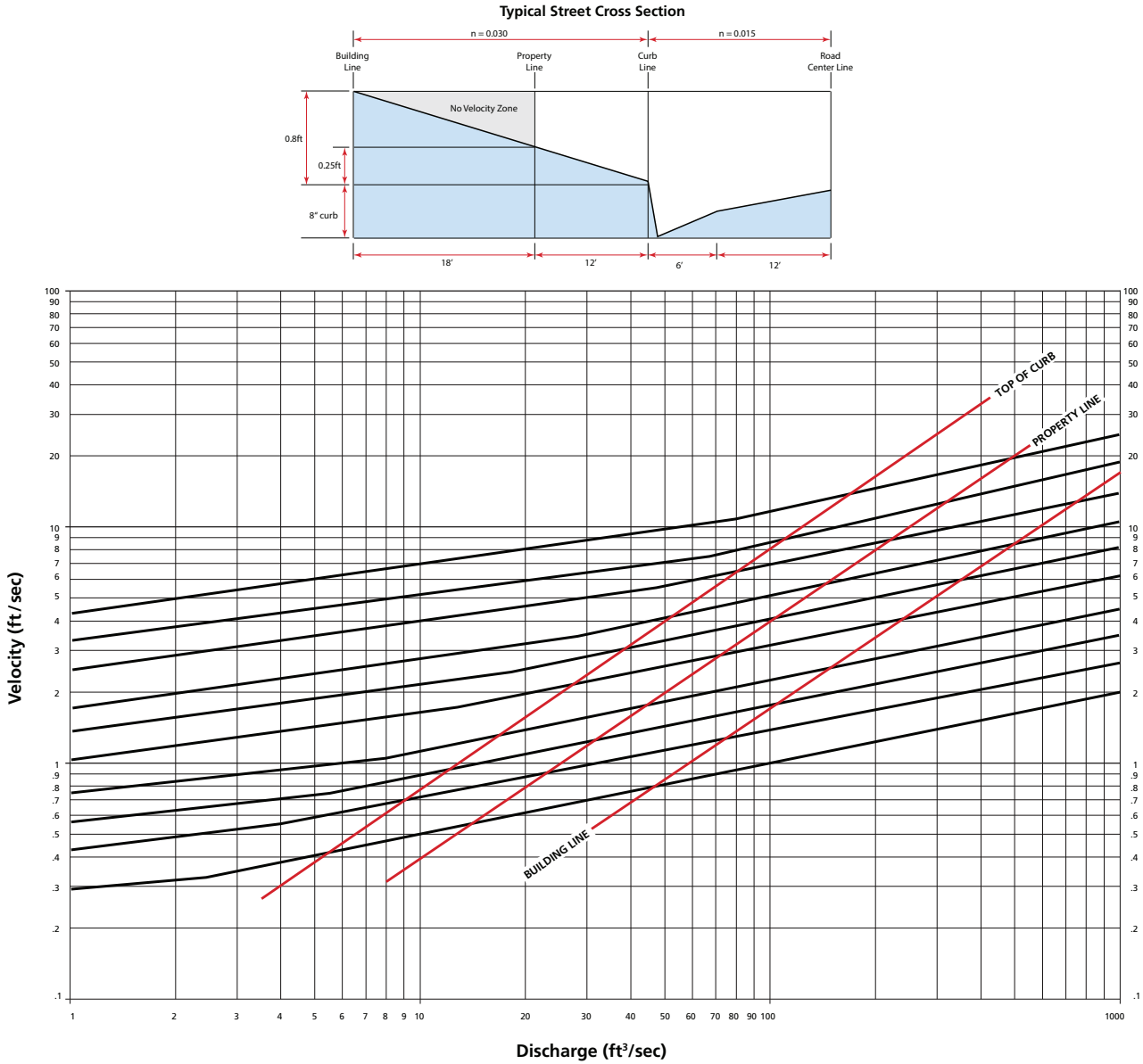
(District 1989)


100
10
1
0.1
Slope (percent)
0.1
1
10
100
Velocity (feet/second)
Woodland (Overland Flow)
Short Grass Pasture (Overland Flow)
Nearly Bare and Untilled Ground or Cultivated Land (Overland Flow)
Grassed Waterway
Paved Area (Sheet Flow) & Small Upland Gullies

(NRCS 2010)



(District 1989)

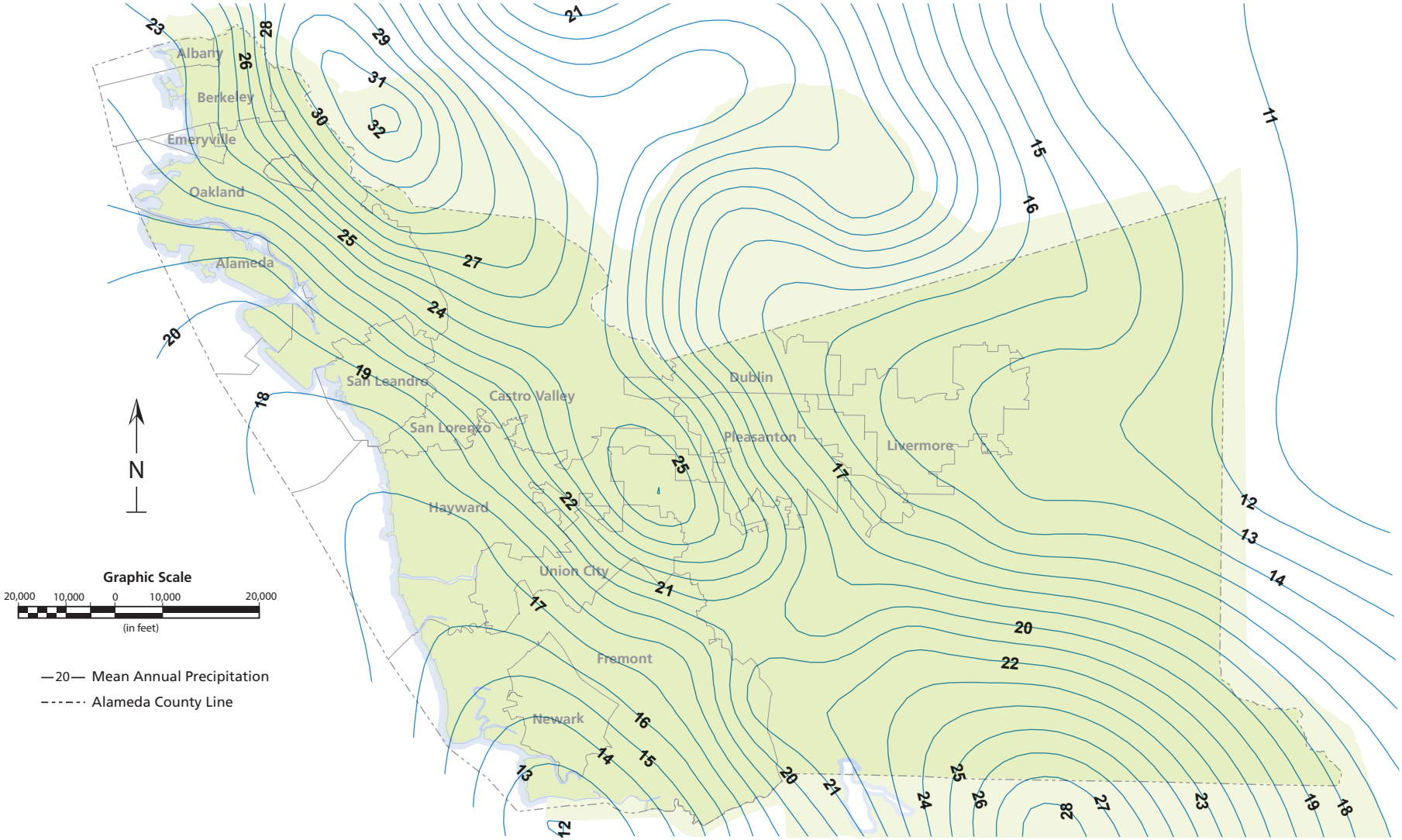


(District 1989)

Alameda County Hydrology & Hydraulics Manual 2016

Gutter Flow Velocity Chart

Attachment 5



Attachment 6 available for download as a GIS file from the Alameda County Flood Control District website.

(District 2011)

T_c (min)	Mean Annual Precipitation (in)																					
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1	3.13	3.35	3.56	3.78	3.99	4.21	4.42	4.64	4.85	5.07	5.28	5.50	5.71	5.93	6.14	6.36	6.57	6.79	7.00	7.22	7.43	7.65
2	2.12	2.26	2.41	2.55	2.70	2.84	2.99	3.13	3.28	3.42	3.57	3.71	3.86	4.00	4.15	4.29	4.44	4.58	4.73	4.87	5.02	5.16
3	1.68	1.80	1.91	2.03	2.14	2.26	2.37	2.49	2.60	2.72	2.83	2.95	3.06	3.18	3.29	3.41	3.53	3.64	3.76	3.87	3.99	4.10
4	1.43	1.53	1.62	1.72	1.82	1.92	2.02	2.11	2.21	2.31	2.41	2.50	2.60	2.70	2.80	2.90	2.99	3.09	3.19	3.29	3.39	3.48
5	1.26	1.34	1.43	1.52	1.60	1.69	1.78	1.86	1.95	2.03	2.12	2.21	2.29	2.38	2.47	2.55	2.64	2.72	2.81	2.90	2.98	3.07
6	1.13	1.21	1.29	1.37	1.45	1.52	1.60	1.68	1.76	1.83	1.91	1.99	2.07	2.15	2.22	2.30	2.38	2.46	2.53	2.61	2.69	2.77
7	1.04	1.11	1.18	1.25	1.32	1.40	1.47	1.54	1.61	1.68	1.75	1.82	1.89	1.97	2.04	2.11	2.18	2.25	2.32	2.39	2.47	2.54
8	0.96	1.03	1.10	1.16	1.23	1.29	1.36	1.43	1.49	1.56	1.62	1.69	1.76	1.82	1.89	1.96	2.02	2.09	2.15	2.22	2.29	2.35
9	0.90	0.96	1.03	1.09	1.15	1.21	1.27	1.33	1.40	1.46	1.52	1.58	1.64	1.71	1.77	1.83	1.89	1.95	2.01	2.08	2.14	2.20
10	0.85	0.91	0.97	1.02	1.08	1.14	1.20	1.26	1.32	1.37	1.43	1.49	1.55	1.61	1.66	1.72	1.78	1.84	1.90	1.96	2.01	2.07
11	0.80	0.86	0.91	0.97	1.03	1.08	1.14	1.19	1.25	1.30	1.36	1.41	1.47	1.52	1.58	1.63	1.69	1.74	1.80	1.85	1.91	1.96
12	0.77	0.82	0.87	0.92	0.98	1.03	1.08	1.13	1.19	1.24	1.29	1.34	1.40	1.45	1.50	1.55	1.61	1.66	1.71	1.76	1.82	1.87
13	0.73	0.78	0.83	0.88	0.93	0.98	1.03	1.08	1.13	1.18	1.23	1.28	1.33	1.38	1.43	1.48	1.53	1.58	1.64	1.69	1.74	1.79
14	0.70	0.75	0.80	0.85	0.89	0.94	0.99	1.04	1.09	1.13	1.18	1.23	1.28	1.33	1.38	1.42	1.47	1.52	1.57	1.62	1.66	1.71
15	0.67	0.72	0.77	0.81	0.86	0.91	0.95	1.00	1.04	1.09	1.14	1.18	1.23	1.28	1.32	1.37	1.42	1.46	1.51	1.55	1.60	1.65
16	0.65	0.70	0.74	0.78	0.83	0.87	0.92	0.96	1.01	1.05	1.10	1.14	1.19	1.23	1.27	1.32	1.36	1.41	1.45	1.50	1.54	1.59
17	0.63	0.67	0.71	0.76	0.80	0.84	0.89	0.93	0.97	1.02	1.06	1.10	1.15	1.19	1.23	1.27	1.32	1.36	1.40	1.45	1.49	1.53
18	0.61	0.65	0.69	0.73	0.78	0.82	0.86	0.90	0.94	0.98	1.03	1.07	1.11	1.15	1.19	1.23	1.28	1.32	1.36	1.40	1.44	1.48
19	0.59	0.63	0.67	0.71	0.75	0.79	0.83	0.87	0.91	0.95	0.99	1.04	1.08	1.12	1.16	1.20	1.24	1.28	1.32	1.36	1.40	1.44
20	0.57	0.61	0.65	0.69	0.73	0.77	0.81	0.85	0.89	0.93	0.97	1.01	1.04	1.08	1.12	1.16	1.20	1.24	1.28	1.32	1.36	1.40
21	0.56	0.60	0.63	0.67	0.71	0.75	0.79	0.83	0.86	0.90	0.94	0.98	1.02	1.05	1.09	1.13	1.17	1.21	1.25	1.28	1.32	1.36
22	0.54	0.58	0.62	0.65	0.69	0.73	0.77	0.80	0.84	0.88	0.92	0.95	0.99	1.03	1.06	1.10	1.14	1.18	1.21	1.25	1.29	1.32
23	0.53	0.57	0.60	0.64	0.67	0.71	0.75	0.78	0.82	0.86	0.89	0.93	0.97	1.00	1.04	1.07	1.11	1.15	1.18	1.22	1.26	1.29
24	0.52	0.55	0.59	0.62	0.66	0.69	0.73	0.76	0.80	0.84	0.87	0.91	0.94	0.98	1.01	1.05	1.08	1.12	1.15	1.19	1.23	1.26
25	0.51	0.54	0.57	0.61	0.64	0.68	0.71	0.75	0.78	0.82	0.85	0.89	0.92	0.96	0.99	1.02	1.06	1.09	1.13	1.16	1.20	1.23
26	0.49	0.53	0.56	0.60	0.63	0.66	0.70	0.73	0.76	0.80	0.83	0.87	0.90	0.93	0.97	1.00	1.04	1.07	1.10	1.14	1.17	1.21
27	0.48	0.52	0.55	0.58	0.62	0.65	0.68	0.72	0.75	0.78	0.81	0.85	0.88	0.91	0.95	0.98	1.01	1.05	1.08	1.11	1.15	1.18
28	0.47	0.51	0.54	0.57	0.60	0.64	0.67	0.70	0.73	0.77	0.80	0.83	0.86	0.90	0.93	0.96	0.99	1.03	1.06	1.09	1.12	1.16
29	0.46	0.50	0.53	0.56	0.59	0.62	0.66	0.69	0.72	0.75	0.78	0.81	0.85	0.88	0.91	0.94	0.97	1.01	1.04	1.07	1.10	1.13
30	0.46	0.49	0.52	0.55	0.58	0.61	0.64	0.67	0.71	0.74	0.77	0.80	0.83	0.86	0.89	0.92	0.96	0.99	1.02	1.05	1.08	1.11
31	0.45	0.48	0.51	0.54	0.57	0.60	0.63	0.66	0.69	0.72	0.75	0.78	0.81	0.85	0.88	0.91	0.94	0.97	1.00	1.03	1.06	1.09
32	0.44	0.47	0.50	0.53	0.56	0.59	0.62	0.65	0.68	0.71	0.74	0.77	0.80	0.83	0.86	0.89	0.92	0.95	0.98	1.01	1.04	1.07
33	0.43	0.46	0.49	0.52	0.55	0.58	0.61	0.64	0.67	0.70	0.73	0.76	0.79	0.82	0.85	0.88	0.90	0.93	0.96	0.99	1.02	1.05
34	0.42	0.45	0.48	0.51	0.54	0.57	0.60	0.63	0.66	0.69	0.72	0.74	0.77	0.80	0.83	0.86	0.89	0.92	0.95	0.98	1.01	1.04
35	0.42	0.45	0.47	0.50	0.53	0.56	0.59	0.62	0.65	0.67	0.70	0.73	0.76	0.79	0.82	0.85	0.88	0.90	0.93	0.96	0.99	1.02
36	0.41	0.44	0.47	0.50	0.52	0.55	0.58	0.61	0.64	0.66	0.69	0.72	0.75	0.78	0.80	0.83	0.86	0.89	0.92	0.95	0.97	1.00
37	0.40	0.43	0.46	0.49	0.52	0.54	0.57	0.60	0.63	0.65	0.68	0.71	0.74	0.76	0.79	0.82	0.85	0.88	0.90	0.93	0.96	0.99
38	0.40	0.43	0.45	0.48	0.51	0.53	0.56	0.59	0.62	0.64	0.67	0.70	0.73	0.75	0.78	0.81	0.84	0.86	0.89	0.92	0.94	0.97
39	0.39	0.42	0.45	0.47	0.50	0.53	0.55	0.58	0.61	0.63	0.66	0.69	0.72	0.74	0.77	0.80	0.82	0.85	0.88	0.90	0.93	0.96
40	0.39	0.41	0.44	0.47	0.49	0.52	0.55	0.57	0.60	0.63	0.65	0.68	0.71	0.73	0.76	0.78	0.81	0.84	0.86	0.89	0.92	0.94
41	0.38	0.41	0.43	0.46	0.49	0.51	0.54	0.56	0.59	0.62	0.64	0.67	0.70	0.72	0.75	0.77	0.80	0.83	0.85	0.88	0.90	0.93
42	0.38	0.40	0.43	0.45	0.48	0.51	0.53	0.56	0.58	0.61	0.63	0.66	0.69	0.71	0.74	0.76	0.79	0.81	0.84	0.87	0.89	0.92
43	0.37	0.40	0.42	0.45	0.47	0.50	0.52	0.55	0.58	0.60	0.63	0.65	0.68	0.70	0.73	0.75	0.78	0.80	0.83	0.86	0.88	0.91
44	0.37	0.39	0.42	0.44	0.47	0.49	0.52	0.54	0.57	0.59	0.62	0.64	0.67	0.69	0.72	0.74	0.77	0.79	0.82	0.84	0.87	0.89
45	0.36	0.39	0.41	0.44	0.46	0.49	0.51	0.54	0.56	0.59	0.61	0.63	0.66	0.68	0.71	0.73	0.76	0.78	0.81	0.83	0.86	0.88
46	0.36	0.38	0.41	0.43	0.46	0.48	0.50	0.53	0.55	0.58	0.60	0.63	0.65	0.68	0.70	0.72	0.75	0.77	0.80	0.82	0.85	0.87
47	0.35	0.38	0.40	0.43	0.45	0.47	0.50	0.52	0.55	0.57	0.60	0.62	0.64	0.67	0.69	0.72	0.74	0.76	0.79	0.81	0.84	0.86
48	0.35	0.37	0.40	0.42	0.44	0.47	0.49	0.52	0.54	0.56	0.59	0.61	0.64	0.66	0.68	0.71	0.73	0.76	0.78	0.80	0.83	0.85
49	0.34	0.37	0.39	0.42	0.44	0.46	0.49	0.51	0.53	0.56	0.58	0.60	0.63	0.65	0.68	0.70	0.72	0.75	0.77	0.79	0.82	0.84
50	0.34	0.36	0.39	0.41	0.43	0.46	0.48	0.50	0.53	0.55	0.57	0.60	0.62	0.64	0.67	0.69	0.71	0.74	0.76	0.78	0.81	0.83
51	0.34	0.36	0.38	0.41	0.43	0.45	0.48	0.50	0.52	0.55	0.57	0.59	0.61	0.64	0.66	0.68	0.71	0.73	0.75	0.78	0.80	0.82
52	0.33	0.36	0.38	0.40	0.42	0.45	0.47	0.49	0.52	0.54	0.56	0.58	0.61	0.63	0.65	0.68	0.70	0.72	0.74	0.77	0.79	0.81
53	0.33	0.35	0.38	0.40	0.42	0.44	0.47	0.49	0.51	0.53	0.56	0.58	0.60	0.62	0.65	0.67	0.69	0.71	0.74	0.76	0.78	0.80
54	0.33	0.35	0.37	0.39	0.42	0.44	0.46	0.48	0.51	0.53	0.55	0.57	0.59	0.62	0.64	0.66	0.68	0.71	0.73	0.75	0.77	0.80
55	0.32	0.35	0.37	0.39	0.41	0.43	0.46	0.48	0.50	0.52	0.54	0.57	0.59	0.61	0.63	0.66	0.68	0.70	0.72	0.74	0.77	0.79
56	0.32	0.34	0.36	0.39	0.41	0.43	0.45	0.47	0.50	0.52	0.54	0.56	0.58	0.60	0.63	0.65	0.67	0.69	0.71	0.74	0.76	0.78
57	0.32	0.34	0.36	0.38	0.40	0.42	0.45	0.47	0.49	0.51	0.53	0.56	0.58	0.60	0.62	0.64	0.66	0.69	0.71	0.73	0.75	0.77
58	0.31	0.33	0.36	0.38	0.40	0.42	0.44	0.46	0.49	0.51	0.53	0.55	0.57	0.59	0.61	0.64	0.66	0.68	0.70	0.72	0.74	0.76
59	0.31	0.33	0.35	0.37	0.40	0.42	0.44	0.46	0.48	0.50	0.52	0.54	0.57	0.59	0.61	0.63	0.65	0.67	0.69	0.71	0.74	0.76
60	0.31	0.33	0.35	0.37	0.39	0.41	0.43	0.45	0.48	0.50	0.52	0.54	0.56	0.58	0.60	0.62	0.64	0.67	0.69	0.71	0.73	0.75

(District 2011)

T_c (min)	Mean Annual Precipitation (in)																					
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
61	0.30	0.33	0.35	0.37	0.39	0.41	0.43	0.45	0.47	0.49	0.51	0.53	0.56	0.58	0.60	0.62	0.64	0.66	0.68	0.70	0.72	0.74
62	0.30	0.32	0.34	0.36	0.38	0.41	0.43	0.45	0.47	0.49	0.51	0.53	0.55	0.57	0.59	0.61	0.63	0.65	0.67	0.69	0.72	0.74
63	0.30	0.32	0.34	0.36	0.38	0.40	0.42	0.44	0.46	0.48	0.50	0.52	0.55	0.57	0.59	0.61	0.63	0.65	0.67	0.69	0.71	0.73
64	0.30	0.32	0.34	0.36	0.38	0.40	0.42	0.44	0.46	0.48	0.50	0.52	0.54	0.56	0.58	0.60	0.62	0.64	0.66	0.68	0.70	0.72
65	0.29	0.31	0.33	0.35	0.37	0.39	0.41	0.43	0.45	0.48	0.50	0.52	0.54	0.56	0.58	0.60	0.62	0.64	0.66	0.68	0.70	0.72
66	0.29	0.31	0.33	0.35	0.37	0.39	0.41	0.43	0.45	0.47	0.49	0.51	0.53	0.55	0.57	0.59	0.61	0.63	0.65	0.67	0.69	0.71
67	0.29	0.31	0.33	0.35	0.37	0.39	0.41	0.43	0.45	0.47	0.49	0.51	0.53	0.55	0.57	0.59	0.61	0.63	0.65	0.66	0.68	0.70
68	0.29	0.31	0.33	0.35	0.36	0.38	0.40	0.42	0.44	0.46	0.48	0.50	0.52	0.54	0.56	0.58	0.60	0.62	0.64	0.66	0.68	0.70
69	0.28	0.30	0.32	0.34	0.36	0.38	0.40	0.42	0.44	0.46	0.48	0.50	0.52	0.54	0.56	0.58	0.60	0.61	0.63	0.65	0.67	0.69
70	0.28	0.30	0.32	0.34	0.36	0.38	0.40	0.42	0.44	0.46	0.47	0.49	0.51	0.53	0.55	0.57	0.59	0.61	0.63	0.65	0.67	0.69
71	0.28	0.30	0.32	0.34	0.36	0.38	0.39	0.41	0.43	0.45	0.47	0.49	0.51	0.53	0.55	0.57	0.59	0.61	0.62	0.64	0.66	0.68
72	0.28	0.30	0.32	0.33	0.35	0.37	0.39	0.41	0.43	0.45	0.47	0.49	0.51	0.52	0.54	0.56	0.58	0.60	0.62	0.64	0.66	0.68
73	0.28	0.29	0.31	0.33	0.35	0.37	0.39	0.41	0.43	0.44	0.46	0.48	0.50	0.52	0.54	0.56	0.58	0.60	0.61	0.63	0.65	0.67
74	0.27	0.29	0.31	0.33	0.35	0.37	0.39	0.40	0.42	0.44	0.46	0.48	0.50	0.52	0.53	0.55	0.57	0.59	0.61	0.63	0.65	0.67
75	0.27	0.29	0.31	0.33	0.35	0.36	0.38	0.40	0.42	0.44	0.46	0.48	0.49	0.51	0.53	0.55	0.57	0.59	0.61	0.62	0.64	0.66
76	0.27	0.29	0.31	0.32	0.34	0.36	0.38	0.40	0.42	0.43	0.45	0.47	0.49	0.51	0.53	0.55	0.56	0.58	0.60	0.62	0.64	0.66
77	0.27	0.29	0.30	0.32	0.34	0.36	0.38	0.39	0.41	0.43	0.45	0.47	0.49	0.50	0.52	0.54	0.56	0.58	0.60	0.61	0.63	0.65
78	0.26	0.28	0.30	0.32	0.34	0.36	0.37	0.39	0.41	0.43	0.45	0.46	0.48	0.50	0.52	0.54	0.56	0.57	0.59	0.61	0.63	0.65
79	0.26	0.28	0.30	0.32	0.34	0.35	0.37	0.39	0.41	0.43	0.44	0.46	0.48	0.50	0.52	0.53	0.55	0.57	0.59	0.61	0.62	0.64
80	0.26	0.28	0.30	0.31	0.33	0.35	0.37	0.39	0.40	0.42	0.44	0.46	0.48	0.49	0.51	0.53	0.55	0.57	0.58	0.60	0.62	0.64
81	0.26	0.28	0.29	0.31	0.33	0.35	0.37	0.38	0.40	0.42	0.44	0.45	0.47	0.49	0.51	0.53	0.54	0.56	0.58	0.60	0.61	0.63
82	0.26	0.28	0.29	0.31	0.33	0.35	0.36	0.38	0.40	0.42	0.43	0.45	0.47	0.49	0.50	0.52	0.54	0.56	0.58	0.59	0.61	0.63
83	0.26	0.27	0.29	0.31	0.33	0.34	0.36	0.38	0.40	0.41	0.43	0.45	0.47	0.48	0.50	0.52	0.54	0.55	0.57	0.59	0.61	0.62
84	0.25	0.27	0.29	0.31	0.32	0.34	0.36	0.38	0.39	0.41	0.43	0.45	0.46	0.48	0.50	0.52	0.53	0.55	0.57	0.58	0.60	0.62
85	0.25	0.27	0.29	0.30	0.32	0.34	0.36	0.37	0.39	0.41	0.43	0.44	0.46	0.48	0.49	0.51	0.53	0.55	0.56	0.58	0.60	0.62
86	0.25	0.27	0.28	0.30	0.32	0.34	0.35	0.37	0.39	0.41	0.42	0.44	0.46	0.47	0.49	0.51	0.53	0.54	0.56	0.58	0.59	0.61
87	0.25	0.27	0.28	0.30	0.32	0.33	0.35	0.37	0.39	0.40	0.42	0.44	0.45	0.47	0.49	0.51	0.52	0.54	0.56	0.57	0.59	0.61
88	0.25	0.26	0.28	0.30	0.32	0.33	0.35	0.37	0.38	0.40	0.42	0.43	0.45	0.47	0.48	0.50	0.52	0.54	0.55	0.57	0.59	0.60
89	0.25	0.26	0.28	0.30	0.31	0.33	0.35	0.36	0.38	0.40	0.41	0.43	0.45	0.46	0.48	0.50	0.52	0.53	0.55	0.57	0.58	0.60
90	0.24	0.26	0.28	0.29	0.31	0.33	0.34	0.36	0.38	0.39	0.41	0.43	0.45	0.46	0.48	0.50	0.51	0.53	0.55	0.56	0.58	0.60
91	0.24	0.26	0.28	0.29	0.31	0.33	0.34	0.36	0.38	0.39	0.41	0.43	0.44	0.46	0.48	0.49	0.51	0.53	0.54	0.56	0.58	0.59
92	0.24	0.26	0.27	0.29	0.31	0.32	0.34	0.36	0.37	0.39	0.41	0.42	0.44	0.46	0.47	0.49	0.51	0.52	0.54	0.56	0.57	0.59
93	0.24	0.26	0.27	0.29	0.31	0.32	0.34	0.35	0.37	0.39	0.40	0.42	0.44	0.45	0.47	0.49	0.50	0.52	0.54	0.55	0.57	0.58
94	0.24	0.25	0.27	0.29	0.30	0.32	0.34	0.35	0.37	0.39	0.40	0.42	0.43	0.45	0.47	0.48	0.50	0.52	0.53	0.55	0.57	0.58
95	0.24	0.25	0.27	0.29	0.30	0.32	0.33	0.35	0.37	0.38	0.40	0.42	0.43	0.45	0.46	0.48	0.50	0.51	0.53	0.55	0.56	0.58
96	0.24	0.25	0.27	0.28	0.30	0.32	0.33	0.35	0.36	0.38	0.40	0.41	0.43	0.45	0.46	0.48	0.49	0.51	0.53	0.54	0.56	0.57
97	0.23	0.25	0.27	0.28	0.30	0.31	0.33	0.35	0.36	0.38	0.39	0.41	0.43	0.44	0.46	0.47	0.49	0.51	0.52	0.54	0.56	0.57
98	0.23	0.25	0.26	0.28	0.30	0.31	0.33	0.34	0.36	0.38	0.39	0.41	0.42	0.44	0.46	0.47	0.49	0.50	0.52	0.54	0.55	0.57
99	0.23	0.25	0.26	0.28	0.29	0.31	0.33	0.34	0.36	0.37	0.39	0.41	0.42	0.44	0.45	0.47	0.49	0.50	0.52	0.53	0.55	0.56
100	0.23	0.25	0.26	0.28	0.29	0.31	0.32	0.34	0.36	0.37	0.39	0.40	0.42	0.44	0.45	0.47	0.48	0.50	0.51	0.53	0.55	0.56
101	0.23	0.24	0.26	0.28	0.29	0.31	0.32	0.34	0.35	0.37	0.39	0.40	0.42	0.43	0.45	0.46	0.48	0.50	0.51	0.53	0.54	0.56
102	0.23	0.24	0.26	0.27	0.29	0.31	0.32	0.34	0.35	0.37	0.38	0.40	0.41	0.43	0.45	0.46	0.48	0.49	0.51	0.52	0.54	0.56
103	0.23	0.24	0.26	0.27	0.29	0.30	0.32	0.33	0.35	0.37	0.38	0.40	0.41	0.43	0.44	0.46	0.47	0.49	0.51	0.52	0.54	0.55
104	0.23	0.24	0.26	0.27	0.29	0.30	0.32	0.33	0.35	0.36	0.38	0.39	0.41	0.43	0.44	0.46	0.47	0.49	0.50	0.52	0.53	0.55
105	0.22	0.24	0.25	0.27	0.29	0.30	0.32	0.33	0.35	0.36	0.38	0.39	0.41	0.42	0.44	0.45	0.47	0.48	0.50	0.52	0.53	0.55
106	0.22	0.24	0.25	0.27	0.28	0.30	0.31	0.33	0.34	0.36	0.38	0.39	0.41	0.42	0.44	0.45	0.47	0.48	0.50	0.51	0.53	0.54
107	0.22	0.24	0.25	0.27	0.28	0.30	0.31	0.33	0.34	0.36	0.37	0.39	0.40	0.42	0.43	0.45	0.46	0.48	0.49	0.51	0.53	0.54
108	0.22	0.24	0.25	0.27	0.28	0.30	0.31	0.33	0.34	0.36	0.37	0.39	0.40	0.42	0.43	0.45	0.46	0.48	0.49	0.51	0.52	0.54
109	0.22	0.23	0.25	0.26	0.28	0.29	0.31	0.32	0.34	0.35	0.37	0.38	0.40	0.41	0.43	0.44	0.46	0.47	0.49	0.50	0.52	0.53
110	0.22	0.23	0.25	0.26	0.28	0.29	0.31	0.32	0.34	0.35	0.37	0.38	0.40	0.41	0.43	0.44	0.46	0.47	0.49	0.50	0.52	0.53
111	0.22	0.23	0.25	0.26	0.28	0.29	0.31	0.32	0.34	0.35	0.37	0.38	0.40	0.41	0.43	0.44	0.45	0.47	0.48	0.50	0.51	0.53
112	0.22	0.23	0.25	0.26	0.27	0.29	0.30	0.32	0.33	0.35	0.36	0.38	0.39	0.41	0.42	0.44	0.45	0.47	0.48	0.50	0.51	0.53
113	0.21	0.23	0.24	0.26	0.27	0.29	0.30	0.32	0.33	0.35	0.36	0.38	0.39	0.41	0.42	0.44	0.45	0.46	0.48	0.49	0.51	0.52
114	0.21	0.23	0.24	0.26	0.27	0.29	0.30	0.32	0.33	0.35	0.36	0.37	0.39	0.40	0.42	0.43	0.45	0.46	0.48	0.49	0.51	0.52
115	0.21	0.23	0.24	0.26	0.27	0.29	0.30	0.31	0.33	0.34	0.36	0.37	0.39	0.40	0.42	0.43	0.45	0.46	0.47	0.49	0.50	0.52
116	0.21	0.23	0.24	0.26	0.27	0.28	0.30	0.31	0.33	0.34	0.36	0.37	0.39	0.40	0.41	0.43	0.44	0.46	0.47	0.49	0.50	0.52
117	0.21	0.22	0.24	0.25	0.27	0.28	0.30	0.31	0.33	0.34	0.35	0.37	0.38	0.40	0.41	0.43	0.44	0.46	0.47	0.48	0.50	0.51
118	0.21	0.22	0.24	0.25	0.27	0.28	0.30	0.31	0.32	0.34	0.35	0.37	0.38	0.40	0.41	0.42	0.44	0.45	0.47	0.48	0.50	0.51
119	0.21	0.22	0.24	0.25	0.27	0.28	0.29	0.31	0.32	0.34	0.35	0.37	0.38	0.39	0.41	0.42	0.44	0.45	0.47	0.48	0.49	0.51
120	0.21	0.22	0.24	0.25	0.26	0.28	0.29	0.31	0.32	0.34	0.35	0.36	0.38	0.39	0.41	0.42	0.44	0.45	0.46	0.48	0.49	0.51

T_c (min)	Mean Annual Precipitation (in)																					
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1	4.42	4.72	5.03	5.33	5.63	5.94	6.24	6.54	6.84	7.15	7.45	7.75	8.06	8.36	8.66	8.97	9.27	9.57	9.88	10.18	10.48	10.78
2	2.98	3.19	3.39	3.60	3.80	4.01	4.21	4.42	4.62	4.82	5.03	5.23	5.44	5.64	5.85	6.05	6.26	6.46	6.67	6.87	7.07	7.28
3	2.37	2.53	2.70	2.86	3.02	3.18	3.35	3.51	3.67	3.83	4.00	4.16	4.32	4.48	4.65	4.81	4.97	5.13	5.30	5.46	5.62	5.78
4	2.01	2.15	2.29	2.43	2.57	2.70	2.84	2.98	3.12	3.26	3.39	3.53	3.67	3.81	3.95	4.08	4.22	4.36	4.50	4.64	4.77	4.91
5	1.77	1.90	2.02	2.14	2.26	2.38	2.50	2.63	2.75	2.87	2.99	3.11	3.23	3.36	3.48	3.60	3.72	3.84	3.96	4.09	4.21	4.33
6	1.60	1.71	1.82	1.93	2.04	2.15	2.26	2.37	2.48	2.59	2.70	2.81	2.92	3.03	3.14	3.25	3.36	3.46	3.57	3.68	3.79	3.90
7	1.47	1.57	1.67	1.77	1.87	1.97	2.07	2.17	2.27	2.37	2.47	2.57	2.67	2.77	2.87	2.97	3.07	3.17	3.28	3.38	3.48	3.58
8	1.36	1.45	1.55	1.64	1.73	1.83	1.92	2.01	2.10	2.20	2.29	2.38	2.48	2.57	2.66	2.76	2.85	2.94	3.04	3.13	3.22	3.32
9	1.27	1.36	1.45	1.53	1.62	1.71	1.79	1.88	1.97	2.06	2.14	2.23	2.32	2.40	2.49	2.58	2.67	2.75	2.84	2.93	3.01	3.10
10	1.20	1.28	1.36	1.44	1.53	1.61	1.69	1.77	1.85	1.94	2.02	2.10	2.18	2.26	2.35	2.43	2.51	2.59	2.68	2.76	2.84	2.92
11	1.13	1.21	1.29	1.37	1.45	1.52	1.60	1.68	1.76	1.83	1.91	1.99	2.07	2.15	2.22	2.30	2.38	2.46	2.53	2.61	2.69	2.77
12	1.08	1.15	1.23	1.30	1.38	1.45	1.52	1.60	1.67	1.75	1.82	1.89	1.97	2.04	2.12	2.19	2.26	2.34	2.41	2.49	2.56	2.63
13	1.03	1.10	1.17	1.24	1.31	1.39	1.46	1.53	1.60	1.67	1.74	1.81	1.88	1.95	2.02	2.09	2.16	2.23	2.31	2.38	2.45	2.52
14	0.99	1.06	1.13	1.19	1.26	1.33	1.40	1.46	1.53	1.60	1.67	1.74	1.80	1.87	1.94	2.01	2.08	2.14	2.21	2.28	2.35	2.41
15	0.95	1.02	1.08	1.15	1.21	1.28	1.34	1.41	1.47	1.54	1.60	1.67	1.73	1.80	1.86	1.93	2.00	2.06	2.13	2.19	2.26	2.32
16	0.92	0.98	1.04	1.11	1.17	1.23	1.29	1.36	1.42	1.48	1.55	1.61	1.67	1.73	1.80	1.86	1.92	1.99	2.05	2.11	2.18	2.24
17	0.89	0.95	1.01	1.07	1.13	1.19	1.25	1.31	1.37	1.43	1.49	1.55	1.62	1.68	1.74	1.80	1.86	1.92	1.98	2.04	2.10	2.16
18	0.86	0.92	0.98	1.03	1.09	1.15	1.21	1.27	1.33	1.39	1.45	1.51	1.56	1.62	1.68	1.74	1.80	1.86	1.92	1.98	2.03	2.09
19	0.83	0.89	0.95	1.00	1.06	1.12	1.17	1.23	1.29	1.35	1.40	1.46	1.52	1.57	1.63	1.69	1.75	1.80	1.86	1.92	1.97	2.03
20	0.81	0.86	0.92	0.97	1.03	1.09	1.14	1.20	1.25	1.31	1.36	1.42	1.47	1.53	1.58	1.64	1.70	1.75	1.81	1.86	1.92	1.97
21	0.79	0.84	0.89	0.95	1.00	1.06	1.11	1.16	1.22	1.27	1.33	1.38	1.43	1.49	1.54	1.59	1.65	1.70	1.76	1.81	1.86	1.92
22	0.77	0.82	0.87	0.92	0.98	1.03	1.08	1.13	1.19	1.24	1.29	1.34	1.40	1.45	1.50	1.55	1.61	1.66	1.71	1.76	1.82	1.87
23	0.75	0.80	0.85	0.90	0.95	1.00	1.05	1.11	1.16	1.21	1.26	1.31	1.36	1.41	1.46	1.51	1.57	1.62	1.67	1.72	1.77	1.82
24	0.73	0.78	0.83	0.88	0.93	0.98	1.03	1.08	1.13	1.18	1.23	1.28	1.33	1.38	1.43	1.48	1.53	1.58	1.63	1.68	1.73	1.78
25	0.71	0.76	0.81	0.86	0.91	0.96	1.01	1.05	1.10	1.15	1.20	1.25	1.30	1.35	1.40	1.44	1.49	1.54	1.59	1.64	1.69	1.74
26	0.70	0.74	0.79	0.84	0.89	0.94	0.98	1.03	1.08	1.13	1.17	1.22	1.27	1.32	1.37	1.41	1.46	1.51	1.56	1.60	1.65	1.70
27	0.68	0.73	0.78	0.82	0.87	0.92	0.96	1.01	1.06	1.10	1.15	1.20	1.24	1.29	1.34	1.38	1.43	1.48	1.52	1.57	1.62	1.66
28	0.67	0.71	0.76	0.81	0.85	0.90	0.94	0.99	1.03	1.08	1.13	1.17	1.22	1.26	1.31	1.35	1.40	1.45	1.49	1.54	1.58	1.63
29	0.65	0.70	0.74	0.79	0.83	0.88	0.92	0.97	1.01	1.06	1.10	1.15	1.19	1.24	1.28	1.33	1.37	1.42	1.46	1.51	1.55	1.60
30	0.64	0.69	0.73	0.77	0.82	0.86	0.91	0.95	0.99	1.04	1.08	1.13	1.17	1.21	1.26	1.30	1.35	1.39	1.43	1.48	1.52	1.57
31	0.63	0.67	0.72	0.76	0.80	0.85	0.89	0.93	0.98	1.02	1.06	1.11	1.15	1.19	1.24	1.28	1.32	1.37	1.41	1.45	1.49	1.54
32	0.62	0.66	0.70	0.75	0.79	0.83	0.87	0.92	0.96	1.00	1.04	1.09	1.13	1.17	1.21	1.26	1.30	1.34	1.38	1.43	1.47	1.51
33	0.61	0.65	0.69	0.73	0.78	0.82	0.86	0.90	0.94	0.98	1.03	1.07	1.11	1.15	1.19	1.23	1.28	1.32	1.36	1.40	1.44	1.48
34	0.60	0.64	0.68	0.72	0.76	0.80	0.84	0.89	0.93	0.97	1.01	1.05	1.09	1.13	1.17	1.21	1.25	1.30	1.34	1.38	1.42	1.46
35	0.59	0.63	0.67	0.71	0.75	0.79	0.83	0.87	0.91	0.95	0.99	1.03	1.07	1.11	1.15	1.19	1.23	1.27	1.31	1.36	1.40	1.44
36	0.58	0.62	0.66	0.70	0.74	0.78	0.82	0.86	0.90	0.94	0.98	1.02	1.06	1.10	1.14	1.17	1.21	1.25	1.29	1.33	1.37	1.41
37	0.57	0.61	0.65	0.69	0.73	0.77	0.80	0.84	0.88	0.92	0.96	1.00	1.04	1.08	1.12	1.16	1.20	1.23	1.27	1.31	1.35	1.39
38	0.56	0.60	0.64	0.68	0.72	0.75	0.79	0.83	0.87	0.91	0.95	0.99	1.02	1.06	1.10	1.14	1.18	1.22	1.25	1.29	1.33	1.37
39	0.55	0.59	0.63	0.67	0.71	0.74	0.78	0.82	0.86	0.89	0.93	0.97	1.01	1.05	1.08	1.12	1.16	1.20	1.24	1.27	1.31	1.35
40	0.55	0.58	0.62	0.66	0.70	0.73	0.77	0.81	0.84	0.88	0.92	0.96	0.99	1.03	1.07	1.11	1.14	1.18	1.22	1.26	1.29	1.33
41	0.54	0.57	0.61	0.65	0.69	0.72	0.76	0.80	0.83	0.87	0.91	0.94	0.98	1.02	1.05	1.09	1.13	1.17	1.20	1.24	1.28	1.31
42	0.53	0.57	0.60	0.64	0.68	0.71	0.75	0.79	0.82	0.86	0.89	0.93	0.97	1.00	1.04	1.08	1.11	1.15	1.19	1.22	1.26	1.29
43	0.52	0.56	0.60	0.63	0.67	0.70	0.74	0.77	0.81	0.85	0.88	0.92	0.95	0.99	1.03	1.06	1.10	1.13	1.17	1.21	1.24	1.28
44	0.52	0.55	0.59	0.62	0.66	0.69	0.73	0.76	0.80	0.84	0.87	0.91	0.94	0.98	1.01	1.05	1.08	1.12	1.15	1.19	1.23	1.26
45	0.51	0.55	0.58	0.62	0.65	0.69	0.72	0.76	0.79	0.83	0.86	0.90	0.93	0.97	1.00	1.04	1.07	1.11	1.14	1.18	1.21	1.25
46	0.50	0.54	0.57	0.61	0.64	0.68	0.71	0.75	0.78	0.81	0.85	0.88	0.92	0.95	0.99	1.02	1.06	1.09	1.13	1.16	1.20	1.23
47	0.50	0.53	0.57	0.60	0.63	0.67	0.70	0.74	0.77	0.81	0.84	0.87	0.91	0.94	0.98	1.01	1.04	1.08	1.11	1.15	1.18	1.21
48	0.49	0.53	0.56	0.59	0.63	0.66	0.69	0.73	0.76	0.80	0.83	0.86	0.90	0.93	0.96	1.00	1.03	1.07	1.10	1.13	1.17	1.20
49	0.49	0.52	0.55	0.59	0.62	0.65	0.69	0.72	0.75	0.79	0.82	0.85	0.89	0.92	0.95	0.99	1.02	1.05	1.09	1.12	1.15	1.19
50	0.48	0.51	0.55	0.58	0.61	0.65	0.68	0.71	0.74	0.78	0.81	0.84	0.88	0.91	0.94	0.98	1.01	1.04	1.07	1.11	1.14	1.17
51	0.48	0.51	0.54	0.57	0.61	0.64	0.67	0.70	0.74	0.77	0.80	0.83	0.87	0.90	0.93	0.96	1.00	1.03	1.06	1.09	1.13	1.16
52	0.47	0.50	0.53	0.57	0.60	0.63	0.66	0.70	0.73	0.76	0.79	0.82	0.86	0.89	0.92	0.95	0.99	1.02	1.05	1.08	1.11	1.15
53	0.47	0.50	0.53	0.56	0.59	0.62	0.66	0.69	0.72	0.75	0.78	0.82	0.85	0.88	0.91	0.94	0.98	1.01	1.04	1.07	1.10	1.13
54	0.46	0.49	0.52	0.55	0.59	0.62	0.65	0.68	0.71	0.74	0.78	0.81	0.84	0.87	0.90	0.93	0.97	1.00	1.03	1.06	1.09	1.12
55	0.46	0.49	0.52	0.55	0.58	0.61	0.64	0.67	0.71	0.74	0.77	0.80	0.83	0.86	0.89	0.92	0.96	0.99	1.02	1.05	1.08	1.11
56	0.45	0.48	0.51	0.54	0.57	0.61	0.64	0.67	0.70	0.73	0.76	0.79	0.82	0.85	0.88	0.91	0.95	0.98	1.01	1.04	1.07	1.10
57	0.45	0.48	0.51	0.54	0.57	0.60	0.63	0.66	0.69	0.72	0.75	0.78	0.81	0.84	0.87	0.91	0.94	0.97	1.00	1.03	1.06	1.09
58	0.44	0.47	0.50	0.53	0.56	0.59	0.62	0.65	0.68	0.71	0.74	0.78	0.81	0.84	0.87	0.90	0.93	0.96	0.99	1.02	1.05	1.08
59	0.44	0.47	0.50	0.53	0.56	0.59	0.62	0.65	0.68	0.71	0.74	0.77	0.80	0.83	0.86	0.89	0.92	0.95	0.98	1.01	1.04	1.07
60	0.43	0.46	0.49	0.52	0.55	0.58	0.61	0.64	0.67	0.70	0.73	0.76	0.79	0.82	0.85	0.88	0.91	0.94	0.97	1.00	1.03	1.06

T_c (min)	Mean Annual Precipitation (in)																					
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
61	0.43	0.46	0.49	0.52	0.55	0.58	0.61	0.64	0.66	0.69	0.72	0.75	0.78	0.81	0.84	0.87	0.90	0.93	0.96	0.99	1.02	1.05
62	0.43	0.45	0.48	0.51	0.54	0.57	0.60	0.63	0.66	0.69	0.72	0.75	0.78	0.80	0.83	0.86	0.89	0.92	0.95	0.98	1.01	1.04
63	0.42	0.45	0.48	0.51	0.54	0.57	0.60	0.62	0.65	0.68	0.71	0.74	0.77	0.80	0.83	0.86	0.88	0.91	0.94	0.97	1.00	1.03
64	0.42	0.45	0.48	0.50	0.53	0.56	0.59	0.62	0.65	0.68	0.70	0.73	0.76	0.79	0.82	0.85	0.88	0.91	0.93	0.96	0.99	1.02
65	0.41	0.44	0.47	0.50	0.53	0.56	0.58	0.61	0.64	0.67	0.70	0.73	0.76	0.78	0.81	0.84	0.87	0.90	0.93	0.95	0.98	1.01
66	0.41	0.44	0.47	0.50	0.52	0.55	0.58	0.61	0.64	0.66	0.69	0.72	0.75	0.78	0.80	0.83	0.86	0.89	0.92	0.95	0.97	1.00
67	0.41	0.44	0.46	0.49	0.52	0.55	0.57	0.60	0.63	0.66	0.69	0.71	0.74	0.77	0.80	0.83	0.85	0.88	0.91	0.94	0.97	0.99
68	0.40	0.43	0.46	0.49	0.51	0.54	0.57	0.60	0.63	0.65	0.68	0.71	0.74	0.76	0.79	0.82	0.85	0.87	0.90	0.93	0.96	0.99
69	0.40	0.43	0.46	0.48	0.51	0.54	0.57	0.59	0.62	0.65	0.68	0.70	0.73	0.76	0.78	0.81	0.84	0.87	0.89	0.92	0.95	0.98
70	0.40	0.42	0.45	0.48	0.51	0.53	0.56	0.59	0.62	0.64	0.67	0.70	0.72	0.75	0.78	0.81	0.83	0.86	0.89	0.91	0.94	0.97
71	0.39	0.42	0.45	0.48	0.50	0.53	0.56	0.58	0.61	0.64	0.66	0.69	0.72	0.75	0.77	0.80	0.83	0.85	0.88	0.91	0.93	0.96
72	0.39	0.42	0.44	0.47	0.50	0.52	0.55	0.58	0.61	0.63	0.66	0.69	0.71	0.74	0.77	0.79	0.82	0.85	0.87	0.90	0.93	0.95
73	0.39	0.41	0.44	0.47	0.49	0.52	0.55	0.57	0.60	0.63	0.65	0.68	0.71	0.73	0.76	0.79	0.81	0.84	0.87	0.89	0.92	0.95
74	0.38	0.41	0.44	0.46	0.49	0.52	0.54	0.57	0.60	0.62	0.65	0.68	0.70	0.73	0.75	0.78	0.81	0.83	0.86	0.89	0.91	0.94
75	0.38	0.41	0.43	0.46	0.49	0.51	0.54	0.57	0.59	0.62	0.64	0.67	0.70	0.72	0.75	0.77	0.80	0.83	0.85	0.88	0.91	0.93
76	0.38	0.41	0.43	0.46	0.48	0.51	0.54	0.56	0.59	0.61	0.64	0.67	0.69	0.72	0.74	0.77	0.79	0.82	0.85	0.87	0.90	0.92
77	0.38	0.40	0.43	0.45	0.48	0.51	0.53	0.56	0.58	0.61	0.63	0.66	0.69	0.71	0.74	0.76	0.79	0.81	0.84	0.87	0.89	0.92
78	0.37	0.40	0.42	0.45	0.48	0.50	0.53	0.55	0.58	0.60	0.63	0.66	0.68	0.71	0.73	0.76	0.78	0.81	0.83	0.86	0.89	0.91
79	0.37	0.40	0.42	0.45	0.47	0.50	0.52	0.55	0.57	0.60	0.63	0.65	0.68	0.70	0.73	0.75	0.78	0.80	0.83	0.85	0.88	0.90
80	0.37	0.39	0.42	0.44	0.47	0.49	0.52	0.54	0.57	0.60	0.62	0.65	0.67	0.70	0.72	0.75	0.77	0.80	0.82	0.85	0.87	0.90
81	0.37	0.39	0.42	0.44	0.47	0.49	0.52	0.54	0.57	0.59	0.62	0.64	0.67	0.69	0.72	0.74	0.77	0.79	0.82	0.84	0.87	0.89
82	0.36	0.39	0.41	0.44	0.46	0.49	0.51	0.54	0.56	0.59	0.61	0.64	0.66	0.69	0.71	0.74	0.76	0.79	0.81	0.84	0.86	0.89
83	0.36	0.39	0.41	0.43	0.46	0.48	0.51	0.53	0.56	0.58	0.61	0.63	0.66	0.68	0.71	0.73	0.76	0.78	0.81	0.83	0.86	0.88
84	0.36	0.38	0.41	0.43	0.46	0.48	0.51	0.53	0.55	0.58	0.60	0.63	0.65	0.68	0.70	0.73	0.75	0.78	0.80	0.82	0.85	0.87
85	0.36	0.38	0.40	0.43	0.45	0.48	0.50	0.53	0.55	0.58	0.60	0.62	0.65	0.67	0.70	0.72	0.75	0.77	0.79	0.82	0.84	0.87
86	0.35	0.38	0.40	0.43	0.45	0.47	0.50	0.52	0.55	0.57	0.60	0.62	0.64	0.67	0.69	0.72	0.74	0.77	0.79	0.81	0.84	0.86
87	0.35	0.38	0.40	0.42	0.45	0.47	0.50	0.52	0.54	0.57	0.59	0.62	0.64	0.66	0.69	0.71	0.74	0.76	0.78	0.81	0.83	0.86
88	0.35	0.37	0.40	0.42	0.44	0.47	0.49	0.52	0.54	0.56	0.59	0.61	0.64	0.66	0.68	0.71	0.73	0.76	0.78	0.80	0.83	0.85
89	0.35	0.37	0.39	0.42	0.44	0.47	0.49	0.51	0.54	0.56	0.58	0.61	0.63	0.66	0.68	0.70	0.73	0.75	0.77	0.80	0.82	0.85
90	0.34	0.37	0.39	0.42	0.44	0.46	0.49	0.51	0.53	0.56	0.58	0.60	0.63	0.65	0.68	0.70	0.72	0.75	0.77	0.79	0.82	0.84
91	0.34	0.37	0.39	0.41	0.44	0.46	0.48	0.51	0.53	0.55	0.58	0.60	0.62	0.65	0.67	0.69	0.72	0.74	0.76	0.79	0.81	0.84
92	0.34	0.36	0.39	0.41	0.43	0.46	0.48	0.50	0.53	0.55	0.57	0.60	0.62	0.64	0.67	0.69	0.71	0.74	0.76	0.78	0.81	0.83
93	0.34	0.36	0.38	0.41	0.43	0.45	0.48	0.50	0.52	0.55	0.57	0.59	0.62	0.64	0.66	0.69	0.71	0.73	0.76	0.78	0.80	0.82
94	0.34	0.36	0.38	0.41	0.43	0.45	0.47	0.50	0.52	0.54	0.57	0.59	0.61	0.64	0.66	0.68	0.70	0.73	0.75	0.77	0.80	0.82
95	0.33	0.36	0.38	0.40	0.43	0.45	0.47	0.49	0.52	0.54	0.56	0.59	0.61	0.63	0.65	0.68	0.70	0.72	0.75	0.77	0.79	0.82
96	0.33	0.35	0.38	0.40	0.42	0.45	0.47	0.49	0.51	0.54	0.56	0.58	0.61	0.63	0.65	0.67	0.70	0.72	0.74	0.76	0.79	0.81
97	0.33	0.35	0.38	0.40	0.42	0.44	0.47	0.49	0.51	0.53	0.56	0.58	0.60	0.62	0.65	0.67	0.69	0.71	0.74	0.76	0.78	0.81
98	0.33	0.35	0.37	0.40	0.42	0.44	0.46	0.49	0.51	0.53	0.55	0.58	0.60	0.62	0.64	0.67	0.69	0.71	0.73	0.76	0.78	0.80
99	0.33	0.35	0.37	0.39	0.42	0.44	0.46	0.48	0.51	0.53	0.55	0.57	0.59	0.62	0.64	0.66	0.68	0.71	0.73	0.75	0.77	0.80
100	0.32	0.35	0.37	0.39	0.41	0.44	0.46	0.48	0.50	0.52	0.55	0.57	0.59	0.61	0.64	0.66	0.68	0.70	0.72	0.75	0.77	0.79
101	0.32	0.34	0.37	0.39	0.41	0.43	0.46	0.48	0.50	0.52	0.54	0.57	0.59	0.61	0.63	0.65	0.68	0.70	0.72	0.74	0.77	0.79
102	0.32	0.34	0.36	0.39	0.41	0.43	0.45	0.47	0.50	0.52	0.54	0.56	0.58	0.61	0.63	0.65	0.67	0.69	0.72	0.74	0.76	0.78
103	0.32	0.34	0.36	0.38	0.41	0.43	0.45	0.47	0.49	0.52	0.54	0.56	0.58	0.60	0.63	0.65	0.67	0.69	0.71	0.73	0.76	0.78
104	0.32	0.34	0.36	0.38	0.40	0.43	0.45	0.47	0.49	0.51	0.53	0.56	0.58	0.60	0.62	0.64	0.67	0.69	0.71	0.73	0.75	0.77
105	0.32	0.34	0.36	0.38	0.40	0.42	0.45	0.47	0.49	0.51	0.53	0.55	0.58	0.60	0.62	0.64	0.66	0.68	0.71	0.73	0.75	0.77
106	0.31	0.34	0.36	0.38	0.40	0.42	0.44	0.46	0.49	0.51	0.53	0.55	0.57	0.59	0.62	0.64	0.66	0.68	0.70	0.72	0.74	0.77
107	0.31	0.33	0.36	0.38	0.40	0.42	0.44	0.46	0.48	0.50	0.53	0.55	0.57	0.59	0.61	0.63	0.65	0.68	0.70	0.72	0.74	0.76
108	0.31	0.33	0.35	0.37	0.40	0.42	0.44	0.46	0.48	0.50	0.52	0.54	0.57	0.59	0.61	0.63	0.65	0.67	0.69	0.72	0.74	0.76
109	0.31	0.33	0.35	0.37	0.39	0.41	0.44	0.46	0.48	0.50	0.52	0.54	0.56	0.58	0.61	0.63	0.65	0.67	0.69	0.71	0.73	0.75
110	0.31	0.33	0.35	0.37	0.39	0.41	0.43	0.45	0.48	0.50	0.52	0.54	0.56	0.58	0.60	0.62	0.64	0.67	0.69	0.71	0.73	0.75
111	0.31	0.33	0.35	0.37	0.39	0.41	0.43	0.45	0.47	0.49	0.52	0.54	0.56	0.58	0.60	0.62	0.64	0.66	0.68	0.70	0.73	0.75
112	0.30	0.33	0.35	0.37	0.39	0.41	0.43	0.45	0.47	0.49	0.51	0.53	0.55	0.58	0.60	0.62	0.64	0.66	0.68	0.70	0.72	0.74
113	0.30	0.32	0.34	0.36	0.39	0.41	0.43	0.45	0.47	0.49	0.51	0.53	0.55	0.57	0.59	0.61	0.63	0.66	0.68	0.70	0.72	0.74
114	0.30	0.32	0.34	0.36	0.38	0.40	0.43	0.45	0.47	0.49	0.51	0.53	0.55	0.57	0.59	0.61	0.63	0.65	0.67	0.69	0.71	0.73
115	0.30	0.32	0.34	0.36	0.38	0.40	0.42	0.44	0.46	0.48	0.51	0.53	0.55	0.57	0.59	0.61	0.63	0.65	0.67	0.69	0.71	0.73
116	0.30	0.32	0.34	0.36	0.38	0.40	0.42	0.44	0.46	0.48	0.50	0.52	0.54	0.56	0.58	0.61	0.63	0.65	0.67	0.69	0.71	0.73
117	0.30	0.32	0.34	0.36	0.38	0.40	0.42	0.44	0.46	0.48	0.50	0.52	0.54	0.56	0.58	0.60	0.62	0.64	0.66	0.68	0.70	0.72
118	0.30	0.32	0.34	0.36	0.38	0.40	0.42	0.44	0.46	0.48	0.50	0.52	0.54	0.56	0.58	0.60	0.62	0.64	0.66	0.68	0.70	0.72
119	0.29	0.31	0.33	0.35	0.37	0.39	0.41	0.44	0.46	0.48	0.50	0.52	0.54	0.56	0.58	0.60	0.62	0.64	0.66	0.68	0.70	0.72
120	0.29	0.31	0.33	0.35	0.37	0.39	0.41	0.43	0.45	0.47	0.49	0.51	0.53	0.55	0.57	0.59	0.61	0.63	0.65	0.67	0.69	0.71

T_c (min)	Mean Annual Precipitation (in)																					
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1	5.28	5.64	6.00	6.36	6.73	7.09	7.45	7.81	8.17	8.53	8.90	9.26	9.62	9.98	10.34	10.71	11.07	11.43	11.79	12.15	12.52	12.88
2	3.56	3.81	4.05	4.30	4.54	4.78	5.03	5.27	5.52	5.76	6.00	6.25	6.49	6.74	6.98	7.23	7.47	7.71	7.96	8.20	8.45	8.69
3	2.83	3.02	3.22	3.41	3.61	3.80	4.00	4.19	4.38	4.58	4.77	4.97	5.16	5.35	5.55	5.74	5.94	6.13	6.32	6.52	6.71	6.91
4	2.40	2.57	2.73	2.90	3.06	3.23	3.39	3.56	3.72	3.89	4.05	4.22	4.38	4.55	4.71	4.88	5.04	5.21	5.37	5.54	5.70	5.87
5	2.12	2.26	2.41	2.55	2.70	2.84	2.99	3.14	3.28	3.43	3.57	3.72	3.86	4.01	4.15	4.30	4.44	4.59	4.73	4.88	5.02	5.17
6	1.91	2.04	2.17	2.30	2.43	2.57	2.70	2.83	2.96	3.09	3.22	3.35	3.48	3.61	3.74	3.88	4.01	4.14	4.27	4.40	4.53	4.66
7	1.75	1.87	1.99	2.11	2.23	2.35	2.47	2.59	2.71	2.83	2.95	3.07	3.19	3.31	3.43	3.55	3.67	3.79	3.91	4.03	4.15	4.27
8	1.62	1.73	1.85	1.96	2.07	2.18	2.29	2.40	2.51	2.62	2.74	2.85	2.96	3.07	3.18	3.29	3.40	3.51	3.63	3.74	3.85	3.96
9	1.52	1.62	1.73	1.83	1.93	2.04	2.14	2.25	2.35	2.45	2.56	2.66	2.77	2.87	2.98	3.08	3.18	3.29	3.39	3.50	3.60	3.70
10	1.43	1.53	1.63	1.72	1.82	1.92	2.02	2.12	2.21	2.31	2.41	2.51	2.61	2.70	2.80	2.90	3.00	3.10	3.19	3.29	3.39	3.49
11	1.35	1.45	1.54	1.63	1.73	1.82	1.91	2.00	2.10	2.19	2.28	2.38	2.47	2.56	2.66	2.75	2.84	2.93	3.03	3.12	3.21	3.31
12	1.29	1.38	1.47	1.55	1.64	1.73	1.82	1.91	2.00	2.09	2.17	2.26	2.35	2.44	2.53	2.62	2.70	2.79	2.88	2.97	3.06	3.15
13	1.23	1.32	1.40	1.49	1.57	1.65	1.74	1.82	1.91	1.99	2.08	2.16	2.25	2.33	2.42	2.50	2.58	2.67	2.75	2.84	2.92	3.01
14	1.18	1.26	1.34	1.42	1.51	1.59	1.67	1.75	1.83	1.91	1.99	2.07	2.15	2.23	2.32	2.40	2.48	2.56	2.64	2.72	2.80	2.88
15	1.14	1.21	1.29	1.37	1.45	1.53	1.60	1.68	1.76	1.84	1.92	1.99	2.07	2.15	2.23	2.30	2.38	2.46	2.54	2.62	2.69	2.77
16	1.10	1.17	1.25	1.32	1.40	1.47	1.55	1.62	1.70	1.77	1.85	1.92	2.00	2.07	2.15	2.22	2.30	2.37	2.45	2.52	2.60	2.67
17	1.06	1.13	1.20	1.28	1.35	1.42	1.49	1.57	1.64	1.71	1.78	1.86	1.93	2.00	2.07	2.15	2.22	2.29	2.36	2.44	2.51	2.58
18	1.02	1.09	1.17	1.24	1.31	1.38	1.45	1.52	1.59	1.66	1.73	1.80	1.87	1.94	2.01	2.08	2.15	2.22	2.29	2.36	2.43	2.50
19	0.99	1.06	1.13	1.20	1.27	1.33	1.40	1.47	1.54	1.61	1.67	1.74	1.81	1.88	1.95	2.02	2.08	2.15	2.22	2.29	2.36	2.42
20	0.97	1.03	1.10	1.16	1.23	1.30	1.36	1.43	1.49	1.56	1.63	1.69	1.76	1.83	1.89	1.96	2.02	2.09	2.16	2.22	2.29	2.35
21	0.94	1.00	1.07	1.13	1.20	1.26	1.33	1.39	1.45	1.52	1.58	1.65	1.71	1.78	1.84	1.90	1.97	2.03	2.10	2.16	2.23	2.29
22	0.91	0.98	1.04	1.10	1.17	1.23	1.29	1.35	1.42	1.48	1.54	1.60	1.67	1.73	1.79	1.85	1.92	1.98	2.04	2.11	2.17	2.23
23	0.89	0.95	1.01	1.08	1.14	1.20	1.26	1.32	1.38	1.44	1.50	1.56	1.63	1.69	1.75	1.81	1.87	1.93	1.99	2.05	2.11	2.18
24	0.87	0.93	0.99	1.05	1.11	1.17	1.23	1.29	1.35	1.41	1.47	1.53	1.59	1.65	1.71	1.77	1.83	1.88	1.94	2.00	2.06	2.12
25	0.85	0.91	0.97	1.03	1.08	1.14	1.20	1.26	1.32	1.38	1.43	1.49	1.55	1.61	1.67	1.73	1.78	1.84	1.90	1.96	2.02	2.08
26	0.83	0.89	0.95	1.00	1.06	1.12	1.17	1.23	1.29	1.34	1.40	1.46	1.52	1.57	1.63	1.69	1.74	1.80	1.86	1.92	1.97	2.03
27	0.81	0.87	0.93	0.98	1.04	1.09	1.15	1.20	1.26	1.32	1.37	1.43	1.48	1.54	1.60	1.65	1.71	1.76	1.82	1.87	1.93	1.99
28	0.80	0.85	0.91	0.96	1.02	1.07	1.13	1.18	1.23	1.29	1.34	1.40	1.45	1.51	1.56	1.62	1.67	1.73	1.78	1.84	1.89	1.95
29	0.78	0.84	0.89	0.94	1.00	1.05	1.10	1.16	1.21	1.26	1.32	1.37	1.43	1.48	1.53	1.59	1.64	1.69	1.75	1.80	1.85	1.91
30	0.77	0.82	0.87	0.92	0.98	1.03	1.08	1.13	1.19	1.24	1.29	1.35	1.40	1.45	1.50	1.56	1.61	1.66	1.71	1.77	1.82	1.87
31	0.75	0.80	0.86	0.91	0.96	1.01	1.06	1.11	1.17	1.22	1.27	1.32	1.37	1.42	1.48	1.53	1.58	1.63	1.68	1.73	1.79	1.84
32	0.74	0.79	0.84	0.89	0.94	0.99	1.04	1.09	1.14	1.20	1.25	1.30	1.35	1.40	1.45	1.50	1.55	1.60	1.65	1.70	1.75	1.80
33	0.73	0.78	0.83	0.88	0.93	0.98	1.03	1.08	1.13	1.17	1.22	1.27	1.32	1.37	1.42	1.47	1.52	1.57	1.62	1.67	1.72	1.77
34	0.71	0.76	0.81	0.86	0.91	0.96	1.01	1.06	1.11	1.16	1.20	1.25	1.30	1.35	1.40	1.45	1.50	1.55	1.60	1.64	1.69	1.74
35	0.70	0.75	0.80	0.85	0.90	0.94	0.99	1.04	1.09	1.14	1.18	1.23	1.28	1.33	1.38	1.43	1.47	1.52	1.57	1.62	1.67	1.71
36	0.69	0.74	0.79	0.83	0.88	0.93	0.98	1.02	1.07	1.12	1.17	1.21	1.26	1.31	1.36	1.40	1.45	1.50	1.55	1.59	1.64	1.69
37	0.68	0.73	0.77	0.82	0.87	0.91	0.96	1.01	1.05	1.10	1.15	1.19	1.24	1.29	1.33	1.38	1.43	1.47	1.52	1.57	1.61	1.66
38	0.67	0.72	0.76	0.81	0.85	0.90	0.95	0.99	1.04	1.08	1.13	1.18	1.22	1.27	1.31	1.36	1.41	1.45	1.50	1.54	1.59	1.64
39	0.66	0.71	0.75	0.80	0.84	0.89	0.93	0.98	1.02	1.07	1.11	1.16	1.20	1.25	1.30	1.34	1.39	1.43	1.48	1.52	1.57	1.61
40	0.65	0.70	0.74	0.79	0.83	0.87	0.92	0.96	1.01	1.05	1.10	1.14	1.19	1.23	1.28	1.32	1.37	1.41	1.46	1.50	1.54	1.59
41	0.64	0.69	0.73	0.77	0.82	0.86	0.91	0.95	0.99	1.04	1.08	1.13	1.17	1.22	1.26	1.30	1.35	1.39	1.44	1.48	1.52	1.57
42	0.63	0.68	0.72	0.76	0.81	0.85	0.89	0.94	0.98	1.02	1.07	1.11	1.16	1.20	1.24	1.29	1.33	1.37	1.42	1.46	1.50	1.55
43	0.63	0.67	0.71	0.75	0.80	0.84	0.88	0.93	0.97	1.01	1.05	1.10	1.14	1.18	1.23	1.27	1.31	1.35	1.40	1.44	1.48	1.53
44	0.62	0.66	0.70	0.74	0.79	0.83	0.87	0.91	0.96	1.00	1.04	1.08	1.12	1.17	1.21	1.25	1.29	1.34	1.38	1.42	1.46	1.51
45	0.61	0.65	0.69	0.73	0.78	0.82	0.86	0.90	0.94	0.99	1.03	1.07	1.11	1.15	1.19	1.24	1.28	1.32	1.36	1.40	1.44	1.49
46	0.60	0.64	0.68	0.73	0.77	0.81	0.85	0.89	0.93	0.97	1.01	1.06	1.10	1.14	1.18	1.22	1.26	1.30	1.34	1.39	1.43	1.47
47	0.59	0.64	0.68	0.72	0.76	0.80	0.84	0.88	0.92	0.96	1.00	1.04	1.08	1.12	1.17	1.21	1.25	1.29	1.33	1.37	1.41	1.45
48	0.59	0.63	0.67	0.71	0.75	0.79	0.83	0.87	0.91	0.95	0.99	1.03	1.07	1.11	1.15	1.19	1.23	1.27	1.31	1.35	1.39	1.43
49	0.58	0.62	0.66	0.70	0.74	0.78	0.82	0.86	0.90	0.94	0.98	1.02	1.06	1.10	1.14	1.18	1.22	1.26	1.30	1.34	1.38	1.42
50	0.57	0.61	0.65	0.69	0.73	0.77	0.81	0.85	0.89	0.93	0.97	1.01	1.05	1.09	1.13	1.16	1.20	1.24	1.28	1.32	1.36	1.40
51	0.57	0.61	0.65	0.68	0.72	0.76	0.80	0.84	0.88	0.92	0.96	1.00	1.03	1.07	1.11	1.15	1.19	1.23	1.27	1.31	1.35	1.38
52	0.56	0.60	0.64	0.68	0.72	0.75	0.79	0.83	0.87	0.91	0.95	0.98	1.02	1.06	1.10	1.14	1.18	1.22	1.25	1.29	1.33	1.37
53	0.56	0.59	0.63	0.67	0.71	0.75	0.78	0.82	0.86	0.90	0.94	0.97	1.01	1.05	1.09	1.13	1.16	1.20	1.24	1.28	1.32	1.36
54	0.55	0.59	0.62	0.66	0.70	0.74	0.78	0.81	0.85	0.89	0.93	0.96	1.00	1.04	1.08	1.11	1.15	1.19	1.23	1.27	1.30	1.34
55	0.54	0.58	0.62	0.66	0.69	0.73	0.77	0.80	0.84	0.88	0.92	0.95	0.99	1.03	1.07	1.10	1.14	1.18	1.21	1.25	1.29	1.33
56	0.54	0.58	0.61	0.65	0.69	0.72	0.76	0.80	0.83	0.87	0.91	0.94	0.98	1.02	1.05	1.09	1.13	1.17	1.20	1.24	1.28	1.31
57	0.53	0.57	0.61	0.64	0.68	0.72	0.75	0.79	0.83	0.86	0.90	0.93	0.97	1.01	1.04	1.08	1.12	1.15	1.19	1.23	1.26	1.30
58	0.53	0.56	0.60	0.64	0.67	0.71	0.74	0.78	0.82	0.85	0.89	0.93	0.96	1.00	1.03	1.07	1.11	1.14	1.18	1.22	1.25	1.29
59	0.52	0.56	0.59	0.63	0.67	0.70	0.74	0.77	0.81	0.85	0.88	0.92	0.95	0.99	1.02	1.06	1.10	1.13	1.17	1.20	1.24	1.28
60	0.52	0.55	0.59	0.62	0.66	0.70	0.73	0.77	0.80	0.84	0.87	0.91	0.94	0.98	1.01	1.05	1.09	1.12	1.16	1.19	1.23	1.26

T_c (min)	Mean Annual Precipitation (in)																					
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
61	0.51	0.55	0.58	0.62	0.65	0.69	0.72	0.76	0.79	0.83	0.86	0.90	0.93	0.97	1.01	1.04	1.08	1.11	1.15	1.18	1.22	1.25
62	0.51	0.54	0.58	0.61	0.65	0.68	0.72	0.75	0.79	0.82	0.86	0.89	0.93	0.96	1.00	1.03	1.07	1.10	1.14	1.17	1.20	1.24
63	0.50	0.54	0.57	0.61	0.64	0.68	0.71	0.75	0.78	0.81	0.85	0.88	0.92	0.95	0.99	1.02	1.06	1.09	1.12	1.16	1.19	1.23
64	0.50	0.53	0.57	0.60	0.64	0.67	0.70	0.74	0.77	0.81	0.84	0.88	0.91	0.94	0.98	1.01	1.05	1.08	1.11	1.15	1.18	1.22
65	0.49	0.53	0.56	0.60	0.63	0.66	0.70	0.73	0.77	0.80	0.83	0.87	0.90	0.94	0.97	1.00	1.04	1.07	1.11	1.14	1.17	1.21
66	0.49	0.52	0.56	0.59	0.62	0.66	0.69	0.73	0.76	0.79	0.83	0.86	0.89	0.93	0.96	0.99	1.03	1.06	1.10	1.13	1.16	1.20
67	0.49	0.52	0.55	0.59	0.62	0.65	0.69	0.72	0.75	0.79	0.82	0.85	0.89	0.92	0.95	0.99	1.02	1.05	1.09	1.12	1.15	1.19
68	0.48	0.52	0.55	0.58	0.61	0.65	0.68	0.71	0.75	0.78	0.81	0.85	0.88	0.91	0.94	0.98	1.01	1.04	1.08	1.11	1.14	1.18
69	0.48	0.51	0.54	0.58	0.61	0.64	0.67	0.71	0.74	0.77	0.81	0.84	0.87	0.90	0.94	0.97	1.00	1.04	1.07	1.10	1.13	1.17
70	0.47	0.51	0.54	0.57	0.60	0.64	0.67	0.70	0.73	0.77	0.80	0.83	0.86	0.90	0.93	0.96	0.99	1.03	1.06	1.09	1.12	1.16
71	0.47	0.50	0.54	0.57	0.60	0.63	0.66	0.70	0.73	0.76	0.79	0.83	0.86	0.89	0.92	0.95	0.99	1.02	1.05	1.08	1.12	1.15
72	0.47	0.50	0.53	0.56	0.59	0.63	0.66	0.69	0.72	0.75	0.79	0.82	0.85	0.88	0.91	0.95	0.98	1.01	1.04	1.07	1.11	1.14
73	0.46	0.49	0.53	0.56	0.59	0.62	0.65	0.69	0.72	0.75	0.78	0.81	0.84	0.88	0.91	0.94	0.97	1.00	1.03	1.07	1.10	1.13
74	0.46	0.49	0.52	0.55	0.59	0.62	0.65	0.68	0.71	0.74	0.77	0.81	0.84	0.87	0.90	0.93	0.96	1.00	1.03	1.06	1.09	1.12
75	0.46	0.49	0.52	0.55	0.58	0.61	0.64	0.68	0.71	0.74	0.77	0.80	0.83	0.86	0.89	0.93	0.96	0.99	1.02	1.05	1.08	1.11
76	0.45	0.48	0.51	0.55	0.58	0.61	0.64	0.67	0.70	0.73	0.76	0.79	0.83	0.86	0.89	0.92	0.95	0.98	1.01	1.04	1.07	1.10
77	0.45	0.48	0.51	0.54	0.57	0.60	0.63	0.67	0.70	0.73	0.76	0.79	0.82	0.85	0.88	0.91	0.94	0.97	1.00	1.03	1.07	1.10
78	0.45	0.48	0.51	0.54	0.57	0.60	0.63	0.66	0.69	0.72	0.75	0.78	0.81	0.84	0.87	0.90	0.94	0.97	1.00	1.03	1.06	1.09
79	0.44	0.47	0.50	0.53	0.56	0.59	0.63	0.66	0.69	0.72	0.75	0.78	0.81	0.84	0.87	0.90	0.93	0.96	0.99	1.02	1.05	1.08
80	0.44	0.47	0.50	0.53	0.56	0.59	0.62	0.65	0.68	0.71	0.74	0.77	0.80	0.83	0.86	0.89	0.92	0.95	0.98	1.01	1.04	1.07
81	0.44	0.47	0.50	0.53	0.56	0.59	0.62	0.65	0.68	0.71	0.74	0.77	0.80	0.83	0.86	0.89	0.92	0.95	0.98	1.01	1.04	1.07
82	0.43	0.46	0.49	0.52	0.55	0.58	0.61	0.64	0.67	0.70	0.73	0.76	0.79	0.82	0.85	0.88	0.91	0.94	0.97	1.00	1.03	1.06
83	0.43	0.46	0.49	0.52	0.55	0.58	0.61	0.64	0.67	0.70	0.73	0.76	0.78	0.81	0.84	0.87	0.90	0.93	0.96	0.99	1.02	1.05
84	0.43	0.46	0.49	0.52	0.55	0.57	0.60	0.63	0.66	0.69	0.72	0.75	0.78	0.81	0.84	0.87	0.90	0.93	0.96	0.98	1.01	1.04
85	0.42	0.45	0.48	0.51	0.54	0.57	0.60	0.63	0.66	0.69	0.72	0.75	0.77	0.80	0.83	0.86	0.89	0.92	0.95	0.98	1.01	1.04
86	0.42	0.45	0.48	0.51	0.54	0.57	0.60	0.62	0.65	0.68	0.71	0.74	0.77	0.80	0.83	0.86	0.89	0.91	0.94	0.97	1.00	1.03
87	0.42	0.45	0.48	0.51	0.53	0.56	0.59	0.62	0.65	0.68	0.71	0.74	0.76	0.79	0.82	0.85	0.88	0.91	0.94	0.97	0.99	1.02
88	0.42	0.45	0.47	0.50	0.53	0.56	0.59	0.62	0.65	0.67	0.70	0.73	0.76	0.79	0.82	0.85	0.87	0.90	0.93	0.96	0.99	1.02
89	0.41	0.44	0.47	0.50	0.53	0.56	0.58	0.61	0.64	0.67	0.70	0.73	0.75	0.78	0.81	0.84	0.87	0.90	0.92	0.95	0.98	1.01
90	0.41	0.44	0.47	0.50	0.52	0.55	0.58	0.61	0.64	0.67	0.69	0.72	0.75	0.78	0.81	0.83	0.86	0.89	0.92	0.95	0.98	1.00
91	0.41	0.44	0.46	0.49	0.52	0.55	0.58	0.60	0.63	0.66	0.69	0.72	0.75	0.77	0.80	0.83	0.86	0.89	0.91	0.94	0.97	1.00
92	0.41	0.43	0.46	0.49	0.52	0.55	0.57	0.60	0.63	0.66	0.68	0.71	0.74	0.77	0.80	0.82	0.85	0.88	0.91	0.94	0.96	0.99
93	0.40	0.43	0.46	0.49	0.51	0.54	0.57	0.60	0.63	0.65	0.68	0.71	0.74	0.76	0.79	0.82	0.85	0.87	0.90	0.93	0.96	0.99
94	0.40	0.43	0.46	0.48	0.51	0.54	0.57	0.59	0.62	0.65	0.68	0.70	0.73	0.76	0.79	0.81	0.84	0.87	0.90	0.92	0.95	0.98
95	0.40	0.43	0.45	0.48	0.51	0.54	0.56	0.59	0.62	0.65	0.67	0.70	0.73	0.75	0.78	0.81	0.84	0.86	0.89	0.92	0.95	0.97
96	0.40	0.42	0.45	0.48	0.51	0.53	0.56	0.59	0.61	0.64	0.67	0.70	0.72	0.75	0.78	0.80	0.83	0.86	0.89	0.91	0.94	0.97
97	0.39	0.42	0.45	0.48	0.50	0.53	0.56	0.58	0.61	0.64	0.66	0.69	0.72	0.75	0.77	0.80	0.83	0.85	0.88	0.91	0.93	0.96
98	0.39	0.42	0.45	0.47	0.50	0.53	0.55	0.58	0.61	0.63	0.66	0.69	0.71	0.74	0.77	0.79	0.82	0.85	0.88	0.90	0.93	0.96
99	0.39	0.42	0.44	0.47	0.50	0.52	0.55	0.58	0.60	0.63	0.66	0.68	0.71	0.74	0.76	0.79	0.82	0.84	0.87	0.90	0.92	0.95
100	0.39	0.41	0.44	0.47	0.49	0.52	0.55	0.57	0.60	0.63	0.65	0.68	0.71	0.73	0.76	0.79	0.81	0.84	0.87	0.89	0.92	0.95
101	0.39	0.41	0.44	0.46	0.49	0.52	0.54	0.57	0.60	0.62	0.65	0.68	0.70	0.73	0.76	0.78	0.81	0.83	0.86	0.89	0.91	0.94
102	0.38	0.41	0.44	0.46	0.49	0.51	0.54	0.57	0.59	0.62	0.65	0.67	0.70	0.72	0.75	0.78	0.80	0.83	0.86	0.88	0.91	0.93
103	0.38	0.41	0.43	0.46	0.49	0.51	0.54	0.56	0.59	0.62	0.64	0.67	0.69	0.72	0.75	0.77	0.80	0.83	0.85	0.88	0.90	0.93
104	0.38	0.40	0.43	0.46	0.48	0.51	0.53	0.56	0.59	0.61	0.64	0.66	0.69	0.72	0.74	0.77	0.79	0.82	0.85	0.87	0.90	0.92
105	0.38	0.40	0.43	0.45	0.48	0.51	0.53	0.56	0.58	0.61	0.64	0.66	0.69	0.71	0.74	0.76	0.79	0.82	0.84	0.87	0.89	0.92
106	0.37	0.40	0.43	0.45	0.48	0.50	0.53	0.55	0.58	0.61	0.63	0.66	0.68	0.71	0.73	0.76	0.79	0.81	0.84	0.86	0.89	0.91
107	0.37	0.40	0.42	0.45	0.48	0.50	0.53	0.55	0.58	0.60	0.63	0.65	0.68	0.71	0.73	0.76	0.78	0.81	0.83	0.86	0.88	0.91
108	0.37	0.40	0.42	0.45	0.47	0.50	0.52	0.55	0.57	0.60	0.63	0.65	0.68	0.70	0.73	0.75	0.78	0.80	0.83	0.85	0.88	0.90
109	0.37	0.39	0.42	0.44	0.47	0.50	0.52	0.55	0.57	0.60	0.62	0.65	0.67	0.70	0.72	0.75	0.77	0.80	0.82	0.85	0.87	0.90
110	0.37	0.39	0.42	0.44	0.47	0.49	0.52	0.54	0.57	0.59	0.62	0.64	0.67	0.69	0.72	0.74	0.77	0.79	0.82	0.85	0.87	0.90
111	0.37	0.39	0.42	0.44	0.47	0.49	0.52	0.54	0.57	0.59	0.62	0.64	0.67	0.69	0.72	0.74	0.77	0.79	0.82	0.84	0.87	0.89
112	0.36	0.39	0.41	0.44	0.46	0.49	0.51	0.54	0.56	0.59	0.61	0.64	0.66	0.69	0.71	0.74	0.76	0.79	0.81	0.84	0.86	0.89
113	0.36	0.39	0.41	0.44	0.46	0.49	0.51	0.53	0.56	0.58	0.61	0.63	0.66	0.68	0.71	0.73	0.76	0.78	0.81	0.83	0.86	0.88
114	0.36	0.38	0.41	0.43	0.46	0.48	0.51	0.53	0.56	0.58	0.61	0.63	0.66	0.68	0.70	0.73	0.75	0.78	0.80	0.83	0.85	0.88
115	0.36	0.38	0.41	0.43	0.46	0.48	0.51	0.53	0.55	0.58	0.60	0.63	0.65	0.68	0.70	0.73	0.75	0.78	0.80	0.82	0.85	0.87
116	0.36	0.38	0.40	0.43	0.45	0.48	0.50	0.53	0.55	0.58	0.60	0.62	0.65	0.67	0.70	0.72	0.75	0.77	0.80	0.82	0.84	0.87
117	0.35	0.38	0.40	0.43	0.45	0.48	0.50	0.52	0.55	0.57	0.60	0.62	0.65	0.67	0.69	0.72	0.74	0.77	0.79	0.82	0.84	0.86
118	0.35	0.38	0.40	0.43	0.45	0.47	0.50	0.52	0.55	0.57	0.59	0.62	0.64	0.67	0.69	0.72	0.74	0.76	0.79	0.81	0.84	0.86
119	0.35	0.38	0.40	0.42	0.45	0.47	0.50	0.52	0.54	0.57	0.59	0.62	0.64	0.66	0.69	0.71	0.74	0.76	0.78	0.81	0.83	0.86
120	0.35	0.37	0.40	0.42	0.45	0.47	0.49	0.52	0.54	0.56	0.59	0.61	0.64	0.66	0.68	0.71	0.73	0.76	0.78	0.80	0.83	0.85

T_c (min)	Mean Annual Precipitation (in)																					
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1	5.76	6.15	6.54	6.94	7.33	7.73	8.12	8.52	8.91	9.31	9.70	10.10	10.49	10.89	11.28	11.67	12.07	12.46	12.86	13.25	13.65	14.04
2	3.88	4.15	4.42	4.68	4.95	5.22	5.48	5.75	6.02	6.28	6.55	6.81	7.08	7.35	7.61	7.88	8.15	8.41	8.68	8.95	9.21	9.48
3	3.09	3.30	3.51	3.72	3.93	4.14	4.36	4.57	4.78	4.99	5.20	5.41	5.63	5.84	6.05	6.26	6.47	6.68	6.90	7.11	7.32	7.53
4	2.62	2.80	2.98	3.16	3.34	3.52	3.70	3.88	4.06	4.24	4.42	4.60	4.78	4.96	5.14	5.32	5.50	5.68	5.86	6.04	6.22	6.40
5	2.31	2.47	2.63	2.79	2.94	3.10	3.26	3.42	3.58	3.74	3.89	4.05	4.21	4.37	4.53	4.69	4.84	5.00	5.16	5.32	5.48	5.64
6	2.08	2.23	2.37	2.51	2.65	2.80	2.94	3.08	3.23	3.37	3.51	3.65	3.80	3.94	4.08	4.23	4.37	4.51	4.65	4.80	4.94	5.08
7	1.91	2.04	2.17	2.30	2.43	2.56	2.69	2.83	2.96	3.09	3.22	3.35	3.48	3.61	3.74	3.87	4.00	4.13	4.26	4.40	4.53	4.66
8	1.77	1.89	2.01	2.13	2.26	2.38	2.50	2.62	2.74	2.86	2.98	3.10	3.23	3.35	3.47	3.59	3.71	3.83	3.95	4.08	4.20	4.32
9	1.66	1.77	1.88	2.00	2.11	2.22	2.34	2.45	2.56	2.68	2.79	2.90	3.02	3.13	3.24	3.36	3.47	3.58	3.70	3.81	3.93	4.04
10	1.56	1.67	1.77	1.88	1.99	2.09	2.20	2.31	2.41	2.52	2.63	2.74	2.84	2.95	3.06	3.16	3.27	3.38	3.48	3.59	3.70	3.80
11	1.48	1.58	1.68	1.78	1.88	1.98	2.09	2.19	2.29	2.39	2.49	2.59	2.69	2.79	2.90	3.00	3.10	3.20	3.30	3.40	3.50	3.60
12	1.41	1.50	1.60	1.70	1.79	1.89	1.98	2.08	2.18	2.27	2.37	2.47	2.56	2.66	2.76	2.85	2.95	3.05	3.14	3.24	3.33	3.43
13	1.34	1.44	1.53	1.62	1.71	1.80	1.90	1.99	2.08	2.17	2.27	2.36	2.45	2.54	2.63	2.73	2.82	2.91	3.00	3.09	3.19	3.28
14	1.29	1.38	1.47	1.55	1.64	1.73	1.82	1.91	2.00	2.08	2.17	2.26	2.35	2.44	2.53	2.61	2.70	2.79	2.88	2.97	3.06	3.14
15	1.24	1.32	1.41	1.49	1.58	1.66	1.75	1.83	1.92	2.00	2.09	2.17	2.26	2.34	2.43	2.51	2.60	2.68	2.77	2.85	2.94	3.02
16	1.19	1.28	1.36	1.44	1.52	1.60	1.69	1.77	1.85	1.93	2.01	2.10	2.18	2.26	2.34	2.42	2.50	2.59	2.67	2.75	2.83	2.91
17	1.15	1.23	1.31	1.39	1.47	1.55	1.63	1.71	1.79	1.87	1.95	2.02	2.10	2.18	2.26	2.34	2.42	2.50	2.58	2.66	2.74	2.82
18	1.12	1.19	1.27	1.35	1.42	1.50	1.58	1.65	1.73	1.81	1.88	1.96	2.04	2.11	2.19	2.27	2.34	2.42	2.50	2.57	2.65	2.73
19	1.08	1.16	1.23	1.31	1.38	1.46	1.53	1.60	1.68	1.75	1.83	1.90	1.98	2.05	2.12	2.20	2.27	2.35	2.42	2.50	2.57	2.64
20	1.05	1.12	1.20	1.27	1.34	1.41	1.49	1.56	1.63	1.70	1.77	1.85	1.92	1.99	2.06	2.13	2.21	2.28	2.35	2.42	2.50	2.57
21	1.02	1.09	1.16	1.23	1.30	1.37	1.44	1.52	1.59	1.66	1.73	1.80	1.87	1.94	2.01	2.08	2.15	2.22	2.29	2.36	2.43	2.50
22	1.00	1.07	1.13	1.20	1.27	1.34	1.41	1.48	1.54	1.61	1.68	1.75	1.82	1.89	1.95	2.02	2.09	2.16	2.23	2.30	2.36	2.43
23	0.97	1.04	1.11	1.17	1.24	1.31	1.37	1.44	1.51	1.57	1.64	1.71	1.77	1.84	1.91	1.97	2.04	2.11	2.17	2.24	2.31	2.37
24	0.95	1.01	1.08	1.14	1.21	1.27	1.34	1.40	1.47	1.53	1.60	1.66	1.73	1.80	1.86	1.93	1.99	2.06	2.12	2.19	2.25	2.32
25	0.93	0.99	1.05	1.12	1.18	1.25	1.31	1.37	1.44	1.50	1.56	1.63	1.69	1.75	1.82	1.88	1.94	2.01	2.07	2.14	2.20	2.26
26	0.91	0.97	1.03	1.09	1.16	1.22	1.28	1.34	1.40	1.47	1.53	1.59	1.65	1.72	1.78	1.84	1.90	1.96	2.03	2.09	2.15	2.21
27	0.89	0.95	1.01	1.07	1.13	1.19	1.25	1.31	1.37	1.44	1.50	1.56	1.62	1.68	1.74	1.80	1.86	1.92	1.98	2.04	2.11	2.17
28	0.87	0.93	0.99	1.05	1.11	1.17	1.23	1.29	1.35	1.41	1.47	1.53	1.59	1.64	1.70	1.76	1.82	1.88	1.94	2.00	2.06	2.12
29	0.85	0.91	0.97	1.03	1.09	1.14	1.20	1.26	1.32	1.38	1.44	1.50	1.55	1.61	1.67	1.73	1.79	1.85	1.90	1.96	2.02	2.08
30	0.84	0.89	0.95	1.01	1.07	1.12	1.18	1.24	1.29	1.35	1.41	1.47	1.52	1.58	1.64	1.70	1.75	1.81	1.87	1.93	1.98	2.04
31	0.82	0.88	0.93	0.99	1.05	1.10	1.16	1.21	1.27	1.33	1.38	1.44	1.50	1.55	1.61	1.67	1.72	1.78	1.83	1.89	1.95	2.00
32	0.81	0.86	0.92	0.97	1.03	1.08	1.14	1.19	1.25	1.30	1.36	1.41	1.47	1.52	1.58	1.64	1.69	1.75	1.80	1.86	1.91	1.97
33	0.79	0.85	0.90	0.96	1.01	1.06	1.12	1.17	1.23	1.28	1.34	1.39	1.44	1.50	1.55	1.61	1.66	1.72	1.77	1.82	1.88	1.93
34	0.78	0.83	0.89	0.94	0.99	1.05	1.10	1.15	1.21	1.26	1.31	1.37	1.42	1.47	1.53	1.58	1.63	1.69	1.74	1.79	1.85	1.90
35	0.77	0.82	0.87	0.92	0.98	1.03	1.08	1.13	1.19	1.24	1.29	1.34	1.40	1.45	1.50	1.55	1.61	1.66	1.71	1.76	1.82	1.87
36	0.75	0.81	0.86	0.91	0.96	1.01	1.06	1.12	1.17	1.22	1.27	1.32	1.37	1.43	1.48	1.53	1.58	1.63	1.68	1.74	1.79	1.84
37	0.74	0.79	0.84	0.90	0.95	1.00	1.05	1.10	1.15	1.20	1.25	1.30	1.35	1.40	1.46	1.51	1.56	1.61	1.66	1.71	1.76	1.81
38	0.73	0.78	0.83	0.88	0.93	0.98	1.03	1.08	1.13	1.18	1.23	1.28	1.33	1.38	1.43	1.48	1.53	1.58	1.63	1.68	1.73	1.78
39	0.72	0.77	0.82	0.87	0.92	0.97	1.02	1.07	1.12	1.17	1.21	1.26	1.31	1.36	1.41	1.46	1.51	1.56	1.61	1.66	1.71	1.76
40	0.71	0.76	0.81	0.86	0.91	0.95	1.00	1.05	1.10	1.15	1.20	1.25	1.29	1.34	1.39	1.44	1.49	1.54	1.59	1.64	1.68	1.73
41	0.70	0.75	0.80	0.84	0.89	0.94	0.99	1.04	1.08	1.13	1.18	1.23	1.28	1.32	1.37	1.42	1.47	1.52	1.57	1.61	1.66	1.71
42	0.69	0.74	0.79	0.83	0.88	0.93	0.98	1.02	1.07	1.12	1.16	1.21	1.26	1.31	1.35	1.40	1.45	1.50	1.54	1.59	1.64	1.69
43	0.68	0.73	0.78	0.82	0.87	0.92	0.96	1.01	1.06	1.10	1.15	1.20	1.24	1.29	1.34	1.38	1.43	1.48	1.52	1.57	1.62	1.66
44	0.67	0.72	0.77	0.81	0.86	0.90	0.95	1.00	1.04	1.09	1.13	1.18	1.23	1.27	1.32	1.37	1.41	1.46	1.50	1.55	1.60	1.64
45	0.66	0.71	0.76	0.80	0.85	0.89	0.94	0.98	1.03	1.07	1.12	1.17	1.21	1.26	1.30	1.35	1.39	1.44	1.48	1.53	1.58	1.62
46	0.66	0.70	0.75	0.79	0.84	0.88	0.93	0.97	1.02	1.06	1.11	1.15	1.20	1.24	1.29	1.33	1.38	1.42	1.47	1.51	1.56	1.60
47	0.65	0.69	0.74	0.78	0.83	0.87	0.91	0.96	1.00	1.05	1.09	1.14	1.18	1.23	1.27	1.32	1.36	1.40	1.45	1.49	1.54	1.58
48	0.64	0.68	0.73	0.77	0.82	0.86	0.90	0.95	0.99	1.04	1.08	1.12	1.17	1.21	1.26	1.30	1.34	1.39	1.43	1.48	1.52	1.56
49	0.63	0.68	0.72	0.76	0.81	0.85	0.89	0.94	0.98	1.02	1.07	1.11	1.15	1.20	1.24	1.28	1.33	1.37	1.41	1.46	1.50	1.54
50	0.63	0.67	0.71	0.75	0.80	0.84	0.88	0.93	0.97	1.01	1.06	1.10	1.14	1.18	1.23	1.27	1.31	1.36	1.40	1.44	1.48	1.53
51	0.62	0.66	0.70	0.75	0.79	0.83	0.87	0.92	0.96	1.00	1.04	1.09	1.13	1.17	1.21	1.26	1.30	1.34	1.38	1.43	1.47	1.51
52	0.61	0.65	0.70	0.74	0.78	0.82	0.86	0.91	0.95	0.99	1.03	1.07	1.12	1.16	1.20	1.24	1.28	1.33	1.37	1.41	1.45	1.49
53	0.61	0.65	0.69	0.73	0.77	0.81	0.85	0.90	0.94	0.98	1.02	1.06	1.10	1.15	1.19	1.23	1.27	1.31	1.35	1.39	1.44	1.48
54	0.60	0.64	0.68	0.72	0.76	0.80	0.85	0.89	0.93	0.97	1.01	1.05	1.09	1.13	1.17	1.22	1.26	1.30	1.34	1.38	1.42	1.46
55	0.59	0.63	0.67	0.71	0.76	0.80	0.84	0.88	0.92	0.96	1.00	1.04	1.08	1.12	1.16	1.20	1.24	1.28	1.32	1.37	1.41	1.45
56	0.59	0.63	0.67	0.71	0.75	0.79	0.83	0.87	0.91	0.95	0.99	1.03	1.07	1.11	1.15	1.19	1.23	1.27	1.31	1.35	1.39	1.43
57	0.58	0.62	0.66	0.70	0.74	0.78	0.82	0.86	0.90	0.94	0.98	1.02	1.06	1.10	1.14	1.18	1.22	1.26	1.30	1.34	1.38	1.42
58	0.58	0.61	0.65	0.69	0.73	0.77	0.81	0.85	0.89	0.93	0.97	1.01	1.05	1.09	1.13	1.17	1.21	1.25	1.29	1.33	1.36	1.40
59	0.57	0.61	0.65	0.69	0.73	0.77	0.80	0.84	0.88	0.92	0.96	1.00	1.04	1.08	1.12	1.16	1.20	1.23	1.27	1.31	1.35	1.39
60	0.56	0.60	0.64	0.68	0.72	0.76	0.80	0.84	0.87	0.91	0.95	0.99	1.03	1.07	1.11	1.14	1.18	1.22	1.26	1.30	1.34	1.38

T_c (min)	Mean Annual Precipitation (in)																					
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
61	0.56	0.60	0.64	0.67	0.71	0.75	0.79	0.83	0.87	0.90	0.94	0.98	1.02	1.06	1.10	1.13	1.17	1.21	1.25	1.29	1.33	1.36
62	0.55	0.59	0.63	0.67	0.71	0.74	0.78	0.82	0.86	0.90	0.93	0.97	1.01	1.05	1.09	1.12	1.16	1.20	1.24	1.28	1.31	1.35
63	0.55	0.59	0.62	0.66	0.70	0.74	0.77	0.81	0.85	0.89	0.93	0.96	1.00	1.04	1.08	1.11	1.15	1.19	1.23	1.26	1.30	1.34
64	0.54	0.58	0.62	0.66	0.69	0.73	0.77	0.81	0.84	0.88	0.92	0.95	0.99	1.03	1.07	1.10	1.14	1.18	1.22	1.25	1.29	1.33
65	0.54	0.58	0.61	0.65	0.69	0.72	0.76	0.80	0.84	0.87	0.91	0.95	0.98	1.02	1.06	1.09	1.13	1.17	1.21	1.24	1.28	1.32
66	0.53	0.57	0.61	0.64	0.68	0.72	0.75	0.79	0.83	0.86	0.90	0.94	0.97	1.01	1.05	1.08	1.12	1.16	1.19	1.23	1.27	1.30
67	0.53	0.57	0.60	0.64	0.68	0.71	0.75	0.78	0.82	0.86	0.89	0.93	0.97	1.00	1.04	1.08	1.11	1.15	1.18	1.22	1.26	1.29
68	0.53	0.56	0.60	0.63	0.67	0.71	0.74	0.78	0.81	0.85	0.89	0.92	0.96	0.99	1.03	1.07	1.10	1.14	1.17	1.21	1.25	1.28
69	0.52	0.56	0.59	0.63	0.66	0.70	0.74	0.77	0.81	0.84	0.88	0.91	0.95	0.99	1.02	1.06	1.09	1.13	1.16	1.20	1.24	1.27
70	0.52	0.55	0.59	0.62	0.66	0.69	0.73	0.77	0.80	0.84	0.87	0.91	0.94	0.98	1.01	1.05	1.08	1.12	1.16	1.19	1.23	1.26
71	0.51	0.55	0.58	0.62	0.65	0.69	0.72	0.76	0.79	0.83	0.86	0.90	0.94	0.97	1.01	1.04	1.08	1.11	1.15	1.18	1.22	1.25
72	0.51	0.54	0.58	0.61	0.65	0.68	0.72	0.75	0.79	0.82	0.86	0.89	0.93	0.96	1.00	1.03	1.07	1.10	1.14	1.17	1.21	1.24
73	0.51	0.54	0.57	0.61	0.64	0.68	0.71	0.75	0.78	0.82	0.85	0.89	0.92	0.96	0.99	1.02	1.06	1.09	1.13	1.16	1.20	1.23
74	0.50	0.54	0.57	0.60	0.64	0.67	0.71	0.74	0.78	0.81	0.84	0.88	0.91	0.95	0.98	1.02	1.05	1.09	1.12	1.15	1.19	1.22
75	0.50	0.53	0.57	0.60	0.63	0.67	0.70	0.74	0.77	0.80	0.84	0.87	0.91	0.94	0.97	1.01	1.04	1.08	1.11	1.15	1.18	1.21
76	0.49	0.53	0.56	0.60	0.63	0.66	0.70	0.73	0.76	0.80	0.83	0.87	0.90	0.93	0.97	1.00	1.04	1.07	1.10	1.14	1.17	1.20
77	0.49	0.52	0.56	0.59	0.62	0.66	0.69	0.73	0.76	0.79	0.83	0.86	0.89	0.93	0.96	0.99	1.03	1.06	1.09	1.13	1.16	1.20
78	0.49	0.52	0.55	0.59	0.62	0.65	0.69	0.72	0.75	0.79	0.82	0.85	0.89	0.92	0.95	0.99	1.02	1.05	1.09	1.12	1.15	1.19
79	0.48	0.52	0.55	0.58	0.62	0.65	0.68	0.71	0.75	0.78	0.81	0.85	0.88	0.91	0.95	0.98	1.01	1.05	1.08	1.11	1.15	1.18
80	0.48	0.51	0.55	0.58	0.61	0.64	0.68	0.71	0.74	0.78	0.81	0.84	0.87	0.91	0.94	0.97	1.01	1.04	1.07	1.10	1.14	1.17
81	0.48	0.51	0.54	0.57	0.61	0.64	0.67	0.70	0.74	0.77	0.80	0.84	0.87	0.90	0.93	0.97	1.00	1.03	1.06	1.10	1.13	1.16
82	0.47	0.51	0.54	0.57	0.60	0.63	0.67	0.70	0.73	0.76	0.80	0.83	0.86	0.89	0.93	0.96	0.99	1.02	1.06	1.09	1.12	1.15
83	0.47	0.50	0.53	0.57	0.60	0.63	0.66	0.69	0.73	0.76	0.79	0.82	0.86	0.89	0.92	0.95	0.98	1.02	1.05	1.08	1.11	1.15
84	0.47	0.50	0.53	0.56	0.59	0.63	0.66	0.69	0.72	0.75	0.79	0.82	0.85	0.88	0.91	0.95	0.98	1.01	1.04	1.07	1.11	1.14
85	0.46	0.50	0.53	0.56	0.59	0.62	0.65	0.69	0.72	0.75	0.78	0.81	0.84	0.88	0.91	0.94	0.97	1.00	1.04	1.07	1.10	1.13
86	0.46	0.49	0.52	0.55	0.59	0.62	0.65	0.68	0.71	0.74	0.78	0.81	0.84	0.87	0.90	0.93	0.97	1.00	1.03	1.06	1.09	1.12
87	0.46	0.49	0.52	0.55	0.58	0.61	0.65	0.68	0.71	0.74	0.77	0.80	0.83	0.86	0.90	0.93	0.96	0.99	1.02	1.05	1.08	1.12
88	0.45	0.49	0.52	0.55	0.58	0.61	0.64	0.67	0.70	0.73	0.77	0.80	0.83	0.86	0.89	0.92	0.95	0.98	1.01	1.05	1.08	1.11
89	0.45	0.48	0.51	0.54	0.58	0.61	0.64	0.67	0.70	0.73	0.76	0.79	0.82	0.85	0.88	0.92	0.95	0.98	1.01	1.04	1.07	1.10
90	0.45	0.48	0.51	0.54	0.57	0.60	0.63	0.66	0.69	0.73	0.76	0.79	0.82	0.85	0.88	0.91	0.94	0.97	1.00	1.03	1.06	1.09
91	0.45	0.48	0.51	0.54	0.57	0.60	0.63	0.66	0.69	0.72	0.75	0.78	0.81	0.84	0.87	0.90	0.93	0.97	1.00	1.03	1.06	1.09
92	0.44	0.47	0.50	0.53	0.56	0.59	0.63	0.66	0.69	0.72	0.75	0.78	0.81	0.84	0.87	0.90	0.93	0.96	0.99	1.02	1.05	1.08
93	0.44	0.47	0.50	0.53	0.56	0.59	0.62	0.65	0.68	0.71	0.74	0.77	0.80	0.83	0.86	0.89	0.92	0.95	0.98	1.01	1.04	1.07
94	0.44	0.47	0.50	0.53	0.56	0.59	0.62	0.65	0.68	0.71	0.74	0.77	0.80	0.83	0.86	0.89	0.92	0.95	0.98	1.01	1.04	1.07
95	0.43	0.46	0.49	0.52	0.55	0.58	0.61	0.64	0.67	0.70	0.73	0.76	0.79	0.82	0.85	0.88	0.91	0.94	0.97	1.00	1.03	1.06
96	0.43	0.46	0.49	0.52	0.55	0.58	0.61	0.64	0.67	0.70	0.73	0.76	0.79	0.82	0.85	0.88	0.91	0.94	0.97	1.00	1.03	1.05
97	0.43	0.46	0.49	0.52	0.55	0.58	0.61	0.64	0.67	0.70	0.72	0.75	0.78	0.81	0.84	0.87	0.90	0.93	0.96	0.99	1.02	1.05
98	0.43	0.46	0.49	0.52	0.54	0.57	0.60	0.63	0.66	0.69	0.72	0.75	0.78	0.81	0.84	0.87	0.90	0.93	0.95	0.98	1.01	1.04
99	0.42	0.45	0.48	0.51	0.54	0.57	0.60	0.63	0.66	0.69	0.72	0.75	0.77	0.80	0.83	0.86	0.89	0.92	0.95	0.98	1.01	1.04
100	0.42	0.45	0.48	0.51	0.54	0.57	0.60	0.63	0.65	0.68	0.71	0.74	0.77	0.80	0.83	0.86	0.89	0.91	0.94	0.97	1.00	1.03
101	0.42	0.45	0.48	0.51	0.54	0.56	0.59	0.62	0.65	0.68	0.71	0.74	0.77	0.79	0.82	0.85	0.88	0.91	0.94	0.97	1.00	1.03
102	0.42	0.45	0.48	0.50	0.53	0.56	0.59	0.62	0.65	0.68	0.70	0.73	0.76	0.79	0.82	0.85	0.88	0.90	0.93	0.96	0.99	1.02
103	0.42	0.44	0.47	0.50	0.53	0.56	0.59	0.61	0.64	0.67	0.70	0.73	0.76	0.79	0.81	0.84	0.87	0.90	0.93	0.96	0.99	1.01
104	0.41	0.44	0.47	0.50	0.53	0.55	0.58	0.61	0.64	0.67	0.70	0.72	0.75	0.78	0.81	0.84	0.87	0.89	0.92	0.95	0.98	1.01
105	0.41	0.44	0.47	0.50	0.52	0.55	0.58	0.61	0.64	0.66	0.69	0.72	0.75	0.78	0.81	0.83	0.86	0.89	0.92	0.95	0.97	1.00
106	0.41	0.44	0.46	0.49	0.52	0.55	0.58	0.60	0.63	0.66	0.69	0.72	0.75	0.77	0.80	0.83	0.86	0.89	0.91	0.94	0.97	1.00
107	0.41	0.43	0.46	0.49	0.52	0.55	0.57	0.60	0.63	0.66	0.69	0.71	0.74	0.77	0.80	0.82	0.85	0.88	0.91	0.94	0.96	0.99
108	0.40	0.43	0.46	0.49	0.52	0.54	0.57	0.60	0.63	0.65	0.68	0.71	0.74	0.76	0.79	0.82	0.85	0.88	0.90	0.93	0.96	0.99
109	0.40	0.43	0.46	0.49	0.51	0.54	0.57	0.60	0.62	0.65	0.68	0.71	0.73	0.76	0.79	0.82	0.84	0.87	0.90	0.93	0.95	0.98
110	0.40	0.43	0.46	0.48	0.51	0.54	0.56	0.59	0.62	0.65	0.67	0.70	0.73	0.76	0.78	0.81	0.84	0.87	0.89	0.92	0.95	0.98
111	0.40	0.43	0.45	0.48	0.51	0.53	0.56	0.59	0.62	0.64	0.67	0.70	0.73	0.75	0.78	0.81	0.84	0.86	0.89	0.92	0.94	0.97
112	0.40	0.42	0.45	0.48	0.50	0.53	0.56	0.59	0.61	0.64	0.67	0.69	0.72	0.75	0.78	0.80	0.83	0.86	0.89	0.91	0.94	0.97
113	0.39	0.42	0.45	0.48	0.50	0.53	0.56	0.58	0.61	0.64	0.66	0.69	0.72	0.75	0.77	0.80	0.83	0.85	0.88	0.91	0.93	0.96
114	0.39	0.42	0.45	0.47	0.50	0.53	0.55	0.58	0.61	0.63	0.66	0.69	0.71	0.74	0.77	0.80	0.82	0.85	0.88	0.90	0.93	0.96
115	0.39	0.42	0.44	0.47	0.50	0.52	0.55	0.58	0.60	0.63	0.66	0.68	0.71	0.74	0.76	0.79	0.82	0.85	0.87	0.90	0.93	0.95
116	0.39	0.41	0.44	0.47	0.49	0.52	0.55	0.57	0.60	0.63	0.65	0.68	0.71	0.73	0.76	0.79	0.81	0.84	0.87	0.89	0.92	0.95
117	0.39	0.41	0.44	0.47	0.49	0.52	0.55	0.57	0.60	0.62	0.65	0.68	0.70	0.73	0.76	0.78	0.81	0.84	0.86	0.89	0.92	0.94
118	0.38	0.41	0.44	0.46	0.49	0.52	0.54	0.57	0.60	0.62	0.65	0.67	0.70	0.73	0.75	0.78	0.81	0.83	0.86	0.89	0.91	0.94
119	0.38	0.41	0.44	0.46	0.49	0.51	0.54	0.57	0.59	0.62	0.65	0.67	0.70	0.72	0.75	0.78	0.80	0.83	0.86	0.88	0.91	0.93
120	0.38	0.41	0.43	0.46	0.49	0.51	0.54	0.56	0.59	0.62	0.64	0.67	0.69	0.72	0.75	0.77	0.80	0.83	0.85	0.88	0.90	0.93

T_c (min)	Mean Annual Precipitation (in)																					
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1	6.34	6.78	7.21	7.65	8.08	8.52	8.95	9.39	9.82	10.26	10.69	11.13	11.56	12.00	12.43	12.86	13.30	13.73	14.17	14.60	15.04	15.47
2	4.28	4.57	4.87	5.16	5.45	5.75	6.04	6.34	6.63	6.92	7.22	7.51	7.80	8.10	8.39	8.68	8.98	9.27	9.56	9.86	10.15	10.44
3	3.40	3.63	3.87	4.10	4.33	4.57	4.80	5.03	5.27	5.50	5.73	5.97	6.20	6.43	6.67	6.90	7.13	7.37	7.60	7.83	8.07	8.30
4	2.89	3.09	3.29	3.48	3.68	3.88	4.08	4.28	4.47	4.67	4.87	5.07	5.27	5.46	5.66	5.86	6.06	6.26	6.46	6.65	6.85	7.05
5	2.55	2.72	2.89	3.07	3.24	3.42	3.59	3.77	3.94	4.12	4.29	4.47	4.64	4.82	4.99	5.16	5.34	5.51	5.69	5.86	6.04	6.21
6	2.30	2.45	2.61	2.77	2.93	3.08	3.24	3.40	3.55	3.71	3.87	4.03	4.18	4.34	4.50	4.66	4.81	4.97	5.13	5.29	5.44	5.60
7	2.10	2.25	2.39	2.54	2.68	2.82	2.97	3.11	3.26	3.40	3.55	3.69	3.83	3.98	4.12	4.27	4.41	4.56	4.70	4.84	4.99	5.13
8	1.95	2.08	2.22	2.35	2.48	2.62	2.75	2.89	3.02	3.15	3.29	3.42	3.55	3.69	3.82	3.96	4.09	4.22	4.36	4.49	4.62	4.76
9	1.82	1.95	2.07	2.20	2.32	2.45	2.57	2.70	2.82	2.95	3.07	3.20	3.32	3.45	3.58	3.70	3.83	3.95	4.08	4.20	4.33	4.45
10	1.72	1.84	1.95	2.07	2.19	2.31	2.43	2.54	2.66	2.78	2.90	3.01	3.13	3.25	3.37	3.49	3.60	3.72	3.84	3.96	4.07	4.19
11	1.63	1.74	1.85	1.96	2.07	2.19	2.30	2.41	2.52	2.63	2.74	2.86	2.97	3.08	3.19	3.30	3.41	3.53	3.64	3.75	3.86	3.97
12	1.55	1.66	1.76	1.87	1.97	2.08	2.19	2.29	2.40	2.51	2.61	2.72	2.82	2.93	3.04	3.14	3.25	3.36	3.46	3.57	3.67	3.78
13	1.48	1.58	1.68	1.79	1.89	1.99	2.09	2.19	2.29	2.39	2.50	2.60	2.70	2.80	2.90	3.00	3.11	3.21	3.31	3.41	3.51	3.61
14	1.42	1.52	1.61	1.71	1.81	1.91	2.00	2.10	2.20	2.30	2.39	2.49	2.59	2.69	2.78	2.88	2.98	3.07	3.17	3.27	3.37	3.46
15	1.37	1.46	1.55	1.65	1.74	1.83	1.93	2.02	2.11	2.21	2.30	2.40	2.49	2.58	2.68	2.77	2.86	2.96	3.05	3.14	3.24	3.33
16	1.32	1.41	1.50	1.59	1.68	1.77	1.86	1.95	2.04	2.13	2.22	2.31	2.40	2.49	2.58	2.67	2.76	2.85	2.94	3.03	3.12	3.21
17	1.27	1.36	1.45	1.53	1.62	1.71	1.79	1.88	1.97	2.06	2.14	2.23	2.32	2.41	2.49	2.58	2.67	2.75	2.84	2.93	3.02	3.10
18	1.23	1.32	1.40	1.48	1.57	1.65	1.74	1.82	1.91	1.99	2.08	2.16	2.24	2.33	2.41	2.50	2.58	2.67	2.75	2.84	2.92	3.00
19	1.19	1.28	1.36	1.44	1.52	1.60	1.69	1.77	1.85	1.93	2.01	2.09	2.18	2.26	2.34	2.42	2.50	2.59	2.67	2.75	2.83	2.91
20	1.16	1.24	1.32	1.40	1.48	1.56	1.64	1.72	1.80	1.88	1.95	2.03	2.11	2.19	2.27	2.35	2.43	2.51	2.59	2.67	2.75	2.83
21	1.13	1.21	1.28	1.36	1.44	1.51	1.59	1.67	1.75	1.82	1.90	1.98	2.06	2.13	2.21	2.29	2.37	2.44	2.52	2.60	2.68	2.75
22	1.10	1.17	1.25	1.32	1.40	1.48	1.55	1.63	1.70	1.78	1.85	1.93	2.00	2.08	2.15	2.23	2.30	2.38	2.45	2.53	2.61	2.68
23	1.07	1.14	1.22	1.29	1.37	1.44	1.51	1.59	1.66	1.73	1.81	1.88	1.95	2.03	2.10	2.17	2.25	2.32	2.39	2.47	2.54	2.61
24	1.05	1.12	1.19	1.26	1.33	1.40	1.48	1.55	1.62	1.69	1.76	1.83	1.91	1.98	2.05	2.12	2.19	2.26	2.34	2.41	2.48	2.55
25	1.02	1.09	1.16	1.23	1.30	1.37	1.44	1.51	1.58	1.65	1.72	1.79	1.86	1.93	2.00	2.07	2.14	2.21	2.28	2.35	2.42	2.49
26	1.00	1.07	1.14	1.21	1.27	1.34	1.41	1.48	1.55	1.62	1.68	1.75	1.82	1.89	1.96	2.03	2.10	2.16	2.23	2.30	2.37	2.44
27	0.98	1.05	1.11	1.18	1.25	1.31	1.38	1.45	1.51	1.58	1.65	1.72	1.78	1.85	1.92	1.98	2.05	2.12	2.19	2.25	2.32	2.39
28	0.96	1.02	1.09	1.16	1.22	1.29	1.35	1.42	1.48	1.55	1.62	1.68	1.75	1.81	1.88	1.94	2.01	2.08	2.14	2.21	2.27	2.34
29	0.94	1.00	1.07	1.13	1.20	1.26	1.33	1.39	1.45	1.52	1.58	1.65	1.71	1.78	1.84	1.91	1.97	2.03	2.10	2.16	2.23	2.29
30	0.92	0.98	1.05	1.11	1.17	1.24	1.30	1.36	1.43	1.49	1.55	1.62	1.68	1.74	1.81	1.87	1.93	2.00	2.06	2.12	2.19	2.25
31	0.90	0.97	1.03	1.09	1.15	1.21	1.28	1.34	1.40	1.46	1.52	1.59	1.65	1.71	1.77	1.83	1.90	1.96	2.02	2.08	2.14	2.21
32	0.89	0.95	1.01	1.07	1.13	1.19	1.25	1.31	1.38	1.44	1.50	1.56	1.62	1.68	1.74	1.80	1.86	1.92	1.98	2.05	2.11	2.17
33	0.87	0.93	0.99	1.05	1.11	1.17	1.23	1.29	1.35	1.41	1.47	1.53	1.59	1.65	1.71	1.77	1.83	1.89	1.95	2.01	2.07	2.13
34	0.86	0.92	0.98	1.03	1.09	1.15	1.21	1.27	1.33	1.39	1.45	1.51	1.56	1.62	1.68	1.74	1.80	1.86	1.92	1.98	2.04	2.09
35	0.84	0.90	0.96	1.02	1.08	1.13	1.19	1.25	1.31	1.37	1.42	1.48	1.54	1.60	1.65	1.71	1.77	1.83	1.89	1.94	2.00	2.06
36	0.83	0.89	0.94	1.00	1.06	1.12	1.17	1.23	1.29	1.34	1.40	1.46	1.51	1.57	1.63	1.69	1.74	1.80	1.86	1.91	1.97	2.03
37	0.82	0.87	0.93	0.99	1.04	1.10	1.15	1.21	1.27	1.32	1.38	1.44	1.49	1.55	1.60	1.66	1.72	1.77	1.83	1.88	1.94	2.00
38	0.81	0.86	0.92	0.97	1.03	1.08	1.14	1.19	1.25	1.30	1.36	1.41	1.47	1.52	1.58	1.63	1.69	1.75	1.80	1.86	1.91	1.97
39	0.79	0.85	0.90	0.96	1.01	1.07	1.12	1.18	1.23	1.28	1.34	1.39	1.45	1.50	1.56	1.61	1.67	1.72	1.77	1.83	1.88	1.94
40	0.78	0.84	0.89	0.94	1.00	1.05	1.10	1.16	1.21	1.27	1.32	1.37	1.43	1.48	1.53	1.59	1.64	1.70	1.75	1.80	1.86	1.91
41	0.77	0.82	0.88	0.93	0.98	1.04	1.09	1.14	1.20	1.25	1.30	1.35	1.41	1.46	1.51	1.57	1.62	1.67	1.72	1.78	1.83	1.88
42	0.76	0.81	0.87	0.92	0.97	1.02	1.07	1.13	1.18	1.23	1.28	1.34	1.39	1.44	1.49	1.54	1.60	1.65	1.70	1.75	1.81	1.86
43	0.75	0.80	0.85	0.91	0.96	1.01	1.06	1.11	1.16	1.21	1.27	1.32	1.37	1.42	1.47	1.52	1.58	1.63	1.68	1.73	1.78	1.83
44	0.74	0.79	0.84	0.89	0.95	1.00	1.05	1.10	1.15	1.20	1.25	1.30	1.35	1.40	1.45	1.50	1.56	1.61	1.66	1.71	1.76	1.81
45	0.73	0.78	0.83	0.88	0.93	0.98	1.03	1.08	1.13	1.18	1.23	1.28	1.33	1.38	1.44	1.49	1.54	1.59	1.64	1.69	1.74	1.79
46	0.72	0.77	0.82	0.87	0.92	0.97	1.02	1.07	1.12	1.17	1.22	1.27	1.32	1.37	1.42	1.47	1.52	1.57	1.62	1.67	1.71	1.76
47	0.71	0.76	0.81	0.86	0.91	0.96	1.01	1.06	1.11	1.16	1.20	1.25	1.30	1.35	1.40	1.45	1.50	1.55	1.60	1.65	1.69	1.74
48	0.71	0.75	0.80	0.85	0.90	0.95	1.00	1.04	1.09	1.14	1.19	1.24	1.29	1.34	1.38	1.43	1.48	1.53	1.58	1.63	1.67	1.72
49	0.70	0.75	0.79	0.84	0.89	0.94	0.98	1.03	1.08	1.13	1.18	1.22	1.27	1.32	1.37	1.42	1.46	1.51	1.56	1.61	1.65	1.70
50	0.69	0.74	0.78	0.83	0.88	0.93	0.97	1.02	1.07	1.12	1.16	1.21	1.26	1.30	1.35	1.40	1.45	1.49	1.54	1.59	1.64	1.68
51	0.68	0.73	0.78	0.82	0.87	0.92	0.96	1.01	1.06	1.10	1.15	1.20	1.24	1.29	1.34	1.38	1.43	1.48	1.52	1.57	1.62	1.66
52	0.67	0.72	0.77	0.81	0.86	0.91	0.95	1.00	1.04	1.09	1.14	1.18	1.23	1.28	1.32	1.37	1.41	1.46	1.51	1.55	1.60	1.65
53	0.67	0.71	0.76	0.80	0.85	0.90	0.94	0.99	1.03	1.08	1.12	1.17	1.22	1.26	1.31	1.35	1.40	1.45	1.49	1.54	1.58	1.63
54	0.66	0.71	0.75	0.80	0.84	0.89	0.93	0.98	1.02	1.07	1.11	1.16	1.20	1.25	1.29	1.34	1.38	1.43	1.48	1.52	1.57	1.61
55	0.65	0.70	0.74	0.79	0.83	0.88	0.92	0.97	1.01	1.06	1.10	1.15	1.19	1.24	1.28	1.33	1.37	1.42	1.46	1.50	1.55	1.59
56	0.65	0.69	0.74	0.78	0.82	0.87	0.91	0.96	1.00	1.05	1.09	1.13	1.18	1.22	1.27	1.31	1.36	1.40	1.45	1.49	1.53	1.58
57	0.64	0.68	0.73	0.77	0.82	0.86	0.90	0.95	0.99	1.04	1.08	1.12	1.17	1.21	1.26	1.30	1.34	1.39	1.43	1.47	1.52	1.56
58	0.63	0.68	0.72	0.76	0.81	0.85	0.89	0.94	0.98	1.03	1.07	1.11	1.16	1.20	1.24	1.29	1.33	1.37	1.42	1.46	1.50	1.55
59	0.63	0.67	0.71	0.76	0.80	0.84	0.89	0.93	0.97	1.02	1.06	1.10	1.14	1.19	1.23	1.27	1.32	1.36	1.40	1.45	1.49	1.53
60	0.62	0.66	0.71	0.75	0.79	0.84	0.88	0.92	0.96	1.01	1.05	1.09	1.13	1.18	1.22	1.26	1.30	1.35	1.39	1.43	1.47	1.52

T_c (min)	Mean Annual Precipitation (in)																					
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
61	0.62	0.66	0.70	0.74	0.79	0.83	0.87	0.91	0.95	1.00	1.04	1.08	1.12	1.17	1.21	1.25	1.29	1.33	1.38	1.42	1.46	1.50
62	0.61	0.65	0.69	0.74	0.78	0.82	0.86	0.90	0.95	0.99	1.03	1.07	1.11	1.15	1.20	1.24	1.28	1.32	1.36	1.41	1.45	1.49
63	0.61	0.65	0.69	0.73	0.77	0.81	0.85	0.90	0.94	0.98	1.02	1.06	1.10	1.14	1.19	1.23	1.27	1.31	1.35	1.39	1.43	1.48
64	0.60	0.64	0.68	0.72	0.76	0.81	0.85	0.89	0.93	0.97	1.01	1.05	1.09	1.13	1.18	1.22	1.26	1.30	1.34	1.38	1.42	1.46
65	0.59	0.64	0.68	0.72	0.76	0.80	0.84	0.88	0.92	0.96	1.00	1.04	1.08	1.12	1.16	1.21	1.25	1.29	1.33	1.37	1.41	1.45
66	0.59	0.63	0.67	0.71	0.75	0.79	0.83	0.87	0.91	0.95	0.99	1.03	1.07	1.11	1.15	1.20	1.24	1.28	1.32	1.36	1.40	1.44
67	0.58	0.62	0.66	0.70	0.74	0.78	0.82	0.86	0.90	0.94	0.98	1.02	1.06	1.11	1.15	1.19	1.23	1.27	1.31	1.35	1.39	1.43
68	0.58	0.62	0.66	0.70	0.74	0.78	0.82	0.86	0.90	0.94	0.98	1.02	1.06	1.10	1.14	1.18	1.21	1.25	1.29	1.33	1.37	1.41
69	0.57	0.61	0.65	0.69	0.73	0.77	0.81	0.85	0.89	0.93	0.97	1.01	1.05	1.09	1.13	1.17	1.20	1.24	1.28	1.32	1.36	1.40
70	0.57	0.61	0.65	0.69	0.73	0.77	0.80	0.84	0.88	0.92	0.96	1.00	1.04	1.08	1.12	1.16	1.20	1.23	1.27	1.31	1.35	1.39
71	0.57	0.60	0.64	0.68	0.72	0.76	0.80	0.84	0.88	0.91	0.95	0.99	1.03	1.07	1.11	1.15	1.19	1.22	1.26	1.30	1.34	1.38
72	0.56	0.60	0.64	0.68	0.71	0.75	0.79	0.83	0.87	0.91	0.95	0.98	1.02	1.06	1.10	1.14	1.18	1.21	1.25	1.29	1.33	1.37
73	0.56	0.59	0.63	0.67	0.71	0.75	0.79	0.82	0.86	0.90	0.94	0.98	1.01	1.05	1.09	1.13	1.17	1.21	1.24	1.28	1.32	1.36
74	0.55	0.59	0.63	0.67	0.70	0.74	0.78	0.82	0.86	0.89	0.93	0.97	1.01	1.04	1.08	1.12	1.16	1.20	1.23	1.27	1.31	1.35
75	0.55	0.59	0.62	0.66	0.70	0.74	0.77	0.81	0.85	0.89	0.92	0.96	1.00	1.04	1.07	1.11	1.15	1.19	1.22	1.26	1.30	1.34
76	0.54	0.58	0.62	0.66	0.69	0.73	0.77	0.81	0.84	0.88	0.92	0.95	0.99	1.03	1.07	1.10	1.14	1.18	1.22	1.25	1.29	1.33
77	0.54	0.58	0.61	0.65	0.69	0.73	0.76	0.80	0.84	0.87	0.91	0.95	0.98	1.02	1.06	1.10	1.13	1.17	1.21	1.24	1.28	1.32
78	0.54	0.57	0.61	0.65	0.68	0.72	0.76	0.79	0.83	0.87	0.90	0.94	0.98	1.01	1.05	1.09	1.12	1.16	1.20	1.23	1.27	1.31
79	0.53	0.57	0.61	0.64	0.68	0.71	0.75	0.79	0.82	0.86	0.90	0.93	0.97	1.01	1.04	1.08	1.12	1.15	1.19	1.23	1.26	1.30
80	0.53	0.56	0.60	0.64	0.67	0.71	0.75	0.78	0.82	0.85	0.89	0.93	0.96	1.00	1.04	1.07	1.11	1.14	1.18	1.22	1.25	1.29
81	0.52	0.56	0.60	0.63	0.67	0.70	0.74	0.78	0.81	0.85	0.88	0.92	0.96	0.99	1.03	1.06	1.10	1.14	1.17	1.21	1.24	1.28
82	0.52	0.56	0.59	0.63	0.66	0.70	0.74	0.77	0.81	0.84	0.88	0.91	0.95	0.99	1.02	1.06	1.09	1.13	1.16	1.20	1.24	1.27
83	0.52	0.55	0.59	0.62	0.66	0.69	0.73	0.77	0.80	0.84	0.87	0.91	0.94	0.98	1.01	1.05	1.09	1.12	1.16	1.19	1.23	1.26
84	0.51	0.55	0.58	0.62	0.65	0.69	0.73	0.76	0.80	0.83	0.87	0.90	0.94	0.97	1.01	1.04	1.08	1.11	1.15	1.18	1.22	1.25
85	0.51	0.55	0.58	0.62	0.65	0.69	0.72	0.76	0.79	0.83	0.86	0.90	0.93	0.97	1.00	1.04	1.07	1.11	1.14	1.18	1.21	1.25
86	0.51	0.54	0.58	0.61	0.65	0.68	0.72	0.75	0.79	0.82	0.85	0.89	0.92	0.96	0.99	1.03	1.06	1.10	1.13	1.17	1.20	1.24
87	0.50	0.54	0.57	0.61	0.64	0.68	0.71	0.75	0.78	0.81	0.85	0.88	0.92	0.95	0.99	1.02	1.06	1.09	1.13	1.16	1.19	1.23
88	0.50	0.53	0.57	0.60	0.64	0.67	0.71	0.74	0.78	0.81	0.84	0.88	0.91	0.95	0.98	1.02	1.05	1.08	1.12	1.15	1.19	1.22
89	0.50	0.53	0.57	0.60	0.63	0.67	0.70	0.74	0.77	0.80	0.84	0.87	0.91	0.94	0.97	1.01	1.04	1.08	1.11	1.15	1.18	1.21
90	0.49	0.53	0.56	0.60	0.63	0.66	0.70	0.73	0.77	0.80	0.83	0.87	0.90	0.93	0.97	1.00	1.04	1.07	1.10	1.14	1.17	1.21
91	0.49	0.52	0.56	0.59	0.63	0.66	0.69	0.73	0.76	0.79	0.83	0.86	0.90	0.93	0.96	1.00	1.03	1.06	1.10	1.13	1.16	1.20
92	0.49	0.52	0.56	0.59	0.62	0.66	0.69	0.72	0.76	0.79	0.82	0.86	0.89	0.92	0.96	0.99	1.02	1.06	1.09	1.12	1.16	1.19
93	0.49	0.52	0.55	0.58	0.62	0.65	0.68	0.72	0.75	0.78	0.82	0.85	0.88	0.92	0.95	0.98	1.02	1.05	1.08	1.12	1.15	1.18
94	0.48	0.52	0.55	0.58	0.61	0.65	0.68	0.71	0.75	0.78	0.81	0.85	0.88	0.91	0.95	0.98	1.01	1.04	1.08	1.11	1.14	1.18
95	0.48	0.51	0.55	0.58	0.61	0.64	0.68	0.71	0.74	0.78	0.81	0.84	0.87	0.91	0.94	0.97	1.01	1.04	1.07	1.10	1.14	1.17
96	0.48	0.51	0.54	0.57	0.61	0.64	0.67	0.71	0.74	0.77	0.80	0.84	0.87	0.90	0.93	0.97	1.00	1.03	1.06	1.10	1.13	1.16
97	0.47	0.51	0.54	0.57	0.60	0.64	0.67	0.70	0.73	0.77	0.80	0.83	0.86	0.90	0.93	0.96	0.99	1.03	1.06	1.09	1.12	1.16
98	0.47	0.50	0.54	0.57	0.60	0.63	0.66	0.70	0.73	0.76	0.79	0.83	0.86	0.89	0.92	0.96	0.99	1.02	1.05	1.08	1.12	1.15
99	0.47	0.50	0.53	0.56	0.60	0.63	0.66	0.69	0.73	0.76	0.79	0.82	0.85	0.89	0.92	0.95	0.98	1.01	1.05	1.08	1.11	1.14
100	0.47	0.50	0.53	0.56	0.59	0.63	0.66	0.69	0.72	0.75	0.78	0.82	0.85	0.88	0.91	0.94	0.98	1.01	1.04	1.07	1.10	1.14
101	0.46	0.49	0.53	0.56	0.59	0.62	0.65	0.69	0.72	0.75	0.78	0.81	0.84	0.88	0.91	0.94	0.97	1.00	1.03	1.07	1.10	1.13
102	0.46	0.49	0.52	0.56	0.59	0.62	0.65	0.68	0.71	0.74	0.78	0.81	0.84	0.87	0.90	0.93	0.97	1.00	1.03	1.06	1.09	1.12
103	0.46	0.49	0.52	0.55	0.58	0.61	0.65	0.68	0.71	0.74	0.77	0.80	0.83	0.87	0.90	0.93	0.96	0.99	1.02	1.05	1.09	1.12
104	0.46	0.49	0.52	0.55	0.58	0.61	0.64	0.67	0.71	0.74	0.77	0.80	0.83	0.86	0.89	0.92	0.95	0.99	1.02	1.05	1.08	1.11
105	0.45	0.48	0.51	0.55	0.58	0.61	0.64	0.67	0.70	0.73	0.76	0.79	0.83	0.86	0.89	0.92	0.95	0.98	1.01	1.04	1.07	1.10
106	0.45	0.48	0.51	0.54	0.57	0.60	0.64	0.67	0.70	0.73	0.76	0.79	0.82	0.85	0.88	0.91	0.94	0.98	1.01	1.04	1.07	1.10
107	0.45	0.48	0.51	0.54	0.57	0.60	0.63	0.66	0.69	0.72	0.76	0.79	0.82	0.85	0.88	0.91	0.94	0.97	1.00	1.03	1.06	1.09
108	0.45	0.48	0.51	0.54	0.57	0.60	0.63	0.66	0.69	0.72	0.75	0.78	0.81	0.84	0.87	0.90	0.93	0.97	1.00	1.03	1.06	1.09
109	0.44	0.47	0.50	0.53	0.56	0.60	0.63	0.66	0.69	0.72	0.75	0.78	0.81	0.84	0.87	0.90	0.93	0.96	0.99	1.02	1.05	1.08
110	0.44	0.47	0.50	0.53	0.56	0.59	0.62	0.65	0.68	0.71	0.74	0.77	0.80	0.83	0.86	0.89	0.92	0.96	0.99	1.02	1.05	1.08
111	0.44	0.47	0.50	0.53	0.56	0.59	0.62	0.65	0.68	0.71	0.74	0.77	0.80	0.83	0.86	0.89	0.92	0.95	0.98	1.01	1.04	1.07
112	0.44	0.47	0.50	0.53	0.56	0.59	0.62	0.65	0.68	0.71	0.74	0.77	0.80	0.83	0.86	0.89	0.92	0.95	0.98	1.01	1.04	1.07
113	0.43	0.46	0.49	0.52	0.55	0.58	0.61	0.64	0.67	0.70	0.73	0.76	0.79	0.82	0.85	0.88	0.91	0.94	0.97	1.00	1.03	1.06
114	0.43	0.46	0.49	0.52	0.55	0.58	0.61	0.64	0.67	0.70	0.73	0.76	0.79	0.82	0.85	0.88	0.91	0.94	0.97	1.00	1.02	1.05
115	0.43	0.46	0.49	0.52	0.55	0.58	0.61	0.64	0.67	0.70	0.72	0.75	0.78	0.81	0.84	0.87	0.90	0.93	0.96	0.99	1.02	1.05
116	0.43	0.46	0.49	0.52	0.55	0.57	0.60	0.63	0.66	0.69	0.72	0.75	0.78	0.81	0.84	0.87	0.90	0.93	0.96	0.99	1.01	1.04
117	0.43	0.46	0.48	0.51	0.54	0.57	0.60	0.63	0.66	0.69	0.72	0.75	0.78	0.81	0.83	0.86	0.89	0.92	0.95	0.98	1.01	1.04
118	0.42	0.45	0.48	0.51	0.54	0.57	0.60	0.63	0.66	0.69	0.71	0.74	0.77	0.80	0.83	0.86	0.89	0.92	0.95	0.98	1.01	1.03
119	0.42	0.45	0.48	0.51	0.54	0.57	0.60	0.62	0.65	0.68	0.71	0.74	0.77	0.80	0.83	0.86	0.88	0.91	0.94	0.97	1.00	1.03
120	0.42	0.45	0.48	0.51	0.53	0.56	0.59	0.62	0.65	0.68	0.71	0.74	0.77	0.79	0.82	0.85	0.88	0.91	0.94	0.97	1.00	1.02

T_c (min)	Mean Annual Precipitation (in)																					
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1	7.12	7.60	8.09	8.58	9.07	9.55	10.04	10.53	11.02	11.51	11.99	12.48	12.97	13.46	13.95	14.43	14.92	15.41	15.90	16.39	16.87	17.36
2	4.80	5.13	5.46	5.79	6.12	6.45	6.78	7.11	7.44	7.77	8.10	8.43	8.75	9.08	9.41	9.74	10.07	10.40	10.73	11.06	11.39	11.72
3	3.82	4.08	4.34	4.60	4.86	5.12	5.39	5.65	5.91	6.17	6.43	6.69	6.96	7.22	7.48	7.74	8.00	8.26	8.53	8.79	9.05	9.31
4	3.24	3.46	3.69	3.91	4.13	4.35	4.58	4.80	5.02	5.24	5.46	5.69	5.91	6.13	6.35	6.58	6.80	7.02	7.24	7.46	7.69	7.91
5	2.86	3.05	3.25	3.44	3.64	3.84	4.03	4.23	4.42	4.62	4.81	5.01	5.21	5.40	5.60	5.79	5.99	6.19	6.38	6.58	6.77	6.97
6	2.58	2.75	2.93	3.11	3.28	3.46	3.64	3.81	3.99	4.17	4.34	4.52	4.70	4.87	5.05	5.22	5.40	5.58	5.75	5.93	6.11	6.28
7	2.36	2.52	2.68	2.85	3.01	3.17	3.33	3.49	3.65	3.82	3.98	4.14	4.30	4.46	4.63	4.79	4.95	5.11	5.27	5.43	5.60	5.76
8	2.19	2.34	2.49	2.64	2.79	2.94	3.09	3.24	3.39	3.54	3.69	3.84	3.99	4.14	4.29	4.44	4.59	4.74	4.89	5.04	5.19	5.34
9	2.05	2.19	2.33	2.47	2.61	2.75	2.89	3.03	3.17	3.31	3.45	3.59	3.73	3.87	4.01	4.15	4.29	4.43	4.57	4.71	4.85	4.99
10	1.93	2.06	2.19	2.32	2.46	2.59	2.72	2.85	2.99	3.12	3.25	3.38	3.51	3.65	3.78	3.91	4.04	4.18	4.31	4.44	4.57	4.70
11	1.83	1.95	2.08	2.20	2.33	2.45	2.58	2.70	2.83	2.95	3.08	3.20	3.33	3.45	3.58	3.70	3.83	3.96	4.08	4.21	4.33	4.46
12	1.74	1.86	1.98	2.10	2.22	2.33	2.45	2.57	2.69	2.81	2.93	3.05	3.17	3.29	3.41	3.53	3.65	3.76	3.88	4.00	4.12	4.24
13	1.66	1.78	1.89	2.00	2.12	2.23	2.34	2.46	2.57	2.69	2.80	2.91	3.03	3.14	3.26	3.37	3.48	3.60	3.71	3.83	3.94	4.05
14	1.59	1.70	1.81	1.92	2.03	2.14	2.25	2.36	2.47	2.58	2.69	2.79	2.90	3.01	3.12	3.23	3.34	3.45	3.56	3.67	3.78	3.89
15	1.53	1.64	1.74	1.85	1.95	2.06	2.16	2.27	2.37	2.48	2.58	2.69	2.79	2.90	3.00	3.11	3.21	3.32	3.42	3.53	3.63	3.74
16	1.48	1.58	1.68	1.78	1.88	1.98	2.08	2.19	2.29	2.39	2.49	2.59	2.69	2.79	2.89	3.00	3.10	3.20	3.30	3.40	3.50	3.60
17	1.43	1.52	1.62	1.72	1.82	1.92	2.01	2.11	2.21	2.31	2.41	2.50	2.60	2.70	2.80	2.89	2.99	3.09	3.19	3.29	3.38	3.48
18	1.38	1.48	1.57	1.67	1.76	1.85	1.95	2.04	2.14	2.23	2.33	2.42	2.52	2.61	2.71	2.80	2.90	2.99	3.09	3.18	3.28	3.37
19	1.34	1.43	1.52	1.62	1.71	1.80	1.89	1.98	2.07	2.17	2.26	2.35	2.44	2.53	2.63	2.72	2.81	2.90	2.99	3.08	3.18	3.27
20	1.30	1.39	1.48	1.57	1.66	1.75	1.84	1.93	2.02	2.10	2.19	2.28	2.37	2.46	2.55	2.64	2.73	2.82	2.91	3.00	3.09	3.17
21	1.27	1.35	1.44	1.53	1.61	1.70	1.79	1.87	1.96	2.05	2.13	2.22	2.31	2.39	2.48	2.57	2.65	2.74	2.83	2.91	3.00	3.09
22	1.23	1.32	1.40	1.49	1.57	1.66	1.74	1.82	1.91	1.99	2.08	2.16	2.25	2.33	2.42	2.50	2.59	2.67	2.75	2.84	2.92	3.01
23	1.20	1.28	1.37	1.45	1.53	1.61	1.70	1.78	1.86	1.94	2.03	2.11	2.19	2.27	2.36	2.44	2.52	2.60	2.69	2.77	2.85	2.93
24	1.17	1.25	1.33	1.41	1.50	1.58	1.66	1.74	1.82	1.90	1.98	2.06	2.14	2.22	2.30	2.38	2.46	2.54	2.62	2.70	2.78	2.86
25	1.15	1.23	1.30	1.38	1.46	1.54	1.62	1.70	1.78	1.85	1.93	2.01	2.09	2.17	2.25	2.33	2.40	2.48	2.56	2.64	2.72	2.80
26	1.12	1.20	1.28	1.35	1.43	1.51	1.58	1.66	1.74	1.81	1.89	1.97	2.04	2.12	2.20	2.27	2.35	2.43	2.51	2.58	2.66	2.74
27	1.10	1.17	1.25	1.32	1.40	1.47	1.55	1.62	1.70	1.77	1.85	1.93	2.00	2.08	2.15	2.23	2.30	2.38	2.45	2.53	2.60	2.68
28	1.08	1.15	1.22	1.30	1.37	1.44	1.52	1.59	1.66	1.74	1.81	1.89	1.96	2.03	2.11	2.18	2.25	2.33	2.40	2.48	2.55	2.62
29	1.05	1.13	1.20	1.27	1.34	1.42	1.49	1.56	1.63	1.70	1.78	1.85	1.92	1.99	2.07	2.14	2.21	2.28	2.35	2.43	2.50	2.57
30	1.03	1.10	1.18	1.25	1.32	1.39	1.46	1.53	1.60	1.67	1.74	1.81	1.88	1.96	2.03	2.10	2.17	2.24	2.31	2.38	2.45	2.52
31	1.01	1.08	1.15	1.22	1.29	1.36	1.43	1.50	1.57	1.64	1.71	1.78	1.85	1.92	1.99	2.06	2.13	2.20	2.27	2.34	2.41	2.48
32	1.00	1.07	1.13	1.20	1.27	1.34	1.41	1.48	1.54	1.61	1.68	1.75	1.82	1.89	1.95	2.02	2.09	2.16	2.23	2.30	2.36	2.43
33	0.98	1.05	1.11	1.18	1.25	1.32	1.38	1.45	1.52	1.58	1.65	1.72	1.79	1.85	1.92	1.99	2.05	2.12	2.19	2.26	2.32	2.39
34	0.96	1.03	1.10	1.16	1.23	1.29	1.36	1.43	1.49	1.56	1.62	1.69	1.76	1.82	1.89	1.95	2.02	2.09	2.15	2.22	2.28	2.35
35	0.95	1.01	1.08	1.14	1.21	1.27	1.34	1.40	1.47	1.53	1.60	1.66	1.73	1.79	1.86	1.92	1.99	2.05	2.12	2.18	2.25	2.31
36	0.93	1.00	1.06	1.12	1.19	1.25	1.32	1.38	1.44	1.51	1.57	1.64	1.70	1.76	1.83	1.89	1.96	2.02	2.08	2.15	2.21	2.27
37	0.92	0.98	1.04	1.11	1.17	1.23	1.30	1.36	1.42	1.48	1.55	1.61	1.67	1.74	1.80	1.86	1.93	1.99	2.05	2.11	2.18	2.24
38	0.90	0.97	1.03	1.09	1.15	1.21	1.28	1.34	1.40	1.46	1.52	1.59	1.65	1.71	1.77	1.83	1.90	1.96	2.02	2.08	2.14	2.21
39	0.89	0.95	1.01	1.07	1.14	1.20	1.26	1.32	1.38	1.44	1.50	1.56	1.62	1.69	1.75	1.81	1.87	1.93	1.99	2.05	2.11	2.17
40	0.88	0.94	1.00	1.06	1.12	1.18	1.24	1.30	1.36	1.42	1.48	1.54	1.60	1.66	1.72	1.78	1.84	1.90	1.96	2.02	2.08	2.14
41	0.87	0.93	0.98	1.04	1.10	1.16	1.22	1.28	1.34	1.40	1.46	1.52	1.58	1.64	1.70	1.76	1.82	1.88	1.93	1.99	2.05	2.11
42	0.85	0.91	0.97	1.03	1.09	1.15	1.21	1.26	1.32	1.38	1.44	1.50	1.56	1.62	1.67	1.73	1.79	1.85	1.91	1.97	2.03	2.08
43	0.84	0.90	0.96	1.02	1.07	1.13	1.19	1.25	1.31	1.36	1.42	1.48	1.54	1.59	1.65	1.71	1.77	1.83	1.88	1.94	2.00	2.06
44	0.83	0.89	0.95	1.00	1.06	1.12	1.17	1.23	1.29	1.35	1.40	1.46	1.52	1.57	1.63	1.69	1.74	1.80	1.86	1.92	1.97	2.03
45	0.82	0.88	0.93	0.99	1.05	1.10	1.16	1.22	1.27	1.33	1.38	1.44	1.50	1.55	1.61	1.67	1.72	1.78	1.84	1.89	1.95	2.00
46	0.81	0.87	0.92	0.98	1.03	1.09	1.15	1.20	1.26	1.31	1.37	1.42	1.48	1.53	1.59	1.65	1.70	1.76	1.81	1.87	1.92	1.98
47	0.80	0.86	0.91	0.97	1.02	1.08	1.13	1.19	1.24	1.30	1.35	1.41	1.46	1.52	1.57	1.63	1.68	1.74	1.79	1.85	1.90	1.96
48	0.79	0.85	0.90	0.95	1.01	1.06	1.12	1.17	1.23	1.28	1.34	1.39	1.44	1.50	1.55	1.61	1.66	1.72	1.77	1.82	1.88	1.93
49	0.78	0.84	0.89	0.94	1.00	1.05	1.10	1.16	1.21	1.27	1.32	1.37	1.43	1.48	1.53	1.59	1.64	1.70	1.75	1.80	1.86	1.91
50	0.77	0.83	0.88	0.93	0.99	1.04	1.09	1.15	1.20	1.25	1.30	1.36	1.41	1.46	1.52	1.57	1.62	1.68	1.73	1.78	1.84	1.89
51	0.77	0.82	0.87	0.92	0.98	1.03	1.08	1.13	1.18	1.24	1.29	1.34	1.39	1.45	1.50	1.55	1.60	1.66	1.71	1.76	1.81	1.87
52	0.76	0.81	0.86	0.91	0.96	1.02	1.07	1.12	1.17	1.22	1.28	1.33	1.38	1.43	1.48	1.54	1.59	1.64	1.69	1.74	1.79	1.85
53	0.75	0.80	0.85	0.90	0.95	1.01	1.06	1.11	1.16	1.21	1.26	1.31	1.36	1.42	1.47	1.52	1.57	1.62	1.67	1.72	1.78	1.83
54	0.74	0.79	0.84	0.89	0.94	0.99	1.05	1.10	1.15	1.20	1.25	1.30	1.35	1.40	1.45	1.50	1.55	1.60	1.66	1.71	1.76	1.81
55	0.73	0.78	0.83	0.88	0.93	0.98	1.03	1.09	1.14	1.19	1.24	1.29	1.34	1.39	1.44	1.49	1.54	1.59	1.64	1.69	1.74	1.79
56	0.73	0.78	0.83	0.87	0.92	0.97	1.02	1.07	1.12	1.17	1.22	1.27	1.32	1.37	1.42	1.47	1.52	1.57	1.62	1.67	1.72	1.77
57	0.72	0.77	0.82	0.87	0.92	0.96	1.01	1.06	1.11	1.16	1.21	1.26	1.31	1.36	1.41	1.46	1.51	1.56	1.61	1.65	1.70	1.75
58	0.71	0.76	0.81	0.86	0.91	0.96	1.00	1.05	1.10	1.15	1.20	1.25	1.30	1.35	1.39	1.44	1.49	1.54	1.59	1.64	1.69	1.74
59	0.70	0.75	0.80	0.85	0.90	0.95	0.99	1.04	1.09	1.14	1.19	1.24	1.28	1.33	1.38	1.43	1.48	1.53	1.57	1.62	1.67	1.72
60	0.70	0.75	0.79	0.84	0.89	0.94	0.98	1.03	1.08	1.13	1.18	1.22	1.27	1.32	1.37	1.42	1.46	1.51	1.56	1.61	1.65	1.70

T_c (min)	Mean Annual Precipitation (in)																					
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
61	0.69	0.74	0.79	0.83	0.88	0.93	0.98	1.02	1.07	1.12	1.17	1.21	1.26	1.31	1.35	1.40	1.45	1.50	1.54	1.59	1.64	1.69
62	0.68	0.73	0.78	0.83	0.87	0.92	0.97	1.01	1.06	1.11	1.15	1.20	1.25	1.30	1.34	1.39	1.44	1.48	1.53	1.58	1.62	1.67
63	0.68	0.73	0.77	0.82	0.86	0.91	0.96	1.00	1.05	1.10	1.14	1.19	1.24	1.28	1.33	1.38	1.42	1.47	1.52	1.56	1.61	1.66
64	0.67	0.72	0.77	0.81	0.86	0.90	0.95	1.00	1.04	1.09	1.13	1.18	1.23	1.27	1.32	1.36	1.41	1.46	1.50	1.55	1.60	1.64
65	0.67	0.71	0.76	0.80	0.85	0.90	0.94	0.99	1.03	1.08	1.12	1.17	1.22	1.26	1.31	1.35	1.40	1.44	1.49	1.54	1.58	1.63
66	0.66	0.71	0.75	0.80	0.84	0.89	0.93	0.98	1.02	1.07	1.11	1.16	1.21	1.25	1.30	1.34	1.39	1.43	1.48	1.52	1.57	1.61
67	0.66	0.70	0.75	0.79	0.84	0.88	0.93	0.97	1.02	1.06	1.10	1.15	1.19	1.24	1.28	1.33	1.37	1.42	1.46	1.51	1.55	1.60
68	0.65	0.69	0.74	0.78	0.83	0.87	0.92	0.96	1.01	1.05	1.10	1.14	1.18	1.23	1.27	1.32	1.36	1.41	1.45	1.50	1.54	1.59
69	0.64	0.69	0.73	0.78	0.82	0.87	0.91	0.95	1.00	1.04	1.09	1.13	1.18	1.22	1.26	1.31	1.35	1.40	1.44	1.48	1.53	1.57
70	0.64	0.68	0.73	0.77	0.81	0.86	0.90	0.95	0.99	1.03	1.08	1.12	1.17	1.21	1.25	1.30	1.34	1.38	1.43	1.47	1.52	1.56
71	0.63	0.68	0.72	0.76	0.81	0.85	0.90	0.94	0.98	1.03	1.07	1.11	1.16	1.20	1.24	1.29	1.33	1.37	1.42	1.46	1.50	1.55
72	0.63	0.67	0.72	0.76	0.80	0.85	0.89	0.93	0.97	1.02	1.06	1.10	1.15	1.19	1.23	1.28	1.32	1.36	1.41	1.45	1.49	1.54
73	0.62	0.67	0.71	0.75	0.80	0.84	0.88	0.92	0.97	1.01	1.05	1.10	1.14	1.18	1.22	1.27	1.31	1.35	1.40	1.44	1.48	1.52
74	0.62	0.66	0.70	0.75	0.79	0.83	0.87	0.92	0.96	1.00	1.04	1.09	1.13	1.17	1.21	1.26	1.30	1.34	1.38	1.43	1.47	1.51
75	0.61	0.66	0.70	0.74	0.78	0.83	0.87	0.91	0.95	0.99	1.04	1.08	1.12	1.16	1.21	1.25	1.29	1.33	1.37	1.42	1.46	1.50
76	0.61	0.65	0.69	0.74	0.78	0.82	0.86	0.90	0.95	0.99	1.03	1.07	1.11	1.15	1.20	1.24	1.28	1.32	1.36	1.41	1.45	1.49
77	0.61	0.65	0.69	0.73	0.77	0.81	0.86	0.90	0.94	0.98	1.02	1.06	1.10	1.15	1.19	1.23	1.27	1.31	1.35	1.40	1.44	1.48
78	0.60	0.64	0.68	0.73	0.77	0.81	0.85	0.89	0.93	0.97	1.01	1.05	1.10	1.14	1.18	1.22	1.26	1.30	1.34	1.38	1.43	1.47
79	0.60	0.64	0.68	0.72	0.76	0.80	0.84	0.88	0.92	0.97	1.01	1.05	1.09	1.13	1.17	1.21	1.25	1.29	1.33	1.37	1.42	1.46
80	0.59	0.63	0.67	0.71	0.76	0.80	0.84	0.88	0.92	0.96	1.00	1.04	1.08	1.12	1.16	1.20	1.24	1.28	1.32	1.37	1.41	1.45
81	0.59	0.63	0.67	0.71	0.75	0.79	0.83	0.87	0.91	0.95	0.99	1.03	1.07	1.11	1.15	1.19	1.23	1.27	1.32	1.36	1.40	1.44
82	0.58	0.62	0.66	0.70	0.74	0.78	0.83	0.87	0.91	0.95	0.99	1.03	1.07	1.11	1.15	1.19	1.23	1.27	1.31	1.35	1.39	1.43
83	0.58	0.62	0.66	0.70	0.74	0.78	0.82	0.86	0.90	0.94	0.98	1.02	1.06	1.10	1.14	1.18	1.22	1.26	1.30	1.34	1.38	1.42
84	0.58	0.62	0.66	0.70	0.73	0.77	0.81	0.85	0.89	0.93	0.97	1.01	1.05	1.09	1.13	1.17	1.21	1.25	1.29	1.33	1.37	1.41
85	0.57	0.61	0.65	0.69	0.73	0.77	0.81	0.85	0.89	0.93	0.97	1.00	1.04	1.08	1.12	1.16	1.20	1.24	1.28	1.32	1.36	1.40
86	0.57	0.61	0.65	0.69	0.73	0.76	0.80	0.84	0.88	0.92	0.96	1.00	1.04	1.08	1.12	1.15	1.19	1.23	1.27	1.31	1.35	1.39
87	0.57	0.60	0.64	0.68	0.72	0.76	0.80	0.84	0.88	0.91	0.95	0.99	1.03	1.07	1.11	1.15	1.19	1.22	1.26	1.30	1.34	1.38
88	0.56	0.60	0.64	0.68	0.72	0.75	0.79	0.83	0.87	0.91	0.95	0.99	1.02	1.06	1.10	1.14	1.18	1.22	1.25	1.29	1.33	1.37
89	0.56	0.60	0.63	0.67	0.71	0.75	0.79	0.83	0.86	0.90	0.94	0.98	1.02	1.06	1.09	1.13	1.17	1.21	1.25	1.29	1.32	1.36
90	0.55	0.59	0.63	0.67	0.71	0.74	0.78	0.82	0.86	0.90	0.93	0.97	1.01	1.05	1.09	1.12	1.16	1.20	1.24	1.28	1.31	1.35
91	0.55	0.59	0.63	0.66	0.70	0.74	0.78	0.82	0.85	0.89	0.93	0.97	1.00	1.04	1.08	1.12	1.16	1.19	1.23	1.27	1.31	1.34
92	0.55	0.59	0.62	0.66	0.70	0.74	0.77	0.81	0.85	0.89	0.92	0.96	1.00	1.04	1.07	1.11	1.15	1.19	1.22	1.26	1.30	1.34
93	0.54	0.58	0.62	0.66	0.69	0.73	0.77	0.81	0.84	0.88	0.92	0.95	0.99	1.03	1.07	1.10	1.14	1.18	1.22	1.25	1.29	1.33
94	0.54	0.58	0.62	0.65	0.69	0.73	0.76	0.80	0.84	0.87	0.91	0.95	0.99	1.02	1.06	1.10	1.13	1.17	1.21	1.25	1.28	1.32
95	0.54	0.57	0.61	0.65	0.69	0.72	0.76	0.80	0.83	0.87	0.91	0.94	0.98	1.02	1.05	1.09	1.13	1.16	1.20	1.24	1.28	1.31
96	0.53	0.57	0.61	0.64	0.68	0.72	0.75	0.79	0.83	0.86	0.90	0.94	0.97	1.01	1.05	1.08	1.12	1.16	1.19	1.23	1.27	1.30
97	0.53	0.57	0.60	0.64	0.68	0.71	0.75	0.79	0.82	0.86	0.90	0.93	0.97	1.01	1.04	1.08	1.11	1.15	1.19	1.22	1.26	1.30
98	0.53	0.56	0.60	0.64	0.67	0.71	0.75	0.78	0.82	0.85	0.89	0.93	0.96	1.00	1.04	1.07	1.11	1.14	1.18	1.22	1.25	1.29
99	0.53	0.56	0.60	0.63	0.67	0.71	0.74	0.78	0.81	0.85	0.89	0.92	0.96	0.99	1.03	1.07	1.10	1.14	1.17	1.21	1.25	1.28
100	0.52	0.56	0.59	0.63	0.67	0.70	0.74	0.77	0.81	0.84	0.88	0.92	0.95	0.99	1.02	1.06	1.10	1.13	1.17	1.20	1.24	1.27
101	0.52	0.56	0.59	0.63	0.66	0.70	0.73	0.77	0.80	0.84	0.88	0.91	0.95	0.98	1.02	1.05	1.09	1.12	1.16	1.20	1.23	1.27
102	0.52	0.55	0.59	0.62	0.66	0.69	0.73	0.76	0.80	0.84	0.87	0.91	0.94	0.98	1.01	1.05	1.08	1.12	1.15	1.19	1.22	1.26
103	0.51	0.55	0.58	0.62	0.65	0.69	0.72	0.76	0.80	0.83	0.87	0.90	0.94	0.97	1.01	1.04	1.08	1.11	1.15	1.18	1.22	1.25
104	0.51	0.55	0.58	0.62	0.65	0.69	0.72	0.76	0.79	0.83	0.86	0.90	0.93	0.97	1.00	1.04	1.07	1.11	1.14	1.18	1.21	1.25
105	0.51	0.54	0.58	0.61	0.65	0.68	0.72	0.75	0.79	0.82	0.86	0.89	0.93	0.96	1.00	1.03	1.07	1.10	1.14	1.17	1.20	1.24
106	0.51	0.54	0.57	0.61	0.64	0.68	0.71	0.75	0.78	0.82	0.85	0.89	0.92	0.96	0.99	1.03	1.06	1.09	1.13	1.16	1.20	1.23
107	0.50	0.54	0.57	0.61	0.64	0.68	0.71	0.74	0.78	0.81	0.85	0.88	0.92	0.95	0.99	1.02	1.05	1.09	1.12	1.16	1.19	1.23
108	0.50	0.53	0.57	0.60	0.64	0.67	0.71	0.74	0.77	0.81	0.84	0.88	0.91	0.95	0.98	1.01	1.05	1.08	1.12	1.15	1.19	1.22
109	0.50	0.53	0.57	0.60	0.63	0.67	0.70	0.74	0.77	0.80	0.84	0.87	0.91	0.94	0.97	1.01	1.04	1.08	1.11	1.15	1.18	1.21
110	0.49	0.53	0.56	0.60	0.63	0.66	0.70	0.73	0.77	0.80	0.83	0.87	0.90	0.94	0.97	1.00	1.04	1.07	1.11	1.14	1.17	1.21
111	0.49	0.53	0.56	0.59	0.63	0.66	0.69	0.73	0.76	0.80	0.83	0.86	0.90	0.93	0.96	1.00	1.03	1.07	1.10	1.13	1.17	1.20
112	0.49	0.52	0.56	0.59	0.62	0.66	0.69	0.72	0.76	0.79	0.83	0.86	0.89	0.93	0.96	0.99	1.03	1.06	1.09	1.13	1.16	1.20
113	0.49	0.52	0.55	0.59	0.62	0.65	0.69	0.72	0.75	0.79	0.82	0.85	0.89	0.92	0.96	0.99	1.02	1.06	1.09	1.12	1.16	1.19
114	0.48	0.52	0.55	0.58	0.62	0.65	0.68	0.72	0.75	0.78	0.82	0.85	0.88	0.92	0.95	0.98	1.02	1.05	1.08	1.12	1.15	1.18
115	0.48	0.52	0.55	0.58	0.61	0.65	0.68	0.71	0.75	0.78	0.81	0.85	0.88	0.91	0.95	0.98	1.01	1.04	1.08	1.11	1.14	1.18
116	0.48	0.51	0.55	0.58	0.61	0.64	0.68	0.71	0.74	0.78	0.81	0.84	0.88	0.91	0.94	0.97	1.01	1.04	1.07	1.11	1.14	1.17
117	0.48	0.51	0.54	0.58	0.61	0.64	0.67	0.71	0.74	0.77	0.81	0.84	0.87	0.90	0.94	0.97	1.00	1.03	1.07	1.10	1.13	1.17
118	0.48	0.51	0.54	0.57	0.61	0.64	0.67	0.70	0.74	0.77	0.80	0.83	0.87	0.90	0.93	0.96	1.00	1.03	1.06	1.10	1.13	1.16
119	0.47	0.51	0.54	0.57	0.60	0.64	0.67	0.70	0.73	0.77	0.80	0.83	0.86	0.90	0.93	0.96	0.99	1.02	1.06	1.09	1.12	1.15
120	0.47	0.50	0.54	0.57	0.60	0.63	0.66	0.70	0.73	0.76	0.79	0.83	0.86	0.89	0.92	0.96	0.99	1.02	1.05	1.08	1.12	1.15

T_c (min)	Mean Annual Precipitation (in)																					
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1	7.87	8.41	8.95	9.49	10.03	10.57	11.11	11.64	12.18	12.72	13.26	13.80	14.34	14.88	15.42	15.96	16.50	17.04	17.58	18.12	18.66	19.20
2	5.31	5.67	6.04	6.40	6.77	7.13	7.50	7.86	8.22	8.59	8.95	9.32	9.68	10.04	10.41	10.77	11.14	11.50	11.87	12.23	12.59	12.96
3	4.22	4.51	4.80	5.09	5.38	5.67	5.96	6.25	6.53	6.82	7.11	7.40	7.69	7.98	8.27	8.56	8.85	9.14	9.43	9.72	10.01	10.30
4	3.58	3.83	4.08	4.32	4.57	4.81	5.06	5.31	5.55	5.80	6.04	6.29	6.53	6.78	7.03	7.27	7.52	7.76	8.01	8.25	8.50	8.75
5	3.16	3.38	3.59	3.81	4.02	4.24	4.46	4.67	4.89	5.11	5.32	5.54	5.76	5.97	6.19	6.41	6.62	6.84	7.06	7.27	7.49	7.71
6	2.85	3.04	3.24	3.43	3.63	3.82	4.02	4.22	4.41	4.61	4.80	5.00	5.19	5.39	5.58	5.78	5.97	6.17	6.36	6.56	6.75	6.95
7	2.61	2.79	2.97	3.15	3.33	3.50	3.68	3.86	4.04	4.22	4.40	4.58	4.76	4.94	5.12	5.29	5.47	5.65	5.83	6.01	6.19	6.37
8	2.42	2.59	2.75	2.92	3.08	3.25	3.41	3.58	3.75	3.91	4.08	4.24	4.41	4.58	4.74	4.91	5.07	5.24	5.41	5.57	5.74	5.90
9	2.26	2.42	2.57	2.73	2.88	3.04	3.19	3.35	3.50	3.66	3.81	3.97	4.13	4.28	4.44	4.59	4.75	4.90	5.06	5.21	5.37	5.52
10	2.13	2.28	2.42	2.57	2.72	2.86	3.01	3.16	3.30	3.45	3.59	3.74	3.89	4.03	4.18	4.32	4.47	4.62	4.76	4.91	5.06	5.20
11	2.02	2.16	2.30	2.44	2.57	2.71	2.85	2.99	3.13	3.27	3.40	3.54	3.68	3.82	3.96	4.10	4.24	4.37	4.51	4.65	4.79	4.93
12	1.92	2.05	2.19	2.32	2.45	2.58	2.71	2.85	2.98	3.11	3.24	3.37	3.50	3.64	3.77	3.90	4.03	4.16	4.30	4.43	4.56	4.69
13	1.84	1.96	2.09	2.21	2.34	2.47	2.59	2.72	2.84	2.97	3.10	3.22	3.35	3.47	3.60	3.73	3.85	3.98	4.10	4.23	4.36	4.48
14	1.76	1.88	2.00	2.12	2.24	2.37	2.49	2.61	2.73	2.85	2.97	3.09	3.21	3.33	3.45	3.57	3.69	3.81	3.94	4.06	4.18	4.30
15	1.69	1.81	1.93	2.04	2.16	2.27	2.39	2.51	2.62	2.74	2.86	2.97	3.09	3.20	3.32	3.44	3.55	3.67	3.78	3.90	4.02	4.13
16	1.63	1.74	1.86	1.97	2.08	2.19	2.30	2.42	2.53	2.64	2.75	2.86	2.98	3.09	3.20	3.31	3.42	3.54	3.65	3.76	3.87	3.98
17	1.58	1.69	1.79	1.90	2.01	2.12	2.23	2.34	2.44	2.55	2.66	2.77	2.88	2.98	3.09	3.20	3.31	3.42	3.53	3.63	3.74	3.85
18	1.53	1.63	1.74	1.84	1.95	2.05	2.16	2.26	2.37	2.47	2.57	2.68	2.78	2.89	2.99	3.10	3.20	3.31	3.41	3.52	3.62	3.73
19	1.48	1.58	1.68	1.79	1.89	1.99	2.09	2.19	2.29	2.40	2.50	2.60	2.70	2.80	2.90	3.00	3.11	3.21	3.31	3.41	3.51	3.61
20	1.44	1.54	1.64	1.73	1.83	1.93	2.03	2.13	2.23	2.33	2.43	2.52	2.62	2.72	2.82	2.92	3.02	3.12	3.21	3.31	3.41	3.51
21	1.40	1.50	1.59	1.69	1.78	1.88	1.98	2.07	2.17	2.26	2.36	2.46	2.55	2.65	2.74	2.84	2.94	3.03	3.13	3.22	3.32	3.41
22	1.36	1.46	1.55	1.64	1.74	1.83	1.92	2.02	2.11	2.20	2.30	2.39	2.48	2.58	2.67	2.77	2.86	2.95	3.05	3.14	3.23	3.33
23	1.33	1.42	1.51	1.60	1.69	1.78	1.88	1.97	2.06	2.15	2.24	2.33	2.42	2.51	2.61	2.70	2.79	2.88	2.97	3.06	3.15	3.24
24	1.30	1.39	1.48	1.56	1.65	1.74	1.83	1.92	2.01	2.10	2.19	2.28	2.37	2.45	2.54	2.63	2.72	2.81	2.90	2.99	3.08	3.17
25	1.27	1.35	1.44	1.53	1.62	1.70	1.79	1.88	1.96	2.05	2.14	2.22	2.31	2.40	2.48	2.57	2.66	2.75	2.83	2.92	3.01	3.09
26	1.24	1.32	1.41	1.50	1.58	1.67	1.75	1.84	1.92	2.01	2.09	2.18	2.26	2.35	2.43	2.52	2.60	2.69	2.77	2.86	2.94	3.03
27	1.21	1.30	1.38	1.46	1.55	1.63	1.71	1.80	1.88	1.96	2.05	2.13	2.21	2.30	2.38	2.46	2.55	2.63	2.71	2.79	2.88	2.96
28	1.19	1.27	1.35	1.43	1.52	1.60	1.68	1.76	1.84	1.92	2.00	2.09	2.17	2.25	2.33	2.41	2.49	2.57	2.66	2.74	2.82	2.90
29	1.17	1.25	1.33	1.41	1.49	1.57	1.64	1.72	1.80	1.88	1.96	2.04	2.12	2.20	2.28	2.36	2.44	2.52	2.60	2.68	2.76	2.84
30	1.14	1.22	1.30	1.38	1.46	1.54	1.61	1.69	1.77	1.85	1.93	2.01	2.08	2.16	2.24	2.32	2.40	2.48	2.55	2.63	2.71	2.79
31	1.12	1.20	1.28	1.35	1.43	1.51	1.58	1.66	1.74	1.81	1.89	1.97	2.05	2.12	2.20	2.28	2.35	2.43	2.51	2.58	2.66	2.74
32	1.10	1.18	1.25	1.33	1.40	1.48	1.56	1.63	1.71	1.78	1.86	1.93	2.01	2.08	2.16	2.24	2.31	2.39	2.46	2.54	2.61	2.69
33	1.08	1.16	1.23	1.31	1.38	1.45	1.53	1.60	1.68	1.75	1.83	1.90	1.97	2.05	2.12	2.20	2.27	2.35	2.42	2.49	2.57	2.64
34	1.06	1.14	1.21	1.28	1.36	1.43	1.50	1.58	1.65	1.72	1.80	1.87	1.94	2.01	2.09	2.16	2.23	2.31	2.38	2.45	2.53	2.60
35	1.05	1.12	1.19	1.26	1.33	1.41	1.48	1.55	1.62	1.69	1.77	1.84	1.91	1.98	2.05	2.13	2.20	2.27	2.34	2.41	2.48	2.56
36	1.03	1.10	1.17	1.24	1.31	1.38	1.46	1.53	1.60	1.67	1.74	1.81	1.88	1.95	2.02	2.09	2.16	2.23	2.30	2.37	2.44	2.52
37	1.02	1.08	1.15	1.22	1.29	1.36	1.43	1.50	1.57	1.64	1.71	1.78	1.85	1.92	1.99	2.06	2.13	2.20	2.27	2.34	2.41	2.48
38	1.00	1.07	1.14	1.21	1.27	1.34	1.41	1.48	1.55	1.62	1.69	1.75	1.82	1.89	1.96	2.03	2.10	2.17	2.23	2.30	2.37	2.44
39	0.99	1.05	1.12	1.19	1.26	1.32	1.39	1.46	1.53	1.59	1.66	1.73	1.80	1.86	1.93	2.00	2.07	2.13	2.20	2.27	2.34	2.40
40	0.97	1.04	1.10	1.17	1.24	1.30	1.37	1.44	1.50	1.57	1.64	1.70	1.77	1.84	1.90	1.97	2.04	2.10	2.17	2.24	2.30	2.37
41	0.96	1.02	1.09	1.15	1.22	1.29	1.35	1.42	1.48	1.55	1.61	1.68	1.75	1.81	1.88	1.94	2.01	2.07	2.14	2.21	2.27	2.34
42	0.94	1.01	1.07	1.14	1.20	1.27	1.33	1.40	1.46	1.53	1.59	1.66	1.72	1.79	1.85	1.92	1.98	2.05	2.11	2.18	2.24	2.30
43	0.93	1.00	1.06	1.12	1.19	1.25	1.32	1.38	1.44	1.51	1.57	1.64	1.70	1.76	1.83	1.89	1.95	2.02	2.08	2.15	2.21	2.27
44	0.92	0.98	1.05	1.11	1.17	1.24	1.30	1.36	1.42	1.49	1.55	1.61	1.68	1.74	1.80	1.87	1.93	1.99	2.06	2.12	2.18	2.24
45	0.91	0.97	1.03	1.10	1.16	1.22	1.28	1.34	1.41	1.47	1.53	1.59	1.66	1.72	1.78	1.84	1.91	1.97	2.03	2.09	2.15	2.22
46	0.90	0.96	1.02	1.08	1.14	1.20	1.27	1.33	1.39	1.45	1.51	1.57	1.64	1.70	1.76	1.82	1.88	1.94	2.00	2.07	2.13	2.19
47	0.89	0.95	1.01	1.07	1.13	1.19	1.25	1.31	1.37	1.43	1.49	1.55	1.62	1.68	1.74	1.80	1.86	1.92	1.98	2.04	2.10	2.16
48	0.88	0.94	1.00	1.06	1.12	1.18	1.24	1.30	1.36	1.42	1.48	1.54	1.60	1.66	1.72	1.78	1.84	1.90	1.96	2.02	2.08	2.14
49	0.87	0.92	0.98	1.04	1.10	1.16	1.22	1.28	1.34	1.40	1.46	1.52	1.58	1.64	1.70	1.76	1.82	1.87	1.93	1.99	2.05	2.11
50	0.86	0.91	0.97	1.03	1.09	1.15	1.21	1.27	1.33	1.38	1.44	1.50	1.56	1.62	1.68	1.74	1.79	1.85	1.91	1.97	2.03	2.09
51	0.85	0.90	0.96	1.02	1.08	1.14	1.19	1.25	1.31	1.37	1.43	1.48	1.54	1.60	1.66	1.72	1.77	1.83	1.89	1.95	2.01	2.06
52	0.84	0.89	0.95	1.01	1.07	1.12	1.18	1.24	1.30	1.35	1.41	1.47	1.53	1.58	1.64	1.70	1.76	1.81	1.87	1.93	1.98	2.04
53	0.83	0.88	0.94	1.00	1.06	1.11	1.17	1.23	1.28	1.34	1.40	1.45	1.51	1.57	1.62	1.68	1.74	1.79	1.85	1.91	1.96	2.02
54	0.82	0.88	0.93	0.99	1.04	1.10	1.16	1.21	1.27	1.32	1.38	1.44	1.49	1.55	1.61	1.66	1.72	1.77	1.83	1.89	1.94	2.00
55	0.81	0.87	0.92	0.98	1.03	1.09	1.14	1.20	1.26	1.31	1.37	1.42	1.48	1.53	1.59	1.64	1.70	1.76	1.81	1.87	1.92	1.98
56	0.80	0.86	0.91	0.97	1.02	1.08	1.13	1.19	1.24	1.30	1.35	1.41	1.46	1.52	1.57	1.63	1.68	1.74	1.79	1.85	1.90	1.96
57	0.79	0.85	0.90	0.96	1.01	1.07	1.12	1.18	1.23	1.28	1.34	1.39	1.45	1.50	1.56	1.61	1.67	1.72	1.78	1.83	1.88	1.94
58	0.79	0.84	0.89	0.95	1.00	1.06	1.11	1.16	1.22	1.27	1.33	1.38	1.43	1.49	1.54	1.60	1.65	1.70	1.76	1.81	1.87	1.92
59	0.78	0.83	0.89	0.94	0.99	1.05	1.10	1.15	1.21	1.26	1.31	1.37	1.42	1.47	1.53	1.58	1.63	1.69	1.74	1.79	1.85	1.90
60	0.77	0.82	0.88	0.93	0.98	1.04	1.09	1.14	1.19	1.25	1.30	1.35	1.41	1.46	1.51	1.57	1.62	1.67	1.72	1.78	1.83	1.88

T_c (min)	Mean Annual Precipitation (in)																					
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
61	0.76	0.82	0.87	0.92	0.97	1.03	1.08	1.13	1.18	1.24	1.29	1.34	1.39	1.45	1.50	1.55	1.60	1.66	1.71	1.76	1.81	1.87
62	0.76	0.81	0.86	0.91	0.97	1.02	1.07	1.12	1.17	1.22	1.28	1.33	1.38	1.43	1.48	1.54	1.59	1.64	1.69	1.74	1.80	1.85
63	0.75	0.80	0.85	0.91	0.96	1.01	1.06	1.11	1.16	1.21	1.27	1.32	1.37	1.42	1.47	1.52	1.57	1.63	1.68	1.73	1.78	1.83
64	0.74	0.79	0.85	0.90	0.95	1.00	1.05	1.10	1.15	1.20	1.25	1.31	1.36	1.41	1.46	1.51	1.56	1.61	1.66	1.71	1.76	1.82
65	0.74	0.79	0.84	0.89	0.94	0.99	1.04	1.09	1.14	1.19	1.24	1.29	1.34	1.39	1.45	1.50	1.55	1.60	1.65	1.70	1.75	1.80
66	0.73	0.78	0.83	0.88	0.93	0.98	1.03	1.08	1.13	1.18	1.23	1.28	1.33	1.38	1.43	1.48	1.53	1.58	1.63	1.68	1.73	1.78
67	0.72	0.77	0.82	0.87	0.92	0.97	1.02	1.07	1.12	1.17	1.22	1.27	1.32	1.37	1.42	1.47	1.52	1.57	1.62	1.67	1.72	1.77
68	0.72	0.77	0.82	0.87	0.92	0.97	1.01	1.06	1.11	1.16	1.21	1.26	1.31	1.36	1.41	1.46	1.51	1.56	1.61	1.66	1.70	1.75
69	0.71	0.76	0.81	0.86	0.91	0.96	1.01	1.06	1.10	1.15	1.20	1.25	1.30	1.35	1.40	1.45	1.49	1.54	1.59	1.64	1.69	1.74
70	0.71	0.76	0.80	0.85	0.90	0.95	1.00	1.05	1.09	1.14	1.19	1.24	1.29	1.34	1.39	1.43	1.48	1.53	1.58	1.63	1.68	1.73
71	0.70	0.75	0.80	0.85	0.89	0.94	0.99	1.04	1.09	1.13	1.18	1.23	1.28	1.33	1.37	1.42	1.47	1.52	1.57	1.62	1.66	1.71
72	0.70	0.74	0.79	0.84	0.89	0.93	0.98	1.03	1.08	1.13	1.17	1.22	1.27	1.32	1.36	1.41	1.46	1.51	1.55	1.60	1.65	1.70
73	0.69	0.74	0.79	0.83	0.88	0.93	0.97	1.02	1.07	1.12	1.16	1.21	1.26	1.31	1.35	1.40	1.45	1.50	1.54	1.59	1.64	1.68
74	0.69	0.73	0.78	0.83	0.87	0.92	0.97	1.01	1.06	1.11	1.15	1.20	1.25	1.30	1.34	1.39	1.44	1.48	1.53	1.58	1.62	1.67
75	0.68	0.73	0.77	0.82	0.87	0.91	0.96	1.01	1.05	1.10	1.15	1.19	1.24	1.29	1.33	1.38	1.43	1.47	1.52	1.57	1.61	1.66
76	0.67	0.72	0.77	0.81	0.86	0.91	0.95	1.00	1.05	1.09	1.14	1.18	1.23	1.28	1.32	1.37	1.42	1.46	1.51	1.55	1.60	1.65
77	0.67	0.72	0.76	0.81	0.85	0.90	0.95	0.99	1.04	1.08	1.13	1.18	1.22	1.27	1.31	1.36	1.40	1.45	1.50	1.54	1.59	1.63
78	0.66	0.71	0.76	0.80	0.85	0.89	0.94	0.98	1.03	1.08	1.12	1.17	1.21	1.26	1.30	1.35	1.39	1.44	1.49	1.53	1.58	1.62
79	0.66	0.71	0.75	0.80	0.84	0.89	0.93	0.98	1.02	1.07	1.11	1.16	1.20	1.25	1.29	1.34	1.38	1.43	1.48	1.52	1.57	1.61
80	0.66	0.70	0.75	0.79	0.84	0.88	0.93	0.97	1.02	1.06	1.10	1.15	1.19	1.24	1.28	1.33	1.37	1.42	1.46	1.51	1.55	1.60
81	0.65	0.70	0.74	0.78	0.83	0.87	0.92	0.96	1.01	1.05	1.10	1.14	1.19	1.23	1.28	1.32	1.37	1.41	1.45	1.50	1.54	1.59
82	0.65	0.69	0.74	0.78	0.82	0.87	0.91	0.96	1.00	1.05	1.09	1.13	1.18	1.22	1.27	1.31	1.36	1.40	1.44	1.49	1.53	1.58
83	0.64	0.69	0.73	0.77	0.82	0.86	0.91	0.95	0.99	1.04	1.08	1.13	1.17	1.21	1.26	1.30	1.35	1.39	1.43	1.48	1.52	1.57
84	0.64	0.68	0.73	0.77	0.81	0.86	0.90	0.94	0.99	1.03	1.07	1.12	1.16	1.21	1.25	1.29	1.34	1.38	1.42	1.47	1.51	1.56
85	0.63	0.68	0.72	0.76	0.81	0.85	0.89	0.94	0.98	1.02	1.07	1.11	1.15	1.20	1.24	1.28	1.33	1.37	1.42	1.46	1.50	1.55
86	0.63	0.67	0.72	0.76	0.80	0.84	0.89	0.93	0.97	1.02	1.06	1.10	1.15	1.19	1.23	1.28	1.32	1.36	1.41	1.45	1.49	1.54
87	0.63	0.67	0.71	0.75	0.80	0.84	0.88	0.93	0.97	1.01	1.05	1.10	1.14	1.18	1.23	1.27	1.31	1.35	1.40	1.44	1.48	1.53
88	0.62	0.66	0.71	0.75	0.79	0.83	0.88	0.92	0.96	1.00	1.05	1.09	1.13	1.17	1.22	1.26	1.30	1.34	1.39	1.43	1.47	1.52
89	0.62	0.66	0.70	0.74	0.79	0.83	0.87	0.91	0.96	1.00	1.04	1.08	1.12	1.17	1.21	1.25	1.29	1.34	1.38	1.42	1.46	1.51
90	0.61	0.66	0.70	0.74	0.78	0.82	0.87	0.91	0.95	0.99	1.03	1.08	1.12	1.16	1.20	1.24	1.29	1.33	1.37	1.41	1.45	1.50
91	0.61	0.65	0.69	0.73	0.78	0.82	0.86	0.90	0.94	0.99	1.03	1.07	1.11	1.15	1.19	1.24	1.28	1.32	1.36	1.40	1.44	1.49
92	0.61	0.65	0.69	0.73	0.77	0.81	0.85	0.90	0.94	0.98	1.02	1.06	1.10	1.15	1.19	1.23	1.27	1.31	1.35	1.39	1.44	1.48
93	0.60	0.64	0.68	0.73	0.77	0.81	0.85	0.89	0.93	0.97	1.01	1.06	1.10	1.14	1.18	1.22	1.26	1.30	1.34	1.39	1.43	1.47
94	0.60	0.64	0.68	0.72	0.76	0.80	0.84	0.89	0.93	0.97	1.01	1.05	1.09	1.13	1.17	1.21	1.25	1.30	1.34	1.38	1.42	1.46
95	0.59	0.64	0.68	0.72	0.76	0.80	0.84	0.88	0.92	0.96	1.00	1.04	1.08	1.12	1.17	1.21	1.25	1.29	1.33	1.37	1.41	1.45
96	0.59	0.63	0.67	0.71	0.75	0.79	0.83	0.87	0.92	0.96	1.00	1.04	1.08	1.12	1.16	1.20	1.24	1.28	1.32	1.36	1.40	1.44
97	0.59	0.63	0.67	0.71	0.75	0.79	0.83	0.87	0.91	0.95	0.99	1.03	1.07	1.11	1.15	1.19	1.23	1.27	1.31	1.35	1.39	1.43
98	0.58	0.62	0.66	0.70	0.74	0.78	0.82	0.86	0.90	0.94	0.98	1.02	1.06	1.11	1.15	1.19	1.23	1.27	1.31	1.35	1.39	1.43
99	0.58	0.62	0.66	0.70	0.74	0.78	0.82	0.86	0.90	0.94	0.98	1.02	1.06	1.10	1.14	1.18	1.22	1.26	1.30	1.34	1.38	1.42
100	0.58	0.62	0.66	0.70	0.74	0.78	0.82	0.85	0.89	0.93	0.97	1.01	1.05	1.09	1.13	1.17	1.21	1.25	1.29	1.33	1.37	1.41
101	0.57	0.61	0.65	0.69	0.73	0.77	0.81	0.85	0.89	0.93	0.97	1.01	1.05	1.09	1.13	1.17	1.20	1.24	1.28	1.32	1.36	1.40
102	0.57	0.61	0.65	0.69	0.73	0.77	0.81	0.85	0.88	0.92	0.96	1.00	1.04	1.08	1.12	1.16	1.20	1.24	1.28	1.32	1.35	1.39
103	0.57	0.61	0.65	0.68	0.72	0.76	0.80	0.84	0.88	0.92	0.96	1.00	1.04	1.07	1.11	1.15	1.19	1.23	1.27	1.31	1.35	1.39
104	0.56	0.60	0.64	0.68	0.72	0.76	0.80	0.84	0.87	0.91	0.95	0.99	1.03	1.07	1.11	1.15	1.18	1.22	1.26	1.30	1.34	1.38
105	0.56	0.60	0.64	0.68	0.72	0.75	0.79	0.83	0.87	0.91	0.95	0.99	1.02	1.06	1.10	1.14	1.18	1.22	1.26	1.29	1.33	1.37
106	0.56	0.60	0.64	0.67	0.71	0.75	0.79	0.83	0.87	0.90	0.94	0.98	1.02	1.06	1.10	1.13	1.17	1.21	1.25	1.29	1.33	1.36
107	0.56	0.59	0.63	0.67	0.71	0.75	0.78	0.82	0.86	0.90	0.94	0.98	1.01	1.05	1.09	1.13	1.17	1.20	1.24	1.28	1.32	1.36
108	0.55	0.59	0.63	0.67	0.70	0.74	0.78	0.82	0.86	0.89	0.93	0.97	1.01	1.05	1.08	1.12	1.16	1.20	1.24	1.27	1.31	1.35
109	0.55	0.59	0.63	0.66	0.70	0.74	0.78	0.81	0.85	0.89	0.93	0.96	1.00	1.04	1.08	1.12	1.15	1.19	1.23	1.27	1.30	1.34
110	0.55	0.58	0.62	0.66	0.70	0.73	0.77	0.81	0.85	0.88	0.92	0.96	1.00	1.03	1.07	1.11	1.15	1.19	1.22	1.26	1.30	1.34
111	0.54	0.58	0.62	0.66	0.69	0.73	0.77	0.81	0.84	0.88	0.92	0.96	0.99	1.03	1.07	1.10	1.14	1.18	1.22	1.25	1.29	1.33
112	0.54	0.58	0.62	0.65	0.69	0.73	0.76	0.80	0.84	0.88	0.91	0.95	0.99	1.02	1.06	1.10	1.14	1.17	1.21	1.25	1.28	1.32
113	0.54	0.58	0.61	0.65	0.69	0.72	0.76	0.80	0.83	0.87	0.91	0.95	0.98	1.02	1.06	1.09	1.13	1.17	1.20	1.24	1.28	1.31
114	0.54	0.57	0.61	0.65	0.68	0.72	0.76	0.79	0.83	0.87	0.90	0.94	0.98	1.01	1.05	1.09	1.12	1.16	1.20	1.23	1.27	1.31
115	0.53	0.57	0.61	0.64	0.68	0.72	0.75	0.79	0.83	0.86	0.90	0.94	0.97	1.01	1.05	1.08	1.12	1.16	1.19	1.23	1.27	1.30
116	0.53	0.57	0.60	0.64	0.68	0.71	0.75	0.79	0.82	0.86	0.90	0.93	0.97	1.00	1.04	1.08	1.11	1.15	1.19	1.22	1.26	1.30
117	0.53	0.56	0.60	0.64	0.67	0.71	0.75	0.78	0.82	0.85	0.89	0.93	0.96	1.00	1.04	1.07	1.11	1.14	1.18	1.22	1.25	1.29
118	0.53	0.56	0.60	0.63	0.67	0.71	0.74	0.78	0.81	0.85	0.89	0.92	0.96	0.99	1.03	1.07	1.10	1.14	1.17	1.21	1.25	1.28
119	0.52	0.56	0.60	0.63	0.67	0.70	0.74	0.77	0.81	0.85	0.88	0.92	0.95	0.99	1.03	1.06	1.10	1.13	1.17	1.21	1.24	1.28
120	0.52	0.56	0.59	0.63	0.66	0.70	0.74	0.77	0.81	0.84	0.88	0.91	0.95	0.99	1.02	1.06	1.09	1.13	1.16	1.20	1.24	1.27

T_c (min)	Mean Annual Precipitation (in)																					
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1	8.61	9.20	9.79	10.38	10.97	11.56	12.15	12.74	13.33	13.92	14.51	15.10	15.69	16.28	16.87	17.46	18.05	18.64	19.23	19.82	20.41	21.00
2	5.81	6.21	6.61	7.00	7.40	7.80	8.20	8.60	9.00	9.39	9.79	10.19	10.59	10.99	11.39	11.78	12.18	12.58	12.98	13.38	13.78	14.17
3	4.62	4.93	5.25	5.57	5.88	6.20	6.52	6.83	7.15	7.46	7.78	8.10	8.41	8.73	9.05	9.36	9.68	10.00	10.31	10.63	10.95	11.26
4	3.92	4.19	4.46	4.73	5.00	5.27	5.53	5.80	6.07	6.34	6.61	6.88	7.15	7.42	7.69	7.95	8.22	8.49	8.76	9.03	9.30	9.57
5	3.46	3.69	3.93	4.17	4.40	4.64	4.88	5.11	5.35	5.59	5.82	6.06	6.30	6.53	6.77	7.01	7.25	7.48	7.72	7.96	8.19	8.43
6	3.12	3.33	3.54	3.76	3.97	4.18	4.40	4.61	4.82	5.04	5.25	5.47	5.68	5.89	6.11	6.32	6.53	6.75	6.96	7.17	7.39	7.60
7	2.85	3.05	3.25	3.44	3.64	3.83	4.03	4.23	4.42	4.62	4.81	5.01	5.20	5.40	5.60	5.79	5.99	6.18	6.38	6.57	6.77	6.97
8	2.65	2.83	3.01	3.19	3.37	3.55	3.74	3.92	4.10	4.28	4.46	4.64	4.82	5.01	5.19	5.37	5.55	5.73	5.91	6.09	6.28	6.46
9	2.48	2.65	2.82	2.98	3.15	3.32	3.49	3.66	3.83	4.00	4.17	4.34	4.51	4.68	4.85	5.02	5.19	5.36	5.53	5.70	5.87	6.04
10	2.33	2.49	2.65	2.81	2.97	3.13	3.29	3.45	3.61	3.77	3.93	4.09	4.25	4.41	4.57	4.73	4.89	5.05	5.21	5.37	5.53	5.69
11	2.21	2.36	2.51	2.66	2.82	2.97	3.12	3.27	3.42	3.57	3.72	3.88	4.03	4.18	4.33	4.48	4.63	4.78	4.94	5.09	5.24	5.39
12	2.10	2.25	2.39	2.54	2.68	2.82	2.97	3.11	3.26	3.40	3.54	3.69	3.83	3.98	4.12	4.27	4.41	4.55	4.70	4.84	4.99	5.13
13	2.01	2.15	2.29	2.42	2.56	2.70	2.84	2.97	3.11	3.25	3.39	3.53	3.66	3.80	3.94	4.08	4.21	4.35	4.49	4.63	4.77	4.90
14	1.93	2.06	2.19	2.32	2.46	2.59	2.72	2.85	2.98	3.12	3.25	3.38	3.51	3.64	3.78	3.91	4.04	4.17	4.31	4.44	4.57	4.70
15	1.85	1.98	2.11	2.23	2.36	2.49	2.62	2.74	2.87	3.00	3.12	3.25	3.38	3.50	3.63	3.76	3.89	4.01	4.14	4.27	4.39	4.52
16	1.79	1.91	2.03	2.15	2.28	2.40	2.52	2.64	2.77	2.89	3.01	3.13	3.26	3.38	3.50	3.62	3.75	3.87	3.99	4.11	4.24	4.36
17	1.73	1.84	1.96	2.08	2.20	2.32	2.44	2.55	2.67	2.79	2.91	3.03	3.15	3.26	3.38	3.50	3.62	3.74	3.86	3.97	4.09	4.21
18	1.67	1.79	1.90	2.01	2.13	2.24	2.36	2.47	2.59	2.70	2.82	2.93	3.05	3.16	3.27	3.39	3.50	3.62	3.73	3.85	3.96	4.08
19	1.62	1.73	1.84	1.95	2.06	2.18	2.29	2.40	2.51	2.62	2.73	2.84	2.95	3.06	3.18	3.29	3.40	3.51	3.62	3.73	3.84	3.95
20	1.57	1.68	1.79	1.90	2.01	2.11	2.22	2.33	2.44	2.55	2.65	2.76	2.87	2.98	3.09	3.19	3.30	3.41	3.52	3.62	3.73	3.84
21	1.53	1.64	1.74	1.85	1.95	2.06	2.16	2.27	2.37	2.48	2.58	2.69	2.79	2.90	3.00	3.11	3.21	3.32	3.42	3.53	3.63	3.74
22	1.49	1.59	1.70	1.80	1.90	2.00	2.10	2.21	2.31	2.41	2.51	2.62	2.72	2.82	2.92	3.02	3.13	3.23	3.33	3.43	3.54	3.64
23	1.45	1.55	1.65	1.75	1.85	1.95	2.05	2.15	2.25	2.35	2.45	2.55	2.65	2.75	2.85	2.95	3.05	3.15	3.25	3.35	3.45	3.55
24	1.42	1.52	1.61	1.71	1.81	1.91	2.00	2.10	2.20	2.30	2.39	2.49	2.59	2.68	2.78	2.88	2.98	3.07	3.17	3.27	3.37	3.46
25	1.39	1.48	1.58	1.67	1.77	1.86	1.96	2.05	2.15	2.24	2.34	2.43	2.53	2.62	2.72	2.81	2.91	3.00	3.10	3.19	3.29	3.38
26	1.36	1.45	1.54	1.64	1.73	1.82	1.91	2.01	2.10	2.19	2.29	2.38	2.47	2.57	2.66	2.75	2.84	2.94	3.03	3.12	3.22	3.31
27	1.33	1.42	1.51	1.60	1.69	1.78	1.87	1.96	2.06	2.15	2.24	2.33	2.42	2.51	2.60	2.69	2.78	2.88	2.97	3.06	3.15	3.24
28	1.30	1.39	1.48	1.57	1.66	1.75	1.84	1.92	2.01	2.10	2.19	2.28	2.37	2.46	2.55	2.64	2.73	2.82	2.91	2.99	3.08	3.17
29	1.27	1.36	1.45	1.54	1.62	1.71	1.80	1.89	1.97	2.06	2.15	2.24	2.32	2.41	2.50	2.59	2.67	2.76	2.85	2.94	3.02	3.11
30	1.25	1.34	1.42	1.51	1.59	1.68	1.77	1.85	1.94	2.02	2.11	2.19	2.28	2.37	2.45	2.54	2.62	2.71	2.79	2.88	2.97	3.05
31	1.23	1.31	1.40	1.48	1.56	1.65	1.73	1.82	1.90	1.99	2.07	2.15	2.24	2.32	2.41	2.49	2.57	2.66	2.74	2.83	2.91	3.00
32	1.21	1.29	1.37	1.45	1.54	1.62	1.70	1.78	1.87	1.95	2.03	2.12	2.20	2.28	2.36	2.45	2.53	2.61	2.69	2.78	2.86	2.94
33	1.18	1.27	1.35	1.43	1.51	1.59	1.67	1.75	1.83	1.92	2.00	2.08	2.16	2.24	2.32	2.40	2.48	2.57	2.65	2.73	2.81	2.89
34	1.16	1.24	1.32	1.40	1.48	1.56	1.64	1.72	1.80	1.88	1.96	2.04	2.12	2.20	2.28	2.36	2.44	2.52	2.60	2.68	2.76	2.84
35	1.15	1.22	1.30	1.38	1.46	1.54	1.62	1.70	1.77	1.85	1.93	2.01	2.09	2.17	2.25	2.32	2.40	2.48	2.56	2.64	2.72	2.80
36	1.13	1.21	1.28	1.36	1.44	1.51	1.59	1.67	1.75	1.82	1.90	1.98	2.06	2.13	2.21	2.29	2.37	2.44	2.52	2.60	2.67	2.75
37	1.11	1.19	1.26	1.34	1.41	1.49	1.57	1.64	1.72	1.80	1.87	1.95	2.02	2.10	2.18	2.25	2.33	2.40	2.48	2.56	2.63	2.71
38	1.09	1.17	1.24	1.32	1.39	1.47	1.54	1.62	1.69	1.77	1.84	1.92	1.99	2.07	2.14	2.22	2.29	2.37	2.44	2.52	2.59	2.67
39	1.08	1.15	1.23	1.30	1.37	1.45	1.52	1.60	1.67	1.74	1.82	1.89	1.96	2.04	2.11	2.19	2.26	2.33	2.41	2.48	2.56	2.63
40	1.06	1.14	1.21	1.28	1.35	1.43	1.50	1.57	1.65	1.72	1.79	1.86	1.94	2.01	2.08	2.16	2.23	2.30	2.37	2.45	2.52	2.59
41	1.05	1.12	1.19	1.26	1.33	1.41	1.48	1.55	1.62	1.69	1.77	1.84	1.91	1.98	2.05	2.13	2.20	2.27	2.34	2.41	2.48	2.56
42	1.03	1.10	1.18	1.25	1.32	1.39	1.46	1.53	1.60	1.67	1.74	1.81	1.88	1.95	2.03	2.10	2.17	2.24	2.31	2.38	2.45	2.52
43	1.02	1.09	1.16	1.23	1.30	1.37	1.44	1.51	1.58	1.65	1.72	1.79	1.86	1.93	2.00	2.07	2.14	2.21	2.28	2.35	2.42	2.49
44	1.01	1.08	1.14	1.21	1.28	1.35	1.42	1.49	1.56	1.63	1.70	1.77	1.83	1.90	1.97	2.04	2.11	2.18	2.25	2.32	2.39	2.46
45	0.99	1.06	1.13	1.20	1.27	1.33	1.40	1.47	1.54	1.61	1.68	1.74	1.81	1.88	1.95	2.02	2.08	2.15	2.22	2.29	2.36	2.42
46	0.98	1.05	1.12	1.18	1.25	1.32	1.39	1.45	1.52	1.59	1.65	1.72	1.79	1.86	1.92	1.99	2.06	2.13	2.19	2.26	2.33	2.39
47	0.97	1.04	1.10	1.17	1.24	1.30	1.37	1.43	1.50	1.57	1.63	1.70	1.77	1.83	1.90	1.97	2.03	2.10	2.17	2.23	2.30	2.37
48	0.96	1.02	1.09	1.16	1.22	1.29	1.35	1.42	1.48	1.55	1.61	1.68	1.75	1.81	1.88	1.94	2.01	2.07	2.14	2.21	2.27	2.34
49	0.95	1.01	1.08	1.14	1.21	1.27	1.34	1.40	1.47	1.53	1.60	1.66	1.73	1.79	1.86	1.92	1.99	2.05	2.12	2.18	2.25	2.31
50	0.94	1.00	1.06	1.13	1.19	1.26	1.32	1.39	1.45	1.51	1.58	1.64	1.71	1.77	1.83	1.90	1.96	2.03	2.09	2.16	2.22	2.28
51	0.93	0.99	1.05	1.12	1.18	1.24	1.31	1.37	1.43	1.50	1.56	1.62	1.69	1.75	1.81	1.88	1.94	2.00	2.07	2.13	2.20	2.26
52	0.92	0.98	1.04	1.10	1.17	1.23	1.29	1.35	1.42	1.48	1.54	1.61	1.67	1.73	1.79	1.86	1.92	1.98	2.05	2.11	2.17	2.23
53	0.91	0.97	1.03	1.09	1.15	1.22	1.28	1.34	1.40	1.46	1.53	1.59	1.65	1.71	1.78	1.84	1.90	1.96	2.02	2.09	2.15	2.21
54	0.90	0.96	1.02	1.08	1.14	1.20	1.26	1.33	1.39	1.45	1.51	1.57	1.63	1.69	1.76	1.82	1.88	1.94	2.00	2.06	2.13	2.19
55	0.89	0.95	1.01	1.07	1.13	1.19	1.25	1.31	1.37	1.43	1.49	1.56	1.62	1.68	1.74	1.80	1.86	1.92	1.98	2.04	2.10	2.16
56	0.88	0.94	1.00	1.06	1.12	1.18	1.24	1.30	1.36	1.42	1.48	1.54	1.60	1.66	1.72	1.78	1.84	1.90	1.96	2.02	2.08	2.14
57	0.87	0.93	0.99	1.05	1.11	1.17	1.23	1.29	1.35	1.41	1.46	1.52	1.58	1.64	1.70	1.76	1.82	1.88	1.94	2.00	2.06	2.12
58	0.86	0.92	0.98	1.04	1.10	1.16	1.21	1.27	1.33	1.39	1.45	1.51	1.57	1.63	1.69	1.75	1.80	1.86	1.92	1.98	2.04	2.10
59	0.85	0.91	0.97	1.03	1.09	1.14	1.20	1.26	1.32	1.38	1.44	1.50	1.55	1.61	1.67	1.73	1.79	1.85	1.90	1.96	2.02	2.08
60	0.84	0.90	0.96	1.02	1.08	1.13	1.19	1.25	1.31	1.37	1.42	1.48	1.54	1.60	1.65	1.71	1.77	1.83	1.89	1.94	2.00	2.06

T_c (min)	Mean Annual Precipitation (in)																					
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
61	0.84	0.89	0.95	1.01	1.07	1.12	1.18	1.24	1.30	1.35	1.41	1.47	1.52	1.58	1.64	1.70	1.75	1.81	1.87	1.93	1.98	2.04
62	0.83	0.89	0.94	1.00	1.06	1.11	1.17	1.23	1.28	1.34	1.40	1.45	1.51	1.57	1.62	1.68	1.74	1.79	1.85	1.91	1.96	2.02
63	0.82	0.88	0.93	0.99	1.05	1.10	1.16	1.22	1.27	1.33	1.38	1.44	1.50	1.55	1.61	1.67	1.72	1.78	1.83	1.89	1.95	2.00
64	0.81	0.87	0.93	0.98	1.04	1.09	1.15	1.20	1.26	1.32	1.37	1.43	1.48	1.54	1.60	1.65	1.71	1.76	1.82	1.87	1.93	1.99
65	0.81	0.86	0.92	0.97	1.03	1.08	1.14	1.19	1.25	1.30	1.36	1.42	1.47	1.53	1.58	1.64	1.69	1.75	1.80	1.86	1.91	1.97
66	0.80	0.85	0.91	0.96	1.02	1.07	1.13	1.18	1.24	1.29	1.35	1.40	1.46	1.51	1.57	1.62	1.68	1.73	1.79	1.84	1.90	1.95
67	0.79	0.85	0.90	0.96	1.01	1.06	1.12	1.17	1.23	1.28	1.34	1.39	1.45	1.50	1.55	1.61	1.66	1.72	1.77	1.83	1.88	1.93
68	0.79	0.84	0.89	0.95	1.00	1.06	1.11	1.16	1.22	1.27	1.33	1.38	1.43	1.49	1.54	1.60	1.65	1.70	1.76	1.81	1.86	1.92
69	0.78	0.83	0.89	0.94	0.99	1.05	1.10	1.15	1.21	1.26	1.31	1.37	1.42	1.47	1.53	1.58	1.64	1.69	1.74	1.80	1.85	1.90
70	0.77	0.83	0.88	0.93	0.99	1.04	1.09	1.14	1.20	1.25	1.30	1.36	1.41	1.46	1.52	1.57	1.62	1.68	1.73	1.78	1.83	1.89
71	0.77	0.82	0.87	0.93	0.98	1.03	1.08	1.14	1.19	1.24	1.29	1.35	1.40	1.45	1.50	1.56	1.61	1.66	1.71	1.77	1.82	1.87
72	0.76	0.81	0.87	0.92	0.97	1.02	1.07	1.13	1.18	1.23	1.28	1.34	1.39	1.44	1.49	1.54	1.60	1.65	1.70	1.75	1.81	1.86
73	0.76	0.81	0.86	0.91	0.96	1.01	1.07	1.12	1.17	1.22	1.27	1.32	1.38	1.43	1.48	1.53	1.58	1.64	1.69	1.74	1.79	1.84
74	0.75	0.80	0.85	0.90	0.96	1.01	1.06	1.11	1.16	1.21	1.26	1.31	1.37	1.42	1.47	1.52	1.57	1.62	1.67	1.73	1.78	1.83
75	0.74	0.79	0.85	0.90	0.95	1.00	1.05	1.10	1.15	1.20	1.25	1.30	1.36	1.41	1.46	1.51	1.56	1.61	1.66	1.71	1.76	1.81
76	0.74	0.79	0.84	0.89	0.94	0.99	1.04	1.09	1.14	1.19	1.24	1.30	1.35	1.40	1.45	1.50	1.55	1.60	1.65	1.70	1.75	1.80
77	0.73	0.78	0.83	0.88	0.93	0.98	1.03	1.08	1.13	1.19	1.24	1.29	1.34	1.39	1.44	1.49	1.54	1.59	1.64	1.69	1.74	1.79
78	0.73	0.78	0.83	0.88	0.93	0.98	1.03	1.08	1.13	1.18	1.23	1.28	1.33	1.38	1.43	1.48	1.53	1.58	1.63	1.68	1.73	1.77
79	0.72	0.77	0.82	0.87	0.92	0.97	1.02	1.07	1.12	1.17	1.22	1.27	1.32	1.37	1.42	1.47	1.51	1.56	1.61	1.66	1.71	1.76
80	0.72	0.77	0.82	0.86	0.91	0.96	1.01	1.06	1.11	1.16	1.21	1.26	1.31	1.36	1.41	1.45	1.50	1.55	1.60	1.65	1.70	1.75
81	0.71	0.76	0.81	0.86	0.91	0.96	1.00	1.05	1.10	1.15	1.20	1.25	1.30	1.35	1.40	1.44	1.49	1.54	1.59	1.64	1.69	1.74
82	0.71	0.76	0.80	0.85	0.90	0.95	1.00	1.05	1.09	1.14	1.19	1.24	1.29	1.34	1.39	1.43	1.48	1.53	1.58	1.63	1.68	1.73
83	0.70	0.75	0.80	0.85	0.89	0.94	0.99	1.04	1.09	1.14	1.18	1.23	1.28	1.33	1.38	1.42	1.47	1.52	1.57	1.62	1.67	1.71
84	0.70	0.75	0.79	0.84	0.89	0.94	0.98	1.03	1.08	1.13	1.18	1.22	1.27	1.32	1.37	1.41	1.46	1.51	1.56	1.61	1.65	1.70
85	0.69	0.74	0.79	0.84	0.88	0.93	0.98	1.03	1.07	1.12	1.17	1.22	1.26	1.31	1.36	1.41	1.45	1.50	1.55	1.60	1.64	1.69
86	0.69	0.74	0.78	0.83	0.88	0.92	0.97	1.02	1.07	1.11	1.16	1.21	1.25	1.30	1.35	1.40	1.44	1.49	1.54	1.58	1.63	1.68
87	0.68	0.73	0.78	0.82	0.87	0.92	0.97	1.01	1.06	1.11	1.15	1.20	1.25	1.29	1.34	1.39	1.43	1.48	1.53	1.57	1.62	1.67
88	0.68	0.73	0.77	0.82	0.87	0.91	0.96	1.01	1.05	1.10	1.15	1.19	1.24	1.28	1.33	1.38	1.42	1.47	1.52	1.56	1.61	1.66
89	0.68	0.72	0.77	0.81	0.86	0.91	0.95	1.00	1.05	1.09	1.14	1.18	1.23	1.28	1.32	1.37	1.42	1.46	1.51	1.55	1.60	1.65
90	0.67	0.72	0.76	0.81	0.85	0.90	0.95	0.99	1.04	1.08	1.13	1.18	1.22	1.27	1.31	1.36	1.41	1.45	1.50	1.54	1.59	1.64
91	0.67	0.71	0.76	0.80	0.85	0.90	0.94	0.99	1.03	1.08	1.12	1.17	1.21	1.26	1.31	1.35	1.40	1.44	1.49	1.53	1.58	1.63
92	0.66	0.71	0.75	0.80	0.84	0.89	0.93	0.98	1.03	1.07	1.12	1.16	1.21	1.25	1.30	1.34	1.39	1.43	1.48	1.53	1.57	1.62
93	0.66	0.70	0.75	0.79	0.84	0.88	0.93	0.97	1.02	1.06	1.11	1.15	1.20	1.25	1.29	1.34	1.38	1.43	1.47	1.52	1.56	1.61
94	0.65	0.70	0.74	0.79	0.83	0.88	0.92	0.97	1.01	1.06	1.10	1.15	1.19	1.24	1.28	1.33	1.37	1.42	1.46	1.51	1.55	1.60
95	0.65	0.70	0.74	0.78	0.83	0.87	0.92	0.96	1.01	1.05	1.10	1.14	1.19	1.23	1.27	1.32	1.36	1.41	1.45	1.50	1.54	1.59
96	0.65	0.69	0.74	0.78	0.82	0.87	0.91	0.96	1.00	1.05	1.09	1.13	1.18	1.22	1.27	1.31	1.36	1.40	1.44	1.49	1.53	1.58
97	0.64	0.69	0.73	0.78	0.82	0.86	0.91	0.95	1.00	1.04	1.08	1.13	1.17	1.22	1.26	1.30	1.35	1.39	1.44	1.48	1.52	1.57
98	0.64	0.68	0.73	0.77	0.81	0.86	0.90	0.95	0.99	1.03	1.08	1.12	1.16	1.21	1.25	1.30	1.34	1.38	1.43	1.47	1.52	1.56
99	0.64	0.68	0.72	0.77	0.81	0.85	0.90	0.94	0.98	1.03	1.07	1.11	1.16	1.20	1.25	1.29	1.33	1.38	1.42	1.46	1.51	1.55
100	0.63	0.68	0.72	0.76	0.81	0.85	0.89	0.94	0.98	1.02	1.07	1.11	1.15	1.20	1.24	1.28	1.33	1.37	1.41	1.45	1.50	1.54
101	0.63	0.67	0.71	0.76	0.80	0.84	0.89	0.93	0.97	1.02	1.06	1.10	1.15	1.19	1.23	1.27	1.32	1.36	1.40	1.45	1.49	1.53
102	0.62	0.67	0.71	0.75	0.80	0.84	0.88	0.92	0.97	1.01	1.05	1.10	1.14	1.18	1.22	1.27	1.31	1.35	1.40	1.44	1.48	1.52
103	0.62	0.66	0.71	0.75	0.79	0.83	0.88	0.92	0.96	1.00	1.05	1.09	1.13	1.18	1.22	1.26	1.30	1.35	1.39	1.43	1.47	1.52
104	0.62	0.66	0.70	0.75	0.79	0.83	0.87	0.91	0.96	1.00	1.04	1.08	1.13	1.17	1.21	1.25	1.30	1.34	1.38	1.42	1.47	1.51
105	0.61	0.66	0.70	0.74	0.78	0.83	0.87	0.91	0.95	0.99	1.04	1.08	1.12	1.16	1.20	1.25	1.29	1.33	1.37	1.42	1.46	1.50
106	0.61	0.65	0.70	0.74	0.78	0.82	0.86	0.90	0.95	0.99	1.03	1.07	1.11	1.16	1.20	1.24	1.28	1.32	1.37	1.41	1.45	1.49
107	0.61	0.65	0.69	0.73	0.77	0.82	0.86	0.90	0.94	0.98	1.02	1.07	1.11	1.15	1.19	1.23	1.28	1.32	1.36	1.40	1.44	1.48
108	0.60	0.65	0.69	0.73	0.77	0.81	0.85	0.90	0.94	0.98	1.02	1.06	1.10	1.14	1.19	1.23	1.27	1.31	1.35	1.39	1.43	1.48
109	0.60	0.64	0.68	0.73	0.77	0.81	0.85	0.89	0.93	0.97	1.01	1.06	1.10	1.14	1.18	1.22	1.26	1.30	1.34	1.39	1.43	1.47
110	0.60	0.64	0.68	0.72	0.76	0.80	0.84	0.89	0.93	0.97	1.01	1.05	1.09	1.13	1.17	1.21	1.26	1.30	1.34	1.38	1.42	1.46
111	0.60	0.64	0.68	0.72	0.76	0.80	0.84	0.88	0.92	0.96	1.00	1.04	1.09	1.13	1.17	1.21	1.25	1.29	1.33	1.37	1.41	1.45
112	0.59	0.63	0.67	0.71	0.76	0.80	0.84	0.88	0.92	0.96	1.00	1.04	1.08	1.12	1.16	1.20	1.24	1.28	1.32	1.36	1.41	1.45
113	0.59	0.63	0.67	0.71	0.75	0.79	0.83	0.87	0.91	0.95	0.99	1.03	1.07	1.12	1.16	1.20	1.24	1.28	1.32	1.36	1.40	1.44
114	0.59	0.63	0.67	0.71	0.75	0.79	0.83	0.87	0.91	0.95	0.99	1.03	1.07	1.11	1.15	1.19	1.23	1.27	1.31	1.35	1.39	1.43
115	0.58	0.62	0.66	0.70	0.74	0.78	0.82	0.86	0.90	0.94	0.98	1.02	1.06	1.10	1.14	1.18	1.22	1.26	1.30	1.34	1.38	1.42
116	0.58	0.62	0.66	0.70	0.74	0.78	0.82	0.86	0.90	0.94	0.98	1.02	1.06	1.10	1.14	1.18	1.22	1.26	1.30	1.34	1.38	1.42
117	0.58	0.62	0.66	0.70	0.74	0.78	0.82	0.86	0.90	0.93	0.97	1.01	1.05	1.09	1.13	1.17	1.21	1.25	1.29	1.33	1.37	1.41
118	0.58	0.61	0.65	0.69	0.73	0.77	0.81	0.85	0.89	0.93	0.97	1.01	1.05	1.09	1.13	1.17	1.21	1.25	1.29	1.32	1.36	1.40
119	0.57	0.61	0.65	0.69	0.73	0.77	0.81	0.85	0.89	0.93	0.97	1.00	1.04	1.08	1.12	1.16	1.20	1.24	1.28	1.32	1.36	1.40
120	0.57	0.61	0.65	0.69	0.73	0.77	0.80	0.84	0.88	0.92	0.96	1.00	1.04	1.08	1.12	1.16	1.19	1.23	1.27	1.31	1.35	1.39

T_c (min)	Mean Annual Precipitation (in)																					
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1	9.56	10.22	10.88	11.53	12.19	12.84	13.50	14.16	14.81	15.47	16.12	16.78	17.43	18.09	18.75	19.40	20.06	20.71	21.37	22.03	22.68	23.34
2	6.46	6.90	7.34	7.78	8.23	8.67	9.11	9.55	10.00	10.44	10.88	11.33	11.77	12.21	12.65	13.10	13.54	13.98	14.42	14.87	15.31	15.75
3	5.13	5.48	5.83	6.18	6.54	6.89	7.24	7.59	7.94	8.30	8.65	9.00	9.35	9.70	10.05	10.41	10.76	11.11	11.46	11.81	12.16	12.52
4	4.36	4.66	4.95	5.25	5.55	5.85	6.15	6.45	6.75	7.05	7.35	7.64	7.94	8.24	8.54	8.84	9.14	9.44	9.74	10.03	10.33	10.63
5	3.84	4.10	4.37	4.63	4.89	5.16	5.42	5.68	5.95	6.21	6.47	6.74	7.00	7.26	7.53	7.79	8.05	8.31	8.58	8.84	9.10	9.37
6	3.46	3.70	3.94	4.17	4.41	4.65	4.89	5.12	5.36	5.60	5.84	6.07	6.31	6.55	6.79	7.02	7.26	7.50	7.74	7.97	8.21	8.45
7	3.17	3.39	3.61	3.83	4.04	4.26	4.48	4.70	4.91	5.13	5.35	5.57	5.78	6.00	6.22	6.44	6.65	6.87	7.09	7.31	7.52	7.74
8	2.94	3.14	3.34	3.55	3.75	3.95	4.15	4.35	4.55	4.76	4.96	5.16	5.36	5.56	5.76	5.97	6.17	6.37	6.57	6.77	6.97	7.18
9	2.75	2.94	3.13	3.32	3.51	3.69	3.88	4.07	4.26	4.45	4.64	4.83	5.01	5.20	5.39	5.58	5.77	5.96	6.15	6.34	6.52	6.71
10	2.59	2.77	2.95	3.12	3.30	3.48	3.66	3.84	4.01	4.19	4.37	4.55	4.72	4.90	5.08	5.26	5.43	5.61	5.79	5.97	6.15	6.32
11	2.46	2.62	2.79	2.96	3.13	3.30	3.47	3.63	3.80	3.97	4.14	4.31	4.48	4.64	4.81	4.98	5.15	5.32	5.49	5.65	5.82	5.99
12	2.34	2.50	2.66	2.82	2.98	3.14	3.30	3.46	3.62	3.78	3.94	4.10	4.26	4.42	4.58	4.74	4.90	5.06	5.22	5.38	5.54	5.70
13	2.23	2.39	2.54	2.69	2.85	3.00	3.15	3.31	3.46	3.61	3.76	3.92	4.07	4.22	4.38	4.53	4.68	4.84	4.99	5.14	5.30	5.45
14	2.14	2.29	2.43	2.58	2.73	2.88	3.02	3.17	3.32	3.46	3.61	3.76	3.90	4.05	4.20	4.34	4.49	4.64	4.78	4.93	5.08	5.22
15	2.06	2.20	2.34	2.48	2.62	2.77	2.91	3.05	3.19	3.33	3.47	3.61	3.75	3.89	4.04	4.18	4.32	4.46	4.60	4.74	4.88	5.02
16	1.99	2.12	2.26	2.39	2.53	2.67	2.80	2.94	3.07	3.21	3.35	3.48	3.62	3.75	3.89	4.03	4.16	4.30	4.44	4.57	4.71	4.84
17	1.92	2.05	2.18	2.31	2.44	2.58	2.71	2.84	2.97	3.10	3.23	3.36	3.50	3.63	3.76	3.89	4.02	4.15	4.29	4.42	4.55	4.68
18	1.86	1.98	2.11	2.24	2.37	2.49	2.62	2.75	2.88	3.00	3.13	3.26	3.38	3.51	3.64	3.77	3.89	4.02	4.15	4.28	4.40	4.53
19	1.80	1.92	2.05	2.17	2.29	2.42	2.54	2.67	2.79	2.91	3.04	3.16	3.28	3.41	3.53	3.65	3.78	3.90	4.02	4.15	4.27	4.39
20	1.75	1.87	1.99	2.11	2.23	2.35	2.47	2.59	2.71	2.83	2.95	3.07	3.19	3.31	3.43	3.55	3.67	3.79	3.91	4.03	4.15	4.27
21	1.70	1.82	1.93	2.05	2.17	2.28	2.40	2.52	2.63	2.75	2.87	2.98	3.10	3.22	3.33	3.45	3.57	3.68	3.80	3.92	4.03	4.15
22	1.66	1.77	1.88	2.00	2.11	2.23	2.34	2.45	2.57	2.68	2.79	2.91	3.02	3.13	3.25	3.36	3.48	3.59	3.70	3.82	3.93	4.04
23	1.62	1.73	1.84	1.95	2.06	2.17	2.28	2.39	2.50	2.61	2.72	2.83	2.95	3.06	3.17	3.28	3.39	3.50	3.61	3.72	3.83	3.94
24	1.58	1.69	1.79	1.90	2.01	2.12	2.23	2.33	2.44	2.55	2.66	2.77	2.88	2.98	3.09	3.20	3.31	3.42	3.52	3.63	3.74	3.85
25	1.54	1.65	1.75	1.86	1.96	2.07	2.18	2.28	2.39	2.49	2.60	2.70	2.81	2.92	3.02	3.13	3.23	3.34	3.44	3.55	3.65	3.76
26	1.51	1.61	1.71	1.82	1.92	2.02	2.13	2.23	2.33	2.44	2.54	2.64	2.75	2.85	2.95	3.06	3.16	3.26	3.37	3.47	3.57	3.68
27	1.48	1.58	1.68	1.78	1.88	1.98	2.08	2.18	2.28	2.39	2.49	2.59	2.69	2.79	2.89	2.99	3.09	3.20	3.30	3.40	3.50	3.60
28	1.45	1.54	1.64	1.74	1.84	1.94	2.04	2.14	2.24	2.34	2.44	2.54	2.63	2.73	2.83	2.93	3.03	3.13	3.23	3.33	3.43	3.53
29	1.42	1.51	1.61	1.71	1.81	1.90	2.00	2.10	2.19	2.29	2.39	2.49	2.58	2.68	2.78	2.87	2.97	3.07	3.17	3.26	3.36	3.46
30	1.39	1.49	1.58	1.68	1.77	1.87	1.96	2.06	2.15	2.25	2.34	2.44	2.53	2.63	2.72	2.82	2.91	3.01	3.11	3.20	3.30	3.39
31	1.36	1.46	1.55	1.64	1.74	1.83	1.93	2.02	2.11	2.21	2.30	2.39	2.49	2.58	2.67	2.77	2.86	2.95	3.05	3.14	3.24	3.33
32	1.34	1.43	1.52	1.62	1.71	1.80	1.89	1.98	2.07	2.17	2.26	2.35	2.44	2.53	2.63	2.72	2.81	2.90	2.99	3.09	3.18	3.27
33	1.32	1.41	1.50	1.59	1.68	1.77	1.86	1.95	2.04	2.13	2.22	2.31	2.40	2.49	2.58	2.67	2.76	2.85	2.94	3.03	3.12	3.21
34	1.29	1.38	1.47	1.56	1.65	1.74	1.83	1.92	2.00	2.09	2.18	2.27	2.36	2.45	2.54	2.63	2.71	2.80	2.89	2.98	3.07	3.16
35	1.27	1.36	1.45	1.54	1.62	1.71	1.80	1.88	1.97	2.06	2.15	2.23	2.32	2.41	2.50	2.58	2.67	2.76	2.85	2.93	3.02	3.11
36	1.25	1.34	1.43	1.51	1.60	1.68	1.77	1.85	1.94	2.03	2.11	2.20	2.28	2.37	2.46	2.54	2.63	2.71	2.80	2.89	2.97	3.06
37	1.23	1.32	1.40	1.49	1.57	1.66	1.74	1.83	1.91	2.00	2.08	2.16	2.25	2.33	2.42	2.50	2.59	2.67	2.76	2.84	2.93	3.01
38	1.22	1.30	1.38	1.47	1.55	1.63	1.72	1.80	1.88	1.97	2.05	2.13	2.22	2.30	2.38	2.47	2.55	2.63	2.72	2.80	2.88	2.97
39	1.20	1.28	1.36	1.44	1.53	1.61	1.69	1.77	1.85	1.94	2.02	2.10	2.18	2.27	2.35	2.43	2.51	2.59	2.68	2.76	2.84	2.92
40	1.18	1.26	1.34	1.42	1.50	1.59	1.67	1.75	1.83	1.91	1.99	2.07	2.15	2.23	2.31	2.39	2.48	2.56	2.64	2.72	2.80	2.88
41	1.16	1.24	1.32	1.40	1.48	1.56	1.64	1.72	1.80	1.88	1.96	2.04	2.12	2.20	2.28	2.36	2.44	2.52	2.60	2.68	2.76	2.84
42	1.15	1.23	1.31	1.38	1.46	1.54	1.62	1.70	1.78	1.86	1.94	2.01	2.09	2.17	2.25	2.33	2.41	2.49	2.57	2.64	2.72	2.80
43	1.13	1.21	1.29	1.37	1.44	1.52	1.60	1.68	1.75	1.83	1.91	1.99	2.07	2.14	2.22	2.30	2.38	2.45	2.53	2.61	2.69	2.76
44	1.12	1.20	1.27	1.35	1.43	1.50	1.58	1.66	1.73	1.81	1.89	1.96	2.04	2.12	2.19	2.27	2.35	2.42	2.50	2.58	2.65	2.73
45	1.10	1.18	1.26	1.33	1.41	1.48	1.56	1.63	1.71	1.79	1.86	1.94	2.01	2.09	2.16	2.24	2.32	2.39	2.47	2.54	2.62	2.69
46	1.09	1.17	1.24	1.31	1.39	1.46	1.54	1.61	1.69	1.76	1.84	1.91	1.99	2.06	2.14	2.21	2.29	2.36	2.44	2.51	2.59	2.66
47	1.08	1.15	1.23	1.30	1.37	1.45	1.52	1.59	1.67	1.74	1.82	1.89	1.96	2.04	2.11	2.19	2.26	2.33	2.41	2.48	2.55	2.63
48	1.06	1.14	1.21	1.28	1.36	1.43	1.50	1.58	1.65	1.72	1.79	1.87	1.94	2.01	2.09	2.16	2.23	2.31	2.38	2.45	2.52	2.60
49	1.05	1.12	1.20	1.27	1.34	1.41	1.49	1.56	1.63	1.70	1.77	1.85	1.92	1.99	2.06	2.13	2.21	2.28	2.35	2.42	2.50	2.57
50	1.04	1.11	1.18	1.25	1.33	1.40	1.47	1.54	1.61	1.68	1.75	1.82	1.90	1.97	2.04	2.11	2.18	2.25	2.32	2.40	2.47	2.54
51	1.03	1.10	1.17	1.24	1.31	1.38	1.45	1.52	1.59	1.66	1.73	1.80	1.88	1.95	2.02	2.09	2.16	2.23	2.30	2.37	2.44	2.51
52	1.02	1.09	1.16	1.23	1.30	1.37	1.44	1.51	1.58	1.65	1.71	1.78	1.85	1.92	1.99	2.06	2.13	2.20	2.27	2.34	2.41	2.48
53	1.01	1.08	1.14	1.21	1.28	1.35	1.42	1.49	1.56	1.63	1.70	1.77	1.83	1.90	1.97	2.04	2.11	2.18	2.25	2.32	2.39	2.46
54	1.00	1.06	1.13	1.20	1.27	1.34	1.41	1.47	1.54	1.61	1.68	1.75	1.82	1.88	1.95	2.02	2.09	2.16	2.22	2.29	2.36	2.43
55	0.99	1.05	1.12	1.19	1.26	1.32	1.39	1.46	1.53	1.59	1.66	1.73	1.80	1.86	1.93	2.00	2.07	2.13	2.20	2.27	2.34	2.40
56	0.98	1.04	1.11	1.18	1.24	1.31	1.38	1.44	1.51	1.58	1.64	1.71	1.78	1.85	1.91	1.98	2.05	2.11	2.18	2.25	2.31	2.38
57	0.97	1.03	1.10	1.16	1.23	1.30	1.36	1.43	1.50	1.56	1.63	1.69	1.76	1.83	1.89	1.96	2.03	2.09	2.16	2.22	2.29	2.36
58	0.96	1.02	1.09	1.15	1.22	1.28	1.35	1.42	1.48	1.55	1.61	1.68	1.74	1.81	1.87	1.94	2.01	2.07	2.14	2.20	2.27	2.33
59	0.95	1.01	1.08	1.14	1.21	1.27	1.34	1.40	1.47	1.53	1.60	1.66	1.73	1.79	1.86	1.92	1.99	2.05	2.12	2.18	2.25	2.31
60	0.94	1.00	1.07	1.13	1.20	1.26	1.32	1.39	1.45	1.52	1.58	1.65	1.71	1.77	1.84	1.90	1.97	2.03	2.10	2.16	2.22	2.29

T_c (min)	Mean Annual Precipitation (in)																					
	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
61	0.93	0.99	1.06	1.12	1.18	1.25	1.31	1.38	1.44	1.50	1.57	1.63	1.69	1.76	1.82	1.89	1.95	2.01	2.08	2.14	2.20	2.27
62	0.92	0.98	1.05	1.11	1.17	1.24	1.30	1.36	1.43	1.49	1.55	1.62	1.68	1.74	1.80	1.87	1.93	1.99	2.06	2.12	2.18	2.25
63	0.91	0.98	1.04	1.10	1.16	1.23	1.29	1.35	1.41	1.48	1.54	1.60	1.66	1.73	1.79	1.85	1.91	1.98	2.04	2.10	2.16	2.23
64	0.90	0.97	1.03	1.09	1.15	1.21	1.28	1.34	1.40	1.46	1.52	1.59	1.65	1.71	1.77	1.83	1.90	1.96	2.02	2.08	2.14	2.21
65	0.90	0.96	1.02	1.08	1.14	1.20	1.27	1.33	1.39	1.45	1.51	1.57	1.63	1.70	1.76	1.82	1.88	1.94	2.00	2.06	2.13	2.19
66	0.89	0.95	1.01	1.07	1.13	1.19	1.25	1.32	1.38	1.44	1.50	1.56	1.62	1.68	1.74	1.80	1.86	1.92	1.99	2.05	2.11	2.17
67	0.88	0.94	1.00	1.06	1.12	1.18	1.24	1.30	1.36	1.42	1.49	1.55	1.61	1.67	1.73	1.79	1.85	1.91	1.97	2.03	2.09	2.15
68	0.87	0.93	0.99	1.05	1.11	1.17	1.23	1.29	1.35	1.41	1.47	1.53	1.59	1.65	1.71	1.77	1.83	1.89	1.95	2.01	2.07	2.13
69	0.87	0.93	0.99	1.04	1.10	1.16	1.22	1.28	1.34	1.40	1.46	1.52	1.58	1.64	1.70	1.76	1.82	1.88	1.94	2.00	2.05	2.11
70	0.86	0.92	0.98	1.04	1.10	1.15	1.21	1.27	1.33	1.39	1.45	1.51	1.57	1.63	1.68	1.74	1.80	1.86	1.92	1.98	2.04	2.10
71	0.85	0.91	0.97	1.03	1.09	1.14	1.20	1.26	1.32	1.38	1.44	1.50	1.55	1.61	1.67	1.73	1.79	1.85	1.91	1.96	2.02	2.08
72	0.85	0.90	0.96	1.02	1.08	1.14	1.19	1.25	1.31	1.37	1.43	1.48	1.54	1.60	1.66	1.72	1.77	1.83	1.89	1.95	2.01	2.06
73	0.84	0.90	0.95	1.01	1.07	1.13	1.18	1.24	1.30	1.36	1.41	1.47	1.53	1.59	1.65	1.70	1.76	1.82	1.88	1.93	1.99	2.05
74	0.83	0.89	0.95	1.00	1.06	1.12	1.18	1.23	1.29	1.35	1.40	1.46	1.52	1.58	1.63	1.69	1.75	1.80	1.86	1.92	1.98	2.03
75	0.83	0.88	0.94	1.00	1.05	1.11	1.17	1.22	1.28	1.34	1.39	1.45	1.51	1.56	1.62	1.68	1.73	1.79	1.85	1.90	1.96	2.02
76	0.82	0.88	0.93	0.99	1.05	1.10	1.16	1.21	1.27	1.33	1.38	1.44	1.50	1.55	1.61	1.66	1.72	1.78	1.83	1.89	1.95	2.00
77	0.81	0.87	0.93	0.98	1.04	1.09	1.15	1.21	1.26	1.32	1.37	1.43	1.48	1.54	1.60	1.65	1.71	1.76	1.82	1.88	1.93	1.99
78	0.81	0.86	0.92	0.97	1.03	1.09	1.14	1.20	1.25	1.31	1.36	1.42	1.47	1.53	1.58	1.64	1.70	1.75	1.81	1.86	1.92	1.97
79	0.80	0.86	0.91	0.97	1.02	1.08	1.13	1.19	1.24	1.30	1.35	1.41	1.46	1.52	1.57	1.63	1.68	1.74	1.79	1.85	1.90	1.96
80	0.80	0.85	0.91	0.96	1.02	1.07	1.12	1.18	1.23	1.29	1.34	1.40	1.45	1.51	1.56	1.62	1.67	1.73	1.78	1.83	1.89	1.94
81	0.79	0.85	0.90	0.95	1.01	1.06	1.12	1.17	1.23	1.28	1.33	1.39	1.44	1.50	1.55	1.61	1.66	1.71	1.77	1.82	1.88	1.93
82	0.79	0.84	0.89	0.95	1.00	1.06	1.11	1.16	1.22	1.27	1.32	1.38	1.43	1.49	1.54	1.59	1.65	1.70	1.76	1.81	1.86	1.92
83	0.78	0.83	0.89	0.94	0.99	1.05	1.10	1.15	1.21	1.26	1.32	1.37	1.42	1.48	1.53	1.58	1.64	1.69	1.74	1.80	1.85	1.90
84	0.78	0.83	0.88	0.93	0.99	1.04	1.09	1.15	1.20	1.25	1.31	1.36	1.41	1.47	1.52	1.57	1.63	1.68	1.73	1.78	1.84	1.89
85	0.77	0.82	0.88	0.93	0.98	1.03	1.09	1.14	1.19	1.25	1.30	1.35	1.40	1.46	1.51	1.56	1.61	1.67	1.72	1.77	1.83	1.88
86	0.76	0.82	0.87	0.92	0.97	1.03	1.08	1.13	1.18	1.24	1.29	1.34	1.39	1.45	1.50	1.55	1.60	1.66	1.71	1.76	1.81	1.87
87	0.76	0.81	0.86	0.92	0.97	1.02	1.07	1.12	1.18	1.23	1.28	1.33	1.39	1.44	1.49	1.54	1.59	1.65	1.70	1.75	1.80	1.85
88	0.75	0.81	0.86	0.91	0.96	1.01	1.07	1.12	1.17	1.22	1.27	1.32	1.38	1.43	1.48	1.53	1.58	1.63	1.69	1.74	1.79	1.84
89	0.75	0.80	0.85	0.90	0.96	1.01	1.06	1.11	1.16	1.21	1.26	1.32	1.37	1.42	1.47	1.52	1.57	1.62	1.68	1.73	1.78	1.83
90	0.75	0.80	0.85	0.90	0.95	1.00	1.05	1.10	1.15	1.21	1.26	1.31	1.36	1.41	1.46	1.51	1.56	1.61	1.67	1.72	1.77	1.82
91	0.74	0.79	0.84	0.89	0.94	0.99	1.05	1.10	1.15	1.20	1.25	1.30	1.35	1.40	1.45	1.50	1.55	1.60	1.65	1.71	1.76	1.81
92	0.74	0.79	0.84	0.89	0.94	0.99	1.04	1.09	1.14	1.19	1.24	1.29	1.34	1.39	1.44	1.49	1.54	1.59	1.64	1.70	1.75	1.80
93	0.73	0.78	0.83	0.88	0.93	0.98	1.03	1.08	1.13	1.18	1.23	1.28	1.33	1.38	1.43	1.48	1.53	1.58	1.63	1.68	1.73	1.79
94	0.73	0.78	0.83	0.88	0.93	0.98	1.03	1.08	1.13	1.18	1.23	1.28	1.33	1.38	1.43	1.48	1.53	1.57	1.62	1.67	1.72	1.77
95	0.72	0.77	0.82	0.87	0.92	0.97	1.02	1.07	1.12	1.17	1.22	1.27	1.32	1.37	1.42	1.47	1.52	1.57	1.62	1.66	1.71	1.76
96	0.72	0.77	0.82	0.87	0.92	0.96	1.01	1.06	1.11	1.16	1.21	1.26	1.31	1.36	1.41	1.46	1.51	1.56	1.61	1.65	1.70	1.75
97	0.71	0.76	0.81	0.86	0.91	0.96	1.01	1.06	1.11	1.16	1.20	1.25	1.30	1.35	1.40	1.45	1.50	1.55	1.60	1.65	1.69	1.74
98	0.71	0.76	0.81	0.86	0.91	0.95	1.00	1.05	1.10	1.15	1.20	1.25	1.29	1.34	1.39	1.44	1.49	1.54	1.59	1.64	1.68	1.73
99	0.71	0.75	0.80	0.85	0.90	0.95	1.00	1.05	1.09	1.14	1.19	1.24	1.29	1.34	1.38	1.43	1.48	1.53	1.58	1.63	1.67	1.72
100	0.70	0.75	0.80	0.85	0.89	0.94	0.99	1.04	1.09	1.14	1.18	1.23	1.28	1.33	1.38	1.42	1.47	1.52	1.57	1.62	1.67	1.71
101	0.70	0.75	0.79	0.84	0.89	0.94	0.99	1.03	1.08	1.13	1.18	1.22	1.27	1.32	1.37	1.42	1.46	1.51	1.56	1.61	1.66	1.70
102	0.69	0.74	0.79	0.84	0.88	0.93	0.98	1.03	1.08	1.12	1.17	1.22	1.27	1.31	1.36	1.41	1.46	1.50	1.55	1.60	1.65	1.69
103	0.69	0.74	0.79	0.83	0.88	0.93	0.97	1.02	1.07	1.12	1.16	1.21	1.26	1.31	1.35	1.40	1.45	1.50	1.54	1.59	1.64	1.68
104	0.69	0.73	0.78	0.83	0.88	0.92	0.97	1.02	1.06	1.11	1.16	1.20	1.25	1.30	1.35	1.39	1.44	1.49	1.53	1.58	1.63	1.68
105	0.68	0.73	0.78	0.82	0.87	0.92	0.96	1.01	1.06	1.10	1.15	1.20	1.24	1.29	1.34	1.39	1.43	1.48	1.53	1.57	1.62	1.67
106	0.68	0.73	0.77	0.82	0.87	0.91	0.96	1.01	1.05	1.10	1.15	1.19	1.24	1.28	1.33	1.38	1.42	1.47	1.52	1.56	1.61	1.66
107	0.68	0.72	0.77	0.81	0.86	0.91	0.95	1.00	1.05	1.09	1.14	1.19	1.23	1.28	1.32	1.37	1.42	1.46	1.51	1.56	1.60	1.65
108	0.67	0.72	0.76	0.81	0.86	0.90	0.95	0.99	1.04	1.09	1.13	1.18	1.23	1.27	1.32	1.36	1.41	1.46	1.50	1.55	1.59	1.64
109	0.67	0.71	0.76	0.81	0.85	0.90	0.94	0.99	1.04	1.08	1.13	1.17	1.22	1.26	1.31	1.36	1.40	1.45	1.49	1.54	1.59	1.63
110	0.67	0.71	0.76	0.80	0.85	0.89	0.94	0.98	1.03	1.08	1.12	1.17	1.21	1.26	1.30	1.35	1.39	1.44	1.49	1.53	1.58	1.62
111	0.66	0.71	0.75	0.80	0.84	0.89	0.93	0.98	1.02	1.07	1.12	1.16	1.21	1.25	1.30	1.34	1.39	1.43	1.48	1.52	1.57	1.61
112	0.66	0.70	0.75	0.79	0.84	0.88	0.93	0.97	1.02	1.06	1.11	1.16	1.20	1.25	1.29	1.34	1.38	1.43	1.47	1.52	1.56	1.61
113	0.66	0.70	0.74	0.79	0.83	0.88	0.92	0.97	1.01	1.06	1.10	1.15	1.19	1.24	1.28	1.33	1.37	1.42	1.46	1.51	1.55	1.60
114	0.65	0.70	0.74	0.79	0.83	0.88	0.92	0.96	1.01	1.05	1.10	1.14	1.19	1.23	1.28	1.32	1.37	1.41	1.46	1.50	1.55	1.59
115	0.65	0.69	0.74	0.78	0.83	0.87	0.92	0.96	1.00	1.05	1.09	1.14	1.18	1.23	1.27	1.32	1.36	1.40	1.45	1.49	1.54	1.58
116	0.65	0.69	0.73	0.78	0.82	0.87	0.91	0.96	1.00	1.04	1.09	1.13	1.18	1.22	1.27	1.31	1.35	1.40	1.44	1.49	1.53	1.57
117	0.64	0.69	0.73	0.77	0.82	0.86	0.91	0.95	0.99	1.04	1.08	1.13	1.17	1.21	1.26	1.30	1.35	1.39	1.44	1.48	1.52	1.57
118	0.64	0.68	0.73	0.77	0.81	0.86	0.90	0.95	0.99	1.03	1.08	1.12	1.17	1.21	1.25	1.30	1.34	1.38	1.43	1.47	1.52	1.56
119	0.64	0.68	0.72	0.77	0.81	0.85	0.90	0.94	0.99	1.03	1.07	1.12	1.16	1.20	1.25	1.29	1.33	1.38	1.42	1.46	1.51	1.55
120	0.63	0.68	0.72	0.76	0.81	0.85	0.89	0.94	0.98	1.02	1.07	1.11	1.15	1.20	1.24	1.28	1.33	1.37	1.41	1.46	1.50	1.54

2-Year Storm for Alameda County

Mean Annual Precipitation	Duration																				
	Minutes				Hours						Days										
	5	10	15	30	1	2	3	6	12	24	2	3	4	5	6	8	10	15	20	30	60
10	0.10	0.13	0.16	0.21	0.29	0.39	0.46	0.62	0.84	1.13	1.51	1.80	2.06	2.28	2.47	2.81	3.14	3.79	4.30	5.09	7.01
11	0.10	0.14	0.17	0.23	0.31	0.41	0.49	0.67	0.90	1.22	1.62	1.93	2.21	2.45	2.65	3.01	3.37	4.07	4.61	5.46	7.52
12	0.11	0.15	0.18	0.24	0.33	0.44	0.53	0.71	0.96	1.30	1.73	2.07	2.36	2.62	2.84	3.22	3.60	4.35	4.93	5.84	8.04
13	0.12	0.16	0.19	0.26	0.35	0.47	0.56	0.76	1.02	1.38	1.84	2.20	2.51	2.79	3.02	3.43	3.83	4.63	5.24	6.21	8.56
14	0.13	0.17	0.20	0.27	0.37	0.50	0.60	0.80	1.09	1.47	1.95	2.33	2.66	2.96	3.20	3.63	4.06	4.91	5.56	6.59	9.07
15	0.13	0.18	0.21	0.29	0.39	0.53	0.63	0.85	1.15	1.55	2.06	2.46	2.81	3.13	3.38	3.84	4.29	5.18	5.88	6.96	9.59
16	0.14	0.19	0.23	0.31	0.41	0.56	0.66	0.90	1.21	1.63	2.18	2.60	2.96	3.29	3.56	4.04	4.52	5.46	6.19	7.34	10.10
17	0.15	0.20	0.24	0.32	0.43	0.59	0.70	0.94	1.27	1.72	2.29	2.73	3.11	3.46	3.75	4.25	4.75	5.74	6.51	7.71	10.62
18	0.16	0.21	0.25	0.34	0.45	0.61	0.73	0.99	1.33	1.80	2.40	2.86	3.27	3.63	3.93	4.46	4.98	6.02	6.82	8.09	11.13
19	0.16	0.22	0.26	0.35	0.48	0.64	0.77	1.03	1.40	1.88	2.51	2.99	3.42	3.80	4.11	4.66	5.21	6.30	7.14	8.46	11.65
20	0.17	0.23	0.27	0.37	0.50	0.67	0.80	1.08	1.46	1.97	2.62	3.13	3.57	3.97	4.29	4.87	5.44	6.58	7.46	8.83	12.17
21	0.18	0.24	0.28	0.38	0.52	0.70	0.83	1.13	1.52	2.05	2.73	3.26	3.72	4.13	4.47	5.08	5.67	6.86	7.77	9.21	12.68
22	0.18	0.25	0.30	0.40	0.54	0.73	0.87	1.17	1.58	2.13	2.84	3.39	3.87	4.30	4.66	5.28	5.91	7.14	8.09	9.58	13.20
23	0.19	0.26	0.31	0.42	0.56	0.76	0.90	1.22	1.64	2.22	2.95	3.52	4.02	4.47	4.84	5.49	6.14	7.42	8.41	9.96	13.71
24	0.20	0.27	0.32	0.43	0.58	0.78	0.94	1.26	1.70	2.30	3.06	3.66	4.17	4.64	5.02	5.70	6.37	7.70	8.72	10.33	14.23
25	0.21	0.28	0.33	0.45	0.60	0.81	0.97	1.31	1.77	2.38	3.18	3.79	4.32	4.81	5.20	5.90	6.60	7.97	9.04	10.71	14.75
26	0.21	0.29	0.34	0.46	0.62	0.84	1.00	1.35	1.83	2.47	3.29	3.92	4.48	4.97	5.38	6.11	6.83	8.25	9.35	11.08	15.26
27	0.22	0.30	0.35	0.48	0.64	0.87	1.04	1.40	1.89	2.55	3.40	4.06	4.63	5.14	5.57	6.32	7.06	8.53	9.67	11.46	15.78
28	0.23	0.31	0.37	0.49	0.67	0.90	1.07	1.45	1.95	2.63	3.51	4.19	4.78	5.31	5.75	6.52	7.29	8.81	9.99	11.83	16.29
29	0.23	0.32	0.38	0.51	0.69	0.93	1.10	1.49	2.01	2.72	3.62	4.32	4.93	5.48	5.93	6.73	7.52	9.09	10.30	12.21	16.81
30	0.24	0.33	0.39	0.52	0.71	0.96	1.14	1.54	2.08	2.80	3.73	4.45	5.08	5.65	6.11	6.94	7.75	9.37	10.62	12.58	17.33
31	0.25	0.34	0.40	0.54	0.73	0.98	1.17	1.58	2.14	2.88	3.84	4.59	5.23	5.82	6.29	7.14	7.98	9.65	10.94	12.96	17.84
32	0.26	0.35	0.41	0.56	0.75	1.01	1.21	1.63	2.20	2.97	3.95	4.72	5.38	5.98	6.48	7.35	8.21	9.93	11.25	13.33	18.36
33	0.26	0.35	0.42	0.57	0.77	1.04	1.24	1.67	2.26	3.05	4.06	4.85	5.54	6.15	6.66	7.56	8.44	10.21	11.57	13.70	18.87
34	0.27	0.36	0.43	0.59	0.79	1.07	1.27	1.72	2.32	3.13	4.18	4.98	5.69	6.32	6.84	7.76	8.68	10.49	11.88	14.08	19.39
35	0.28	0.37	0.45	0.60	0.81	1.10	1.31	1.77	2.38	3.22	4.29	5.12	5.84	6.49	7.02	7.97	8.91	10.76	12.20	14.45	19.91
36	0.28	0.38	0.46	0.62	0.83	1.13	1.34	1.81	2.45	3.30	4.40	5.25	5.99	6.66	7.20	8.18	9.14	11.04	12.52	14.83	20.42

5-Year Storm for Alameda County

Mean Annual Precipitation	Duration																				
	Minutes				Hours						Days										
	5	10	15	30	1	2	3	6	12	24	2	3	4	5	6	8	10	15	20	30	60
10	0.14	0.19	0.22	0.30	0.40	0.54	0.65	0.88	1.18	1.60	2.18	2.59	2.94	3.24	3.51	3.95	4.37	5.23	5.91	7.00	9.53
11	0.15	0.20	0.24	0.32	0.43	0.59	0.70	0.94	1.27	1.72	2.34	2.78	3.16	3.48	3.76	4.24	4.69	5.61	6.34	7.51	10.23
12	0.16	0.21	0.25	0.34	0.46	0.63	0.75	1.01	1.36	1.83	2.50	2.97	3.38	3.72	4.02	4.53	5.01	6.00	6.78	8.03	10.93
13	0.17	0.23	0.27	0.37	0.49	0.67	0.79	1.07	1.44	1.95	2.66	3.16	3.59	3.95	4.28	4.82	5.33	6.38	7.21	8.54	11.63
14	0.18	0.24	0.29	0.39	0.52	0.71	0.84	1.13	1.53	2.07	2.82	3.35	3.81	4.19	4.54	5.11	5.65	6.77	7.64	9.06	12.33
15	0.19	0.25	0.30	0.41	0.55	0.75	0.89	1.20	1.62	2.19	2.98	3.54	4.03	4.43	4.80	5.40	5.97	7.15	8.08	9.58	13.03
16	0.20	0.27	0.32	0.43	0.58	0.79	0.94	1.26	1.71	2.30	3.14	3.73	4.24	4.67	5.05	5.69	6.30	7.54	8.51	10.09	13.73
17	0.21	0.28	0.34	0.45	0.61	0.83	0.98	1.33	1.79	2.42	3.30	3.93	4.46	4.91	5.31	5.98	6.62	7.92	8.95	10.61	14.44
18	0.22	0.30	0.35	0.48	0.64	0.87	1.03	1.39	1.88	2.54	3.46	4.12	4.68	5.15	5.57	6.27	6.94	8.31	9.38	11.12	15.14
19	0.23	0.31	0.37	0.50	0.67	0.91	1.08	1.46	1.97	2.66	3.62	4.31	4.89	5.39	5.83	6.56	7.26	8.69	9.82	11.64	15.84
20	0.24	0.32	0.38	0.52	0.70	0.95	1.13	1.52	2.05	2.77	3.78	4.50	5.11	5.62	6.09	6.85	7.58	9.08	10.25	12.15	16.54
21	0.25	0.34	0.40	0.54	0.73	0.99	1.18	1.59	2.14	2.89	3.94	4.69	5.33	5.86	6.34	7.14	7.90	9.46	10.69	12.67	17.24
22	0.26	0.35	0.42	0.56	0.76	1.03	1.22	1.65	2.23	3.01	4.10	4.88	5.54	6.10	6.60	7.43	8.22	9.85	11.12	13.18	17.94
23	0.27	0.36	0.43	0.59	0.79	1.07	1.27	1.72	2.32	3.13	4.26	5.07	5.76	6.34	6.86	7.73	8.55	10.23	11.56	13.70	18.64
24	0.28	0.38	0.45	0.61	0.82	1.11	1.32	1.78	2.40	3.24	4.43	5.26	5.98	6.58	7.12	8.02	8.87	10.62	11.99	14.21	19.35
25	0.29	0.39	0.47	0.63	0.85	1.15	1.37	1.84	2.49	3.36	4.59	5.45	6.19	6.82	7.38	8.31	9.19	11.00	12.43	14.73	20.05
26	0.30	0.40	0.48	0.65	0.88	1.19	1.41	1.91	2.58	3.48	4.75	5.64	6.41	7.05	7.63	8.60	9.51	11.39	12.86	15.24	20.75
27	0.31	0.42	0.50	0.67	0.91	1.23	1.46	1.97	2.66	3.60	4.91	5.83	6.63	7.29	7.89	8.89	9.83	11.77	13.30	15.76	21.45
28	0.32	0.43	0.52	0.70	0.94	1.27	1.51	2.04	2.75	3.71	5.07	6.02	6.84	7.53	8.15	9.18	10.15	12.16	13.73	16.27	22.15
29	0.33	0.45	0.53	0.72	0.97	1.31	1.56	2.10	2.84	3.83	5.23	6.21	7.06	7.77	8.41	9.47	10.47	12.54	14.17	16.79	22.85
30	0.34	0.46	0.55	0.74	1.00	1.35	1.61	2.17	2.93	3.95	5.39	6.40	7.28	8.01	8.67	9.76	10.80	12.93	14.60	17.30	23.55
31	0.35	0.47	0.56	0.76	1.03	1.39	1.65	2.23	3.01	4.07	5.55	6.59	7.50	8.25	8.92	10.05	11.12	13.31	15.04	17.82	24.25
32	0.36	0.49	0.58	0.78	1.06	1.43	1.70	2.30	3.10	4.19	5.71	6.79	7.71	8.48	9.18	10.34	11.44	13.70	15.47	18.33	24.96
33	0.37	0.50	0.60	0.81	1.09	1.47	1.75	2.36	3.19	4.30	5.87	6.98	7.93	8.72	9.44	10.63	11.76	14.08	15.91	18.85	25.66
34	0.38	0.51	0.61	0.83	1.12	1.51	1.80	2.43	3.27	4.42	6.03	7.17	8.15	8.96	9.70	10.92	12.08	14.47	16.34	19.36	26.36
35	0.39	0.53	0.63	0.85	1.15	1.55	1.84	2.49	3.36	4.54	6.19	7.36	8.36	9.20	9.96	11.21	12.40	14.85	16.77	19.88	27.06
36	0.40	0.54	0.65	0.87	1.18	1.59	1.89	2.55	3.45	4.66	6.35	7.55	8.58	9.44	10.21	11.50	12.72	15.24	17.21	20.40	27.76

10-Year Storm for Alameda County

Mean Annual Precipitation	Duration																				
	Minutes				Hours						Days										
	5	10	15	30	1	2	3	6	12	24	2	3	4	5	6	8	10	15	20	30	60
10	0.16	0.22	0.26	0.36	0.48	0.65	0.78	1.05	1.41	1.91	2.63	3.13	3.54	3.86	4.18	4.69	5.14	6.11	6.89	8.19	11.01
11	0.18	0.24	0.28	0.38	0.52	0.70	0.83	1.12	1.52	2.05	2.83	3.36	3.80	4.15	4.49	5.04	5.52	6.56	7.39	8.79	11.82
12	0.19	0.25	0.30	0.41	0.55	0.75	0.89	1.20	1.62	2.19	3.02	3.59	4.06	4.43	4.80	5.39	5.90	7.01	7.90	9.39	12.63
13	0.20	0.27	0.32	0.44	0.59	0.79	0.95	1.28	1.73	2.33	3.22	3.82	4.32	4.72	5.10	5.73	6.28	7.46	8.41	9.99	13.45
14	0.21	0.29	0.34	0.46	0.62	0.84	1.00	1.36	1.83	2.47	3.41	4.05	4.58	5.00	5.41	6.08	6.66	7.91	8.92	10.60	14.26
15	0.22	0.30	0.36	0.49	0.66	0.89	1.06	1.43	1.93	2.61	3.60	4.28	4.84	5.29	5.72	6.42	7.04	8.36	9.42	11.20	15.07
16	0.24	0.32	0.38	0.51	0.69	0.94	1.12	1.51	2.04	2.75	3.80	4.51	5.10	5.57	6.03	6.77	7.42	8.81	9.93	11.80	15.88
17	0.25	0.34	0.40	0.54	0.73	0.99	1.18	1.59	2.14	2.89	3.99	4.74	5.36	5.85	6.34	7.11	7.79	9.26	10.44	12.41	16.69
18	0.26	0.35	0.42	0.57	0.77	1.03	1.23	1.66	2.25	3.03	4.19	4.97	5.62	6.14	6.64	7.46	8.17	9.71	10.94	13.01	17.50
19	0.27	0.37	0.44	0.59	0.80	1.08	1.29	1.74	2.35	3.17	4.38	5.20	5.88	6.42	6.95	7.80	8.55	10.15	11.45	13.61	18.31
20	0.29	0.39	0.46	0.62	0.84	1.13	1.35	1.82	2.45	3.31	4.57	5.43	6.14	6.71	7.26	8.15	8.93	10.60	11.96	14.21	19.12
21	0.30	0.40	0.48	0.65	0.87	1.18	1.40	1.89	2.56	3.45	4.77	5.66	6.40	6.99	7.57	8.50	9.31	11.05	12.47	14.82	19.93
22	0.31	0.42	0.50	0.67	0.91	1.23	1.46	1.97	2.66	3.59	4.96	5.89	6.66	7.28	7.87	8.84	9.69	11.50	12.97	15.42	20.74
23	0.32	0.43	0.52	0.70	0.94	1.27	1.52	2.05	2.77	3.73	5.16	6.12	6.92	7.56	8.18	9.19	10.07	11.95	13.48	16.02	21.55
24	0.33	0.45	0.54	0.73	0.98	1.32	1.57	2.13	2.87	3.87	5.35	6.35	7.18	7.85	8.49	9.53	10.44	12.40	13.99	16.62	22.36
25	0.35	0.47	0.56	0.75	1.01	1.37	1.63	2.20	2.97	4.01	5.54	6.58	7.44	8.13	8.80	9.88	10.82	12.85	14.49	17.23	23.17
26	0.36	0.48	0.58	0.78	1.05	1.42	1.69	2.28	3.08	4.16	5.74	6.81	7.70	8.41	9.11	10.22	11.20	13.30	15.00	17.83	23.99
27	0.37	0.50	0.60	0.80	1.09	1.47	1.75	2.36	3.18	4.30	5.93	7.04	7.96	8.70	9.41	10.57	11.58	13.75	15.51	18.43	24.80
28	0.38	0.52	0.62	0.83	1.12	1.51	1.80	2.43	3.29	4.44	6.13	7.27	8.22	8.98	9.72	10.91	11.96	14.20	16.01	19.03	25.61
29	0.39	0.53	0.63	0.86	1.16	1.56	1.86	2.51	3.39	4.58	6.32	7.50	8.48	9.27	10.03	11.26	12.34	14.65	16.52	19.64	26.42
30	0.41	0.55	0.65	0.88	1.19	1.61	1.92	2.59	3.49	4.72	6.51	7.73	8.74	9.55	10.34	11.61	12.72	15.10	17.03	20.24	27.23
31	0.42	0.57	0.67	0.91	1.23	1.66	1.97	2.67	3.60	4.86	6.71	7.96	9.01	9.84	10.64	11.95	13.09	15.55	17.54	20.84	28.04
32	0.43	0.58	0.69	0.94	1.26	1.70	2.03	2.74	3.70	5.00	6.90	8.19	9.27	10.12	10.95	12.30	13.47	16.00	18.04	21.45	28.85
33	0.44	0.60	0.71	0.96	1.30	1.75	2.09	2.82	3.81	5.14	7.09	8.42	9.53	10.41	11.26	12.64	13.85	16.45	18.55	22.05	29.66
34	0.45	0.61	0.73	0.99	1.33	1.80	2.15	2.90	3.91	5.28	7.29	8.65	9.79	10.69	11.57	12.99	14.23	16.90	19.06	22.65	30.47
35	0.47	0.63	0.75	1.01	1.37	1.85	2.20	2.97	4.01	5.42	7.48	8.88	10.05	10.97	11.88	13.33	14.61	17.35	19.56	23.25	31.28
36	0.48	0.65	0.77	1.04	1.40	1.90	2.26	3.05	4.12	5.56	7.68	9.11	10.31	11.26	12.18	13.68	14.99	17.80	20.07	23.86	32.09

15-Year Storm for Alameda County

Mean Annual Precipitation	Duration																				
	Minutes				Hours						Days										
	5	10	15	30	1	2	3	6	12	24	2	3	4	5	6	8	10	15	20	30	60
10	0.18	0.24	0.29	0.39	0.53	0.74	0.85	1.14	1.54	2.08	2.89	3.43	3.87	4.21	4.56	5.11	5.57	6.58	7.42	8.83	11.80
11	0.19	0.26	0.31	0.42	0.56	0.76	0.91	1.23	1.65	2.23	3.10	3.68	4.15	4.52	4.89	5.49	5.98	7.07	7.97	9.48	12.67
12	0.21	0.28	0.33	0.45	0.60	0.81	0.97	1.31	1.77	2.39	3.32	3.93	4.44	4.83	5.23	5.86	6.39	7.55	8.51	10.13	13.54
13	0.22	0.30	0.35	0.48	0.64	0.87	1.03	1.39	1.88	2.54	3.53	4.18	4.72	5.14	5.56	6.24	6.80	8.04	9.06	10.78	14.41
14	0.23	0.31	0.37	0.50	0.68	0.92	1.09	1.48	1.99	2.69	3.74	4.44	5.01	5.45	5.90	6.62	7.21	8.52	9.60	11.43	15.28
15	0.25	0.33	0.39	0.53	0.72	0.97	1.16	1.56	2.11	2.85	3.95	4.69	5.29	5.76	6.23	6.99	7.62	9.01	10.15	12.08	16.15
16	0.26	0.35	0.42	0.56	0.76	1.02	1.22	1.65	2.22	3.00	4.17	4.94	5.58	6.07	6.57	7.37	8.03	9.49	10.70	12.73	17.01
17	0.27	0.37	0.44	0.59	0.80	1.08	1.28	1.73	2.34	3.15	4.38	5.19	5.86	6.38	6.91	7.74	8.44	9.98	11.24	13.38	17.88
18	0.28	0.38	0.46	0.62	0.84	1.13	1.34	1.81	2.45	3.31	4.59	5.45	6.14	6.69	7.24	8.12	8.85	10.46	11.79	14.03	18.75
19	0.30	0.40	0.48	0.65	0.87	1.18	1.41	1.90	2.56	3.46	4.80	5.70	6.43	7.00	7.58	8.50	9.26	10.94	12.33	14.68	19.62
20	0.31	0.42	0.50	0.68	0.91	1.23	1.47	1.98	2.68	3.61	5.02	5.95	6.71	7.31	7.91	8.87	9.67	11.43	12.88	15.33	20.49
21	0.32	0.44	0.52	0.70	0.95	1.28	1.53	2.07	2.79	3.77	5.23	6.20	7.00	7.62	8.25	9.25	10.08	11.91	13.43	15.98	21.36
22	0.34	0.46	0.54	0.73	0.99	1.34	1.59	2.15	2.90	3.92	5.44	6.46	7.28	7.93	8.58	9.62	10.49	12.40	13.97	16.63	22.23
23	0.35	0.47	0.56	0.76	1.03	1.39	1.66	2.23	3.02	4.07	5.66	6.71	7.57	8.24	8.92	10.00	10.90	12.88	14.52	17.28	23.10
24	0.36	0.49	0.59	0.79	1.07	1.44	1.72	2.32	3.13	4.22	5.87	6.96	7.85	8.55	9.25	10.38	11.31	13.37	15.07	17.94	23.96
25	0.38	0.51	0.61	0.82	1.11	1.49	1.78	2.40	3.24	4.38	6.08	7.21	8.14	8.86	9.59	10.75	11.72	13.85	15.61	18.59	24.83
26	0.39	0.53	0.63	0.85	1.14	1.55	1.84	2.49	3.36	4.53	6.29	7.47	8.42	9.17	9.92	11.13	12.13	14.34	16.16	19.24	25.70
27	0.40	0.54	0.65	0.88	1.18	1.60	1.90	2.57	3.47	4.68	6.51	7.72	8.71	9.48	10.26	11.51	12.54	14.82	16.70	19.89	26.57
28	0.42	0.56	0.67	0.91	1.22	1.65	1.97	2.65	3.58	4.84	6.72	7.97	8.99	9.79	10.60	11.88	12.95	15.31	17.25	20.54	27.44
29	0.43	0.58	0.69	0.93	1.26	1.70	2.03	2.74	3.70	4.99	6.93	8.22	9.28	10.10	10.93	12.26	13.36	15.79	17.80	21.19	28.31
30	0.44	0.60	0.71	0.96	1.30	1.75	2.09	2.82	3.81	5.14	7.15	8.47	9.56	10.41	11.27	12.63	13.77	16.28	18.34	21.84	29.18
31	0.46	0.62	0.73	0.99	1.34	1.81	2.15	2.91	3.92	5.30	7.36	8.73	9.85	10.72	11.60	13.01	14.18	16.76	18.89	22.49	30.05
32	0.47	0.63	0.76	1.02	1.38	1.86	2.22	2.99	4.04	5.45	7.57	8.98	10.13	11.03	11.94	13.39	14.59	17.25	19.44	23.14	30.91
33	0.48	0.65	0.78	1.05	1.42	1.91	2.28	3.07	4.15	5.60	7.78	9.23	10.41	11.34	12.27	13.76	15.00	17.73	19.98	23.79	31.78
34	0.50	0.67	0.80	1.08	1.45	1.96	2.34	3.16	4.26	5.76	8.00	9.48	10.70	11.65	12.61	14.14	15.41	18.21	20.53	24.44	32.65
35	0.51	0.69	0.82	1.11	1.49	2.02	2.40	3.24	4.38	5.91	8.21	9.74	10.98	11.96	12.94	14.52	15.82	18.70	21.07	25.09	33.52
36	0.52	0.71	0.84	1.13	1.53	2.07	2.46	3.33	4.49	6.06	8.42	9.99	11.27	12.27	13.28	14.89	16.23	19.18	21.62	25.74	34.39

25-Year Storm for Alameda County

Mean Annual Precipitation	Duration																				
	Minutes				Hours						Days										
	5	10	15	30	1	2	3	6	12	24	2	3	4	5	6	8	10	15	20	30	60
10	0.20	0.27	0.32	0.43	0.58	0.78	0.93	1.26	1.70	2.29	3.20	3.80	4.27	4.63	5.01	5.61	6.08	7.15	8.05	9.60	12.72
11	0.21	0.29	0.34	0.46	0.62	0.84	1.00	1.35	1.82	2.46	3.44	4.08	4.59	4.97	5.38	6.03	6.53	7.67	8.64	10.31	13.66
12	0.23	0.31	0.36	0.49	0.66	0.90	1.07	1.44	1.95	2.63	3.68	4.36	4.90	5.32	5.75	6.44	6.98	8.20	9.23	11.01	14.60
13	0.24	0.33	0.39	0.52	0.71	0.95	1.14	1.54	2.07	2.80	3.91	4.64	5.22	5.66	6.12	6.85	7.43	8.72	9.83	11.72	15.53
14	0.26	0.35	0.41	0.56	0.75	1.01	1.21	1.63	2.20	2.97	4.15	4.92	5.53	6.00	6.49	7.27	7.87	9.25	10.42	12.43	16.47
15	0.27	0.36	0.43	0.59	0.79	1.07	1.27	1.72	2.32	3.14	4.38	5.20	5.85	6.34	6.86	7.68	8.32	9.78	11.01	13.13	17.41
16	0.28	0.38	0.46	0.62	0.84	1.13	1.34	1.81	2.45	3.31	4.62	5.48	6.16	6.68	7.23	8.09	8.77	10.30	11.60	13.84	18.34
17	0.30	0.40	0.48	0.65	0.88	1.18	1.41	1.91	2.57	3.47	4.86	5.75	6.47	7.02	7.60	8.51	9.22	10.83	12.20	14.55	19.28
18	0.31	0.42	0.51	0.68	0.92	1.24	1.48	2.00	2.70	3.64	5.09	6.03	6.79	7.36	7.97	8.92	9.66	11.35	12.79	15.26	20.22
19	0.33	0.44	0.53	0.71	0.96	1.30	1.55	2.09	2.82	3.81	5.33	6.31	7.10	7.70	8.34	9.33	10.11	11.88	13.38	15.96	21.15
20	0.34	0.46	0.55	0.74	1.01	1.36	1.62	2.18	2.95	3.98	5.56	6.59	7.42	8.04	8.70	9.75	10.56	12.41	13.97	16.67	22.09
21	0.36	0.48	0.58	0.78	1.05	1.42	1.69	2.28	3.07	4.15	5.80	6.87	7.73	8.38	9.07	10.16	11.01	12.93	14.56	17.38	23.03
22	0.37	0.50	0.60	0.81	1.09	1.47	1.76	2.37	3.20	4.32	6.03	7.15	8.05	8.73	9.44	10.57	11.45	13.46	15.16	18.08	23.96
23	0.39	0.52	0.62	0.84	1.13	1.53	1.82	2.46	3.32	4.49	6.27	7.43	8.36	9.07	9.81	10.99	11.90	13.98	15.75	18.79	24.90
24	0.40	0.54	0.65	0.87	1.18	1.59	1.89	2.55	3.45	4.66	6.51	7.71	8.68	9.41	10.18	11.40	12.35	14.51	16.34	19.50	25.84
25	0.42	0.56	0.67	0.90	1.22	1.65	1.96	2.65	3.57	4.82	6.74	7.99	8.99	9.75	10.55	11.81	12.80	15.04	16.93	20.20	26.78
26	0.43	0.58	0.69	0.93	1.26	1.70	2.03	2.74	3.70	4.99	6.98	8.27	9.31	10.09	10.92	12.23	13.25	15.56	17.53	20.91	27.71
27	0.44	0.60	0.72	0.97	1.30	1.76	2.10	2.83	3.82	5.16	7.21	8.55	9.62	10.43	11.29	12.64	13.69	16.09	18.12	21.62	28.65
28	0.46	0.62	0.74	1.00	1.35	1.82	2.17	2.93	3.95	5.33	7.45	8.83	9.93	10.77	11.66	13.05	14.14	16.61	18.71	22.32	29.59
29	0.47	0.64	0.76	1.03	1.39	1.88	2.24	3.02	4.07	5.50	7.69	9.11	10.25	11.11	12.03	13.47	14.59	17.14	19.30	23.03	30.52
30	0.49	0.66	0.79	1.06	1.43	1.93	2.30	3.11	4.20	5.67	7.92	9.39	10.56	11.45	12.39	13.88	15.04	17.67	19.90	23.74	31.46
31	0.50	0.68	0.81	1.09	1.47	1.99	2.37	3.20	4.32	5.84	8.16	9.67	10.88	11.80	12.76	14.29	15.48	18.19	20.49	24.44	32.40
32	0.52	0.70	0.83	1.12	1.52	2.05	2.44	3.30	4.45	6.01	8.39	9.95	11.19	12.14	13.13	14.71	15.93	18.72	21.08	25.15	33.33
33	0.53	0.72	0.86	1.16	1.56	2.11	2.51	3.39	4.57	6.17	8.63	10.23	11.51	12.48	13.50	15.12	16.38	19.24	21.67	25.86	34.27
34	0.55	0.74	0.88	1.19	1.60	2.16	2.58	3.48	4.70	6.34	8.87	10.51	11.82	12.82	13.87	15.53	16.83	19.77	22.27	26.56	35.21
35	0.56	0.76	0.90	1.22	1.65	2.22	2.65	3.57	4.82	6.51	9.10	10.79	12.14	13.16	14.24	15.95	17.28	20.30	22.86	27.27	36.14
36	0.58	0.78	0.93	1.25	1.69	2.28	2.72	3.67	4.95	6.68	9.34	11.07	12.45	13.50	14.61	16.36	17.72	20.82	23.45	27.98	37.08

50-Year Storm for Alameda County

Mean Annual Precipitation	Duration																				
	Minutes				Hours						Days										
	5	10	15	30	1	2	3	6	12	24	2	3	4	5	6	8	10	15	20	30	60
10	0.22	0.30	0.36	0.48	0.65	0.88	1.05	1.41	1.91	2.57	3.62	4.29	4.81	5.19	5.61	6.28	6.75	7.87	8.86	10.60	13.90
11	0.24	0.32	0.38	0.52	0.70	0.94	1.12	1.52	2.05	2.76	3.89	4.60	5.16	5.57	6.03	6.74	7.24	8.45	9.51	11.38	14.93
12	0.25	0.34	0.41	0.55	0.75	1.01	1.20	1.62	2.19	2.95	4.15	4.92	5.52	5.95	6.44	7.20	7.74	9.03	10.16	12.16	15.95
13	0.27	0.37	0.44	0.59	0.79	1.07	1.28	1.72	2.33	3.14	4.42	5.24	5.87	6.33	6.85	7.66	8.24	9.61	10.82	12.94	16.97
14	0.29	0.39	0.46	0.62	0.84	1.14	1.35	1.83	2.47	3.33	4.69	5.55	6.22	6.71	7.27	8.12	8.74	10.19	11.47	13.72	18.00
15	0.30	0.41	0.49	0.66	0.89	1.20	1.43	1.93	2.61	3.52	4.95	5.87	6.58	7.10	7.68	8.59	9.23	10.77	12.12	14.50	19.02
16	0.32	0.43	0.51	0.69	0.94	1.26	1.51	2.03	2.75	3.71	5.22	6.18	6.93	7.48	8.09	9.05	9.73	11.35	12.77	15.28	20.04
17	0.34	0.45	0.54	0.73	0.98	1.33	1.58	2.14	2.89	3.90	5.49	6.50	7.28	7.86	8.50	9.51	10.23	11.93	13.43	16.06	21.07
18	0.35	0.48	0.57	0.76	1.03	1.39	1.66	2.24	3.03	4.09	5.75	6.81	7.64	8.24	8.92	9.97	10.72	12.51	14.08	16.84	22.09
19	0.37	0.50	0.59	0.80	1.08	1.46	1.74	2.35	3.17	4.28	6.02	7.13	7.99	8.62	9.33	10.44	11.22	13.09	14.73	17.62	23.11
20	0.38	0.52	0.62	0.84	1.13	1.52	1.82	2.45	3.31	4.47	6.29	7.45	8.35	9.00	9.74	10.90	11.72	13.67	15.38	18.41	24.14
21	0.40	0.54	0.65	0.87	1.18	1.59	1.89	2.55	3.45	4.65	6.55	7.76	8.70	9.39	10.16	11.36	12.21	14.25	16.04	19.19	25.16
22	0.42	0.56	0.67	0.91	1.22	1.65	1.97	2.66	3.59	4.84	6.82	8.08	9.05	9.77	10.57	11.82	12.71	14.83	16.69	19.97	26.18
23	0.43	0.59	0.70	0.94	1.27	1.72	2.05	2.76	3.73	5.03	7.09	8.39	9.41	10.15	10.98	12.28	13.21	15.41	17.34	20.75	27.21
24	0.45	0.61	0.72	0.98	1.32	1.78	2.12	2.87	3.87	5.22	7.35	8.71	9.76	10.53	11.40	12.75	13.70	15.98	17.99	21.53	28.23
25	0.47	0.63	0.75	1.01	1.37	1.85	2.20	2.97	4.01	5.41	7.62	9.02	10.12	10.91	11.81	13.21	14.20	16.56	18.64	22.31	29.25
26	0.48	0.65	0.78	1.05	1.42	1.91	2.28	3.07	4.15	5.60	7.89	9.34	10.47	11.30	12.22	13.67	14.70	17.14	19.30	23.09	30.28
27	0.50	0.67	0.80	1.08	1.46	1.98	2.35	3.18	4.29	5.79	8.15	9.65	10.82	11.68	12.64	14.13	15.19	17.72	19.95	23.87	31.30
28	0.52	0.70	0.83	1.12	1.51	2.04	2.43	3.28	4.43	5.98	8.42	9.97	11.18	12.06	13.05	14.59	15.69	18.30	20.60	24.65	32.32
29	0.53	0.72	0.86	1.15	1.56	2.10	2.51	3.39	4.57	6.17	8.68	10.29	11.53	12.44	13.46	15.06	16.19	18.88	21.25	25.43	33.35
30	0.55	0.74	0.88	1.19	1.61	2.17	2.59	3.49	4.71	6.36	8.95	10.60	11.89	12.82	13.88	15.52	16.68	19.46	21.91	26.21	34.37
31	0.56	0.76	0.91	1.23	1.65	2.23	2.66	3.59	4.85	6.55	9.22	10.92	12.24	13.20	14.29	15.98	17.18	20.04	22.56	26.99	35.39
32	0.58	0.78	0.93	1.26	1.70	2.30	2.74	3.70	4.99	6.74	9.48	11.23	12.59	13.59	14.70	16.44	17.68	20.62	23.21	27.77	36.42
33	0.60	0.81	0.96	1.30	1.75	2.36	2.82	3.80	5.13	6.93	9.75	11.55	12.95	13.97	15.12	16.90	18.17	21.20	23.86	28.55	37.44
34	0.61	0.83	0.99	1.33	1.80	2.43	2.89	3.91	5.27	7.12	10.02	11.86	13.30	14.35	15.53	17.37	18.67	21.78	24.51	29.33	38.46
35	0.63	0.85	1.01	1.37	1.85	2.49	2.97	4.01	5.41	7.31	10.28	12.18	13.66	14.73	15.94	17.83	19.17	22.36	25.17	30.11	39.49
36	0.65	0.87	1.04	1.40	1.89	2.56	3.05	4.11	5.55	7.50	10.55	12.50	14.01	15.11	16.35	18.29	19.66	22.94	25.82	30.89	40.51

100-Year Storm for Alameda County

Mean Annual Precipitation	Duration																				
	Minutes				Hours						Days										
	5	10	15	30	1	2	3	6	12	24	2	3	4	5	6	8	10	15	20	30	60
10	0.25	0.33	0.39	0.53	0.72	0.97	1.16	1.56	2.11	2.84	4.03	4.77	5.33	5.72	6.19	6.92	7.39	8.56	9.63	11.56	15.01
11	0.26	0.36	0.42	0.57	0.77	1.04	1.24	1.68	2.26	3.05	4.32	5.12	5.72	6.15	6.65	7.43	7.93	9.19	10.34	12.41	16.12
12	0.28	0.38	0.45	0.61	0.82	1.11	1.33	1.79	2.42	3.26	4.62	5.47	6.11	6.57	7.11	7.94	8.48	9.82	11.05	13.26	17.22
13	0.30	0.40	0.48	0.65	0.88	1.18	1.41	1.91	2.57	3.47	4.92	5.82	6.50	6.99	7.56	8.45	9.02	10.45	11.76	14.11	18.33
14	0.32	0.43	0.51	0.69	0.93	1.26	1.50	2.02	2.73	3.68	5.21	6.17	6.90	7.41	8.02	8.96	9.57	11.09	12.47	14.96	19.43
15	0.34	0.45	0.54	0.73	0.98	1.33	1.58	2.14	2.88	3.89	5.51	6.52	7.29	7.83	8.47	9.47	10.11	11.72	13.18	15.81	20.54
16	0.35	0.48	0.57	0.77	1.04	1.40	1.67	2.25	3.04	4.10	5.81	6.87	7.68	8.25	8.93	9.98	10.65	12.35	13.89	16.66	21.64
17	0.37	0.50	0.60	0.81	1.09	1.47	1.75	2.37	3.19	4.31	6.10	7.22	8.07	8.67	9.39	10.49	11.20	12.98	14.60	17.51	22.75
18	0.39	0.53	0.63	0.85	1.14	1.54	1.84	2.48	3.35	4.52	6.40	7.58	8.47	9.10	9.84	11.00	11.74	13.61	15.31	18.36	23.85
19	0.41	0.55	0.66	0.89	1.19	1.61	1.92	2.59	3.50	4.73	6.70	7.93	8.86	9.52	10.30	11.51	12.29	14.24	16.02	19.21	24.96
20	0.43	0.57	0.68	0.92	1.25	1.68	2.01	2.71	3.66	4.94	6.99	8.28	9.25	9.94	10.75	12.01	12.83	14.87	16.73	20.07	26.07
21	0.44	0.60	0.71	0.96	1.30	1.76	2.09	2.82	3.81	5.15	7.29	8.63	9.64	10.36	11.21	12.52	13.37	15.50	17.44	20.92	27.17
22	0.46	0.62	0.74	1.00	1.35	1.83	2.18	2.94	3.97	5.36	7.59	8.98	10.03	10.78	11.67	13.03	13.92	16.13	18.14	21.77	28.28
23	0.48	0.65	0.77	1.04	1.41	1.90	2.26	3.05	4.12	5.57	7.88	9.33	10.43	11.20	12.12	13.54	14.46	16.76	18.85	22.62	29.38
24	0.50	0.67	0.80	1.08	1.46	1.97	2.35	3.17	4.28	5.78	8.18	9.68	10.82	11.62	12.58	14.05	15.01	17.39	19.56	23.47	30.49
25	0.52	0.70	0.83	1.12	1.51	2.04	2.43	3.28	4.43	5.98	8.47	10.03	11.21	12.05	13.03	14.56	15.55	18.02	20.27	24.32	31.59
26	0.53	0.72	0.86	1.16	1.57	2.11	2.52	3.40	4.59	6.19	8.77	10.38	11.60	12.47	13.49	15.07	16.10	18.65	20.98	25.17	32.70
27	0.55	0.74	0.89	1.20	1.62	2.18	2.60	3.51	4.74	6.40	9.07	10.73	12.00	12.89	13.95	15.58	16.64	19.28	21.69	26.02	33.80
28	0.57	0.77	0.92	1.24	1.67	2.26	2.69	3.63	4.90	6.61	9.36	11.09	12.39	13.31	14.40	16.09	17.18	19.91	22.40	26.87	34.91
29	0.59	0.79	0.95	1.28	1.72	2.33	2.77	3.74	5.05	6.82	9.66	11.44	12.78	13.73	14.86	16.60	17.73	20.54	23.11	27.72	36.01
30	0.61	0.82	0.97	1.32	1.78	2.40	2.86	3.86	5.21	7.03	9.96	11.79	13.17	14.15	15.32	17.11	18.27	21.17	23.82	28.57	37.12
31	0.62	0.84	1.00	1.36	1.83	2.47	2.94	3.97	5.36	7.24	10.25	12.14	13.56	14.57	15.77	17.62	18.82	21.80	24.53	29.42	38.22
32	0.64	0.87	1.03	1.39	1.88	2.54	3.03	4.09	5.52	7.45	10.55	12.49	13.96	15.00	16.23	18.13	19.36	22.43	25.24	30.27	39.33
33	0.66	0.89	1.06	1.43	1.94	2.61	3.11	4.20	5.67	7.66	10.85	12.84	14.35	15.42	16.68	18.64	19.90	23.06	25.95	31.13	40.43
34	0.68	0.92	1.09	1.47	1.99	2.68	3.20	4.32	5.83	7.87	11.14	13.19	14.74	15.84	17.14	19.15	20.45	23.69	26.65	31.98	41.54
35	0.70	0.94	1.12	1.51	2.04	2.76	3.28	4.43	5.98	8.08	11.44	13.54	15.13	16.26	17.60	19.66	20.99	24.32	27.36	32.83	42.64
36	0.71	0.96	1.15	1.55	2.09	2.83	3.37	4.55	6.14	8.29	11.74	13.89	15.53	16.68	18.05	20.17	21.54	24.95	28.07	33.68	43.75

200-Year Storm for Alameda County

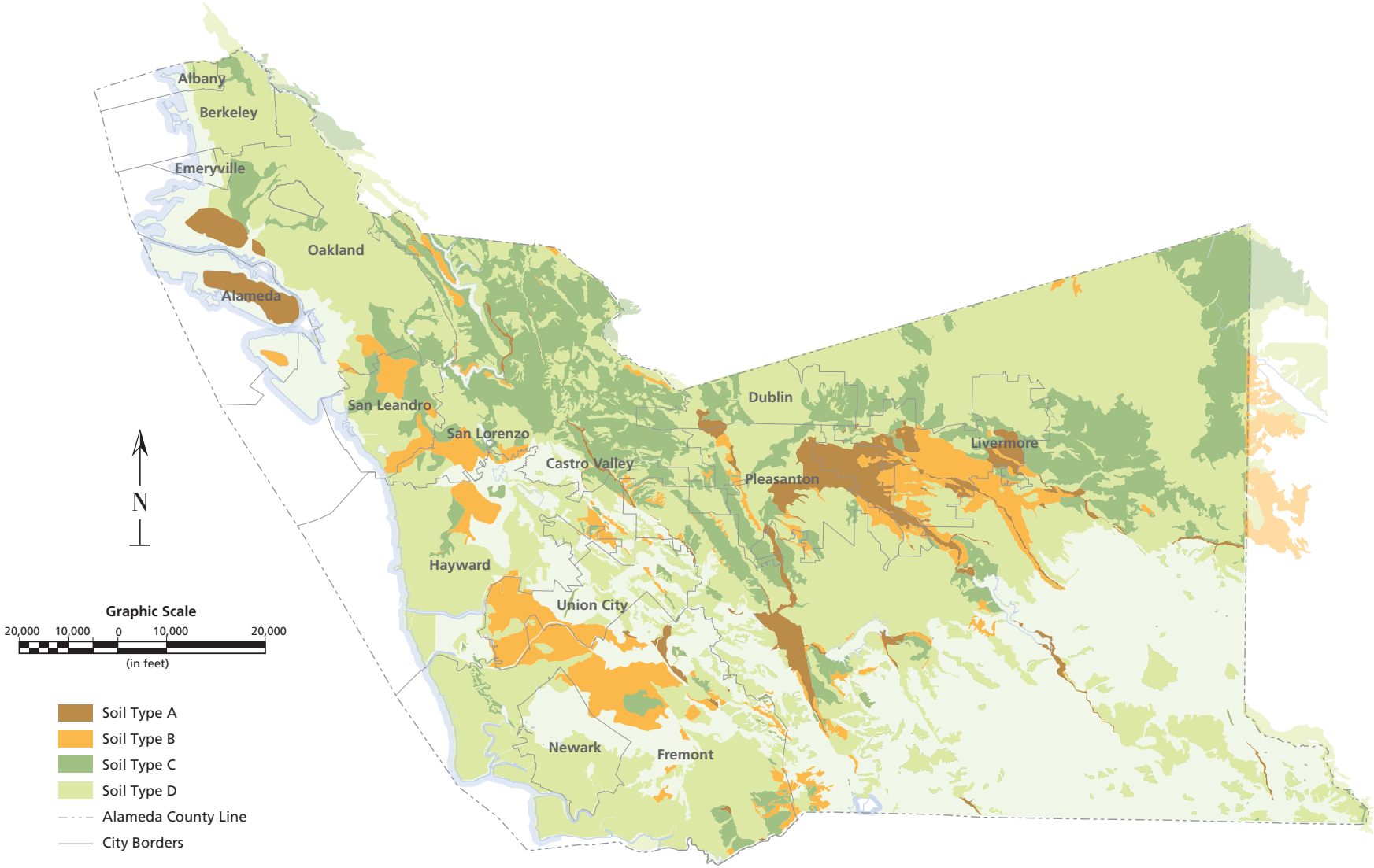
Mean Annual Precipitation	Duration																				
	Minutes				Hours						Days										
	5	10	15	30	1	2	3	6	12	24	2	3	4	5	6	8	10	15	20	30	60
10	0.27	0.36	0.43	0.58	0.79	1.06	1.26	1.71	2.30	3.11	4.43	5.24	5.84	6.25	6.76	7.55	8.01	9.23	10.38	12.48	16.07
11	0.29	0.39	0.46	0.63	0.84	1.14	1.36	1.83	2.47	3.34	4.75	5.63	6.27	6.71	7.26	8.11	8.60	9.91	11.14	13.40	17.25
12	0.31	0.42	0.49	0.67	0.90	1.22	1.45	1.96	2.64	3.57	5.08	6.01	6.70	7.17	7.76	8.66	9.19	10.59	11.91	14.32	18.44
13	0.33	0.44	0.53	0.71	0.96	1.30	1.54	2.08	2.81	3.80	5.41	6.40	7.13	7.63	8.26	9.22	9.78	11.27	12.67	15.24	19.62
14	0.35	0.47	0.56	0.75	1.02	1.37	1.64	2.21	2.98	4.03	5.73	6.78	7.56	8.09	8.76	9.77	10.37	11.95	13.43	16.16	20.80
15	0.37	0.50	0.59	0.80	1.08	1.45	1.73	2.34	3.15	4.26	6.06	7.17	7.99	8.55	9.25	10.33	10.96	12.63	14.20	17.08	21.99
16	0.39	0.52	0.62	0.84	1.13	1.53	1.82	2.46	3.32	4.49	6.38	7.55	8.42	9.01	9.75	10.89	11.55	13.30	14.96	18.00	23.17
17	0.41	0.55	0.65	0.88	1.19	1.61	1.92	2.59	3.49	4.71	6.71	7.94	8.85	9.47	10.25	11.44	12.14	13.98	15.72	18.91	24.35
18	0.43	0.58	0.69	0.93	1.25	1.69	2.01	2.71	3.66	4.94	7.04	8.33	9.28	9.93	10.75	12.00	12.73	14.66	16.49	19.83	25.54
19	0.45	0.60	0.72	0.97	1.31	1.76	2.10	2.84	3.83	5.17	7.36	8.71	9.71	10.39	11.25	12.55	13.32	15.34	17.25	20.75	26.72
20	0.47	0.63	0.75	1.01	1.36	1.84	2.20	2.96	4.00	5.40	7.69	9.10	10.14	10.85	11.74	13.11	13.91	16.02	18.02	21.67	27.90
21	0.49	0.66	0.78	1.05	1.42	1.92	2.29	3.09	4.17	5.63	8.02	9.48	10.57	11.31	12.24	13.66	14.50	16.70	18.78	22.59	29.08
22	0.50	0.68	0.81	1.10	1.48	2.00	2.38	3.22	4.34	5.86	8.34	9.87	11.00	11.77	12.74	14.22	15.09	17.38	19.54	23.51	30.27
23	0.52	0.71	0.84	1.14	1.54	2.08	2.48	3.34	4.51	6.09	8.67	10.26	11.43	12.23	13.24	14.78	15.68	18.06	20.31	24.43	31.45
24	0.54	0.73	0.88	1.18	1.60	2.15	2.57	3.47	4.68	6.32	8.99	10.64	11.86	12.69	13.74	15.33	16.27	18.74	21.07	25.35	32.63
25	0.56	0.76	0.91	1.23	1.65	2.23	2.66	3.59	4.85	6.55	9.32	11.03	12.29	13.15	14.23	15.89	16.86	19.42	21.84	26.27	33.82
26	0.58	0.79	0.94	1.27	1.71	2.31	2.75	3.72	5.02	6.78	9.65	11.41	12.72	13.61	14.73	16.44	17.45	20.10	22.60	27.18	35.00
27	0.60	0.81	0.97	1.31	1.77	2.39	2.85	3.84	5.19	7.01	9.97	11.80	13.15	14.07	15.23	17.00	18.04	20.78	23.36	28.10	36.18
28	0.62	0.84	1.00	1.35	1.83	2.47	2.94	3.97	5.36	7.23	10.30	12.18	13.58	14.53	15.73	17.55	18.63	21.46	24.13	29.02	37.37
29	0.64	0.87	1.03	1.40	1.89	2.55	3.03	4.10	5.53	7.46	10.62	12.57	14.01	14.99	16.23	18.11	19.22	22.14	24.89	29.94	38.55
30	0.66	0.89	1.07	1.44	1.94	2.62	3.13	4.22	5.70	7.69	10.95	12.96	14.44	15.46	16.72	18.67	19.81	22.82	25.66	30.86	39.73
31	0.68	0.92	1.10	1.48	2.00	2.70	3.22	4.35	5.87	7.92	11.28	13.34	14.86	15.92	17.22	19.22	20.40	23.50	26.42	31.78	40.91
32	0.70	0.95	1.13	1.53	2.06	2.78	3.31	4.47	6.04	8.15	11.60	13.73	15.29	16.38	17.72	19.78	20.99	24.17	27.18	32.70	42.10
33	0.72	0.97	1.16	1.57	2.12	2.86	3.41	4.60	6.21	8.38	11.93	14.11	15.72	16.84	18.22	20.33	21.58	24.85	27.95	33.62	43.28
34	0.74	1.00	1.19	1.61	2.18	2.94	3.50	4.72	6.38	8.61	12.25	14.50	16.15	17.30	18.72	20.89	22.17	25.53	28.71	34.54	44.46
35	0.76	1.03	1.23	1.65	2.23	3.01	3.59	4.85	6.55	8.84	12.58	14.88	16.58	17.76	19.21	21.45	22.76	26.21	29.48	35.45	45.65
36	0.78	1.05	1.26	1.70	2.29	3.09	3.69	4.98	6.72	9.07	12.91	15.27	17.01	18.22	19.71	22.00	23.35	26.89	30.24	36.37	46.83

500-Year Storm for Alameda County

Mean Annual Precipitation	Duration																				
	Minutes				Hours						Days										
	5	10	15	30	1	2	3	6	12	24	2	3	4	5	6	8	10	15	20	30	60
10	0.30	0.40	0.48	0.65	0.87	1.18	1.41	1.90	2.56	3.46	4.95	5.86	6.50	6.93	7.50	8.36	8.81	10.07	11.32	13.66	17.41
11	0.32	0.43	0.51	0.69	0.94	1.27	1.51	2.04	2.75	3.71	5.32	6.29	6.98	7.44	8.05	8.98	9.46	10.81	12.15	14.67	18.70
12	0.34	0.46	0.55	0.74	1.00	1.35	1.61	2.18	2.94	3.97	5.68	6.72	7.46	7.95	8.60	9.59	10.11	11.55	12.99	15.67	19.98
13	0.36	0.49	0.59	0.79	1.07	1.44	1.72	2.32	3.13	4.22	6.05	7.15	7.94	8.46	9.16	10.21	10.76	12.29	13.82	16.68	21.26
14	0.39	0.52	0.62	0.84	1.13	1.53	1.82	2.46	3.32	4.48	6.41	7.58	8.41	8.97	9.71	10.83	11.41	13.04	14.65	17.68	22.54
15	0.41	0.55	0.66	0.89	1.20	1.61	1.92	2.60	3.50	4.73	6.78	8.01	8.89	9.48	10.26	11.44	12.05	13.78	15.48	18.69	23.82
16	0.43	0.58	0.69	0.93	1.26	1.70	2.03	2.74	3.69	4.98	7.14	8.44	9.37	9.99	10.81	12.06	12.70	14.52	16.32	19.70	25.11
17	0.45	0.61	0.73	0.98	1.32	1.79	2.13	2.88	3.88	5.24	7.50	8.88	9.85	10.50	11.37	12.67	13.35	15.26	17.15	20.70	26.39
18	0.47	0.64	0.76	1.03	1.39	1.87	2.23	3.01	4.07	5.49	7.87	9.31	10.33	11.01	11.92	13.29	14.00	16.00	17.98	21.71	27.67
19	0.50	0.67	0.80	1.08	1.45	1.96	2.34	3.15	4.26	5.75	8.23	9.74	10.81	11.52	12.47	13.90	14.65	16.74	18.82	22.71	28.95
20	0.52	0.70	0.83	1.12	1.52	2.05	2.44	3.29	4.45	6.00	8.60	10.17	11.29	12.03	13.02	14.52	15.30	17.48	19.65	23.72	30.23
21	0.54	0.73	0.87	1.17	1.58	2.13	2.54	3.43	4.64	6.26	8.96	10.60	11.76	12.54	13.57	15.14	15.95	18.22	20.48	24.72	31.52
22	0.56	0.76	0.90	1.22	1.65	2.22	2.65	3.57	4.82	6.51	9.33	11.03	12.24	13.05	14.13	15.75	16.59	18.97	21.32	25.73	32.80
23	0.58	0.79	0.94	1.27	1.71	2.31	2.75	3.71	5.01	6.77	9.69	11.46	12.72	13.56	14.68	16.37	17.24	19.71	22.15	26.74	34.08
24	0.61	0.82	0.97	1.31	1.77	2.39	2.85	3.85	5.20	7.02	10.06	11.89	13.20	14.07	15.23	16.98	17.89	20.45	22.98	27.74	35.36
25	0.63	0.85	1.01	1.36	1.84	2.48	2.96	3.99	5.39	7.28	10.42	12.33	13.68	14.59	15.78	17.60	18.54	21.19	23.82	28.75	36.64
26	0.65	0.88	1.04	1.41	1.90	2.57	3.06	4.13	5.58	7.53	10.79	12.76	14.16	15.10	16.33	18.21	19.19	21.93	24.65	29.75	37.93
27	0.67	0.91	1.08	1.46	1.97	2.66	3.16	4.27	5.77	7.78	11.15	13.19	14.64	15.61	16.89	18.83	19.84	22.67	25.48	30.76	39.21
28	0.69	0.94	1.11	1.50	2.03	2.74	3.27	4.41	5.96	8.04	11.51	13.62	15.11	16.12	17.44	19.45	20.49	23.41	26.32	31.76	40.49
29	0.71	0.96	1.15	1.55	2.10	2.83	3.37	4.55	6.14	8.29	11.88	14.05	15.59	16.63	17.99	20.06	21.13	24.16	27.15	32.77	41.77
30	0.74	0.99	1.19	1.60	2.16	2.92	3.47	4.69	6.33	8.55	12.24	14.48	16.07	17.14	18.54	20.68	21.78	24.90	27.98	33.78	43.05
31	0.76	1.02	1.22	1.65	2.22	3.00	3.58	4.83	6.52	8.80	12.61	14.91	16.55	17.65	19.10	21.29	22.43	25.64	28.82	34.78	44.34
32	0.78	1.05	1.26	1.70	2.29	3.09	3.68	4.97	6.71	9.06	12.97	15.34	17.03	18.16	19.65	21.91	23.08	26.38	29.65	35.79	45.62
33	0.80	1.08	1.29	1.74	2.35	3.18	3.79	5.11	6.90	9.31	13.34	15.77	17.51	18.67	20.20	22.52	23.73	27.12	30.48	36.79	46.90
34	0.82	1.11	1.33	1.79	2.42	3.26	3.89	5.25	7.09	9.57	13.70	16.21	17.99	19.18	20.75	23.14	24.38	27.86	31.32	37.80	48.18
35	0.85	1.14	1.36	1.84	2.48	3.35	3.99	5.39	7.27	9.82	14.07	16.64	18.46	19.69	21.30	23.76	25.03	28.60	32.15	38.80	49.46
36	0.87	1.17	1.40	1.89	2.55	3.44	4.10	5.53	7.46	10.08	14.43	17.07	18.94	20.20	21.86	24.37	25.68	29.34	32.98	39.81	50.75

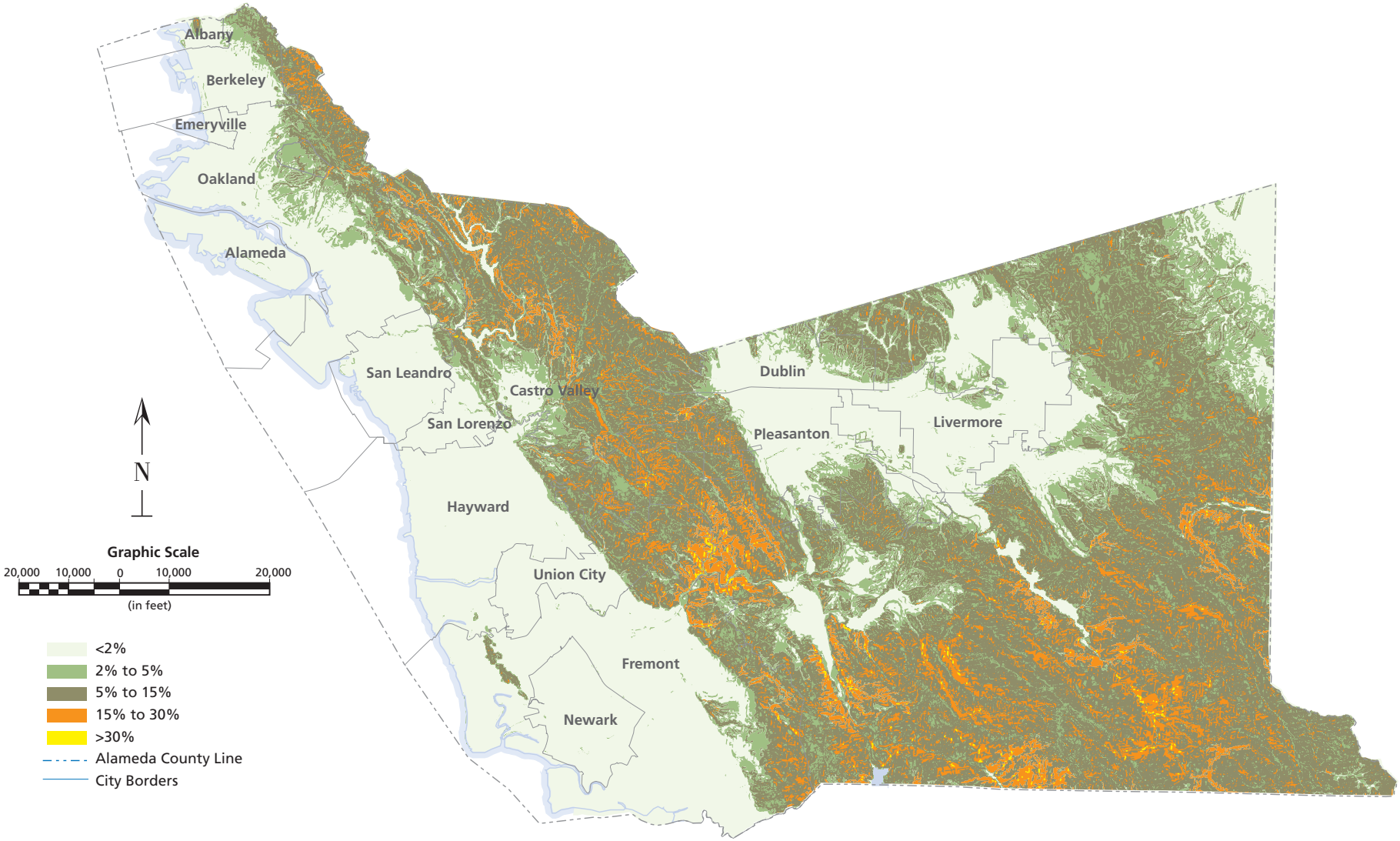
1000-Year Storm for Alameda County

Mean Annual Precipitation	Duration																				
	Minutes				Hours						Days										
	5	10	15	30	1	2	3	6	12	24	2	3	4	5	6	8	10	15	20	30	60
10	0.32	0.43	0.52	0.70	0.94	1.27	1.51	2.04	2.75	3.72	5.34	6.32	7.00	7.44	8.05	8.97	9.40	10.70	12.02	14.54	18.38
11	0.34	0.46	0.55	0.75	1.01	1.36	1.62	2.19	2.96	3.99	5.73	6.78	7.51	7.99	8.64	9.63	10.10	11.49	12.91	15.61	19.74
12	0.37	0.50	0.59	0.80	1.08	1.45	1.73	2.34	3.16	4.26	6.13	7.25	8.03	8.53	9.23	10.29	10.79	12.28	13.79	16.68	21.09
13	0.39	0.53	0.63	0.85	1.15	1.55	1.84	2.49	3.36	4.54	6.52	7.71	8.54	9.08	9.83	10.95	11.48	13.06	14.68	17.75	22.44
14	0.41	0.56	0.67	0.90	1.22	1.64	1.96	2.64	3.56	4.81	6.91	8.18	9.06	9.63	10.42	11.61	12.17	13.85	15.56	18.82	23.79
15	0.44	0.59	0.70	0.95	1.28	1.73	2.07	2.79	3.77	5.08	7.31	8.64	9.57	10.18	11.01	12.27	12.87	14.64	16.45	19.89	25.15
16	0.46	0.62	0.74	1.00	1.35	1.83	2.18	2.94	3.97	5.36	7.70	9.11	10.09	10.72	11.60	12.93	13.56	15.43	17.33	20.96	26.50
17	0.49	0.66	0.78	1.05	1.42	1.92	2.29	3.09	4.17	5.63	8.09	9.57	10.60	11.27	12.20	13.59	14.25	16.21	18.22	22.03	27.85
18	0.51	0.69	0.82	1.11	1.49	2.01	2.40	3.24	4.37	5.91	8.49	10.03	11.12	11.82	12.79	14.25	14.94	17.00	19.10	23.10	29.21
19	0.53	0.72	0.86	1.16	1.56	2.11	2.51	3.39	4.58	6.18	8.88	10.50	11.63	12.37	13.38	14.91	15.63	17.79	19.99	24.17	30.56
20	0.56	0.75	0.89	1.21	1.63	2.20	2.62	3.54	4.78	6.45	9.27	10.96	12.15	12.91	13.97	15.57	16.33	18.58	20.87	25.24	31.91
21	0.58	0.78	0.93	1.26	1.70	2.29	2.73	3.69	4.98	6.73	9.67	11.43	12.66	13.46	14.57	16.23	17.02	19.37	21.76	26.31	33.27
22	0.60	0.81	0.97	1.31	1.77	2.39	2.85	3.84	5.19	7.00	10.06	11.89	13.18	14.01	15.16	16.89	17.71	20.15	22.64	27.38	34.62
23	0.63	0.85	1.01	1.36	1.84	2.48	2.96	3.99	5.39	7.27	10.45	12.36	13.69	14.56	15.75	17.55	18.40	20.94	23.53	28.45	35.97
24	0.65	0.88	1.05	1.41	1.91	2.57	3.07	4.14	5.59	7.55	10.85	12.82	14.21	15.10	16.35	18.21	19.10	21.73	24.41	29.52	37.33
25	0.67	0.91	1.08	1.46	1.98	2.67	3.18	4.29	5.79	7.82	11.24	13.29	14.72	15.65	16.94	18.88	19.79	22.52	25.30	30.59	38.68
26	0.70	0.94	1.12	1.51	2.05	2.76	3.29	4.44	6.00	8.09	11.63	13.75	15.24	16.20	17.53	19.54	20.48	23.30	26.18	31.66	40.03
27	0.72	0.97	1.16	1.57	2.11	2.85	3.40	4.59	6.20	8.37	12.03	14.22	15.75	16.75	18.12	20.20	21.17	24.09	27.07	32.73	41.39
28	0.74	1.01	1.20	1.62	2.18	2.95	3.51	4.74	6.40	8.64	12.42	14.68	16.27	17.30	18.72	20.86	21.86	24.88	27.96	33.80	42.74
29	0.77	1.04	1.24	1.67	2.25	3.04	3.62	4.89	6.60	8.91	12.81	15.15	16.78	17.84	19.31	21.52	22.56	25.67	28.84	34.87	44.09
30	0.79	1.07	1.27	1.72	2.32	3.13	3.74	5.04	6.81	9.19	13.21	15.61	17.30	18.39	19.90	22.18	23.25	26.45	29.73	35.94	45.45
31	0.82	1.10	1.31	1.77	2.39	3.23	3.85	5.19	7.01	9.46	13.60	16.08	17.81	18.94	20.49	22.84	23.94	27.24	30.61	37.01	46.80
32	0.84	1.13	1.35	1.82	2.46	3.32	3.96	5.34	7.21	9.74	13.99	16.54	18.33	19.49	21.09	23.50	24.63	28.03	31.50	38.08	48.15
33	0.86	1.16	1.39	1.87	2.53	3.41	4.07	5.49	7.41	10.01	14.39	17.01	18.84	20.03	21.68	24.16	25.33	28.82	32.38	39.15	49.51
34	0.89	1.20	1.43	1.92	2.60	3.51	4.18	5.64	7.62	10.28	14.78	17.47	19.36	20.58	22.27	24.82	26.02	29.61	33.27	40.22	50.86
35	0.91	1.23	1.46	1.98	2.67	3.60	4.29	5.79	7.82	10.56	15.17	17.94	19.87	21.13	22.86	25.48	26.71	30.39	34.15	41.29	52.21
36	0.93	1.26	1.50	2.03	2.74	3.69	4.40	5.94	8.02	10.83	15.57	18.40	20.39	21.68	23.46	26.14	27.40	31.18	35.04	42.37	53.57



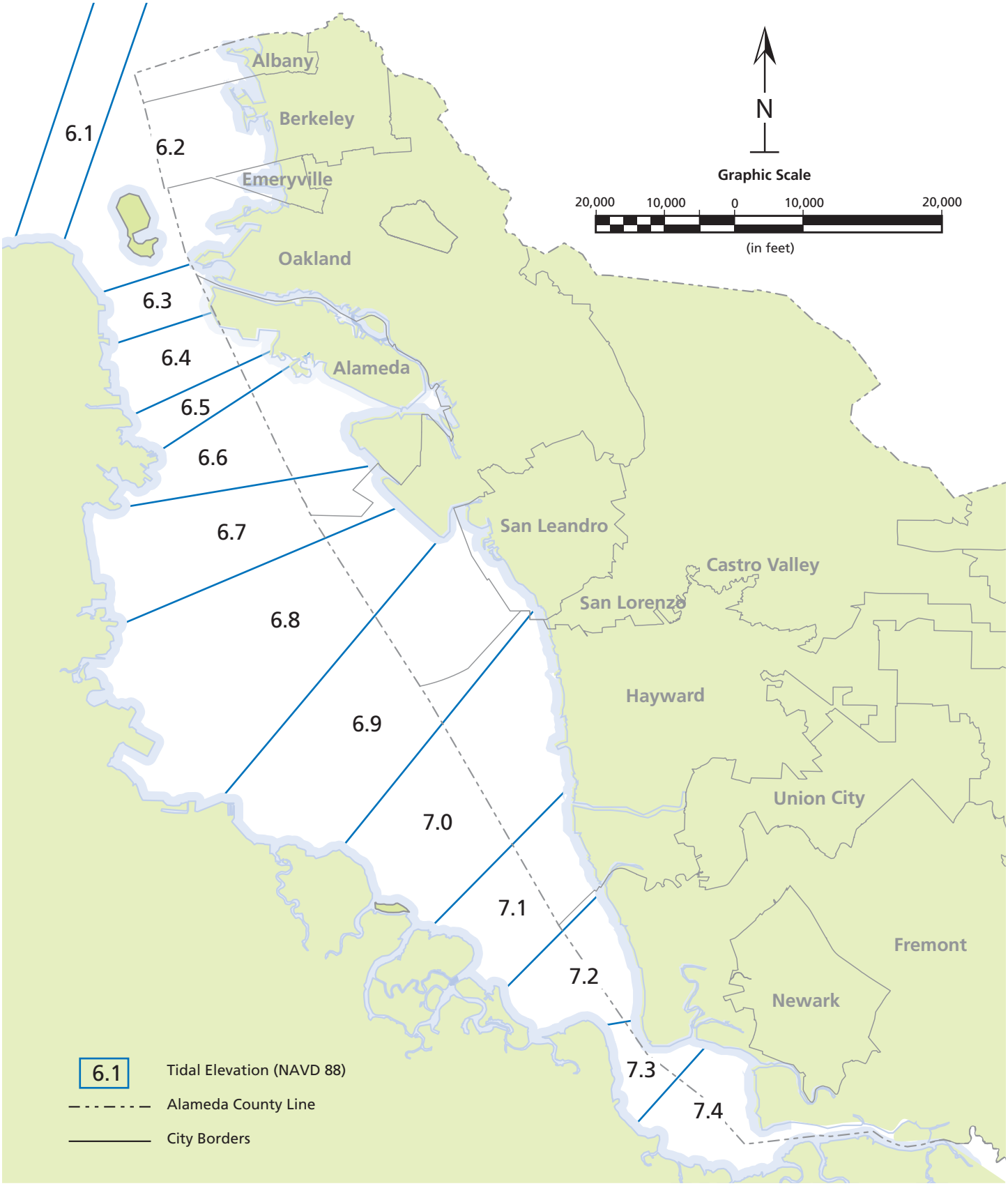
Attachment 9 available for download in GIS file from the Alameda County Flood Control District website.

(NRCS 2015) and (District 2015)



Attachment 10 available for download as a GIS file from the Alameda County Flood Control District website.

(District 2015)



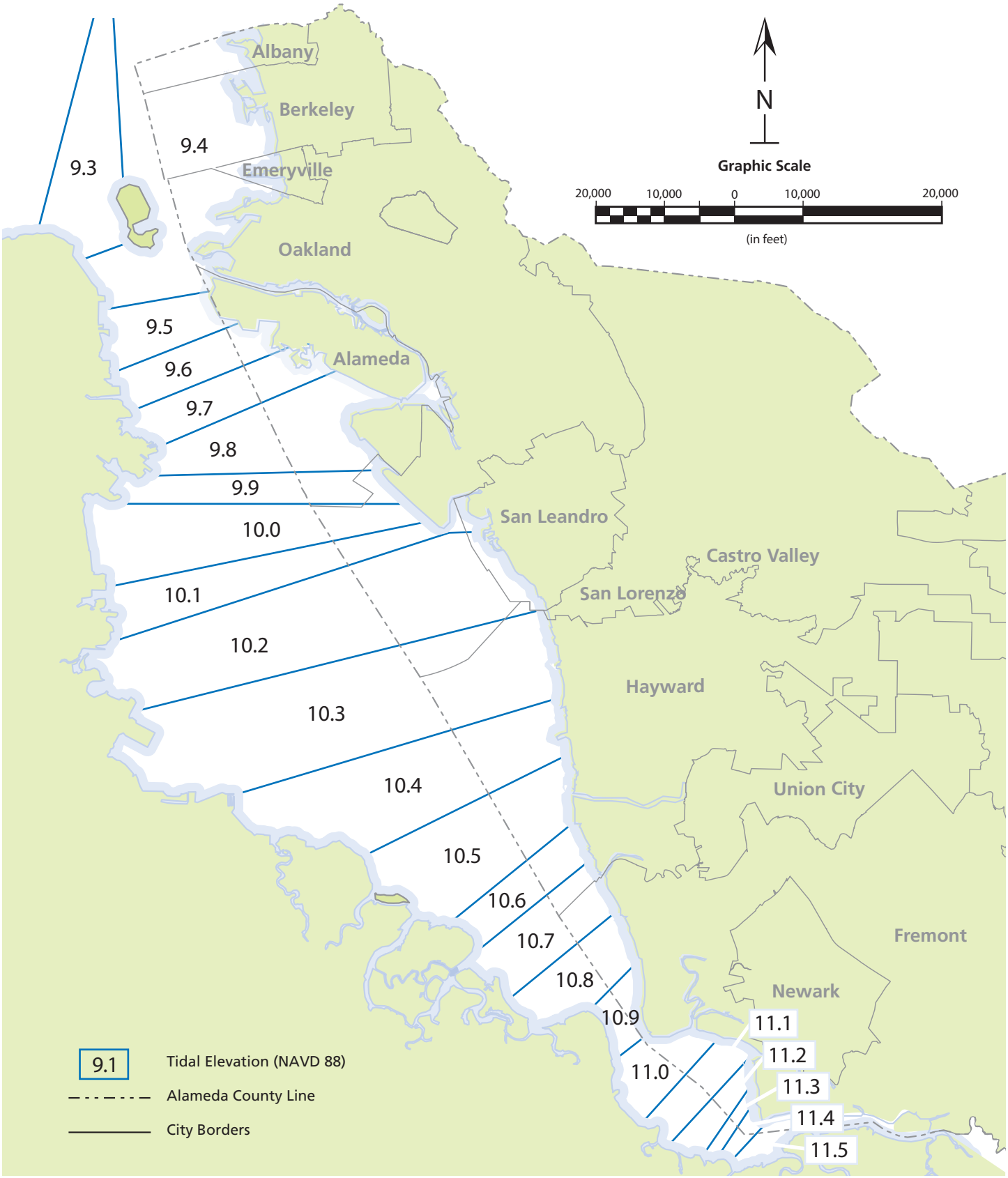
(USACE 1984)

Flood Control & Water Conservation DISTRICT

Alameda County Hydrology & Hydraulics Manual 2016

Tidal Summary
Adopted MHHW Tidal Elevation

Attachment 11A



(FEMA 2016)

Flood Control & Water Conservation DISTRICT

Alameda County Hydrology & Hydraulics Manual 2016

Tidal Summary
Adopted 100-yr Tidal Elevation

Attachment 11B

Frequency Factor, K_j																						
Recurrence Interval	Storm Duration (t_d)																					
	Consecutive Minutes				Consecutive Hours						Consecutive Days											
	5	10	15	30	1	2	3	6	12	24	2	3	4	5	6	8	10	15	20	30	60	365
2	-0.210	-0.210	-0.210	-0.210	-0.210	-0.210	-0.210	-0.210	-0.210	-0.210	-0.225	-0.225	-0.210	-0.195	-0.195	-0.195	-0.164	-0.132	-0.132	-0.148	-0.099	-0.083
5	0.719	0.719	0.719	0.719	0.719	0.719	0.719	0.719	0.719	0.719	0.705	0.705	0.719	0.733	0.733	0.733	0.758	0.780	0.780	0.769	0.799	0.808
10	1.339	1.339	1.339	1.339	1.339	1.339	1.339	1.339	1.339	1.339	1.337	1.337	1.339	1.340	1.340	1.340	1.340	1.336	1.336	1.339	1.329	1.323
15	1.684	1.684	1.684	1.684	1.684	1.684	1.684	1.684	1.684	1.684	1.692	1.692	1.684	1.678	1.678	1.678	1.660	1.637	1.637	1.649	1.610	1.595
20	1.920	1.920	1.920	1.920	1.920	1.920	1.920	1.920	1.920	1.920	1.938	1.938	1.920	1.910	1.910	1.910	1.877	1.839	1.839	1.859	1.797	1.774
25	2.108	2.108	2.108	2.108	2.108	2.108	2.108	2.108	2.108	2.108	2.128	2.128	2.108	2.088	2.088	2.088	2.043	1.993	1.993	2.018	1.939	1.910
40	2.489	2.489	2.489	2.489	2.489	2.489	2.489	2.489	2.489	2.489	2.521	2.521	2.489	2.455	2.455	2.455	2.384	2.308	2.308	2.346	2.228	2.185
50	2.667	2.667	2.667	2.667	2.667	2.667	2.667	2.667	2.667	2.667	2.706	2.706	2.667	2.626	2.626	2.626	2.542	2.453	2.453	2.498	2.359	2.311
100	3.211	3.211	3.211	3.211	3.211	3.211	3.211	3.211	3.211	3.211	3.271	3.271	3.211	3.149	3.149	3.149	3.023	2.891	2.891	2.957	2.755	2.686
200	3.745	3.745	3.745	3.745	3.745	3.745	3.745	3.745	3.745	3.745	3.828	3.828	3.745	3.661	3.661	3.661	3.489	3.312	3.312	3.401	3.132	3.041
500	4.417	4.417	4.417	4.417	4.417	4.417	4.417	4.417	4.417	4.417	4.535	4.535	4.417	4.298	4.298	4.298	4.058	3.887	3.887	4.012	3.631	3.499
1,000	4.955	4.955	4.955	4.955	4.955	4.955	4.955	4.955	4.955	4.955	5.095	5.095	4.955	4.815	4.815	4.815	4.531	4.244	4.244	4.388	3.956	3.811
C_s	**1.3**	**1.3**	**1.3**	**1.3**	**1.3**	**1.3**	**1.3**	**1.3**	**1.3**	**1.3**	**1.4**	**1.4**	**1.3**	**1.2**	**1.2**	**1.2**	**1.0**	**0.8**	**0.8**	**0.9**	**0.6**	**0.5**

Frequency factors for storm durations (t_d) up to 24 hours are constant for a given recurrence interval because the coefficient of skew (C_s) is a constant at 1.3. For durations greater than 24 hours, the coefficient of skew (C_s) and frequency factors (K_j) vary with storm duration (t_d).

Regional Coefficient of Variation, CV																					
Storm Duration (t_d)																					
Consecutive Minutes				Consecutive Hours						Consecutive Days											
5	10	15	30	1	2	3	6	12	24	2	3	4	5	6	8	10	15	20	30	60	365
0.404	0.404	0.404	0.404	0.404	0.404	0.404	0.404	0.404	0.404	0.431	0.426	0.424	0.141	4.414	0.404	0.398	0.395	0.390	0.386	0.385	0.336

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