a

Parameters of log normal

μ(y)	0.621150443	1.31106	1.663867	2.252811	2.853894	3.452484	3.701365	3.974082	4.425831
sigma(y)	0.533333259	0.381177	0.404955	0.348322	0.264485	0.213325	0.244879	0.23752	0.295372

AIC BIC for log normal

AIC	202.6916283	223.9203	276.2177	313.587	349.504	406.1433	444.4826	479.3375	557.6038
BIC	206.8803174	228.109	280.4064	317.7757	353.6927	410.332	448.6713	483.5261	561.7925

Parameters of Gumbel Distribution

a	0.959530848	1.230119	1.886206	2.830963	3.772058	5.434947	8.089405	10.27883	20.55355
b	1.591850701	3.279888	4.642492	8.476035	15.79652	29.16954	37.06775	48.79245	75.4496

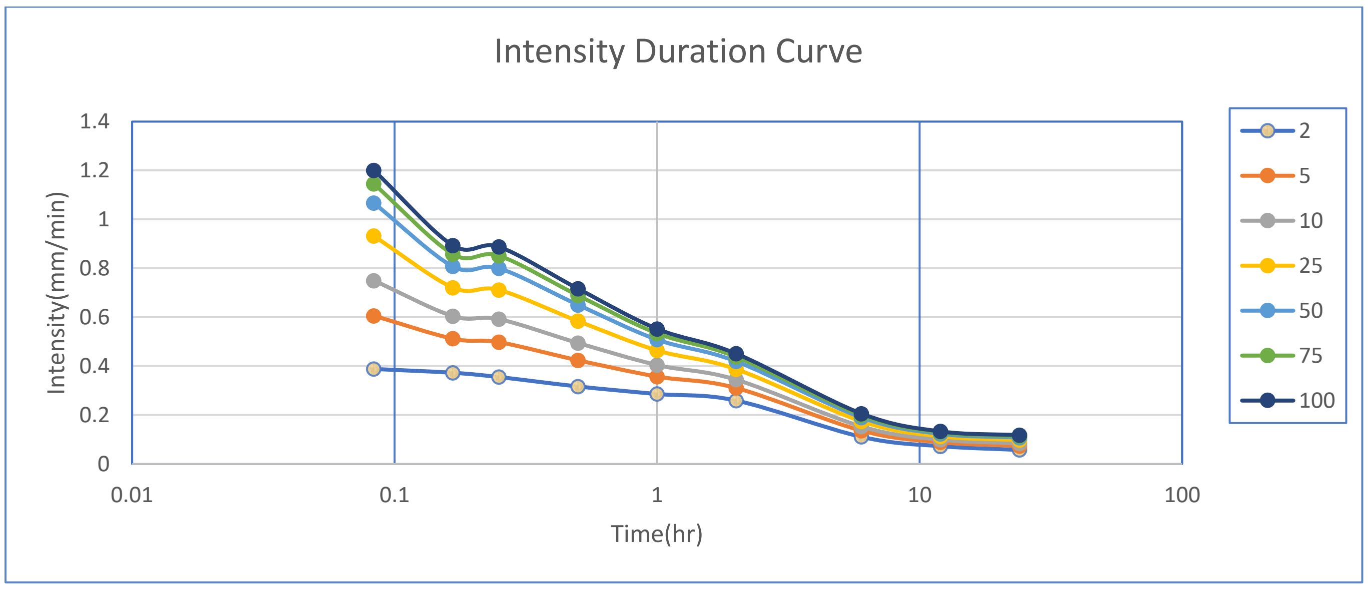
AIC BIC for gumbel

AIC	189.3939541	193.56	193.7046	183.6422	182.3899	203.8144	186.6247	196.3505	189.8204
BIC	193.5826433	197.7486	197.8932	187.8309	186.5785	208.0031	190.8134	200.5392	194.0091

In all the cases AIC as well as BIC value for gumbel is lower than log normal => In all the cases gumbel fit is a better fit.

Intensity Duration Frequency Data (Intensity in mm/min)

Duration(min)	5	10	15	30	60	120	360	720	1440
T/Duration(hr)	0.083333333	0.166667	0.25	0.5	1	2	6	12	24
2	0.388706231	0.373074	0.355587	0.317121	0.286317	0.259679	0.111202	0.073	0.057627
5	0.606217878	0.512499	0.498113	0.424077	0.357573	0.311014	0.13667	0.089181	0.073805
10	0.750229514	0.604811	0.592477	0.494891	0.404751	0.345001	0.153533	0.099894	0.084516
25	0.932188599	0.721447	0.711706	0.584366	0.46436	0.387945	0.174839	0.11343	0.098049
50	1.067176242	0.807974	0.800157	0.650743	0.508581	0.419803	0.190645	0.123472	0.108089
75	1.145636207	0.858267	0.851568	0.689323	0.534284	0.43832	0.199832	0.129309	0.113925
100	1.201167158	0.893862	0.887955	0.71663	0.552476	0.451426	0.206334	0.13344	0.118055



$$I_{D,T} = \frac{1.84891 \cdot T^{0.205529}}{[t_D(D) + 13.1819]^{0.49399}}$$

$I_{D,T}$ is intensity in mm/min.
$t_D(D)$ is in min.
T is in year.

b.

Sewer	Directly Drained Catchment or Contributing Upstre -am Sewer	Area(Aj) (Km^2)	Runoff Coefficient (Cj)	CjAj	∑CjAj	Inlet Time (min)	Upstream Sewer Flow Time (min)	Time of Concentration tc (min)	Design Rain Duration tD (min)	Design Rain Intensity (mm/min)
11-21	I	0.0085	0.609	0.005177	0.005177	7.20908		7.209079924	7.209079924	0.4807694
21-31	II	0.013	0.604	0.007852		8.591422		8.591422183		
	11-21			0.005177		7.20908	5.2288282	12.43790811		
					0.013029				12.43790811	0.4295006
31-41	III	0.015	0.6	0.009		9.412158		9.412157591		
	21-31			0.013029		12.43791	3.8300027	16.26791086		
					0.022029				16.26791086	0.4009351
41-51	IV	0.012	0.6175	0.00741		8.876569		8.876568922		
	31-41			0.022029		16.26791	3.5791726	19.8470835		
					0.029439				19.8470835	0.3788499
51-61	V	0.012	0.597	0.007164		8.730324		8.730323872		
	41-51			0.029439		19.84708	2.8258607	22.67294423		
					0.036603				22.67294423	0.3637936
61-71	VI	0.012	0.612	0.007344		8.465158		8.465158396		
	51-61			0.036603		22.67294	2.7806157	25.45355992		
					0.043947				25.45355992	0.3506153
17-71	VII	0.017	0.601	0.010217	0.010217	9.830124		9.830124016	9.830124016	0.4528914
18-71	VIII	0.012	0.62	0.00744	0.00744	8.868038		8.86803768	8.86803768	0.4625475
71-81	61-71			0.043947		25.45356	2.8050922	28.25865216		
	17-71			0.010217		9.830124	3.5101821	13.34030612		
	18-71			0.00744		8.868038	4.7124315	13.58046914		
					0.061604				28.25865216	0.3386836

Sewer	Upstream manhole ground elevation (m)	Length L (m)	Slope S	Design Discharge Qp, m3/sec	Required Diameter dr, (m)	Diameter used dn, (m)	Flow Velocity V (m/sec)	Sewer Flow Time (min)	SL (m)	Upstream Crown Elevation (m)	Upstream Invert Elevation (m)	Downstream Crown Elevation (m)	Downstream Invert Elevation (m)
11	135.2	500	0.003	0.04148	0.3117	0.35	0.4309442	5.228828187	1.5	134.2	133.85	132.7	132.35
21	134.7	500	0.0025	0.09326	0.4224	0.45	0.5861615	3.830002746	1.25	132.7	132.25	131.45	131
31	133	300	0.0021	0.1472	0.5012	0.55	0.6193238	3.579172646	0.63	131.45	130.9	130.82	130.27
41	132.6	1000	0.0042	0.18588	0.547	0.55	0.7820626	2.825860727	4.2	130.82	130.27	126.62	126.07
51	130.9	400	0.0032	0.22193	0.5846	0.6	0.7845984	2.780615694	1.28	126.62	126.02	125.34	124.74
61	130.2	400	0.0051	0.25681	0.6175	0.65	0.7735931	2.805092235	2.04	125.34	124.69	123.3	122.65
17	129.2	500	0.0036	0.07712	0.3933	0.4	0.6134535	3.510182105	1.8	128.2	127.8	126.4	126
18	129	600	0.004	0.05736	0.352	0.4	0.4562401	4.712431458	2.4	128	127.6	125.6	125.2
71	128.6			0.34773	0.6919	0.7	0.9032075	2.373024296		123.3	122.6		

c) $F(K_m) = \exp\left\{-1 \times \left[1 + \frac{0.13(K_m - 0.44)}{0.60}\right]^{-7.69}\right\}$

$F(K_m) = 1 - \frac{1}{1000} = 0.999$

$0.999 = \exp\left\{-1\left(1 + \frac{0.13(K_m - 0.44)}{0.60}\right)^{-7.69}\right\}$

$0.001^{-1/7.69} = 1 + \frac{0.13(K_m - 0.44)}{0.60}$

$\cancel{2.455} = 2.455 - 1 = \frac{0.13(K_m - 0.44)}{0.60}$

$K_m = 7.156$

Now we have $P_m = \bar{P} + K_m \sigma_P$

where

P_m = annual max rainfall for a given t_d

$\bar{P}$ = mean " " " " " " " = 87.309 mm

σ_P = std dev " " " " " " " = 26.36148 mm.

Both $\bar{P}$ and σ_P are calculated in the table.

$P_m = 87.309 + 7.156 \times 26.36148$

$= 275.95$ mm.

we also have,

$\frac{P_{D,T}}{t_D} \times g(t_D) = \frac{P_{D_1,T}}{t_{D_1}} g(t_{D_1})$

$g(t_D) = (D + 13.1819)^{0.49399}$

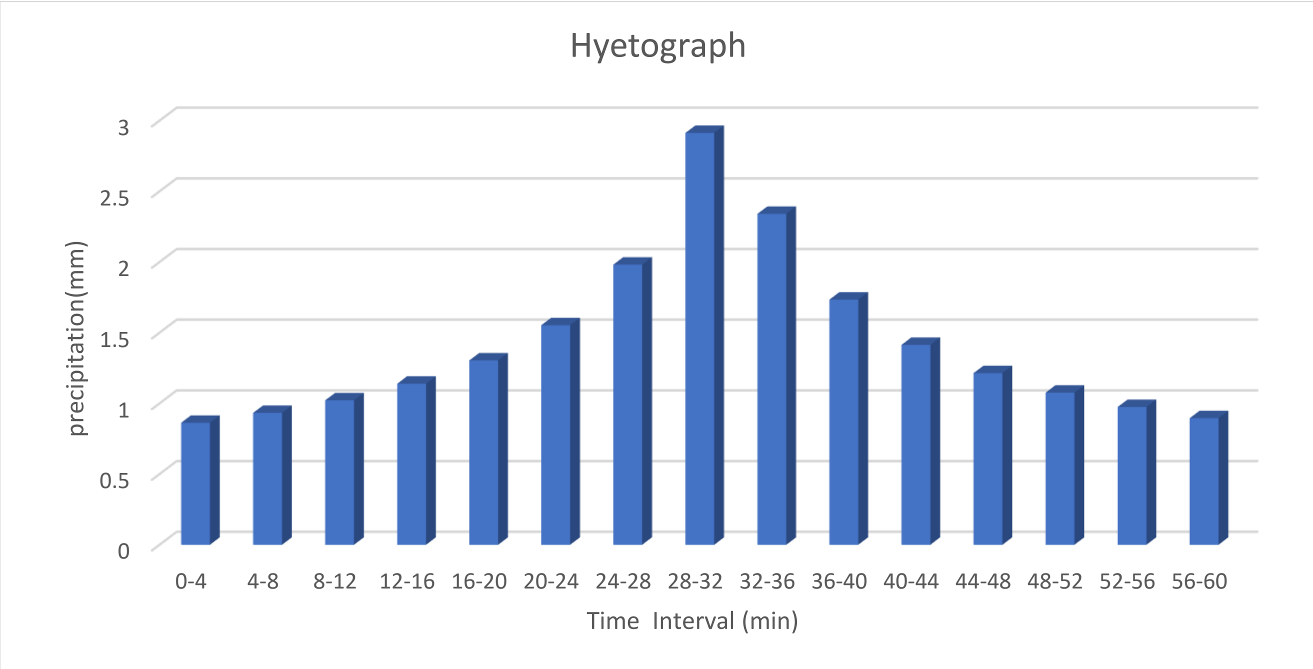
$D = 24$ hr $\qquad D_1 = 24$ hr

$\because D = D_1 \quad \therefore g(t_D) = g(t_{D_1})$

~~and~~ and thus. $P_{D,T} = P_{D_1T} = 275.95$ mm

Thus, the probable maximum 24-h precipitation with a return period of 1000 yrs is 275.95mm d.

Duration(min)	Intensity(mm/min)	Cum. Dep.	Incre. Dep.	Time	Precipitation(mm)
4	0.7283363	2.913345	2.9133452	0-4	0.862684041
8	0.656797308	5.254378	2.3410333	4-8	0.932802487
12	0.603005212	7.236063	1.9816841	8-12	1.021864893
16	0.56065193	8.970431	1.7343683	12-16	1.139613047
20	0.526180516	10.52361	1.5531794	16-20	1.304113193
24	0.497412477	11.9379	1.4142891	20-24	1.553179449
28	0.472929023	13.24201	1.3041132	24-28	1.98168408
32	0.451761132	14.45636	1.2143436	28-32	2.913345201
36	0.433221369	15.59597	1.139613	32-36	2.34103326
40	0.416806696	16.67227	1.0762986	36-40	1.734368338
44	0.402139381	17.69413	1.0218649	40-44	1.414289123
48	0.388929509	18.66862	0.9744837	44-48	1.21434358
52	0.376950364	19.60142	0.9328025	48-52	1.076298581
56	0.366021742	20.49722	0.8957986	52-56	0.974483692
60	0.35599836	21.3599	0.862684	56-60	0.895798628



e.

Time(min)	Precipitation(mm)
0-4	0.862684041
4-8	0.932802487
8-12	1.021864893
12-16	1.139613047
16-20	1.304113193
20-24	1.553179449
24-28	1.98168408
28-32	2.913345201
32-36	2.34103326
36-40	1.734368338
40-44	1.414289123
44-48	1.21434358
48-52	1.076298581
52-56	0.974483692
56-60	0.895798628

The maximum flodding will be in the time interval of (28-32)min when the precipitation is 2.913345201mm and if drainage can sustain this precipitation then it will be safe
Other way, to check for every interval and for each gutter, sewer pipes and inlet capacity.