Kurdistan Engineers Union

یەکێتی ئەندازیارانی کوردستان

Using GIS for Determine Peak Flood Discharge of Karam Bast Dam

For Kurdistan Engineering Union

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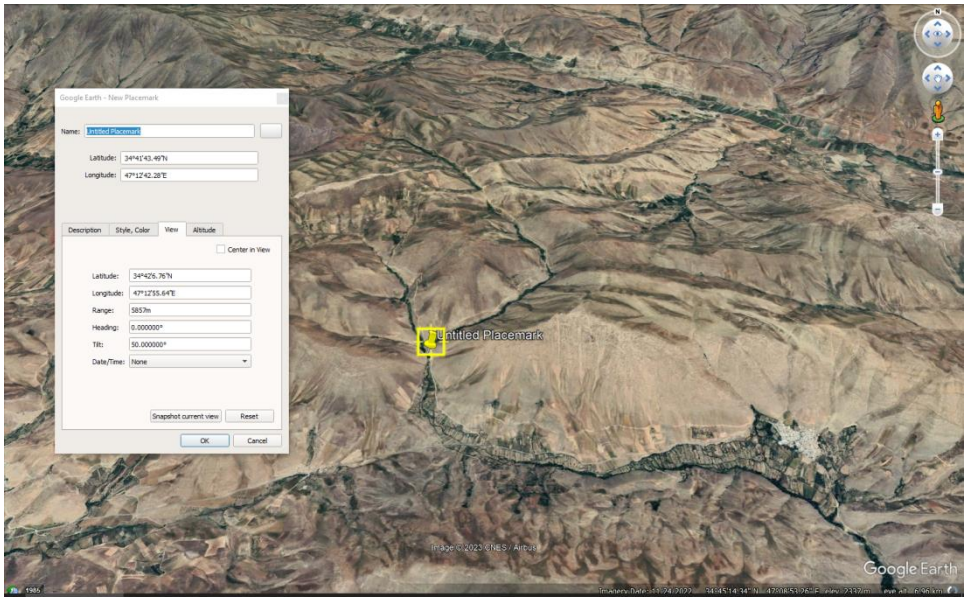
Karam Bast Dam:

Karam Bast Dam is located in the northern Kermanshah province that is considered a semi-humid area with cold water and air from a regional point of view. coordinate is located in geographical specifications with length 47°12'42.90"E and width 34°41'42.14"N, The location of the dam in the UTM system is as follows: Y = 3841500 X = and 702600.

The dam is the source of the agricultural water for the civilian of karam bast and kandula villages.

The medium soil cover of the area is 6.5 mm per hour and the vegetation cover of the area includes 5% medium forest cover, 60% wetland with medium cover and 35% wetland with good cover.



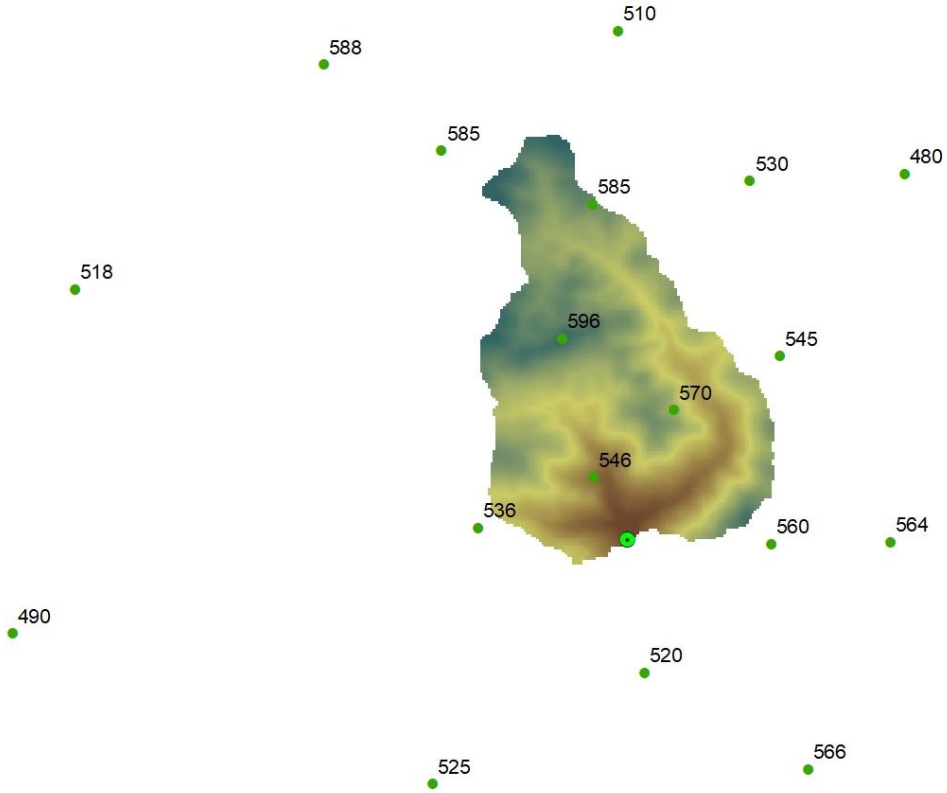
There is a small constant flow in this area that occurred in 1991 with a slight increase in the surface of this waterfall. Below is the photo of the small wire of the area;

The rainfall gauge:

The rainfall gauge is located surrounding dam that has the bellow information:

Annual rainfall records are available at each of the gauge rainfall stations in the region

No.	X (m)	Y (m)	P (mm)
1	695700	3840400	490
2	696400	3844250	518
3	699180	3846760	588
4	700400	3838720	525
5	700500	3845800	585
6	700910	3841580	536
7	701850	3843700	596
8	702190	3845200	585
9	702200	3842150	546
10	702470	3847140	510
11	702770	3839960	520
12	703100	3842900	570
13	703950	3845460	530
14	705680	3845540	480
15	704190	3841400	560
16	704280	3843500	545
17	704600	3838880	566
18	705520	3841420	564

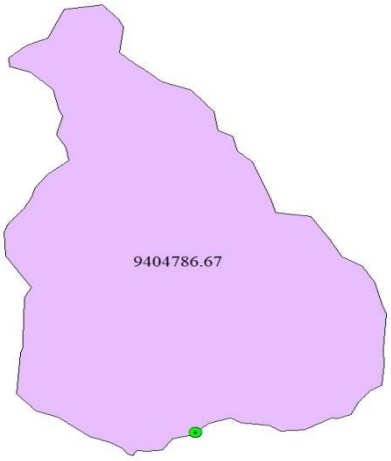


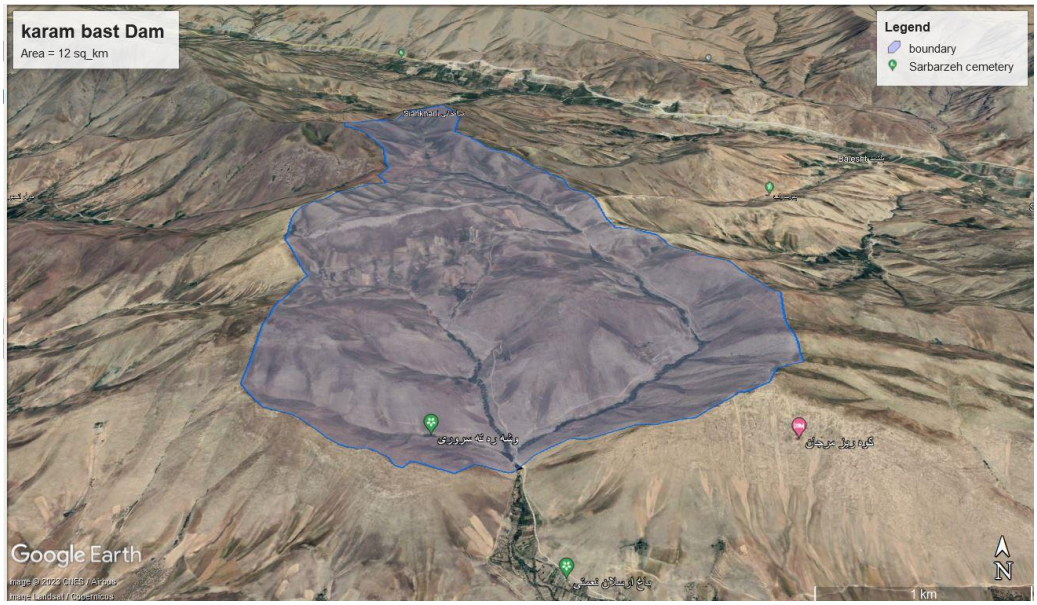
Catchment area:

Is calculated by ArcGIS computer program and exported to location of dam in Google earth map:

Catchment area =9,404,786.67 m^2 =9.4 km^2

Catchment perimeter = 13,936.30 m = 13.936 km





Shape coefficient:

Gravelius Coefficient = $0.28*13.936/(9.4)^{0.5} = 1.27$

L= $1.27*(9.4)^{0.5} +(((1.27)^2*9.4)-(1.2544*9.4))^{0.5}/1.12 = 5.11$ km

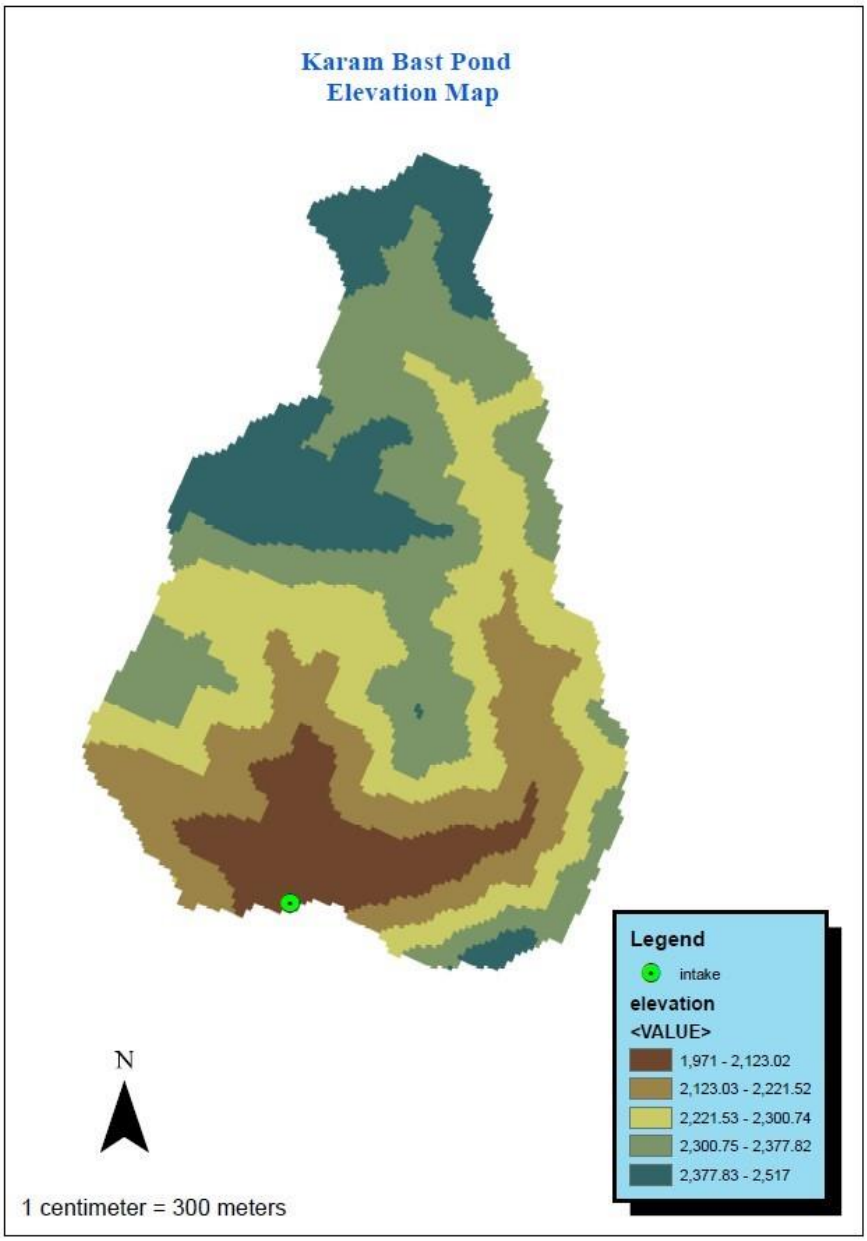
B= $1.27*(9.4)^{0.5} -(((1.27)^2*9.4)-(1.2544*9.4))^{0.5}/1.12 = 1.83$ km

Topography of the catchment:

Is calculated by ArcGIS computer program, and has the following results;

Max. elevation of catchment area = 2,517 m

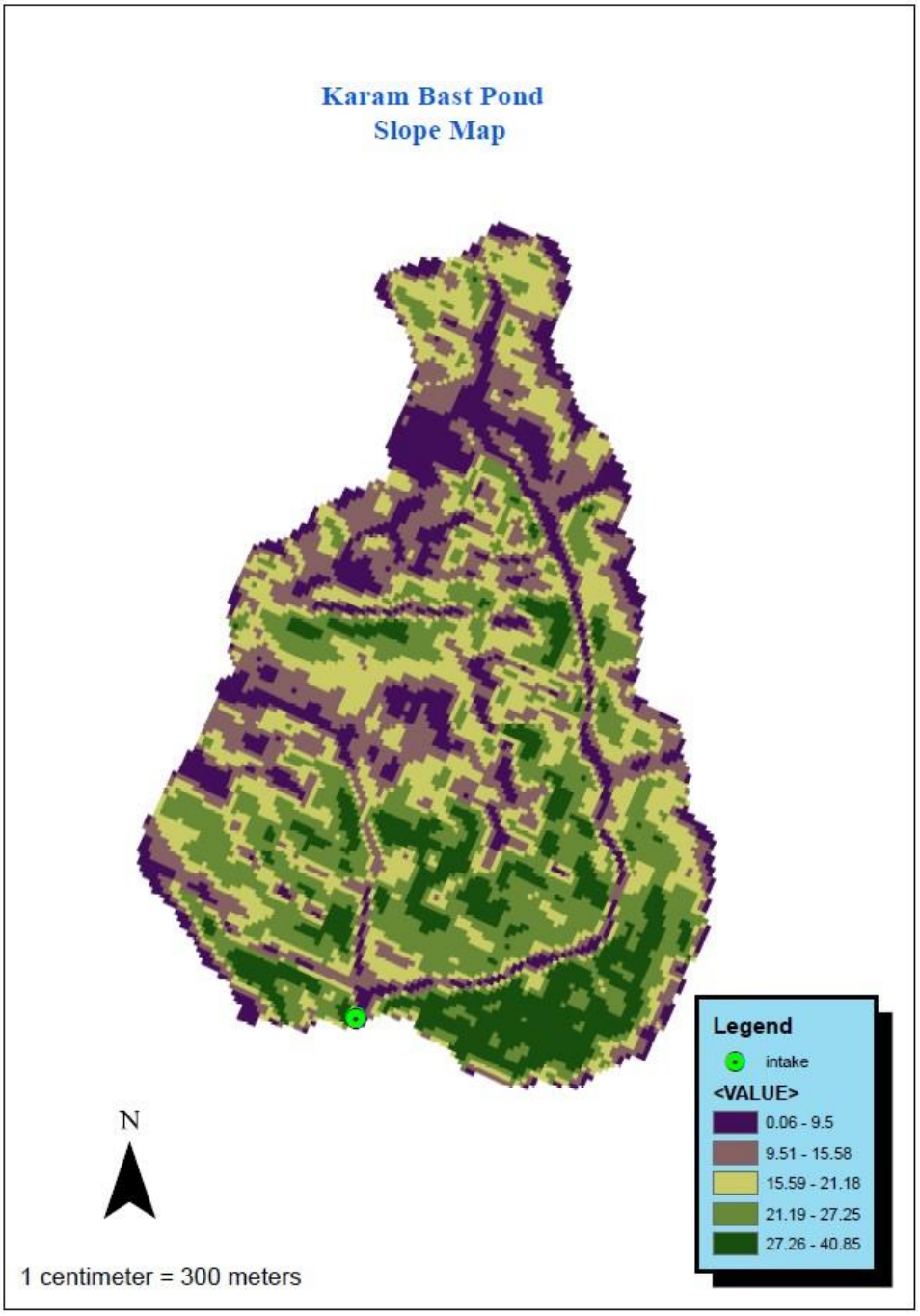
Min. elevation of catchment area = 1,971 m



Slope of the catchment:

Is calculated by ArcGIS computer program, and has the following results;

Avg. catchment slope = (H_{max}-H_{min})/ $\sqrt{A}$ = (2.517-1.971)/ $\sqrt{9.4}$ = 17.81 m/m

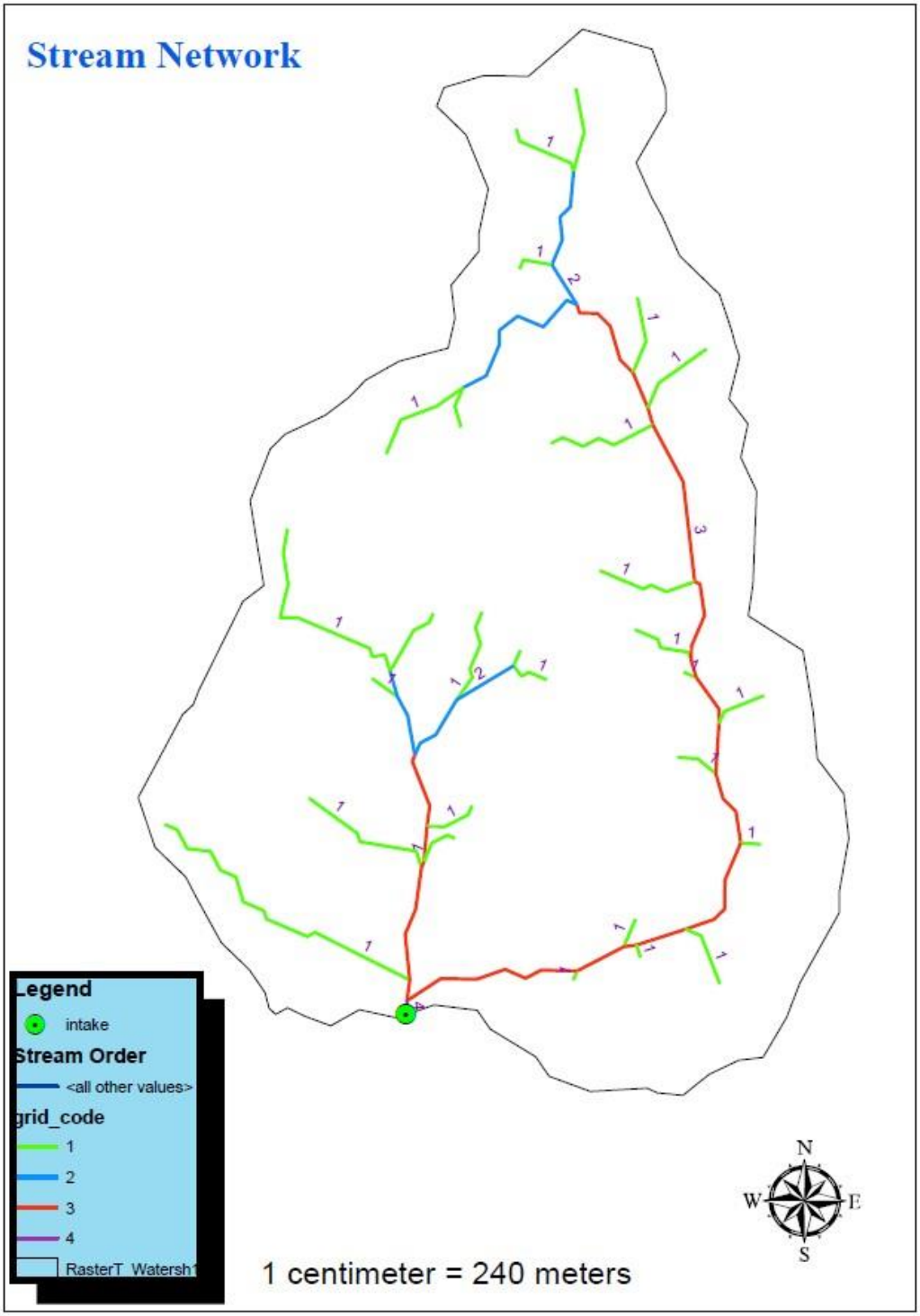


Stream network;

Is calculated by ArcGIS computer program, and has the following results;

The main stream length = 5.68 km

Slope of the main stream line =(2290-1900) /4.59 = 8.5%



Time characteristics of the basin:

$$S = \frac{1000}{CN} - 10$$

$$t_L = \frac{L^{0.8}(S+1)^{0.7}}{(1900)y^{0.5}}$$

$$t_c = 1.66 \times t_L$$

$$t_p = 0.6 \times t_c + \sqrt{t_c}$$

$$Q_p = \frac{0.208 \times A}{t_p}$$

$$T_b = 2.67 \times t_p$$

CN = (0.05*60*9.4+0.6*69*9.4+0.35*61*9.4)/9.4 = 65.75

S =(1000/65.75)-10 = 5.21 mm

t_{lag} = $(18635.17)^{0.8}$ $(5.21+1)^{0.7}$/1900*$17.81^{0.5}$ = 1.17 hr = 70.06 min

t_c = 1.67*1.17 = 1.95 hr = 117.01 min

t_p = 0.6*1.95+$\sqrt{1.95} = 2.57\ hr$ =153.99 min

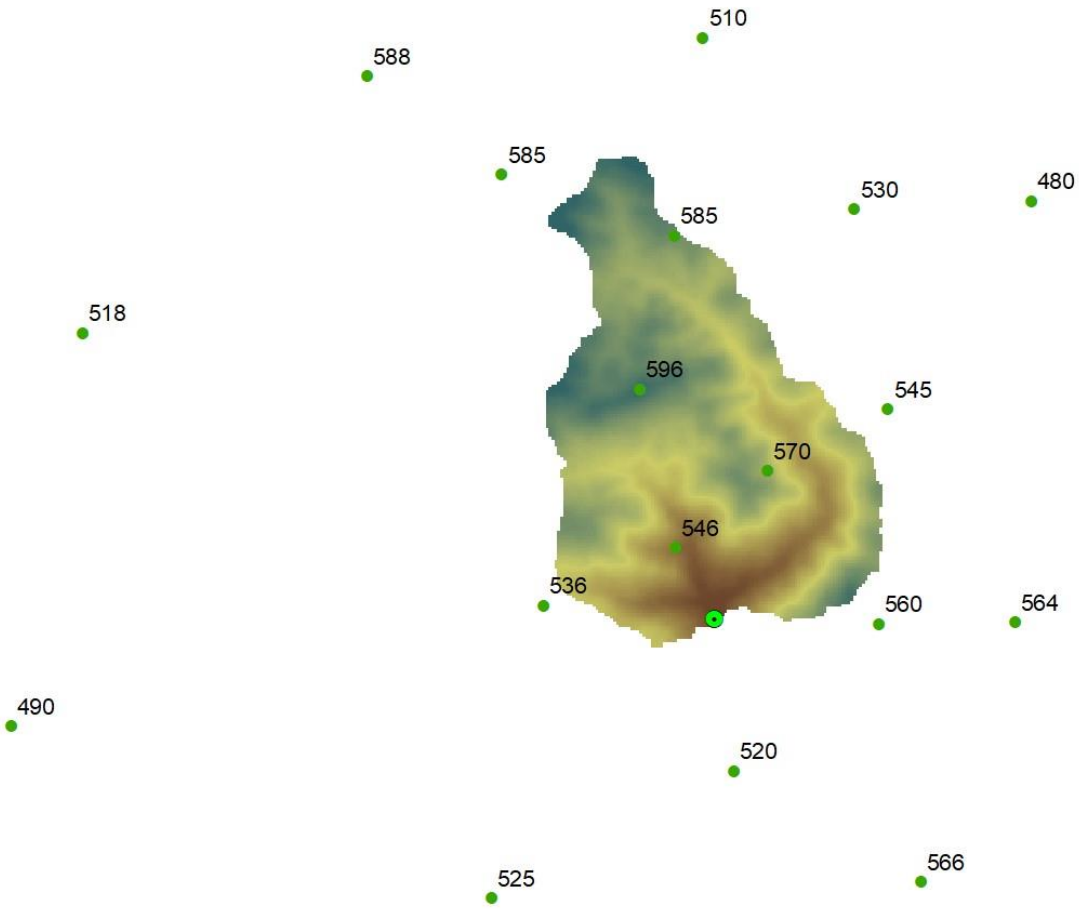
Q_p = 0.0208*950/2.57 = 7.69 m3/s

t_b =2.67*2.57 = 6.86 hr = 412 min

Avg. Rainfall Depth over Catchment Area:

1- Arithmatic Method :

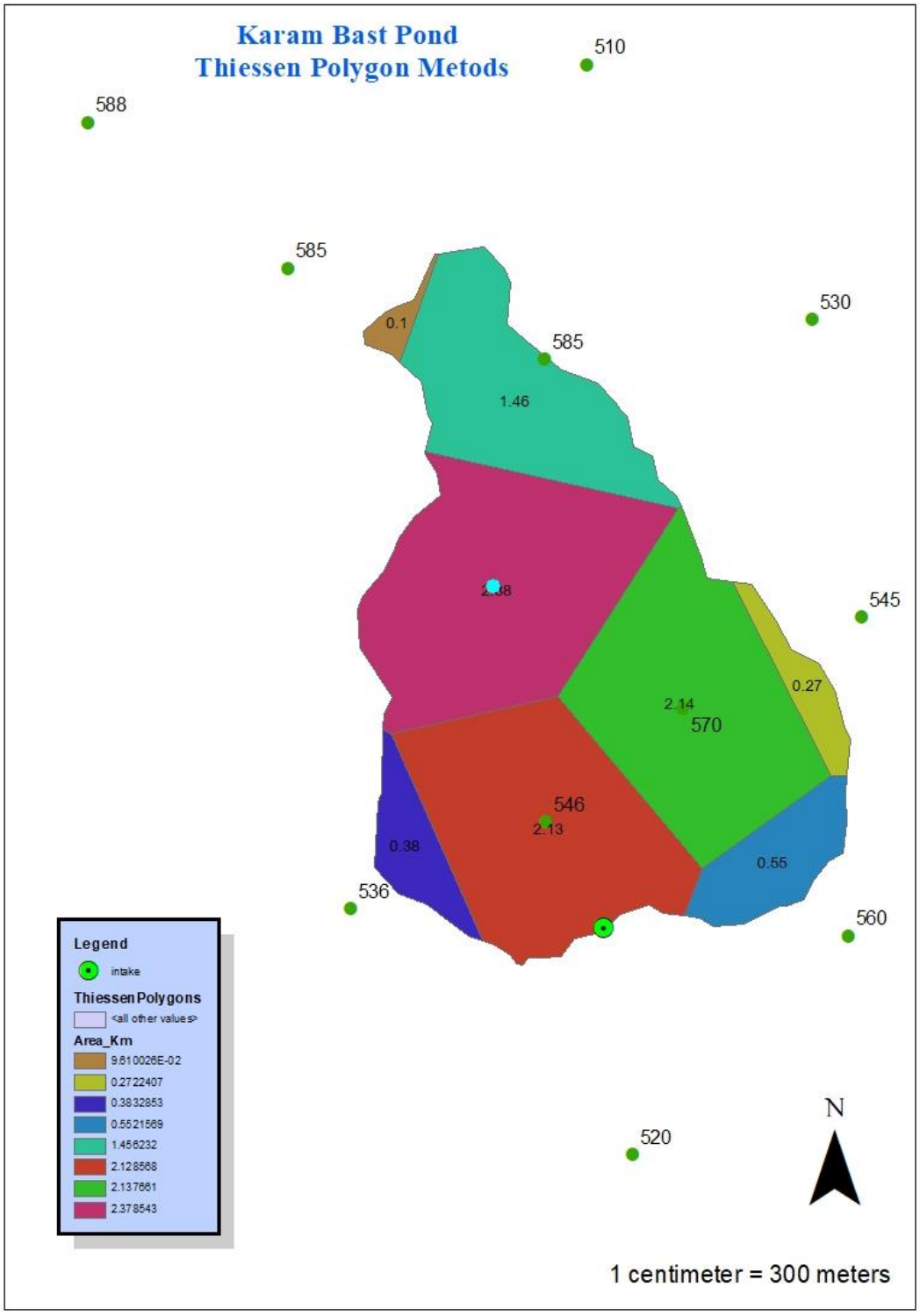
$\mathbf{P_{avg}}$ = (585+596+570+546)/4 = **574.25 mm**



2- Thiessen Polygon Method :

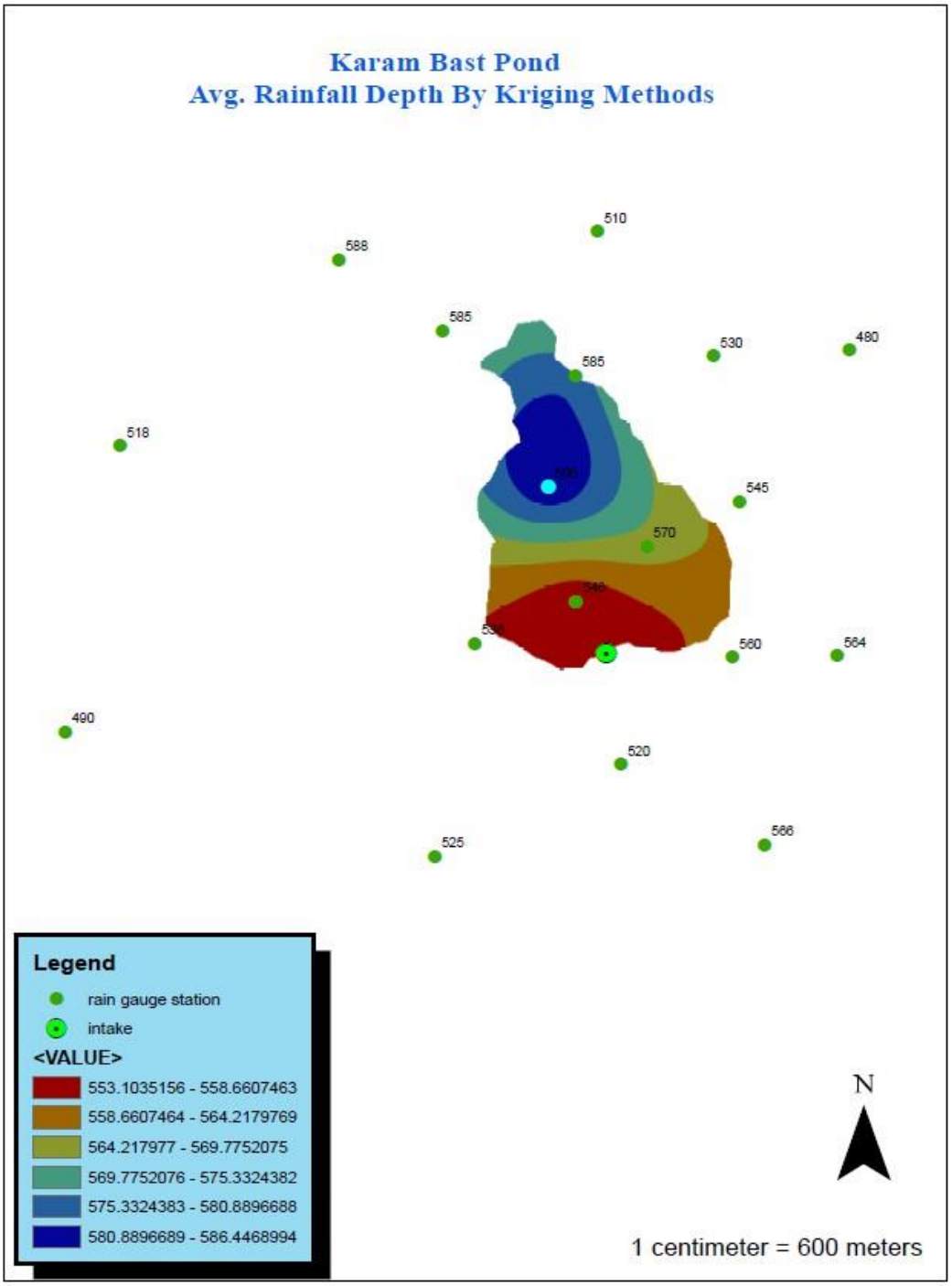
Is calculated by ArcGIS computer program, and has the following results;

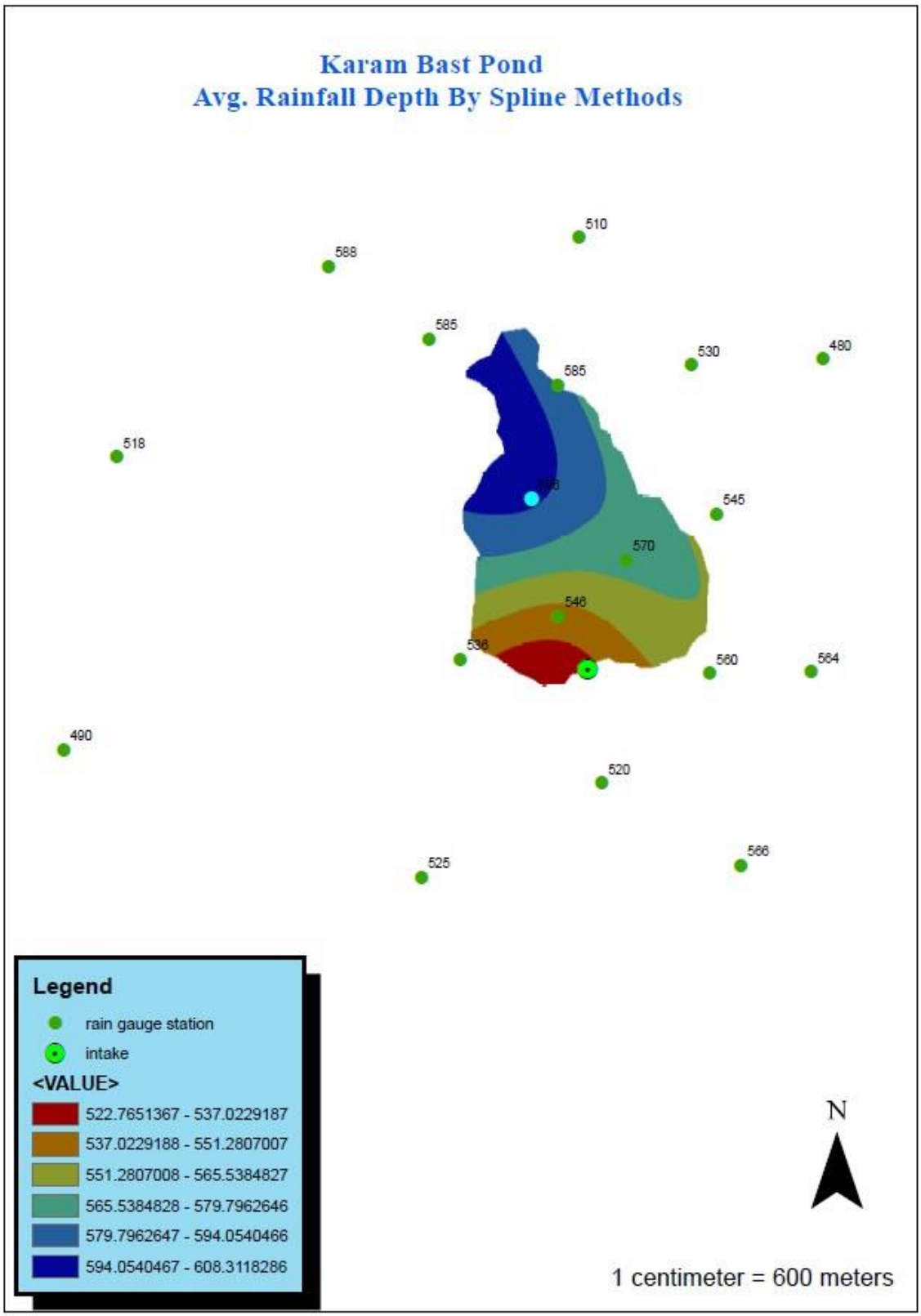
$\mathbf{P_{avg}}$=(585*0.1+596*2.38+585*1.46+570*2.14+546*2.13+545*0.27+560*0.55+536*0.38)/(585+596+585+570+546+545+560+536)= **570.96 mm**

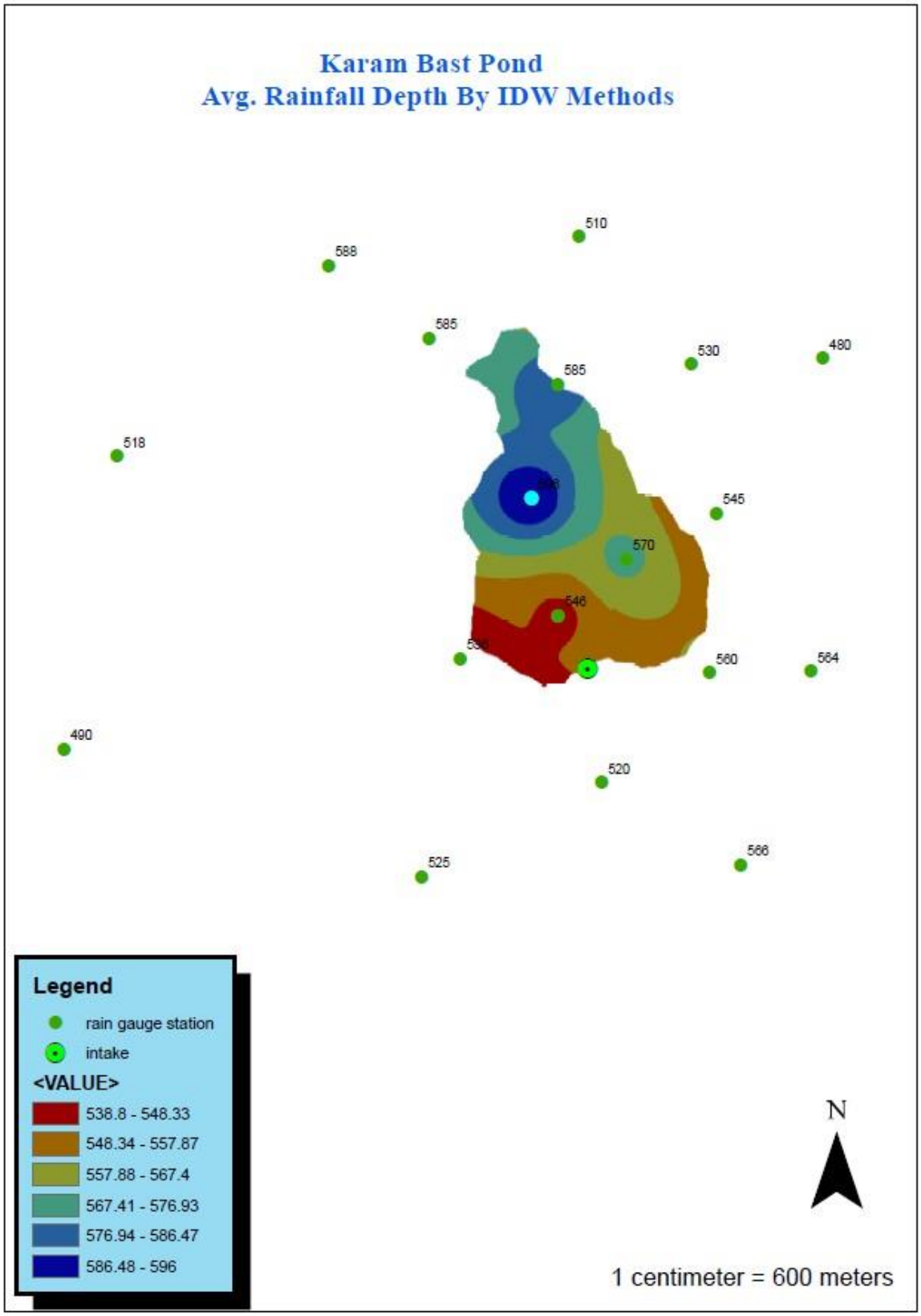


3- Isohyetal Method:

Is calculated by ArcGIS computer program with three methods (kriging, spline and IDW methods), and has the following results;




Karam Bast Pond
Avg. Rainfall Depth By Spline Methods
510
588
585
530
480
585
518
545
570
546
538
560
564
490
520
525
566
Legend
rain gauge station
intake
<VALUE>
522.7651367 - 537.0229187
537.0229188 - 551.2807007
551.2807008 - 565.5384827
565.5384828 - 579.7962646
579.7962647 - 594.0540466
594.0540467 - 608.3118286
N
1 centimeter = 600 meters


Karam Bast Pond
Avg. Rainfall Depth By IDW Methods
510
588
585
530
480
585
518
545
570
546
560
564
490
520
525
566
Legend
rain gauge station
intake
<VALUE>
538.8 - 548.33
548.34 - 557.87
557.88 - 567.4
567.41 - 576.93
576.94 - 586.47
586.48 - 596
N
1 centimeter = 600 meters

Discharge data of the basin for 30 years periods :

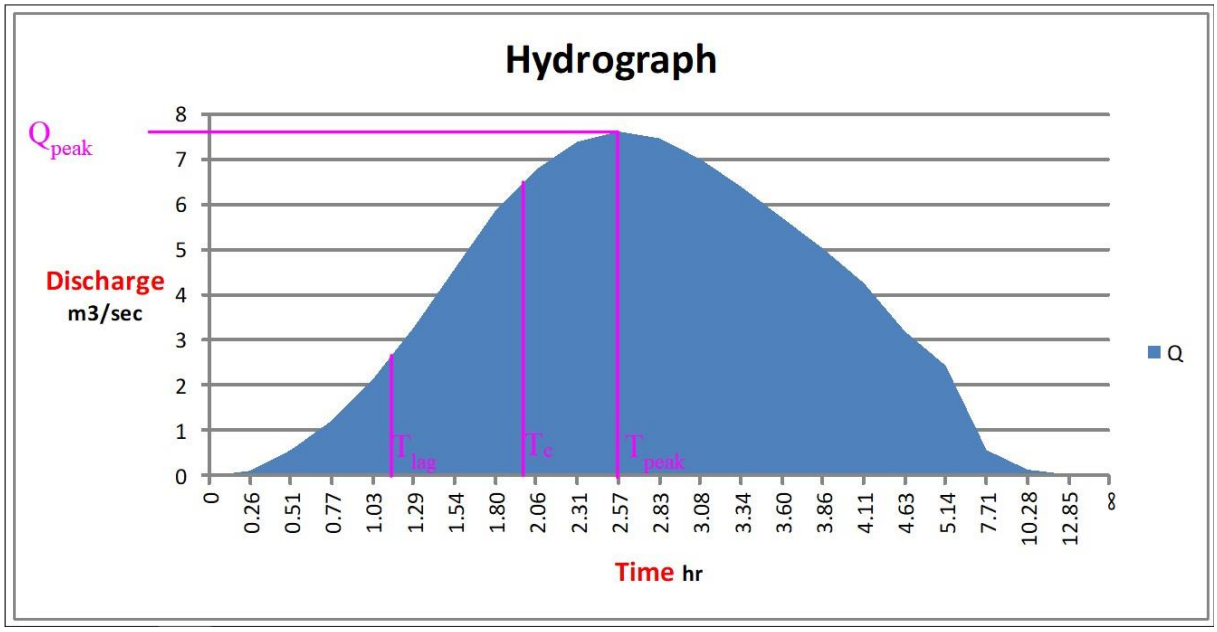
Years	Max. flood discharge
1351-52	0.18
1352-53	1.62
1353-54	1.27
1354-55	0.42
1355-56	0.21
1356-57	2.28
1357-58	1.19
1358-59	2.44
1359-60	1.56
1360-61	0.12
1361-62	1.47
1362-63	0.26
1363-64	0.19
1364-65	0.49
1365-66	2.43
1366-67	1.48
1367-68	0.39
1368-69	0.77
1369-70	0.35
1370-71	1.23
1371-72	0.85
1372-73	0.90
1373-74	1.72
1374-75	0.77
1375-76	0.25
1376-77	1.62
1377-78	0.25
1378-79	0.50
1379-80	0.40
1380-81	0.69

Max. Discharge according $Q_p = \frac{0.208 \times A}{t_p}$

Is equal to 7.69 m^3/sec that calculated above with time results of the catchment.

Hydrograph of the catchment by SCS methods;

t/tp	Q/QP	t	Q
0	0	0	0
0.1	0.015	0.26	0.11
0.2	0.075	0.51	0.57
0.3	0.16	0.77	1.22
0.4	0.28	1.03	2.13
0.5	0.43	1.29	3.27
0.6	0.6	1.54	4.57
0.7	0.77	1.80	5.86
0.8	0.89	2.06	6.77
0.9	0.97	2.31	7.38
1	1	2.57	7.61
1.1	0.98	2.83	7.46
1.2	0.92	3.08	7.00
1.3	0.84	3.34	6.39
1.4	0.75	3.60	5.71
1.5	0.66	3.86	5.02
1.6	0.56	4.11	4.26
1.8	0.42	4.63	3.20
2	0.32	5.14	2.44
3	0.075	7.71	0.57
4	0.018	10.28	0.14
5	0.004	12.85	0.03
	0	∞	0



Estimation of the maximum flood discharge with a return period of 25 years;

years	Q m3/s	cumulative	Xi-Mean	(Xi-Mean)^2	(Xi-Mean)^3
1351-52	0.18	0.18	-0.76	0.58	-0.45
1352-53	1.62	1.80	0.68	0.46	0.31
1353-54	1.27	3.07	0.33	0.11	0.03
1354-55	0.42	3.49	-0.52	0.27	-0.14
1355-56	0.21	3.70	-0.73	0.54	-0.40
1356-57	2.28	5.98	1.34	1.78	2.38
1357-58	1.19	7.17	0.25	0.06	0.01
1358-59	2.44	9.61	1.50	2.24	3.35
1359-60	1.56	11.17	0.62	0.38	0.23
1360-61	0.12	11.29	-0.82	0.68	-0.56
1361-62	1.47	12.76	0.53	0.28	0.15
1362-63	0.26	13.02	-0.68	0.47	-0.32
1363-64	0.19	13.21	-0.75	0.57	-0.43
1364-65	0.49	13.70	-0.45	0.21	-0.09
1365-66	2.43	16.13	1.49	2.21	3.28
1366-67	1.48	17.61	0.54	0.29	0.15
1367-68	0.39	18.00	-0.55	0.31	-0.17
1368-69	0.77	18.77	-0.17	0.03	-0.01
1369-70	0.35	19.12	-0.59	0.35	-0.21
1370-71	1.23	20.35	0.29	0.08	0.02
1371-72	0.85	21.20	-0.09	0.01	0.00
1372-73	0.90	22.10	-0.04	0.00	0.00
1373-74	1.72	23.82	0.78	0.60	0.47
1374-75	0.77	24.59	-0.17	0.03	-0.01
1375-76	0.25	24.84	-0.69	0.48	-0.33
1376-77	1.62	26.46	0.68	0.46	0.31
1377-78	0.25	26.71	-0.69	0.48	-0.33
1378-79	0.50	27.21	-0.44	0.20	-0.09
1379-80	0.40	27.61	-0.54	0.30	-0.16
1380-81	0.69	28.30	-0.25	0.06	-0.02
	28.30				
			Mean = Sum. Of Discharge / No. years = 28.32/30 = 0.944		
				Variance = 1.42	
				Standard Deviation = 1.19	
				Skewness = 0.23	
				Cv = 1.26	

By Person Type three :

$X = \bar{x} + K_{25} * S$

$K_{25} = 1.797$

$X_{25} = 0.944+(1.19*1.797) = 3.09\ m^3/s$

By Gumble;

$X_{25} = 0.944+(1.19*2.393) = 3.8\ m^3/s$