

7 Appendix

A Total precipitation - Dick Peschke

Table A.1: Total precipitation calculated based on the Dick Peschke formula

Duration (min)	Precipitation 24 hours (mm)								
	95.42	131.38	154.45	182.57	202.78	222.40	241.58	266.47	285.04
	Return period (year)								
	2	5	10	25	50	100	200	500	1000
	Precipitation (mm)								
5	23.16	31.89	37.49	44.32	49.22	53.99	58.64	64.69	69.19
10	27.55	37.93	44.59	52.70	58.54	64.20	69.74	76.92	82.28
15	30.48	41.97	49.34	58.33	64.78	71.05	77.18	85.13	91.06
20	32.76	45.10	53.02	62.68	69.61	76.35	82.93	91.48	97.85
25	34.64	47.69	56.06	66.27	73.61	80.73	87.69	96.73	103.47
30	36.25	49.91	58.68	69.36	77.04	84.49	91.78	101.24	108.29
35	37.68	51.87	60.98	72.09	80.07	87.81	95.39	105.22	112.55
40	38.96	53.64	63.05	74.54	82.79	90.79	98.63	108.79	116.37
45	40.12	55.24	64.94	76.76	85.26	93.51	101.57	112.04	119.84
50	41.19	56.71	66.67	78.81	87.54	96.00	104.28	115.03	123.04
55	42.18	58.08	68.28	80.71	89.65	98.32	106.80	117.80	126.01
60	43.11	59.36	69.78	82.49	91.62	100.48	109.15	120.39	128.78
120	51.27	70.59	82.98	98.09	108.95	119.49	129.80	143.17	153.15
180	56.74	78.12	91.84	108.56	120.58	132.24	143.65	158.45	169.48
240	60.97	83.94	98.69	116.65	129.57	142.10	154.36	170.26	182.12
300	64.47	88.76	104.35	123.35	137.00	150.25	163.21	180.03	192.57
360	67.47	92.90	109.21	129.10	143.39	157.26	170.82	188.42	201.55
420	70.12	96.55	113.51	134.17	149.02	163.44	177.54	195.83	209.47
480	72.50	99.83	117.36	138.73	154.08	168.98	183.56	202.48	216.58
540	74.67	102.81	120.87	142.87	158.69	174.03	189.05	208.53	223.05
600	76.66	105.55	124.09	146.68	162.92	178.68	194.09	214.09	229.01
660	78.51	108.10	127.08	150.22	166.85	182.99	198.77	219.25	234.53
720	80.24	110.48	129.88	153.53	170.52	187.01	203.15	224.08	239.69
780	81.86	112.71	132.50	156.63	173.97	190.79	207.25	228.60	244.53
840	83.39	114.82	134.98	159.56	177.22	194.36	211.13	232.88	249.10
900	84.84	116.81	137.33	162.33	180.30	197.74	214.80	236.93	253.44
960	86.22	118.71	139.56	164.97	183.23	200.96	218.29	240.78	257.56
1020	87.54	120.53	141.69	167.49	186.03	204.03	221.63	244.46	261.49
1080	88.80	122.26	143.73	169.90	188.71	206.96	224.82	247.98	265.26
1140	90.01	123.93	145.69	172.22	191.28	209.78	227.88	251.36	268.87
1200	91.17	125.53	147.57	174.44	193.75	212.49	230.82	254.60	272.34
1260	92.29	127.07	149.38	176.58	196.13	215.10	233.65	257.72	275.68
1320	93.37	128.55	151.13	178.64	198.42	217.61	236.38	260.74	278.90
1380	94.41	129.99	152.82	180.64	200.64	220.04	239.03	263.65	282.02
1440	95.42	131.38	154.45	182.57	202.78	222.40	241.58	266.47	285.04

B Design hyetograph

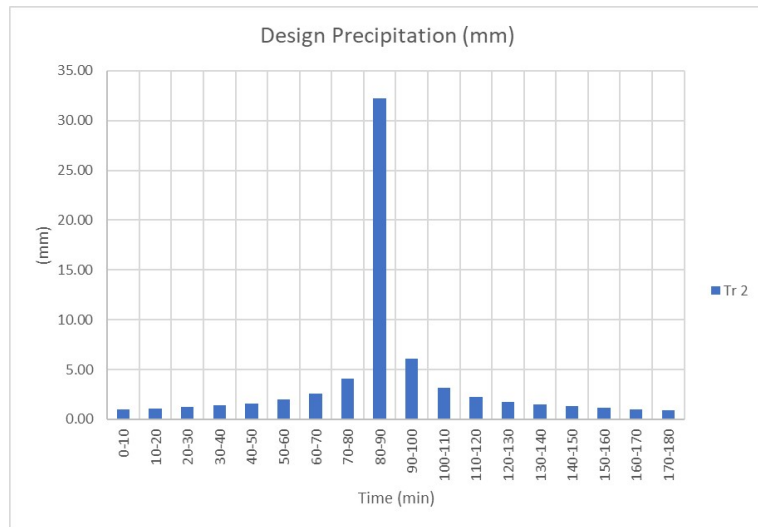


Figure B.1: Design precipitation event for a return period of 2 years.

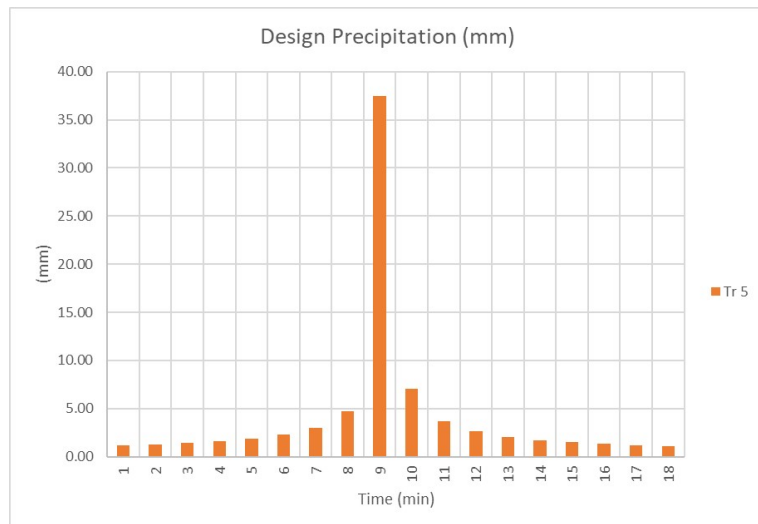


Figure B.2: Design precipitation event for a return period of 5 years.

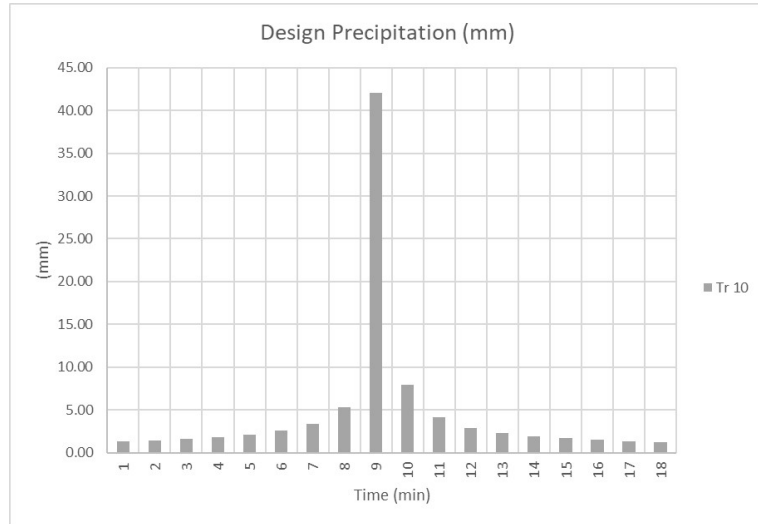


Figure B.3: Design precipitation event for a return period of 10 years.

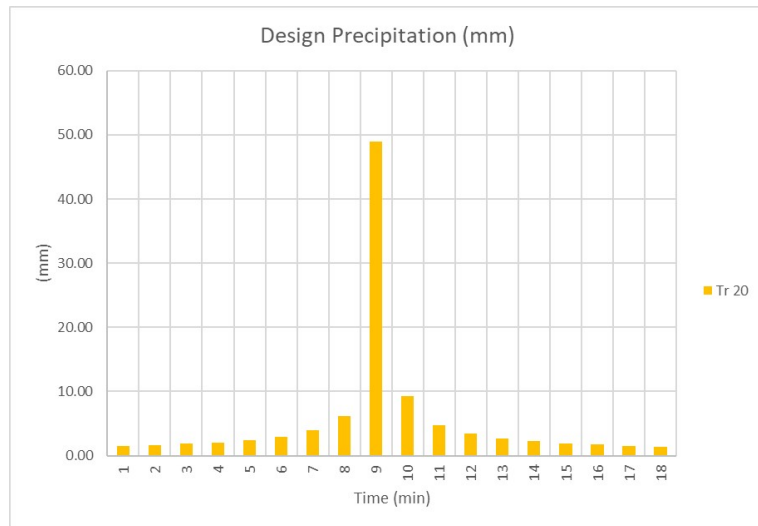


Figure B.4: Design precipitation event for a return period of 25 years.

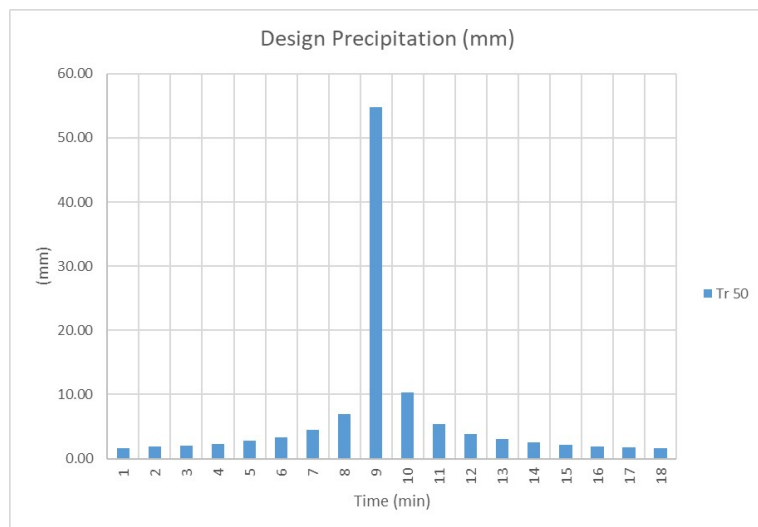


Figure B.5: Design precipitation event for a return period of 50 years.

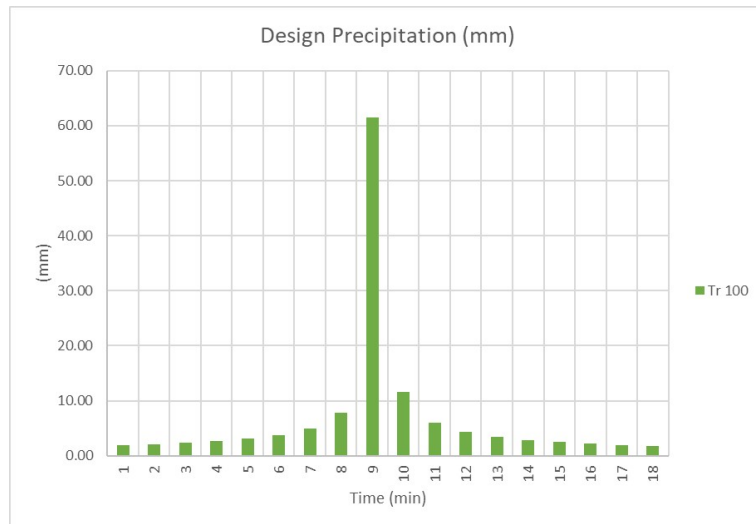


Figure B.6: Design precipitation event for a return period of 100 years.

C Water level time series

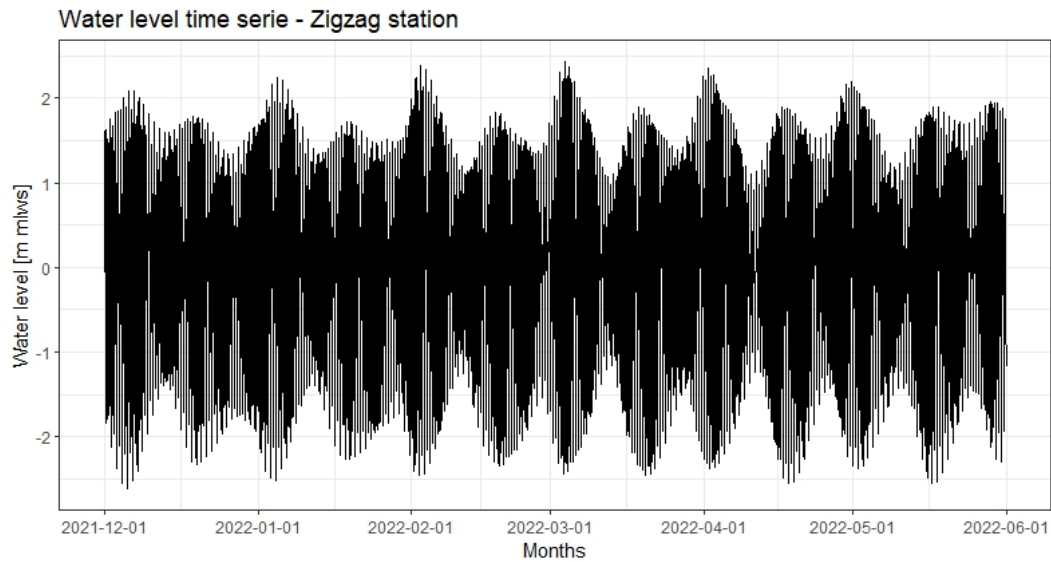


Figure C.1: Water level time series from the Zigzag station. Data measured from 01/12/2021 to 31/05/2022

D HEC - HMS output

Table D.1: Design hydrograph output from HEC - HMS for boundary condition

Boundary condition							
Time	minutes	TR2	TR5	TR10	TR25	TR50	TR100
12:00	0:00	0:00	0:00	0:00	0:00	0:00	0
12:30	0:00	0:00	0:00	0:00	2:24	2:24	0.1
13:00	0:00	4:48	4:48	7:12	7:12	9:36	0.5
13:30	0:00	9:36	16:48	0:00	9:36	16:48	3.1
14:00	0:00	21:36	19:12	14:24	21:36	0:00	10.2
14:30	0:00	14:24	2:24	4:48	12:00	9:36	27.6
15:00	0:00	14:24	2:24	2:24	2:24	4:48	51.1
15:30	0:00	7:12	2:24	4:48	21:36	12:00	65.9
16:00	0:00	2:24	4:48	12:00	12:00	7:12	69.1
16:30	0:00	0:00	12:00	7:12	14:24	19:12	62.9
17:00	0:00	14:24	9:36	12:00	16:48	2:24	54.2
17:30	0:00	4:48	4:48	16:48	21:36	9:36	45.5
18:00	0:00	7:12	14:24	12:00	19:12	14:24	37.8
18:30	0:00	0:00	19:12	4:48	19:12	21:36	31.4
19:00	0:00	7:12	14:24	14:24	14:24	4:48	26.1
19:30	0:00	0:00	21:36	14:24	2:24	4:48	21.7
20:00	0:00	4:48	16:48	2:24	4:48	0:00	18
20:30	0:00	14:24	21:36	2:24	19:12	7:12	14.9
21:00	0:00	7:12	9:36	9:36	19:12	0:00	12.4
21:30	0:00	4:48	4:48	21:36	2:24	4:48	10.3
22:00	0:00	9:36	2:24	19:12	19:12	14:24	8.6
22:30	0:00	14:24	4:48	19:12	14:24	7:12	7.1
23:00	0:00	0:00	12:00	0:00	16:48	4:48	5.9
23:30	0:00	12:00	21:36	7:12	21:36	9:36	4.9
0:00	0:00	2:24	9:36	16:48	4:48	14:24	4.1
0:30	0:00	16:48	0:00	7:12	16:48	0:00	3.4
1:00	0:00	9:36	16:48	21:36	4:48	12:00	2.8
1:30	0:00	4:48	9:36	14:24	19:12	2:24	2.3
2:00	0:00	0:00	4:48	7:12	12:00	16:48	1.9
2:30	0:00	19:12	0:00	2:24	7:12	9:36	1.6
3:00	0:00	16:48	19:12	21:36	2:24	4:48	1.3
3:30	0:00	14:24	16:48	16:48	21:36	0:00	1.1
4:00	0:00	12:00	14:24	14:24	16:48	19:12	0.9
4:30	0:00	9:36	12:00	12:00	14:24	16:48	0.8
5:00	0:00	7:12	9:36	9:36	12:00	14:24	0.6
5:30	0:00	7:12	7:12	9:36	9:36	12:00	0.5
6:00	0:00	4:48	7:12	7:12	7:12	9:36	0.4

Table D.2: Design hydrograph output from HEC - HMS for uniform lateral flow

Uniform							
Time	minutes	TR2	TR5	TR10	TR25	TR50	TR100
12:00	0:00	0:00	0:00	0:00	0:00	0:00	0
12:30	0:00	0:00	2:24	2:24	2:24	2:24	0.2
13:00	0:00	9:36	14:24	16:48	21:36	2:24	1.3
13:30	0:00	16:48	12:00	4:48	4:48	2:24	8.1
14:00	0:00	2:24	12:00	14:24	16:48	9:36	26.5
14:30	0:00	19:12	19:12	7:12	7:12	14:24	33.4
15:00	0:00	21:36	21:36	12:00	9:36	19:12	33.6
15:30	0:00	7:12	0:00	7:12	19:12	19:12	30.2
16:00	0:00	4:48	7:12	2:24	21:36	7:12	23.9
16:30	0:00	2:24	16:48	2:24	2:24	21:36	17.9
17:00	0:00	14:24	19:12	19:12	7:12	14:24	13
17:30	0:00	16:48	12:00	7:12	7:12	7:12	9.3
18:00	0:00	9:36	0:00	12:00	4:48	21:36	6.6
18:30	0:00	9:36	19:12	4:48	16:48	4:48	4.7
19:00	0:00	16:48	0:00	7:12	16:48	0:00	3.4
19:30	0:00	4:48	12:00	14:24	21:36	4:48	2.4
20:00	0:00	21:36	2:24	4:48	9:36	14:24	1.8
20:30	0:00	16:48	19:12	21:36	0:00	2:24	1.3
21:00	0:00	12:00	14:24	14:24	16:48	19:12	0.9
21:30	0:00	7:12	9:36	12:00	12:00	14:24	0.7
22:00	0:00	7:12	7:12	7:12	9:36	9:36	0.5
22:30	0:00	4:48	4:48	4:48	7:12	7:12	0.4
23:00	0:00	2:24	4:48	4:48	4:48	4:48	0.3
23:30	0:00	2:24	2:24	2:24	4:48	4:48	0.2
0:00	0:00	2:24	2:24	2:24	2:24	2:24	0.1
0:30	0:00	2:24	2:24	2:24	2:24	2:24	0.1
1:00	0:00	0:00	0:00	2:24	2:24	2:24	0.1
1:30	0:00	0:00	0:00	0:00	0:00	2:24	0.1
2:00	0:00	0:00	0:00	0:00	0:00	0:00	0
2:30	0:00	0:00	0:00	0:00	0:00	0:00	0
3:00	0:00	0:00	0:00	0:00	0:00	0:00	0
3:30	0:00	0:00	0:00	0:00	0:00	0:00	0
4:00	0:00	0:00	0:00	0:00	0:00	0:00	0
4:30	0:00	0:00	0:00	0:00	0:00	0:00	0
5:00	0:00	0:00	0:00	0:00	0:00	0:00	0
5:30	0:00	0:00	0:00	0:00	0:00	0:00	0
6:00	0:00	0:00	0:00	0:00	0:00	0:00	0

E HEC - RAS output

E.1 Upstream boundary condition

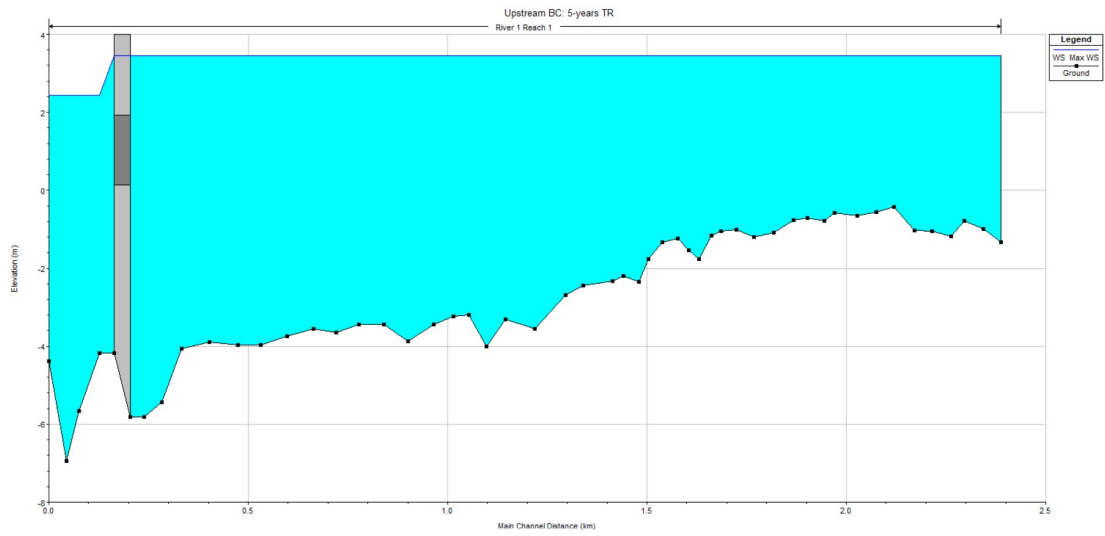


Figure E.1: Maximum water surface elevation output for an upstream boundary condition of 5-year return period hydrograph.

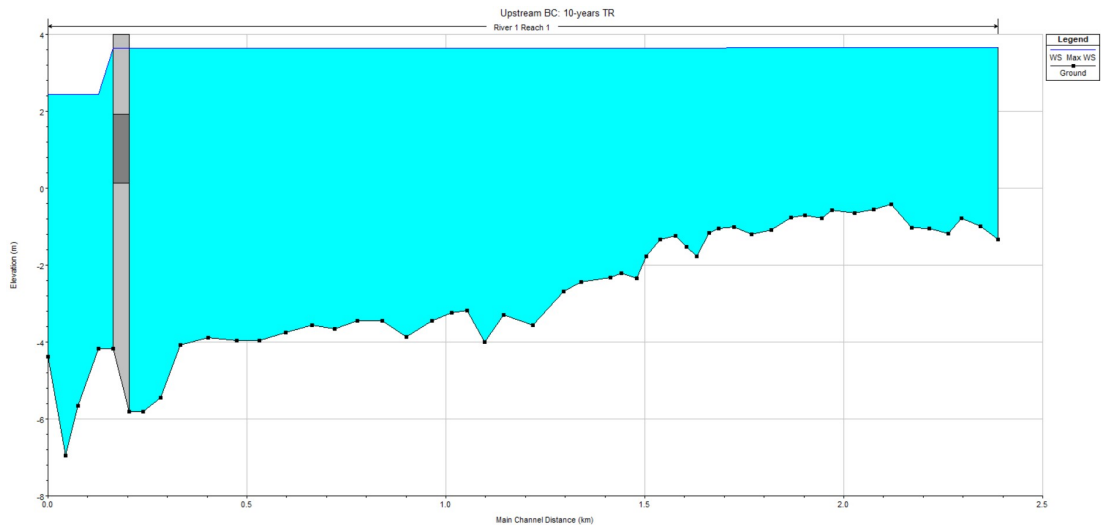


Figure E.2: Maximum water surface elevation output for a upstream boundary condition of 10-years return period hydrograph.

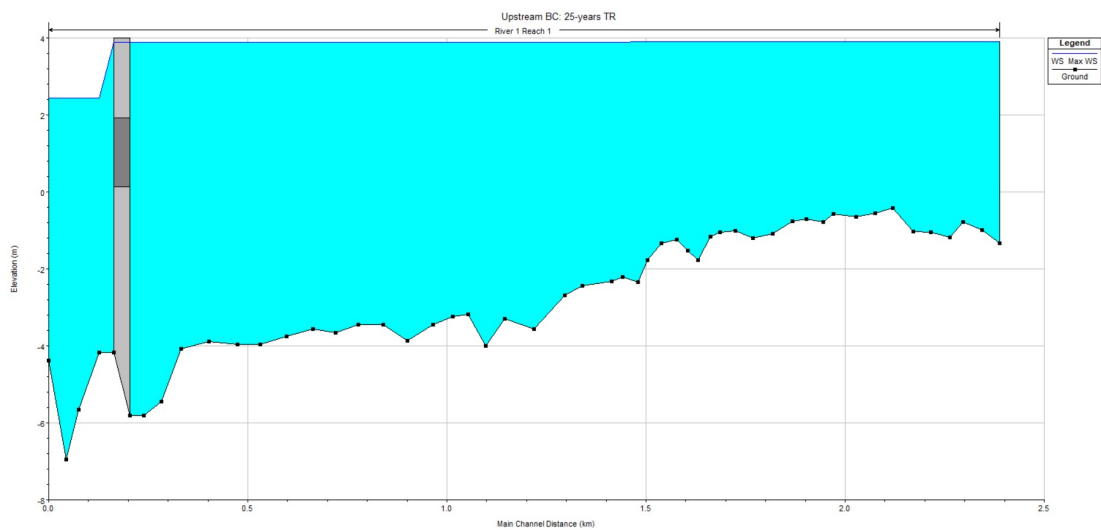


Figure E.3: Maximum water surface elevation output for a upstream boundary condition of 25-years return period hydrograph.

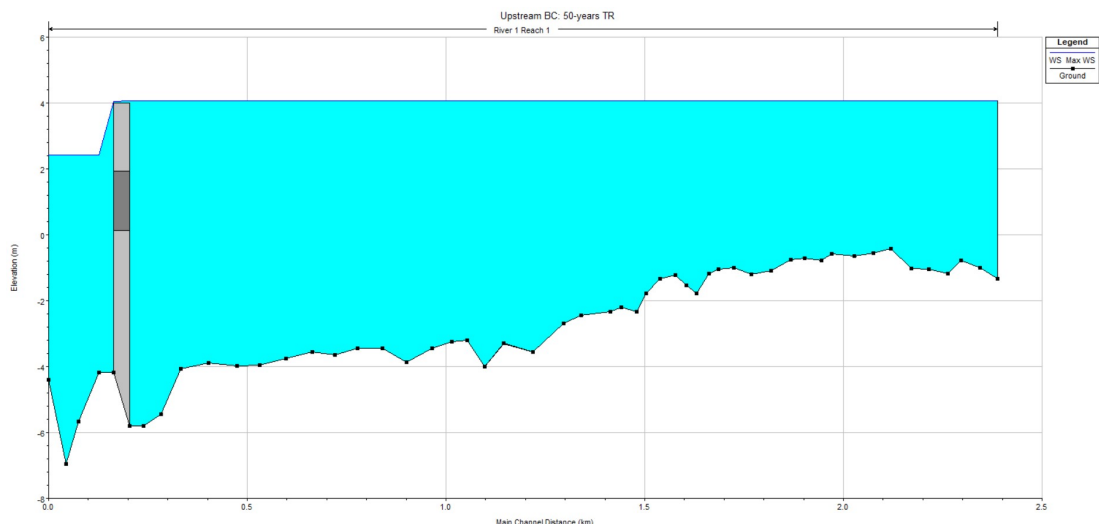


Figure E.4: Maximum water surface elevation output for a upstream boundary condition of 50-years return period hydrograph.

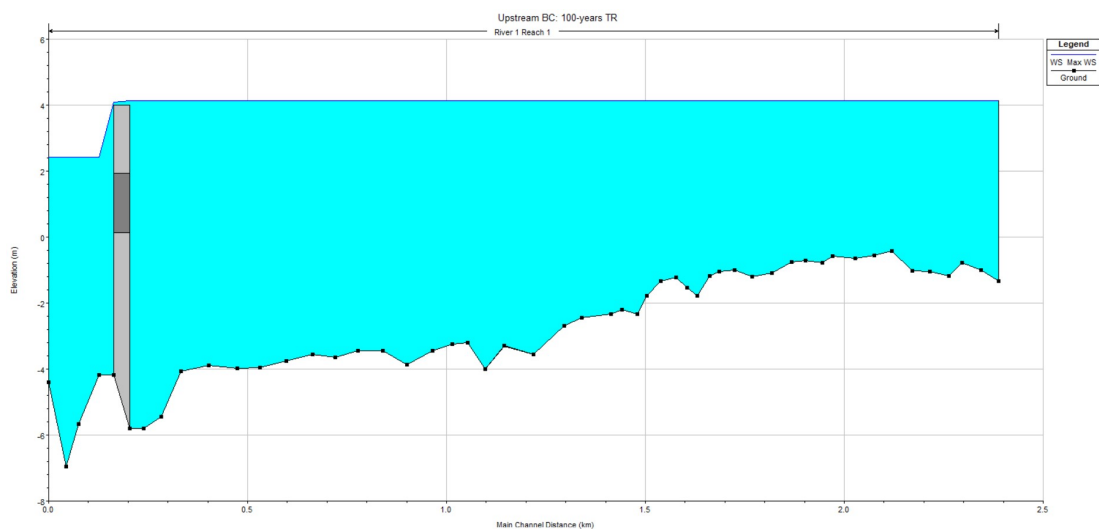


Figure E.5: Maximum water surface elevation output for a upstream boundary condition of 100-years return period hydrograph.

E.2 Hydraulic manning

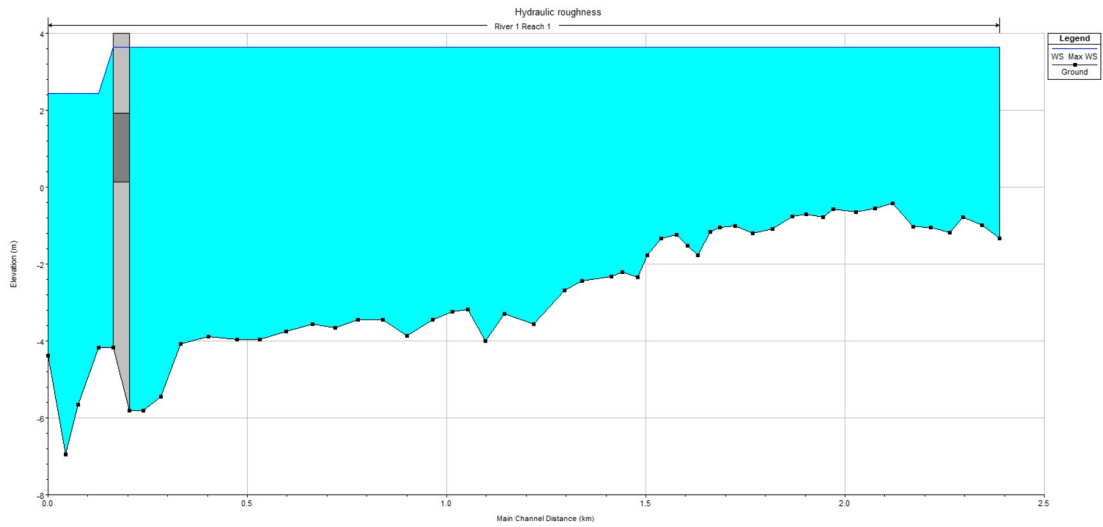


Figure E.6: Maximum water surface elevation output for a upstream boundary condition of ten-years return period hydrograph, main channel roughness = 0.044 and flood plain roughness = 0.096.

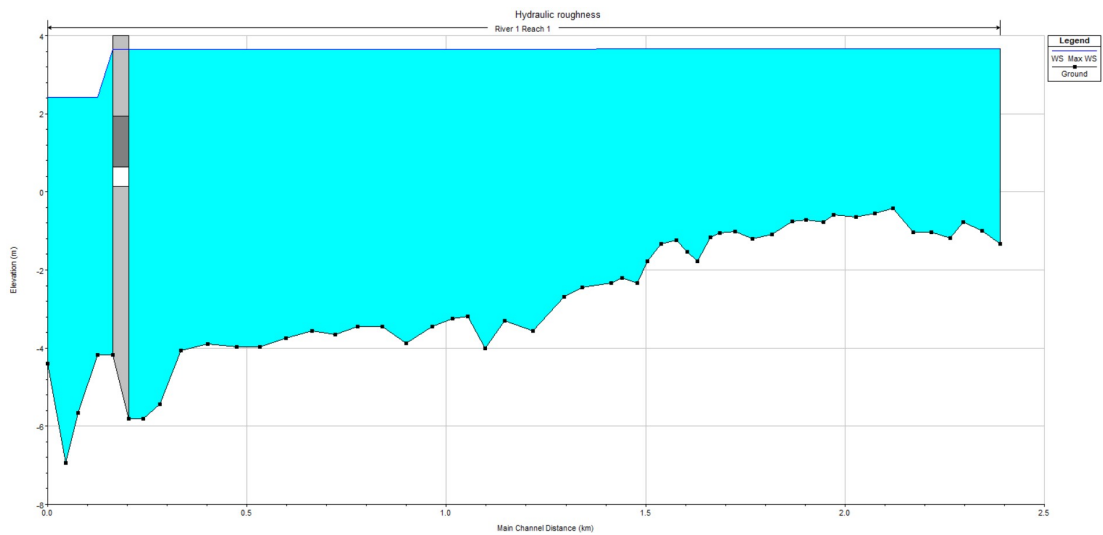


Figure E.7: Maximum water surface elevation output for a upstream boundary condition of ten-years return period hydrograph, main channel roughness = 0.066 and flood plain roughness = 0.144.

E.3 Time step

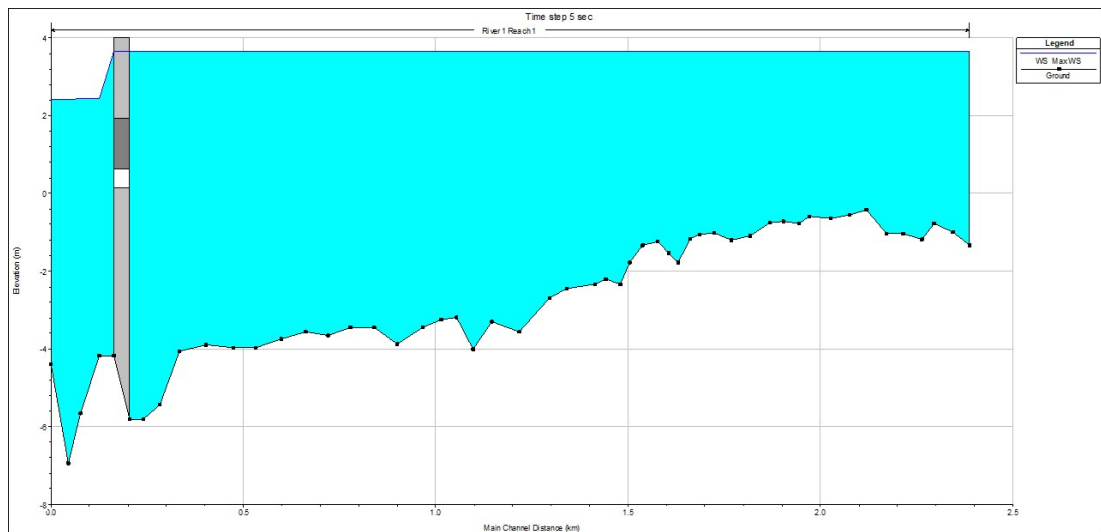


Figure E.8: Maximum water surface elevation output for a upstream boundary condition of ten-years return period hydrograph, main channel roughness = 0.066 and flood plain roughness = 0.144, and time step = 5 seconds.

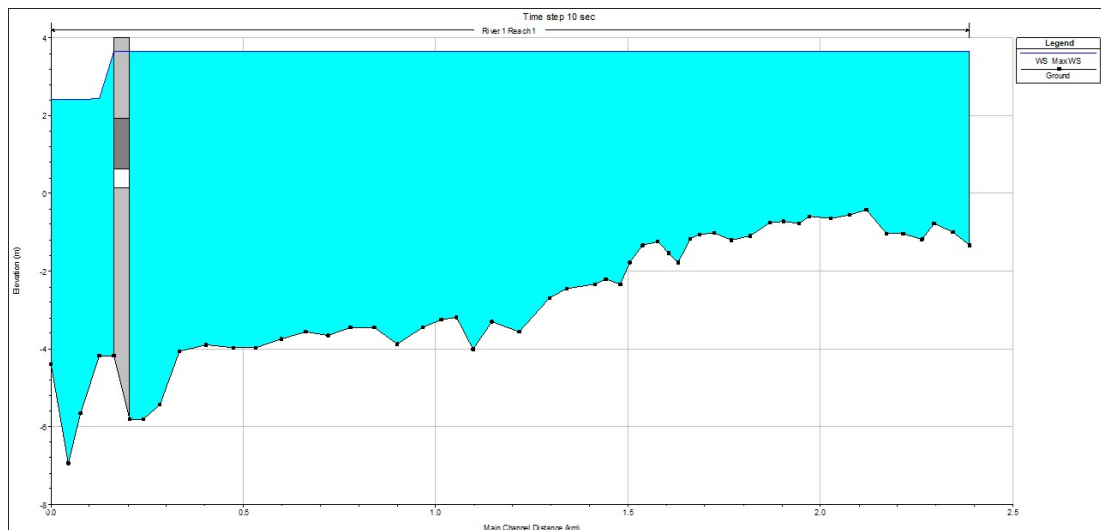


Figure E.9: Maximum water surface elevation output for a upstream boundary condition of ten-years return period hydrograph, main channel roughness = 0.066 and flood plain roughness = 0.144, and time step = 10 seconds.

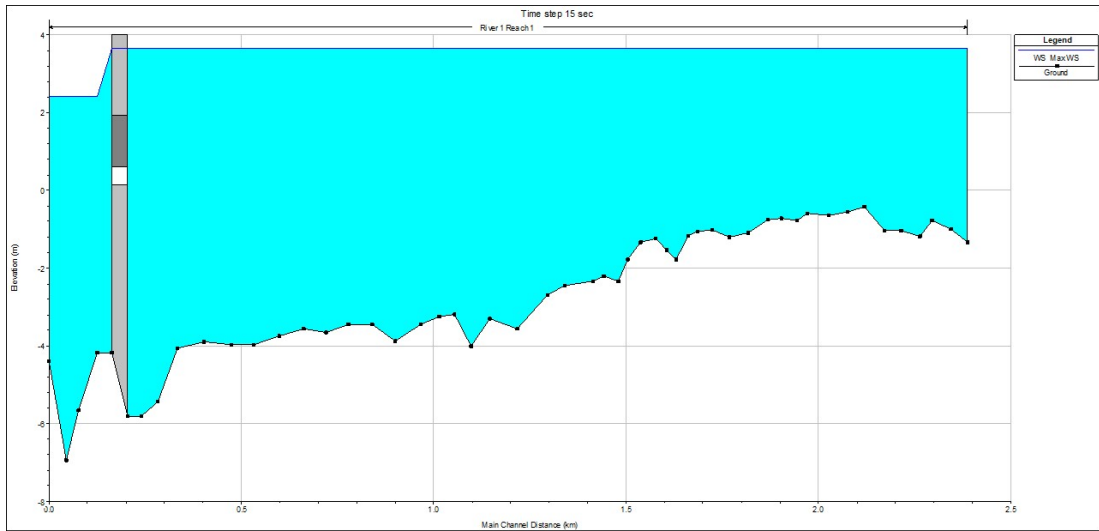


Figure E.10: Maximum water surface elevation output for a upstream boundary condition of ten-years return period hydrograph, main channel roughness = 0.066 and flood plain roughness = 0.144, and time step = 15 seconds.

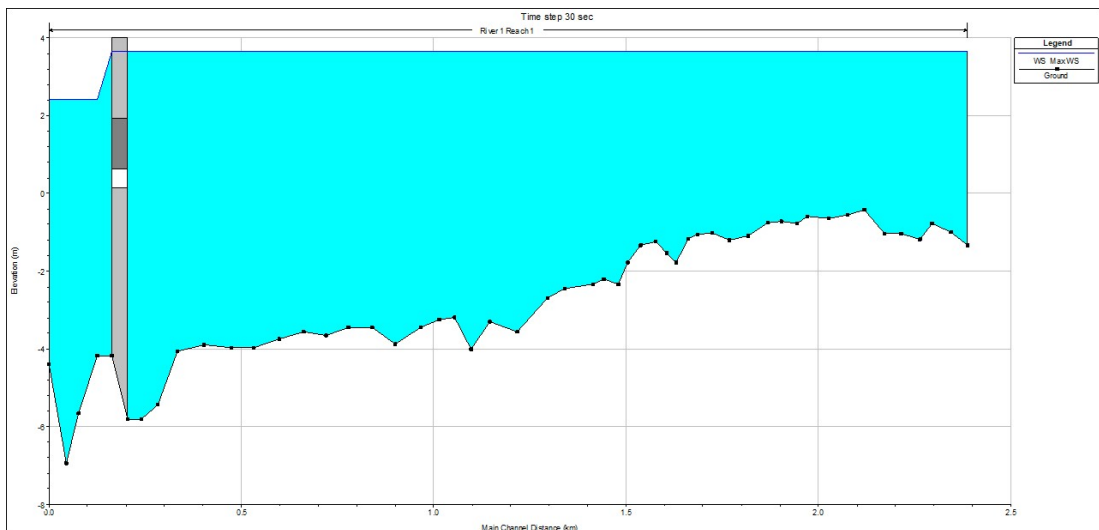


Figure E.11: Maximum water surface elevation output for a upstream boundary condition of ten-years return period hydrograph, main channel roughness = 0.066 and flood plain roughness = 0.144, and time step = 30 seconds.

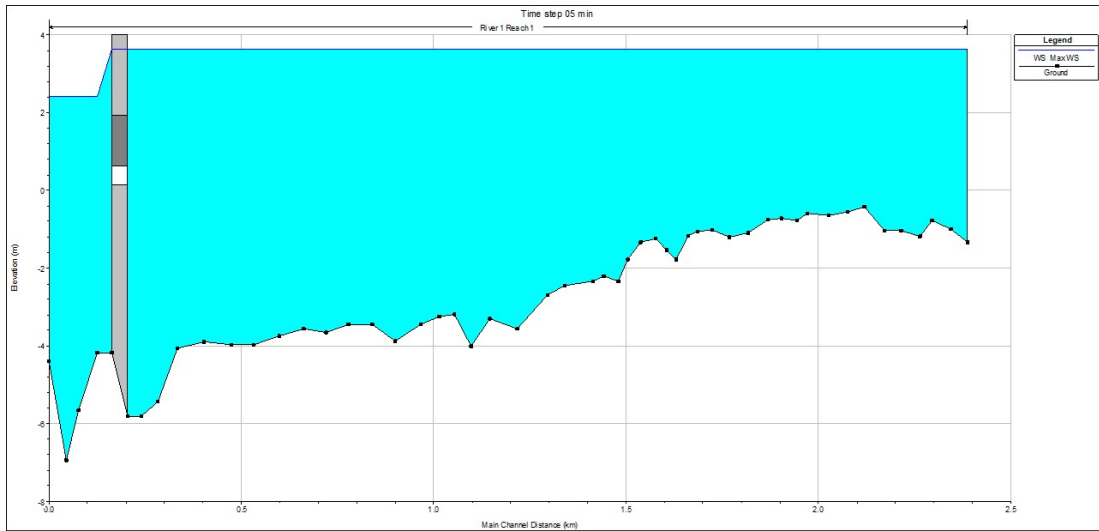


Figure E.12: Maximum water surface elevation output for a upstream boundary condition of ten-years return period hydrograph, main channel roughness = 0.066 and flood plain roughness = 0.144, and time step = 5 minutes.

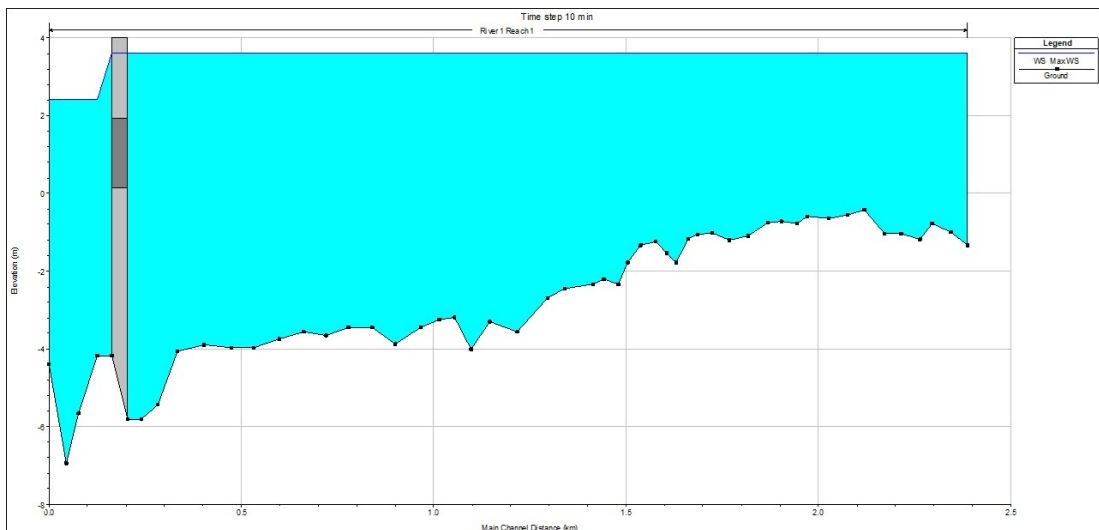


Figure E.13: Maximum water surface elevation output for a upstream boundary condition of ten-years return period hydrograph, main channel roughness = 0.066 and flood plain roughness = 0.144, and time step = 10 minutes.

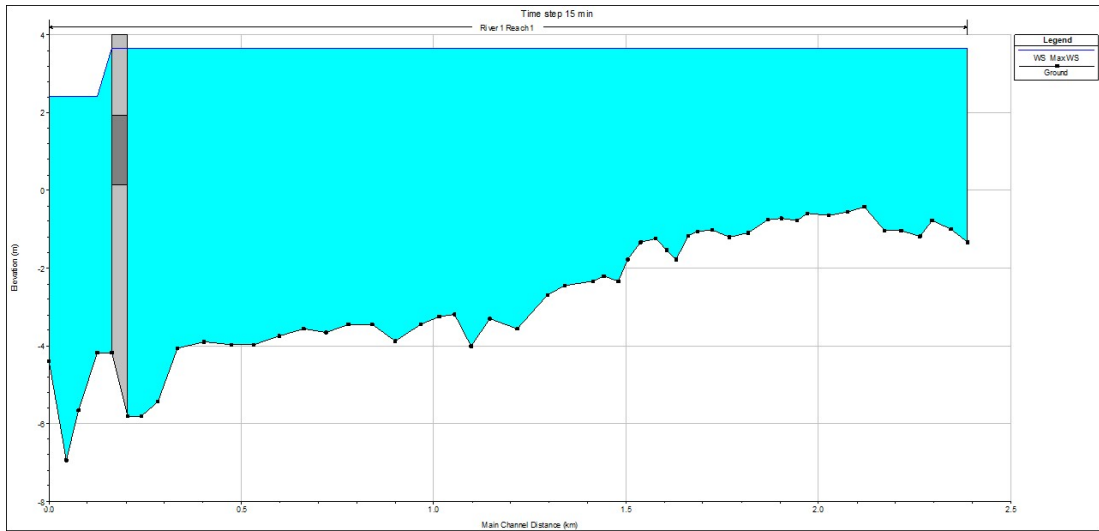


Figure E.14: Maximum water surface elevation output for a upstream boundary condition of ten-years return period hydrograph, main channel roughness = 0.066 and flood plain roughness = 0.144, and time step = 15 minutes.

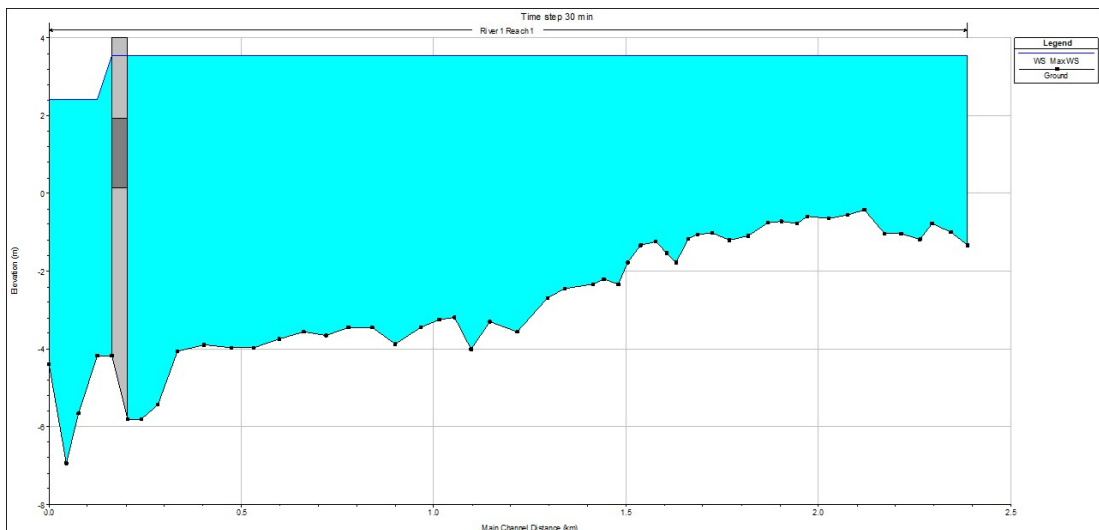


Figure E.15: Maximum water surface elevation output for a upstream boundary condition of ten-years return period hydrograph, main channel roughness = 0.066 and flood plain roughness = 0.144, and time step = 30 minutes.



Figure E.16: Maximum water surface elevation output for a upstream boundary condition of ten-years return period hydrograph, main channel roughness = 0.066 and flood plain roughness = 0.144, and time step = 5 seconds.



Figure E.17: Maximum water surface elevation output for a upstream boundary condition of ten-years return period hydrograph, main channel roughness = 0.066 and flood plain roughness = 0.144, and time step = 10 seconds.

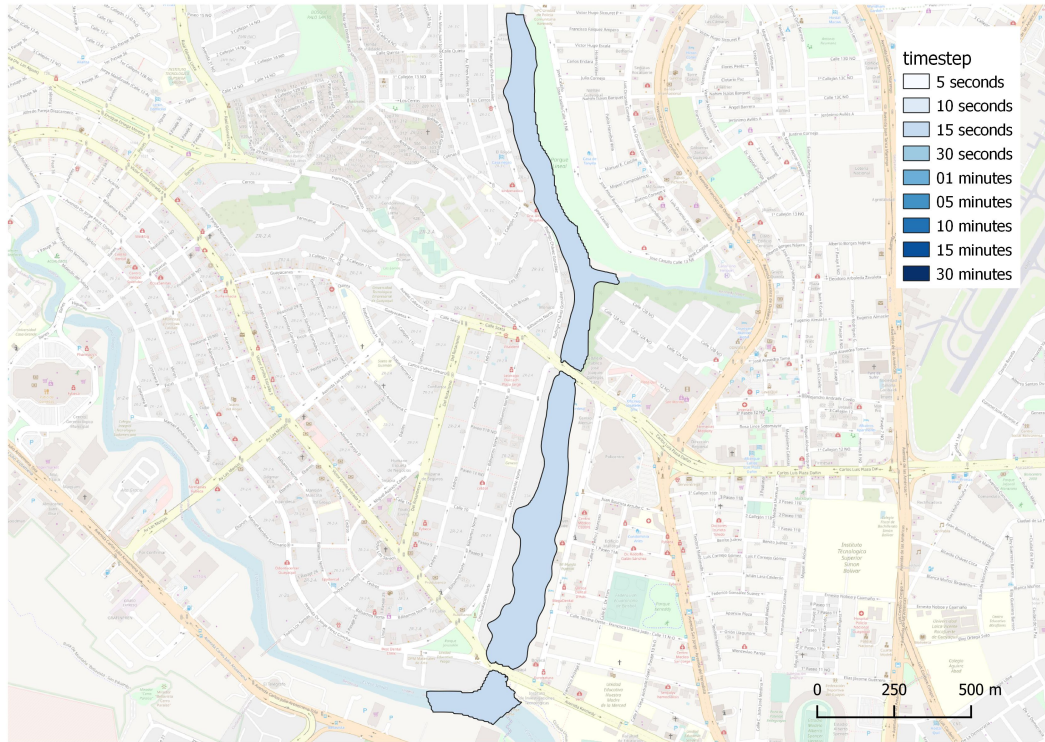


Figure E.18: Maximum water surface elevation output for a upstream boundary condition of ten-years return period hydrograph, main channel roughness = 0.066 and flood plain roughness = 0.144, and time step = 15 seconds.

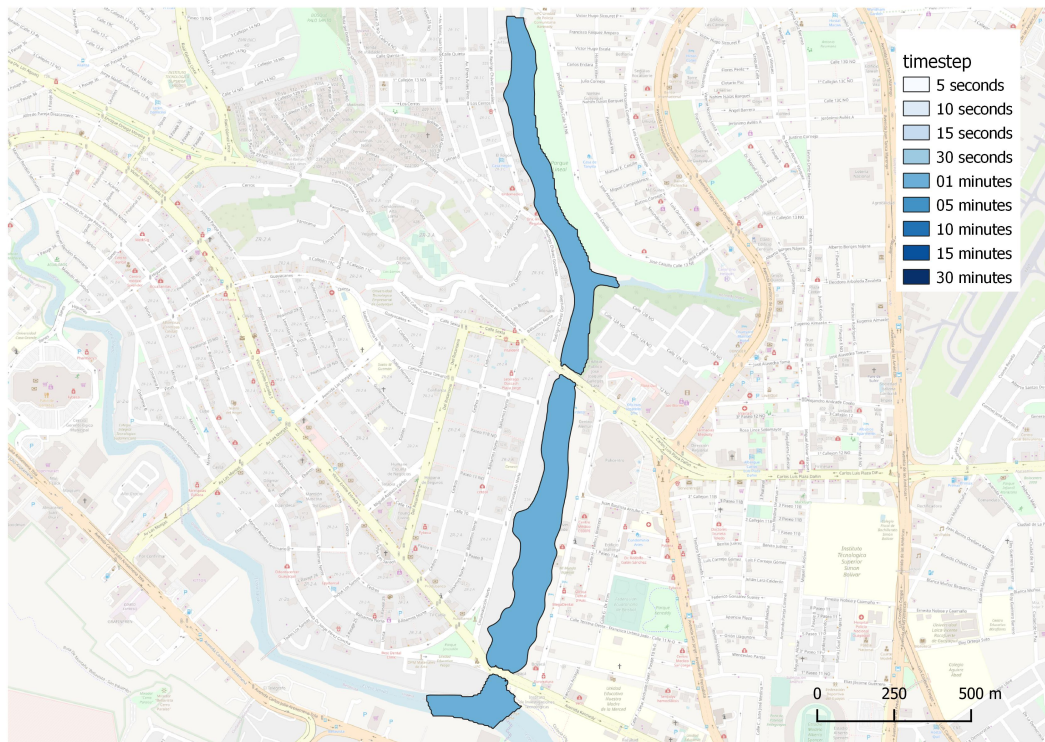


Figure E.19: Maximum water surface elevation output for a upstream boundary condition of ten-years return period hydrograph, main channel roughness = 0.066 and flood plain roughness = 0.144, and time step = 30 seconds.

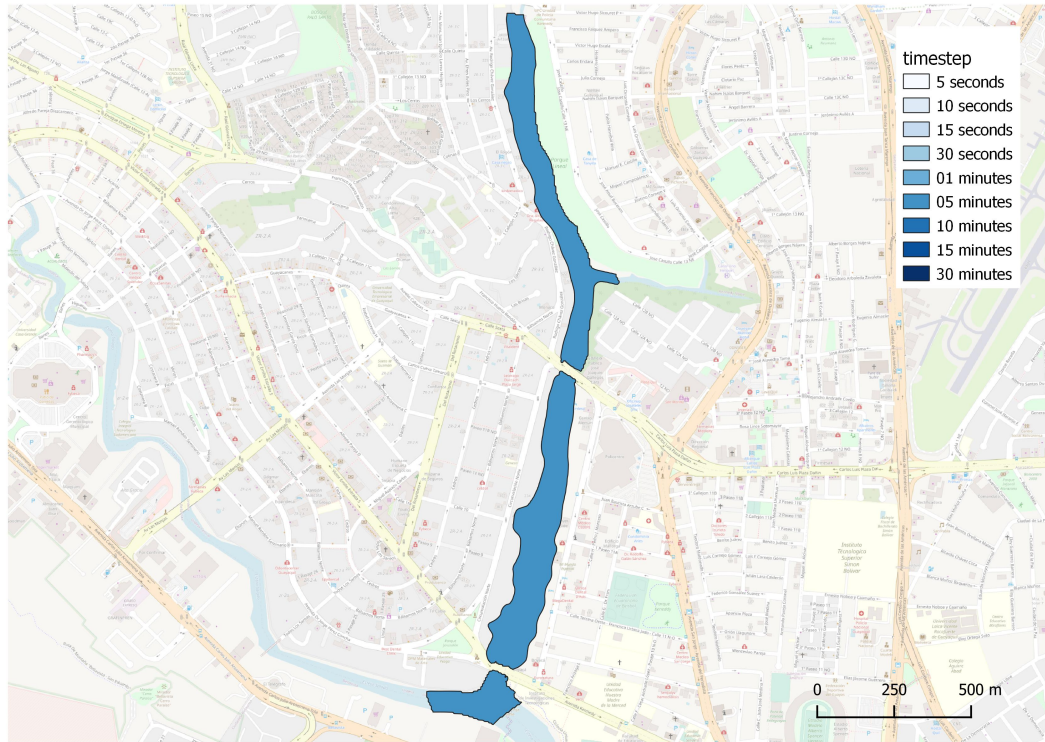


Figure E.20: Maximum water surface elevation output for a upstream boundary condition of ten-years return period hydrograph, main channel roughness = 0.066 and flood plain roughness = 0.144, and time step = 5 minutes.



Figure E.21: Maximum water surface elevation output for a upstream boundary condition of ten-years return period hydrograph, main channel roughness = 0.066 and flood plain roughness = 0.144, and time step = 10 minutes.

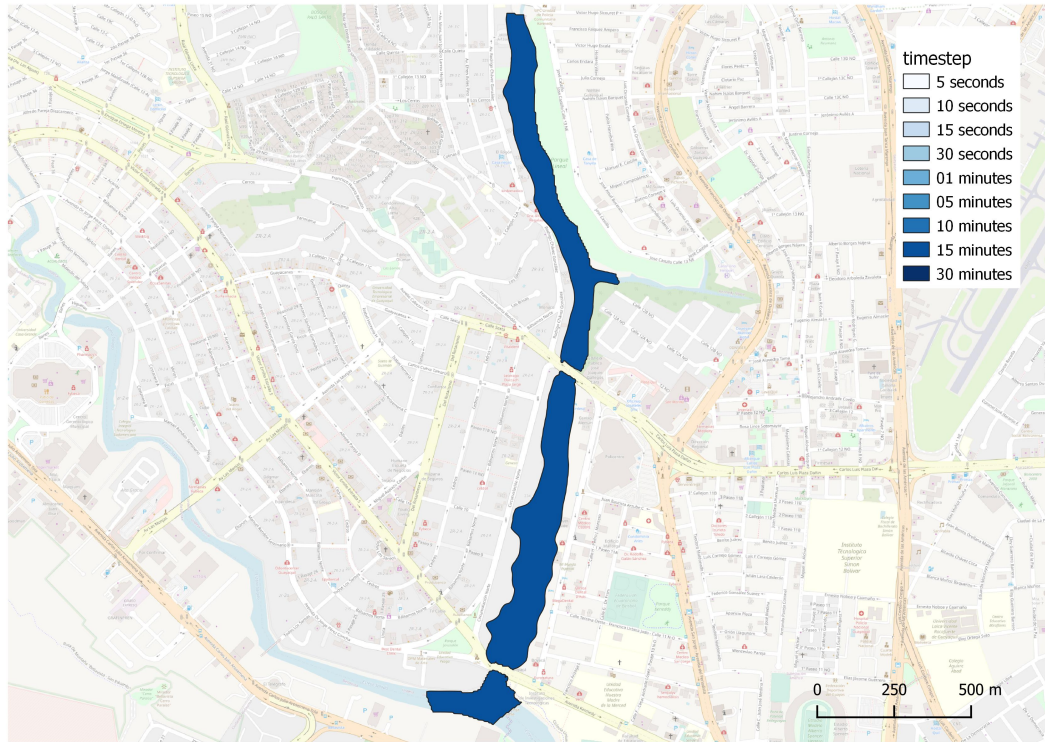


Figure E.22: Maximum water surface elevation output for a upstream boundary condition of ten-years return period hydrograph, main channel roughness = 0.066 and flood plain roughness = 0.144, and time step = 15 minutes.

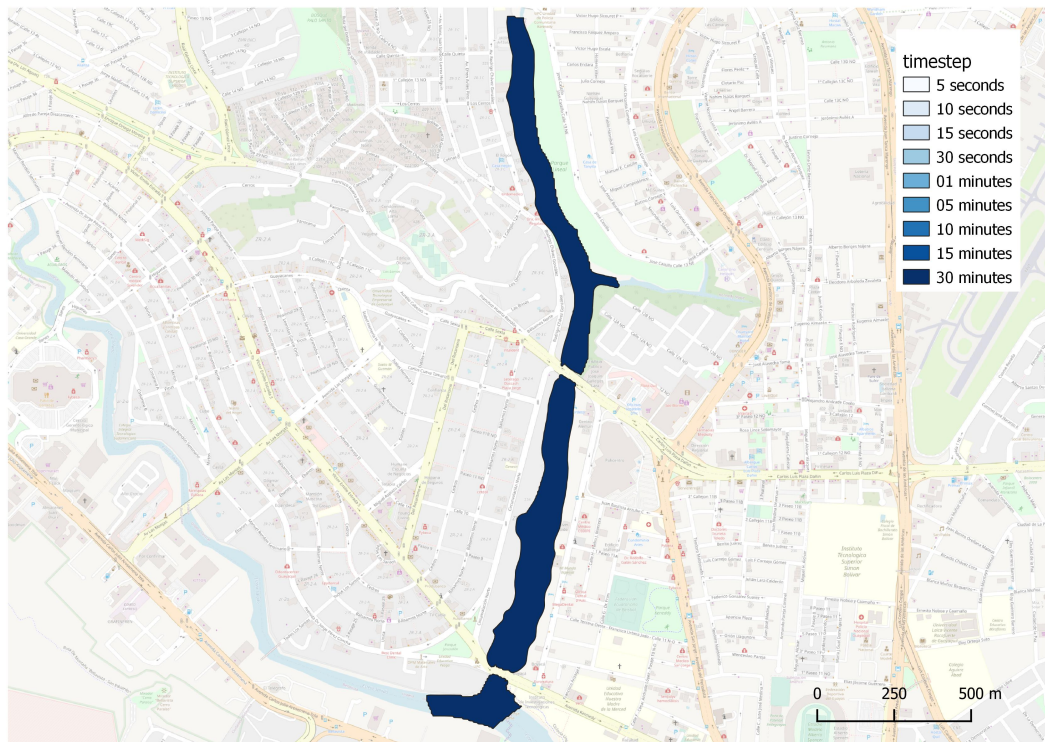


Figure E.23: Maximum water surface elevation output for a upstream boundary condition of ten-years return period hydrograph, main channel roughness = 0.066 and flood plain roughness = 0.144, and time step = 30 minutes.