6. MODELING RESULTS

Stable RUNOFF and EXTRAN runs were obtained for all modeling scenarios, with EXTRAN continuity errors well below two percent in each case.

Milldam Creek is a low-lying watershed that incurs frequent street flooding in many locations. Figures 6-1 and 6-2 depict street and property flooding volumes for the 50-year design storm event as modeled for this study. The circular orange symbols in these figures indicate problem areas in the watershed models. The symbols are not drawn to any scale, but they are proportional. It is easy to see that the most significant existing flooding problems are along the drainageway under Military Highway and Campostella Road. Roadway and property flooding in these areas is known to occur frequently, and the previous Master Drainage Plan study in 1986 recommended significant improvements at these locations.

As shown in Figures 6-1 and 6-2, there are several areas where the SWMM models indicate property and ditch flooding will occur for the 50-year design storm, most notably along the Norfolk Southern railroad tracks, in the neighborhoods southwest of the Portlock area along Bainbridge Boulevard, and at the Hess industrial site at the Elizabeth River. Although the models indicate that flooding will occur in these areas, there is not a lot of complaint history to justify making Master Drainage Plan improvements at these locations. In many locations, such as at the Hess site and along the railroad right-of-way, flooding merely creates temporary surface ponding on low-lying ground that does not cause any real problem. If the City decides that flooding complaints and/or other issues warrant large-scale improvements, these models can easily be used to design the improvements.

It is important to bear in mind that a 50-year design storm event is an extreme event, and that most drainage systems are not required to accommodate 50-year return periods.

All of the models run for this study assume that the drainage system is maintained in sound working condition. Often flooding complaints—particularly those in residential neighborhoods—result from maintenance conditions such as a clogged pipe. In considering whether or not large-scale drainage improvements might be required at a given location, the model results should indicate a flooding problem *and* there should be some flooding history to support the need for improvements. If both of these conditions are not met, then either the system maintenance should be reviewed or the computer models should be carefully checked.

These SWMM models are prepared knowing that many future changes will be made to the data files. The SWMM output files contain a great deal of meaningful engineering data that is too voluminous to summarize in the body of this document. However, Sections 6.1 and 6.2 contain tables that summarize the existing and future condition hydraulic grade line elevations throughout the Milldam Creek watershed, at the time this study was completed. It is anticipated that these models will undergo frequent changes, so the City of Chesapeake Department of Public Works should be consulted to obtain the latest version of these models.

It is also important to understand when reviewing these results that there are several low-lying structures in this watershed that have finished floor elevations below the hydraulic grade lines computed in the SWMM models. In order to estimate whether or not a particular structure will be subject to flooding for a given design condition, the maximum hydraulic grade line elevation at that location should be checked against the finished floor elevation. An example of this situation can be found at Bainbridge Boulevard over Milldam Creek—where ground elevations at certain structures are as much as one foot below the starting water surface elevation used in the models.

The FEMA flood insurance models are the definitive source of floodplain limits and elevations in all cases. The City's SWMM models are design scenarios based on 2-, 5-, 25- and 50-year rainfall events—THEY ARE NOT TO BE CONSTRUED AS INDICATIVE OF EXPECTED WATER SURFACE ELEVATIONS FOR THE PURPOSE OF FLOODPLAIN MANAGEMENT AND/OR INSURANCE REQUIREMENTS.

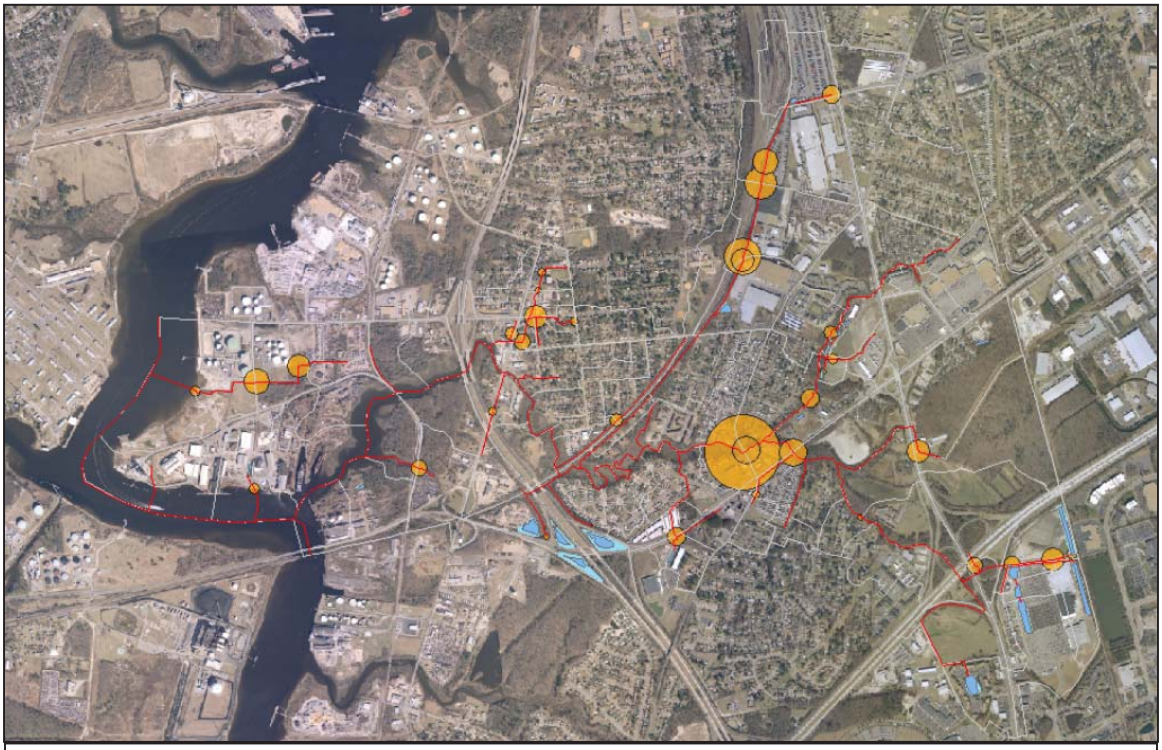

Figure 6-1. Existing (2003) Conditions Significant 50-year Flooding

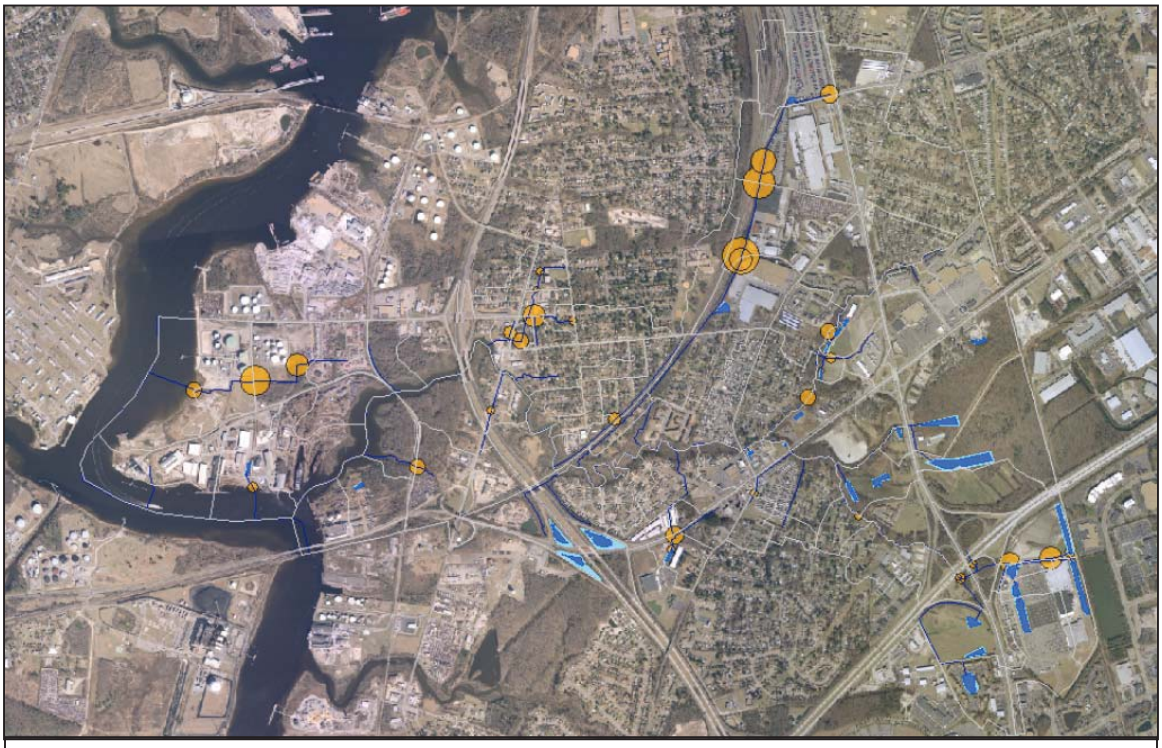

Figure 6-2. Future Conditions Significant 50-year Flooding (Shown On 2002 Aerial Imagery)

6.1 Existing (2003) Conditions Maximum Water Surface Elevations

Table 6-1. Existing (2003) Conditions, Maximum Computed Water Surface Elevations

	Maximum Junction Elevation (FT, NAVD88)				
Junction Number	2-yr	5-yr	10-yr	25-yr	50-yr
100	3.55	3.55	3.55	3.55	3.55
110	3.55	3.55	3.56	3.56	3.56
120	3.56	3.56	3.56	3.56	3.57
130	3.56	3.57	3.58	3.58	3.58
140	3.57	3.58	3.59	3.59	3.60
150	3.57	3.59	3.59	3.60	3.61
160	3.58	3.59	3.60	3.60	3.61
170	3.58	3.60	3.61	3.62	3.63
180	3.59	3.61	3.62	3.63	3.64
190	3.59	3.61	3.62	3.63	3.64
200	3.60	3.62	3.63	3.64	3.66
210	3.60	3.62	3.63	3.65	3.66
220	3.61	3.64	3.65	3.67	3.70
230	3.62	3.66	3.67	3.70	3.73
240	3.62	3.66	3.68	3.71	3.74
245	3.63	3.68	3.71	3.74	3.77
250	3.66	3.72	3.76	3.80	3.85
260	3.67	3.75	3.79	3.84	3.90
270	3.69	3.78	3.83	3.89	3.95
280	3.70	3.80	3.86	3.92	3.99
290	3.71	3.81	3.87	3.94	4.01
300	3.73	3.85	3.92	4.00	4.09
310	3.76	3.89	3.97	4.05	4.15
320	3.82	3.96	4.04	4.14	4.24
325	3.94	4.11	4.20	4.30	4.41
327	4.08	4.23	4.32	4.41	4.51
330	4.17	4.30	4.38	4.47	4.56
340	5.50	5.50	5.50	5.50	5.50
350	5.85	6.00	6.00	6.00	6.00
360	5.89	6.33	6.41	6.43	6.46
370	6.45	7.85	8.00	8.00	8.00
380	6.46	7.87	8.00	8.00	8.00
390	6.51	7.65	8.13	8.29	8.40
400	8.03	8.41	8.74	8.94	9.10
410	12.88	13.63	14.08	14.95	15.00
420	13.27	14.87	16.95	18.19	18.58
430	13.51	14.95	15.79	16.77	17.25
440	15.20	15.85	16.35	17.32	18.03
450	15.20	15.85	16.36	17.30	18.03
460	15.64	16.41	16.84	19.09	18.97
470	15.67	16.44	16.86	18.00	18.00
480	15.78	16.56	16.96	18.00	18.00

Table 6-1. Existing (2003) Conditions, Maximum Computed Water Surface Elevations					
	Maximum Junction Elevation (FT, NAVD88)				
Junction Number	2-yr	5-yr	10-yr	25-yr	50-yr
490	15.94	16.77	17.17	17.74	18.38
500	16.02	16.83	17.23	17.78	18.55
510	16.05	16.86	17.25	17.78	18.29
520	16.05	16.86	17.25	17.78	18.29
530	16.06	16.86	17.26	17.79	18.29
535	16.06	16.86	17.25	17.78	18.04
539	16.06	16.86	17.25	17.78	18.00
540	14.17	15.23	15.84	16.47	16.83
550	14.17	15.23	15.84	16.47	16.83
552	16.21	17.07	17.44	17.76	18.10
555	16.27	17.16	17.35	17.45	17.63
560	3.57	3.58	3.58	3.59	3.59
570	5.20	5.62	5.92	6.58	7.00
580	3.58	3.59	3.60	3.60	3.62
590	4.49	5.30	5.30	5.30	5.30
600	3.56	3.56	3.56	3.56	3.56
610	6.50	6.50	6.50	6.50	6.50
620	6.50	6.50	6.50	6.50	6.50
630	6.50	6.50	6.50	6.50	6.50
640	7.00	7.00	7.00	7.00	7.00
650	3.76	3.76	3.76	3.76	3.76
660	3.77	3.77	3.77	3.77	3.77
670	3.59	3.62	3.62	3.62	3.64
680	3.87	4.02	4.03	3.94	4.05
690	4.49	4.70	4.70	4.70	4.70
700	3.66	3.71	3.74	3.78	3.82
705	3.70	3.75	3.78	3.81	3.84
710	3.80	3.83	3.85	3.88	3.90
720	4.00	4.00	4.00	4.00	4.00
730	4.39	4.52	4.58	4.63	4.67
740	4.54	4.72	4.80	4.87	4.92
750	4.58	4.73	4.80	4.84	4.90
760	4.80	4.80	4.80	4.80	4.80
770	6.80	6.80	6.80	6.80	6.80
780	6.50	6.50	6.50	6.50	6.50
790	8.90	8.90	8.90	8.90	8.90
800	9.00	9.00	9.00	9.00	9.00
810	3.76	3.89	3.97	4.06	4.15
820	3.77	3.93	4.03	4.14	4.26
830	4.81	5.21	5.42	5.65	5.90
840	10.04	10.78	11.20	11.65	12.00
850	10.28	10.61	10.85	11.10	11.30
860	16.50	16.50	16.50	16.50	16.50
870	4.17	4.48	4.63	4.78	4.95

Table 6-1. Existing (2003) Conditions, Maximum Computed Water Surface Elevations					
	Maximum Junction Elevation (FT, NAVD88)				
Junction Number	2-yr	5-yr	10-yr	25-yr	50-yr
880	5.35	6.05	6.36	6.66	7.03
890	10.41	10.92	11.15	11.37	11.60
900	12.67	13.16	13.37	13.60	13.96
910	12.82	13.28	13.48	13.68	14.03
920	13.28	13.55	13.69	13.81	13.94
930	13.59	13.72	13.80	13.87	13.96
940	14.00	14.00	14.00	14.00	14.00
950	15.50	15.50	15.50	15.50	15.50
960	16.00	16.00	16.00	16.00	16.00
970	16.50	16.50	16.50	16.50	16.50
980	17.00	17.00	17.00	17.00	17.00
990	17.30	17.73	18.00	18.00	18.00
1000	14.66	16.00	16.00	16.00	16.00
1010	10.02	10.02	10.02	10.02	10.02
1020	6.37	7.94	8.00	8.00	8.00
1030	6.47	8.00	8.00	8.00	8.00
1040	6.87	8.80	8.80	8.80	8.80
1050	7.36	10.20	10.20	10.20	10.20
1060	8.79	9.61	10.50	10.50	10.50
1070	8.80	9.62	10.35	10.64	10.69
1080	10.86	11.07	11.32	11.53	11.54
1090	14.00	14.00	14.00	14.00	14.00
1110	13.32	13.70	13.97	14.00	14.00
1120	11.34	11.69	11.86	12.05	12.23
1140	10.23	10.83	11.07	11.29	11.50
1150	10.68	11.33	11.60	11.87	12.13
1160	11.24	11.96	12.34	12.77	13.30
1170	16.67	16.67	16.67	16.67	16.67
1180	18.00	18.00	18.00	18.00	18.00
1190	15.89	16.55	16.92	17.64	18.17
1200	15.92	16.58	16.93	17.60	18.18
1210	15.95	16.60	16.93	17.73	18.20
1220	15.96	16.61	16.94	17.67	18.23
1230	17.84	20.00	20.00	19.45	20.00
1240	18.74	20.00	20.00	20.00	20.00
1250	16.18	17.09	17.55	18.05	18.60
1260	16.21	17.13	17.61	18.15	18.73
1270	16.22	17.16	17.64	18.19	18.79
1290	3.69	3.82	3.90	4.00	4.12
1300	6.88	8.61	8.70	8.73	8.80
1310	6.88	8.56	8.69	8.73	8.80
1320	6.96	8.80	8.80	8.80	8.80
1330	10.27	10.55	10.70	10.85	11.00
1340	15.09	15.39	15.55	15.70	15.85

Table 6-1. Existing (2003) Conditions, Maximum Computed Water Surface Elevations					
	Maximum Junction Elevation (FT, NAVD88)				
Junction Number	2-yr	5-yr	10-yr	25-yr	50-yr
1350	6.90	8.01	8.48	8.74	8.88
1360	6.94	8.02	8.56	8.96	9.35
1370	7.68	8.03	8.58	9.00	9.42
1390	6.92	8.04	8.59	8.85	9.03
1400	11.30	11.64	11.85	12.00	12.00
1410	14.17	15.23	15.84	16.47	16.83
1420	16.46	17.12	17.26	17.26	17.26
1430	14.17	15.22	15.83	16.47	16.83
1440	8.25	9.00	9.00	9.00	9.00
1450	17.91	18.35	18.60	18.86	19.70
1460	3.78	3.97	4.09	4.23	4.39
1470	4.09	4.42	4.65	4.89	5.13
1480	8.04	8.63	8.95	9.32	9.71
1490	8.08	8.67	9.01	9.38	9.82
1500	11.80	11.80	11.80	11.80	11.80
1510	5.10	5.10	5.10	5.10	5.11
1520	5.48	5.49	5.49	5.49	5.49
1530	8.20	8.20	8.20	8.20	8.20
1540	13.20	12.02	12.12	12.14	12.14
1550	13.58	12.98	13.01	13.03	13.03
1560	13.80	13.80	13.80	13.80	13.80
1570	3.77	3.82	3.85	3.88	3.89
1580	3.80	3.84	3.87	3.90	3.90
1590	6.00	6.00	6.00	6.00	6.00
1600	17.55	17.80	17.94	18.16	20.00
1610	17.67	18.06	18.27	18.55	19.84
1620	18.32	19.20	19.72	20.31	20.96
1630	8.15	8.74	9.06	9.43	9.87

6.2 Future Conditions Maximum Water Surface Elevations

Table 6-2. Future Conditions, Maximum Computed Water Surface Elevations					
	Maximum Junction Elevation (FT, NAVD88)				
Junction Number	2-yr	5-yr	10-yr	25-yr	50-yr
100	3.55	3.55	3.55	3.55	3.55
110	3.55	3.55	3.56	3.56	3.56
120	3.56	3.56	3.56	3.56	3.57
130	3.56	3.57	3.58	3.58	3.59
140	3.57	3.58	3.59	3.60	3.60
150	3.57	3.59	3.59	3.60	3.61
160	3.58	3.59	3.60	3.60	3.61

Table 6-2. Future Conditions, Maximum Computed Water Surface Elevations					
	Maximum Junction Elevation (FT, NAVD88)				
Junction Number	2-yr	5-yr	10-yr	25-yr	50-yr
170	3.58	3.60	3.61	3.62	3.63
180	3.59	3.61	3.62	3.63	3.65
190	3.59	3.61	3.62	3.63	3.65
200	3.60	3.62	3.63	3.65	3.67
210	3.60	3.62	3.63	3.65	3.67
220	3.61	3.64	3.66	3.68	3.71
230	3.62	3.66	3.68	3.71	3.74
240	3.63	3.67	3.69	3.73	3.76
245	3.64	3.70	3.74	3.78	3.82
250	3.68	3.79	3.85	3.92	4.00
260	3.71	3.84	3.92	4.00	4.09
270	3.75	3.91	4.00	4.10	4.20
280	3.77	3.95	4.05	4.16	4.28
290	3.79	3.99	4.11	4.22	4.35
300	3.88	4.16	4.33	4.50	4.69
310	3.93	4.26	4.45	4.63	4.83
320	4.04	4.41	4.61	4.80	5.00
325	4.27	4.75	4.99	5.21	5.41
327	4.53	5.07	5.32	5.55	5.74
330	4.70	5.29	5.56	5.81	5.99
340	4.70	5.29	5.56	6.11	6.14
350	4.84	5.49	5.78	6.05	6.28
360	5.00	5.70	6.00	6.27	6.53
370	5.36	6.31	6.77	7.19	7.86
380	5.39	6.34	6.79	7.22	7.93
390	5.79	6.64	7.05	7.43	7.81
400	8.22	8.68	8.90	9.00	9.01
410	13.05	13.83	14.67	15.00	15.00
420	13.46	15.31	18.24	18.50	18.51
430	13.67	15.36	16.48	17.18	17.45
440	15.24	16.06	16.90	18.26	19.21
450	15.25	16.06	16.90	18.26	19.21
460	15.72	16.59	17.27	17.99	18.00
470	15.75	16.62	17.28	18.00	18.00
480	15.81	16.68	17.30	18.00	18.00
490	15.90	16.80	17.36	18.11	18.37
500	15.99	16.86	17.41	18.33	18.36
510	16.02	16.88	17.44	18.19	18.38
520	16.02	16.88	17.44	18.19	18.38
530	16.03	16.89	17.44	18.20	18.39
535	16.03	16.88	17.44	18.03	18.05
539	16.03	16.88	17.44	18.00	18.00
540	14.17	15.23	15.85	16.48	16.83
550	14.17	15.23	15.85	16.48	16.83

Table 6-2. Future Conditions, Maximum Computed Water Surface Elevations					
	Maximum Junction Elevation (FT, NAVD88)				
Junction Number	2-yr	5-yr	10-yr	25-yr	50-yr
552	16.18	17.09	17.50	17.87	18.13
555	16.24	17.17	17.35	17.45	17.63
560	3.57	3.58	3.58	3.59	3.59
570	5.20	5.62	5.92	6.59	7.00
580	3.58	3.59	3.61	3.60	3.62
590	4.49	5.30	5.30	5.30	5.30
600	3.56	3.56	3.56	3.56	3.56
610	6.50	6.50	6.50	6.50	6.50
620	6.50	6.50	6.50	6.50	6.50
630	6.50	6.50	6.50	6.50	6.50
640	7.00	7.00	7.00	7.00	7.00
650	3.76	3.76	3.76	3.76	3.76
660	3.77	3.77	3.77	3.77	3.77
670	3.59	3.62	3.62	3.62	3.64
680	3.87	4.02	4.01	3.94	4.05
690	4.49	4.70	4.70	4.70	4.70
700	3.66	3.72	3.75	3.79	3.83
705	3.70	3.75	3.78	3.82	3.85
710	3.80	3.84	3.86	3.88	3.90
720	4.00	4.00	4.00	4.00	4.00
730	4.39	4.52	4.58	4.63	4.67
740	4.54	4.72	4.80	4.87	4.92
750	4.58	4.73	4.80	4.85	4.90
760	4.80	4.80	4.80	4.80	4.80
770	6.80	6.80	6.80	6.80	6.80
780	6.50	6.50	6.50	6.50	6.50
790	8.90	8.90	8.90	8.90	8.90
800	9.00	9.00	9.00	9.00	9.00
810	3.93	4.26	4.45	4.63	4.90
820	3.94	4.28	4.46	4.65	4.85
830	5.09	5.55	5.78	6.03	6.28
840	9.85	10.44	10.81	11.22	11.66
850	10.28	10.61	10.85	11.11	11.30
860	16.50	16.50	16.50	16.50	16.50
870	4.24	4.58	4.75	4.93	5.11
880	5.35	6.05	6.36	6.66	7.03
890	10.41	10.92	11.15	11.37	11.60
900	12.67	13.16	13.37	13.60	14.00
910	12.82	13.28	13.48	13.68	14.04
920	13.28	13.55	13.69	13.81	13.95
930	13.59	13.72	13.80	13.87	13.96
940	14.00	14.00	14.00	14.00	14.00
950	15.50	15.50	15.50	15.50	15.50
960	16.00	16.00	16.00	16.00	16.00

Table 6-2. Future Conditions, Maximum Computed Water Surface Elevations					
	Maximum Junction Elevation (FT, NAVD88)				
Junction Number	2-yr	5-yr	10-yr	25-yr	50-yr
970	16.50	16.50	16.50	16.50	16.50
980	17.00	17.00	17.00	17.00	17.00
990	17.30	17.73	18.00	18.00	18.00
1000	14.66	16.00	16.00	16.00	16.00
1010	10.02	10.02	10.02	10.02	10.02
1020	5.71	7.88	8.00	7.98	8.00
1030	5.89	7.56	8.00	8.00	8.00
1040	6.68	8.23	8.80	8.80	8.80
1050	7.38	8.96	10.20	10.20	10.20
1060	8.91	9.66	10.50	10.50	10.50
1070	8.92	9.67	10.56	10.63	10.73
1080	10.86	11.07	11.43	11.53	11.54
1090	14.00	14.00	14.00	14.00	14.00
1110	13.32	13.70	13.99	14.00	14.00
1120	11.34	11.69	11.87	12.05	12.23
1140	10.35	11.07	11.35	11.61	11.83
1150	10.89	11.52	11.77	11.99	12.17
1160	11.44	12.14	12.40	12.64	12.85
1170	12.40	13.36	13.88	14.45	15.04
1180	13.27	14.67	15.42	16.25	17.13
1190	16.25	16.95	17.44	18.17	18.42
1200	16.38	17.08	17.53	18.25	18.60
1210	16.46	17.13	17.55	18.28	18.65
1220	16.51	17.19	17.58	18.34	18.74
1230	16.48	19.28	20.00	20.00	20.00
1240	17.30	18.72	20.00	20.00	20.00
1250	16.15	17.10	17.64	18.23	18.65
1260	16.17	17.15	17.71	18.33	18.77
1270	16.18	17.17	17.74	18.38	18.84
1290	4.07	4.46	4.67	4.92	5.50
1300	6.69	8.16	8.69	8.75	8.80
1310	6.69	8.15	8.67	8.75	8.80
1320	6.82	8.80	8.80	8.80	8.80
1330	10.27	10.55	10.70	10.85	11.00
1340	15.09	15.39	15.55	15.70	15.85
1350	6.70	7.79	8.45	8.77	8.89
1360	6.75	7.86	8.53	8.99	9.37
1370	7.68	7.93	8.55	9.03	9.44
1390	6.72	7.83	8.55	8.88	9.04
1400	11.30	11.64	11.89	12.00	12.00
1410	14.17	15.23	15.85	16.48	16.83
1420	16.41	17.13	17.26	17.26	17.26
1430	14.17	15.23	15.84	16.48	16.83
1440	8.25	9.00	9.00	9.00	9.00

Table 6-2. Future Conditions, Maximum Computed Water Surface Elevations					
	Maximum Junction Elevation (FT, NAVD88)				
Junction Number	2-yr	5-yr	10-yr	25-yr	50-yr
1450	17.91	18.35	18.58	18.93	19.70
1460	3.94	4.28	4.46	4.65	4.85
1470	4.53	5.08	5.35	5.58	5.79
1480	8.00	8.57	8.89	9.25	9.67
1490	8.04	8.62	8.94	9.31	9.75
1500	11.80	11.80	11.80	11.80	11.80
1510	5.10	5.10	5.10	5.11	5.12
1520	5.48	5.49	5.49	5.49	5.49
1530	8.20	8.20	8.20	8.20	8.20
1540	13.20	13.20	13.20	13.20	12.25
1550	13.58	13.60	13.58	13.58	13.10
1560	13.80	13.80	13.80	13.80	13.80
1570	3.78	3.82	3.85	3.88	3.89
1580	3.80	3.85	3.87	3.90	3.90
1590	6.00	6.00	6.00	6.00	6.00
1600	17.56	17.81	17.95	20.00	20.00
1610	17.70	18.11	18.33	20.00	19.77
1620	18.44	19.43	19.99	20.61	21.00
1630	8.13	8.69	9.00	9.37	9.81
1700	4.75	5.37	5.66	6.00	6.00
1710	4.92	5.60	5.91	6.18	6.49
1720	4.92	5.60	5.91	6.18	6.42
1730	4.73	5.33	5.61	6.21	6.28
1740	10.71	11.47	11.83	12.24	12.63
1750	7.24	7.72	7.99	8.35	8.78
1760	16.11	16.38	16.61	16.89	17.09
1770	10.70	11.38	11.64	11.88	12.07
1780	13.49	14.55	15.25	16.10	17.09