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Appendix B: Glossary

CBEM – Chesapeake Bay Estuary Model. Hydrodynamic and water quality model developed by USACE.

CE-QUAL-ICM – Three-Dimensional Eutrophication Model. Water quality model developed by USACE-WES.

CE-QUAL-W2 – Two-Dimensional Hydrodynamic and Water Quality Model. Hydrodynamic and water quality model developed by USACE-WES.

CH3D – Curvilinear Hydrodynamics in Three-Dimensions. Hydrodynamic model developed by USACE-WES.

DYNHYD – Link-Node Tidal Hydrodynamic Model. Hydrodynamic model developed by USEPA.

EFDC – Environmental Fluid Dynamics Code. Hydrodynamic model developed by VIMS.

HEM-3D – Three-Dimensional Hydrodynamic-Eutrophication Model. Hydrodynamic and water quality model developed by VIMS.

HSPF – Hydrologic Simulation Program – Fortran. Hydrodynamic and water quality model developed by USGS.

QUAL2E – Enhanced Stream Water Quality Model. Hydrodynamic and water quality model developed by USEPA.

RIVMOD-H – River Hydrodynamics Model. Hydrodynamic and sediment transport model developed USEPA.

TMDL – Total Maximum Daily Load.

TPWQM – Tidal Prism Water Quality Model. Hydrodynamic and water quality model developed by VIMS.

TVA – Tennessee Valley Authority.

USACE – United States Army Corps of Engineers.

USACE-WES – United States Army Corps of Engineers Waterways Experiment Station.

USEPA – United States Environmental Protection Agency.

USGS – United States Geological Survey.

VADEQ – Virginia Department of Environmental Quality.

VIMS – Virginia Institute of Marine Science. College of William and Mary. Gloucester Point, Virginia.

WASP – Water Quality Analysis Simulation Program. Water quality model developed by USEPA.

WSEL – Water Surface Elevation.

<u>Appendix C:</u> Tables Utilized for Model Selection

Table C.1 Water Quality Model Comparison Matrix

Model Name	Model Developer / Agency	Model Contact Information	Model Availability Information
Water Quality Analysis Simulation Program **WASP6.1** Proposed Hydrodynamic Model: DYNHYD5 RIVMOD-H EFDC	US EPA	CEAM 706-355-8400 US EPA	Downloadable from US EPA website
Enhanced Stream Water Quality Model **QUAL2E**	US EPA	Gerald D. LaVeck 202-260-7771 US EPA	Downloadable from US EPA website
Three-Dimensional Hydrodynamic-Eutrophication Model **HEM-3D** Hydrodynamic Model Code: EFDC	VIMS	VIMS	Availibility subject to question
Tidal Prism Water Quality Model **TPWQM**	Albert Y. Kuo VIMS	Albert Y. Kuo VIMS 804-642-7212	None Specified
Two Dimensional, Laterally Averaged, Hydrodynamic and Water Quality Model **CE-QUAL-W2**	USACE-WES	WQCMB 601-634-3785 USACE-WES Scott Welss Civil Engineering Portland State University	Downloadable from Portland State University CEE website
CE-QUAL-ICM: Three-Dimensional Eutrophication Model **CE-QUAL-ICM** (Chesapeake Bay Estuary Model) Proposed Hydrodynamic Model: CH3D	USACE-WES	WQCMB 601-634-3785 USACE-WES	Currently for USACE use only

Table C.1 Water Quality Model Comparison Matrix (cont.)

Model Name	Model Computer Requirements	Model Applicable to Tidal Estuaries	Specific Fecal Coliform Routine
Water Quality Analysis Simulation Program **WASP6.1** Proposed Hydrodynamic Model: DYNHYD5 RIVMOD-H EFDC	PC Compatible System	Yes, when coupled with a hydrodynamic model	Yes
Enhanced Stream Water Quality Model **QUAL2E**	PC Compatible System	Yes, for rivers / estuaries that are well-mixed	Yes
Three-Dimensional Hydrodynamic-Eutrophication Model **HEM-3D** Hydrodynamic Model Code: EFDC	PC Compatible System	Yes	Yes
Tidal Prism Water Quality Model **TPWQM**	PC Compatible System	Yes, for estuaries that are well-mixed	Yes
Two Dimensional, Laterally Averaged, Hydrodynamic and Water Quality Model **CE-QUAL-W2**	PC Compatible System	Yes, for estuaries that are well-mixed	Yes
CE-QUAL-ICM: Three-Dimensional Eutrophication Model **CE-QUAL-ICM** (Chesapeake Bay Estuary Model) Proposed Hydrodynamic Model: CH3D	PC Compatible System	Yes, when coupled with a hydrodynamic model	No Will model first-order decay

Table C.1 Water Quality Comparison Matrix (cont.)

Model Name	Previous use for US EPA Approved Tidal Estuary TMDLs in Virginia	Previous Modeling use in Virginia
Water Quality Analysis Simulation Program **WASP6.1** Proposed Hydrodynamic Model: DYNHYD5 RIVMOD-H EFDC	None Specified	None Specified
Enhanced Stream Water Quality Model **QUAL2E**	None Specified	None Specified
Three-Dimensional Hydrodynamic-Eutrophication Model **HEM-3D** Hydrodynamic Model Code: EFDC	None Specified	York River System James River System Chesapeake Bay Estuarine System
Tidal Prism Water Quality Model **TPWQM**	None Specified	Lynnhaven River Poquoson River Piankatank River Cherrystone Inlet Hungars Creek
Two Dimensional, Laterally Averaged, Hydrodynamic and Water Quality Model **CE-QUAL-W2**	None Specified	None Specified
CE-QUAL-ICM: Three-Dimensional Eutrophication Model **CE-QUAL-ICM** (Chesapeake Bay Estuary Model) Proposed Hydrodynamic Model: CH3D	None Specified	Chesapeake Bay Estuarine System

Table C.1 Water Quality Comparison Matrix (cont.)

Model Name	Previous use for US EPA Approved Tidal Estuary TMDLs in other US EPA Region 3 States	Previous use for US EPA Approved Tidal Estuary TMDLs in other US EPA Regions
Water Quality Analysis Simulation Program **WASP6.1** Proposed Hydrodynamic Model: DYNHYD5 RIVMOD-H EFDC	Maryland TMDL Development Delaware TMDL Development District of Columbia TMDL Development	North Carolina TMDL Development Mississippi TMDL Development Washington TMDL Development
Enhanced Stream Water Quality Model **QUAL2E**	None Specified	None Specified
Three-Dimensional Hydrodynamic-Eutrophication Model **HEM-3D** Hydrodynamic Model Code: EFDC	Pennsylvania TMDL Development	Mississippi TMDL Development
Tidal Prism Water Quality Model **TPWQM**	None Specified	None Specified
Two Dimensional, Laterally Averaged, Hydrodynamic and Water Quality Model **CE-QUAL-W2**	None Specified	None Specified
CE-QUAL-ICM: Three-Dimensional Eutrophication Model **CE-QUAL-ICM** (Chesapeake Bay Estuary Model) Proposed Hydrodynamic Model: CH3D	Delaware TMDL development	None Specified

Table C.1 Water Quality Comparison Matrix (cont.)

Model Name	Model Dimension Capability 1-D, 2-D, 3-D	Coupled or Uncoupled Model	Steady-state or Unsteady Model
Water Quality Analysis Simulation Program **WASP6.1** Proposed Hydrodynamic Model: DYNHYD5 RIVMOD-H EFDC	1-D 2-D 3-D	Uncoupled Water Quality Model	Unsteady and Steady-state Model
Enhanced Stream Water Quality Model **QUAL2E**	1-D	Coupled Water Quality and Hydrodynamic Model	Steady-State Model
Three-Dimensional Hydrodynamic-Eutrophication Model **HEM-3D** Hydrodynamic Model Code: EFDC	1-D 2-D 3-D	Coupled Water Quality and Hydrodynamic Model	Unsteady Model
Tidal Prism Water Quality Model **TPWQM**	1-D	Coupled Water Quality and Hydrodynamic Model	Steady-State Model
Two Dimensional, Laterally Averaged, Hydrodynamic and Water Quality Model **CE-QUAL-W2**	1-D 2-D (Laterally Averaged)	Coupled Water Quality and Hydrodynamic Model	Unsteady Model
CE-QUAL-ICM: Three-Dimensional Eutrophication Model **CE-QUAL-ICM** (Chesapeake Bay Estuary Model) Proposed Hydrodynamic Model: CH3D	1-D 2-D (Depth Averaged) 3-D	Uncoupled Water Quality Model	Unsteady Model

Table C.1 Water Quality Comparison Matrix (cont.)

Model Name	Water Quality Kinetics Source Code	Simulation Time Frame Continuous / Discrete	Minimum Simulation Time Step
Water Quality Analysis Simulation Program **WASP6.1** Proposed Hydrodynamic Model: DYNHYD5 RIVMOD-H EFDC	Potomac Eutrophication Model (PEM)	Continuous, will model more than 1 tidal cycle	No Minimum Specified Model can autostep
Enhanced Stream Water Quality Model **QUAL2E**	QUAL-II	None Specified	No Minimum Specified
Three-Dimensional Hydrodynamic-Eutrophication Model **HEM-3D** Hydrodynamic Model Code: EFDC	TPWQM CE-QUAL-ICM	Continuous, will model more than 1 tidal cycle	No Minimum Specified
Tidal Prism Water Quality Model **TPWQM**	CE-QUAL-ICM	Continuous, model utilizes an average tidal range for calculations	No Minimum Specified
Two Dimensional, Laterally Averaged, Hydrodynamic and Water Quality Model **CE-QUAL-W2**	Developed by USACE-WES	Continuous, will model more than 1 tidal cycle	1 second minimum Model can autostep
CE-QUAL-ICM: Three-Dimensional Eutrophication Model **CE-QUAL-ICM** (Chesapeake Bay Estuary Model) Proposed Hydrodynamic Model: CH3D	Developed by USACE-WES for application to Chesapeake Bay	Continuous, will model more than 1 tidal cycle	No Minimum Specified Model can autostep

Table C.1 Water Quality Comparison Matrix (cont.)

Model Name	Finite Element or Finite Difference Model	Model Handling of Watershed Loading Inputs	Water Quality Model Output
Water Quality Analysis Simulation Program **WASP6.1** Proposed Hydrodynamic Model: DYNHYD5 RIVMOD-H EFDC	Finite Difference Model	Model can be linked to HSPF for watershed loading inputs	Time-variable water quality constituent concentrations
Enhanced Stream Water Quality Model **QUAL2E**	Finite Difference Model	None Specified	Steady-state water quality constituent concentrations
Three-Dimensional Hydrodynamic-Eutrophication Model **HEM-3D** Hydrodynamic Model Code: EFDC	Finite Difference Model	None Specified	Time-variable water quality constituent concentrations
Tidal Prism Water Quality Model **TPWQM**	Finite Difference Model	None Specified	Steady-state water quality constituent concentrations
Two Dimensional, Laterally Averaged, Hydrodynamic and Water Quality Model **CE-QUAL-W2**	Finite Difference Model	Watershed loadings are handled as time-varying boundary inputs	Time-variable water quality constituent concentrations
CE-QUAL-ICM: Three-Dimensional Eutrophication Model **CE-QUAL-ICM** (Chesapeake Bay Estuary Model) Proposed Hydrodynamic Model: CH3D	Finite Difference Model	Model can be linked to HSPF for watershed loading inputs	Time-variable water quality constituent concentrations

Table C.2 Hydrodynamic Model Comparison Matrix

Model Name	**Model Developer / Agency**	**Model Contact Information**	**Model Availability Information**	**Model Computer Requirements**
River Hydrodynamics Model **RIVMOD-H** Proposed Water Quality Model: WASP6.1	US EPA	CEAM 706-355-8400 US EPA	Can be requested with WASP	PC Compatible System
Link-Node Tidal Hydrodynamic Model **DYNHYD5** Proposed Water Quality Model: WASP6.1	US EPA	CEAM 706-355-8400 US EPA	Released with WASP	PC Compatible System
Environmental Fluid Dynamics Code **EFDC** Proposed Water Quality Model: WASP6.1	Dr. John Hamrick VIMS	Dr. John Hamrick VIMS 804-642-7000	EFDC is considered public domain software	PC Compatible System
Curvilinear Hydrodynamics in Three-Dimensions **CH3D** Proposed Water Quality Model: CE-QUAL-ICM	USACE-WES	WQCMB 601-634-3785 USACE	Contact USACE-WES	Unix Workstation

Table C.2 Hydrodynamic Model Comparison Matrix (cont.)

Model Name	**Model Applicable to Tidal Estuaries**	**Model Dimensional Capability 1-D, 2-D, 3-D**	Model Main Input Data	Model Output Information
River Hydrodynamics Model **RIVMOD-H** Proposed Water Quality Model: WASP6.1	Yes	1-D	River geometry Boundary conditions Inflow Withdrawals Meteorlogic data	Water surface elevations Velocities Temperatures
Link-Node Tidal Hydrodynamic Model **DYNHYD5** Proposed Water Quality Model: WASP6.1	Yes	1-D	Waterbody geometry Boundary conditions Inflow Withdrawals Meteorlogic data	Water surface elevations Velocities
Environmental Fluid Dynamics Code **EFDC** Proposed Water Quality Model: WASP6.1	Yes	1-D 2-D 3-D	River geometry Bathymetry Geometric data Grid system Boundary conditions Inflows Withdrawals Meteorlogic data	Water surface elevations Velocity magnitude Velocity orientation Temperature Salinity Conservative tracer
Curvilinear Hydrodynamics in Three-Dimensions **CH3D** Proposed Water Quality Model: CE-QUAL-ICM	Yes	1-D 2-D 3-D	River geometry Bathymetry Geometric data Grid system Boundary conditions Inflows Withdrawals Meteorlogic data	Water surface elevations Velocity magnitude Velocity orientation Temperature

Table C.3 Specific Models Utilized to Perform USEPA Water Quality Studies

Waterbody Name	Water Quality Model	Hydrodynamic Model
Anacostia River	WASP	Tidal Anacostia Model
Indian River	CE-QUAL-ICM	CH3D
Indian River Bay	CE-QUAL-ICM	CH3D
Rehoboth Bay	CE-QUAL-ICM	CH3D
Nanticoke River	WASP5	DYNHYD5
Broad Creek	WASP5	DYNHYD5
Christinia River Basin	EFDC	EFDC
Christinia River Basin	EFDC	EFDC
Lower Wicomico River	WASP5.1	DYNHYD5
Manokin River	WASP5.1	DYNHYD5
Northern Coastal Bays System	WASP5.1	DYNHYD5
Christinia River Basin	EFDC	EFDC
Neuse River Estuary	WASP	EFDC
Cooper River	BLTM	BRANCH
Wando River	BLTM	BRANCH
Charleston Harbor System	BLTM	BRANCH
Tidewater bayou	WASP5	DYNHYD5
Back Bay of Biloxi	WASP5	DYNHYD5
Biloxi Bay	WASP5	DYNHYD5
St. Louis Bay	EFDC	EFDC
Bernard Bayou Segment 3	WASP5	DYNHYD5
Wolf River	EFDC	EFDC
Jourdan River	EFDC	EFDC
Inner Bellingham Bay	WASP5	DYNHYD5
Snohomish River Estuary	WASP5	DYNHYD5

Table C.3 Specific Models Utilized to Perform USEPA Water Quality Studies (cont.)

Waterbody Name	TMDL Type	State
Anacostia River	BOD	District of Columbia
Indian River	Nutrients and DO	Delware
Indian River Bay	Nutrients and DO	Delware
Rehoboth Bay	Nutrients and DO	Delware
Nanticoke River	Nutrients and DO	Delware
Broad Creek	Nutrients and DO	Delware
Christinia River Basin	Nutrients	Delware
Christinia River Basin	Nutrients	Maryland
Lower Wicomico River	Nutrients and BOD	Maryland
Manokin River	Nutrients and BOD	Maryland
Northern Coastal Bays System	Nutrients	Maryland
Christinia River Basin	Nutrients	Pennsylvania
Neuse River Estuary	Nitrogen	North Carolina
Cooper River	DO	South Carolina
Wando River	DO	South Carolina
Charleston Harbor System	DO	South Carolina
Tidewater bayou	DO and Toxics	Mississippi
Back Bay of Biloxi	Fecal Coliform	Mississippi
Biloxi Bay	Fecal Coliform	Mississippi
St. Louis Bay	Fecal Coliform	Mississippi
Bernard Bayou Segment 3	Nutrients and DO	Mississippi
Wolf River	Fecal Coliform	Mississippi
Jourdan River	Fecal Coliform	Mississippi
Inner Bellingham Bay	Sediments	Washington
Snohomish River Estuary	BOD and Ammonia	Washington

<u>Appendix D:</u> Sample DYNHYD5 Input File

```
'  Revised Appomattox Calibration: 01/01/2003 - 07/31/2003'
'  23 Nodes, 29 Channels, 4 Variable Inflows'
****PROGRAM*CONTROL*DATA******************************
23      29      0       30      0       1       0       0       212     0       0
        37622.0000      1       1       2003    0       0
*******************************************************
0.0000  0.5000  23
1       2       3       4       5       6       7       8       9       10      11      12
        13      14      15      16      17      18      19      20      21      22      23
****SUMMARY*CONTROL*DATA******************************
1       1       0       0       12.5000 30      3
****JUNCTION*DATA**************************************
1       3.7300  459373.4000     0.0000  1       0       0       0       0
2       3.7300  600667.4400     0.0000  1       2       0       0       0
3       3.7300  245250.6400     1.0200  2       3       0       0       0
4       3.7300  232229.0000     0.6100  3       4       0       0       0
5       3.7300  504640.6400     1.3200  4       5       6       7       0
6       3.7300  309089.7000     1.0200  7       10      0       0       0
7       3.7300  313488.0400     2.4400  5       6       8       9       0
8       3.7300  355222.3100     1.4500  9       10      13      14      15
9       3.7300  369511.7000     2.8500  8       11      12      0       0
10      3.7300  254911.8000     2.6400  14      15      17      0       0
11      3.7300  336902.3200     2.4400  12      13      16      17      19
12      3.7300  195781.9100     2.4400  11      16      18      0       0
13      3.7300  249867.9300     2.1400  19      21      0       0       0
14      3.7300  165072.4000     2.4400  18      20      0       0       0
15      3.7300  224703.2900     2.7500  21      23      24      0       0
16      3.7300  155411.6300     3.3600  20      22      0       0       0
17      3.7300  129953.1400     2.7500  23      24      26      0       0
18      3.7300  99558.5400      3.3600  22      25      0       0       0
19      3.7300  81449.2700      3.3600  26      28      0       0       0
20      3.7300  126197.5000     3.3600  25      27      0       0       0
21      3.7300  79631.9000      3.3600  28      29      0       0       0
22      3.7300  74083.2000      3.3600  27      0       0       0       0
23      3.7300  48835.1600      3.3600  29      0       0       0       0
****CHANNEL*DATA***************************************
1       1298.0500       707.7900        3.7600  254.000 0.0350  0.000   1       2
2       1282.1600       220.4000        3.7600  262.000 0.0350  0.000   2       3
3       1316.9900       157.8700        3.4600  267.000 0.0350  0.000   3       4
4       1256.7100       204.1400        3.3100  301.000 0.0350  0.000   4       5
5       1151.0100       191.9900        2.3900  250.000 0.0350  0.000   5       7
6       1328.9200       157.7500        2.3900  250.000 0.0350  0.000   5       7
7       2060.2300       156.3500        3.1000  252.000 0.0350  0.000   5       6
8       1071.1000       179.2200        1.6300  187.000 0.0350  0.000   7       9
9       1120.9200       3.9200          2.3300  266.000 0.0350  0.000   7       8
10      1095.2700       270.3100        3.0400  189.000 0.0350  0.000   6       8
11      1697.5100       148.7000        1.6300  189.000 0.0350  0.000   9       12
12      1885.1000       156.3000        1.6300  212.000 0.0350  0.000   9       11
13      1963.0200       11.5800         2.3300  181.000 0.0350  0.000   8       11
14      1159.3000       152.2800        2.2300  230.000 0.0350  0.000   8       10
15      1461.1900       144.2100        2.2300  231.000 0.0350  0.000   8       10
16      853.0300        29.2300         1.8300  128.000 0.0350  0.000   11      12
17      959.4300        127.7500        1.7300  153.000 0.0350  0.000   10      11
18      1095.7500       104.2300        1.8300  190.000 0.0350  0.000   12      14
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19	1341.6200	155.7300	1.9800	178.000	0.0350	0.000	11	13
20	1885.0700	114.5500	1.3700	228.000	0.0350	0.000	14	16
21	1866.5300	155.8000	1.4500	226.000	0.0350	0.000	13	15
22	1617.0500	58.6800	0.9100	193.000	0.0350	0.000	16	18
23	1390.1900	67.5200	1.1400	185.000	0.0350	0.000	15	17
24	1408.5200	45.9600	1.1400	183.000	0.0350	0.000	15	17
25	1622.7400	64.2300	0.9100	185.000	0.0350	0.000	18	20
26	1774.4800	57.0900	1.2200	187.000	0.0350	0.000	17	19
27	2046.7800	72.3900	0.9100	252.000	0.0350	0.000	20	22
28	1243.8100	49.5200	0.9100	257.000	0.0350	0.000	19	21
29	1760.4600	55.4800	0.9100	245.000	0.0350	0.000	21	23

****CONSTANT*FLOW*BOUNDARY*DATA***********************

19

1	-0.011
2	-0.072
3	-0.399
4	-0.072
5	-0.06
7	-0.016
8	-0.043
9	-0.034
11	-0.028
12	-0.02
13	-0.048
14	-0.122
15	-0.043
16	-0.071
18	-0.194
19	-0.023
20	-0.497
21	-0.039
22	-0.138

****VARIABLE*FLOW*BOUNDARY*DATA***********************

4

6	211		
1	1	0	-0.4842
2	1	0	-3.7077
3	1	0	-1.79
4	1	0	-1.407
5	1	0	-1.0633
6	1	0	-0.8115
7	1	0	-0.6663
8	1	0	-0.574
9	1	0	-0.5321
10	1	0	-0.4408
11	1	0	-0.403
12	1	0	-0.4353
13	1	0	-0.4256
14	1	0	-0.406
15	1	0	-0.3765
16	1	0	-0.371
17	1	0	-0.3554
18	1	0	-0.5788
19	1	0	-0.5085
20	1	0	-0.4232
21	1	0	-0.374

22	1	0	-0.3142
23	1	0	-0.3196
24	1	0	-0.3031
25	1	0	-0.2882
26	1	0	-0.2748
27	1	0	-0.2625
28	1	0	-0.2509
29	1	0	-0.2399
30	1	0	-0.2294
31	1	0	-0.5754
32	1	0	-0.6631
33	1	0	-0.535
34	1	0	-0.4054
35	1	0	-0.3247
36	1	0	-0.2977
37	1	0	-0.2697
38	1	0	-0.2751
39	1	0	-1.5455
40	1	0	-1.1145
41	1	0	-0.7117
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43	1	0	-0.5457
44	1	0	-0.4172
45	1	0	-0.3637
46	1	0	-0.328
47	1	0	-1.3475
48	1	0	-1.5872
49	1	0	-1.1422
50	1	0	-0.76
51	1	0	-0.5624
52	1	0	-0.4288
53	1	0	-0.3715
54	1	0	-2.8376
55	1	0	-1.5308
56	1	0	-0.9801
57	1	0	-0.6539
58	1	0	-0.5303
59	1	0	-1.1767
60	1	0	-1.9702
61	1	0	-1.4363
62	1	0	-1.239
63	1	0	-0.9221
64	1	0	-0.6987
65	1	0	-0.9706
66	1	0	-0.9951
67	1	0	-0.8137
68	1	0	-0.6574
69	1	0	-0.4973
70	1	0	-0.3959
71	1	0	-0.4103
72	1	0	-0.3934
73	1	0	-0.3092
74	1	0	-0.3065
75	1	0	-0.3429
76	1	0	-0.334
77	1	0	-0.2567

78	1	0	-0.1879
79	1	0	-0.1796
80	1	0	-7.1247
81	1	0	-1.6602
82	1	0	-0.9921
83	1	0	-0.6406
84	1	0	-0.4524
85	1	0	-0.3262
86	1	0	-0.2378
87	1	0	-0.2395
88	1	0	-0.2461
89	1	0	-3.5175
90	1	0	-1.2657
91	1	0	-0.8519
92	1	0	-0.5763
93	1	0	-0.3602
94	1	0	-0.2307
95	1	0	-0.1717
96	1	0	-0.127
97	1	0	-0.1704
98	1	0	-5.6561
99	1	0	-2.2562
100	1	0	-6.3921
101	1	0	-2.489
102	1	0	-3.8988
103	1	0	-2.148
104	1	0	-1.2538
105	1	0	-0.8314
106	1	0	-0.5889
107	1	0	-0.4326
108	1	0	-0.3361
109	1	0	-0.3479
110	1	0	-0.4396
111	1	0	-0.356
112	1	0	-0.2984
113	1	0	-0.2315
114	1	0	-0.2415
115	1	0	-0.2467
116	1	0	-0.1891
117	1	0	-0.3821
118	1	0	-0.2565
119	1	0	-0.2109
120	1	0	-0.1485
121	1	0	-0.1007
122	1	0	-0.0892
123	1	0	-0.0839
124	1	0	-0.0877
125	1	0	-0.105
126	1	0	-0.1273
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128	1	0	-0.0877
129	1	0	-0.0794
130	1	0	-0.0717
131	1	0	-0.0647
132	1	0	-0.0584
133	1	0	-0.0527

134	1	0	-0.0476
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136	1	0	-0.04
137	1	0	-0.036
138	1	0	-0.0325
139	1	0	-0.0721
140	1	0	-0.0823
141	1	0	-0.0838
142	1	0	-0.0784
143	1	0	-0.7072
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145	1	0	-0.5222
146	1	0	-0.3165
147	1	0	-10.3539
148	1	0	-1.6935
149	1	0	-1.1076
150	1	0	-1.7611
151	1	0	-1.2406
152	1	0	-0.7057
153	1	0	-2.0828
154	1	0	-1.235
155	1	0	-0.7463
156	1	0	-0.4859
157	1	0	-0.864
158	1	0	-0.6834
159	1	0	-2.91
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163	1	0	-0.538
164	1	0	-0.3611
165	1	0	-0.3228
166	1	0	-0.231
167	1	0	-0.1822
168	1	0	-0.174
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182	1	0	-0.0765
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190	1	0	-0.0783
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194	1	0	-0.1006
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198	1	0	-0.0821
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201	1	0	-0.0722
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210	1	0	-0.0516
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10	211		
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23	1	0	-4.1354
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29	1	0	-3.2243
30	1	0	-3.0862
31	1	0	-3.4011
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65	1	0	-11.4145
66	1	0	-11.7696
67	1	0	-12.1886
68	1	0	-11.7499
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72	1	0	-8.1442
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98	1	0	-12.9216
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103	1	0	-29.9416
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115	1	0	-5.9171
116	1	0	-5.418
117	1	0	-5.3105
118	1	0	-5.5247
119	1	0	-5.0283
120	1	0	-4.505
121	1	0	-3.9385
122	1	0	-3.616
123	1	0	-4.0725
124	1	0	-3.8431
125	1	0	-4.3889
126	1	0	-4.3704
127	1	0	-4.1785
128	1	0	-3.4666
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139	1	0	-3.071
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141	1	0	-23.6152
142	1	0	-15.7445
143	1	0	-20.0823
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146	1	0	-14.9445
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148	1	0	-94.8312
149	1	0	-42.8214
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151	1	0	-17.4237
152	1	0	-12.7272
153	1	0	-23.7335
154	1	0	-27.5174
155	1	0	-18.8144
156	1	0	-13.8925
157	1	0	-11.1412
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161	1	0	-25.1098
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164	1	0	-11.0522
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166	1	0	-7.2653
167	1	0	-6.2699
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193	1	0	-3.1096
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199	1	0	-1.7693
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211	1	0	-1.2621
17	211		
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32	1	0	-0.472
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73	1	0	-0.4878
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78	1	0	-0.3414
79	1	0	-0.2974
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91	1	0	-1.2129
92	1	0	-0.9073
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284	17	07	4.238
284	23	50	3.354
285	5	32	4.146
285	11	40	3.354
285	17	41	4.238
286	0	29	3.384
286	6	09	4.116
286	12	06	3.384
286	18	13	4.207
287	1	06	3.415
287	6	46	4.085
287	12	35	3.384
287	18	44	4.177
288	1	42	3.445
288	7	23	4.055
288	13	10	3.415
288	19	20	4.177
289	2	20	3.445
289	8	04	4.024
289	13	54	3.415
289	20	02	4.146
290	3	06	3.476
290	8	51	3.994
290	14	45	3.445
290	20	53	4.116
291	4	00	3.476
291	9	48	3.994
291	15	44	3.445
291	21	54	4.116
292	4	59	3.476
292	10	51	3.994
292	16	50	3.445
292	23	02	4.116
293	5	58	3.445

293	11	52	4.024
293	18	01	3.415
294	0	8	4.116
294	6	54	3.384
294	12	47	4.085
294	19	09	3.384
295	1	07	4.146
295	7	45	3.354
295	13	38	4.146
295	20	10	3.354
296	2	00	4.177
296	8	33	3.293
296	14	25	4.207
296	21	07	3.293
297	2	50	4.177
297	9	19	3.263
297	15	11	4.268
297	22	01	3.263
298	3	38	4.177
298	10	04	3.263
298	15	36	4.329
298	22	53	3.232
299	3	26	4.177
299	9	50	3.232
299	15	42	4.329
299	22	46	3.232
300	4	15	4.177
300	10	37	3.263
300	16	29	4.329
300	23	38	3.263
301	5	06	4.146
301	11	28	3.263
301	17	19	4.299
302	0	33	3.263
302	5	59	4.116
302	12	23	3.293
302	18	13	4.268
303	1	29	3.293
303	6	58	4.085
303	13	22	3.323
303	19	13	4.207
304	2	26	3.323
304	8	01	4.055
304	14	26	3.354
304	20	20	4.146
305	3	25	3.323
305	9	07	4.024
305	15	32	3.354
305	21	31	4.116
306	4	24	3.323
306	10	13	4.055
306	16	36	3.354
306	22	39	4.116
307	5	19	3.323
307	11	14	4.085
307	17	38	3.323

307	23	40	4.116
308	6	12	3.293
308	12	09	4.116
308	18	35	3.293
309	0	34	4.116
309	7	00	3.293
309	12	59	4.146
309	19	28	3.293
310	1	22	4.116
310	7	44	3.293
310	13	44	4.177
310	20	18	3.293
311	2	07	4.085
311	8	24	3.293
311	14	25	4.177
311	21	03	3.293
312	2	49	4.085
312	9	02	3.293
312	15	03	4.177
312	21	46	3.293
313	3	29	4.055
313	9	36	3.293
313	15	38	4.177
313	22	27	3.293
283	4	08	4.055
283	10	07	3.323
283	16	11	4.177
283	23	05	3.323
315	4	44	4.024
315	10	38	3.323
315	16	42	4.146
315	23	41	3.354
316	5	19	3.994
316	11	11	3.354
316	17	14	4.146
317	0	17	3.354
317	5	54	3.994
317	11	49	3.354
317	17	50	4.116
318	0	54	3.384
318	6	32	3.994
318	12	33	3.354
318	18	33	4.085
319	1	36	3.384
319	7	16	3.964
319	13	23	3.384
319	19	23	4.085
320	2	24	3.384
320	8	08	3.964
320	14	20	3.384
320	20	21	4.055
321	3	17	3.354
321	9	07	3.994
321	15	23	3.384
321	21	25	4.055
322	4	11	3.323

322	10	07	4.024
322	16	32	3.354
322	22	30	4.055
323	5	05	3.293
323	11	05	4.085
323	17	41	3.323
323	23	32	4.055
324	5	59	3.263
324	12	00	4.146
324	18	46	3.293
325	0	29	4.085
325	6	51	3.232
325	12	52	4.207
325	19	46	3.232
326	1	23	4.085
326	7	42	3.202
326	13	42	4.238
326	20	42	3.202
327	2	15	4.085
327	8	34	3.202
327	14	31	4.268
327	21	37	3.171
328	3	07	4.085
328	9	26	3.202
328	15	20	4.299
328	22	30	3.171
329	3	58	4.085
329	10	20	3.202
329	16	11	4.268
329	23	22	3.171
330	4	50	4.055
330	11	14	3.202
330	17	03	4.238
331	0	15	3.202
331	5	44	4.055
331	12	11	3.232
331	17	59	4.177
332	1	09	3.232
332	6	41	4.024
332	13	10	3.263
332	18	59	4.116
333	2	03	3.232
333	7	41	3.994
333	14	10	3.263
333	20	04	4.085
334	2	57	3.263
334	8	44	3.994
334	15	11	3.293
334	21	09	4.024
335	3	50	3.263
335	9	46	3.994
335	16	12	3.293
335	22	12	4.024
336	4	43	3.263
336	10	44	4.024
336	17	12	3.293

336	23	10	3.994
337	5	33	3.263
337	11	39	4.055
337	18	09	3.263
338	0	4	3.994
338	6	20	3.263
338	12	28	4.085
338	19	02	3.263
339	0	53	3.994
339	7	05	3.263
339	13	14	4.085
339	19	52	3.263
340	1	40	3.994
340	7	47	3.263
340	13	56	4.085
340	20	38	3.232
341	2	24	3.964
341	8	27	3.263
341	14	35	4.085
341	21	22	3.263
342	3	05	3.964
342	9	06	3.263
342	15	11	4.085
342	22	03	3.263
343	3	45	3.964
343	9	43	3.263
343	15	46	4.085
343	22	42	3.263
344	4	21	3.964
344	10	20	3.263
344	16	18	4.085
344	23	19	3.263
345	4	56	3.933
345	10	58	3.293
345	16	53	4.055
345	23	56	3.293
346	5	30	3.933
346	11	38	3.293
346	17	30	4.055
347	0	33	3.293
347	6	07	3.964
347	12	21	3.293
347	18	13	4.055
348	1	12	3.263
348	6	49	3.964
348	13	09	3.293
348	19	02	4.055
349	1	54	3.263
349	7	38	3.964
349	14	02	3.293
349	19	55	4.024
350	2	39	3.263
350	8	31	3.994
350	15	02	3.293
350	20	54	4.024
351	3	28	3.232

351	9	29	4.024
351	16	08	3.293
351	21	57	3.994
352	4	20	3.232
352	10	27	4.085
352	17	18	3.263
352	23	00	3.994
353	5	15	3.202
353	11	25	4.116
353	18	24	3.232
354	0	1	3.994
354	6	14	3.202
354	12	22	4.177
354	19	26	3.202
355	0	59	3.994
355	7	14	3.171
355	13	16	4.207
355	20	25	3.171
356	1	55	3.994
356	8	13	3.171
356	14	10	4.207
356	21	20	3.141
357	2	49	4.024
357	9	11	3.171
357	15	04	4.207
357	22	13	3.141
358	3	42	4.024
358	10	08	3.141
358	15	57	4.177
358	23	05	3.141
359	4	34	4.024
359	11	03	3.141
359	16	52	4.146
359	23	55	3.141
360	5	27	4.024
360	11	58	3.171
360	17	47	4.116
361	12	45	3.171
361	6	21	3.994
361	12	53	3.171
361	18	43	4.055
362	1	34	3.171
362	7	17	3.994
362	13	48	3.202
362	19	41	4.024
363	2	22	3.202
363	8	13	3.994
363	14	44	3.232
363	20	39	3.994
364	3	10	3.232
364	9	10	3.994
364	15	41	3.263
364	21	37	3.964
365	3	58	3.232
365	10	06	3.994
365	16	39	3.263

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****JUNCTION*GEOMETRY*DATA*****************************
0
****CHANNEL*GEOMETRY*DATA******************************
0
****MAP*TO*WASP*6**************************************
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2         1
3         2
4         3
5         4
6         5
7         6
8         7
9         8
10        9
11        10
12        11
13        12
14        13
15        14
16        15
17        16
18        17
19        18
20        19
21        20
22        21
23        0
```

Appendix E: Sample NOAA Tide Predictions – Calendar Year 2002

Hopewell, City Point, James River, Virginia
Tide Predictions (High and Low Waters) January, 2002
NOAA, National Ocean Service

Standard Time

Day	Time		Ht.	Time		Ht.	Time		Ht.	Time		Ht.
1 Tu	436	H	2.4	1106	L	-0.3	1648	H	2.8	2356	L	-0.3
2 W	524	H	2.4	1159	L	-0.3	1740	H	2.8			
3 Th	44	L	-0.4	615	H	2.5	1254	L	-0.3	1835	H	2.7
4 F	132	L	-0.4	710	H	2.5	1352	L	-0.3	1934	H	2.6
5 Sa	222	L	-0.4	808	H	2.6	1452	L	-0.2	2035	H	2.5
6 Su	314	L	-0.3	907	H	2.6	1554	L	-0.2	2138	H	2.4
7 M	407	L	-0.3	1007	H	2.7	1657	L	-0.2	2240	H	2.4
8 Tu	503	L	-0.3	1106	H	2.7	1758	L	-0.2	2340	H	2.3
9 W	559	L	-0.2	1202	H	2.7	1857	L	-0.3			
10 Th	37	H	2.3	655	L	-0.2	1256	H	2.7	1952	L	-0.3
11 F	130	H	2.3	749	L	-0.2	1347	H	2.7	2044	L	-0.3
12 Sa	220	H	2.3	840	L	-0.2	1436	H	2.7	2132	L	-0.3
13 Su	308	H	2.3	928	L	-0.2	1523	H	2.7	2217	L	-0.2
14 M	353	H	2.3	1014	L	-0.2	1608	H	2.6	2259	L	-0.2
15 Tu	436	H	2.3	1056	L	-0.2	1651	H	2.5	2337	L	-0.1
16 W	517	H	2.3	1136	L	-0.1	1732	H	2.5			
17 Th	12	L	-0.1	557	H	2.3	1214	L	0.0	1812	H	2.4
18 F	44	L	0.0	635	H	2.3	1253	L	0.0	1852	H	2.3
19 Sa	113	L	0.0	714	H	2.3	1333	L	0.1	1934	H	2.3
20 Su	145	L	0.0	754	H	2.3	1419	L	0.1	2020	H	2.2
21 M	222	L	0.0	838	H	2.4	1511	L	0.2	2111	H	2.1
22 Tu	306	L	0.0	926	H	2.4	1612	L	0.2	2208	H	2.1
23 W	357	L	0.0	1019	H	2.4	1718	L	0.2	2307	H	2.1
24 Th	454	L	0.0	1115	H	2.5	1822	L	0.1			
25 F	4	H	2.1	558	L	0.0	1211	H	2.6	1922	L	0.0
26 Sa	58	H	2.2	705	L	0.0	1306	H	2.7	2017	L	-0.1
27 Su	150	H	2.3	807	L	-0.1	1401	H	2.7	2109	L	-0.2
28 M	239	H	2.4	906	L	-0.2	1453	H	2.8	2158	L	-0.3
29 Tu	328	H	2.5	1001	L	-0.3	1545	H	2.9	2246	L	-0.4
30 W	417	H	2.6	1055	L	-0.4	1637	H	2.9	2333	L	-0.4
31 Th	506	H	2.7	1148	L	-0.4	1729	H	2.8			

Hopewell, City Point, James River, Virginia
Tide Predictions (High and Low Waters)   February, 2002
NOAA, National Ocean Service

Standard Time

Day		Time		Ht.	Time		Ht.	Time		Ht.	Time		Ht.
1	F	19	L	-0.4	557	H	2.8	1242	L	-0.4	1823	H	2.8
2	Sa	106	L	-0.4	649	H	2.8	1338	L	-0.3	1918	H	2.7
3	Su	154	L	-0.4	744	H	2.8	1435	L	-0.3	2017	H	2.5
4	M	244	L	-0.3	841	H	2.8	1535	L	-0.2	2118	H	2.4
5	Tu	338	L	-0.2	941	H	2.7	1636	L	-0.1	2219	H	2.3
6	W	436	L	-0.1	1041	H	2.7	1737	L	-0.1	2320	H	2.3
7	Th	535	L	-0.1	1140	H	2.7	1835	L	-0.1			
8	F	17	H	2.3	634	L	0.0	1237	H	2.6	1930	L	-0.1
9	Sa	111	H	2.3	730	L	-0.1	1331	H	2.6	2021	L	-0.1
10	Su	202	H	2.4	823	L	-0.1	1421	H	2.6	2108	L	-0.1
11	M	248	H	2.4	911	L	-0.1	1508	H	2.6	2151	L	-0.1
12	Tu	332	H	2.5	955	L	-0.1	1551	H	2.6	2230	L	0.0
13	W	412	H	2.5	1036	L	-0.1	1631	H	2.6	2305	L	0.0
14	Th	450	H	2.5	1115	L	0.0	1708	H	2.6	2335	L	0.0
15	F	524	H	2.5	1151	L	0.0	1744	H	2.5			
16	Sa	2	L	0.0	556	H	2.6	1226	L	0.1	1819	H	2.5
17	Su	29	L	0.0	628	H	2.6	1303	L	0.1	1856	H	2.4
18	M	101	L	0.0	704	H	2.6	1344	L	0.2	1938	H	2.3
19	Tu	139	L	0.1	746	H	2.7	1431	L	0.2	2026	H	2.3
20	W	224	L	0.1	834	H	2.7	1528	L	0.3	2122	H	2.2
21	Th	317	L	0.2	930	H	2.7	1636	L	0.3	2224	H	2.2
22	F	418	L	0.2	1032	H	2.7	1746	L	0.3	2327	H	2.3
23	Sa	529	L	0.2	1137	H	2.7	1850	L	0.2			
24	Su	27	H	2.4	643	L	0.1	1241	H	2.8	1948	L	0.1
25	M	122	H	2.5	750	L	0.0	1341	H	2.9	2041	L	-0.1
26	Tu	215	H	2.7	850	L	-0.1	1437	H	3.0	2131	L	-0.2
27	W	306	H	2.8	946	L	-0.3	1530	H	3.0	2219	L	-0.3
28	Th	355	H	3.0	1040	L	-0.3	1621	H	3.0	2305	L	-0.3

Hopewell, City Point, James River, Virginia
Tide Predictions (High and Low Waters) March, 2002
NOAA, National Ocean Service

Standard Time

Day	Time	Ht.	Time	Ht.	Time	Ht.	Time	Ht.
1 F	445 H	3.1	1133 L	-0.3	1713 H	3.0	2351 L	-0.3
2 Sa	534 H	3.1	1226 L	-0.3	1805 H	2.9		
3 Su	37 L	-0.2	625 H	3.1	1320 L	-0.2	1859 H	2.8
4 M	125 L	-0.1	717 H	3.1	1416 L	-0.1	1956 H	2.6
5 Tu	216 L	0.0	813 H	3.0	1513 L	0.0	2056 H	2.5
6 W	311 L	0.1	913 H	2.9	1612 L	0.1	2158 H	2.5
7 Th	411 L	0.2	1016 H	2.8	1711 L	0.2	2258 H	2.5
8 F	513 L	0.2	1118 H	2.7	1809 L	0.2	2356 H	2.5
9 Sa	613 L	0.2	1218 H	2.7	1903 L	0.2		
10 Su	50 H	2.5	709 L	0.2	1313 H	2.7	1953 L	0.2
11 M	140 H	2.6	801 L	0.1	1402 H	2.7	2038 L	0.2
12 Tu	225 H	2.7	849 L	0.1	1447 H	2.7	2118 L	0.2
13 W	307 H	2.7	933 L	0.1	1529 H	2.7	2155 L	0.2
14 Th	345 H	2.8	1014 L	0.1	1607 H	2.7	2228 L	0.2
15 F	419 H	2.8	1053 L	0.1	1642 H	2.7	2257 L	0.2
16 Sa	450 H	2.8	1129 L	0.2	1716 H	2.7	2324 L	0.2
17 Su	518 H	2.9	1205 L	0.2	1749 H	2.6	2353 L	0.2
18 M	549 H	2.9	1241 L	0.3	1825 H	2.6		
19 Tu	27 L	0.3	626 H	3.0	1320 L	0.3	1906 H	2.5
20 W	108 L	0.3	709 H	3.0	1406 L	0.4	1954 H	2.5
21 Th	156 L	0.3	759 H	2.9	1501 L	0.4	2050 H	2.5
22 F	251 L	0.4	857 H	2.9	1606 L	0.4	2153 H	2.5
23 Sa	357 L	0.4	1003 H	2.9	1715 L	0.4	2258 H	2.6
24 Su	513 L	0.4	1113 H	2.9	1819 L	0.3		
25 M	0 H	2.7	628 L	0.3	1220 H	3.0	1917 L	0.2
26 Tu	57 H	2.9	734 L	0.1	1321 H	3.0	2011 L	0.1
27 W	151 H	3.1	834 L	0.0	1418 H	3.1	2101 L	0.0
28 Th	242 H	3.2	930 L	-0.1	1511 H	3.1	2149 L	-0.1
29 F	332 H	3.4	1024 L	-0.2	1602 H	3.1	2235 L	-0.1
30 Sa	420 H	3.4	1116 L	-0.2	1653 H	3.1	2322 L	-0.1
31 Su	509 H	3.5	1208 L	-0.2	1745 H	3.0		

Hopewell, City Point, James River, Virginia
Tide Predictions (High and Low Waters) April, 2002
NOAA, National Ocean Service

Day	Time	Ht.	Time	Ht.	Time	Ht.	Time	Ht.
1 M	9 L	0.0	558 H	3.4	1300 L	-0.1	1838 H	2.9
2 Tu	58 L	0.1	650 H	3.3	1354 L	0.1	1934 H	2.8
3 W	150 L	0.3	745 H	3.1	1448 L	0.2	2033 H	2.7
4 Th	246 L	0.4	845 H	2.9	1545 L	0.3	2134 H	2.6
5 F	346 L	0.4	950 H	2.8	1641 L	0.4	2233 H	2.6
6 Sa	447 L	0.5	1054 H	2.7	1736 L	0.4	2330 H	2.7

Daylight Saving Time begins at 0200

Day	Time	Ht.	Time	Ht.	Time	Ht.	Time	Ht.
7 Su	647 L	0.5	1253 H	2.7	1928 L	0.4		
8 M	124 H	2.7	743 L	0.4	1347 H	2.7	2016 L	0.4
9 Tu	212 H	2.8	835 L	0.4	1436 H	2.8	2100 L	0.4
10 W	257 H	2.9	923 L	0.3	1520 H	2.8	2139 L	0.4
11 Th	337 H	3.0	1008 L	0.3	1601 H	2.8	2216 L	0.4
12 F	414 H	3.0	1050 L	0.3	1639 H	2.8	2249 L	0.4
13 Sa	446 H	3.1	1130 L	0.3	1714 H	2.8	2320 L	0.4
14 Su	514 H	3.1	1208 L	0.3	1748 H	2.7	2351 L	0.4
15 M	543 H	3.1	1246 L	0.3	1823 H	2.7		
16 Tu	25 L	0.4	617 H	3.2	1324 L	0.4	1900 H	2.7
17 W	103 L	0.5	657 H	3.2	1405 L	0.4	1942 H	2.7
18 Th	148 L	0.5	743 H	3.2	1452 L	0.4	2032 H	2.7
19 F	239 L	0.5	835 H	3.1	1546 L	0.5	2128 H	2.7
20 Sa	339 L	0.5	936 H	3.0	1646 L	0.5	2231 H	2.7
21 Su	449 L	0.5	1044 H	3.0	1748 L	0.4	2335 H	2.8
22 M	604 L	0.5	1155 H	3.0	1849 L	0.4		
23 Tu	37 H	3.0	714 L	0.3	1301 H	3.0	1945 L	0.3
24 W	134 H	3.2	818 L	0.2	1401 H	3.1	2039 L	0.2
25 Th	228 H	3.4	917 L	0.1	1457 H	3.1	2129 L	0.1
26 F	319 H	3.5	1013 L	0.0	1550 H	3.1	2218 L	0.1
27 Sa	407 H	3.6	1106 L	-0.1	1642 H	3.1	2306 L	0.1
28 Su	455 H	3.6	1158 L	-0.1	1733 H	3.1	2354 L	0.1
29 M	543 H	3.6	1248 L	0.0	1824 H	3.0		
30 Tu	43 L	0.2	632 H	3.4	1339 L	0.1	1916 H	2.9

Hopewell, City Point, James River, Virginia
Tide Predictions (High and Low Waters) May, 2002
NOAA, National Ocean Service

Daylight Saving Time

Day		Time		Ht.	Time		Ht.	Time		Ht.	Time		Ht.
1	W	133	L	0.3	723	H	3.3	1429	L	0.2	2010	H	2.8
2	Th	225	L	0.4	818	H	3.1	1521	L	0.3	2107	H	2.8
3	F	320	L	0.5	917	H	2.9	1613	L	0.5	2205	H	2.7
4	Sa	418	L	0.6	1020	H	2.8	1705	L	0.5	2303	H	2.7
5	Su	517	L	0.6	1122	H	2.7	1756	L	0.6	2359	H	2.8
6	M	615	L	0.6	1220	H	2.7	1845	L	0.6			
7	Tu	51	H	2.9	712	L	0.6	1313	H	2.7	1931	L	0.5
8	W	139	H	2.9	804	L	0.5	1402	H	2.7	2014	L	0.5
9	Th	223	H	3.0	854	L	0.4	1447	H	2.7	2054	L	0.5
10	F	302	H	3.1	940	L	0.4	1529	H	2.7	2133	L	0.4
11	Sa	338	H	3.1	1024	L	0.4	1609	H	2.7	2210	L	0.4
12	Su	410	H	3.2	1106	L	0.3	1646	H	2.7	2247	L	0.5
13	M	441	H	3.2	1147	L	0.3	1723	H	2.7	2324	L	0.5
14	Tu	514	H	3.3	1228	L	0.3	1759	H	2.7			
15	W	5	L	0.5	552	H	3.3	1310	L	0.3	1839	H	2.7
16	Th	49	L	0.5	636	H	3.3	1354	L	0.4	1924	H	2.7
17	F	139	L	0.5	725	H	3.2	1441	L	0.4	2015	H	2.8
18	Sa	235	L	0.5	820	H	3.1	1532	L	0.4	2112	H	2.8
19	Su	337	L	0.5	922	H	3.1	1627	L	0.4	2213	H	2.9
20	M	445	L	0.5	1030	H	3.0	1723	L	0.3	2316	H	3.0
21	Tu	555	L	0.4	1138	H	3.0	1819	L	0.3			
22	W	16	H	3.2	701	L	0.3	1242	H	3.0	1915	L	0.2
23	Th	112	H	3.4	803	L	0.2	1342	H	3.0	2008	L	0.2
24	F	205	H	3.5	901	L	0.1	1437	H	3.0	2101	L	0.1
25	Sa	256	H	3.6	956	L	0.0	1531	H	3.0	2152	L	0.1
26	Su	345	H	3.6	1048	L	0.0	1622	H	3.0	2242	L	0.2
27	M	433	H	3.6	1139	L	0.0	1712	H	2.9	2331	L	0.2
28	Tu	521	H	3.5	1228	L	0.0	1802	H	2.9			
29	W	20	L	0.3	609	H	3.3	1315	L	0.2	1852	H	2.8
30	Th	109	L	0.4	659	H	3.2	1402	L	0.3	1943	H	2.8
31	F	159	L	0.5	751	H	3.0	1449	L	0.4	2036	H	2.7

Hopewell, City Point, James River, Virginia
Tide Predictions (High and Low Waters) June, 2002
NOAA, National Ocean Service

Daylight Saving Time

Day	Time	Ht.	Time	Ht.	Time	Ht.	Time	Ht.
1 Sa	250 L	0.6	846 H	2.9	1535 L	0.5	2130 H	2.7
2 Su	344 L	0.6	944 H	2.7	1620 L	0.5	2225 H	2.7
3 M	440 L	0.7	1042 H	2.7	1705 L	0.5	2319 H	2.8
4 Tu	537 L	0.7	1139 H	2.6	1750 L	0.5		
5 W	10 H	2.9	634 L	0.6	1233 H	2.6	1835 L	0.5
6 Th	58 H	2.9	729 L	0.6	1323 H	2.6	1920 L	0.5
7 F	142 H	3.0	820 L	0.5	1410 H	2.6	2005 L	0.5
8 Sa	222 H	3.1	910 L	0.4	1455 H	2.6	2049 L	0.5
9 Su	259 H	3.1	956 L	0.4	1537 H	2.6	2134 L	0.5
10 M	335 H	3.2	1041 L	0.3	1618 H	2.6	2219 L	0.4
11 Tu	412 H	3.2	1125 L	0.3	1657 H	2.7	2305 L	0.4
12 W	452 H	3.3	1209 L	0.2	1738 H	2.7	2352 L	0.4
13 Th	535 H	3.3	1253 L	0.2	1821 H	2.8		
14 F	42 L	0.4	622 H	3.2	1338 L	0.2	1907 H	2.8
15 Sa	135 L	0.4	713 H	3.2	1424 L	0.2	1959 H	2.9
16 Su	232 L	0.4	809 H	3.1	1513 L	0.2	2055 H	2.9
17 M	333 L	0.4	911 H	3.0	1604 L	0.2	2155 H	3.0
18 Tu	437 L	0.4	1016 H	2.9	1657 L	0.2	2255 H	3.1
19 W	543 L	0.3	1122 H	2.9	1751 L	0.2	2354 H	3.3
20 Th	646 L	0.3	1225 H	2.8	1847 L	0.2		
21 F	51 H	3.4	747 L	0.2	1324 H	2.8	1943 L	0.2
22 Sa	145 H	3.5	845 L	0.1	1420 H	2.8	2038 L	0.2
23 Su	236 H	3.5	939 L	0.0	1513 H	2.8	2131 L	0.2
24 M	326 H	3.5	1030 L	0.0	1604 H	2.9	2222 L	0.2
25 Tu	415 H	3.4	1119 L	0.0	1653 H	2.8	2312 L	0.3
26 W	502 H	3.3	1205 L	0.1	1740 H	2.8		
27 Th	0 L	0.3	549 H	3.2	1249 L	0.2	1827 H	2.8
28 F	46 L	0.4	636 H	3.1	1331 L	0.3	1914 H	2.8
29 Sa	132 L	0.5	723 H	2.9	1411 L	0.4	2001 H	2.7
30 Su	218 L	0.5	811 H	2.8	1449 L	0.4	2049 H	2.7

Hopewell, City Point, James River, Virginia
Tide Predictions (High and Low Waters) July, 2002
NOAA, National Ocean Service

Daylight Saving Time

Day		Time		Ht.	Time		Ht.	Time		Ht.	Time		Ht.
1	M	306	L	0.6	902	H	2.7	1526	L	0.5	2139	H	2.7
2	Tu	358	L	0.7	955	H	2.6	1603	L	0.5	2229	H	2.8
3	W	453	L	0.7	1050	H	2.5	1644	L	0.5	2319	H	2.8
4	Th	551	L	0.7	1146	H	2.5	1730	L	0.5			
5	F	8	H	2.9	649	L	0.6	1240	H	2.5	1821	L	0.5
6	Sa	54	H	3.0	745	L	0.5	1331	H	2.5	1915	L	0.5
7	Su	139	H	3.0	837	L	0.4	1420	H	2.5	2010	L	0.5
8	M	222	H	3.1	927	L	0.4	1506	H	2.6	2105	L	0.4
9	Tu	305	H	3.2	1015	L	0.3	1550	H	2.6	2157	L	0.4
10	W	349	H	3.2	1101	L	0.2	1633	H	2.7	2249	L	0.3
11	Th	435	H	3.3	1146	L	0.1	1716	H	2.8	2340	L	0.3
12	F	521	H	3.3	1231	L	0.1	1801	H	2.9			
13	Sa	33	L	0.3	610	H	3.3	1316	L	0.1	1849	H	3.0
14	Su	126	L	0.3	702	H	3.2	1401	L	0.1	1940	H	3.0
15	M	223	L	0.3	757	H	3.1	1448	L	0.1	2035	H	3.1
16	Tu	322	L	0.3	857	H	3.0	1538	L	0.1	2133	H	3.2
17	W	425	L	0.3	1000	H	2.8	1630	L	0.1	2233	H	3.2
18	Th	528	L	0.3	1105	H	2.8	1726	L	0.2	2333	H	3.3
19	F	630	L	0.2	1208	H	2.7	1824	L	0.2			
20	Sa	31	H	3.3	731	L	0.2	1308	H	2.7	1923	L	0.2
21	Su	127	H	3.3	827	L	0.1	1404	H	2.7	2020	L	0.2
22	M	221	H	3.3	920	L	0.1	1457	H	2.8	2115	L	0.2
23	Tu	312	H	3.3	1010	L	0.1	1547	H	2.8	2206	L	0.2
24	W	400	H	3.3	1056	L	0.1	1633	H	2.8	2254	L	0.3
25	Th	446	H	3.2	1140	L	0.2	1718	H	2.9	2339	L	0.3
26	F	530	H	3.1	1220	L	0.2	1801	H	2.8			
27	Sa	22	L	0.4	613	H	3.0	1256	L	0.3	1842	H	2.8
28	Su	104	L	0.5	654	H	2.9	1329	L	0.4	1923	H	2.8
29	M	144	L	0.5	735	H	2.8	1358	L	0.4	2003	H	2.8
30	Tu	226	L	0.6	817	H	2.7	1427	L	0.4	2044	H	2.8
31	W	312	L	0.7	903	H	2.6	1502	L	0.4	2127	H	2.8

Hopewell, City Point, James River, Virginia
Tide Predictions (High and Low Waters) August, 2002
NOAA, National Ocean Service

Daylight Saving Time

Day	Time	Ht.	Time	Ht.	Time	Ht.	Time	Ht.
1 Th	405 L	0.7	956 H	2.5	1545 L	0.5	2215 H	2.9
2 F	504 L	0.7	1054 H	2.4	1634 L	0.5	2307 H	2.9
3 Sa	607 L	0.7	1154 H	2.4	1731 L	0.5		
4 Su	2 H	2.9	707 L	0.6	1251 H	2.5	1834 L	0.5
5 M	56 H	3.0	804 L	0.5	1345 H	2.5	1940 L	0.5
6 Tu	149 H	3.1	857 L	0.4	1434 H	2.6	2042 L	0.4
7 W	241 H	3.2	947 L	0.3	1522 H	2.8	2139 L	0.3
8 Th	330 H	3.3	1034 L	0.2	1607 H	2.9	2234 L	0.2
9 F	419 H	3.3	1120 L	0.1	1653 H	3.0	2327 L	0.2
10 Sa	508 H	3.3	1204 L	0.0	1740 H	3.1		
11 Su	19 L	0.2	557 H	3.3	1249 L	0.0	1827 H	3.2
12 M	113 L	0.2	648 H	3.2	1334 L	0.0	1918 H	3.3
13 Tu	209 L	0.2	742 H	3.1	1421 L	0.1	2011 H	3.3
14 W	307 L	0.3	840 H	2.9	1511 L	0.1	2108 H	3.3
15 Th	408 L	0.3	942 H	2.8	1605 L	0.2	2208 H	3.2
16 F	510 L	0.3	1047 H	2.7	1704 L	0.3	2311 H	3.2
17 Sa	612 L	0.3	1151 H	2.7	1806 L	0.3		
18 Su	13 H	3.2	711 L	0.3	1252 H	2.7	1907 L	0.4
19 M	112 H	3.2	807 L	0.2	1349 H	2.8	2006 L	0.3
20 Tu	208 H	3.2	859 L	0.2	1440 H	2.8	2059 L	0.3
21 W	259 H	3.2	947 L	0.2	1528 H	2.9	2149 L	0.3
22 Th	346 H	3.2	1030 L	0.2	1613 H	2.9	2235 L	0.3
23 F	429 H	3.2	1110 L	0.2	1654 H	3.0	2318 L	0.3
24 Sa	510 H	3.1	1146 L	0.3	1733 H	3.0	2358 L	0.4
25 Su	548 H	3.0	1218 L	0.3	1809 H	3.0		
26 M	36 L	0.5	624 H	2.9	1244 L	0.4	1843 H	3.0
27 Tu	113 L	0.6	659 H	2.8	1309 L	0.4	1915 H	3.0
28 W	150 L	0.6	736 H	2.7	1338 L	0.4	1949 H	3.0
29 Th	231 L	0.7	817 H	2.6	1416 L	0.5	2029 H	3.0
30 F	319 L	0.7	905 H	2.6	1501 L	0.5	2116 H	3.0
31 Sa	418 L	0.8	1002 H	2.5	1553 L	0.6	2211 H	3.0

Hopewell, City Point, James River, Virginia
Tide Predictions (High and Low Waters) September, 2002
NOAA, National Ocean Service

Daylight Saving Time

Day	Time	Ht.	Time	Ht.	Time	Ht.	Time	Ht.
1 Su	525 L	0.7	1107 H	2.5	1655 L	0.6	2314 H	3.0
2 M	631 L	0.7	1211 H	2.5	1805 L	0.6		
3 Tu	20 H	3.0	731 L	0.6	1310 H	2.6	1917 L	0.5
4 W	122 H	3.1	826 L	0.4	1404 H	2.8	2022 L	0.4
5 Th	219 H	3.2	916 L	0.3	1454 H	2.9	2122 L	0.3
6 F	311 H	3.3	1004 L	0.1	1542 H	3.1	2217 L	0.2
7 Sa	401 H	3.4	1050 L	0.0	1629 H	3.3	2311 L	0.1
8 Su	450 H	3.4	1135 L	0.0	1716 H	3.4		
9 M	4 L	0.1	540 H	3.3	1219 L	0.0	1804 H	3.5
10 Tu	57 L	0.1	630 H	3.2	1305 L	0.0	1853 H	3.5
11 W	152 L	0.1	723 H	3.1	1353 L	0.1	1945 H	3.4
12 Th	249 L	0.2	821 H	2.9	1445 L	0.2	2042 H	3.3
13 F	348 L	0.3	923 H	2.8	1542 L	0.3	2143 H	3.2
14 Sa	449 L	0.4	1028 H	2.7	1644 L	0.4	2249 H	3.1
15 Su	550 L	0.4	1133 H	2.7	1748 L	0.4	2355 H	3.0
16 M	648 L	0.4	1234 H	2.7	1850 L	0.4		
17 Tu	57 H	3.0	743 L	0.3	1330 H	2.8	1948 L	0.4
18 W	152 H	3.1	833 L	0.3	1421 H	2.9	2041 L	0.3
19 Th	242 H	3.1	918 L	0.3	1507 H	3.0	2129 L	0.3
20 F	327 H	3.1	959 L	0.3	1549 H	3.0	2214 L	0.3
21 Sa	408 H	3.1	1036 L	0.3	1628 H	3.1	2256 L	0.3
22 Su	446 H	3.0	1110 L	0.3	1704 H	3.1	2335 L	0.4
23 M	522 H	3.0	1138 L	0.3	1735 H	3.1		
24 Tu	12 L	0.4	556 H	2.9	1203 L	0.4	1804 H	3.1
25 W	47 L	0.5	628 H	2.8	1229 L	0.4	1833 H	3.1
26 Th	122 L	0.6	702 H	2.7	1302 L	0.4	1907 H	3.1
27 F	201 L	0.6	741 H	2.6	1342 L	0.5	1948 H	3.1
28 Sa	247 L	0.7	827 H	2.6	1429 L	0.5	2036 H	3.0
29 Su	343 L	0.7	922 H	2.5	1525 L	0.6	2133 H	3.0
30 M	449 L	0.7	1027 H	2.5	1630 L	0.6	2240 H	2.9

Hopewell, City Point, James River, Virginia
Tide Predictions (High and Low Waters) October, 2002
NOAA, National Ocean Service

Day	Time	Ht.	Time	Ht.	Time	Ht.	Time	Ht.
1 Tu	556 L	0.6	1135 H	2.6	1744 L	0.6	2351 H	3.0
2 W	657 L	0.5	1238 H	2.7	1859 L	0.4		
3 Th	57 H	3.1	753 L	0.3	1335 H	2.9	2005 L	0.3
4 F	156 H	3.2	844 L	0.2	1427 H	3.1	2104 L	0.2
5 Sa	250 H	3.2	932 L	0.0	1517 H	3.3	2200 L	0.0
6 Su	341 H	3.3	1019 L	0.0	1605 H	3.5	2254 L	0.0
7 M	431 H	3.3	1104 L	-0.1	1652 H	3.6	2347 L	-0.1
8 Tu	521 H	3.2	1150 L	-0.1	1739 H	3.6		
9 W	40 L	0.0	611 H	3.1	1238 L	0.0	1828 H	3.5
10 Th	133 L	0.0	704 H	2.9	1328 L	0.1	1920 H	3.4
11 F	229 L	0.1	801 H	2.8	1422 L	0.2	2017 H	3.2
12 Sa	326 L	0.3	902 H	2.7	1521 L	0.3	2119 H	3.0
13 Su	424 L	0.3	1006 H	2.6	1623 L	0.4	2227 H	2.9
14 M	522 L	0.4	1110 H	2.6	1726 L	0.4	2334 H	2.8
15 Tu	619 L	0.4	1210 H	2.6	1827 L	0.4		
16 W	35 H	2.8	711 L	0.3	1306 H	2.7	1924 L	0.3
17 Th	129 H	2.9	759 L	0.3	1356 H	2.8	2017 L	0.3
18 F	218 H	2.9	843 L	0.2	1441 H	2.9	2105 L	0.3
19 Sa	302 H	2.9	923 L	0.2	1522 H	3.0	2150 L	0.2
20 Su	342 H	2.9	959 L	0.2	1559 H	3.0	2232 L	0.2
21 M	420 H	2.8	1032 L	0.2	1632 H	3.0	2312 L	0.3
22 Tu	456 H	2.8	1102 L	0.2	1702 H	3.0	2350 L	0.3
23 W	529 H	2.7	1130 L	0.3	1730 H	3.0		
24 Th	26 L	0.4	602 H	2.6	1201 L	0.3	1800 H	3.0
25 F	103 L	0.4	636 H	2.6	1238 L	0.3	1836 H	3.0
26 Sa	143 L	0.4	715 H	2.5	1320 L	0.4	1920 H	3.0
Standard Time begins								
27 Su	128 L	0.5	701 H	2.5	1310 L	0.4	1910 H	2.9
28 M	222 L	0.5	755 H	2.5	1408 L	0.4	2008 H	2.9
29 Tu	322 L	0.5	858 H	2.5	1515 L	0.4	2115 H	2.8
30 W	423 L	0.4	1005 H	2.6	1630 L	0.4	2227 H	2.8
31 Th	522 L	0.3	1109 H	2.7	1742 L	0.3	2333 H	2.9

Hopewell, City Point, James River, Virginia
Tide Predictions (High and Low Waters) November, 2002
NOAA, National Ocean Service

Standard Time

Day	Time	Ht.	Time	Ht.	Time	Ht.	Time	Ht.
1 F	618 L	0.1	1207 H	2.9	1847 L	0.1		
2 Sa	33 H	3.0	710 L	0.0	1301 H	3.1	1947 L	0.0
3 Su	129 H	3.0	800 L	-0.1	1352 H	3.3	2043 L	-0.1
4 M	221 H	3.0	849 L	-0.2	1441 H	3.4	2137 L	-0.2
5 Tu	312 H	3.0	937 L	-0.2	1529 H	3.5	2230 L	-0.2
6 W	402 H	2.9	1026 L	-0.2	1617 H	3.4	2322 L	-0.2
7 Th	453 H	2.8	1115 L	-0.1	1706 H	3.3		
8 F	14 L	-0.1	545 H	2.7	1207 L	0.0	1758 H	3.2
9 Sa	106 L	0.0	640 H	2.6	1301 L	0.1	1854 H	3.0
10 Su	200 L	0.1	737 H	2.5	1358 L	0.2	1955 H	2.8
11 M	254 L	0.2	838 H	2.5	1457 L	0.3	2059 H	2.7
12 Tu	348 L	0.3	939 H	2.5	1558 L	0.3	2203 H	2.6
13 W	440 L	0.3	1038 H	2.5	1657 L	0.3	2303 H	2.5
14 Th	530 L	0.2	1133 H	2.6	1754 L	0.3	2357 H	2.5
15 F	617 L	0.2	1223 H	2.6	1847 L	0.2		
16 Sa	45 H	2.5	701 L	0.1	1308 H	2.7	1936 L	0.2
17 Su	131 H	2.5	741 L	0.1	1349 H	2.8	2023 L	0.1
18 M	213 H	2.5	819 L	0.1	1427 H	2.8	2107 L	0.1
19 Tu	253 H	2.5	855 L	0.1	1500 H	2.8	2148 L	0.1
20 W	330 H	2.5	931 L	0.1	1531 H	2.9	2229 L	0.1
21 Th	405 H	2.4	1006 L	0.1	1602 H	2.9	2308 L	0.1
22 F	440 H	2.4	1044 L	0.1	1636 H	2.9	2348 L	0.1
23 Sa	516 H	2.4	1125 L	0.2	1716 H	2.9		
24 Su	30 L	0.2	556 H	2.4	1211 L	0.2	1802 H	2.8
25 M	115 L	0.2	642 H	2.4	1303 L	0.2	1853 H	2.8
26 Tu	204 L	0.2	736 H	2.4	1401 L	0.2	1952 H	2.7
27 W	257 L	0.1	836 H	2.4	1507 L	0.2	2057 H	2.7
28 Th	352 L	0.1	939 H	2.5	1617 L	0.1	2205 H	2.6
29 F	448 L	0.0	1042 H	2.7	1726 L	0.0	2310 H	2.6
30 Sa	543 L	-0.1	1140 H	2.9	1830 L	-0.1		

Hopewell, City Point, James River, Virginia
Tide Predictions (High and Low Waters) December, 2002
NOAA, National Ocean Service

Standard Time

Day	Time		Ht.	Time		Ht.	Time		Ht.	Time		Ht.
1 Su	11	H	2.6	638	L	-0.2	1236	H	3.0	1930	L	-0.2
2 M	108	H	2.7	731	L	-0.3	1328	H	3.1	2027	L	-0.3
3 Tu	202	H	2.7	824	L	-0.3	1419	H	3.2	2121	L	-0.4
4 W	254	H	2.7	916	L	-0.3	1509	H	3.2	2213	L	-0.4
5 Th	344	H	2.6	1007	L	-0.3	1558	H	3.1	2303	L	-0.3
6 F	435	H	2.6	1058	L	-0.2	1648	H	3.0	2353	L	-0.3
7 Sa	525	H	2.5	1149	L	-0.2	1739	H	2.9			
8 Su	42	L	-0.2	617	H	2.4	1240	L	-0.1	1833	H	2.7
9 M	130	L	-0.1	710	H	2.4	1332	L	0.0	1928	H	2.6
10 Tu	218	L	0.0	805	H	2.3	1426	L	0.1	2026	H	2.4
11 W	305	L	0.1	901	H	2.3	1522	L	0.1	2125	H	2.3
12 Th	352	L	0.1	957	H	2.3	1619	L	0.2	2222	H	2.3
13 F	438	L	0.1	1051	H	2.4	1716	L	0.2	2316	H	2.2
14 Sa	524	L	0.1	1141	H	2.4	1811	L	0.1			
15 Su	7	H	2.2	609	L	0.1	1228	H	2.5	1903	L	0.1
16 M	55	H	2.2	653	L	0.0	1311	H	2.5	1952	L	0.0
17 Tu	141	H	2.2	738	L	0.0	1350	H	2.6	2039	L	0.0
18 W	223	H	2.2	822	L	0.0	1427	H	2.6	2124	L	-0.1
19 Th	304	H	2.2	906	L	0.0	1503	H	2.6	2207	L	-0.1
20 F	342	H	2.2	950	L	0.0	1540	H	2.7	2249	L	-0.1
21 Sa	419	H	2.2	1034	L	-0.1	1620	H	2.7	2331	L	-0.1
22 Su	458	H	2.3	1120	L	-0.1	1703	H	2.7			
23 M	14	L	-0.1	540	H	2.3	1208	L	-0.1	1750	H	2.7
24 Tu	58	L	-0.1	626	H	2.4	1300	L	-0.1	1842	H	2.6
25 W	143	L	-0.2	718	H	2.4	1357	L	-0.1	1939	H	2.6
26 Th	231	L	-0.2	815	H	2.5	1458	L	-0.1	2040	H	2.5
27 F	322	L	-0.2	914	H	2.6	1604	L	-0.1	2145	H	2.4
28 Sa	416	L	-0.2	1015	H	2.7	1710	L	-0.1	2249	H	2.4
29 Su	513	L	-0.3	1115	H	2.8	1813	L	-0.2	2351	H	2.4
30 M	611	L	-0.3	1212	H	2.9	1914	L	-0.3			
31 Tu	49	H	2.4	709	L	-0.3	1308	H	2.9	2010	L	-0.4

Appendix F: **Sample Pressure Transducer Tidal Heights**

Table F.1 Sample Unprocessed Tidal Heights

Date	Time	Depth (ft)	Date	Time	Depth (ft)
5/22	11:30	12.8785	5/23	8:30	13.1370
5/22	12:00	12.6769	5/23	9:00	13.3167
5/22	12:30	12.4841	5/23	9:30	13.4569
5/22	13:00	12.2826	5/23	10:00	13.5577
5/22	13:30	12.0723	5/23	10:30	13.5927
5/22	14:00	11.8795	5/23	11:00	13.5621
5/22	14:30	11.7042	5/23	11:30	13.4613
5/22	15:00	11.5333	5/23	12:00	13.3035
5/22	15:30	11.3712	5/23	12:30	13.1195
5/22	16:00	11.2178	5/23	13:00	12.9267
5/22	16:30	11.1652	5/23	13:30	12.7120
5/22	17:00	11.1915	5/23	14:00	12.5411
5/22	17:30	11.4150	5/23	14:30	12.3483
5/22	18:00	11.7480	5/23	15:00	12.1643
5/22	18:30	12.0723	5/23	15:30	11.9890
5/22	19:00	12.3921	5/23	16:00	11.8488
5/22	19:30	12.6594	5/23	16:30	11.7261
5/22	20:00	12.8697	5/23	17:00	11.6341
5/22	20:30	13.0494	5/23	17:30	11.6472
5/22	21:00	13.1546	5/23	18:00	11.8050
5/22	21:30	13.2378	5/23	18:30	12.0635
5/22	22:00	13.2378	5/23	19:00	12.3483
5/22	22:30	13.1721	5/23	19:30	12.6419
5/22	23:00	13.0143	5/23	20:00	12.8741
5/22	23:30	12.8654	5/23	20:30	13.1107
5/23	0:00	12.6769	5/23	21:00	13.3079
5/23	0:30	12.4841	5/23	21:30	13.4700
5/23	1:00	12.2870	5/23	22:00	13.6146
5/23	1:30	12.0854	5/23	22:30	13.6935
5/23	2:00	11.8926	5/23	23:00	13.7023
5/23	2:30	11.7217	5/23	23:30	13.6409
5/23	3:00	11.5859	5/24	0:00	13.5358
5/23	3:30	11.4413	5/24	0:30	13.3824
5/23	4:00	11.3361	5/24	1:00	13.1809
5/23	4:30	11.2660	5/24	1:30	13.0363
5/23	5:00	11.2748	5/24	2:00	12.8391
5/23	5:30	11.4719	5/24	2:30	12.6507
5/23	6:00	11.7787	5/24	3:00	12.4447
5/23	6:30	12.0898	5/24	3:30	12.2913
5/23	7:00	12.4009	5/24	4:00	12.1205
5/23	7:30	12.6857	5/24	4:30	11.9671
5/23	8:00	12.9355	5/24	5:00	11.8137

Table F.1 Sample Unprocessed Tidal Heights (cont.)

Date	Time	Depth (ft)	Date	Time	Depth (ft)
5/24	5:30	11.7436	5/25	2:30	12.9092
5/24	6:00	11.7392	5/25	3:00	12.6989
5/24	6:30	11.8663	5/25	3:30	12.5104
5/24	7:00	12.1161	5/25	4:00	12.3133
5/24	7:30	12.3877	5/25	4:30	12.1205
5/24	8:00	12.6463	5/25	5:00	11.9452
5/24	8:30	12.8697	5/25	5:30	11.7787
5/24	9:00	13.0888	5/25	6:00	11.6472
5/24	9:30	13.2641	5/25	6:30	11.5464
5/24	10:00	13.3999	5/25	7:00	11.5201
5/24	10:30	13.4788	5/25	7:30	11.6428
5/24	11:00	13.5139	5/25	8:00	11.8882
5/24	11:30	13.4788	5/25	8:30	12.1774
5/24	12:00	13.3780	5/25	9:00	12.4491
5/24	12:30	13.2291	5/25	9:30	12.6857
5/24	13:00	13.0538	5/25	10:00	12.9048
5/24	13:30	12.8741	5/25	10:30	13.0845
5/24	14:00	12.6857	5/25	11:00	13.2203
5/24	14:30	12.4798	5/25	11:30	13.3255
5/24	15:00	12.2957	5/25	12:00	13.3737
5/24	15:30	12.1073	5/25	12:30	13.3605
5/24	16:00	11.9145	5/25	13:00	13.2773
5/24	16:30	11.7611	5/25	13:30	13.1458
5/24	17:00	11.6078	5/25	14:00	12.9442
5/24	17:30	11.4895	5/25	14:30	12.7821
5/24	18:00	11.4018	5/25	15:00	12.5805
5/24	18:30	11.3887	5/25	15:30	12.3834
5/24	19:00	11.5333	5/25	16:00	12.1643
5/24	19:30	11.8356	5/25	16:30	11.9846
5/24	20:00	12.1292	5/25	17:00	11.8006
5/24	20:30	12.4535	5/25	17:30	11.6560
5/24	21:00	12.7383	5/25	18:00	11.5289
5/24	21:30	12.9793	5/25	18:30	11.4413
5/24	22:00	13.1721	5/25	19:00	11.4588
5/24	22:30	13.3342	5/25	19:30	11.6428
5/24	23:00	13.4788	5/25	20:00	11.9583
5/24	23:30	13.5533	5/25	20:30	12.2782
5/25	0:00	13.5664	5/25	21:00	12.5893
5/25	0:30	13.5358	5/25	21:30	12.8917
5/25	1:00	13.4394	5/25	22:00	13.1370
5/25	1:30	13.2773	5/25	22:30	13.3561
5/25	2:00	13.0888	5/25	23:00	13.5708

<u>Appendix G:</u> VITA

Andrew J. Hammond, II was born on May 26, 1980 in Richmond, Virginia. He attended Essex County Public Schools and graduated from Essex High School located in Tappahannock, Virginia in June 1998. In August 1998 Andrew enrolled in Virginia Tech and received a Bachelor of Science degree in Civil Engineering in December 2002. He was employed as an Engineering and Surveying Intern with J. L. Howeth, P.C. in Tappahannock, Virginia during the summers of 1999, 2000, 2001, and 2002. Virginia Tech's Department of Civil and Environmental Engineering also employed Andrew as a Civil and Environmental Engineering Computer Lab (CEECL) consultant during the Fall 2001, Spring 2002, and Fall 2002 semesters. Andrew began his graduate study at Virginia Tech in August 2002 as a dual enrolled student in the Hydrosystems program area within Civil Engineering. He completed all necessary course work in May 2004 and successfully defended his thesis on September 9, 2004. Andrew is currently working as a full-time Project Engineer with Paciulli, Simmons and Associates in Leesburg, Virginia.