

ASSESSING THE ON-GOING IMPACTS OF HUMAN ACTIVITIES TO
WATER QUALITY IN THE HARRIS NECK ESTUARY IN MCINTOSH
COUNTY, GEORGIA



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INTRODUCTION

In October 2008, the University of Georgia Marine Extension Service (UGA MAREX) received funding from the Georgia Department of Natural Resources' Coastal Incentive Grant program to evaluate water quality in the Harris Neck estuary. The project was designed to assess water quality in the area prior to development to form a scientifically valid baseline of water quality as a standard for future comparisons. The study area included the Julienton River, Little Mud River and several small tributaries adjacent to the Harris Neck peninsula. Six stations were chosen for monitoring (Figure 1) and sample collection took place monthly from December 2008 through October 2009. In June 2009, a sediment study was conducted at the six monitoring sites as well as an additional four sites. Quarterly, continuously monitoring data loggers were deployed at selected sites to record temperature, salinity, pH, dissolved oxygen and turbidity for one to two weeks at a time. Assessment criteria for the project were based on values used by the National Park Service (NPS) in their Coastal Assessment Program. The NPS Southeast Coast Network slightly modified the indices for water and sediment quality used by the Environmental Protection Agency (EPA) for their National Coastal Assessment Program.

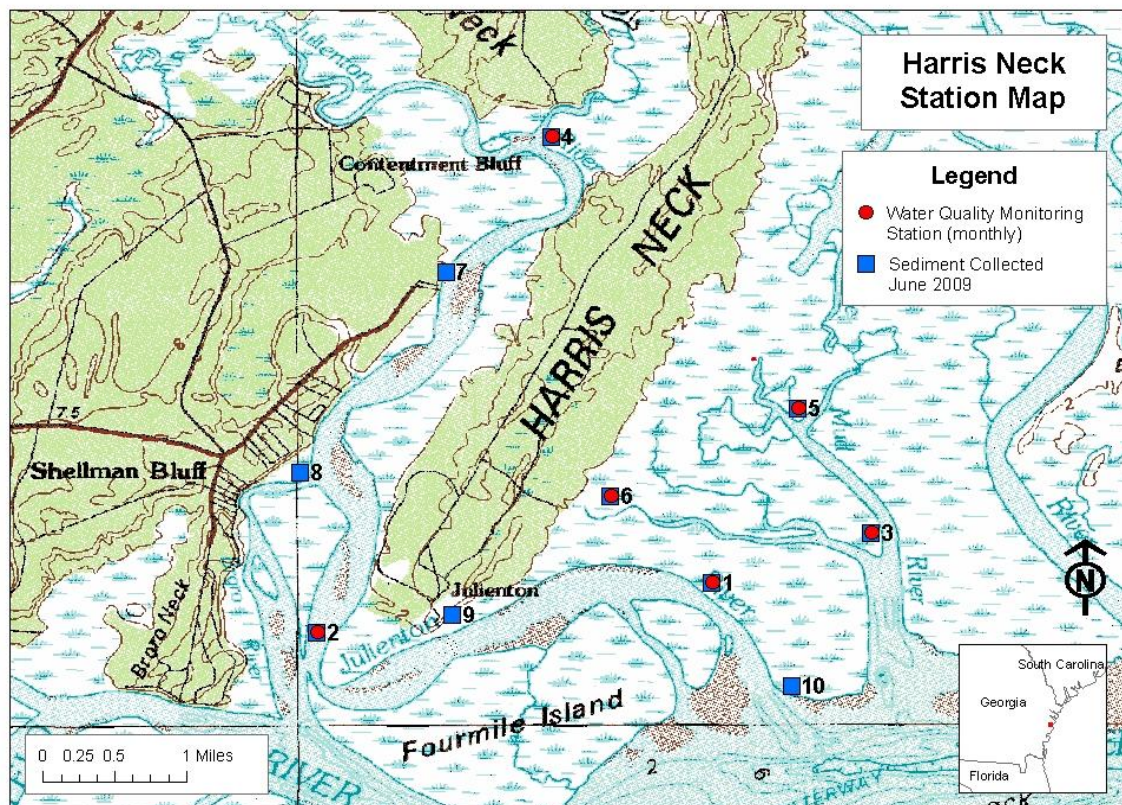


Figure 1. Map of water quality monitoring locations and sediment sampling sites around Harris Neck. Image provided by Doug Atkinson, UGA Marine Extension Service.

FIELD METHODS

Six water quality monitoring sites were selected in the Harris Neck area. Three sites were chosen along the Julinton River (sites 1, 2 and 4), wrapping from southeast to northwest around the southern end of the Harris Neck peninsula. Three sites (sites 3, 5, and 6) were chosen in smaller tributaries, Little Mud River and Shell Creek. These six water quality sites were monitored monthly from December 2008 to October 2009. Sediment was collected from the six monitoring sites and four additional locations, sites 7-10, in June 2009. Sediment samples were analyzed for organic contaminants, trace metals, total organic carbon (TOC) and grain size. During regular monthly water quality monitoring, a Hydrolab Quanta[®] was used to collect water column profiles – temperature, salinity, pH, dissolved oxygen, and conductivity – at each station. Secchi depth was recorded at each site and values were used to evaluate water clarity. Water samples – surface, mid-depth and bottom water, depending on station depth – were collected and filtered for analysis of total dissolved nitrogen (TDN) and total dissolved phosphorous (TDP). The filter was retained for analysis of chlorophyll *a*. TDN, TDP, and chlorophyll *a* samples were held on dry ice in the field and stored at -20 degC in the laboratory prior to analysis. Samples were also collected for total suspended solids (TSS) determination. These were processed within 24 hours of sampling. Sterile water samples were collected for enumeration of fecal coliform bacteria and Enterococci populations within 24 hours of collection. Field procedures followed were those set forth by the NPS Southeast Coast Network for their Coastal Assessment Program (modified from EPA's Quality Assurance Project Plan used during the National Coastal Assessment Program).



Figure 2. Filtration set up for TDN, TDP and chlorophyll *a*.



Figure 3. Measuring secchi depth at a water quality monitoring site.

Hydrolab Datasonde[®] instruments were used to collect continuous water quality measurements for one to two weeks at a time (depending on water temperature) at several locations in the Harris Neck study area. A 70lb weight was used to secure the instrument at a chosen location. A float was suspended underwater near the top of the instrument to keep it vertical in the water column. A second float, visible from the surface at low tide and sometimes at high tide, was used to keep the deployment line stretched tight in the water column. A third float was used on a tag line to help in relocating the instrument. The table below summarizes the deployment events during the project period. Data for the September 2009 deployment can be seen graphically in Figures 7-9.



Figure 4. Datasonde deployment configuration.



Figure 5. Lowering instrument into the river.



Figure 6. Second float visible from the surface and tag line Used to relocate the instrument at the end of the deployment period.

Table 1. Summary of Datasonde deployments in the Harris Neck Estuary.

Dates of Deployment	Deployment Locations	Notes
12/3/2008 – 12/17/08	S/N 44201 at station 2 S/N 44202 at station 4	S/N 44201 – dissolved oxygen values low, calibration in question
3/3/09 – 3/17/09	S/N 44202 at station 2 S/N 44201 at station 4	S/N 44201 – turbidity readings questionable; instrument sent in for repair S/N 44202 – instrument lost in field, replaced by UGA Risk Management
6/9/09 – 6/16/09	S/N 39027 at station 4	instrument extremely fouled upon retrieval; data beyond 6/16/09 unusable
9/8/09 – 9/15/09	S/N 44201 at station 3 S/N 48174 at station 4	S/N 44201 – new turbidity sensor S/N 48174 – brand new instrument
10/15/09 – 10/23/10	S/N 44201 at station 4 S/N 48174 at 31.56467°N, 81.25686°W	

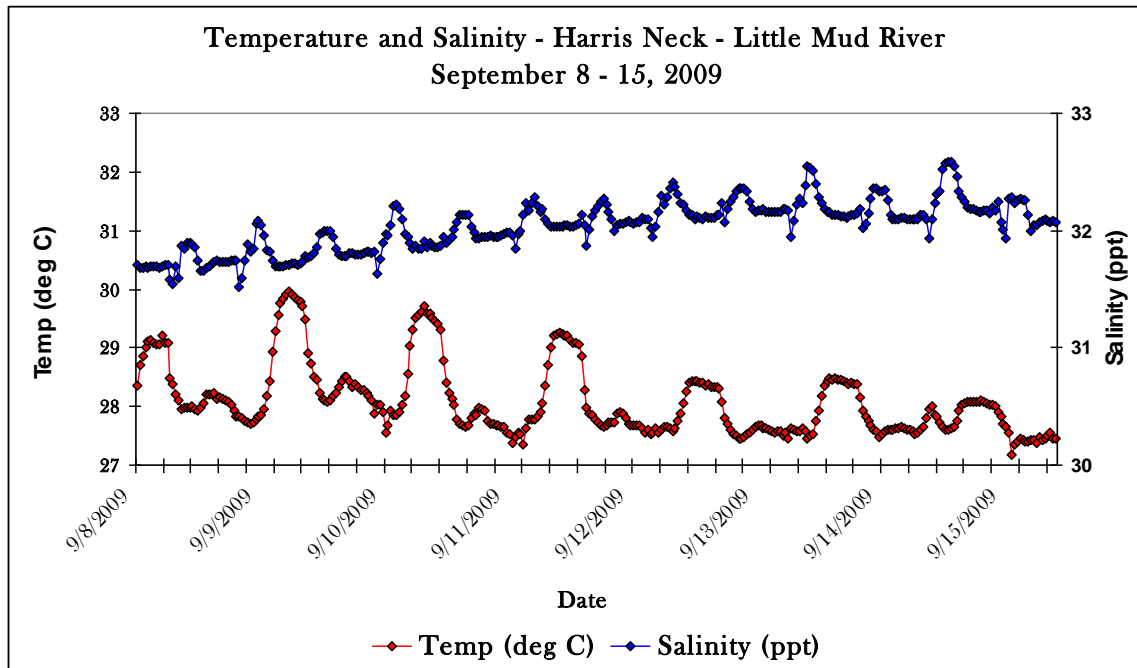


Figure 7. Temperature and salinity measured in Little Mud River from September 8-15, 2009.

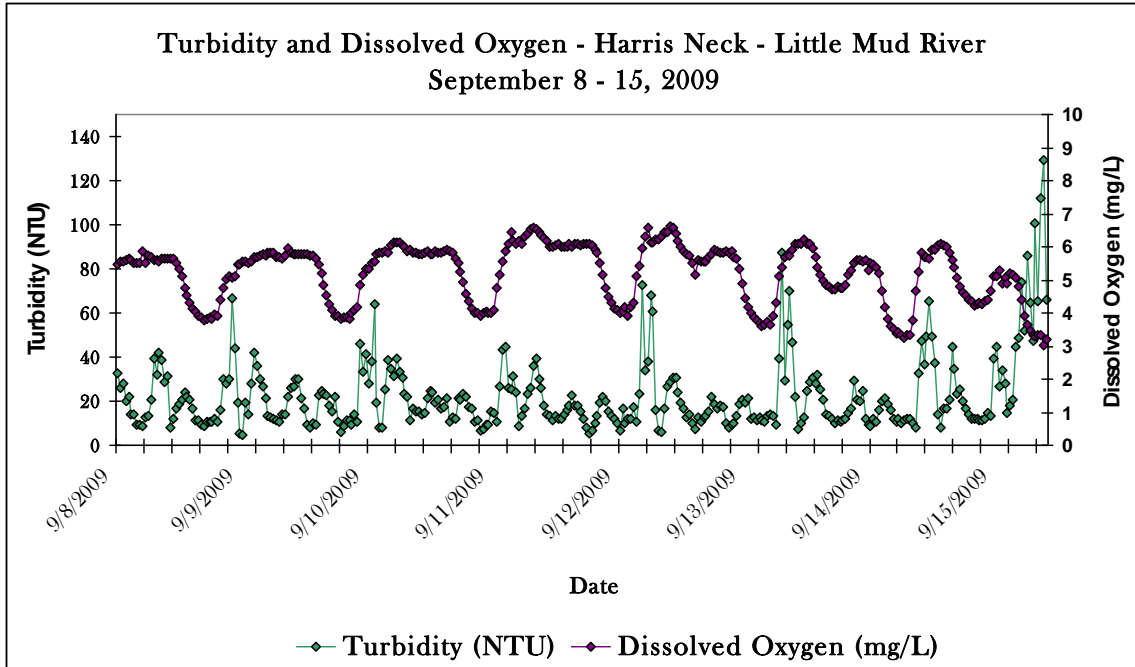


Figure 8. Turbidity and dissolved oxygen measured in Little Mud River from September 8-15, 2009.

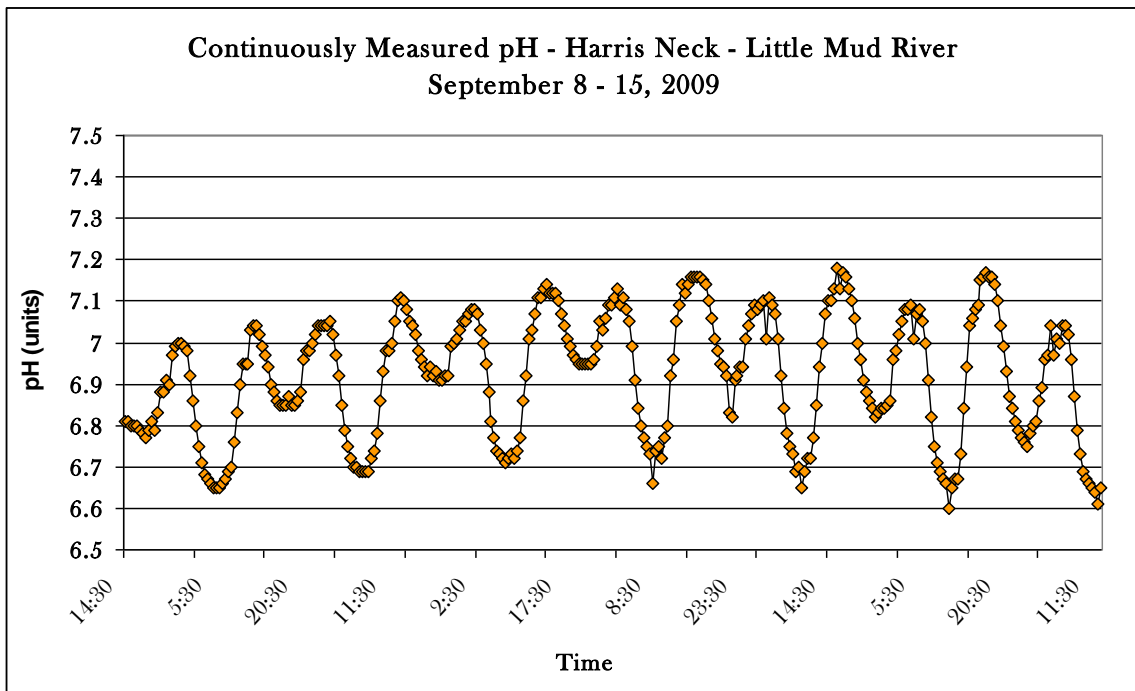


Figure 9. Continuous measurements of pH in Little Mud River from September 8-15, 2009.

WATER QUALITY INDEX

The EPA water quality index is made up of five indicators: nitrogen, phosphorous, chlorophyll *a*, water clarity, and dissolved oxygen. The EPA's National Coastal Condition Report II (NCCR II) describes criteria for nitrogen and phosphorous in terms of dissolved inorganic nitrogen (DIN) and dissolved inorganic phosphorous (DIP). The NPS Southeast Coast Network (SECN) followed the EPA criteria for their Coastal Assessment, but used total *dissolved* nitrogen (TDN) and total *dissolved* phosphorous (TDP) as indicators. The water quality in the Harris Neck area was evaluated based on the SECN assessment criteria.

Table 2. Criteria for Determining the Water Quality Index Rating by Site (National Coastal Condition Report II, December 2004).

Rating	Criteria
Good	A maximum of one indicator is fair, and no indicators are poor.
Fair	One or more of the indicators is rated poor, or two or more indicators are rated fair.
Poor	Two or more of the five indicators are rated poor.
Missing	Two components of the indicator are missing, and the available indicators do not suggest a fair or poor rating.

The following tables (3-7) contain water quality data used to assess overall water quality in the Harris Neck estuary. Total Dissolved Nitrogen (TDN) received a rating of 'Fair,' with 80.38% of TDN results falling in the '0.1-0.5 mg/L' range set by the EPA. Total Phosphorous received a rating of 'Poor,' with 56.96% of TDP results falling in the 'greater than 0.05 mg/L' range set by the EPA. Chlorophyll *a* received a rating of 'Fair,' with 79.19% of results falling in the '5-20 ug/L' range set by the EPA. Water clarity received a rating of 'Good' with 87.88% of results falling in the 'less than 2.30' range set by the EPA. Finally, dissolved oxygen received a rating of 'Good' with 69.70% of results falling in the 'greater than 5 mg/L' range set by the EPA. Overall, the Harris Neck estuary received a water quality rating of 'Fair,' based on the EPA criteria described in Table 2. This rating was due to the fact that TDP received a rating of 'Poor.' Since there is not much development in this area, the TDP values may be from a naturally high phosphorous background in the sediment of the marshes. Further investigation of this area could help to reveal potential sources of high phosphorous in the area.

TABLE 3. TOTAL DISSOLVED NITROGEN – HARRIS NECK ESTUARY

East/Gulf Coast Site Assessment Criteria:		Regional Scores:										
Good	<0.1 mg/L	< 10% area in poor condition, and >50% area in good condition										
Fair	0.1-0.5 mg/L	10% - 25% area in poor condition, or more than 50% area in combined poor and fair condition										
Poor	>0.5 mg/L	>25% area in poor condition										
Station ID	TDN (mg/L)	TDN (mg/L)	TDN (mg/L)	TDN (mg/L)	TDN (mg/L)	TDN (mg/L)	TDN (mg/L)	TDN (mg/L)	TDN (mg/L)	TDN (mg/L)	TDN (mg/L)	TDN (mg/L)
	12/3/2008	1/8/2009	2/3/2009	3/3/2009	4/7/2009	5/5/2009	6/2/2009	7/6/2009	8/4/2009	9/8/2009	10/6/2009	
1S	0.2545	0.2384	0.3335	0.1215	0.697	0.3573	0.3327	No data	0.4031	0.2998	0.3331	
1M	0.2062	0.2443	0.2422	0.2142	0.7042	0.4648	0.3165	No data	0.3189	0.3084	0.3169	
1B	0.1947	0.2694	0.2574	0.1619	0.5227	0.5274	0.3189	No data	0.358	0.3882	0.3177	
2S	0.2946	0.3454	0.3666	0.2558	0.519	0.2211	0.4031	No data	0.3842	0.312	0.3435	
2M	0.2139	0.3189	0.2513	0.4226	0.567	0.3944	0.4308	No data	0.3811	0.3597	0.3371	
2B	0.1149	0.2825	0.4297		0.5028	0.1688	0.6276	No data	0.6786	0.3723	0.2004	
3S	0.2301	0.2796	0.2537	0.2348	0.4337	0.5696	0.3484	No data	0.5662	0.3226	0.2807	
3M	0.2486						0.367	No data	0.4707	0.3542	0.2862	
3B	0.2331	0.2959	0.2351	0.1952	0.4216	0.4741	0.3221	No data	0.5899	0.3606	0.3051	
4S	0.2729	0.3165	0.6087	0.5072	0.6493	0.8023	0.618	No data	0.6664	0.4666	0.4273	
4M	0.2085	0.2756	0.5969	0.3437		0.3577	0.6682	No data	0.5422	0.941	0.4112	
4B	0.521	0.4943	0.1165	0.3186	0.5887	0.4314	0.6718	No data	0.515	0.4563	0.3942	
5S	0.2893	0.347	0.2161	0.1634	0.3376	0.3921	0.3491	No data	0.3957	0.3232	0.3467	
5M	0.0608	0.3598	0.2051	0.28	0.2931	0.386	0.3324	No data		0.4062	0.3249	
5B	0.0516	0.1657	0.1956	0.3293	0.3568	0.2194	0.3261	No data	0.2744	0.3795	0.3172	
6S		0.9637	0.1664	0.3227	0.6628			No data		0.4262		
6M	0.0481		0.2573			0.411	0.3541	No data	0.4798	0.4454	0.2011	
6B		0.3688		0.3266	0.2687			No data		0.334		
N =	16	16	16	15	15	15	16	0	15	18	16	
TDN results	Good	Fair	Poor	Total								
N=158	1.90%	80.38%	17.72%	100.00%								

TABLE 4. TOTAL DISSOLVED PHOSPHOROUS – HARRIS NECK ESTUARY

East/Gulf Coast Site		Regional Scores:										
Assessment Criteria:												
Good	<0.01 mg/L	< 10% area in poor condition, and >50% area in good condition										
Fair	0.01-0.05 mg/L	10% - 25% area in poor condition, or more than 50% area in combined poor and fair condition										
Poor	>0.05 mg/L	>25% area in poor condition										
Station ID	TDP (mg/L)	TDP (mg/L)	TDP (mg/L)	TDP (mg/L)	TDP (mg/L)	TDP (mg/L)	TDP (mg/L)	TDP (mg/L)	TDP (mg/L)	TDP (mg/L)	TDP (mg/L)	TDP (mg/L)
	12/3/2008	1/8/2009	2/3/2009	3/3/2009	4/7/2009	5/5/2009	6/2/2009	7/6/2009	8/4/2009	9/8/2009	10/6/2009	
1S	0.047	0.043	0.033	0.028	0.031	0.033	0.033	No data	0.076	0.059	0.067	
1M	0.049	0.038	0.047	0.044	0.044	0.035	0.031	No data	0.078	0.063	0.065	
1B	0.043	0.035	0.041	0.043	0.042	0.024	0.035	No data	0.082	0.067	0.06	
2S	0.059	0.054	0.056	0.047	0.036	0.043	0.048	No data	0.091	0.062	0.069	
2M	0.055	0.045	0.061	0.054	0.041	0.026	0.047	No data	0.09	0.057	0.074	
2B	0.088	0.047	0.066		0.044	0.032	0.049	No data	0.084	0.083	0.073	
3S	0.059	0.04	0.04	0.034	0.035	0.033	0.033	No data	0.092	0.07	0.057	
3M	0.065						0.031	No data	0.088	0.07	0.066	
3B	0.052	0.036	0.053	0.028	0.041	0.039	0.028	No data	0.087	0.083	0.071	
4S	0.054	0.083	0.077	0.068	0.051	0.053	0.063	No data	0.092	0.085	0.089	
4M	0.064	0.084	0.081	0.075		0.068	0.064	No data	0.12	0.074	0.089	
4B	0.066	0.096	0.076	0.061	0.046	0.05	0.062	No data	0.12	0.08	0.008	
5S	0.071	0.042	0.033	0.042	0.039	0.037	0.035	No data	0.098	0.062	0.077	
5M	0.072	0.045	0.025	0.053	0.036	0.033	0.034	No data		0.063	0.068	
5B	0.076	0.081	0.03	0.038	0.046	0.033	0.055	No data	0.105	0.065	0.076	
6S		0.072	0.033	0.042	0.048			No data		0.064		
6M	0.07					0.055	0.053	No data	0.153	0.065	0.078	
6B		0.073	0.026	0.041	0.052			No data		0.056		
N =	16	16	16	15	15	15	16	0	15	18	16	
TDP results	Good	Fair	Poor	Total								
N=158	0.63%	42.41%	56.96%	100.00%								

TABLE 5. CHLOROPHYLL A – HARRIS NECK ESTUARY

East/Gulf Coast Site Assessment Criteria:		Regional Scores:										
Good	<5 ug/L	< 10% area in poor condition, and >50% area in good condition										
Fair	5-20 ug/L	10% - 20% area in poor condition, or more than 50% area in combined poor and fair condition										
Poor	>20 ug/L	>20% area in poor condition										
Sample ID	Chl-a (ug/L)	Chl-a (ug/L)	Chl-a (ug/L)	Chl-a (ug/L)	Chl-a (ug/L)	Chl-a (ug/L)	Chl-a (ug/L)	Chl-a (ug/L)	Chl-a (ug/L)	Chl-a (ug/L)	Chl-a (ug/L)	
	12/3/2008	1/8/2009	2/3/2009	3/3/2009	4/7/2009	5/5/2009	6/2/2009	7/6/2009	8/4/2009	9/8/2009	10/6/2009	
1S	4.65	9.84	6.85	5.36	10.93	17.08	18.99	13.4	10.8	5.7	7.1	
1M	6.08	9.11	6.08	5.38	11.96	13.70	19.12	13.8	12.6	7.6	8.7	
1B	4.10	8.84	6.57	6.26	13.03	13.91	18.16	15.5	12.8	4.7	9.5	
2S	8.50	9.51	4.98	5.93	15.18	13.30	15.38	24.1	15.6	8.0	7.5	
2M	9.14	8.40	6.14	6.88	14.79	9.28	11.05	21.5	16.7	7.1	7.1	
2B	8.36	9.27	5.94	5.43	13.58	14.72	13.01	21.1	17.3		7.0	
3S	4.90	9.31	5.82	4.46	8.21	14.47	28.67	13.7	12.5	9.6	5.9	
3M	4.92						21.95		10.8	9.4	7.8	
3B	3.86	7.34	6.24	5.70	9.77	12.39	19.24	12.7	12.0	11.4	6.5	
4S	7.17	15.72	9.00	6.87	31.52	9.87	9.74	21.0	13.4	9.1	6.7	
4M	7.21	17.63	6.63	6.47		7.64	9.87	22.0	14.1	9.9	10.0	
4B	6.74	14.51	6.90	6.09	10.26	8.05	7.94	22.9	16.6	10.1	7.6	
5S	2.93	7.31	1.60	2.22	9.12	15.47	20.76	24.3	24.6	8.8	6.9	
5M	2.87	6.49	5.31	3.48	8.89	14.32	19.92	23.5		7.8	5.7	
5B	3.52	5.62	6.11	4.30	6.89	12.83	18.57	18.0	20.3	10.4	6.2	
6S		5.31	3.80	3.77	19.86					7.5		
6M	3.21					19.51	19.50	29.1	22.0	8.5	6.2	
6B		4.17	5.73	3.30	13.82					9.0		
6M DUP						18.26						
N=	16	16	16	16	15	15	16	15	15	17	16	
Chl-a results	Good	Fair	Poor	Total								
N=173	11.56%	79.19%	9.25%	100.00%								

TABLE 6. WATER CLARITY – HARRIS NECK ESTUARY

WCI	Light attenuation coefficient (k)										
Turbidity class	Good	Fair	Poor								
High (a=1.0)	<2.30	2.30-2.99	>2.99								
Date	12/3/2008	1/8/2009	2/3/2009	3/3/2009	4/7/2009	5/5/2009	6/2/2009	7/6/2009	8/4/2009	9/8/2009	10/6/2009
Station	Secchi (m)	Secchi (m)	Secchi (m)	Secchi (m)	Secchi (m)	Secchi (m)	Secchi (m)	Secchi (m)	Secchi (m)	Secchi (m)	Secchi (m)
1	1.47	1.02	0.81	0.86	0.35	0.47	0.78	0.96	0.76	1.21	0.80
2	1.27	1.20	1.23	0.85	0.68	0.38	0.61	0.79	0.59	1.08	1.03
3	1.04	0.81	0.55	0.85	0.31	0.38	0.82	0.72	0.79	0.60	0.92
4	1.44	1.25	1.17	1.02	1.59	0.39	0.70	0.72	0.49	0.82	1.50
5	1.21	0.82	1.21	1.02	0.47	0.63	0.84	0.64	0.76	0.52	0.98
6	1.24	0.64	1.09	1.26	0.28	0.24	0.50	0.46	0.37	0.61	0.67
k=a/secchi depth (m)											
Date	12/3/2008	1/8/2009	2/3/2009	3/3/2009	4/7/2009	5/5/2009	6/2/2009	7/6/2009	8/4/2009	9/8/2009	10/6/2009
Station	k	k	k	k	k	k	k	k	k	k	k
1	0.68	0.98	1.23	1.16	2.86	2.13	1.28	1.04	1.32	0.83	1.25
2	0.79	0.83	0.81	1.18	1.47	2.63	1.64	1.27	1.69	0.93	0.97
3	0.96	1.23	1.82	1.18	3.23	2.63	1.23	1.39	1.27	1.67	1.09
4	0.69	0.80	0.85	0.98	0.63	2.56	1.43	1.39	2.04	1.22	0.67
5	0.83	1.22	0.83	0.98	2.13	1.59	1.19	1.56	1.32	1.92	1.02
6	0.81	1.56	0.92	0.79	3.57	4.17	2.00	2.17	2.70	1.64	1.49
WCI results	Good	Fair	Poor	Total							
N=66	87.88%	7.58%	4.55%	100.00%							

TABLE 7. DISSOLVED OXYGEN – HARRIS NECK ESTUARY

East/Gulf Coast Site Assessment Criteria:		Regional Scores:										
Good	>5 mg/L	< 5% area in poor condition, and >50% area in good condition										
Fair	2-5 mg/L	5% - 15% area in poor condition, or more than 50% area in combined poor and fair condition										
Poor	<2 mg/L	>15% area in poor condition										
Sample ID	DO (mg/L)	DO (mg/L)	DO (mg/L)	DO (mg/L)	DO (mg/L)	DO (mg/L)	DO (mg/L)	DO (mg/L)	DO (mg/L)	DO (mg/L)	DO (mg/L)	DO (mg/L)
	12/3/2008	1/8/2009	2/3/2009	3/3/2009	4/7/2009	5/5/2009	6/2/2009	7/6/2009	8/4/2009	9/8/2009	10/6/2009	
1S	8.89	7.78	8.89	8.32	7.40	5.52	6.23	4.52	5.09	5.29	4.85	
2S	8.84	7.07	8.80	8.45	7.00	5.24	4.80	4.56	4.74	4.25	5.00	
3S	8.57	7.66	8.93	9.60	6.52	5.16	7.04	3.20	5.35	5.63	4.72	
4S	7.91	7.33	8.31	7.25	7.54	4.13	3.71	3.71	3.41	4.28	4.30	
5S	8.60	6.92	8.70	7.94	6.37	5.32	6.51	3.32	6.31	5.41	4.21	
6S	8.51	5.89	8.50	7.34	5.69	5.38	5.32	3.28	3.19	4.96	4.17	
N=	6	6	6	6	6	6	6	6	6	6	6	
DO results	Good	Fair	Poor	Total								
N=66	69.70%	30.30%	0.00%	100.00%								

Reference: National Coastal Condition Report II
 U.S. EPA Office of Research and Development/Office of Water
 Chapter 1 Introduction

SEDIMENT QUALITY INDEX

The sediment quality index (SQI) used for the Harris Neck - Julienton River study was the same as that used for the Coastal Assessments conducted by the National Park Service Southeast Coast Network (SECN). The SECN chose two indicators of sediment condition, sediment contaminants and sediment total organic carbon (TOC) concentration, from three indicators used in the EPA's National Coastal Assessment Program (U.S. EPA 2001). Evaluation of sediment toxicity by measuring the survival of the marine amphipod *Ampelisca abdita*, following exposure to the sediment, was excluded from the SECN assessments and the Harris Neck study. Since there are no absolute chemical concentrations that correspond to sediment toxicity, Effects Range Median (ERM) and Effects Range Low (ERL) values (described below) are used to assess sediment contamination. Ecological effects are not likely to occur at contaminant concentrations below the ERL criterion (EPA National Coastal Condition Report II, 2004).

Sediment Contaminant Criteria

(Long et al., 1995)

ERM (Effects Range Median)—Determined for each chemical as the 50th percentile (median) in a database of ascending concentrations associated with adverse biological effects.

ERL (Effects Range Low)—Determined values for each chemical as the 10th percentile in a database of ascending concentrations associated with adverse biological effects.

Table 8. ERM and ERL Guidance Values in Sediments (Long et al., 1995) (National Coastal Condition Report II, December 2004).

Contaminant	ERL	ERM
Metals^a		
Arsenic	8.2	70
Cadmium	1.2	9.6
Chromium	81	370
Copper	34	270
Lead	46.7	218
Mercury	0.15	0.71
Nickel	20.9	51.6
Silver	1	3.7
Zinc	150	410
Organics^b		
Acenaphthene	16	500
Acenaphthylene	44	640
Anthracene	85.3	1,100
Flourene	19	540
2-Methyl naphthalene	70	670

Napthalene	160	2,100
Phenanthrene	240	1,500
Benz(a)anthracene	261	1,600
Benzo(a)pyrene	430	1,600
Chrysene	384	2,800
Dibenzo(a,h)anthracene	63.4	260
Fluoranthene	600	5,100
Pyrene	665	2,600
Low molecular weight PAH	552	3,160
High molecular weight PAH	1,700	9,600
Total PAHs	4,020	44,800
4,4'-DDE	2.2	27
Total DDT	1.6	46.1
Total PCBs	22.7	180

^a Units are ug/g dry sediment, equivalent to ppm.

^b Units are ng/g dry sediment, equivalent to ppb.

Table 9. Criteria for Assessing Sediment Contaminants by Site (National Coastal Condition Report II, December 2004).

Rating	Criteria
Good	No ERM concentrations are exceeded, and less than five ERL concentrations are exceeded.
Fair	Five or more ERL concentrations are exceeded.
Poor	An ERM concentration is exceeded for one or more contaminants.

Table 10. Criteria for Assessing Sediment TOC by Site with concentrations on a dry-weight basis (National Coastal Condition Report II, December 2004).

Rating	Criteria
Good	The TOC concentration is less than 2%.
Fair	The TOC concentration is between 2% and 5%.
Poor	The TOC concentration is greater than 5%.

Sediment samples collected from the Harris Neck estuary were very low in organic contaminants. Most of the compounds tested for were not detectable during analysis. Those contaminants that were detected during analysis revealed concentrations below the method detection limit, or MDL. No ERL or ERM values were exceeded for the organics portion of the sediment analysis, resulting in a 'Good' rating.

Sediment TOC is used to assess sediment toxicity from organic matter. The criteria used to rate TOC are described in Table 10 (EPA National Coastal Condition Report II, 2004). Table 11 displays sediment TOC concentrations measured in the Harris Neck estuary in June 2009. Concentrations less than 2% received a 'Good' rating (highlighted in green). Only one station exceeded 2%, resulting in one 'Fair' reading (highlighted in yellow), station 6 with a TOC concentration of 2.2%.

All metals analyzed in the Harris Neck estuary received a rating of 'Good,' except in one instance (Table 12) where arsenic measured 12.2 ug/g at station 6, a value above the ERL, 8.2 ug/g (Table 8). This value resulted in one 'Fair' rating, but still an overall 'Good' rating for the Harris Neck area in terms of metals.

Together, all portions of the sediment analysis in the Harris Neck estuary received a 'Good' rating during our study.

Table 11. TOC concentrations measured in the Harris Neck estuary in June 2009.

Station ID	TOC (mg/kg)	TOC %
HN1	3800	0.38
HN2	890	0.089
HN3	5800	0.58
HN4	630	0.063
HN5	9700	0.97
HN6	22000	2.2
HN7	*BQL	*BQL
HN8	3800	0.38
HN9	10000	1
HN10	6200	0.62
HN1 DUP	5000	0.5

*Below Quantitation Limit

TABLE 12.
TRACE METALS (ug/g) –
HARRIS NECK
ESTUARY

Effects Range Low (ERL)	8.2	1.2	81	34	46.7	0.15	20.9	1	150
Station ID	Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Silver	Zinc
1	1.4	0.10	6.3	0.92	4.2	*BQL	1.9	*BQL	7.5
2	*BQL	*BQL	*BQL	0.45	2.3	0.0043	0.40	*BQL	2.5
3	2.9	*BQL	8.3	1.1	6.0	*BQL	2.4	0.027	10.5
4	*BQL	*BQL	*BQL	0.054	3.1	*BQL	0.46	*BQL	2.4
5	4.3	*BQL	18.3	2.4	8.1	0.0071	5.1	0.042	18.4
6	12.2	0.33	50.2	7.5	17.5	0.039	13.9	0.065	49.9
7	1.3	*BQL	1.6	0.68	2.9	0.021	0.61	*BQL	3.2
8	1.9	0.17	4.5	*BQL	4.5	0.020	1.3	0.027	5.6
9	4.5	0.14	20.1	3.3	9.6	0.025	5.9	0.037	23.1
10	2.8	0.18	9.6	0.67	6.1	0.015	2.6	0.035	11.1

*Below Quantitation Limit

TABLE 12. MICROBIOLOGICAL RESULTS – HARRIS NECK ESTUARY

Harris Neck Bacterial Results		Month											
Enterococci - Membrane Filtration		Standards : Marine waters - Geo Mean 35/100mL, Beach - Single sample 104/100mL											
Station ID	12/3/2008	1/8/2009	2/3/2009	3/3/2009	4/7/2009	5/5/2009	5/12/2009	6/2/2009	6/9/2009	7/6/2009	8/4/2009	9/8/2009	10/6/2009
1S	2	11	2	1	4	8	N/A	1	N/A	2	2	3	2
1B	3	3	3	8	10	5	N/A	2	N/A	3	<2	3	<2
2S	2	25	3	6	9	4	N/A	8	N/A	9	4	7	1
2B	7	12	3	1	3	4	N/A	13	N/A	14	4	8	<2
3S	2	14	4	2	4	6	N/A	1	N/A	11	2	16	1
3B	5	19	3	5	10	7	N/A	4	N/A	4	9	13	2
4S	2	33	29	30	13	27	N/A	11	N/A	21	21	15	4
4B	8	75	21	15	24	23	N/A	8	N/A	27	16	6	10
5S	2	12	<2	2	3	4	N/A	3	N/A	3	2	17	8
5B	3	5	2	1	3	4	N/A	5	N/A	2	<2	14	2
6S	78	15	<2	<2	12	3	N/A		N/A			25	
6M								12	N/A	10	10		
6B		8	1	2	7	4	N/A		N/A			29	
Fecal Coliforms - A-1		Standards : Coastal - 100/100mL, Other recreational areas - 200/100mL											
Station ID	12/3/2008	1/8/2009	2/3/2009	3/3/2009	4/7/2009	5/5/2009	5/12/2009	6/2/2009	6/9/2009	7/6/2009	8/4/2009	9/8/2009	10/6/2009
1S	<2	14	2	<2	7	23	4	8	4	2	2	2	<2
1B	<2	<2	4	2	2	23	<2	4	<2	2	4	<2	<2
2S	<2	30	11	8	4	9	4	8	4	2	14	4	<2
2B	11	50	8	<2	22	11	<2	17	2	14	8	<2	2
3S	<2	8	4	<2	2	2	<2	2	4	<2	<2	4	<2
3B	<2	4	2	<2	4	2	2	<2	4	4	2	2	4
4S	11	26	13	11	17	13	23	30	17	11	21	8	17
4B	4	50	30	8	17	50	2	14	8	7	50	4	30
5S	<2	4	2	<2	4	2	2	<2	4	2	4	<2	4
5B	2	13	<2	<2	14	<2	4	<2	<2	<2	8	2	7
6S	2	23	4	2	50	80	4		14			2	
6M								17		50	23		
6B		17	2	2	21	23	14		30			<2	
Fecal Coliforms - mTEC		Standards : Coastal - 100/100mL, Other recreational areas - 200/100mL											
Station ID	12/3/2008	1/8/2009	2/3/2009	3/3/2009	4/7/2009	5/5/2009	5/12/2009	6/2/2009	6/9/2009	7/6/2009	8/4/2009	9/8/2009	10/6/2009
1S		4	1	1	6	12	<2	4	2	no result	3	<2	18
1B		5	1	1	3	11	1	<2	1	no result	2	<2	7
2S		21	4	3	5	9	7	3	4	no result	7	1	25
2B		20	2	1	2	8	3	12	3	no result	9	10	15
3S		4	3	<2	2	5	<2	<2	5	no result	1	<2	63
3B		4	1	1	4	5	1	<2	10	no result	2	7	79
4S		37	9	8	13	33	14	12	7	no result	25	3	32
4B		36	18	8	11	16	11	14	15	no result	24	5	26
5S		7	<2	<2	4	2	<2	<2	4	no result	5	1	52
5B		4	2	1	3	1	2	3	8	no result	4	<2	43
6S		9	<2	1	9	17	4		10			1	
6M								7		no result	13		
6B		15	1	1	11	15	3		11			<2	

The University of Georgia Marine Extension Service conducted a comparative study of the recovery and enumeration of total fecal coliform bacteria from estuarine waters using the AIM and mTEC methods. Both methods are “Approved National Shellfish Sanitation Program Laboratory Tests: Microbiological and Biotxin Analytical Methods” according to the *National Shellfish Sanitation Program’s Guide for the Control of Molluscan Shellfish (Chapter II. Growing Areas)*. MAREX compared water column samples processed by both methods over a twelve-month period. The mTEC method is a membrane filtration process that produces an actual bacterial count while the AIM method calculates a most probable number (MPN), a statistical estimate of fecal coliform levels. Normally in the mTEC method, mTEC agar is used to isolate, differentiate and rapidly enumerate thermotolerant *Escherichia coli* recovered from water by membrane filtration. The method is coupled to an *in situ* urease test. Halting the test at an intermediate step permits the determination of fecal coliform levels. MAREX assessed enterococci populations in the same samples with EPA Method 1600, a membrane filtration method, to provide information on the relationships among two fecal indicator bacteria used to assess water quality in coastal Georgia waters (Gates, 2008). These data are shown in Table 12.

Bacterial counts were generally very low in the Harris Neck estuary. There were no cases of samples exceeding the recreational standards during the study. A regression analysis of fecal coliform bacteria results from two approved microbiological methods, AIM and mTEC, yielded a low overall r square value of 0.109. By removing the September and October results from the regression analysis, the r square value increases to 0.48 (128 observations). Sample results from February and March yielded the highest r square values, 0.93 and 0.82, respectively. These were followed by the June and August results, with r square values of 0.69 and 0.74, respectively. Causes for the low overall r square value is unclear, but repeating the comparative study in an area known to have higher bacterial counts might yield a more conclusive comparison of the methods.

In conclusion, the Harris Neck Estuary received an overall rating of ‘Fair’ for water quality. The fair rating was due to a ‘Poor’ rating for total dissolved phosphorous (TDP). The high TDP concentrations may be due to naturally occurring high levels in the area from the nutrient rich sediments of the surrounding marsh. The sediment analysis received an overall rating of ‘Good.’ Bacterial levels were low in the Harris Neck estuary, all sample results were below Georgia’s recreational standards.

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