Report on Nutrient Synoptic Survey in the Deer Creek River Watershed, Harford County Maryland, April, 2005 as part of a Watershed Restoration Action Strategy.

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DEPARTMENT OF THE ENVIRONMENT

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Cover photo: Deer Creek at Priest Ford Rd. by Niles Primrose

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Executive Summary

A nutrient synoptic survey was conducted during April, 2005 in the Deer Creek watershed as part of the Deer Creek Watershed Restoration Action Strategy (WRAS). Water samples were analyzed from 104 sites throughout the watershed. Nitrate/nitrite concentrations were found to be excessive (>5 mg/L) in twenty-one subwatersheds, high (3-5 mg/L) in forty-four, moderately elevated (1-3 mg/L) in thirty-five, and baseline (<1 mg/L) in the remaining four subwatersheds. Instantaneous nitrate/nitrite yields were found to be excessive (>.03 Kg/Hectare/day) in sixty-seven subwatersheds, high (.02-.03 Kg/Hectare/day) in nine, moderate (.01-.02 Kg/Hectare/day) in six, and baseline (<.01 Kg/Hectare/day) in seven. Yields were not calculated in the remaining fifteen subwatersheds. Excessive concentrations (>.015 mg/L) of orthophosphate were found in eleven subwatersheds, high concentrations (.01- .015 mg/L) in thirteen, moderate concentrations (.005- .01 mg/L) in thirty-five, and the remaining forty-five were below baseline (<.005 mg/L). Orthophosphate yields were found to be moderate (.0005-.001 Kg/Hectare/day) in two watersheds, and baseline (<.0005 Kg/Hectare/day) in eighty-seven. Yields were not calculated in the remaining fifteen subwatersheds. No significant anomalies were found in the insitu measurements of dissolved oxygen. Marginally depressed ph values (<6.5) were found in four subwatersheds. Six subwatersheds in the Deer Creek watershed had low specific conductivity (<100 mS/cm). Relatively high temperatures (>18 C) were found in 2 subwatersheds. Moderately elevated nitrate/nitrite concentrations may be associated with row crop and animal agriculture, and communities on well and septic. Elevated ground water discharges due to a wet spring appears to be responsible for the elevated nitrate/nitrite yields. The nutrient concentrations found in the Deer Creek watershed are very similar to those found in neighboring and similar watersheds across the state.

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Introduction

A nutrient synoptic survey was conducted during April, 2005 in the Deer Creek watershed as part of the Deer Creek Watershed Restoration Action Strategy (WRAS).

Nutrient synoptic sampling was scheduled for early spring to coincide with the period of maximum nitrogen concentrations in the free flowing fresh water streams. The major proportion of the nitrogen compounds are carried dissolved in the ground water rather than in surface runoff. The higher nitrogen concentrations in the late winter and early spring reflect the higher proportion of nitrogen rich shallow ground water present in the base flow at this time of year. Nitrogen concentrations are reduced in summer as the proportion of shallow ground water is reduced through plant uptake, and replaced by deeper ground water that may have lower nitrate concentrations, or has been denitrified through interaction with anoxic conditions in the soils below the streambed. Point sources can also contribute to in stream nitrate concentrations.

Orthophosphate is generally transported bound to suspended sediments in the water column. In stream orthophosphate concentrations can also be produced through mobilization of sediment bound phosphorus in anoxic water column and/or sediment conditions, sediment in surface runoff from areas having had surface applied phosphorus, ground water from phosphorus saturated soils, and point source discharges.

Ranges used for nutrient concentrations and yields (Table 1) were derived from work done by Frink (1991). The low end values are based on estimated nutrient exports from forested watersheds, and the high end values are based on estimated nutrient exports from intensively agricultural watersheds. As an additional benchmark, the Chesapeake Bay Program uses 1 mg/L total nitrogen as a threshold for indicating anthropogenic impact. The dissolved nitrogen fraction looked at in these synoptic surveys constitutes approximately 50% to 70% of the total nitrogen.

Table 1. Nutrient Ranges and Rating

Rating	NO2+NO3 Concentration mg/L	NO2+NO3 Yield Kg/ha/day	PO4 Concentration mg/L	PO4 Yield Kg/ha/day
Baseline	<1	<.01	<.005	<.0005
Moderate	1 to 3	.01 to .02	.005 to .01	.0005 to .001
High	3 to 5	.02 to .03	.01 to .015	.001 to .002
Excessive	>5	>.03	>.015	>.002

A Note of Caution

Estimates of annual dissolved nitrogen loads/yields from spring samples will result in inflated load estimates, but the relative contributions of subwatersheds should remain reasonably stable. More accurate nitrate/nitrite load/yield estimates need to include sampling during the growing season to account for potential lower concentrations and discharges. Storm flows can also significantly impact loads delivered to a watershed outlet.

The tendency of orthophosphate to be transported bound to sediments makes any estimates of annual orthophosphate loads/yields derived from base flow conditions very conservative. More accurate estimates of orthophosphate loads/yields in a watershed must include samples from storm flows that carry the vast majority of the sediment load

of a watershed. Residual suspended sediments from recent rains, or instream activities of livestock or construction can produce apparently elevated orthophosphate concentrations and yields at base flow.

METHODS

Synoptic water chemistry samples were collected in early spring throughout the watershed. Sampling was halted for a minimum of 24 hours after rainfall events totaling more than .25 inches. Grab samples of whole water (500 ml) were collected just below the water surface at mid-stream and filtered using a 0.45 micron pore size (Gelman GF/C) filter. The samples were stored on ice and frozen on the day of collection. Filtered samples were analyzed by the Nutrient Analytical Services Laboratory at the University of Maryland's Chesapeake Biological Laboratory (CBL) for dissolved inorganic nitrogen (NO_3, NO_2), and dissolved inorganic phosphorus (PO_4). All analyses were conducted in accordance with U.S. Environmental Protection Agency (EPA) protocols. Stream discharge measurements were taken at the time of all water chemistry samples. Water temperature, dissolved oxygen, pH, and conductivity were measured in the field with a Hydrolab Surveyor II at selected sites at the time of water quality collections. Watershed areas used to calculate nutrient yields per unit area were determined from a digitized watershed map using Arcview software.

Where sites are nested in a watershed, the mapped concentration data for the downstream site is shown only for the area between the sites. Yield calculations for a downstream site are based on the entire area upstream of the site, but are mapped showing just the area between sites. The downstream sites therefore illustrate the cumulative impact from all upstream activities.

RESULTS

A nutrient synoptic survey was conducted during April, 2005 in the Deer Creek watershed as part of the Deer Creek WRAS. Water samples were analyzed from 104 sites throughout the watershed. Sampling site locations are noted in Table 2 and mapped with subwatersheds in Figure 1. Dissolved nutrient concentrations and yields from all sites are noted in Table 3. Nitrate/nitrite concentrations were found to be excessive (>5 mg/L) in twenty-one subwatersheds, high (3-5 mg/L) in forty-four, moderately elevated (1-3 mg/L) in thirty-five, and baseline (<1 mg/L) in the remaining four subwatersheds (Figure 2). Instantaneous nitrate/nitrite yields were found to be excessive (>.03 Kg/Hectare/day) in sixty-seven subwatersheds, high (.02-.03 Kg/Hectare/day) in nine, moderate (.01-.02 Kg/Hectare/day) in six, and baseline (<.01 Kg/Hectare/day) in seven (Figure 3). Yields were not calculated in the remaining fifteen subwatersheds because direct access to the stream was blocked therefore no discharge measurements could be taken. Excessive concentrations (>.015 mg/L) of orthophosphate were found in eleven subwatersheds, high concentrations (.01- .015 mg/L) in thirteen, moderate concentrations (.005- .01 mg/L) in thirty-five, and the remaining forty-five were below baseline (<.005 mg/L) (Figure 4). Orthophosphate yields were found to be moderate (.0005-.001 Kg/Hectare/day) in two watersheds, and baseline (<.0005 Kg/Hectare/day) in eighty-seven (Figure 5). As noted above, yields were not calculated in the remaining fifteen subwatersheds. Temperature, dissolved oxygen, pH, and specific conductivity values are noted for all sites in Table 4. No significant anomalies were

found in the insitu measurements of dissolved oxygen. Marginally depressed ph values (<6.5) were found in four subwatersheds (Figure 6). Six subwatersheds in the Deer Creek watershed had low specific conductivity (<100 mS/cm) (Figure 7). Relatively high temperatures (>18 C) were found in 2 subwatersheds (Figure 8).

Table 2. Deer Creek Watershed WRAS Nutrient Synoptic Survey April, 2005
Sampling Site Locations

Station	Location	ADC Map	Date	Lat	Long
DC0	UT to Deer Cr at Stafford Rd	13 D 6	04/18/05	39.62042	-76.15603
DC1	Elbow Br at Stump Church Rd	13 B 7	04/18/05	39.61678	-76.16904
DC2	Elbow Br off Wilkinson Rd	13 A 9	04/18/05	39.60266	-76.17519
DC3	Elbow Br at Rt 161	12 K 11	04/18/05	39.59284	-76.18700
DC4	UT to Elbow Br at Rt 161	12 K 12	04/18/05	39.58976	-76.18521
DC5	UT to Deer Cr at Glenville Rd	12 J 7	04/18/05	39.61733	-76.19391
DC6	UT to Deer Cr at Harmony Church Rd	12 G 8	04/18/05	39.60772	-76.20250
DC8	Graveyard Cr at Harmony Church rd	12 E 8	04/18/05	39.61095	-76.21790
DC9	Graveyard Cr at Old Level Rd	12 E 12	04/19/05	39.58814	-76.21510
DC10	Mill Br at Harmony Church Rd	12 B 9	04/18/05	39.60506	-76.24001
DC11	Mill Br at Glenville Rd	12 C 12	04/19/05	39.58639	-76.23076
DC12	Mill Br at Oak Farm Rd	19 C 2	04/19/05	39.37225	-76.23048
DC14	Mill Br at rt 155	19 C3	04/19/05	39.56605	-76.23241
DC15	Coolbranch at Harmony Church Rd	12 A 9	04/18/05	39.60281	-76.24611
DC16	Cool branch at Coolbranch Rd	11 K 13	04/19/05	39.58168	-76.24951
DC17	UT to Coolbranch at Whitfield Rd	12 A 13	04/19/05	39.58184	-76.24858
DC18	UT to Deer Cr at Moore farm	11 H 11	04/19/05	39.58927	-76.25970
DC19	UT to Deer Cr at Moore farm	11H 11	04/19/05	39.58926	-76.26091
DC20	UT to Deer Cr at Moore farm	11 H 11	04/19/05	39.59145	-76.36098
DC21	UT to Deer Cr at Cool Spring Rd	11 H 11	04/19/05	39.59579	-76.26426
DC22	Tobacco Rn at Cool Spring Rd	11G 11	04/20/05		
DC23	UT to Tobacco Rn off Gunston Rd	11 G 13	04/19/05	39.58467	-76.27418
DC24	UT to Tobacco Rn off Gunston Rd	11 G 13	04/19/05	39.58467	-76.27418
DC28	Deer Cr at Priestford Rd	11 J 10	05/04/05	39.60199	-76.24980
DC29	Thomas Rn off Thomas Rn Rd	11 E 11	04/19/05	39.59276	-76.28677
DC30	UT to Thomas Rn at Thomas Rn Rd	11E 11	04/19/05	39.59276	-76.28677
DC31	UT to Thomas Rn at Thomas Rn Rd	11 C 13	04/19/05	39.58468	-76.30013
DC32	Thomas Rn at Pennington Rd	11 C 13	04/20/05	39.58002	-76.30151
DC33	UT to Thomas Rn at Thomas Rn Rd	18 A 1	04/20/05	39.57759	-76.31056
DC35	St Omer Br at Walters Mill Rd	10 K 7	04/20/05	39.61432	-76.37079
DC36	St Omer Br at Gibson Rd	10 H 10	04/20/05	39.59941	-76.33212
DC37	Deer Cr at Ady Rd	10 H 6	05/04/05	39.61987	-76.33198
DC38	Stout Bottle Br at Walters Mill Rd	10 H 6	04/20/05	39.62095	-76.33315
DC39	Stout Bottle Br at Deer Cr Church Rd	10 G 7	04/20/05	39.61768	-76.33987
DC40	UT to Stout Bottle Br off Deer Cr Church Rd	10 G 7	04/20/05	39.61768	-76.33987
DC41	Stout Bottle Br at Chestnut Hill Rd	10 F 9	04/20/05	39.61768	-76.33987
DC42	Cabbage Br at Chestnut Hill Rd	10 F 9	04/20/05	39.60640	-76.34863
DC43	Stout Bottle Br at Johnson Mill Rd	10 E 12	04/20/05	39.58626	-76.35559
DC44	UT to Stout Bottle Br at Johnson MIll Rd	10 D 11	04/20/05	39.59016	-76.36986

DC45	Cabbage Rn at Johnson Mill Rd	10 B 10	04/20/05	39.59840	-76.37227
DC46	UT to Stout Bottle Br at Pyle Rd	10 B 7	04/20/05	39.61271	-76.37075
DC47	Deer Cr at Nursery Rd	10 B 4	05/04/05	39.62918	-76.37518
DC48	Stirrup Rn at Rocks Rd	9 H 7	04/26/05	39.61619	-76.40054
DC49	UT to S Stirrup Rn at Sharon Rd	9 H 10	04/26/05	39.60081	-76.40266
DC50	S Stirrup Rn at Sharon Rd	9 G 10	04/26/05	39.60109	-76.40402
DC51	UT to S STirrup Rn at Bailey Rd	9 G 11	04/26/05	39.59133	-76.40774
DC52	S Stirrup Rn at Bailey Rd	9 F 11	04/28/05	39.59259	-76.41294
DC53	N Stirrup Rn at Sharon Rd	9 F 8	04/26/05	39.61040	-76.41261
DC54	N Stirrup Rn at Rigdon Rd	9 E 8	04/26/05	39.60595	-76.42221
DC55	Kellogg Br at Chrome Hill Rd	9 F 4	04/26/05	39.63081	-76.41550
DC56	UT to Kellogg Br off Knopp Rd	9 C 5	04/26/05	39.62726	-76.43113
DC58	UT to Deer Cr at St Clair Br Rd	9 D 3	04/26/05	39.63853	-76.42463
DC59	Deer Cr at St Clair Br Rd	9 D 2	05/03/05	39.63776	-76.41191
DC61	Rock Hollow Br at St Clair Br Rd	3 B 13	04/28/05	39.65277	-76.43871
DC62	Little Deer Cr off St Clair Br Rd	3 A 12	04/28/05	39.66162	-76.44817
DC63	L Deer Cre at Mt Horeb Rd	2 F 12	04/28/05	39.65818	-76.48347
DC63	UT to L Deer Cr at Mt Horeb Rd	2 F 12	04/28/05	39.65818	-76.48347
DC65	Cattail Br off Madonna Rd	2 E 13	04/28/05	39.65471	-76.49138
DC66	L Deer Cr off Madonna Rd	2 E 13	04/28/05	39.65490	-76.49123
DC68	UT to L Deer Cr at Lemon Rd	8 A 2	04/28/05	39.63859	-76.51463
DC69	UT to L Deer Cr off Troyer Rd	8 A 3	04/28/05	39.63379	-76.52739
DC70	UT to L Deer Cr at Troyer Rd	7 J 4	04/28/05	39.63382	-76.52876
DC72	Deer Cr at Carea Rd	2 E 10	05/02/05	39.68032	-76.56605
DC74	Jackson Br at Harford Creamery Rd	2 A 8	04/29/05	39.67269	-76.53543
DC75	Deer Cr at Harford Creamery Rd	1 H 10	05/02/05	39.67291	-76.53539
DC79	UT to Deer Cr at Dry Br Rd	1 G 9	04/29/05	39.66333	-76.54925
DC80	Plumtree Br nr church	1 F 11	05/02/05	39.67879	-76.55447
DC81	Deer Cr nr Church	1 E 8	05/02/05	39.67893	-76.55450
DC82	Plumtree Br at Kirkwood Shop Rd (in Balto Co)	1 E 8	04/29/05	39.67845	-76.57516
DC83	Deer Cr at Green Rd	1 B 8	04/29/05		
DC84	UT to Deer Cr at Green Rd	1 D 6	04/29/05	39.69074	-76.55662
DC88	UT to Deer Cr at Long Corner Rd	4 D 1	05/02/05	39.71682	-76.56605
DC89	UT to Deer Cr at Duncan Rd	1 D 1	05/02/05	39.70435	-76.55080
DC91	UT to Deer Cr at Jolly Acres Rd	1 K 7	05/02/05	39.59391	-76.53555
DC92	UT to Deer Cr at Amos Rd	1 H 6	04/28/05	39.69779	-76.46569
DC93	Island Br at Telegraph Rd	2 B 7	04/28/05	39.68228	-76.48732
DC94	Island Br at Crea Rd	2 E 8	04/29/05	39.69960	-76.50083
DC95	Island Br at Rt 136	2 C 5	04/29/05		
DC97	Big Br at Eden Mill Rd	1 K 2	05/03/05	39.67736	-76.45430
DC99	UT to Big Br at Onion Rd	2 H 5	04/29/05	39.70252	-76.46329
DC100	UT to Big Br off Neal Rd W	2 J 4	04/29/05	39.70564	-76.47648
DC101	Big Br off Neal Rd W	2 G 3	04/29/05	39.70564	-76.47648
DC102	UT to Big Br at Buttermilk Rd	2 G 3	04/29/05	39.70868	-76.48887
DC103	Big Br at Channel Rd	2 E 3	04/29/05	39.71698	-76.49117
DC104	UT to Big Br at Channel Rd	2 E 1	04/29/05	36.71592	-76.48705
DC105	Falling Br at Red Br Rd	2 E 2	04/28/05	39.67513	-76.44292
DC107	Falling Br at Falling Br Rd	3 B 7	04/28/05	39.68437	-76.43793
DC108	Falling Br at McFadden Rd	3 b 7	04/28/05	39.69688	-76.42757

DC109	Falling Br at McDermott Rd	3 D 5	04/28/05	39.71227	-76.44019
DC112	Gladden Br at Rocks Sta Rd	3 D 11	04/26/05	39.63797	-76.41246
DC113	UT to Deer Cr at Deer Hill Rd	9 F 3	04/26/05	39.62877	-76.38894
DC114	UT to Deer Cr off Thomas Br Rd	9 K 5	04/20/05	39.63999	-76.35072
DC115	UT to Deer Cr off Burkins Rd	10 F 3	04/20/05	39.65217	-76.36279
DC116	UT to Deer Cr (E) off Burkins Rd	4 D 13	04/20/05	39.65217	-76.36279
DC117	UT to Deer Cr (S) at Millers Rd	4 D 13	04/20/05	39.65533	-76.38289
DC119	UT to Deer Cr at Sandy Hook Rd (W)	10 K 5	04/26/05	39.62967	-76.30151
DC120	UT to DEER Cr at Sandy Hook Rd (E)	11 C 4	04/26/05	39.63093	-76.29696
DC124	Hopkins Br at E Noble Rd	11 J 10	04/26/05	39.62704	-76.23586
DC125	Hollands Br at Deths Ford Rd	12 B 5	04/26/05	39.62172	-76.21796
DC126	Holland Br at Trappe Church Rd	12 E 6	04/26/05	39.63063	-76.22393
DC127	UT to Deer Cr from Susq State Park	12 D 4	05/04/05	39.62255	-76.16458
DC128	Buck Br off Stafford Rd	12 K 6	04/18/05	39.62321	-76.16458
DC130	UT to Deer Cr off Thomas Br Rd	9 K 5	04/20/05	39.63999	-76.35072
DC131	Cattail Cr at Cox Rd	8 D 2	04/28/05	39.62784	-76.50356

Figure 1. Deer Creek WRAS Nutrient Synoptic Survey, April 2005
Subwatersheds and Stations

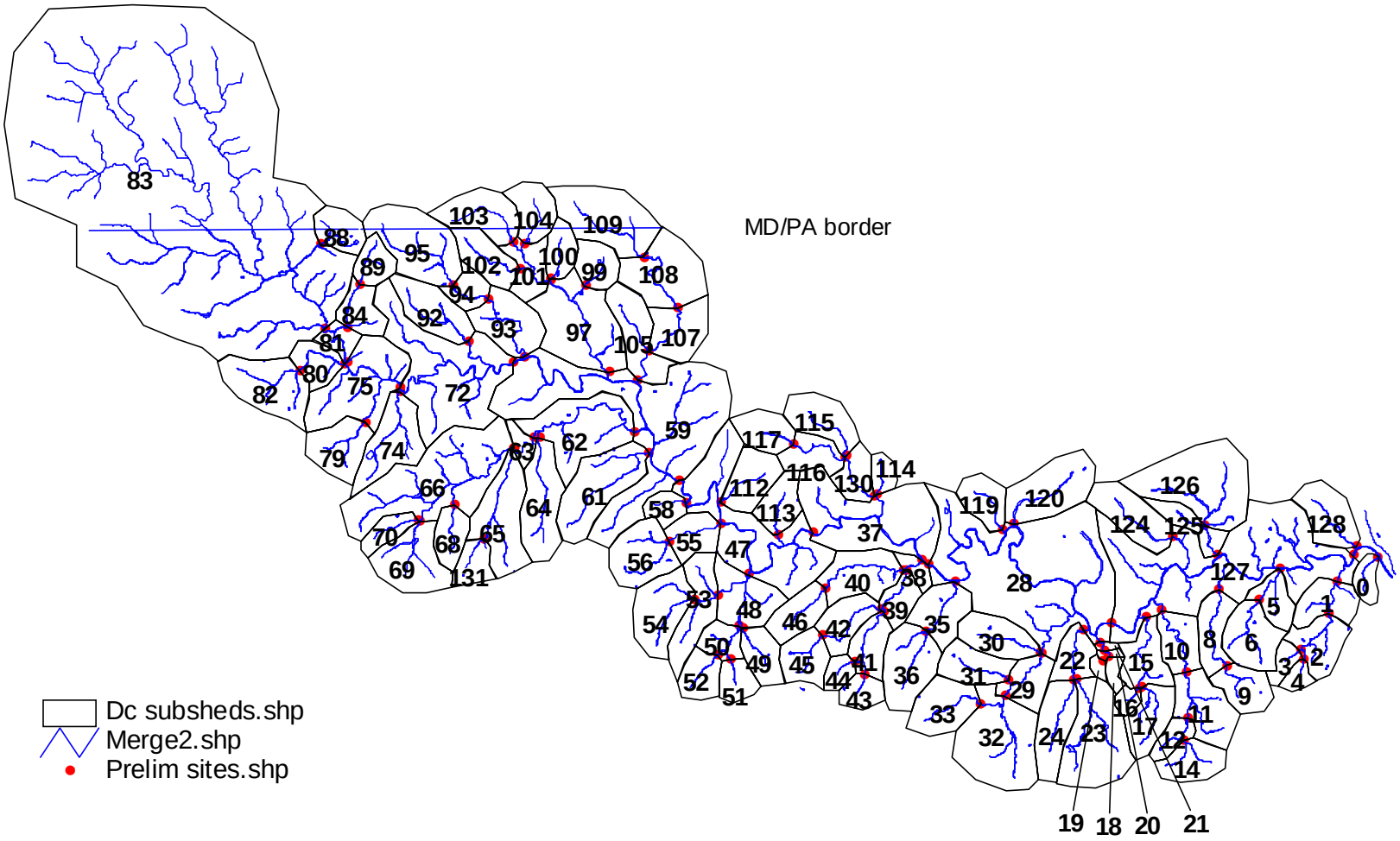


Table 3. Deer Creek Watershed WRAS Nutrient Synoptic Survey April, 2005 Dissolved Nutrient Concentrations and Yields

Site Number	Date	PO4 mg P/l	NO2+NO3 mg N/l	Discharge L/sec	Area Hectares	PO4 Kg/H/D	NO2+NO3 Kg/H/D
DC 0	04/18/05	0.0186	0.76	13.84	110	0.000202	0.008262
DC 1	04/18/05	0.0108	3.46	168.54	649	0.000242	0.077633
DC 2	04/18/05	0.011	5.17	93.24	535	0.000166	0.077849
DC 3	04/18/05	0.0426	6.31	22.11	90	0.000904	0.133934
DC 4	04/18/05	0.0159	7.4	7.45	72	0.000142	0.066156
DC 5	04/18/05	0.0081	3.16	98.43	528	0.000130	0.050897
DC 6	04/18/05	0.0046	3.53	63.3	345	0.000073	0.055959
DC 8	04/18/05	0.0086	3.51	62.98	483	0.000097	0.039544
DC 9	04/19/05	0.0074	5.76	25.8	236	0.000070	0.054406
DC 10	04/18/05	0.0056	2.63	202.065	979	0.000100	0.046901
DC 11	04/19/05	0.0043	2.36	107.36	733	0.000054	0.029865
DC 12	04/19/05	0.0039	2.05	40.47	364	0.000037	0.019692
DC 14	04/19/05	0.0055	2.13	30.226	243	0.000059	0.022891
DC 15	04/18/05	0.0069	2.65	114.13	609	0.000112	0.042908
DC 16	04/19/05	0.0113	2.69	16.6295	63	0.000258	0.061349
DC 17	04/19/05	0.0065	4.46	49.525	272	0.000102	0.070162
DC 18	04/19/05	0.0115	1.91	3.93	55	0.000071	0.011792
DC 19	04/19/05	0.0153	1.64	4.75	37	0.000170	0.018191
DC 20	04/19/05	0.0107	2.6	10.91	111	0.000091	0.022079
DC 21	04/19/05	0.0157	2.1	16.794	131	0.000174	0.023260
DC 22	04/20/05	0.0079	3.15				
DC 23	04/19/05	0.0079	2.75	96.6325	646	0.000102	0.035542
DC 24	04/19/05	0.0154	3.02	49.75	333	0.000199	0.038982
DC 28	05/04/05	0.0065	3.81	6383.35	39207	0.000091	0.053595
DC 29	04/19/05	0.0047	2.68	214.075	1543	0.000056	0.032125
DC 30	04/19/05	0.008	2.12	30.42	297	0.000071	0.018761
DC 31	04/19/05	0.005	0.76	23.56	261	0.000039	0.005927
DC 32	04/20/05	0.006	2.41				
DC 33	04/20/05	0.0036	1.74	43.41	333	0.000041	0.019598
DC 35	04/20/05	0.0061	2.36	118.0275	708	0.000088	0.033992
DC 36	04/20/05	0.0112	3.03	65.038	414	0.000152	0.041127
DC 37	05/04/05	0.0034	4.22	5807.25	32541	0.000052	0.065068
DC 38	04/20/05	0.0055	5.04	379.35	1783	0.000101	0.092647
DC 39	04/20/05	0.0054	4.33	262.7	1098	0.000112	0.089507
DC 40	04/20/05	0.0102	6.93	70.5475	603	0.000103	0.070051

DC 41	04/20/05	0.0054	5.39	65.91	448	0.000069	0.068513
DC 42	04/20/05	0.008	3.55	88.59	495	0.000124	0.054894
DC 43	04/20/05	0.0199	2.88	37.155	136	0.000470	0.067981
DC 44	04/20/05	0.0131	7.34	28.9	98	0.000334	0.187017
DC 45	04/20/05	0.0113	5.45	46.0825	245	0.000184	0.088569
DC 46	04/20/05	0.0114	8.06				
DC 47	05/04/05	0.0027	3.82	4429.15	28778	0.000036	0.050797
DC 48	04/26/05	0.0073	2.58	343	1816	0.000119	0.042103
DC 49	04/26/05	0.0086	2.56	36.11	206	0.000130	0.038772
DC 50	04/26/05	0.0057	2.05	46.64	492	0.000047	0.016790
DC 51	04/26/05	0.0148	2.87	19.21125	152	0.000162	0.031341
DC 52	04/26/05	0.0097	1.97	35.3475	193	0.000153	0.031173
DC 53	04/26/05	0.0187	3.14				
DC 54	04/26/05	0.0078	2.81				
DC 55	04/26/05	0.0054	1.81	99.75	590	0.000079	0.026439
DC 56	04/26/05	0.0052	2.21	42.93	377	0.000051	0.021743
DC 58	04/26/05	0.0041	0.39	21.74	123	0.000063	0.005956
DC 59	05/03/05	0.0031	4.27	4782.75	24684	0.000052	0.071483
DC 61	04/28/05	0.0043	2.18	130.7775	534	0.000091	0.046128
DC 62	04/28/05	0.0025	3.78	622.87	3698	0.000036	0.055009
DC 63	04/28/05	0.0032	3.68	504.24	1921	0.000073	0.083459
DC 64	04/28/05	0.0028	4.39				
DC 65	04/28/05	0.0039	3.35	148.77	662	0.000076	0.065045
DC 66	04/28/05	0.0035	2.8	313.275	1839	0.000052	0.041211
DC 68	04/28/05	0.0036	2.53				
DC 69	04/28/05	0.003	3.11	83.95	428	0.000051	0.052705
DC 70	04/28/05	0.0043	3.34	11.57	135	0.000032	0.024732
DC 72	05/02/05	0.0034	2.24	2109.95	13613	0.000046	0.029997
DC 74	04/29/05	0.0118	5.95	70.1	413	0.000173	0.087257
DC 75	05/02/05	0.0042	4.39	2366.3	11726	0.000073	0.076542
DC 79	04/29/05	0.005	3.14				
DC 80	05/02/05	0.0059	3.77	66.34	661	0.000051	0.032691
DC 81	05/02/05	0.0044	4.99	1667.625	9970	0.000064	0.072114
DC 82	04/29/05	0.0024	1.6	11.56	469	0.000005	0.003407
DC 83	04/29/05	0.0105	4.39				
DC 84	04/29/05	0.0037	4.52	126	376	0.000107	0.130868
DC 88	05/02/05	0.0035	5				
DC 89	05/02/05	0.0081	4.81				
DC 91	05/02/05	0.0028	4.37				
DC 92	04/28/05	0.0043	4.89	27.335	348	0.000029	0.033187
DC 93	04/28/05	0.0043	3.93	134.94	1106	0.000045	0.041428

DC 94	04/29/05	0.0029	2.38	92.0375	732	0.000032	0.025855
DC 95	04/29/05	0.0035	6.34				
DC 97	05/02/05	0.0041	3.94				
DC 99	04/29/05	0.0058	5.08	3.95	199	0.000010	0.008712
DC 100	04/29/05	0.0307	6.78	32.005	167	0.000508	0.112265
DC 101	04/28/05	0.0026	6.14	210.375	1068	0.000044	0.104497
DC 102	04/29/05	0.0035	6.98	39.01	258	0.000046	0.091185
DC 103	04/29/05	0.0026	6.59	90.47	347	0.000059	0.148448
DC 104	04/28/05	0.0036	6.55	47.615	243	0.000061	0.110890
DC 105	04/28/05	0.0041	4.74	295.065	1779	0.000059	0.067926
DC 107	04/28/05	0.0041	4.82	211.92	1413	0.000053	0.062458
DC 108	04/28/05	0.0038	5.6	187.575	1092	0.000056	0.083110
DC 109	04/28/05	0.0028	4.1				
DC 112	04/26/05	0.0044	2.89	55.265	288	0.000073	0.047915
DC 113	04/26/05	0.0079	3.15	29.475	217	0.000093	0.036967
DC 114	04/20/05	0.005	4.23	34.2875	97	0.000153	0.129187
DC 115	04/20/05	0.0033	3.13	57.07	311	0.000052	0.049626
DC 116	04/20/05	0.018	7.05	35.185	439	0.000125	0.048820
DC 117	04/20/05	0.0027	4.04	22.27	227	0.000023	0.034244
DC 119	04/26/05	0.0071	2.89	39.595	221	0.000110	0.044736
DC 120	04/26/05	0.0053	0.84	64.3025	471	0.000063	0.009908
DC 124	04/26/05	0.0033	1.1	32.72	358	0.000026	0.008686
DC 125	04/26/05	0.006	3.56	109.8625	959	0.000059	0.035237
DC 126	04/26/05	0.0041	2.64	126.5325	778	0.000058	0.037097
DC 127	05/04/05	0.0048	3.27	7737.375	44951	0.000071	0.048631
DC 128	04/18/05	0.0179	4.13	57.49	317	0.000280	0.064714
DC 130	04/20/05	0.0083	3.95	106.19	935	0.000081	0.038760
DC 131	04/28/05	0.0031	3	19.635	161	0.000033	0.031611

Figure 2. Deer Creek WRAS - Nutrient Synoptic Survey, April, 2005
Nitrate/Nitrite (NO2+NO3) Concentrations (mg/L)

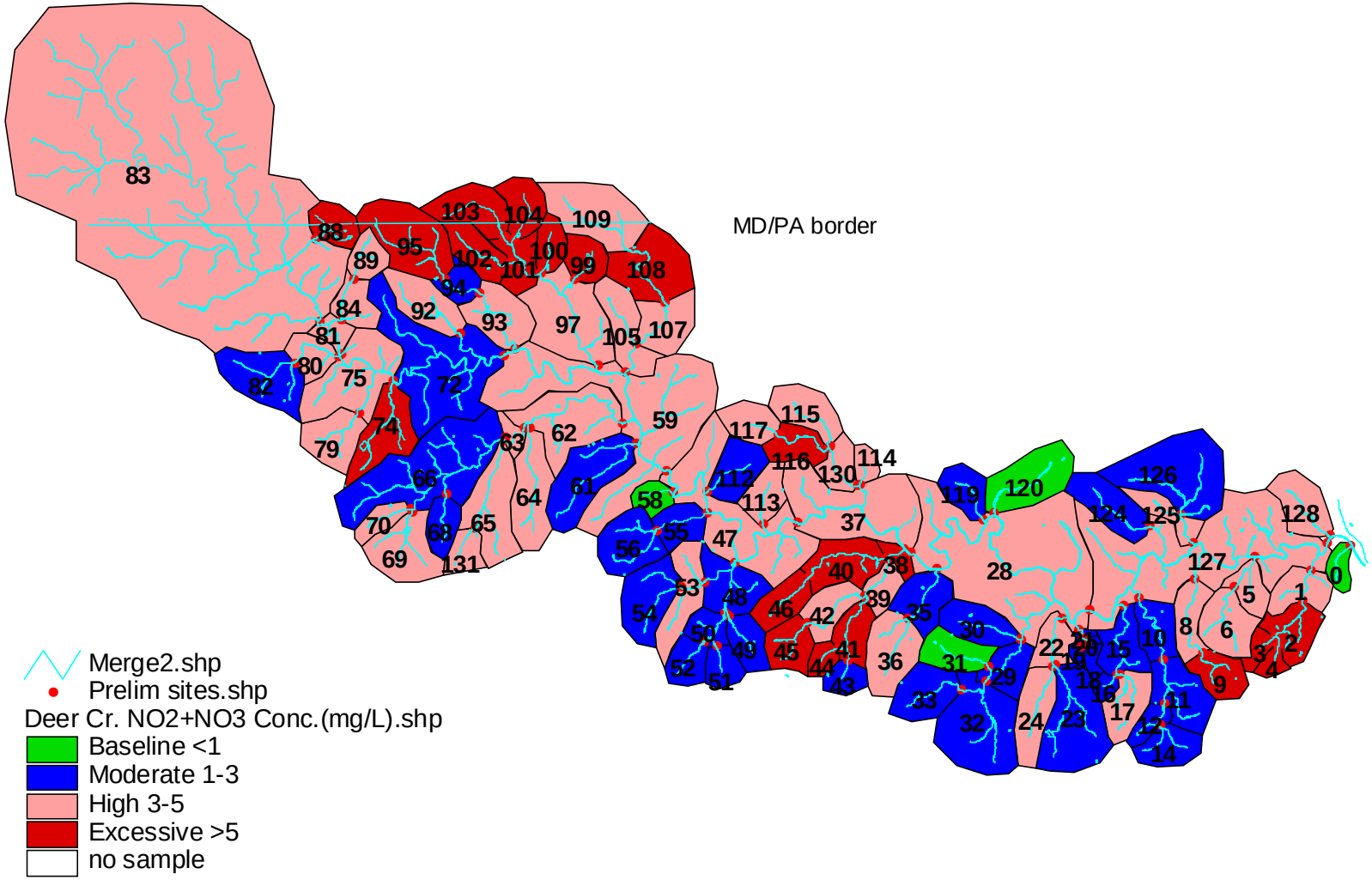


Figure 3. Deer Creek WRAS Nutrient Synoptic Survey, April 2005.
Nitrate/Nitrite (NO2+NO3) yield Kg/H/day

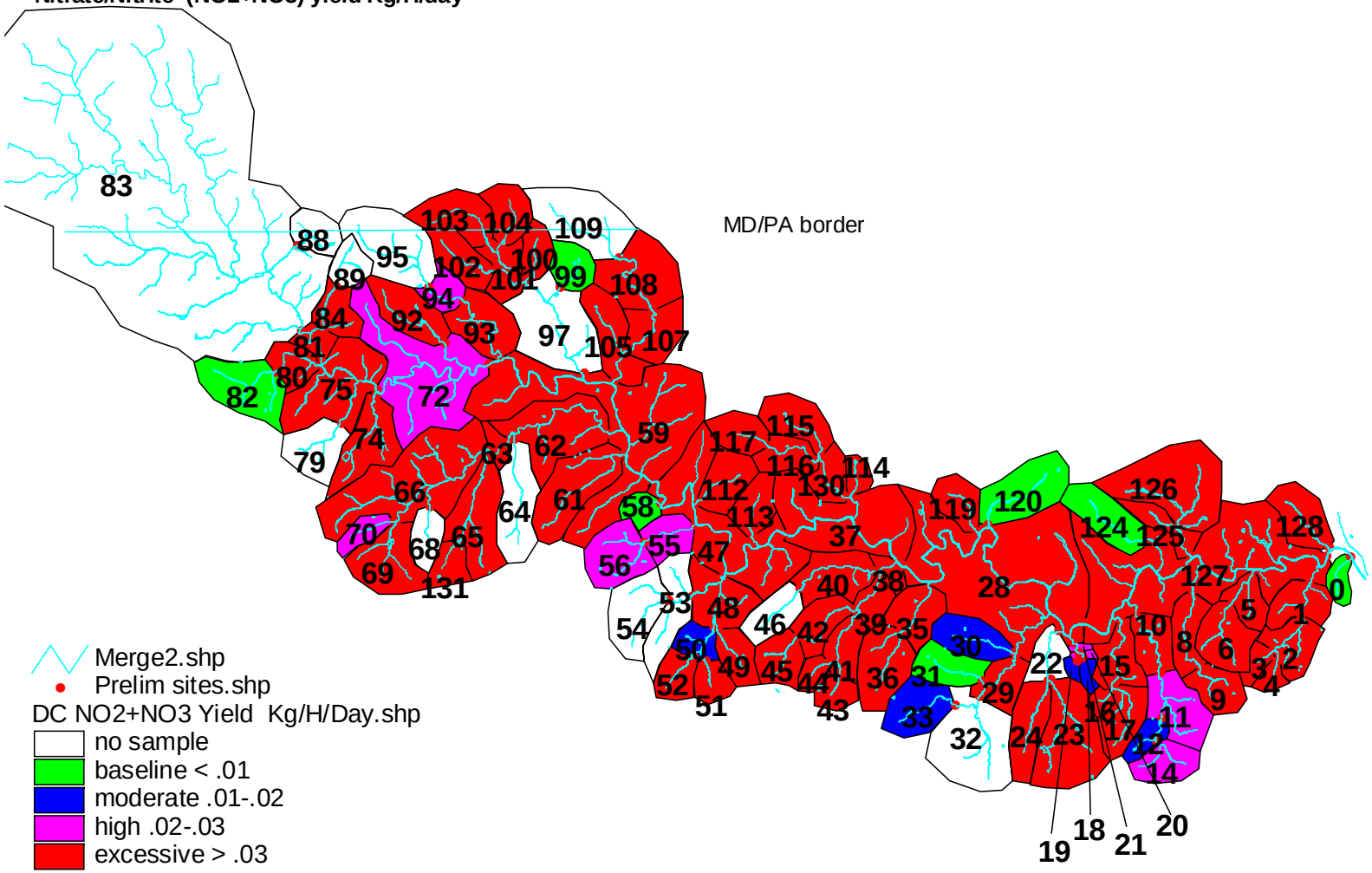


Figure 4. Deer Creek WRAS Nutrient Synoptic Survey, April 2005
Orthophosphate (PO4) Concentration (mg/L)

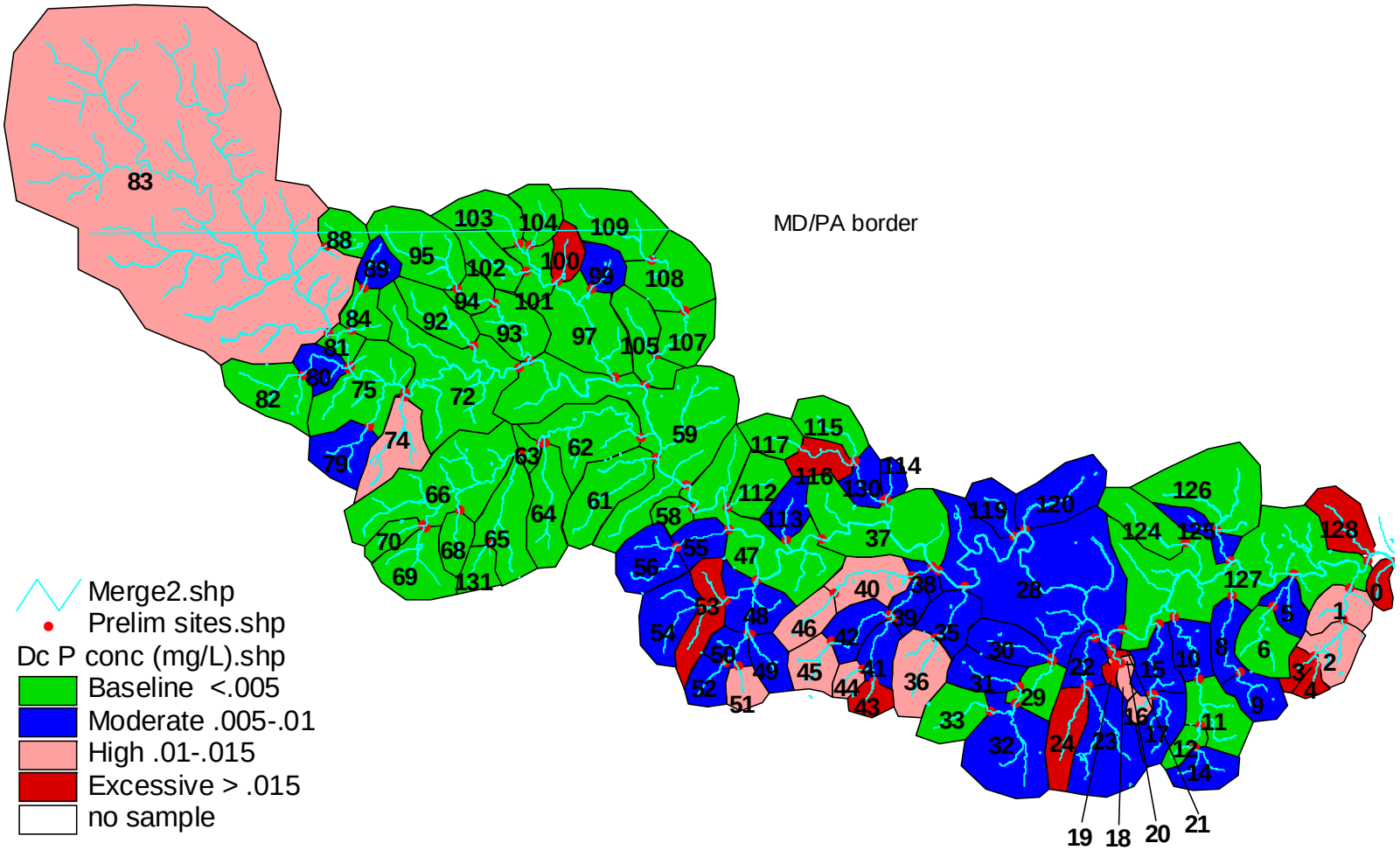


Figure 5. Deer Creek WRAS Nutrient Synoptic Survey, April 2005.
Orthophosphate (PO4) Yield (KG/H/day)

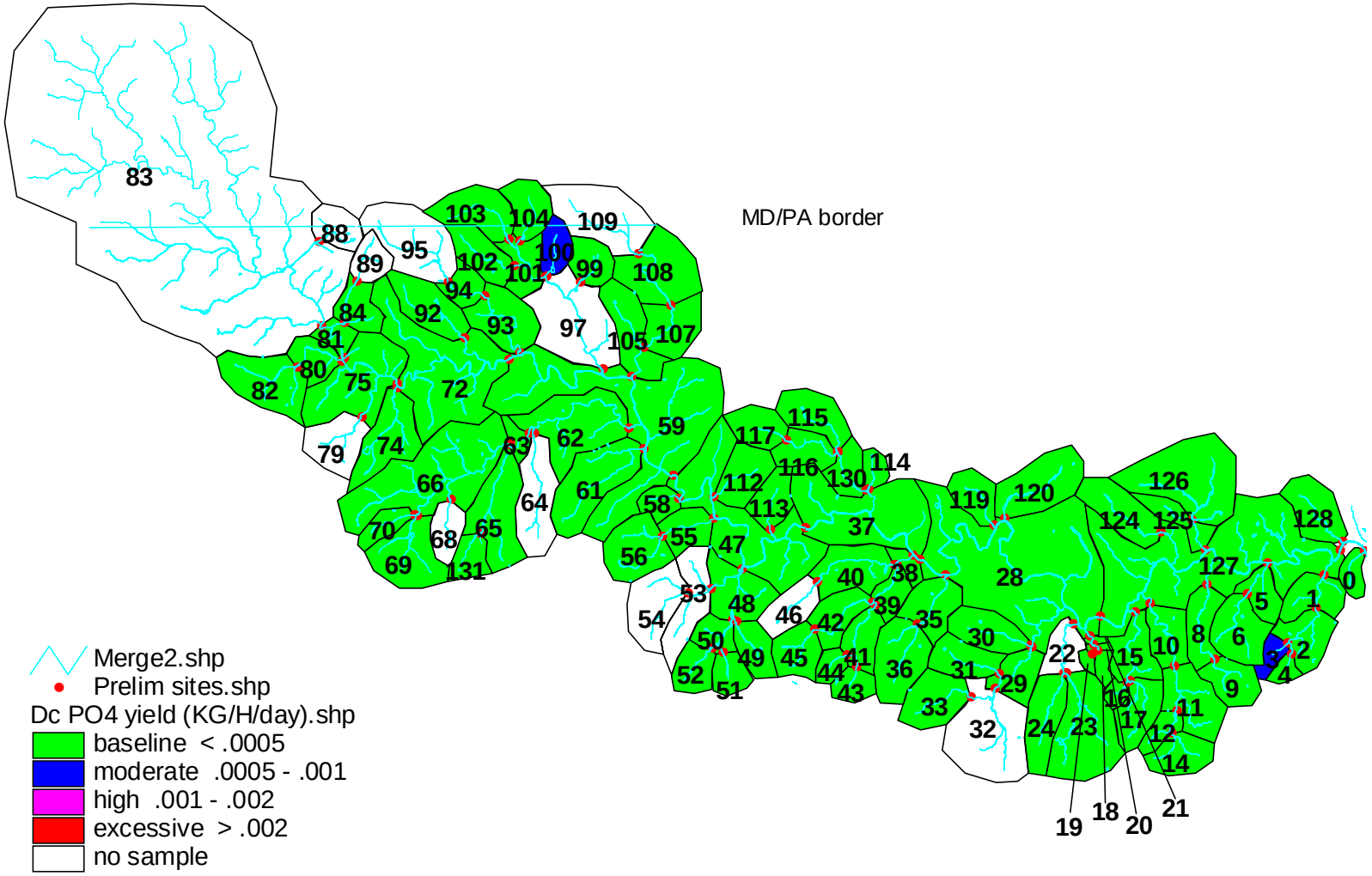


Table 4. Deer Creek Watershed WRAS Nutrient Synoptic Survey April, 2005 Insitu Water Quality Parameters

			Temp	D.O.		Spec Cond		
Station	**Date**	**Time**	**C**	**mg/L**	**pH**	**mS/cm**	**Lat**	**Long**
DC0	04/18/05	1000	10.64	8.94	6.79	112	39.62042	-76.156
DC1	04/18/05	1100	11.04	9.50	7.39	175	39.61678	-76.169
DC2	04/18/05	1200	13.59	9.68	7.80	208	39.60266	-76.1752
DC3	04/18/05	1150	13.22	8.98	6.99	206	39.59284	-76.187
DC4	04/18/05	1130	13.79	8.69	7.11	281	39.58976	-76.1852
DC5	04/18/05	1300	17.70	8.09	7.78	171	39.61733	-76.1939
DC6	04/18/05	1335	16.02	9.34	8.10	151	39.60772	-76.2025
DC8	04/18/05	1350	16.03	9.49	8.21	185	39.61095	-76.2179
DC9	04/19/05	0910	11.23	9.21	6.76	241	39.58814	-76.2151
DC10	04/18/05	1410	16.71	9.34	9.04	208	39.60506	-76.24
DC11	04/19/05	0950	11.43	11.09	7.53	227	39.58639	-76.2308
DC12	04/19/05	1200	14.64	10.49	7.77	319	39.37225	-76.2305
DC14	04/19/05	1140	14.65	9.68	7.38	264	39.56605	-76.2324
DC15	04/18/05	1420	16.44	9.26	8.45	190	39.60281	-76.2461
DC16	04/19/05	1100	110.10	9.63	7.12	215	39.58168	-76.2495
DC17	04/19/05	1010	12.50	10.95	6.96	197	39.58184	-76.2486
DC18	04/19/05	1020	11.71	9.56	6.30	336	39.58927	-76.2597
DC19	04/19/05	1030	11.51	9.56	6.34	196	39.58926	-76.2609
DC20	04/19/05	1040	13.29	10.09	6.84	254	39.59145	-76.361
DC21	04/19/05	1440	17.04	9.90	6.89	224	39.59579	-76.2643
DC22	04/20/05	0930	13.63	8.61	7.19	195		
DC23	04/19/05	1320	16.83	9.19	8.40	179	39.58467	-76.2742
DC24	04/19/05	1325	15.67	9.20	7.22	148	39.58467	-76.2742
DC28	05/04/05	1410	11.68	7.98	7.93	155	39.60199	-76.2498
DC29	04/19/05	1420	17.08	10.64	8.50	193	39.59276	-76.2868
DC30	04/19/05	1415	17.66	9.27	7.89	181	39.59276	-76.2868
DC31	04/19/05	1400	18.93	8.94	7.58	154	39.58468	-76.3001
DC32	04/20/05	0910	13.34	8.76	7.26	203	39.58002	-76.3015
DC33	04/20/05	0845	12.84	8.49	7.30	221	39.57759	-76.3106
DC35	04/20/05	0940	12.79	9.02	7.24	173	39.61432	-76.3708
DC36	04/20/05	1120	14.32	9.33	7.27	149	39.59941	-76.3321
DC37	05/04/05	1440	11.91	8.40	7.59	153	39.61987	-76.332
DC38	04/20/05	1000	12.69	9.18	7.36	195	39.62095	-76.3332
DC39	04/20/05	1030	13.14	9.18	7.45	182	39.61768	-76.3399
DC40	04/20/05	1035	13.04	9.17	7.34	219	39.61768	-76.3399
DC41	04/20/05	1100	13.63	9.60	7.48	175	39.61768	-76.3399
DC42	04/20/05	1055	14.20	9.28	7.34	194	39.60640	-76.3486
DC43	04/20/05	1145	16.08	9.29	7.09	193	39.58626	-76.3556
DC44	04/20/05	1200	15.32	9.33	6.67	190	39.59016	-76.3699
DC45	04/20/05	1210	17.42	9.13	7.05	194	39.59840	-76.3723
DC46	04/20/05	1220	18.34	8.65	7.08	221	39.61271	-76.3708
DC47	05/04/05	1500	13.88	7.58	7.15	191	39.62918	-76.3752
DC48	04/26/05	1200	13.79	8.38	7.80	141	39.61619	-76.4005

DC49	04/26/05	1320	14.17	8.02	6.86	139	39.60081	-76.4027
DC50	04/26/05	1340	14.43	8.16	6.92	115	39.60109	-76.404
DC51	04/26/05	1410	14.72	7.81	6.69	116	39.59133	-76.4077
DC52	04/28/05	1420	15.24	8.21	6.84	113	39.59259	-76.4129
DC53	04/26/05	1350	17.93	7.49	7.13	151	39.61040	-76.4126
DC54	04/26/05	1400	16.80	8.10	7.15	136	39.60595	-76.4222
DC55	04/26/05	1235	12.56	8.41	7.13	113	39.63081	-76.4155
DC56	04/26/05	1215	12.74	8.30	6.87	110	39.62726	-76.4311
DC58	04/26/05	1130	11.62	8.44	6.67	74	39.63853	-76.4246
DC59	05/03/05	1045	9.54	7.71	7.14	149	39.63776	-76.4119
DC61	04/28/05	1045	12.08	7.94	6.71	98	39.65277	-76.4387
DC62	04/28/05	1030	11.88	8.24	7.84	144	39.66162	-76.4482
DC63	04/28/05	1115	12.81	8.12	7.29	136	39.65818	-76.4835
DC63	04/28/05	1115	12.81	8.12	7.29	136	39.65818	-76.4835
DC65	04/28/05	1200	14.15	8.47	7.46	118	39.65471	-76.4914
DC66	04/28/05	1145	13.71	8.28	7.30	139	39.65490	-76.4912
DC68	04/28/05	1230	13.03	8.50	6.77	95	39.63859	-76.5146
DC69	04/28/05	1250	15.52	8.13	7.08	129	39.63379	-76.5274
DC70	04/28/05	1240	12.94	8.66	7.21	163	39.63382	-76.5288
DC72	05/02/05	1300	11.12	8.24	7.44	165	39.68032	-76.5661
DC74	04/29/05	1240	11.44	8.73	6.89	168	39.67269	-76.5354
DC75	05/02/05	1230	10.55	8.32	7.24	170	39.67291	-76.5354
DC79	04/29/05	1230	11.46	8.95	7.06	143	39.66333	-76.5493
DC80	05/02/05	1145	10.41	8.00	6.86	89	39.67879	-76.5545
DC81	05/02/05	1125	10.33	8.04	7.34	173	39.67893	-76.5545
DC82	04/29/05	1200	10.77	8.76	6.88	141	39.67845	-76.5752
DC83	04/29/05	1140	11.18	8.81	6.98	128		
DC84	04/29/05	1130	11.15	8.36	6.19	127	39.69074	-76.5566
DC88	05/02/05	1325	12.47	0.00	6.93	136	39.71682	-76.5661
DC89	05/02/05	1315	11.21	7.26	7.02	139	39.70435	-76.5508
DC91	05/02/05	1135	10.59	0.00	6.74	145	39.59391	-76.5356
DC92	04/28/05	1400	14.75	8.12	6.99	133	39.69779	-76.4657
DC93	04/28/05	1330	15.09	7.75	7.02	127	39.68228	-76.4873
DC94	04/29/05	1110	11.51	8.23	6.88	161	39.69960	-76.5008
DC95	04/29/05	1100	11.45	8.43	6.94	170		
DC97	05/03/05	1330	11.39	8.15	7.33	127	39.67736	-76.4543
DC99	04/29/05	0930	10.39	7.56	6.52	106	39.70252	-76.4633
DC100	04/29/05	0950	10.19	7.81	6.64	121	39.70564	-76.4765
DC101	04/29/05	1000	10.24	8.07	6.84	138	39.70564	-76.4765
DC102	04/29/05	1010	10.54	8.13	6.86	142	39.70868	-76.4889
DC103	04/29/05	1040	10.70	8.24	6.83	138	39.71698	-76.4912
DC104	04/29/05	1030	10.57	8.15	8.65	136	36.71592	-76.4871
DC105	04/28/05	1000	11.23	8.04	7.27	147	39.67513	-76.4429
DC107	04/28/05	0930	10.71	7.95	7.22	147	39.68437	-76.4379
DC108	04/28/05	0900	10.39	7.82	6.78	151	39.69688	-76.4276
DC109	04/28/05	0845	10.53	7.79	6.77	171	39.71227	-76.4402
DC112	04/26/05	1110	11.42	8.39	6.61	79	39.63797	-76.4125

DC113	04/26/05	1050	10.92	8.51	7.06	127	39.62877	-76.3889
DC114	04/20/05	1310	16.49	8.69	6.82	160	39.63999	-76.3507
DC115	04/20/05	1345	17.75	8.98	7.64	104	39.65217	-76.3628
DC116	04/20/05	1340	17.93	8.68	6.78	149	39.65217	-76.3628
DC117	04/20/05	1410	17.21	8.63	5.93	105	39.65533	-76.3829
DC119	04/26/05	1030	10.31	8.92	7.48	213	39.62967	-76.3015
DC120	04/26/05	1015	10.00	8.76	7.20	136	39.63093	-76.297
DC124	04/26/05	0930	9.72	8.35	7.51	161	39.62704	-76.2359
DC125	04/26/05	0900	9.39	8.63	6.92	185	39.62172	-76.218
DC126	04/26/05	0925	9.32	8.50	7.31	173	39.63063	-76.2239
DC127	05/04/05	1300	11.59	7.10	7.27	163	39.62255	-76.1646
DC128	04/18/05	1030	11.55	9.14	7.19	194	39.62321	-76.1646
DC130	04/20/05	1315	17.13	9.21	7.77	129	39.63999	-76.3507
DC131	04/28/05	1315	14.12	7.77	6.80	88	39.62784	-76.5036

Figure 6. Deer Creek WRAS Nutrient Synoptic Survey, April 2005
pH

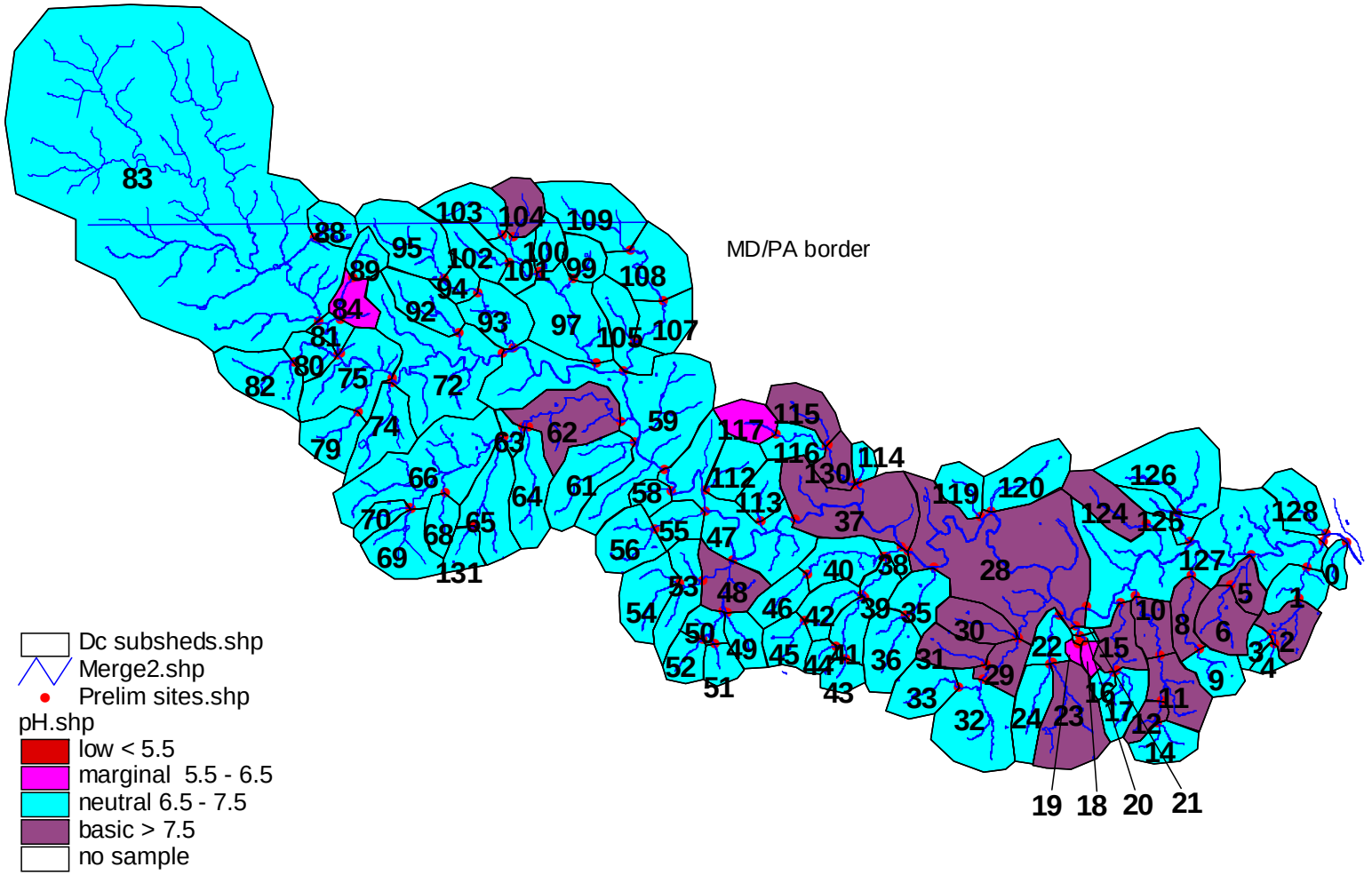


Figure 7. Deer Creek WRAS Nutrient Synoptic Survey, April, 2005
Specific Conductivity (micromohs/cm)

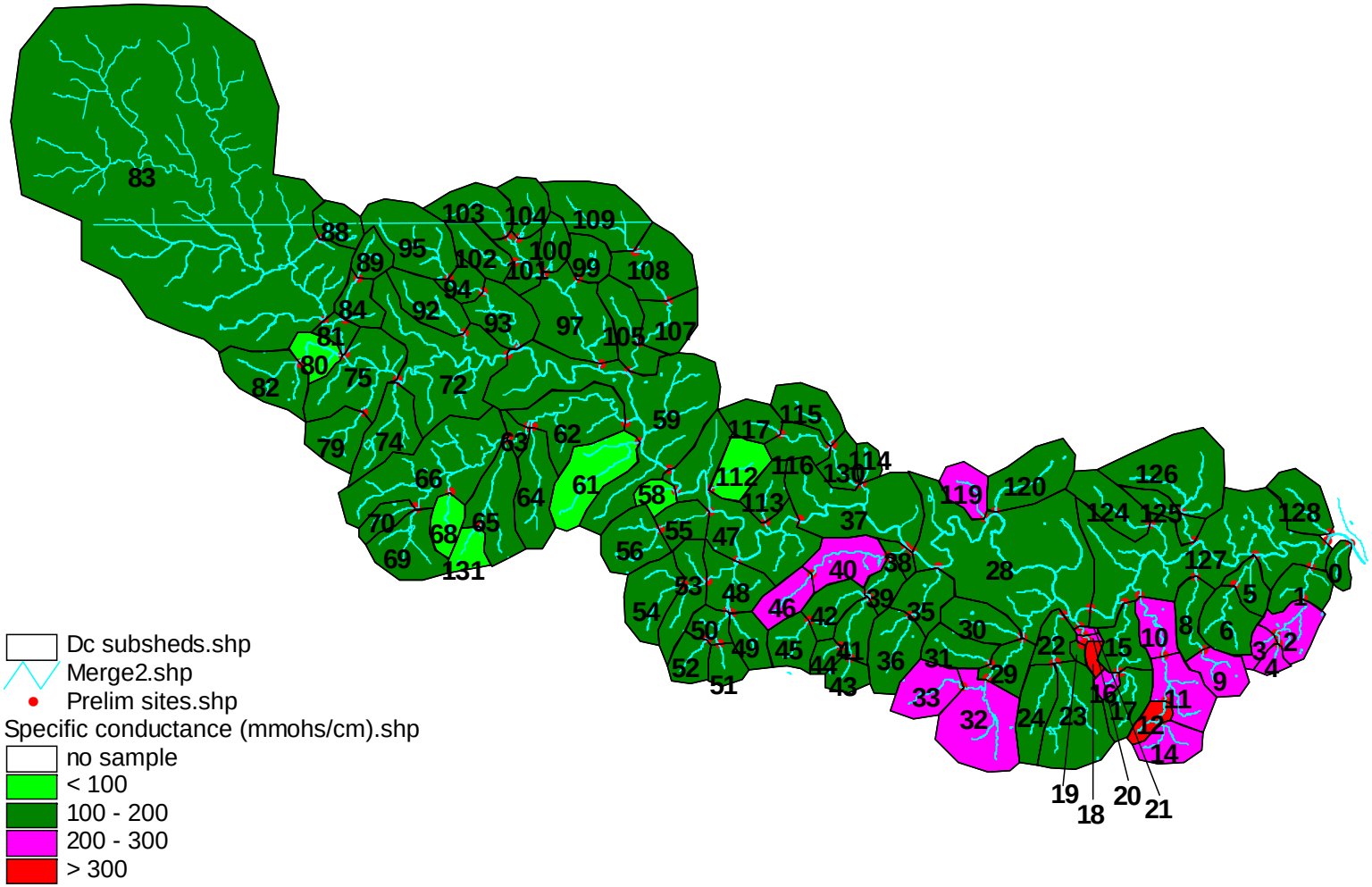
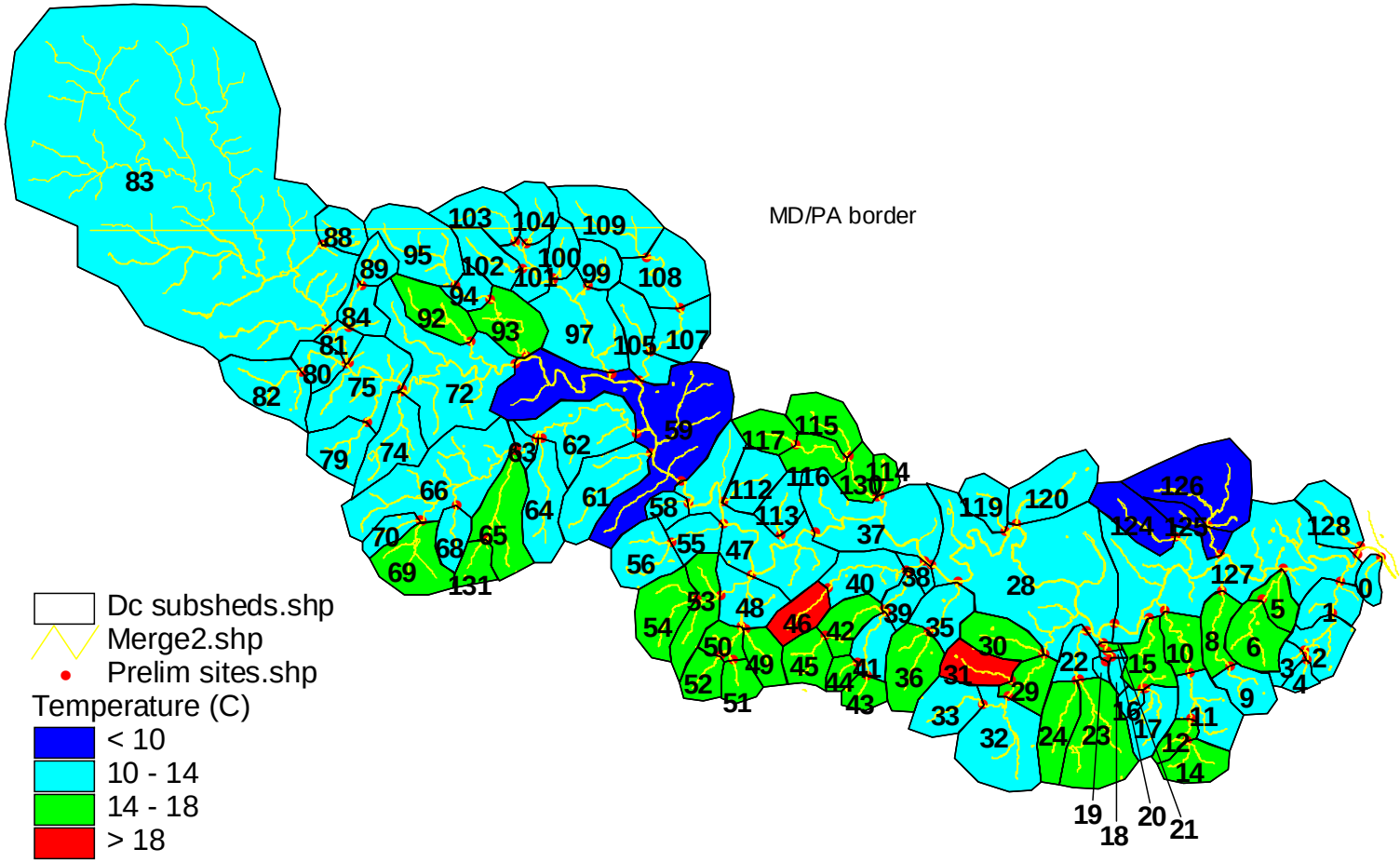


Figure 8. Deer Creek WRAS Nutrient Synoptic Survey April 2005
Temperature (C)



Discussion

Nitrate/nitrite concentrations are elevated throughout the Deer Creek watershed. Subwatersheds with excessive nitrate/nitrite concentrations (>5 mg/L) grouped in three areas; Island, Big, and Falling Branches, Stout Bottle Branch, and Elbow Branch/ Graveyard Creek. The reason for this clumped distribution is unclear from the photos of the sites. Several of the streams have residential houses on septic very close to the stream channel that would be contributing to the nitrogen load. Pasture land is also very prevalent in these watersheds, although wooded riparian corridors were common at most sites. The predominance of high (3-5 mg/L) nitrate/nitrite concentrations in the mainstem of Deer Creek indicate substantial nutrient inputs throughout the watershed. The large number of subwatersheds with excessive nitrate/nitrite yields compared to the number of subwatersheds with excessive concentrations has been found in all other rural piedmont WRAS watersheds. The topography and soils in these piedmont watersheds appear to produce more groundwater than more urban or coastal plain watersheds, especially during wet periods such as the early spring of 2005. Streams with low concentrations can have excessive yields if discharge volumes are high. Orthophosphate tends to travel in association with suspended sediment, thus streams with excessive orthophosphate concentrations (> .015 mg/L) usually had an active sediment source. This source could range from crayfish burrowing activity to domestic animals in the stream or land clearing in the watershed. Because this survey is done during dry weather, sediment associated phosphorus should be at a minimum. The very few subwatersheds with orthophosphate yields over baseline reinforce this assumption. Implementation activities that address either nitrogen or phosphorus will help moderate both due to the tendency of elevated nitrate/nitrite and orthophosphate concentrations to be in the same subwatershed. The nutrient concentrations found in the Deer Creek watershed are very similar to those found in neighboring and similar watersheds across the state (Table 5).

Table 5. Annual & Spring Nutrient Concentration Averages from Other Nutrient Synoptic Surveys

				Lower		**Deer**		Port
Mg/L	Piney	German Br.	Pocomoke	Monocacy	Liberty	**Creek**	Prettyboy	Tobacco
NO2+NO3 Spring	3.742	3.832	3.734	3.11	3.41	**3.7**	4.41	.751
NO2+NO3 Annual	4.823	4.704	2.384					
PO4 Spring	0.800	0.043	0.028	0.013	0.004	**.007**	.006	0.008
PO4 Annual	1.177	0.067	0.022					

The insitu measurements of dissolved oxygen, pH, specific conductivity and temperature found few anomalies. The two subwatersheds with marginally low pH (5.5-6.5) were not associated with low specific conductivity that would have reduced their buffering capacity. There were a small number of subwatersheds with modestly elevated specific conductivity, a measure of dissolved salts. While the maximum specific conductivities found in the Deer Creek watershed are within the natural range of surface water, there is the potential for road salt contamination from nearby heavily traveled

roads. Significantly higher specific conductivities have been found in watersheds transected by interstate highways. The six subwatersheds with specific conductivity below 100 mS/cm may be at risk from acid deposition (rain) that could cause episodic low pH events detrimental to the biological community. Temperature readings taken in early April are not representative of seasonal extremes that might impact stream biota, but they do indicate potential. There were two subwatersheds that had temperatures above 18^{o} C, and for a watersheds that have, or have the potential for, reproducing trout, this is very close to the 20^{o}C trout survival threshold.

Summary

The results of this nutrient synoptic survey indicate that nutrients, especially nitrate/nitrite, could be considered a water quality problem in the Deer Creek watershed. The source of these nutrients appears to be a combination of row crop and animal agriculture, and residential septic. The minor anomalies found in the insitu measurements of pH, specific conductivity, and temperature are not current threats to water quality, but should be considered when formulating a watershed management plan.

Literature Cited

Frink, Charles R.. 1991. *Estimating Nutrient Exports to Estuaries*. Journal of Environmental Quality. 20:717-724.