Assessment of the Impacts of Best Management Practices on Surface Water Quality Within a Small Agricultural Watershed

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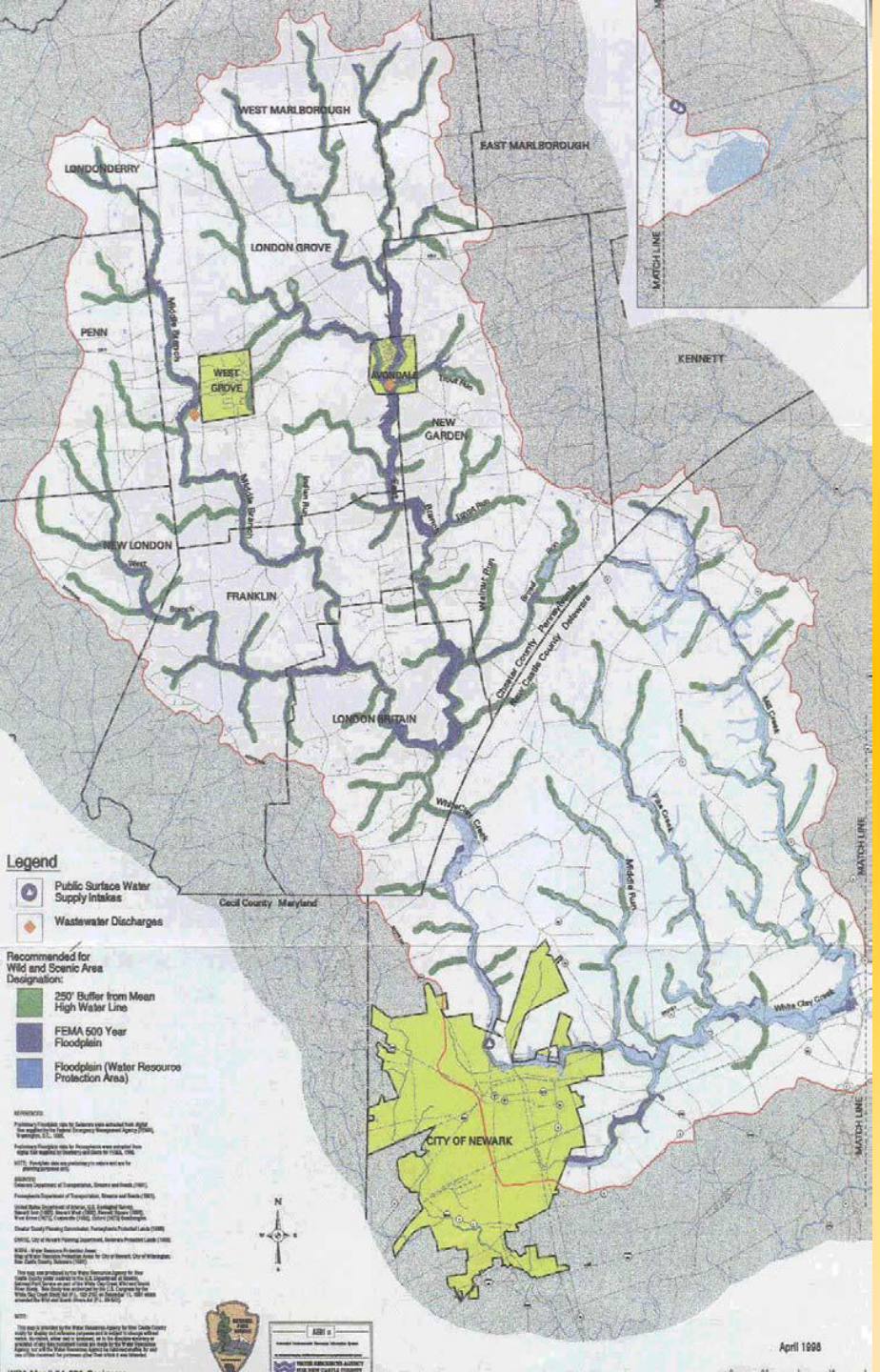
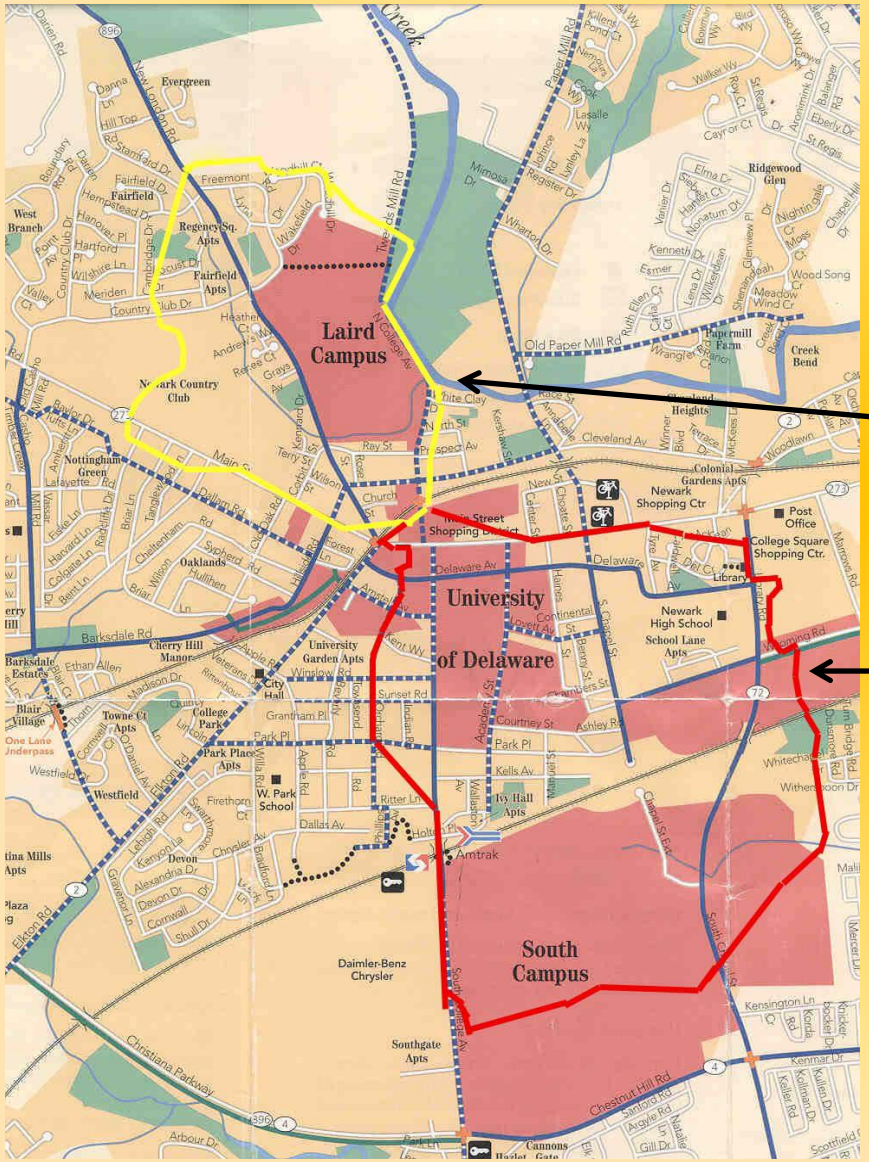


White Clay Creek Watershed

- Wild & Scenic River
- City of Newark
- UD Campus

Image: Campagnini, 2001

UD Experimental Watershed



- Established in 2002
- White Clay Creek
- 2 square miles
- Drains 1312 Ac

Piedmont Plateau Sub-watershed

Coastal Plain Sub-watershed

- Potomac formation
  - sands and sediments
- Drains 896 Ac

Introduction

- Cool Run Tributary of White Clay Creek Wild and Scenic Watershed
  - Agricultural, industrial & urban activities
  - Headwaters located within research farm
- BMP Implementation
  - Wetlands, stream exclusion, manure collection
  - Stream restoration, stormwater controls
- Monitoring Program
  - 2006 - 2011

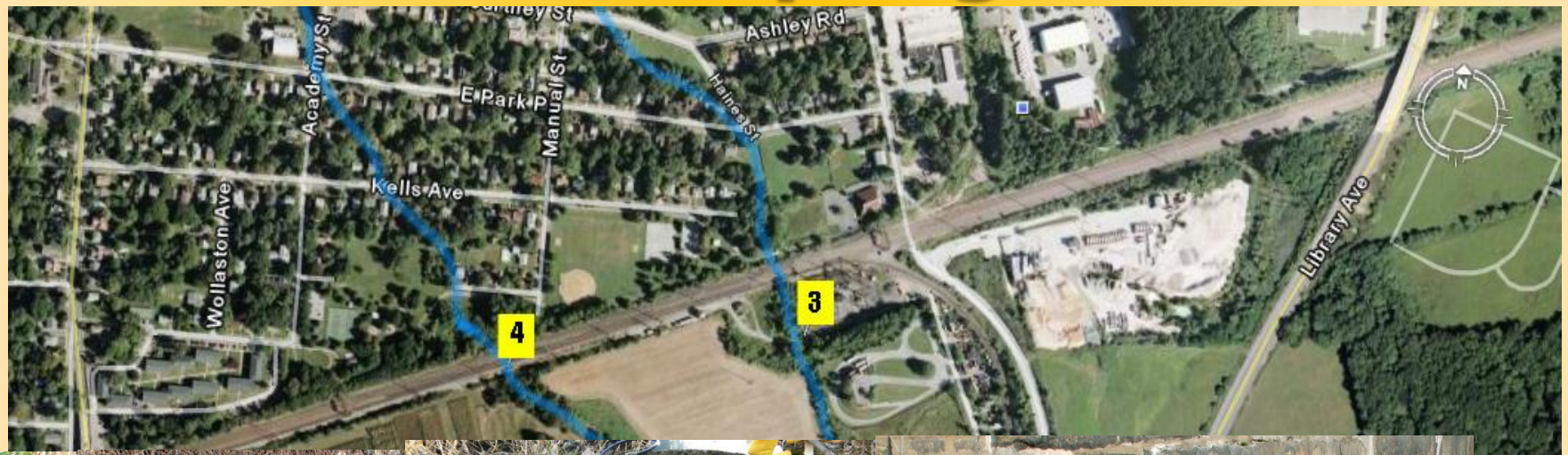
Objectives

- Assess impact of BMPs on Cool Run water quality
  - Assess temporal changes in water quality
  - Compare water quality of tributaries draining institutional and residential lands to those draining agricultural lands
  - Specifically N, P and bacteria

Methods: BMPs

Methods: BMPs

Methods: Sampling Locations



Methods: Monitoring

- Sites 1-6
  - Base flow monitoring
  - Monthly
- Sites 7-9
  - Storm flow monitoring
  - Several times per season
- Parameters
  - NH_3-N, NO_3-N, TKN, TP, DRP, Chlorophyll a, TSS, pH, DO, Enterococcus, T, conductivity, Zn, Cu, Pb, Cr, Ni, As

Results

- Evaluation of Impact of BMPs
  - Wetlands, Riparian Buffers, Fencing
  - Nutrients, TSS, TDS, TDZn, TDCu
- Sites 1,3,4 → 2 → 6,5
  - Base Flow
  - Several times per season
- Parameters
  - NH_3-N, NO_3-N, TKN, TP, DRP, Chlorophyll a, TSS, pH, DO, Enterococcus, T, conductivity, Zn, Cu, Pb, Cr, Ni, As

Average Values of NO_3 per year (mg L^{-1})

Year	2006	2007	2008	2009	2010	2011	Ave	Chi-Sq.
S-1	0.93	2.84	1.87	2.12	2.87	0.71	**1.9**	0.24
S-3	4.29	3.87	3.92	3.45	3.15	4.04	**3.8**	0.25
S-4	3.25	3.46	3.26	3.5	3.7	3.63	**3.5**	0.16
S-2	3.22	4.09	3.02	3.28	3.11	3.2	**3.3**	0.25
S-6	2.91	3.72	2.53	3.33	3.14	3.03	**3.11**	0.32
S-5	3.15	3.67	3.05	3.79	3.10	3.12	**3.3**	0.26

Yearly Average of TSS (mg L^{-1})

Year	2006	2007	2008	2009	2010	2011	Ave	Chi-Sq.
S-1	33	63.55	65.67	28.4	117.5	24	**55.4**	0.25
S-3	5.71	6.55	15.42	22.6	24.4	1	**12.6**	0.33
S-4	12.54	6.09	4.75	10.33	17.67	1	**8.7**	0.17
S-2	14.57	31.18	19.67	28	20.6	161	**45.8**	0.30
S-6	19.86	22.55	14.5	15.6	9.11	44	**20.9**	0.29
S-5	9.43	31.36	7.17	15.9	4.4	7	**12.5**	0.33

Yearly Average of TDS (mg L^{-1})

Year	2006	2007	2008	2009	2010	2011	Ave	Chi-Sq.
S-1	113.1	393.3	622.6	495.2	318.5	702.0	**440.8**	
S-3	182.7	1041.7	790.8	716.2	560.7	1103.3	**732.5**	
S-4	187.2	582.9	895.0	711.5	648.8	990.0	**669.3**	
S-2	160.1	563.7	781.0	595.9	506.4	892	**614.5**	
S-6	175.5	582.5	688.6	636.1	504.5	1084	**611.9**	0.235
S-5	171.5	554.64	739.42	598.18	480.73	877.0	**704.3**	

Yearly Average of Dissolved Zn (mg L^{-1})

Year	2006	2007	2008	2009	2010	Ave	Chi-Sq.
S-1	12.90	23.67	34.92	42.26	36.68	**30.1**	0.241
S-3	59.93	91.01	84.92	76.11	40.76	**70.5**	0.241
S-4	45.08	40.27	53.28	54.49	38.97	**46.4**	0.241
S-2	34.10	32.23	45.57	45.06	31.73	**37.7**	0.249
S-6	40.28	30.6	54.23	46.4	31.9	**40.7**	
S-5	21.5	29.71	35.82	36.40	42.30	**33.2**	0.241

Yearly Average of Total Cu (mg L^{-1})

Year	2006	2007	2008	2009	2010	Ave	Chi-Sq.
S-1	11.05	10.70	16.13	43.61	11.10	**18.5**	0.261
S-3	36.75	47.13	35.92	24.96	12.13	**31.38**	0.241
S-4	13.13	17.71	12.86	13.69	1.71	**11.8**	0.274
S-2	23.95	39.86	19.57	15.59	2.54	**20.3**	0.249
S-6	20.68	24.13	17.37	11.79	2.08	**15.2**	0.25
S-5	11.05	10.70	16.13	43.61	11.10	**18.5**	0.261

Yearly Average of Dissolved Cu (mg L^{-1})

Year	2006	2007	2008	2009	2010	Ave	Chi-Sq.
S-1	5.80	5.81	8.00	13.09	6.53	**7.8**	0.269
S-3	27.73	26.80	27.71	22.43	0.80	**31.9**	0.252
S-4	9.18	12.01	7.77	7.06	0.40	**7.3**	0.97
S-2	10.48	15.46	10.64	15.09	8.13	**12.0**	0.256
S-6	11.63	14.04	7.92	10.08	1.17	**9.0**	0.26
S-5	5.80	5.81	8.00	13.09	6.53	**7.8**	0.269

Discussion

- Importance of long term monitoring
  - Lag times
  - Effects during implementation
- Not all parameters tell the same story
- Reductions significant but still well above criteria
- No change over time but below criteria
- Indices a good ideas to tell story

Thank you ! Questions?