Updated: 17 April 2013

Print version

CEE 577: Surface Water Quality Modeling

Lecture #42

TOC & THMFP Models III

Scientific Literature

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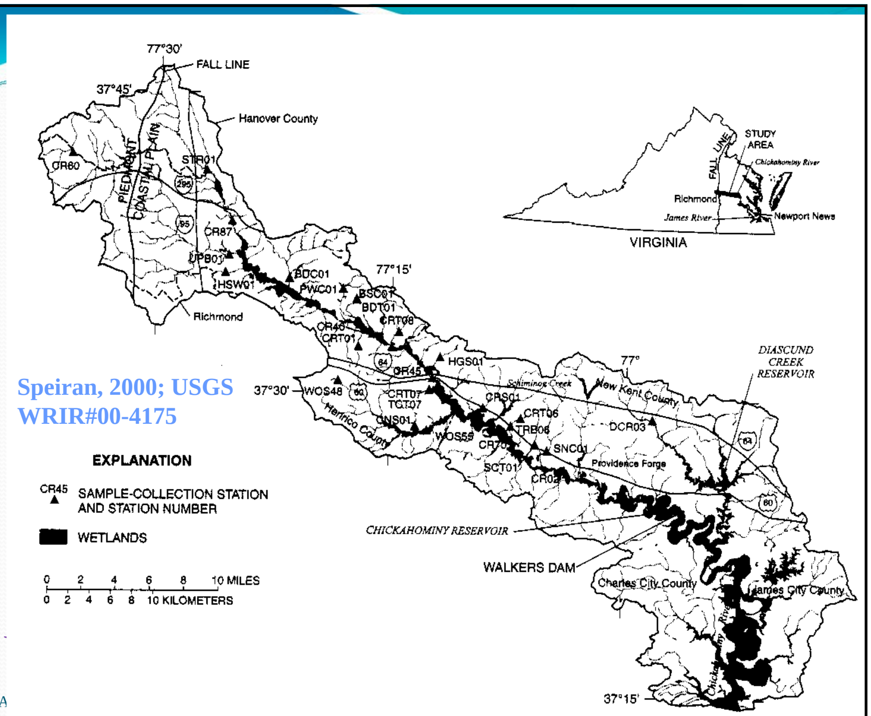

Speiran, 2000; USGS WRIR#00-4175

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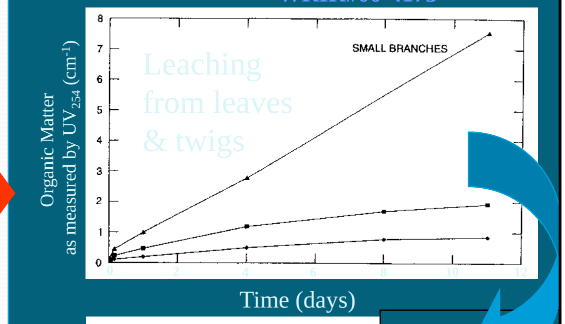
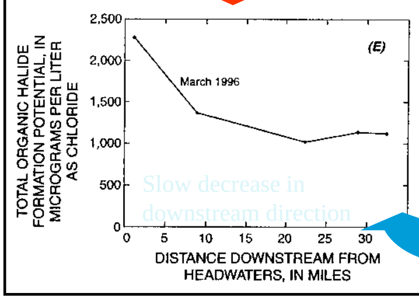
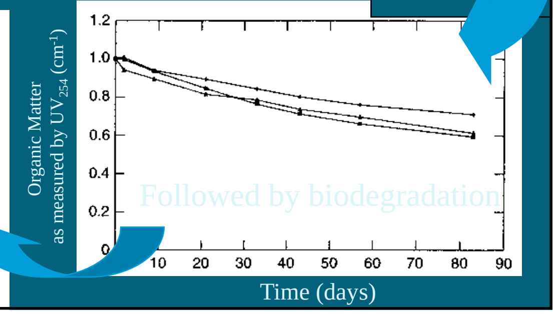
Organics

- Terrestrial origin
  - Lab tests
  - Field studies

Speiran, 2000; USGS WRIR#00-4175







Estimating Primary Productivity

- In situ methods are best
  - Direct observation of natural system over short time intervals
    - Measure changes in O_2, CO_2, pH, conductance
      - e.g., Dissolved O_2 diurnal variation in a lake
  - Naturally isolated water
    - Hypolimnion vs epilimnion
  - Artificially isolate a volume of water (community) and make measurements
    - Light & dark bottle tests

Wetzel & Likens, 1991, Limnological Analyses, 2nd edition, Springer-Verlag

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Primary Productivity (cont.)

- Radiolabel methods
  - $^{14}CO_2$ uptake ($t_{1/2}$=5760 yr)
    - Add a small, known amount of $NaH^{14}CO_3$ to a sample collected at known depth
    - Return sample to collection depth in a headspace-free BOD bottle (light & dark)
    - Bring bottles to surface at the end of ~4 hr
    - Filter (0.45 µm) under weak vacuum
      - Collect particulates (algae)
      - Collect & sparge filtrate (EOM)
        - Concentrate by lyophilization?
    - Analyze samples by scintillation counting

Wetzel & Likens, 1991, Limnological Analyses, 2nd edition, Springer-Verlag

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Data for Allochthonous Loading

- Stepczuk, Martin, Longabucco, Bloomfield & Effler, 1998
  - "Allochthonous Contributions of THM Precursors to a Eutrophic Reservoir, J. Lake & Res. Mgmt., 14(2/3)344-355

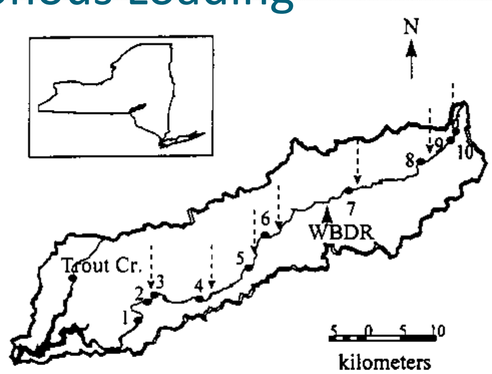

Figure 1.–Cannonsville Reservoir watershed, with two routine monitoring sites [WBDR (1), and Trout Creek]. The 10 synoptic survey sites, including site (1) for WBDR, are also shown. Dashed lines indicate point source locations (see Fig. 3a for point source identification).

Stepczuk et al., 1998, J. Lake & Res. Mgmt., 14(2/3)344-355

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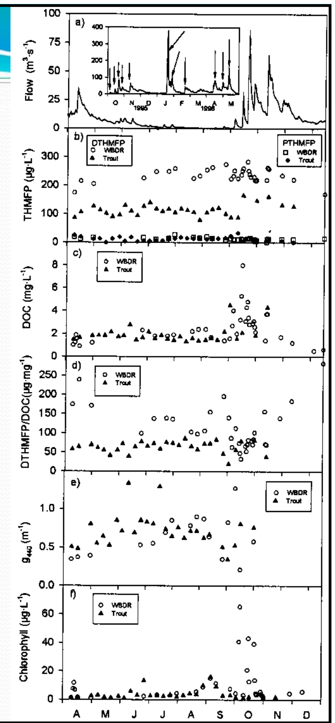
Time variability

- Time series data for WBDR and Trout Creek Apr-Dec interval (1995)
  - a) discharge for WBDR at Boerston
    - inset indentifies eleven runoff events for the fall 95 – spring 96 interval
  - b) DTHMFP and PTHMFP
  - c) DOC
  - d) DTHMFP/DOC (yield)
  - e) g_{440}
  - f) chlorophyll



Stepczuk et al., 1998, J. Lake & Res. Mgmt., 14(2/3)344-355

Average concentrations

Table 1.–Comparison of selected variables for Trout Creek and WBDR from the routine monitoring program* April-December 1995.

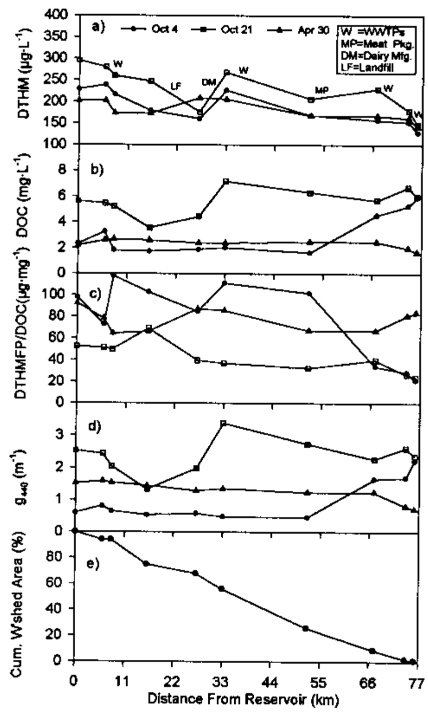
Variables	Units	Trout Cr. Avg.	Trout Cr. Range	Trout Cr. N	WBDR Avg.	WBDR Range	WBDR N
DTHMFP	$\mu g \cdot L^{-1}$	114	79-165	31	235	174-275	19
PTHMFP	$\mu g \cdot L^{-1}$	13	0-34	31	15	7-28	19
DOC	$mg \cdot L^{-1}$	1.9	1.0-4.5	29	2.0	0.9-4.4	19
POC	$mg \cdot L^{-1}$	0.5	0.1-1.2	24	0.8	0.2-3.7	19
Yield**	$\mu g \cdot mg^{-1}$	60	20-86	29	119	48-239	19
g_{440}	m^{-1}	0.7	0.4-1.3	27	0.6	0.2-1.3	16

* Monitoring that was part of the routine program, and not specifically associated with high runoff periods.
**µg DTHMFP / mg DOC.

Stepczuk et al., 1998, J. Lake & Res. Mgmt., 14(2/3)344-355

Synoptic Surveys

- Detailed data on 3 separate days for the WBDR



Stepczuk et al., 1998, J. Lake & Res. Mgmt., 14(2/3)344-355

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Summary of Synoptic Surveys

Table 2.–Selected data for three synoptic surveys of WBDR. Conditions at the mouth (0-km station at Beerston) and over the stream length are presented.

Date	10/4/95	10/21/95	4/30/96
Mean Daily Flow ($m^3 \cdot s^{-1}$)	1	57	55
DTHMFP ($\mu g \cdot L^{-1}$)			
@Beerston *	229	295	203
Stream Average	186	229	181
Range	129-239	148-295	142-209
DOC ($mg \cdot L^{-1}$)			
@Beerston *	2.3	5.6	2.2
Stream Average	3.1	5.6	2.4
Range	1.8-5.9	3.6-7.2	1.7-2.7
g_{440} (m^{-1})			
@Beerston *	0.6	2.5	1.5
Stream Average	1.0	2.4	1.3
Range	0.5-2.2	1.3-3.4	0.7-1.6

* Mouth of WBDR.

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Storm Events

Table 3. Selected hydrologic and water quality data for eleven runoff events for WBDR, October 1995-April 1996.

Runoff Events (1995-1996) Date	Starting Flow* ($m^3 \cdot s^{-1}$)	Peak Flow ($m^3 \cdot s^{-1}$)	%-ile** Peak Flow %	%-ile** Volume %	DTHMFP Flow-wtd. Conc. ($\mu g \cdot L^{-1}$)	DTHMFP Range ($\mu g \cdot L^{-1}$)	DOC Flow-wtd. Conc. ($mg \cdot L^{-1}$)	DOC Range ($mg \cdot L^{-1}$)	Flow-wtd. Avg. Yield ($\mu g \cdot mg^{-1}$ C)‡
10/5	1	11	0	0	243	231-268	3.6	2.0-4.3	68
10/14	2	41	23	10	254	240-275	5.0	3.7-5.8	51
10/21	5	132	85	75	255	249-325	4.2	2.0-5.3	61
10/27	16	55	38	35	223	215-246	2.9	2.0-3.3	76
11/11	12	81	60	55	259	237-279	3.6	1.8-4.1	72
1/18	12	555	100	100	214	169-249	3.7	1.1-4.8	58
1/27	41	166	92	92	163	151-229	2.1	1.5-2.7	78
2/20	6	60	40	37	180	161-233	2.9	1.0-3.6	62
4/12	13	74	47	48	175	161-209	1.9	1.3-2.3	92
4/29	20	88	65	78	225	220-254	2.1	1.2-2.6	107
5/11	32	172	93	97	223	218-258	2.3	1.6-3.3	97
Event Avg.	131	219	3.1	70					
Routine Monitoring Date	Avg. Flow ($m^3 \cdot s^{-1}$)		Avg. Conc. ($\mu g \cdot L^{-1}$)	Range ($\mu g \cdot L^{-1}$)	Avg. Conc. ($mg \cdot L^{-1}$)	Range ($mg \cdot L^{-1}$)	Avg. Yield ($\mu g \cdot mg^{-1}$ C)‡		
4/95-12/95	3		235	174-275	2.0	1.0-4.4	119		

* Base flow = ~ 16 ($m^3 \cdot s^{-1}$).
** Percent storms exceeded (out of 61 total).
‡ Yield is the quotient of DTHMFP and DOC.

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Storm Event Time Series

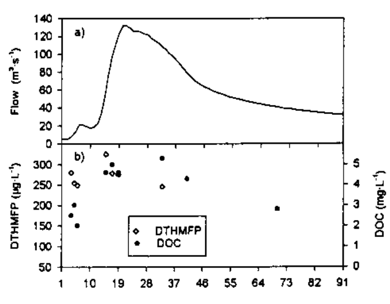

Figure 4.–Time series for runoff event for WBDR starting on October 21, 1995: a) hydrograph, and b) concentrations of DTHMFP and DOC.

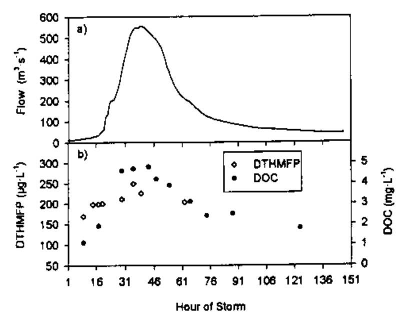

Figure 5.–Time series for runoff event for WBDR starting on January 18, 1996: a) hydrograph, and b) concentrations of DTHMFP and DOC.

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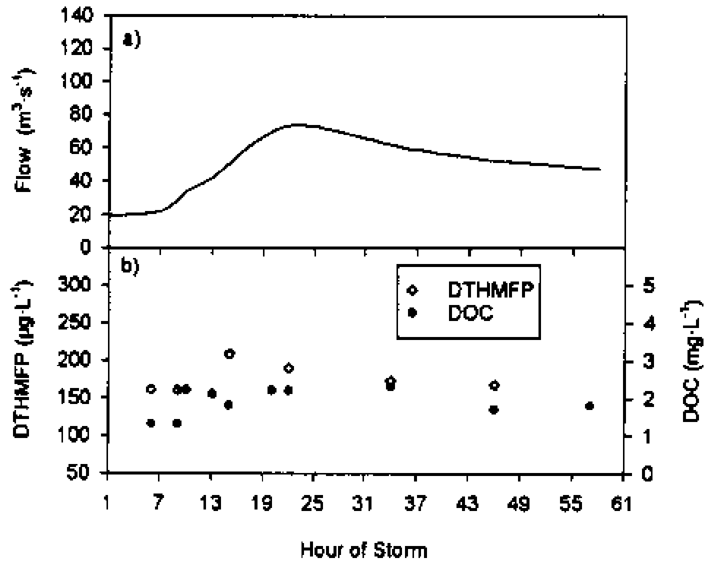

Figure 6.–Time series for runoff event for WBDR starting on April 12, 1996: a) hydrograph, and b) concentrations of DTHMFP and DOC.

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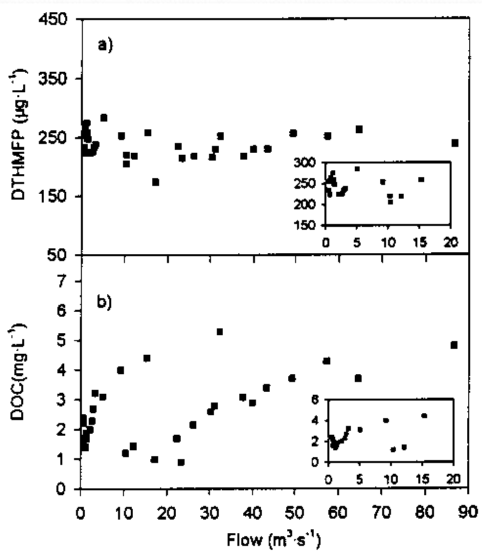

Figure 7.–Evaluation of the relationship between concentration and daily average flow in WBDR: a) DTHMFP (inset for non-event data only), and b) DOC (inset for non-event data only).

Stepczuk et al., 1998, J. Lake & Res. Mgmt., 14(2/3)344-355

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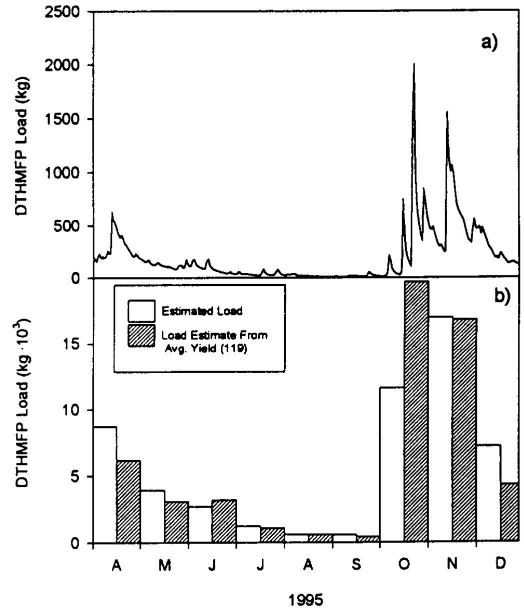

Figure 9. Estimates of DTHMFP loads from WBDR to Cannonsville Reservoir, April-December 1995: a) daily, and b) comparison of monthly, from DTHMFP (as in a), and DOC (from a yield of 119 µg · mg⁻¹ C) concentrations.

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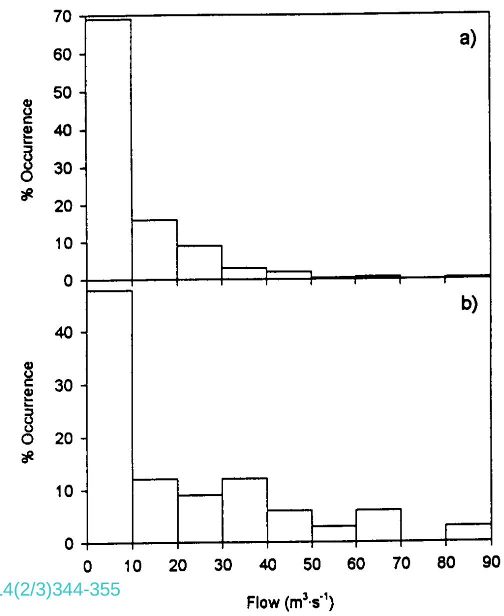

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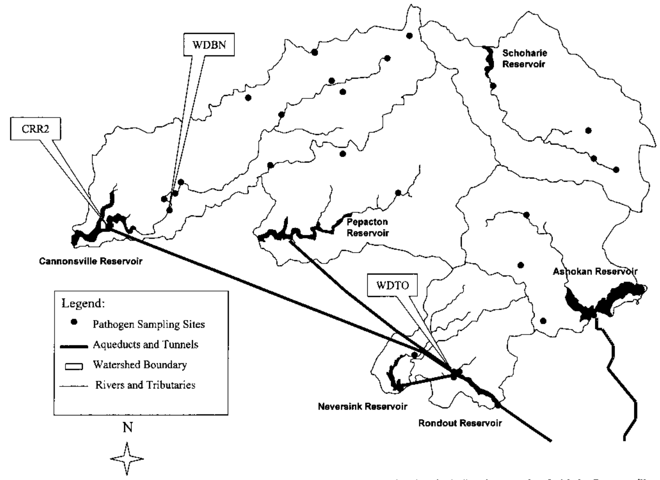

Figure 1.–New York City Department of Environmental Protection pathogen monitoring sites, including sites associated with the Cannonsville Reservoir and watershed.

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Mirror Lake

- Oligotrophic

Jordan & Likens, 1975, Verh. Internat. Veerein. Limnol., 19:994-1003

Cole et al., 1984, Oikos, 42:1-9

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- The End