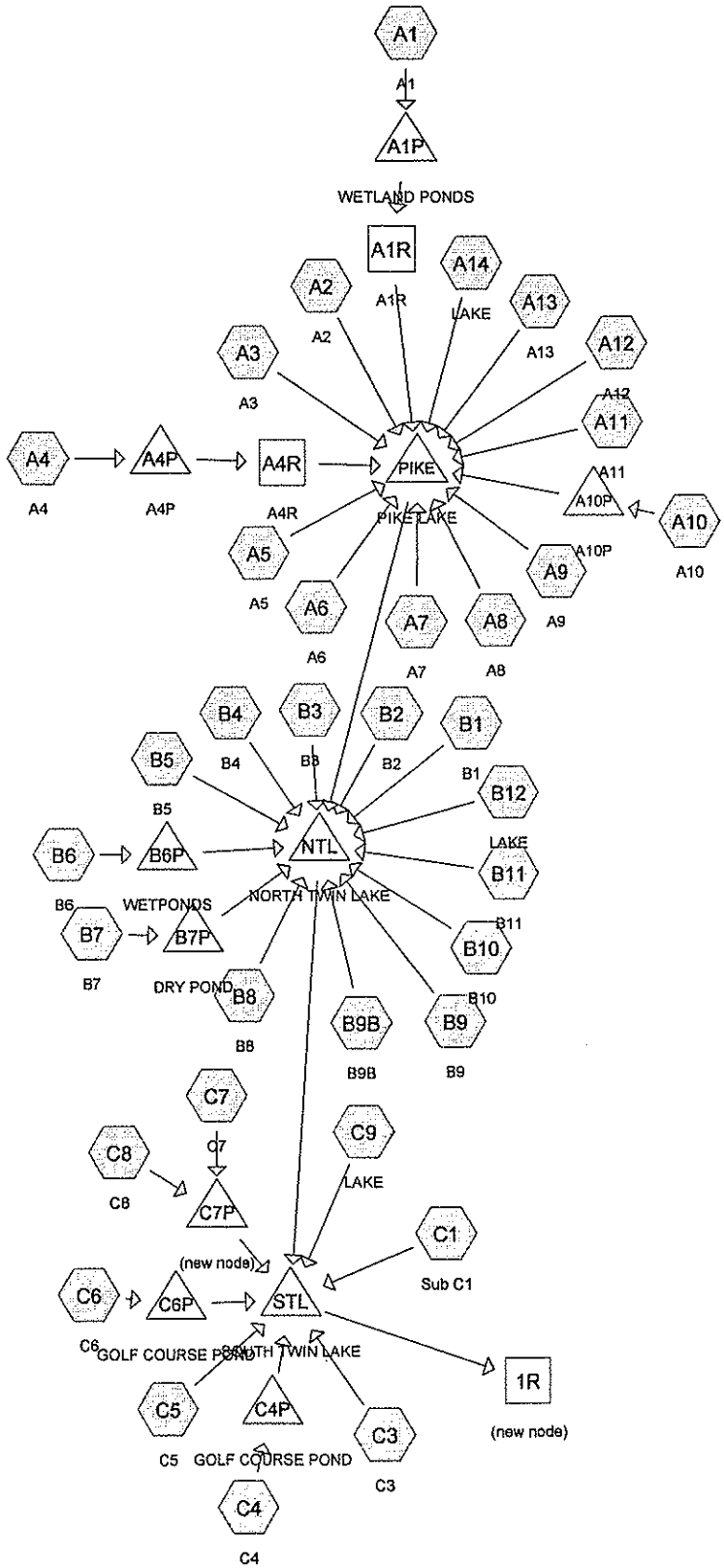
APPENDIX P

HydroCAD Storm Water Model Results



Subcat Reach Pond Link

Drainage Diagram for Amery Lakes-Existing
Prepared by Cedar Corporation, DAS 9/2/2004
HydroCAD® 7.00 s/n 001218 © 1986-2003 Applied Microcomputer Systems

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment A1: A1 Runoff Area=38.900 ac Runoff Depth=0.56"
Tc=30.0 min CN=69 Runoff=15.02 cfs 1.811 af

Subcatchment A10: A10 Runoff Area=9.900 ac Runoff Depth=0.56"
Tc=20.0 min CN=69 Runoff=5.07 cfs 0.463 af

Subcatchment A11: A11 Runoff Area=26.500 ac Runoff Depth=0.56"
Tc=15.0 min CN=69 Runoff=16.25 cfs 1.242 af

Subcatchment A12: A12 Runoff Area=26.300 ac Runoff Depth=0.38"
Tc=35.0 min CN=64 Runoff=4.96 cfs 0.828 af

Subcatchment A13: A13 Runoff Area=25.500 ac Runoff Depth=0.38"
Tc=35.0 min CN=64 Runoff=4.81 cfs 0.803 af

Subcatchment A14: LAKE Runoff Area=169.300 ac Runoff Depth=2.79"
Tc=30.0 min CN=100 Runoff=353.09 cfs 39.310 af

Subcatchment A2: A2 Runoff Area=44.600 ac Runoff Depth=0.64"
Tc=30.0 min CN=71 Runoff=20.94 cfs 2.381 af

Subcatchment A3: A3 Runoff Area=29.400 ac Runoff Depth=0.26"
Flow Length=1,750' Tc=42.7 min CN=60 Runoff=2.54 cfs 0.632 af

Subcatchment A4: A4 Runoff Area=34.000 ac Runoff Depth=0.60"
Tc=35.0 min CN=70 Runoff=13.00 cfs 1.693 af

Subcatchment A5: A5 Runoff Area=14.000 ac Runoff Depth=0.98"
Tc=20.0 min CN=78 Runoff=14.74 cfs 1.146 af

Subcatchment A6: A6 Runoff Area=17.700 ac Runoff Depth=0.41"
Tc=20.0 min CN=65 Runoff=5.69 cfs 0.611 af

Subcatchment A7: A7 Runoff Area=18.300 ac Runoff Depth=0.16"
Tc=25.0 min CN=56 Runoff=0.77 cfs 0.249 af

Subcatchment A8: A8 Runoff Area=13.200 ac Runoff Depth=0.78"
Tc=15.0 min CN=74 Runoff=12.40 cfs 0.858 af

Subcatchment A9: A9 Runoff Area=21.200 ac Runoff Depth=0.35"
Tc=15.0 min CN=63 Runoff=6.18 cfs 0.618 af

Subcatchment B1: B1 Runoff Area=46.720 ac Runoff Depth=0.69"
Flow Length=850' Tc=24.8 min CN=72 Runoff=27.42 cfs 2.669 af

Subcatchment B10: B10
Runoff Area=10.730 ac Runoff Depth=0.83"
Tc=20.0 min CN=75 Runoff=9.20 cfs 0.739 af

Subcatchment B11: B11
Runoff Area=20.100 ac Runoff Depth=1.10"
Tc=15.0 min CN=80 Runoff=27.98 cfs 1.838 af

Subcatchment B12: LAKE
Runoff Area=142.400 ac Runoff Depth=2.79"
Tc=30.0 min CN=100 Runoff=296.99 cfs 33.064 af

Subcatchment B2: B2
Runoff Area=13.670 ac Runoff Depth=0.83"
Tc=20.0 min CN=75 Runoff=11.72 cfs 0.942 af

Subcatchment B3: B3
Runoff Area=8.920 ac Runoff Depth=1.80"
Tc=15.0 min CN=90 Runoff=20.46 cfs 1.335 af

Subcatchment B4: B4
Runoff Area=7.190 ac Runoff Depth=0.48"
Tc=20.0 min CN=67 Runoff=2.97 cfs 0.290 af

Subcatchment B5: B5
Runoff Area=28.040 ac Runoff Depth=1.41"
Tc=25.0 min CN=85 Runoff=38.56 cfs 3.301 af

Subcatchment B6: B6
Runoff Area=18.600 ac Runoff Depth=0.41"
Tc=25.0 min CN=65 Runoff=5.10 cfs 0.640 af

Subcatchment B7: B7
Runoff Area=18.120 ac Runoff Depth=0.29"
Tc=25.0 min CN=61 Runoff=2.63 cfs 0.436 af

Subcatchment B8: B8
Runoff Area=10.510 ac Runoff Depth=0.29"
Tc=25.0 min CN=61 Runoff=1.53 cfs 0.253 af

Subcatchment B9: B9
Runoff Area=21.800 ac Runoff Depth=0.56"
Tc=25.0 min CN=69 Runoff=9.59 cfs 1.017 af

Subcatchment B9B: B9B
Runoff Area=28.040 ac Runoff Depth=1.79"
Tc=20.0 min CN=90 Runoff=55.66 cfs 4.190 af

Subcatchment C1: Sub C1
Runoff Area=18.980 ac Runoff Depth=0.69"
Tc=25.0 min CN=72 Runoff=11.09 cfs 1.084 af

Subcatchment C3: C3
Runoff Area=57.910 ac Runoff Depth=0.69"
Tc=25.0 min CN=72 Runoff=33.84 cfs 3.308 af

Subcatchment C4: C4
Runoff Area=22.860 ac Runoff Depth=0.29"
Flow Length=1,300' Tc=31.4 min CN=61 Runoff=2.86 cfs 0.548 af

Subcatchment C5: C5
Runoff Area=14.780 ac Runoff Depth=1.79"
Tc=20.0 min CN=90 Runoff=29.34 cfs 2.209 af

Subcatchment C6: C6 Runoff Area=16.420 ac Runoff Depth=0.41"
Tc=20.0 min CN=65 Runoff=5.28 cfs 0.566 af

Subcatchment C7: C7 Runoff Area=12.070 ac Runoff Depth=0.45"
Tc=20.0 min CN=66 Runoff=4.41 cfs 0.451 af

Subcatchment C8: C8 Runoff Area=7.510 ac Runoff Depth=1.56"
Tc=25.0 min CN=87 Runoff=11.41 cfs 0.974 af

Subcatchment C9: LAKE Runoff Area=76.200 ac Runoff Depth=2.79"
Tc=20.0 min CN=100 Runoff=200.22 cfs 17.724 af

Reach 1R: (new node) Inflow=0.61 cfs 0.404 af
Outflow=0.61 cfs 0.404 af

Reach A1R: A1R Peak Depth=0.12' Max Vel=2.1 fps Inflow=0.83 cfs 0.696 af
n=0.030 L=1,000.0' S=0.0315 '/' Capacity=330.73 cfs Outflow=0.83 cfs 0.679 af

Reach A4R: A4R Peak Depth=0.13' Max Vel=1.4 fps Inflow=0.42 cfs 0.298 af
n=0.030 L=1,500.0' S=0.0150 '/' Capacity=195.57 cfs Outflow=0.42 cfs 0.278 af

Pond A10P: A10P Peak Elev=1,062.25' Storage=20,146 cf Inflow=5.07 cfs 0.463 af
Outflow=0.00 cfs 0.000 af

Pond A1P: WETLAND PONDS Peak Elev=1,093.02' Storage=50,587 cf Inflow=15.02 cfs 1.811 af
18.0" x 100.0' Culvert Outflow=0.83 cfs 0.696 af

Pond A4P: A4P Peak Elev=1,084.37' Storage=60,745 cf Inflow=13.00 cfs 1.693 af
18.0" x 50.0' Culvert Outflow=0.42 cfs 0.298 af

Pond B6P: WETPONDS Peak Elev=1,060.33' Storage=7,605 cf Inflow=5.10 cfs 0.640 af
Outflow=1.00 cfs 0.629 af

Pond B7P: DRY POND Peak Elev=1,062.10' Storage=4,138 cf Inflow=2.63 cfs 0.436 af
Outflow=0.86 cfs 0.399 af

Pond C4P: GOLF COURSE POND Peak Elev=1,063.09' Storage=5,346 cf Inflow=2.86 cfs 0.548 af
Outflow=1.04 cfs 0.498 af

Pond C6P: GOLF COURSE POND Peak Elev=1,067.74' Storage=20,510 cf Inflow=5.28 cfs 0.566 af
Outflow=0.21 cfs 0.096 af

Pond C7P: (new node) Peak Elev=1,062.27' Storage=1.295 af Inflow=15.78 cfs 1.425 af
12.0" x 50.0' Culvert Outflow=0.18 cfs 0.130 af

Pond NTL: NORTH TWIN LAKE Peak Elev=1,061.19' Storage=55.604 af Inflow=479.14 cfs 63.153 af
Outflow=6.07 cfs 7.516 af

Pond PIKE: PIKE LAKE Peak Elev=1,061.02' Storage=37.507 af Inflow=422.33 cfs 49.635 af
Outflow=13.69 cfs 13.115 af

Pond STL: SOUTH TWIN LAKE Peak Elev=1,060.20' Storage=32.139 af Inflow=271.19 cfs 32.564 af
36.0" x 50.0' Culvert Outflow=0.61 cfs 0.404 af

Total Runoff Area = 1,090.370 ac Runoff Volume = 130.223 af Average Runoff Depth = 1.43"

Subcatchment A1: A1

Runoff = 15.02 cfs @ 12.29 hrs, Volume= 1.811 af, Depth= 0.56"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.80"

Area (ac)	CN	Description
3.000	100	WATER
4.000	65	2 acre lots, 12% imp, HSG B
5.000	55	Woods, Good, HSG B
16.000	74	Row crops, C + CR, Good, HSG B
10.900	61	Pasture/grassland/range, Good, HSG B
38.900	69	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
30.0					**Direct Entry,**

Subcatchment A10: A10

Runoff = 5.07 cfs @ 12.16 hrs, Volume= 0.463 af, Depth= 0.56"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.80"

Area (ac)	CN	Description
2.000	100	WATER
1.500	68	1 acre lots, 20% imp, HSG B
6.400	60	Woods, Fair, HSG B
9.900	69	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment A11: A11

Runoff = 16.25 cfs @ 12.10 hrs, Volume= 1.242 af, Depth= 0.56"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.80"

Area (ac)	CN	Description
19.500	70	1/2 acre lots, 25% imp, HSG B
7.000	66	Woods, Poor, HSG B
26.500	69	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry,**

Subcatchment A12: A12

Runoff = 4.96 cfs @ 12.40 hrs, Volume= 0.828 af, Depth= 0.38"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.80"

Area (ac)	CN	Description
3.600	89	Paved roads w/open ditches, HSG B
22.700	60	Woods, Fair, HSG B
26.300	64	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
35.0					**Direct Entry,**

Subcatchment A13: A13

Runoff = 4.81 cfs @ 12.40 hrs, Volume= 0.803 af, Depth= 0.38"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.80"

Area (ac)	CN	Description
4.500	74	Row crops, C + CR, Good, HSG B
12.500	60	Woods, Fair, HSG B
8.500	65	2 acre lots, 12% imp, HSG B
25.500	64	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
35.0					**Direct Entry,**

Subcatchment A14: LAKE

Runoff = 353.09 cfs @ 12.23 hrs, Volume= 39.310 af, Depth= 2.79"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.80"

Area (ac)	CN	Description
169.300	100	LAKE

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
30.0					**Direct Entry,**

Subcatchment A2: A2

Runoff = 20.94 cfs @ 12.28 hrs, Volume= 2.381 af, Depth= 0.64"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.80"

Area (ac)	CN	Description
2.000	100	WATER
10.000	60	Woods, Fair, HSG B
6.000	68	1 acre lots, 20% imp, HSG B
26.600	74	Row crops, C + CR, Good, HSG B
44.600	71	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
30.0					**Direct Entry,**

Subcatchment A3: A3

Runoff = 2.54 cfs @ 12.59 hrs, Volume= 0.632 af, Depth= 0.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.80"

Area (ac)	CN	Description
8.000	60	Woods, Fair, HSG B
5.000	72	1/4 acre lots, 30% imp, HSG B
16.400	56	Brush, Fair, HSG B
29.400	60	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
30.8	250	0.0600	0.1		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.80"
10.5	500	0.0250	0.8		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.4	1,000	0.0300	11.5	276.58	**Trap/Vee/Rect Channel Flow,** Bot.W=2.00' D=3.00' Z= 2.0 '/' n= 0.030
42.7	1,750	Total			

Subcatchment A4: A4

Runoff = 13.00 cfs @ 12.36 hrs, Volume= 1.693 af, Depth= 0.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.80"

Area (ac)	CN	Description
5.000	100	WATER
19.000	60	Woods, Fair, HSG B
10.000	74	Row crops, C + CR, Good, HSG B
34.000	70	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
35.0					**Direct Entry,**

Subcatchment A5: A5

Runoff = 14.74 cfs @ 12.14 hrs, Volume= 1.146 af, Depth= 0.98"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.80"

Area (ac)	CN	Description
10.000	85	1/8 acre lots, 65% imp, HSG B
4.000	60	Woods, Fair, HSG B
14.000	78	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment A6: A6

Runoff = 5.69 cfs @ 12.17 hrs, Volume= 0.611 af, Depth= 0.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.80"

Area (ac)	CN	Description
6.000	75	1/4 acre lots, 38% imp, HSG B
11.700	60	Woods, Fair, HSG B
17.700	65	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment A7: A7

Runoff = 0.77 cfs @ 12.38 hrs, Volume= 0.249 af, Depth= 0.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.80"

Area (ac)	CN	Description
1.000	100	WATER
3.000	70	FARM
7.300	64	Row crops, C + CR, Good, HSG A
7.000	36	Woods, Fair, HSG A
18.300	56	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.0					**Direct Entry,**

Subcatchment A8: A8

Runoff = 12.40 cfs @ 12.09 hrs, Volume= 0.858 af, Depth= 0.78"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.80"

Area (ac)	CN	Description
4.000	74	>75% Grass cover, Good, HSG C
8.000	73	Woods, Fair, HSG C
1.200	83	1/4 acre lots, 38% imp, HSG C
13.200	74	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry,**

Subcatchment A9: A9

Runoff = 6.18 cfs @ 12.12 hrs, Volume= 0.618 af, Depth= 0.35"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.80"

Area (ac)	CN	Description
8.000	68	1 acre lots, 20% imp, HSG B
8.000	60	Woods, Fair, HSG B
5.200	58	Meadow, non-grazed, HSG B
21.200	63	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry,**

Subcatchment B1: B1

Runoff = 27.42 cfs @ 12.21 hrs, Volume= 2.669 af, Depth= 0.69"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.80"

Area (ac)	CN	Description
38.750	75	1/4 acre lots, 38% imp, HSG B
7.970	60	Woods, Fair, HSG B
46.720	72	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.1	150	0.0100	0.1		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
5.7	700	0.0100	2.0		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
24.8	850	Total			

Subcatchment B10: B10

Runoff = 9.20 cfs @ 12.15 hrs, Volume= 0.739 af, Depth= 0.83"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.80"

Area (ac)	CN	Description
10.730	75	1/4 acre lots, 38% imp, HSG B

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment B11: B11

Runoff = 27.98 cfs @ 12.08 hrs, Volume= 1.838 af, Depth= 1.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.80"

Area (ac)	CN	Description
10.250	75	1/4 acre lots, 38% imp, HSG B
8.000	92	Urban commercial, 85% imp, HSG B
1.850	61	>75% Grass cover, Good, HSG B
20.100	80	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry,**

Subcatchment B12: LAKE

Runoff = 296.99 cfs @ 12.23 hrs, Volume= 33.064 af, Depth= 2.79"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.80"

Area (ac)	CN	Description
142.400	100	LAKE

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
30.0					**Direct Entry,**

Subcatchment B2: B2

Runoff = 11.72 cfs @ 12.15 hrs, Volume= 0.942 af, Depth= 0.83"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.80"

Area (ac)	CN	Description
13.670	75	1/4 acre lots, 38% imp, HSG B

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment B3: B3

Runoff = 20.46 cfs @ 12.07 hrs, Volume= 1.335 af, Depth= 1.80"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.80"

Area (ac)	CN	Description
8.920	90	WETLANDS

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry,**

Subcatchment B4: B4

Runoff = 2.97 cfs @ 12.17 hrs, Volume= 0.290 af, Depth= 0.48"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.80"

Area (ac)	CN	Description
7.190	67	Brush, Poor, HSG B

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment B5: B5

Runoff = 38.56 cfs @ 12.19 hrs, Volume= 3.301 af, Depth= 1.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.80"

Area (ac)	CN	Description
6.000	82	2 acre lots, 12% imp, HSG D
12.600	83	Woods, Poor, HSG D
9.440	90	WETLANDS
28.040	85	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.0					**Direct Entry,**

Subcatchment B6: B6

Runoff = 5.10 cfs @ 12.25 hrs, Volume= 0.640 af, Depth= 0.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.80"

Area (ac)	CN	Description
18.600	65	2 acre lots, 12% imp, HSG B

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.0					**Direct Entry,**

Subcatchment B7: B7

Runoff = 2.63 cfs @ 12.28 hrs, Volume= 0.436 af, Depth= 0.29"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.80"

Area (ac)	CN	Description
5.000	65	2 acre lots, 12% imp, HSG B
13.120	60	Woods, Fair, HSG B
18.120	61	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.0					**Direct Entry,**

Subcatchment B8: B8

Runoff = 1.53 cfs @ 12.28 hrs, Volume= 0.253 af, Depth= 0.29"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.80"

Area (ac)	CN	Description
4.000	61	Pasture/grassland/range, Good, HSG B
3.000	58	Woods/grass comb., Good, HSG B
3.510	65	2 acre lots, 12% imp, HSG B
10.510	61	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.0					**Direct Entry,**

Subcatchment B9: B9

Runoff = 9.59 cfs @ 12.22 hrs, Volume= 1.017 af, Depth= 0.56"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.80"

Area (ac)	CN	Description
16.800	70	1/2 acre lots, 25% imp, HSG B
5.000	65	Woods/grass comb., Fair, HSG B
21.800	69	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.0					**Direct Entry,**

Subcatchment B9B: B9B

Runoff = 55.66 cfs @ 12.12 hrs, Volume= 4.190 af, Depth= 1.79"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.80"

Area (ac)	CN	Description
28.040	90	WETLANDS

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment C1: Sub C1

Runoff = 11.09 cfs @ 12.21 hrs, Volume= 1.084 af, Depth= 0.69"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.80"

Area (ac)	CN	Description
18.980	72	1/4 acre lots, 30% imp, HSG B

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.0					**Direct Entry,**

Subcatchment C3: C3

Runoff = 33.84 cfs @ 12.21 hrs, Volume= 3.308 af, Depth= 0.69"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.80"

Area (ac)	CN	Description
57.910	72	1/4 acre lots, 30% imp, HSG B

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.0					**Direct Entry,**

Subcatchment C4: C4

Runoff = 2.86 cfs @ 12.38 hrs, Volume= 0.548 af, Depth= 0.29"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.80"

Area (ac)	CN	Description
22.860	61	>75% Grass cover, Good, HSG B

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.2	300	0.0200	0.2		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.80"
5.3	500	0.0500	1.6		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.9	500	0.0400	9.4	74.96	**Parabolic Channel,** W=8.00' D=1.50' Area=8.0 sf Perim=8.7' n= 0.030
31.4	1,300	Total			

Subcatchment C5: C5

Runoff = 29.34 cfs @ 12.12 hrs, Volume= 2.209 af, Depth= 1.79"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.80"

Area (ac)	CN	Description
14.780	90	WETLAND

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment C6: C6

Runoff = 5.28 cfs @ 12.17 hrs, Volume= 0.566 af, Depth= 0.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.80"

Area (ac)	CN	Description
9.900	61	>75% Grass cover, Good, HSG B
1.500	100	WATER
3.100	68	1 acre lots, 20% imp, HSG B
1.920	55	Woods, Good, HSG B
16.420	65	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment C7: C7

Runoff = 4.41 cfs @ 12.17 hrs, Volume= 0.451 af, Depth= 0.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.80"

Area (ac)	CN	Description
5.000	68	1 acre lots, 20% imp, HSG B
7.070	65	Woods/grass comb., Fair, HSG B
12.070	66	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Subcatchment C8: C8

Runoff = 11.41 cfs @ 12.19 hrs, Volume= 0.974 af, Depth= 1.56"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.80"

Area (ac)	CN	Description
4.000	90	WETLANDS
3.510	84	1 acre lots, 20% imp, HSG D
7.510	87	Weighted Average

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.0					**Direct Entry,**

Subcatchment C9: LAKE

Runoff = 200.22 cfs @ 12.11 hrs, Volume= 17.724 af, Depth= 2.79"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr Rainfall=2.80"

Area (ac)	CN	Description
76.200	100	LAKE

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry,**

Reach 1R: (new node)

Inflow Area = 1,090.370 ac, Inflow Depth = 0.00"
Inflow = 0.61 cfs @ 24.00 hrs, Volume= 0.404 af
Outflow = 0.61 cfs @ 24.00 hrs, Volume= 0.404 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach A1R: A1R

Inflow Area = 38.900 ac, Inflow Depth = 0.21"
Inflow = 0.83 cfs @ 19.30 hrs, Volume= 0.696 af
Outflow = 0.83 cfs @ 19.51 hrs, Volume= 0.679 af, Atten= 0%, Lag= 13.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.1 fps, Min. Travel Time= 8.1 min
Avg. Velocity = 1.9 fps, Avg. Travel Time= 8.8 min

Peak Depth= 0.12' @ 19.38 hrs
Capacity at bank full= 330.73 cfs
Inlet Invert= 1,092.50', Outlet Invert= 1,061.00'
3.00' x 3.00' deep channel, n= 0.030 Length= 1,000.0' Slope= 0.0315 '/'
Side Slope Z-value= 2.0 '/'

Reach A4R: A4R

Inflow Area = 34.000 ac, Inflow Depth = 0.11"
Inflow = 0.42 cfs @ 24.00 hrs, Volume= 0.298 af
Outflow = 0.42 cfs @ 24.00 hrs, Volume= 0.278 af, Atten= 1%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.4 fps, Min. Travel Time= 17.5 min
Avg. Velocity = 1.2 fps, Avg. Travel Time= 20.4 min

Peak Depth= 0.13' @ 24.00 hrs
Capacity at bank full= 195.57 cfs
Inlet Invert= 1,083.50', Outlet Invert= 1,061.00'
2.00' x 3.00' deep channel, n= 0.030 Length= 1,500.0' Slope= 0.0150 '/'
Side Slope Z-value= 2.0 '/'

Pond A10P: A10P

Inflow Area = 9.900 ac, Inflow Depth = 0.56"
Inflow = 5.07 cfs @ 12.16 hrs, Volume= 0.463 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 1,062.25' @ 24.00 hrs Surf.Area= 61,259 sf Storage= 20,146 cf
Plug-Flow detention time= (not calculated)
Center-of-Mass det. time= (not calculated)

#	Invert	Avail.Storage	Storage Description
1	1,062.00'	640,000 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,062.00	60,000	0	0
1,070.00	100,000	640,000	640,000

#	Routing	Invert	Outlet Devices
1	Primary	1,070.00'	**15.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,062.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond A1P: WETLAND PONDS

Inflow Area =	38.900 ac,	Inflow Depth = 0.56"		
Inflow =	15.02 cfs @	12.29 hrs, Volume=	1.811 af	
Outflow =	0.83 cfs @	19.30 hrs, Volume=	0.696 af,	Atten= 94%, Lag= 420.1 min
Primary =	0.83 cfs @	19.30 hrs, Volume=	0.696 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 1,093.02' @ 19.30 hrs Surf.Area= 84,339 sf Storage= 50,587 cf
Plug-Flow detention time= 380.0 min calculated for 0.695 af (38% of inflow)
Center-of-Mass det. time= 219.9 min (1,123.6 - 903.7)

#	Invert	Avail.Storage	Storage Description
1	1,092.50'	243,750 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,092.50	75,000	0	0
1,095.00	120,000	243,750	243,750

#	Routing	Invert	Outlet Devices
1	Primary	1,092.50'	**18.0" x 100.0' long Culvert** Ke= 0.700 Outlet Invert= 1,091.50' S= 0.0100 '/' n= 0.024 Cc= 0.900

Primary OutFlow Max=0.83 cfs @ 19.30 hrs HW=1,093.02' (Free Discharge)
└─**1=Culvert** (Barrel Controls 0.83 cfs @ 2.3 fps)

Pond A4P: A4P

Inflow Area =	34.000 ac,	Inflow Depth =	0.60"		
Inflow =	13.00 cfs @	12.36 hrs,	Volume=	1.693 af	
Outflow =	0.42 cfs @	24.00 hrs,	Volume=	0.298 af,	Atten= 97%, Lag= 698.4 min
Primary =	0.42 cfs @	24.00 hrs,	Volume=	0.298 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 1,084.37' @ 24.00 hrs Surf.Area= 130,248 sf Storage= 60,745 cf
Plug-Flow detention time= 420.2 min calculated for 0.298 af (18% of inflow)
Center-of-Mass det. time= 251.2 min (1,154.1 - 902.9)

#	Invert	Avail.Storage	Storage Description
1	1,084.00'	330,000 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,084.00	110,000	0	0
1,086.00	220,000	330,000	330,000

#	Routing	Invert	Outlet Devices
1	Primary	1,084.00'	**18.0" x 50.0' long Culvert** Ke= 0.700 Outlet Invert= 1,083.50' S= 0.0100 '/' n= 0.024 Cc= 0.900

Primary OutFlow Max=0.42 cfs @ 24.00 hrs HW=1,084.37' (Free Discharge)
└─**1=Culvert** (Barrel Controls 0.42 cfs @ 1.9 fps)

Pond B6P: WETPONDS

Inflow Area =	18.600 ac,	Inflow Depth =	0.41"		
Inflow =	5.10 cfs @	12.25 hrs,	Volume=	0.640 af	
Outflow =	1.00 cfs @	12.20 hrs,	Volume=	0.629 af,	Atten= 80%, Lag= 0.0 min
Discarded =	1.00 cfs @	12.20 hrs,	Volume=	0.629 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 1,060.33' @ 13.41 hrs Surf.Area= 7,405 sf Storage= 7,605 cf
Plug-Flow detention time= 72.0 min calculated for 0.629 af (98% of inflow)
Center-of-Mass det. time= 63.4 min (983.2 - 919.8)

#	Invert	Avail.Storage	Storage Description
1	1,060.00'	184,000 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,060.00	6,000	0	0
1,068.00	40,000	184,000	184,000

#	Routing	Invert	Outlet Devices
1	Discarded	0.00'	**1.00 cfs Exfiltration at all elevations**

Discarded OutFlow Max=1.00 cfs @ 12.20 hrs HW=1,060.09' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 1.00 cfs)

Pond B7P: DRY POND

Inflow Area =	18.120 ac, Inflow Depth = 0.29"			
Inflow =	2.63 cfs @ 12.28 hrs, Volume=	0.436 af		
Outflow =	0.86 cfs @ 13.13 hrs, Volume=	0.399 af, Atten= 67%, Lag= 51.2 min		
Primary =	0.86 cfs @ 13.13 hrs, Volume=	0.399 af		

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 1,062.10' @ 13.13 hrs Surf.Area= 36,460 sf Storage= 4,138 cf
Plug-Flow detention time= 94.2 min calculated for 0.398 af (91% of inflow)
Center-of-Mass det. time= 54.5 min (999.3 - 944.8)

#	Invert	Avail.Storage	Storage Description
1	1,062.00'	81,000 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,062.00	36,000	0	0
1,064.00	45,000	81,000	81,000

#	Routing	Invert	Outlet Devices
1	Primary	1,062.00'	**10.0' long x 1.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.62 2.64 2.64 2.68 2.75 2.86 2.92 3.07 3.07 3.03 3.28 3.32

Primary OutFlow Max=0.86 cfs @ 13.13 hrs HW=1,062.10' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.86 cfs @ 0.8 fps)

Pond C4P: GOLF COURSE POND

Inflow Area =	22.860 ac, Inflow Depth = 0.29"			
Inflow =	2.86 cfs @ 12.38 hrs, Volume=	0.548 af		
Outflow =	1.04 cfs @ 13.32 hrs, Volume=	0.498 af, Atten= 64%, Lag= 56.4 min		
Primary =	1.04 cfs @ 13.32 hrs, Volume=	0.498 af		

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 1,063.09' @ 13.32 hrs Surf.Area= 55,655 sf Storage= 5,346 cf
Plug-Flow detention time= 99.3 min calculated for 0.497 af (91% of inflow)
Center-of-Mass det. time= 57.7 min (1,006.6 - 948.9)

#	Invert	Avail.Storage	Storage Description
1	1,063.00'	147,275 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,063.00	53,600	0	0
1,063.50	65,000	29,650	29,650
1,064.00	76,500	35,375	65,025
1,065.00	88,000	82,250	147,275

#	Routing	Invert	Outlet Devices
1	Primary	1,063.00'	**15.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=1.03 cfs @ 13.32 hrs HW=1,063.09' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 1.03 cfs @ 0.8 fps)

Pond C6P: GOLF COURSE POND

Inflow Area =	16.420 ac,	Inflow Depth = 0.41"		
Inflow =	5.28 cfs @	12.17 hrs, Volume=	0.566 af	
Outflow =	0.21 cfs @	24.00 hrs, Volume=	0.096 af,	Atten= 96%, Lag= 709.5 min
Primary =	0.21 cfs @	24.00 hrs, Volume=	0.096 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 1,067.74' @ 24.00 hrs Surf.Area= 85,017 sf Storage= 20,510 cf
Plug-Flow detention time= 536.6 min calculated for 0.095 af (17% of inflow)
Center-of-Mass det. time= 348.5 min (1,265.0 - 916.5)

#	Invert	Avail.Storage	Storage Description
1	1,067.50'	185,886 cf	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,067.50	78,544	0	0
1,068.00	92,000	42,636	42,636
1,069.50	99,000	143,250	185,886

#	Routing	Invert	Outlet Devices
1	Primary	1,067.70'	**10.0' long x 1.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.62 2.64 2.64 2.68 2.75 2.86 2.92 3.07 3.07 3.03 3.28 3.32

Primary OutFlow Max=0.21 cfs @ 24.00 hrs HW=1,067.74' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 0.21 cfs @ 0.5 fps)

Pond C7P: (new node)

Inflow Area = 19.580 ac, Inflow Depth = 0.87"
Inflow = 15.78 cfs @ 12.18 hrs, Volume= 1.425 af
Outflow = 0.18 cfs @ 24.00 hrs, Volume= 0.130 af, Atten= 99%, Lag= 709.2 min
Primary = 0.18 cfs @ 24.00 hrs, Volume= 0.130 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 1,062.27' @ 24.00 hrs Surf.Area= 4.204 ac Storage= 1.295 af
Plug-Flow detention time= 461.0 min calculated for 0.130 af (9% of inflow)
Center-of-Mass det. time= 283.3 min (1,142.6 - 859.3)

#	Invert	Avail.Storage	Storage Description
1	1,062.00'	9.500 af	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,062.00	4.000	0.000	0.000
1,064.00	5.500	9.500	9.500

#	Routing	Invert	Outlet Devices
1	Primary	1,062.00'	**12.0" x 50.0' long Culvert** Ke= 0.500 Outlet Invert= 1,061.50' S= 0.0100 '/' n= 0.024 Cc= 0.900

Primary OutFlow Max=0.18 cfs @ 24.00 hrs HW=1,062.27' (Free Discharge)
└**1=Culvert** (Barrel Controls 0.18 cfs @ 1.5 fps)

Pond NTL: NORTH TWIN LAKE

Inflow Area = 863.640 ac, Inflow Depth = 0.88"
Inflow = 479.14 cfs @ 12.19 hrs, Volume= 63.153 af
Outflow = 6.07 cfs @ 24.00 hrs, Volume= 7.516 af, Atten= 99%, Lag= 708.8 min
Primary = 6.07 cfs @ 24.00 hrs, Volume= 7.516 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 1,061.19' @ 24.00 hrs Surf.Area= 143.398 ac Storage= 55.604 af
Plug-Flow detention time= 492.4 min calculated for 7.516 af (12% of inflow)
Center-of-Mass det. time= 83.9 min (925.4 - 841.5)

#	Invert	Avail.Storage	Storage Description
1	1,060.80'	172.740 af	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,060.80	142.400	0.000	0.000
1,062.00	145.500	172.740	172.740

#	Routing	Invert	Outlet Devices
1	Primary	1,059.80'	**30.0" x 50.0' long Culvert** Ke= 0.700 Outlet Invert= 1,059.60' S= 0.0040 '/' n= 0.024 Cc= 0.900
2	Primary	1,062.80'	**100.0' long x 1.0' breadth Broad-Crested Rectangular Weir**

Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00
Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Primary OutFlow Max=6.07 cfs @ 24.00 hrs HW=1,061.19' (Free Discharge)
└─**1=Culvert** (Barrel Controls 6.07 cfs @ 3.1 fps)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond PIKE: PIKE LAKE

Inflow Area =	488.800 ac,	Inflow Depth =	1.22"		
Inflow =	422.33 cfs @	12.22 hrs,	Volume=	49.635 af	
Outflow =	13.69 cfs @	19.04 hrs,	Volume=	13.115 af,	Atten= 97%, Lag= 409.3 min
Primary =	13.69 cfs @	19.04 hrs,	Volume=	13.115 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 1,061.02' @ 19.04 hrs Surf.Area= 169.885 ac Storage= 37.507 af
Plug-Flow detention time= 550.9 min calculated for 13.088 af (26% of inflow)
Center-of-Mass det. time= 300.5 min (1,079.4 - 778.9)

#	Invert	Avail.Storage	Storage Description
1	1,060.80'	205.080 af	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,060.80	169.300	0.000	0.000
1,062.00	172.500	205.080	205.080

#	Routing	Invert	Outlet Devices
1	Primary	1,060.80'	**50.0' long x 1.2' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.66 2.69 2.71 2.78 2.89 2.99 3.09 3.20 3.21 3.19 3.30 3.32

Primary OutFlow Max=13.69 cfs @ 19.04 hrs HW=1,061.02' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 13.69 cfs @ 1.2 fps)

Pond STL: SOUTH TWIN LAKE

Inflow Area =	1,090.370 ac,	Inflow Depth =	0.36"		
Inflow =	271.19 cfs @	12.13 hrs,	Volume=	32.564 af	
Outflow =	0.61 cfs @	24.00 hrs,	Volume=	0.404 af,	Atten= 100%, Lag= 712.2 min
Primary =	0.61 cfs @	24.00 hrs,	Volume=	0.404 af	

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 1,060.20' @ 24.00 hrs Surf.Area= 77.048 ac Storage= 32.139 af
Plug-Flow detention time= 1,064.0 min calculated for 0.404 af (1% of inflow)
Center-of-Mass det. time= 330.5 min (1,141.4 - 810.9)

#	Invert	Avail.Storage	Storage Description
1	1,059.80'	321.440 af	**Custom Stage Data (Prismatic)** Listed below

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
1,059.80	76.220	0.000	0.000
1,063.80	84.500	321.440	321.440

#	Routing	Invert	Outlet Devices
1	Primary	1,059.80'	**36.0" x 50.0' long Culvert** Ke= 0.700 Outlet Invert= 1,059.50' S= 0.0060 '/' n= 0.024 Cc= 0.900

Primary OutFlow Max=0.61 cfs @ 24.00 hrs HW=1,060.20' (Free Discharge)
└─**1=Culvert** (Barrel Controls 0.61 cfs @ 1.7 fps)

APPENDIX Q

Water Quality Model Output

Lake	TP (mg/L)	Diss-OrthoP (mg/L)	Chlorophyll Fluoresence (mg/L)	Secchi m	TSS (mg/L)	Ammonia NH3-N (mg/L)	Nitrate+Nitrate-N Dissolved N (mg/L)	TKN (mg/L)	TN
Pike	0.017	0.002	4.3	3.4	4.0	0.020	0.007	0.454	0.461
North	0.017	0.002	1.4	3.2	1.8				
South	0.019	0.002	3.0		2.0	0.050	0.011	0.576	0.587
Averages	0.017	0.002	2.894		2.586	0.035	0.009	0.515	0.524
Pike	0.160	0.057			37.250	0.588	0.380	1.120	1.500
Pike	0.186	0.049			34.360	0.793	0.288	1.654	1.942
North	0.212	0.079			44.167				
North	0.211667	0.02475			64.75				
Averages	0.192	0.052			45.132	0.690	0.334	1.387	1.721

BATHTUB Modeling Summary

2002 Conditions

CASE: Amery Lakes Project

HYDRAULIC AND DISPERSION PARAMETERS:

SEG	OUT	NET INFLOW HM3/YR	RESIDENCE TIME YRS	OVERFLOW RATE M/YR	MEAN VELOCITY KM/YR	DISPERSION ESTIMATED KM2/YR	DISPERSION NUMERIC KM2/YR	EXCHANGE RATE HM3/YR
1	2	.30	8.64922	.5	1.0	0.	0.	0.
2	3	.51	3.43135	.9	1.0	0.	0.	0.
3	0	.66	.54801	2.2	1.2	0.	0.	0.

GROSS WATER BALANCE:

ID	T	LOCATION	DRAINAGE AREA KM2	FLOW (HM3/YR) MEAN	VARIANCE	CV	RUNOFF M/YR
1	1	Septic	.000	.005	.000E+00	.000	.000
2	1	Pike ungaged	1.300	.230	.000E+00	.000	.177
3	1	Region avg	.300	.050	.000E+00	.000	.167
4	1	General Urban	.530	.100	.000E+00	.000	.189
5	1	NTwin Septic	.000	.001	.000E+00	.000	.000
	1	Reg Avg Values	.400	.070	.000E+00	.000	.175
12	1	Reg UrbanRO	.220	.040	.000E+00	.000	.182
PRECIPITATION			1.490	1.204	.580E-01	.200	.808
TRIBUTARY INFLOW			2.750	.496	.000E+00	.000	.180
***TOTAL INFLOW			4.240	1.700	.580E-01	.142	.401
ADVECTIVE OUTFLOW			4.240	.657	.156E+00	.601	.155
***TOTAL OUTFLOW			4.240	.657	.156E+00	.601	.155
***EVAPORATION			.000	1.043	.979E-01	.300	.000

GROSS MASS BALANCE BASED UPON ESTIMATED CONCENTRATIONS

COMPONENT: TOTAL P

ID	T	LOCATION	LOADING KG/YR	LOADING %(I)	VARIANCE KG/YR**2	VARIANCE %(I)	CV	CONC MG/M3	EXPORT KG/KM2
1	1	Septic	10.0	14.3	.000E+00	.0	.000	2000.0	.0
2	1	Pike ungaged	4.6	6.6	.000E+00	.0	.000	20.0	3.5
3	1	Region avg	1.0	1.4	.000E+00	.0	.000	20.0	3.3
4	1	General Urban	15.0	21.5	.000E+00	.0	.000	150.0	28.3
5	1	NTwin Septic	2.0	2.9	.000E+00	.0	.000	2000.0	.0
11	1	Reg Avg Values	1.4	2.0	.000E+00	.0	.000	20.0	3.5
12	1	Reg UrbanRO	6.0	8.6	.000E+00	.0	.000	150.0	27.3
PRECIPITATION			29.8	42.7	.222E+03	100.0	.500	24.8	20.0
TRIBUTARY INFLOW			40.0	57.3	.000E+00	.0	.000	80.6	14.5
***TOTAL INFLOW			69.8	100.0	.222E+03	100.0	.213	41.1	16.5
ADVECTIVE OUTFLOW			14.1	20.2	.543E+02	24.4	.523	21.5	3.3
***TOTAL OUTFLOW			14.1	20.2	.543E+02	24.4	.523	21.5	3.3
***RETENTION			55.7	79.8	.222E+03	100.1	.268	.0	.0

OVERFLOW RATE M/YR	HYDRAULIC RESIDENCE TIME YRS	TOTAL P POOL CONC MG/M3	TOTAL P RESIDENCE TIME YRS	TOTAL P TURNOVER RATIO -	TOTAL P RETENTION COEF -
.44	7.2397	17.4	1.1858	.8433	.7981

CASE: Amery Lakes Project

SEGMENT BALANCE BASED UPON ESTIMATED CONCENTRATIONS
COMPONENT: TOTAL P **SEGMENT: 1 Pike Lake**

ID	T	LOCATION	FLOW HM3/YR	FLOW %	LOAD KG/YR	LOAD %	CONC MG/M3
1	1	Septic	.00	.7	10.0	36.5	2000.0
2	1	Pike ungaged	.23	30.6	4.6	16.8	20.0
PRECIPITATION			.52	68.8	12.8	46.7	24.8
TRIBUTARY INFLOW			.23	31.2	14.6	53.3	62.1
***TOTAL INFLOW			.75	100.0	27.4	100.0	36.4
ADVECTIVE OUTFLOW			.30	40.4	5.7	20.9	18.8
***TOTAL OUTFLOW			.30	40.4	5.7	20.9	18.8
***EVAPORATION			.45	59.6	.0	.0	.0
***RETENTION			.00	.0	21.7	79.1	.0

RESID. TIME = 8.649 YRS, OVERFLOW RATE = .5 M/YR, DEPTH = 4.1 M

SEGMENT BALANCE BASED UPON ESTIMATED CONCENTRATIONS
COMPONENT: TOTAL P **SEGMENT: 2 North Twin**

ID	T	LOCATION	FLOW HM3/YR	FLOW %	LOAD KG/YR	LOAD %	CONC MG/M3
3	1	Region avg	.05	5.6	1.0	2.9	20.0
4	1	General Urban	.10	11.1	15.0	43.2	150.0
5	1	NTwin Septic	.00	.1	2.0	5.8	2000.0
PRECIPITATION			.44	49.4	11.0	31.7	24.8
TRIBUTARY INFLOW			.15	16.8	18.0	51.8	119.2
ADVECTIVE INFLOW			.30	33.8	5.7	16.5	18.8
***TOTAL INFLOW			.90	100.0	34.7	100.0	38.6
ADVECTIVE OUTFLOW			.51	57.2	10.9	31.4	21.2
***TOTAL OUTFLOW			.51	57.2	10.9	31.4	21.2
***EVAPORATION			.38	42.8	.0	.0	.0
***RETENTION			.00	.0	23.8	68.6	.0

RESID. TIME = 3.431 YRS, OVERFLOW RATE = .9 M/YR, DEPTH = 3.2 M

SEGMENT BALANCE BASED UPON ESTIMATED CONCENTRATIONS
COMPONENT: TOTAL P **SEGMENT: 3 South Twin**

ID	T	LOCATION	FLOW HM3/YR	FLOW %	LOAD KG/YR	LOAD %	CONC MG/M3
11	1	Reg Avg Values	.07	8.1	1.4	5.8	20.0
12	1	Reg UrbanRO	.04	4.6	6.0	24.7	150.0
PRECIPITATION			.24	28.0	6.0	24.7	24.8
TRIBUTARY INFLOW			.11	12.7	7.4	30.5	67.3
ADVECTIVE INFLOW			.51	59.4	10.9	44.8	21.2
***TOTAL INFLOW			.87	100.0	24.3	100.0	28.0
ADVECTIVE OUTFLOW			.66	75.8	14.1	58.0	21.5
***TOTAL OUTFLOW			.66	75.8	14.1	58.0	21.5
***EVAPORATION			.21	24.2	.0	.0	.0
***RETENTION			.00	.0	10.2	42.0	.0

RESID. TIME = .548 YRS, OVERFLOW RATE = 2.2 M/YR, DEPTH = 1.2 M
CASE: Amery Lakes Project

T STATISTICS COMPARE OBSERVED AND PREDICTED MEANS
USING THE FOLLOWING ERROR TERMS:
1 = OBSERVED WATER QUALITY ERROR ONLY
2 = ERROR TYPICAL OF MODEL DEVELOPMENT DATA SET
3 = OBSERVED AND PREDICTED ERROR

SEGMENT: 1 **Pike Lake**

VARIABLE		OBSERVED MEAN	OBSERVED CV	ESTIMATED MEAN	ESTIMATED CV	RATIO	T STATISTICS 1	T STATISTICS 2	T STATISTICS 3
TOTAL P	MG/M3	17.0	.00	18.8	.39	.90	.00	-.37	-.26
TOTAL N	MG/M3	461.0	.00	461.0	.00	1.00	.00	.00	.00
C.NUTRIENT	MG/M3	14.2	.00	15.2	.26	.93	.00	-.34	-.27
CHL-A	MG/M3	4.3	.00	5.3	.47	.82	.00	-.59	-.43
SECCHI	M	3.4	.00	3.1	.22	1.08	.00	.28	.36
ORGANIC N	MG/M3	.0	.00	291.2	.23	.00	.00	.00	.00
TP-ORTHO-P	MG/M3	.0	.00	9.7	.47	.00	.00	.00	.00

SEGMENT: 2 **North Twin**

VARIABLE		OBSERVED MEAN	OBSERVED CV	ESTIMATED MEAN	ESTIMATED CV	RATIO	T STATISTICS 1	T STATISTICS 2	T STATISTICS 3
TOTAL P	MG/M3	17.0	.00	21.2	.38	.80	.00	-.81	-.57
TOTAL N	MG/M3	461.0	.00	461.0	.00	1.00	.00	.00	.00
C.NUTRIENT	MG/M3	14.2	.00	16.4	.23	.87	.00	-.71	-.61
CHL-A	MG/M3	1.4	.00	5.9	.46	.24	.00	-4.17	-3.12
SECCHI	M	3.2	.00	2.3	.19	1.36	.00	1.09	1.62
ORGANIC N	MG/M3	.0	.00	313.4	.23	.00	.00	.00	.00
TP-ORTHO-P	MG/M3	.0	.00	13.1	.40	.00	.00	.00	.00

SEGMENT: 3 **South Twin**

VARIABLE		OBSERVED MEAN	OBSERVED CV	ESTIMATED MEAN	ESTIMATED CV	RATIO	T STATISTICS 1	T STATISTICS 2	T STATISTICS 3
TOTAL P	MG/M3	19.0	.00	21.5	.38	.89	.00	-.45	-.32
TOTAL N	MG/M3	587.0	.00	587.0	.00	1.00	.00	.00	.00
C.NUTRIENT	MG/M3	16.8	.00	18.5	.28	.91	.00	-.46	-.33
CHL-A	MG/M3	3.0	.00	6.0	.46	.50	.00	-2.01	-1.51
SECCHI	M	2.5	.00	2.1	.18	1.19	.00	.62	.98
ORGANIC N	MG/M3	.0	.00	318.4	.23	.00	.00	.00	.00
TP-ORTHO-P	MG/M3	.0	.00	14.3	.37	.00	.00	.00	.00

CASE: Amery Lakes Project
OBSERVED AND PREDICTED **DIAGNOSTIC VARIABLES**
RANKED AGAINST CE MODEL DEVELOPMENT DATA SET

SEGMENT: 1 Pike Lake

VARIABLE		----- VALUES ----- OBSERVED	ESTIMATED	--- RANKS (%) ---- OBSERVED	ESTIMATED
TOTAL P	MG/M3	17.00	18.80	12.5	14.9
TOTAL N	MG/M3	461.00	461.00	11.3	11.3
C.NUTRIENT	MG/M3	14.21	15.22	12.5	14.3
CHL-A	MG/M3	4.30	5.26	15.5	22.6
SECCHI	M	3.38	3.13	93.3	91.9
ORGANIC N	MG/M3	.00	291.22	.0	17.0
TP-ORTHO-P	MG/M3	.00	9.74	.0	11.8
ANTILOG PC-1		38.22	54.84	7.8	12.7
ANTILOG PC-2		9.37	9.74	76.3	78.5
(N - 150) / P		18.29	16.54	54.3	48.4
INORGANIC N / P		.00	18.72	.0	32.1
TURBIDITY	1/M	.19	.19	9.1	9.1
ZMIX * TURBIDITY		.75	.75	3.2	3.2
ZMIX / SECCHI		1.17	1.27	.8	1.1
CHL-A * SECCHI		14.53	16.45	69.2	75.0
CHL-A / TOTAL P		.25	.28	65.6	71.3
FREQ(CHL-a>10)	%	**4.73**	**8.93**	.0	.0
FREQ(CHL-a>20)	%	.26	.69	.0	.0
FREQ(CHL-a>30)	%	.03	.09	.0	.0
FREQ(CHL-a>40)	%	.00	.02	.0	.0
FREQ(CHL-a>50)	%	.00	.00	.0	.0
FREQ(CHL-a>60)	%	.00	.00	.0	.0
CARLSON TSI-P		45.00	46.46	.0	.0
CARLSON TSI-CHLA		44.91	46.89	.0	.0
CARLSON TSI-SEC		42.45	43.58	.0	.0

SEGMENT: 2 North Twin

VARIABLE		----- VALUES ----- OBSERVED	ESTIMATED	--- RANKS (%) ---- OBSERVED	ESTIMATED
TOTAL P	MG/M3	17.00	21.16	12.5	18.2
TOTAL N	MG/M3	461.00	461.00	11.3	11.3
C.NUTRIENT	MG/M3	14.21	16.39	12.5	16.5
CHL-A	MG/M3	1.40	5.93	.7	27.5
SECCHI	M	3.15	2.32	92.1	84.3
ORGANIC N	MG/M3	.00	313.37	.0	20.9
TP-ORTHO-P	MG/M3	.00	13.14	.0	19.2
ANTILOG PC-1		14.07	72.25	1.5	17.6
ANTILOG PC-2		4.17	8.61	20.5	71.1
(N - 150) / P		18.29	14.70	54.3	41.5
INORGANIC N / P		.00	18.40	.0	31.5
TURBIDITY	1/M	.28	.28	19.1	19.1
ZMIX * TURBIDITY		.91	.91	5.4	5.4
ZMIX / SECCHI		1.02	1.38	.4	1.7
CHL-A * SECCHI		4.41	13.76	11.8	66.4
CHL-A / TOTAL P		.08	.28	8.6	71.3
FREQ(CHL-a>10)	%	**.03**	**12.42**	.0	.0
FREQ(CHL-a>20)	%	**.00**	**1.16**	.0	.0
FREQ(CHL-a>30)	%	.00	.17	.0	.0
FREQ(CHL-a>40)	%	.00	.04	.0	.0
FREQ(CHL-a>50)	%	.00	.01	.0	.0
FREQ(CHL-a>60)	%	.00	.00	.0	.0
CARLSON TSI-P		45.00	48.16	.0	.0
CARLSON TSI-CHLA		33.90	48.05	.0	.0
CARLSON TSI-SEC		43.47	47.86	.0	.0

SEGMENT: 3 South Twin

VARIABLE	----- VALUES ----- OBSERVED	ESTIMATED	--- RANKS (%) --- OBSERVED	ESTIMATED
TOTAL P MG/M3	19.00	21.45	15.2	18.6
TOTAL N MG/M3	587.00	587.00	20.2	20.2
C.NUTRIENT MG/M3	16.85	18.49	17.4	20.5
CHL-A MG/M3	3.00	6.01	6.9	28.1
SECCHI M	2.50	2.10	86.5	81.0
ORGANIC N MG/M3	.00	318.44	.0	21.8
TP-ORTHO-P MG/M3	.00	14.30	.0	21.8
ANTILOG PC-1	35.97	82.29	7.2	20.2
ANTILOG PC-2	5.82	7.96	42.4	65.7
(N - 150) / P	23.00	20.37	67.1	60.5
INORGANIC N / P	.00	37.51	.0	59.3
TURBIDITY 1/M	.32	.32	23.8	23.8
ZMIX * TURBIDITY	.39	.39	.4	.4
ZMIX / SECCHI	.48	.57	.0	.0
CHL-A * SECCHI	7.50	12.64	33.2	61.9
CHL-A / TOTAL P	.16	.28	36.7	71.3
FREQ(CHL-a>10) %	**1.22**	**12.88**	.0	.0
FREQ(CHL-a>20) %	**.04**	**1.22**	.0	.0
FREQ(CHL-a>30) %	.00	.18	.0	.0
FREQ(CHL-a>40) %	.00	.04	.0	.0
FREQ(CHL-a>50) %	.00	.01	.0	.0
FREQ(CHL-a>60) %	.00	.00	.0	.0
CARLSON TSI-P	46.61	48.36	.0	.0
CARLSON TSI-CHLA	41.38	48.19	.0	.0
CARLSON TSI-SEC	46.80	49.28	.0	.0

BATHTUB Predictions with Increased Internal Loading

CASE: Amery Lakes Project

GROSS WATER BALANCE:

ID	T	LOCATION	DRAINAGE AREA KM2	FLOW (HM3/YR) MEAN	VARIANCE	CV	RUNOFF M/YR
1	1	Septic	.000	.005	.625E-07	.050	.000
2	1	Pike ungaged	1.300	.230	.132E-03	.050	.177
3	1	Region avg	.300	.050	.625E-05	.050	.167
4	1	General Urban	.530	.100	.250E-04	.050	.189
5	1	NTwin Septic	.000	.001	.250E-08	.050	.000
11	1	Reg Avg Values	.400	.070	.123E-04	.050	.175
12	1	Reg UrbanRO	.220	.040	.400E-05	.050	.182
PRECIPITATION			1.490	1.204	.580E-01	.200	.808
TRIBUTARY INFLOW			2.750	.496	.180E-03	.027	.180
***TOTAL INFLOW			4.240	1.700	.582E-01	.142	.401
ADVECTIVE OUTFLOW			4.240	.657	.156E+00	.601	.155
***TOTAL OUTFLOW			4.240	.657	.156E+00	.601	.155
***EVAPORATION			.000	1.043	.979E-01	.300	.000

GROSS MASS BALANCE BASED UPON ESTIMATED CONCENTRATIONS
COMPONENT: TOTAL P

ID	T	LOCATION	LOADING KG/YR	LOADING %(I)	VARIANCE KG/YR**2	VARIANCE %(I)	CV	CONC MG/M3	EXPORT KG/KM2
1	1	Septic	10.0	6.4	.125E+01	.3	.112	2000.0	.0
2	1	Pike ungaged	4.6	3.0	.264E+00	.1	.112	20.0	3.5
3	1	Region avg	1.0	.6	.125E-01	.0	.112	20.0	3.3
4	1	General Urban	15.0	9.7	.281E+01	.7	.112	150.0	28.3
5	1	NTwin Septic	2.0	1.3	.500E-01	.0	.112	2000.0	.0
11	1	Reg Avg Values	1.4	.9	.245E-01	.0	.112	20.0	3.5
12	1	Reg UrbanRO	6.0	3.9	.450E+00	.1	.112	150.0	27.3
PRECIPITATION			29.8	19.2	.222E+03	56.6	.500	24.8	20.0
INTERNAL LOAD			85.5	55.0	.165E+03	42.1	.150	.0	.0
TRIBUTARY INFLOW			40.0	25.8	.486E+01	1.2	.055	80.6	14.5
***TOTAL INFLOW			155.3	100.0	.392E+03	100.0	.128	91.3	36.6
ADVECTIVE OUTFLOW			24.5	15.8	.177E+03	45.3	.544	37.3	5.8
***TOTAL OUTFLOW			24.5	15.8	.177E+03	45.3	.544	37.3	5.8
***RETENTION			130.8	84.2	.506E+03	129.1	.172	.0	.0

OVERFLOW RATE M/YR	HYDRAULIC RESIDENCE TIME YRS	TOTAL P POOL CONC MG/M3	TOTAL P RESIDENCE TIME YRS	TOTAL P TURNOVER RATIO -	TOTAL P RETENTION COEF -
.44	7.2397	17.4	.5330	1.8760	.8421

CASE: Amery Lakes Project

T STATISTICS COMPARE OBSERVED AND PREDICTED MEANS
USING THE FOLLOWING ERROR TERMS:
1 = OBSERVED WATER QUALITY ERROR ONLY
2 = ERROR TYPICAL OF MODEL DEVELOPMENT DATA SET
3 = OBSERVED AND PREDICTED ERROR

SEGMENT: 1 Pike Lake

VARIABLE		OBSERVED MEAN	OBSERVED CV	ESTIMATED MEAN	ESTIMATED CV	RATIO	T STATISTICS 1	T STATISTICS 2	T STATISTICS 3
TOTAL P	MG/M3	17.0	.00	25.9	.39	.66	.00	-1.56	-1.07
TOTAL N	MG/M3	461.0	.00	461.0	.00	1.00	.00	.00	.00
C.NUTRIENT	MG/M3	14.2	.00	18.3	.20	.78	.00	-1.26	-1.27
CHL-A	MG/M3	4.3	.00	7.2	.47	.59	.00	-1.51	-1.11
SECCHI	M	3.4	.00	2.7	.25	1.25	.00	.79	.88
ORGANIC N	MG/M3	.0	.00	336.3	.26	.00	.00	.00	.00
TP-ORTHO-P	MG/M3	.0	.00	13.3	.48	.00	.00	.00	.00

SEGMENT: 2 North Twin

VARIABLE		OBSERVED MEAN	OBSERVED CV	ESTIMATED MEAN	ESTIMATED CV	RATIO	T STATISTICS 1	T STATISTICS 2	T STATISTICS 3
TOTAL P	MG/M3	17.0	.00	33.3	.39	.51	.00	-2.49	-1.73
TOTAL N	MG/M3	461.0	.00	461.0	.00	1.00	.00	.00	.00
C.NUTRIENT	MG/M3	14.2	.00	20.4	.15	.70	.00	-1.81	-2.43
CHL-A	MG/M3	1.4	.00	9.3	.47	.15	.00	-5.48	-4.06
SECCHI	M	3.2	.00	1.9	.23	1.62	.00	1.73	2.07
ORGANIC N	MG/M3	.0	.00	390.6	.28	.00	.00	.00	.00
TP-ORTHO-P	MG/M3	.0	.00	19.2	.43	.00	.00	.00	.00

SEGMENT: 3 South Twin

VARIABLE		OBSERVED MEAN	OBSERVED CV	ESTIMATED MEAN	ESTIMATED CV	RATIO	T STATISTICS 1	T STATISTICS 2	T STATISTICS 3
TOTAL P	MG/M3	19.0	.00	37.3	.37	.51	.00	-2.51	-1.83
TOTAL N	MG/M3	587.0	.00	587.0	.00	1.00	.00	.00	.00
C.NUTRIENT	MG/M3	16.8	.00	26.1	.18	.65	.00	-2.17	-2.40
CHL-A	MG/M3	3.0	.00	10.4	.45	.29	.00	-3.61	-2.77
SECCHI	M	2.5	.00	1.7	.22	1.47	.00	1.36	1.70
ORGANIC N	MG/M3	.0	.00	419.7	.28	.00	.00	.00	.00
TP-ORTHO-P	MG/M3	.0	.00	22.2	.41	.00	.00	.00	.00

CASE: Amery Lakes Project

OBSERVED AND PREDICTED **DIAGNOSTIC VARIABLES**
RANKED AGAINST CE MODEL DEVELOPMENT DATA SET

SEGMENT: 1 Pike Lake

VARIABLE		----- VALUES ----- OBSERVED	ESTIMATED	--- RANKS (%) --- OBSERVED	ESTIMATED
TOTAL P	MG/M3	17.00	25.86	12.5	24.7
TOTAL N	MG/M3	461.00	461.00	11.3	11.3
C.NUTRIENT	MG/M3	14.21	18.31	12.5	20.2
CHL-A	MG/M3	4.30	7.24	15.5	36.8
SECCHI	M	3.38	2.71	93.3	88.7
ORGANIC N	MG/M3	.00	336.28	.0	25.0
TP-ORTHO-P	MG/M3	.00	13.25	.0	19.5
ANTILOG PC-1		38.22	82.13	7.8	20.2
ANTILOG PC-2		9.37	10.85	76.3	84.0
(N - 150) / P		18.29	12.03	54.3	30.6
INORGANIC N / P		.00	9.89	.0	13.4
TURBIDITY	1/M	.19	.19	9.1	9.1
ZMIX * TURBIDITY		.75	.75	3.2	3.2
ZMIX / SECCHI		1.17	1.46	.8	2.1
CHL-A * SECCHI		14.53	19.60	69.2	82.2
CHL-A / TOTAL P		.25	.28	65.6	71.3
FREQ(CHL-a>10)	%	**4.73**	**20.30**	.0	.0
FREQ(CHL-a>20)	%	.26	**2.57**	.0	.0
FREQ(CHL-a>30)	%	.03	.46	.0	.0
FREQ(CHL-a>40)	%	.00	.11	.0	.0
FREQ(CHL-a>50)	%	.00	.03	.0	.0
FREQ(CHL-a>60)	%	.00	.01	.0	.0
CARLSON TSI-P		45.00	51.05	.0	.0
CARLSON TSI-CHLA		44.91	50.02	.0	.0
CARLSON TSI-SEC		42.45	45.65	.0	.0

SEGMENT: 2 North Twin

VARIABLE		----- VALUES ----- OBSERVED	ESTIMATED	--- RANKS (%) --- OBSERVED	ESTIMATED
TOTAL P	MG/M3	17.00	33.26	12.5	34.3
TOTAL N	MG/M3	461.00	461.00	11.3	11.3
C.NUTRIENT	MG/M3	14.21	20.44	12.5	24.3
CHL-A	MG/M3	1.40	9.31	.7	49.6
SECCHI	M	3.15	1.94	92.1	78.0
ORGANIC N	MG/M3	.00	390.58	.0	35.2
TP-ORTHO-P	MG/M3	.00	19.17	.0	31.9
ANTILOG PC-1		14.07	124.40	1.5	30.2
ANTILOG PC-2		4.17	10.32	20.5	81.6
(N - 150) / P		18.29	9.35	54.3	19.0
INORGANIC N / P		.00	5.00	.0	3.7
TURBIDITY	1/M	.28	.28	19.1	19.1
ZMIX * TURBIDITY		.91	.91	5.4	5.4
ZMIX / SECCHI		1.02	1.65	.4	3.4
CHL-A * SECCHI		4.41	18.07	11.8	79.0
CHL-A / TOTAL P		.08	.28	8.6	71.3
FREQ(CHL-a>10)	%	**.03**	**33.54**	.0	.0
FREQ(CHL-a>20)	%	.00	**6.14**	.0	.0
FREQ(CHL-a>30)	%	.00	**1.40**	.0	.0
FREQ(CHL-a>40)	%	.00	.39	.0	.0
FREQ(CHL-a>50)	%	.00	.13	.0	.0
FREQ(CHL-a>60)	%	.00	.05	.0	.0
CARLSON TSI-P		45.00	54.68	.0	.0
CARLSON TSI-CHLA		33.90	52.49	.0	.0
CARLSON TSI-SEC		43.47	50.44	.0	.0

SEGMENT: 3 South Twin

VARIABLE		----- VALUES ----- OBSERVED	ESTIMATED	--- RANKS (%) --- OBSERVED	ESTIMATED
TOTAL P	MG/M3	19.00	37.31	15.2	39.1
TOTAL N	MG/M3	587.00	587.00	20.2	20.2
C.NUTRIENT	MG/M3	16.85	26.06	17.4	34.7
CHL-A	MG/M3	3.00	10.45	6.9	55.5
SECCHI	M	2.50	1.71	86.5	72.6
ORGANIC N	MG/M3	.00	419.67	.0	40.6
TP-ORTHO-P	MG/M3	.00	22.20	.0	37.6
ANTILOG PC-1		35.97	166.62	7.2	38.4
ANTILOG PC-2		5.82	9.85	42.4	79.1
(N - 150) / P		23.00	11.71	67.1	29.2
INORGANIC N / P		.00	11.07	.0	16.0
TURBIDITY	1/M	.32	.32	23.8	23.8
ZMIX * TURBIDITY		.39	.39	.4	.4
ZMIX / SECCHI		.48	.70	.0	.1
CHL-A * SECCHI		7.50	17.82	33.2	78.5
CHL-A / TOTAL P		.16	.28	36.7	71.3
FREQ(CHL-a>10)	%	**1.22**	**40.53**	.0	.0
FREQ(CHL-a>20)	%	.04	**8.73**	.0	.0
FREQ(CHL-a>30)	%	.00	**2.21**	.0	.0
FREQ(CHL-a>40)	%	.00	.67	.0	.0
FREQ(CHL-a>50)	%	.00	.23	.0	.0
FREQ(CHL-a>60)	%	.00	.09	.0	.0
CARLSON TSI-P		46.61	56.34	.0	.0
CARLSON TSI-CHLA		41.38	53.62	.0	.0
CARLSON TSI-SEC		46.80	52.30	.0	.0

MNLEAP - Minnesota Lake Eutrophication Analysis Procedure

Lake Name: North Twin
Watershed Area: 525 Acres
Mean Depth: 10.5 ft
Lake Outflow: 0.56 hm3/yr
Residence Time: 3.1 years
Areal Water Load: 1.02 m/yr

Ecoregion: NLF
Surface Area: 135 Acres
TP Load: 34 kg/yr
Avg TP Inflow: 60 ug/L
Chiaudani/Vighi TP: 33.7 ug/L
P Retention Coef: 0.66

Variable	Observed	Predicted	Std Error	Residual	T-test
TP (ug/L)	19	20	7	-0.03	-0.18
Chlr a (ug/L)	3.0	5.4	3.2	-0.25	-0.88
Secchi (m)	2.5	2.9	1.2	-0.06	-0.33

Note: Residual = Log10(Observed/Predicted)
T-test for signifigant difference between observed & predicted

Chlrophyll A Interval Frequencies (%)

ppb	Observed	Case A	Case B	Case C
10	0%	6%	8%	18%
20	0%	0%	0%	4%
30	0%	0%	0%	1%
60	0%	0%	0%	0%

Case A = within year variation considered
Case B = within year + year-to-year variation
Case C = Case B + Model Error

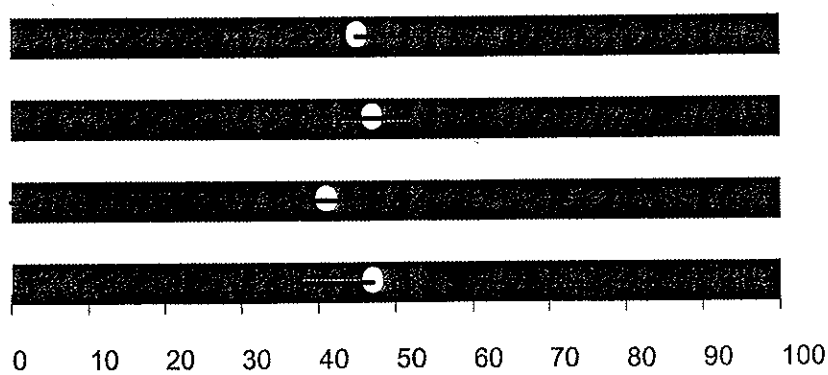
Carlson's Trophic Status Index

Avg TSI = 45

TP TSI = 47

Chlr a TSI = 41

Secchi TSI = 47



MNLEAP - Minnesota Lake Eutrophication Analysis Procedure

Lake Name: Pike
Watershed Area: 320.8 Acres
Mean Depth: 15 ft
Lake Outflow: 0.38 hm3/yr
Residence Time: 7.7 years
Areal Water Load: 0.59 m/yr

Ecoregion: NLF
Surface Area: 159 Acres
TP Load: 31 kg/yr
Avg TP Inflow: 80 ug/L
Chiaudani/Vighi TP: 30.5 ug/L
P Retention Coef: 0.78

Variable	Observed	Predicted	Std Error	Residual	T-test
TP (ug/L)	17	17	6	-0.01	-0.03
Chlr a (ug/L)	4.3	4.2	2.8	0.01	0.03
Secchi (m)	3.2	3.3	1.4	-0.02	-0.08

Note: Residual = Log10(Observed/Predicted)
T-test for signifigant difference between observed & predicted

Chlrophyll A Interval Frequencies (%)

ppb	Observed	Case A	Case B	Case C
10	2%	2%	3%	12%
20	0%	0%	0%	2%
30	0%	0%	0%	1%
60	0%	0%	0%	0%

Case A = within year variation considered
Case B = within year + year-to-year variation
Case C = Case B + Model Error

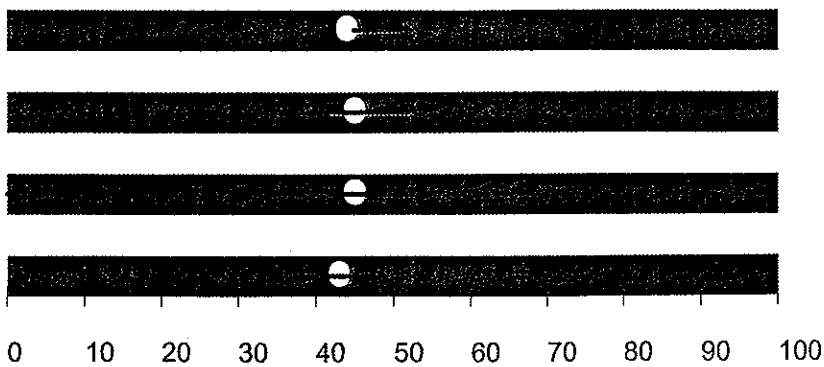
Carlson's Trophic Status Index

Avg TSI = 44

TP TSI = 45

Chlr a TSI = 45

Secchi TSI = 43



MNLEAP - Minnesota Lake Eutrophication Analysis Procedure

Lake Name: South Twin
Watershed Area: 675.8 Acres
Mean Depth: 5 ft
Lake Outflow: 0.67 hm3/yr
Residence Time: 0.7 years
Areal Water Load: 2.23 m/yr

Ecoregion: NLF
Surface Area: 74 Acres
TP Load: 20 kg/yr
Avg TP Inflow: 30 ug/L
Chiaudani/Vighi TP: 40.5 ug/L
P Retention Coef: 0.39

Variable	Observed	Predicted	Std Error	Residual	T-test
TP (ug/L)	19	19	4	0.01	0.08
Chlr a (ug/L)	3.0	4.7	2.3	-0.20	-0.80
Secchi (m)	2.5	3.1	1.1	-0.09	-0.58

Note: Residual = Log10(Observed/Predicted)
T-test for signifigant difference between observed & predicted

Chlrophyll A Interval Frequencies (%)

ppb	Observed	Case A	Case B	Case C
10	0%	4%	5%	11%
20	0%	0%	0%	2%
30	0%	0%	0%	0%
60	0%	0%	0%	0%

Case A = within year variation considered
Case B = within year + year-to-year variation
Case C = Case B + Model Error

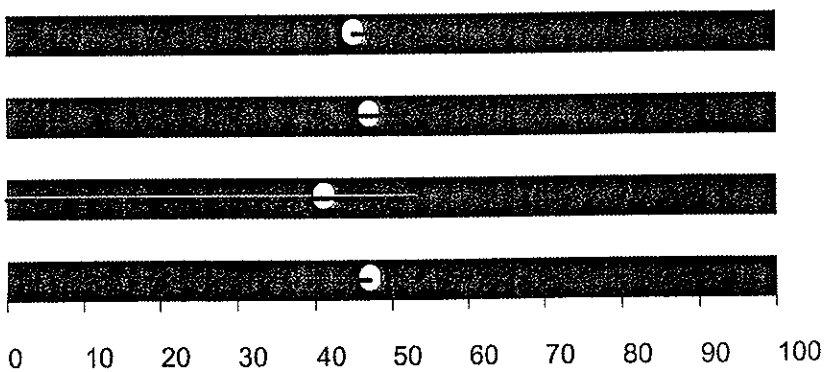
Carlson's Trophic Status Index

Avg TSI = 45

TP TSI = 47

Chlr a TSI = 41

Secchi TSI = 47



APPENDIX R

Lake Sediment Analytical Reports

Wis. nsin Department of Natural Res rces
Laboratory Report

Laboratory: Wisconsin State Laboratory of Hygiene
2601 Agriculture Dr
Madison WI 53707
Phone : 800-442-4618 Fax Phone : 608-224-6276

DNR ID 113133790

Sample:

Field #: PL-SED-1
Sample #: IM026815
Collection Start: 06/20/2002 10:00 am
Collection End:
Collected by: SCHIEFFER
Waterbody/Outfall Id: 2624000
ID #:
ID Point #:
County: Polk
Account #: LM008
Sample Location: PIKE LAKE AT STATION #1
Sample Description: LAKE SEDIMENT
Sample Source: SE
Sample Depth: M008
Date Reported: 08/13/2002
Sample Status: COMPLETE
Project No: LPL801

Analyses and Results:

Analysis Method	Analysis Date	Lab Comment
TOT KJELDAHL NITROGEN,DRY WT (LACHAT13-107-06-2-D)	07/16/2002	MATRIX SPIKE QC EXCEEDED

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
627	NITROGEN KJELDAHL TOTAL	E1644079	*19100	MG/KG		230	

Analysis Method	Analysis Date	Lab Comment
TOTAL PHOSPHORUS, DRY WT (USGS I-6085)	07/22/2002	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
668	PHOSPHORUS	7723140	888.	MG/KG	9.9		29.7

Analysis Method	Analysis Date	Lab Comment
PERCENT SOLIDS (SM 2540G)	06/26/2002	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
70318	SOLIDS PERCENT		4.4	%		0.1	

Analysis Method	Analysis Date	Lab Comment
TEMPERATURE ON RECEIPT-ICED	06/21/2002	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
136	TEMPERATURE AT LAB	E1645696	ICED	C		0	

Wis .nsin Department of Natural Res .rces
Laboratory Report

Laboratory: Wisconsin State Laboratory of Hygiene
2601 Agriculture Dr
Madison WI 53707
Phone : 800-442-4618 Fax Phone : 608-224-6276

DNR ID 113133790

Sample:

Field #: PL-SED-2
Collection Start: 06/20/2002 10:00 am
Collected by: SCHIEFFER
ID #:
County: Polk
Sample Location: PIKE LAKE AT STATION #2
Sample Description: LAKE SEDIMENT
Sample Source: SE
Date Reported: 08/13/2002
Project No: LPL801

Sample #: IM026816
Collection End:
Waterbody/Outfall Id: 2624000
ID Point #:
Account #: LM008
Sample Depth: M007
Sample Status: COMPLETE

Analyses and Results:

Analysis Method	Analysis Date	Lab Comment
TOT KJELDAHL NITROGEN,DRY WT (LACHAT13-107-06-2-D)	07/16/2002	MATRIX SPIKE QC EXCEEDED

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
627	NITROGEN KJELDAHL TOTAL	E1644079	*21900	MG/KG		230	

Analysis Method	Analysis Date	Lab Comment
TOTAL PHOSPHORUS, DRY WT (USGS I-6085)	07/22/2002	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
668	PHOSPHORUS	7723140	903.	MG/KG	9.9		29.7

Analysis Method	Analysis Date	Lab Comment
PERCENT SOLIDS (SM 2540G)	06/26/2002	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
70318	SOLIDS PERCENT		6.2	%		0.1	

Analysis Method	Analysis Date	Lab Comment
TEMPERATURE ON RECEIPT-ICED	06/21/2002	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
136	TEMPERATURE AT LAB	E1645696	ICED	C		0	

Wisconsin Department of Natural Resources
Laboratory Report

Laboratory: Wisconsin State Laboratory of Hygiene — DNR ID 113133790
2601 Agriculture Dr
Madison WI 53707
Phone: 800-442-4618 Fax Phone: 608-224-6276

Sample:

Field #:	PL-SED-3	Sample #:	IM026817
Collection Start:	06/20/2002 10:05 am	Collection End:	
Collected by:	SCHIEFFER	Waterbody/Outfall Id:	2624000
ID #:		ID Point #:	
County:	Polk	Account #:	LM008
Sample Location:	PIKE LAKE AT STATION #3		
Sample Description:	LAKE SEDIMENT		
Sample Source:	SE	Sample Depth:	M009
Date Reported:	08/13/2002	Sample Status:	COMPLETE
Project No:	LPL801		

Analyses and Results:

Analysis Method	Analysis Date	Lab Comment
DIG 750.1, ICP, SOLIDS (SW846 3050B)	07/08/2002	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
99393	PREP DIG SOLIDS 750.1 SW846 3050B		COMPLETE				

Analysis Method	Analysis Date	Lab Comment
ICP QUALITATIVE SCAN, UNDIG (SW846 6010B)	07/09/2002	SEE IM026817.MM

Lab Memo

TO: DAN RYAN SPOONER DNR

FROM: KEVIN KAUFMAN SENIOR CHEMIST INORGANIC CHEMISTRY

RE: RESULTS FROM A 21 ELEMENT QUALITATIVE SCAN ON A SEDIMENT SAMPLE FROM PIKE LAKE @ STATION #3

ELEMENT	LIMIT OF DETECTION (MG/KG)	RESULT (MG/KG)
AL,	3.0	8540.
SB,	5.0	ND
AS,	5.0	12.6
BA,	0.2	93.1
BE,	0.06	0.38
CD,	0.6	0.85
CA,	22.0	14900.
CR,	0.5	19.3
CO,	0.5	5.91
CU,	0.5	21.7
FE,	3.0	60210.
PB,	3.0	61.8

Lab Memo

MG,	9.0	2960.
MN,	0.1	2200.
NI,	2.0	14.4
K,	94.0	901.
SE,	4.0	ND
NA,	9.0	104.0
V,	0.5	50.2
ZN,	2.0	95.8
AG,	0.50	ND

ND= NON DETECT

IF YOU HAVE ANY QUESTIONS PLEASE CALL ME AT (608) 224-6282

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
99112	ICP QUALITATIVE SCAN UNDIG		**				

Analysis Method	Analysis Date	Lab Comment
TOT KJELDAHL NITROGEN,DRY WT (LACHAT13-107-06-2-D)	07/16/2002	MATRIX SPIKE QC EXCEEDED

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
627	NITROGEN KJELDAHL TOTAL	E1644079	*14500	MG/KG		230	

Analysis Method	Analysis Date	Lab Comment
PREP AT 103 DEG.C	06/25/2002	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
99394	PREP SAMPLE PREP/HANDLING 1		COMPLETE				

Analysis Method	Analysis Date	Lab Comment
TOTAL PHOSPHORUS, DRY WT (USGS I-6085)	07/22/2002	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
668	PHOSPHORUS	7723140	7980.	MG/KG	9.9		29.7

Analysis Method	Analysis Date	Lab Comment
PERCENT SOLIDS (SM 2540G)	06/26/2002	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
70318	SOLIDS PERCENT		6.9	%		0.1	

Analysis Method	Analysis Date	Lab Comment
TEMPERATURE ON RECEIPT-ICED	06/21/2002	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ

Wisconsin Department of Natural Resources
Laboratory Report

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
136	TEMPERATURE AT LAB	E1645696	ICED	C		0	

Analysis Method	Analysis Date	Lab Comment
ICP TEST		

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ

Wis. .nsin Department of Natural Res .rces
Laboratory Report

Laboratory: Wisconsin State Laboratory of Hygiene DNR ID 113133790
2601 Agriculture Dr
Madison WI 53707
Phone : 800-442-4618 Fax Phone : 608-224-6276

Sample:

Field #: PL-SED-4
Sample #: IM026818
Collection Start: 06/20/2002 10:10 am
Collection End:
Collected by: SCHIEFFER
Waterbody/Outfall Id: 2624000
ID #:
ID Point #:
County: Polk
Account #: LM008
Sample Location: PIKE LAKE AT STATION #4
Sample Description: LAKE SEDIMENT
Sample Source: SE
Sample Depth: M008
Date Reported: 08/13/2002
Sample Status: COMPLETE
Project No: LPL801

Analyses and Results:

Analysis Method	Analysis Date	Lab Comment
TOT KJELDAHL NITROGEN,DRY WT (LACHAT13-107-06-2-D)	07/16/2002	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
627	NITROGEN KJELDAHL TOTAL	E1644079	17600.	MG/KG		230	

Analysis Method	Analysis Date	Lab Comment
TOTAL PHOSPHORUS, DRY WT (USGS I-6085)	07/22/2002	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
668	PHOSPHORUS	7723140	2360.	MG/KG	9.9		29.7

Analysis Method	Analysis Date	Lab Comment
PERCENT SOLIDS (SM 2540G)	06/26/2002	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
70318	SOLIDS PERCENT		6.1	%		0.1	

Analysis Method	Analysis Date	Lab Comment
TEMPERATURE ON RECEIPT-ICED	06/21/2002	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
136	TEMPERATURE AT LAB	E1645696	ICED	C		0	

Wis asin Department of Natural Res rces
Laboratory Report

Laboratory: Wisconsin State Laboratory of Hygiene
2601 Agriculture Dr
Madison WI 53707
Phone : 800-442-4618 Fax Phone : 608-224-6276

DNR ID 113133790

Sample:

Field #: PL-SED-5
Collection Start: 06/20/2002 10:20 am
Collected by: SCHIEFFER
ID #:
County: Polk
Sample Location: PIKE LAKE AT STATION #5
Sample Description: LAKE SEDIMENT
Sample Source: SE
Date Reported: 08/13/2002
Project No: LPL801

Sample #: IM026819
Collection End:
Waterbody/Outfall Id: 2624000
ID Point #:
Account #: LM008
Sample Depth: M006
Sample Status: COMPLETE

Analyses and Results:

Analysis Method	Analysis Date	Lab Comment
TOT KJELDAHL NITROGEN,DRY WT (LACHAT13-107-06-2-D)	07/16/2002	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
627	NITROGEN KJELDAHL TOTAL	E1644079	21900.	MG/KG		230	

Analysis Method	Analysis Date	Lab Comment
TOTAL PHOSPHORUS, DRY WT (USGS I-6085)	07/22/2002	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
668	PHOSPHORUS	7723140	800.	MG/KG	9.9		29.7

Analysis Method	Analysis Date	Lab Comment
PERCENT SOLIDS (SM 2540G)	06/26/2002	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
70318	SOLIDS PERCENT		4.9	%		0.1	

Analysis Method	Analysis Date	Lab Comment
TEMPERATURE ON RECEIPT-ICED	06/21/2002	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
136	TEMPERATURE AT LAB	E1645696	ICED	C		0	

Wis ısin Department of Natural Res rces
Laboratory Report

Laboratory: Wisconsin State Laboratory of Hygiene
2601 Agriculture Dr
Madison WI 53707
Phone : 800-442-4618 Fax Phone : 608-224-6276

DNR ID 113133790

Sample:

Field #:	NT-SED-4	Sample #:	IM026813
Collection Start:	06/20/2002 11:30 am	Collection End:	
Collected by:	SCHIEFFER	Waterbody/Outfall Id:	2623900
ID #:		ID Point #:	
County:	Polk	Account #:	LM008
Sample Location:	NORTH TWIN LAKE @ STATION #4		
Sample Description:	LAKE SEDIMENT		
Sample Source:	SE	Sample Depth:	M005
Date Reported:	08/13/2002	Sample Status:	COMPLETE
Project No:	LPL800		

Analyses and Results:

Analysis Method	Analysis Date	Lab Comment
TOT KJELDAHL NITROGEN,DRY WT (LACHAT13-107-06-2-D)	07/16/2002	MATRIX SPIKE QC EXCEEDED

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
627	NITROGEN KJELDAHL TOTAL	E1644079	*28200	MG/KG		230	

Analysis Method	Analysis Date	Lab Comment
TOTAL PHOSPHORUS, DRY WT (USGS I-6600 85)	07/22/2002	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
668	PHOSPHORUS	7723140	724.	MG/KG	9.9		29.7

Analysis Method	Analysis Date	Lab Comment
PERCENT SOLIDS (SM 2540G)	06/26/2002	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
70318	SOLIDS PERCENT		4.6	%		0.1	

Analysis Method	Analysis Date	Lab Comment
TEMPERATURE ON RECEIPT-ICED	06/21/2002	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
136	TEMPERATURE AT LAB	E1645696	ICED	C		0	

Wis ısin Department of Natural Res rces
Laboratory Report

Laboratory: Wisconsin State Laboratory of Hygiene
2601 Agriculture Dr
Madison WI 53707
Phone : 800-442-4618 Fax Phone : 608-224-6276

DNR ID 113133790

Sample:

Field #: NT-SED-5
Sample #: IM026814
Collection Start: 06/20/2002 11:40 am
Collection End:
Collected by: SCHIEFFER
Waterbody/Outfall Id: 2623900
ID #:
ID Point #:
County: Polk
Account #: LM008
Sample Location: NORTH TWIN LAKE @ STATION #5
Sample Description: LAKE SEDIMENT
Sample Source: SE
Sample Depth: M004
Date Reported: 08/13/2002
Sample Status: COMPLETE
Project No: LPL800

Analyses and Results:

Analysis Method	Analysis Date	Lab Comment
TOT KJELDAHL NITROGEN,DRY WT (LACHAT13-107-06-2-D)	07/16/2002	MATRIX SPIKE QC EXCEEDED

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
627	NITROGEN KJELDAHL TOTAL	E1644079	*21600	MG/KG		230	

Analysis Method	Analysis Date	Lab Comment
TOTAL PHOSPHORUS, DRY WT (USGS I-6085)	07/22/2002	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
668	PHOSPHORUS	7723140	492.	MG/KG	9.9		29.7

Analysis Method	Analysis Date	Lab Comment
PERCENT SOLIDS (SM 2540G)	06/26/2002	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
70318	SOLIDS PERCENT		6.7	%		0.1	

Analysis Method	Analysis Date	Lab Comment
TEMPERATURE ON RECEIPT-ICED	06/21/2002	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
136	TEMPERATURE AT LAB	E1645696	ICED	C		0	

Wis. .sin Department of Natural Res rces
Laboratory Report

Laboratory: Wisconsin State Laboratory of Hygiene
2601 Agriculture Dr
Madison WI 53707
Phone : 800-442-4618 Fax Phone : 608-224-6276

DNR ID 113133790

Sample:

Field #: NT-SED-1
Sample #: IM026810
Collection Start: 06/20/2002 11:00 am
Collection End:
Collected by: SCHIEFFER
Waterbody/Outfall Id: 2623900
ID #:
ID Point #:
County: Polk
Account #: LM008
Sample Location: NORTH TWIN LAKE @ STATION #1
Sample Description: LAKE SEDIMENT
Sample Source: SE
Sample Depth: M005
Date Reported: 08/13/2002
Sample Status: COMPLETE
Project No: LPL800

Analyses and Results:

Analysis Method	Analysis Date	Lab Comment
TOT KJELDAHL NITROGEN,DRY WT (LACHAT13-107-06-2-D)	07/16/2002	MATRIX SPIKE QC EXCEEDED

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
627	NITROGEN KJELDAHL TOTAL	E1644079	*16600	MG/KG		230	

Analysis Method	Analysis Date	Lab Comment
TOTAL PHOSPHORUS, DRY WT (USGS I-6000 85)	07/22/2002	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
668	PHOSPHORUS	7723140	1000.	MG/KG	9.9		29.7

Analysis Method	Analysis Date	Lab Comment
PERCENT SOLIDS (SM 2540G)	06/26/2002	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
70318	SOLIDS PERCENT		6.6	%		0.1	

Analysis Method	Analysis Date	Lab Comment
TEMPERATURE ON RECEIPT-ICED	06/21/2002	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
136	TEMPERATURE AT LAB	E1645696	ICED	C		0	

Wis ısin Department of Natural Res rces
Laboratory Report

Laboratory: Wisconsin State Laboratory of Hygiene
2601 Agriculture Dr
Madison WI 53707
Phone : 800-442-4618 Fax Phone : 608-224-6276

DNR ID 113133790

Sample:

Field #:	NT-SED-2	Sample #:	IM026811
Collection Start:	06/20/2002 11:10 am	Collection End:	
Collected by:	SCHIEFFER	Waterbody/Outfall Id:	2623900
ID #:		ID Point #:	
County:	Polk	Account #:	LM008
Sample Location:	NORTH TWIN LAKE @ STATION #2		
Sample Description:	LAKE SEDIMENT		
Sample Source:	SE	Sample Depth:	M004
Date Reported:	08/13/2002	Sample Status:	COMPLETE
Project No:	LPL800		

Analyses and Results:

Analysis Method	Analysis Date	Lab Comment
TOT KJELDAHL NITROGEN,DRY WT (LACHAT13-107-06-2-D)	07/16/2002	SPIKE QC EXCEEDED, SPIKE RECOVERY 134%

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
627	NITROGEN KJELDAHL TOTAL	E1644079	*25400	MG/KG		230	

Analysis Method	Analysis Date	Lab Comment
TOTAL PHOSPHORUS, DRY WT (USGS I-6600 85)	07/22/2002	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
668	PHOSPHORUS	7723140	775.	MG/KG	9.9		29.7

Analysis Method	Analysis Date	Lab Comment
PERCENT SOLIDS (SM 2540G)	06/26/2002	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
70318	SOLIDS PERCENT		5.4	%		0.1	

Analysis Method	Analysis Date	Lab Comment
TEMPERATURE ON RECEIPT-ICED	06/21/2002	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
136	TEMPERATURE AT LAB	E1645696	ICED	C		0	

Wisconsin Department of Natural Resources
Laboratory Report

Laboratory: Wisconsin State Laboratory of Hygiene
2601 Agriculture Dr
Madison WI 53707
Phone : 800-442-4618 Fax Phone : 608-224-6276

DNR ID 113133790

Sample:

Field #: NT-SED-3
Sample #: IM026812
Collection Start: 06/20/2002 11:30 am
Collection End:
Collected by: SCHIEFFER
Waterbody/Outfall Id: 2623900
ID #:
ID Point #:
County: Polk
Account #: LM008
Sample Location: NORTH TWIN LAKE @ STATION #3
Sample Description: LAKE SEDIMENT
Sample Source: SE
Sample Depth: M008
Date Reported: 08/13/2002
Sample Status: COMPLETE
Project No: LPL800

Analyses and Results:

Analysis Method	Analysis Date	Lab Comment
DIG 750.1, ICP, SOLIDS (SW846 3050B)	07/08/2002	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
99393	PREP DIG SOLIDS 750.1 SW846 3050B		COMPLETE				

Analysis Method	Analysis Date	Lab Comment
ICP QUALITATIVE SCAN, UNDIG (SW846 6010B)	07/09/2002	SEE IM026812.MM

Lab Memo

TO: DAN RYAN SPOONER DNR

FROM: KEVIN KAUFMAN SENIOR CHEMIST INORGANIC CHEMISTRY

RE: RESULTS FROM A 21 ELEMENT QUALITATIVE SCAN ON A SEDIMENT SAMPLE FROM NORTH TWIN LAKE @ STATION #3

ELEMENT	LIMIT OF DETECTION (MG/KG)	RESULT (MG/KG)
AL,	3.0	14260.
SB,	5.0	ND
AS,	5.0	13.2
BA,	0.2	141.0
BE,	0.06	0.65
CD,	0.6	1.14
CA,	22.0	8100.
CR,	0.5	25.1
CO,	0.5	10.9
CU,	0.5	49.5
FE,	3.0	60510.
PB,	3.0	167.

Wisconsin Department of Natural Resources
Laboratory Report

Lab Memo	MG,	9.0	4865.
	MN,	0.1	726.
	NI,	2.0	25.5
	K,	94.0	1394.
	SE,	4.0	ND
	NA,	9.0	256.0
	V,	0.5	53.0
	ZN,	2.0	214.0
	AG,	0.50	ND

ND= NON DETECT

IF YOU HAVE ANY QUESTIONS PLEASE CALL ME AT (608) 224-6282

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
99112	ICP QUALITATIVE SCAN UNDIG		**				

Analysis Method	Analysis Date	Lab Comment
TOT KJELDAHL NITROGEN,DRY WT (LACHAT13-107-06-2-D)	07/16/2002	MATRIX SPIKE QC EXCEEDED

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
627	NITROGEN KJELDAHL TOTAL	E1644079	*25300	MG/KG		230	

Analysis Method	Analysis Date	Lab Comment
PREP AT 103 DEG.C	06/25/2002	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
99394	PREP SAMPLE PREP/HANDLING 1		COMPLE TE				

Analysis Method	Analysis Date	Lab Comment
TOTAL PHOSPHORUS, DRY WT (USGS I-6085)	07/22/2002	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
668	PHOSPHORUS	7723140	4370.	MG/KG	9.9		29.7

Analysis Method	Analysis Date	Lab Comment
PERCENT SOLIDS (SM 2540G)	06/26/2002	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
70318	SOLIDS PERCENT		5.7	%		0.1	

Analysis Method	Analysis Date	Lab Comment
TEMPERATURE ON RECEIPT-ICED	06/21/2002	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ

Wisconsin Department of Natural Resources
Laboratory Report

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
136	TEMPERATURE AT LAB	E1645696	ICED	C		0	

Analysis Method	Analysis Date	Lab Comment
ICP TEST		

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ

Wisconsin Department of Natural Resources
Laboratory Report

Laboratory: Wisconsin State Laboratory of Hygiene DNR ID 113133790
2601 Agriculture Dr.
Madison WI 53718
Phone : 800-442-4618 Fax Phone : 608-224-6276

Sample:

Field #: SED#1
Sample #: IO001779
Collection Start: 07/16/2003 11:00 am
Collection End:
Collected by: SCHIEFFER
Waterbody/Outfall Id: 2623800
ID #:
ID Point #:
County: Polk
Account #: LM010
Sample Location: SOUTH TWIN LAKE @ STATION #1
Sample Description: LAKE SEDIMENT
Sample Source: SE
Sample Depth:
Date Reported: 09/09/2003
Sample Status: COMPLETE
Project No: LPL838

Analyses and Results:

Analysis Method	Analysis Date	Lab Comment
TOT KJELDAHL NITROGEN,DRY WT (LACH	08/14/2003	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
627	NITROGEN KJELDAHL TOTAL	E1644079	<230.	MG/KG		230	

Analysis Method	Analysis Date	Lab Comment
TOTAL PHOSPHORUS, DRY WT (USGS I-660	07/31/2003	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
668	PHOSPHORUS	7723140	207.	MG/KG	9.9		29.7

Analysis Method	Analysis Date	Lab Comment
PERCENT SOLIDS (SM 2540G)	07/30/2003	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
70318	SOLIDS PERCENT		26.9	%		0.1	

Analysis Method	Analysis Date	Lab Comment
TEMPERATURE ON RECEIPT-ICED	07/17/2003	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
136	TEMPERATURE AT LAB	E1645696	ICED	C		0	

Wisconsin Department of Natural Resources
Laboratory Report

Laboratory: Wisconsin State Laboratory of Hygiene
2601 Agriculture Dr.
Madison WI 53718
Phone : 800-442-4618 Fax Phone : 608-224-6276

DNR ID 113133790

Sample:

Field #: SED#2
Sample #: IO001778
Collection Start: 07/16/2003 11:20 am
Collection End:
Collected by: SCHIEFFER
Waterbody/Outfall Id: 2623800
ID #:
ID Point #:
County: Polk
Account #: LM010
Sample Location: SOUTH TWIN LAKE @ STATION #2
Sample Description: LAKE SEDIMENT
Sample Source: SE
Sample Depth:
Date Reported: 09/09/2003
Sample Status: COMPLETE
Project No: LPL838

Analyses and Results:

Analysis Method	Analysis Date	Lab Comment
DIG 750.1, ICP, SOLIDS (SW846 3050B)	07/29/2003	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
99393	PREP DIG SOLIDS 750.1 SW846 3050B		COMPLETE				

Analysis Method	Analysis Date	Lab Comment
ICP QUALITATIVE SCAN (SW846 6010B)	07/31/2003	SEE IO001788.MM

Lab Memo

```
TO:      SORGEP - DNR EAU CLAIRE
FROM:    D. KENNEDY-PARKER - ESS INORGANIC METALS
RE:      QUALITATIVE 23 ELEMENT SCAN (ICP)
LAB # : IO001788
FIELD # : TL-1
```

ELEMENT	RESULT	MDL*	UNITS
AL	7400	3	MG/KG
SB	ND	5	MG/KG
AS	ND	5	MG/KG
BA	62	0.2	MG/KG
BE	0.25	0.06	MG/KG
B	5.3	2	MG/KG
CD	ND	0.6	MG/KG
CA	5400	22	MG/KG
CR	15	0.5	MG/KG
CO	5.6	0.5	MG/KG
CU	210	0.5	MG/KG
FE	10000	9	MG/KG
PB	46	3	MG/KG
MG	2500	22	MG/KG
MN	500	0.1	MG/KG
MO	ND	0.8	MG/KG
NI	11	2	MG/KG

Wisconsin Department of Natural Resources
Laboratory Report

Lab Memo				
	K	680	94	MG/KG
	SE	ND	4	MG/KG
	NA	168	9	MG/KG
	TL	13	8	MG/KG
	V	22	0.5	MG/KG
	ZN	98	2	MG/KG
	AG	ND	5	MG/KG

* METHOD DETECTION LIMIT

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
99112	ICP QUALITATIVE SCAN UNDIG		**			0	

Analysis Method	Analysis Date	Lab Comment
TOT KJELDAHL NITROGEN,DRY WT (LACI	08/14/2003	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
627	NITROGEN KJELDAHL TOTAL	E1644079	9050.	MG/KG		230	

Analysis Method	Analysis Date	Lab Comment
PREP AT 103 DEG.C	07/25/2003	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
99394	PREP SAMPLE HANDLING		COMPLETE				

Analysis Method	Analysis Date	Lab Comment
TOTAL PHOSPHORUS, DRY WT (USGS I-660	07/31/2003	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
668	PHOSPHORUS	7723140	676.	MG/KG	9.9		29.7

Analysis Method	Analysis Date	Lab Comment
PERCENT SOLIDS (SM 2540G)	07/30/2003	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
70318	SOLIDS PERCENT		12.1	%		0.1	

Analysis Method	Analysis Date	Lab Comment
TEMPERATURE ON RECEIPT-ICED	07/17/2003	

Code	Description	Cas No	Result	Units	LOD	Report Limit	LOQ
136	TEMPERATURE AT LAB	E1645696	ICED	C		0	

APPENDIX S

ALPRD Summer 2004 Newsletter

Protecting & Rehabilitating for

HEALTHIER LAKES

SUMMER 2004

A PUBLICATION FROM AMERY LAKES PROTECTION AND REHABILITATION DISTRICT

WHAT'S INSIDE

SWIMMERS ITCH P. 2

AQUATIC PLANT COMMUNITY... WHAT YOU NEED TO KNOW! P. 3

SURVEY SYNOPSIS P. 3

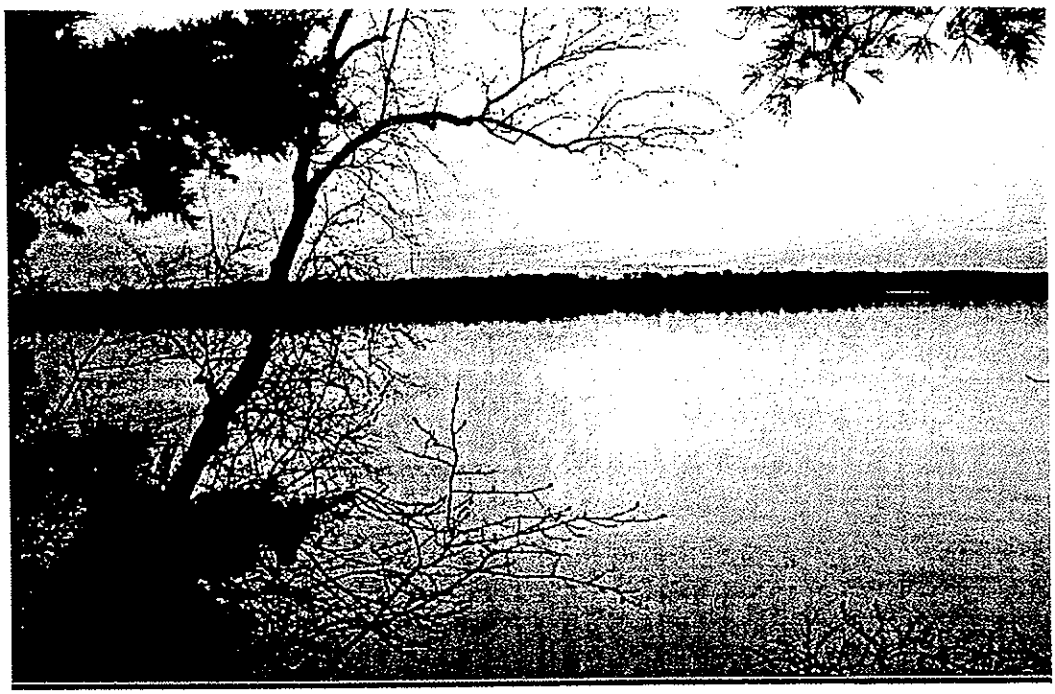
PHOSPHOROUS LIMITS OUR LAKES, YET CAUSES PROBLEMS P. 4

FROGS!!! P. 4

BOARD NOTICES & MEETINGS P. 5

LAKE PLANNING GRANT P. 5

If you have issues or concerns, please join us at one of our scheduled meetings or call one of our board members. See page 5 for details.



Lake Wapogasset at sunset - photo courtesy of WAPO Bible Camp

Welcome to AMERY LAKES DISTRICT NEWSLETTER

We are very excited to welcome you to our first annual Amery Lakes Newsletter. Over the past several years, the Amery Lakes Protection and Rehabilitation District has worked very hard and done some great projects to protect and improve North Twin, Pike and South Twin Lakes. However, we have not done a very good job of communicating our good deeds. For this reason, we have established a commitment to providing an annual newsletter that not only informs people about our work, but also to inform about lakes in general.

This first newsletter contains some basic information about who we are and how you can reach us. Furthermore, we want to give you some information about our latest projects as well as information about lakes. A few key articles in this first edition are dealing with topics that were high interest/concern areas in the recent survey that was carried out by Dragonfly Consulting. These two topics are aquatic plants and swimmer's itch. Presently, we are working on an aquatic plant management plan based off of the study that was completed last summer (2003). One article will be about our rationale about plant management and another about the importance of aquatic plants. Another article will give a basic background on swimmer's itch and what can be done about it.

Please take the time to look over this newsletter as it has some great information. If you have any questions or comments, please feel free to contact me, or anyone on the board. Thank you for your interest in our lakes!

Steve Schieffer, Chairperson
Amery Lakes Protection and Rehabilitation District

3 Frequently Asked Questions About SWIMMER'S ITCH

#1 What causes swimmer's itch?

Swimmer's itch is caused by a flatworm Schistosoma in which the life cycle includes waterfowl and snails. There is a form of the flat worm during its life cycle known as a cercaria. This organism is free swimming and about 1/80 of an inch long, therefore not visible without a microscope. The cercaria is trying to find waterfowl in order to complete its life cycle, especially mergansers. The adults lay eggs which are then passed in the feces of the birds into the lake. Then a free-swimming larva penetrates a particular species of snail where it turns into the cercaria. Not being an intelligent creature, the cercaria (adult worm not the larvae) can inadvertently come upon an unsuspecting human and burrow under their skin just like if that human were a duck. The result for the human is an irritating bump as the body defends itself. The flatworm dies in this venture with no ill affects to the human unless there are complications from the itching of the irritation. Due to the life cycle needs, the flatworm can live in any lake that has waterfowl and the species of snail needed. The only thing an individual can do is not swim in shore, especially when the wind is blowing toward shore, which can concentrate cercariae. A person can also towel off immediately after swimming, which physically removes the cercicae prior to burrowing in the skin. Some people claim oil, Vaseline, and even thick based sunscreen smeared on the skin prior to swimming will help by reducing the flatworm penetration.

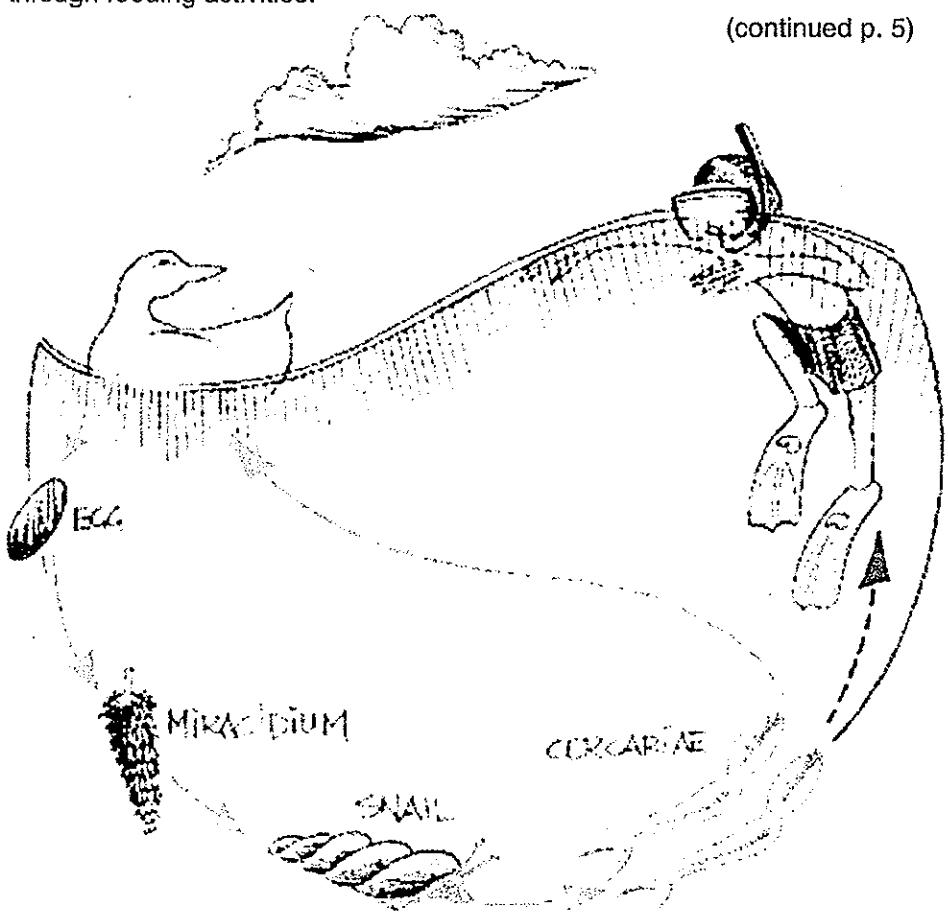
#2 Does the presence of this organism indicate pollution?

The answer to this is absolutely not. In fact, it may indicate a better quality lake. This is because ecologists have shown over many years of research that healthy ecosystems are more diverse. The swimmer's itch organism is part of that diversity and so are the hosts for its life cycle. If a lake had no waterfowl and no snails, then there would be no swimmer's itch. We would then have to ask ourselves why those organisms are absent from our lake ecosystem. In addition, the cercariae are not linked to any chemicals or disease-causing microbes. The only human activity that may help increase swimmer's itch is enhancing the accumulation of duck populations through feeding activities.

#3 Can anything be done?

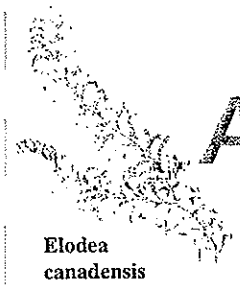
This is the tough issue. Very little research has been done, or at least enough to lead to viable treatments for lakes. Many lakes districts, municipalities and/or private owners have sprayed with cupric sulfate (copper sulfate) to reduce the population of snails. The city of Amery did this for many years at the beach on South Twin Lake. However, they ultimately ended this program two years ago due to the same reasons many other entities have ended their spraying. The two main reasons are that the effectiveness of this method is very questionable and we at least know it is very short term (possibly days) and is mainly cosmetic (and is

(continued p. 5)



what you need to know about your...

AQUATIC PLANT COMMUNITY



Elodea canadensis

"MANY TIMES PEOPLE REFER TO ALL ROOTED AQUATIC PLANTS AS WEEDS AND THEIR LAKE MANAGEMENT IS TO ERADICATE THE WEEDS. THIS THINKING IS SHORTSIGHTED..."

Aquatic macrophytes (not weeds) are higher order vascular plants - that is they have connecting cells to transport nutrients and liquid through their stems. They convert sunlight into usable energy for other species, providing a substrate for periphyton to grow, and provide hiding places and ambush sites for fish and invertebrates. Macrophyte growth is controlled by many factors, including temperature, light, sediment texture, sediment slope, and hydrostatic pressure.

Most rooted macrophytes obtain their nutrients from the bottom sediments rather than the water and are restricted to shallow water in the littoral zone by light availability. The littoral zone is defined as the area of the lake at and above the one percent light level (the amount of light needed for aquatic macrophytes to grow).

Another aquatic macrophyte called duckweed (*Lemna spp.*) is not rooted in the sediments but floats on the surface. Duckweeds float with the wind, currents, or the influence of boat traffic and are not dependent on depth, sediment composition, or water clarity.

Many times people refer to all rooted aquatic plants as weeds and their lake management is to eradicate the weeds. This thinking is shortsighted and disregards the importance of macrophytes to the ecosystem. The aquatic macrophyte community and all their positive attributes make the littoral zone the most productive and important aquatic habitat in freshwater lakes.

- Aquatic plant communities protect the shoreline from erosion by reducing the impact of waves (and wakes) and stabilizing soils and sediments.
- Aquatic macrophytes provide habitat and spawning areas for fish, waterfowl cover and food, habitat for macroinvertebrates (e.g. mayflies and crayfish), and hiding places for zooplankton (which eat algae).
- Many species, such as water lily, pickerelweed, and water buttercup are aesthetically pleasing.

The introduction of exotics is of concern though. Curly-leaf Pondweed and Eurasian Watermilfoil threaten the lakes of our areas. These plants displace native species, deplete the level of oxygen in the water column available for fish, and often grow to nuisance levels that make navigation and recreation impossible. The treatment of these exotic invaders is quite costly, often as much as several thousand dollars per acre.

Therefore, producing stable, diverse aquatic plant communities should be a primary lake management goal from an environmental and economic perspective.

FAMILY LAKES SURVEY SYNOPSIS

Last summer a family lake survey was sent to every resident within the boundaries of the Amery Lakes Protection and Rehabilitation District. What follows are some of the highlights reflected in the responses:

- The majority of the people responding use the lakes for peace, tranquility and to view wildlife. The smallest percentage use indicated was for jet skiing.
- The average response in regard to rating the water quality of the three lakes was good to fair for both Pike Lake and North Twin Lake, with Pike being rated slightly better. South Twin was rated as fair to poor. Most used water clarity and plant growth as their criteria.
- All three lakes were rated as being used a moderate amount of time and that the lakes were generally safe.
- Pike Lake and North Twin Lake were described as having slightly less than heavy growth of plants while South Twin was rated as heavy. Heavy was defined as limiting use of some areas.
- All lakes were indicated to have less than adequate public access.
- An overwhelming majority feels the Lake District should stock fish. The next priority on the list was to harvest aquatic plants. Third (with about 30% responding as priority) was to establish a boat safety program.
- Lastly, almost 50% indicated that the Lakes District should have a newsletter and 37% wanted newspaper articles.

Phosphorus Limits Our Lakes,

So how can something that is needed for life and in such short supply be bad in a lake?

It is needed for formation of DNA in living systems as well as running energy systems in the cell. The "it" here is phosphorus and in the case of most of our lakes, it is limiting the growth of many producers such as algae. By limiting, we mean that this nutrient is in shortest supply and therefore dictates how much production occurs in lakes. Consider making bologna sandwiches. One needs two pieces of bread and one piece of bologna to make one sandwich. However, even if you had 50 pieces of bologna but 50 slices of bread, one could only make 25 sandwiches due to the bread limiting the production of sandwiches. Phosphorus that is needed for algae to grow is 80,000 times more than what is available. Nitrogen and carbon is usually present in amounts higher than what is needed, therefore the phosphorus limits the production of the algae.

So how can something that is needed for life and in such short supply be bad in a lake? The answer is that if more is available than is naturally present, the algae will respond by growing more since there is still ample supply of other nutrients. Therefore, it responds to fluctuations in phosphorus. This increase can lead to more growth and because it gets recycled when those living things die, the phosphorus is there to stay. The result is continuous, increased growth. Add to the fact that most of the excess phosphorus is exotic. This means that the phosphorus came from somewhere else by way of something like fertilizer or sediment. The result is more phosphorus than the ecosystem normally would have in this region. The result is a more productive, less desirable lake ecosystem.

To demonstrate how a little phosphorus can lead to a large amount of growth we can use a reference from J.R. Vallentyne's book, *The Algal Bowl*. In this book, Vallentyne has calculated (it has been validated by others) that one pound of phosphorus can give rise 500 pounds of wet algae. This implies that if someone applied 5 pounds of phosphorus to their lawn and 1/5 of it ran off into the lake, 500 pounds of algae could result in a rather short amount of time. If all of the fertilizer ran off, the algae growth could reach 2500 pounds. If this happens in a short time period, it is referred to as a bloom. These blooms are not only unsightly, but can reduce oxygen levels if that bloom dies quickly as the bacteria consume the dead algae. If the bloom is blue-green algae, as is often times the case, the water can become toxic to some animals, can form scum on the surface and can release a terrible odor. This truly becomes too much of a good thing. Please remember these algae form the base of the food chain and harness the sun's energy for the ecosystem. However, too much can be bad in addition to being a nuisance. If the phosphorus is limited, so will the algae. Therefore, we need to limit our lakes of phosphorus much like bread is limited in sandwich production.

North American Bullfrog
Rana cateseiana

"...Amery lakes has a relatively diverse frog population"

Aquatic creature spotlight

As you pass through the narrows between North Twin and Pike Lake you may hear the low thunderous croak of the North American Bullfrog..."jug-o-rum." As some may realize, the songs of many frogs are disappearing as the number of amphibians continues to decline. However, one of the reasons we still hear numerous bullfrogs is that these frogs are very adaptable.

The North American Bullfrog can withstand higher water temperatures but require dense, undisturbed shoreline vegetation. In addition, they have a high reproductive success, as fish don't care for the taste of bullfrog tadpoles. Their tadpoles require 2 years to metamorphose which is why they are in lakes where there is a continuous water level.

This frog is the largest true frog found in North America. It can be as long as 9 inches (usually 5.5 – 7 inches) and weigh more than a pound. They are prodigious predators eating other frogs, tadpoles, insects, worms, crustaceans, snakes, and even small mammals such as mice or bats. Due to their ability to eat other frogs and adapt so well, these frogs can sometimes compete with other frogs leading to lack of frog diversity.

At this point, the Amery lakes have a relatively diverse frog population though probably not what it used to be in since the 1970's. If people preserve their shoreline habitat and projects such as rip-rapping shorelines is minimized, in addition to maintaining water quality, the frogs will do well in the future. Remember, frogs are good "canaries in the mine" for aquatic ecosystems as their populations tell us the health of the ecosystem.

SWIMMER'S ITCH, CONTINUED

expensive). In addition, the long-term :dition of copper sulfate to water is unknown and some scientists are concerned about the accumulation of copper in lakes. Therefore, based on these factors coupled with the considerable amount it was costing, the City felt it was not very prudent to continue this practice.

Presently, there has been another method of treatment being researched. This involves injecting drugs into waterfowl living on the lake that kills the flatworm while it is harbored in the waterfowl host. This drug has been very effective at killing the parasite in the waterfowl, but common sense will tell you that the implementation of this practice would be rather unrealistic and extremely costly. In addition, some people think collecting all of the snails in a lake would help. The problem is that the species of snail used by the Schistisome is unknown as well as the fact that we would be exterminating an entire population of organism for human benefit. This raises many ethical questions in terms of changing an entire ecosystem simply to avoid a pest.

"For the time being it is best to learn to live with this organism in much the same way we have with mosquitoes."

Remember that its presence does not indicate bad water quality whatsoever.

In addition, there is very little that can be done to control this parasite at a beach or anywhere else in our lakes. With time, we can only hope that more research will be done and more viable treatments will be made available. For the time being it is best to learn to live with this organism in much the same way we have with mosquitoes. If you towel off after swimming, swim in the middle of the lake or upwind you will reduce your chances getting swimmer's itch a great deal. ■

THE AMERY LAKES DISTRICT IS PLANNING TO STOCK 7 INCH WALLEYES THIS YEAR AS A FOLLOW-UP TO THE STOCKING OF 4,100 FISH IN 2001.

Planning Grant

Approximately 2-1/2 years ago, the Amery Lakes Protection and Rehabilitation District was awarded a Lakes Planning Grant from the Wisconsin DNR. This grant has been used to collect water chemistry data, complete an aquatic plant survey, and map the watershed of the lakes, as well as study sediment samples and storm water flowing into the lakes. Cedar Corporation has been modeling the water data and will be writing a final report in the form of a Lake Management Plan.

This management plan will summarize the findings of the study and more importantly give recommendations for protecting the lake resource. These recommendations may include such things as ·torm water management tools, education strategies, and land anagement practices in addition to strategies for the urban surroundings of our lakes.

There are grants available to lake districts to help implement practices. Look for more information about this topic in the future.

Amery Lakes Protection and Rehabilitation District

BOARD OF DIRECTORS:

Steve Schieffer, Chairperson 268-7565

Neil Isakson, Secretary

Roy Beecroft, Treasurer

Ray Siggens, Director

Jeremy Williamson, Director

• • • • •

MEETINGS:

Quarterly Meetings:

The second Tuesday of February, April, June, and August at 6:30 pm in the High School Library

Annual Meeting:

First Tuesday of September at 7:00 pm in the High School Library

Protecting & Rehabilitating for

HEALTHIER LAKES

AMERY LAKES PROTECTION
AND REHABILITATION DISTRICT

754 107th Street
Amery, WI 54001

What's happening on YOUR lake?

Aquatic Plant MANAGEMENT PLAN

Many of you will probably recall seeing the mechanical weed harvester out on our lakes in years past. In addition, some of you may be aware that areas of the lakes were sprayed with chemicals to kill them. In the last three years, the Amery Lakes Protection and Rehabilitation District Board decided to not do anything to the aquatic plants until a plan was developed to manage aquatic plants. By waiting this period it was rationalized that we could see the status of the plant growth in our lakes when nothing was done to directly affect that growth. Presently, the Board has organized to develop that plan.

During the 2003 summer an aquatic macrophyte (plant) survey was completed. This survey results in showing what plants are found where in the lakes. It is also used to determine if any sensitive plants and non-native plants live in the lakes. Furthermore, the plant coverage is calculated and areas of potential nuisance can be designated. The results of the survey indicate that the lakes have a very healthy, diverse population of plants. There is one non-native plant in all three lakes, this being curly leaf pondweed. This plant is a cold-water plant that grows mostly during spring and early summer, while dying off usually by July. It can choke out native species and, if dense enough, can cause oxygen deprivation during the warm water months of July and August. Another non-native, purple loosestrife, was observed in three locations on the southwest shoreline of North Twin Lake. There was only a few plants observed and are being treated to eradicate. This plant can completely take over wetlands and needs to be monitored closely.

"purple loosestrife...observed in three locations on the southwest shoreline of North Twin Lake"

Starting in April, Board members Jeremy Williamson, and Neil Isakson, headed up a committee to study the survey and develop an aquatic management plan, under the guidance of the Wisconsin DNR. This committee is comprised of concerned citizens, members fishing organizations, as well as scientists. This will allow the Board to make sound management decisions that are based on data and best management practices. In the past our plant management has been based on public outcries and "gut feelings." Aquatic plants are too important to lakes to make decisions based on very little information. Whatever the plan indicates and the board decides it will be in the best interest of the lakes and those using the lakes. We feel confident your viewpoint is being represented ar that all concerned will have input.

APPENDIX T

Education Plan Example

Subtopic: Earth Day

Grade levels of mini-unit: 2nd-3rd

Author: Erin Peterson

Background Information:

For many years, John Muir, John J. Audubon and Henry David Thoreau worked to protect our environment. These men and many others had worked hard for almost 100 years to find ways to guard our earth because many of our natural resources were disappearing. Rachel Carson, a biologist, wrote a book in 1962 **Silent Spring** that spoke out on pollution. The work of these people, and many others were the beginnings of a need of environmental protection in the United States and also an awareness in other countries around the world.

During the Santa Barbara oil spill, in 1969, Senator Gaylord Nelson of Wisconsin came up with the idea to create an enviromental awareness day. Denis Hayes, a student at Harvard University, was hired to be the coordinator of this national movement. This celebration became known as Earth Day.

On a beautiful, spring morning in April, 20,000 people gathered together in Washington D.C. to begin a campaign to save our earth. It was the 22nd of April in 1970 when Earth Day was born. There were several college campuses around the United States where Earth Day supporters met to hold their own campaigns. On April 22, 1970, over 20,000,000 people met to begin their fight to save the planet earth. Americans supported the Earth Day Campaign more than the Vietnam Protests.

During Earth Day '70, people all over the nation were working on projects to protect our environment. Projects included: organizing neighborhood clean-ups, and planting trees. In Union Square, demonstrators spoke out on polluters of air, water and noise in an ecology fair. With respect to this outbreak, the government went into action by passing the Clean Air and Water Act and also the Enviromental Protection Agency was founded. After the first Earth Day, Denis Hayes and many others feared that enviromental issues would not become part of the of american way of life, but much to their surprise, activators continued their fight daily to save our environment (Earth Day Resources, pg.1).

Over the years, Earth Day has had its successes and struggles. In 1980, only 3,000,000 activist participated in enviromental activities. Earth Day struggled because of a lack of political support that year. In 1980, supporters held clean up drives, offered educational programs to teach others about saving our earth, and marches were held througout the United States.

In 1990, on the twentieth anniversary of Earth Day, Denis Hayes organized the first International Earth Day. Throughout 140 countries, over 200 million people involved themselves to save our planet. In Washington D.C., parades and rallies were held and organizations had booths set up addressing enviromental issues (Lucas, pg. 1). In New York, activist collected garbage and attended a concert in Central Park.

There are several issues related to Earth Day and our environment that we will discuss throughout this unit. We will be discussing how we can clean up our earth, our air, and our water.

There are billions and billions of people that live on our earth. Each person on earth needs a place to live. We also need materials to build our homes and businesses. We need power to make things work and places to grow food and raise animals. There are several things we should do to preserve the land we live on. We can protect our parks, playgrounds and even our own backyards. We can plant flowers and trees to make our world a beautiful place to live. We can learn to reuse and recycle paper, plastics, aluminum, and glass.

Source: http://teacherlink.ed.usu.edu/tlresources/units/Byrnes-celebrations/earthday.html

Every living thing needs fresh air to breath. There is a lot of air pollution now because of the many factories tl make clothing for us and also in the cars we drive. We can cut down on air pollution by walking more, driving ii car pools, and riding subways and buses.

Water is essential to life. We use water to drink and to grow plants. Our water is being polluted by sewage, factories waste, and oil. We can better conserve water by not throwing garbage in rivers and lakes. We can als- save our water by not wasting water at home.

References:

Earth Day Resources, (1995) Earth Day Jam '95. [On-line]. Available: http://www.iweb-net/earthjam/ej2.html.

Lucas, M. (1995) Earth Day XXV: The National Earth Day Celebration. [On-line]. Available: http://town.hall.org/environment/earth_day/.

Miles, B. (1974) Save the Earth: An Ecology Handbook for Kids. New York: Alfred A. Knopf, Inc.

Mowrey, M. & Redmond, T. (1993) Not in our Backyard. New York: William Morrow and Company, Inc.

Objectives:

- Students will be able to identify things they can do to save our earth.
- Given the list of brainstorming ideas to save our earth, students will be able to list environmental issues into their corresponding category (land, air, or water).
- Students will be able to illustrate something that harms our environment or a solution to that problem.
- Students will be able to categorize litter into paper, plastics, aluminum, glass or other and list ways to recycle these items.
- Students will be able to locate an area at their home that causes high air pollution.
- Students will be able to conduct an interview with their parents about enviromental issues.

Time Allotment: One or two days plus homework

Resources Needed:

Book **For the Love of Our Earth** by P.K. Hallinan

One 11x17 poster board for each child

Plastic grocery sacks (one for every two students)

Large garbage bags (one for every two students)

Two 5x7 recipe cards for each student

Surface Water Model (including: pistol-grip spray bottle with water, baking cocoa, and jell-o)

Procedures:

A. ***Listening:*** The teacher will read the book, **For the Love of Our Earth** by P.K. Hallinan to the class. As children listen, have them think of ways they can help save our earth and environment.

Source: http://teacherlink.ed.usu.edu/tlresources/units/Byrnes-celebrations/earthday.html

B. ***Brainstorming:*** As a class, brainstorm ideas of things we can do to save our earth. Write down the students responses on the chalkboard. Students will each trace their hand and write one thing they can do to save the earth in the center of their hand. Hands will be placed on a bulletin board in the classroom titled, "For the Love of Our Earth We Will..."

C. ***Mini-lecture and Discussion:*** Talk to the class about the different types of things that endanger our environment. Discuss specifically air, water, and land pollutants. With the list the class brain stormed about how they can save the earth, have them categorize their ideas under Water, Land and Air using the worksheet **Water, Land and Air Pollutants** included in the appendix.

D.***Two-Pair Share:*** Students in the class will be paired off by numbering off 1, 2, 1, 2, etc. Each pair will be given time to think of something that harms our environment and they will also think of a solution to this problem. All 1's will design an environmental poster with their idea of something that harms our environment. All 2's will design a poster illustrating a solution to this problem. You many want to assign pairs specific types of things that harm our land, water, or air so that there are a variety of posters. Students will share their posters with the class. Posters will be displayed throughout the school so the other students may see them. **Reference:** Chase, C. (1995) Earth Day Classroom Ideas. [On-line]. Available: http://www.cfe.cornell.edu/EarthDay/organize/classroom.html.

E. ***Hands on:*** Students will be placed in groups of two. Each pair will be given a plastic garbage bag. As a class, we will go and pick up the trash and litter on the playground or at a nearby park. **Reference:** Chase, C. (1995) 60 Ideas for Earth Day Action Projects Your Group Can Do. [On-line]. Available: http://www.cfe.cornell.edu/EarthDay/organize/60ideas.html.

F. ***Data Retrieval::*** When we return to the classroom, each group will divide their litter into paper, plastics, glass (be careful with this one), aluminum and other. They will divide their garbage onto a large garbage bag. Each pair will compare the types of litter they found by completing the worksheet **Our Loot of Litter.** This activity will help the students learn to organize things that can be recycled. Discuss questions as a class after the students have finished collecting and organizing their data. Discussion questions: What could you do with paper, plastics, aluminum and glass to save the environment? What things at home can you recycle? What things at school can we recycle? Why should we recycle? What would happen if everyone recycled their paper, plastics, aluminum and glass?

G. ***Observation and Open Discussion:*** For a homework assignment, have the children conduct an observation dealing with air pollution. Give each child two 5x7 recipe cards and a note explaining the experiment to the parents (included in the appendix). Have the children spread Vaseline on one side of each card. Have them place one card in their garage or near their car and put the other card somewhere in their backyard overnight. Have them write a paragraph explaining the results of their observation. In class the next day, discuss their findings. Which card was dirtier? Why? **Reference:** Miles, B. (1974). Save the Earth: An Ecology Handbook for Kids. New York: Alfred A. Knopf, pp. 48.

H. ***Interview:*** For homework, students will interview their parents concerning environmental issues. Students will generate at least three of their own questions concerning the environment. Have students work in groups of 4 to brainstorm questions they could ask before actually writing the questions down. Have students turn in their questions so you can make sure their questions make sense. Have students interview one or both parents. The student will write a one to two paragraph summary of the things they learned from the interview.

I. ***Hands-on and Small Group Discussion:*** To help students understand water pollution, use the Surface Water Model. (This model can be loaned, free of charge, by contacting Virginia Jensen at 801-528-7299. There are several models throughout the state of Utah and she can help you locate the model closest to you.) Take 5-6 students at a time to see the Surface Water Model. The Surface Water Model is a replica of a city. This city has a factory, farms, a lake, a nearby forested located on a mountain and houses. The model comes with a possible scenario of what could happen to pollute the water in this city. As you read the scenario, have the students

"pollute" the city. Have the students sprinkle dirt (baking cocoa can be used) on the areas where they would fi dirt. Have them place fertilizer (jell-o) on the grassy areas, and a black liquid (included with the model) in the factory to represent its waste. Using a pistol-grip sprayer filled with water, have the children take turns makin rain fall over the city. As the rain falls, the earth erodes and soon the pollution makes its way to the lake, tl main source of water. Discuss with the group water pollution. What are some things that pollute our water? wh can we do to make our water more clean?

J. ***Culminating Activity:*** To culminate our mini-unit on Earth Day, brainstorm as a class a project you could do protect our environment. The teacher could suggest projects that could be done at school or in the community. You could contact your principal, or a local environment protection agency to find out things that need to be c As a class, plan and carry out the project. Here are a few suggestions: plant trees or flowers around the school yard, clean up a park, begin a recycling program at your school or in your community, etc.

Assessment:

The ***Water, Land and Air Pollutants*** worksheet will be assessed.

Environmental Poster sharing will be assessed.

Our Loot of Litter will be assessed.

Paragraphs from air pollution observation and interview with parents will be assessed.

Appendix:

Dear Parents,

Today we have been discussing different types of pollution and ways we can protect our environment. In orde learn more about air pollution, we are going to do a little experiment. I have sent home with your child two 5x recipe cards. Please help your child spread a little Vaseline on one side of each card. Please place one card in yo garage or near your car and the other somewhere in your backyard overnight. In the morning, could you help child collect his cards and also help him or her write a paragraph explaining their results. Please return the paragraph with your child to class tomorrow as we will discuss the results in class.

Thank you so much for your help

Source: http://teacherlink.ed.usu.edu/tlresources/units/Byrnes-celebrations/earthday.html

Our Loot of Litter

1. Using five sheets of paper make labels that read: Paper, Plastics, Glass, Aluminum, and Other.

2. Before you take the litter out of your bag. Guess how many pieces of litter you have. Write your guess here._____

3. Spread the litter you have collected on top of a black garbage bag.

4. Organize your litter under the correct heading. For example: paper under Paper.

5. How many items do you have in each category?

Paper_____ Plastics_____ Glass_____

Aluminum_____ Other_____

6. Which group has the most items? _____

Why do you think it has the most? _____

7. Which group has the least items? _____

Why do you think it has the least? _____

8. How many pieces of litter will you have if you combine the paper and plastic groups? _____

9. How many pieces of litter will you have if you combine the aluminum and glass groups?____

10. How many pieces of litter do you have all together? _____

How close were you to your guess?_____

Source: http://teacherlink.ed.usu.edu/tlresources/units/Byrnes-celebrations/earthday.html

Water, Land and Air Pollutants

Water

Land

Air

Source: http://teacherlink.ed.usu.edu/tlresources/units/Byrnes-celebrations/earthday.html

Water Pollution

An Educator's Reference Desk Lesson Plan

Author: David A. Gillam, Susitna Elementary, Anchorage, AK

Date: May 1994

Grade Level(s): Kindergarten, 1, 2, 3, 4, 5, 6

Subject(s):

- Science/Environmental Education

OVERVIEW:

There are a wide variety of pollutants that can affect water and the plants and animals that live in the water. This pollution can be divided into three groups: chemical pollution, thermal pollution, and ecological pollution. Since not ' 'lution is human produced students need to understand that there are sometimes "natural" reasons for some pollutic

PURPOSE:

These activities will help students' understanding of water pollution and its potential effects on human and wildlife habitats.

OBJECTIVES: Students will be able to:

1. Identify 2 or more pollutants in a bog, marsh, stream or other wetland area.
2. Relate a pollution prevention message through words and art.
3. Understand that some pollutants can not be seen.

ACTIVITIES:

1. Taking student a wetland area helps them become more aware of the water around them. Take with you paper, pencils, clipboards, rubber gloves, plastic garbage bags and extra adults. When you get to your wetland site divide students into groups of 3 or 4. Each group is to look around the wetland area and find as many sources/types of pollution as possible. On their paper a designated recorder for each group will record the different types of pollution found. After 5-7 minutes, come together as a whole group and discuss the pollution that is seen. Since the visible pollution is often in the form of litter, discuss with your students the pollution tha may be present, but not seen. When the group discussion is over, pass out gloves and bags. Divide students int groups and assign an adult to each group. Then have the students pick up the litter pollution and take back to school and put in dumpsters. Repeat throughout the year.

2. For this activity you will need paper, crayons, markers, crayon pastels and other art supplies. Review with the students the types of pollution that they know about. Talk about the ways people can help prevent certain kind of water pollution. List them on the chalk board. Have students draw a picture showing how to prevent polluti

of a wetland of other water source. Encourage students to think about the source of the pollution and ways either prevent or ways to dispose of some pollutants.

3. To help students understand that clear water isn't necessarily free of pollutants, place 5 clear liquids in cups. Things to include should have a definite taste that students would recognize. Use sugar water, white vinegar, salt water, water mixed with citric acid, and tap water. Using cotton swabs, have students taste each liquid (dispose of swab after each taste) and record what they taste after each. After students have all had a chance to taste, discuss that some kinds of pollution can't be seen. If you have local creeks, streams, or other water ways that are unsafe for human use, this is a good jumping off point to discuss the problems these bodies of water have.

RESOURCES/MATERIALS NEEDED:

All resources are available in most areas.

TYING IT ALL TOGETHER:

Environment concerns can be understood by even the youngest school children. Providing them with a background information and an opportunity to actively use that information, they will begin to develop a feeling of stewardship for their world. Using activities that develop environmental stewardship in students will hopefully become a basis for action in their future lives.

May 1994

These lesson plans are the result of the work of the teachers who have attended the Columbia Education Center's Summer Workshop. CEC is a consortium of teacher from 14 western states dedicated to improving the quality of education in the rural, western, United States, and particularly the quality of math and science Education. CEC uses Big Sky Telegraph as the hub of their telecommunications network that allows the participating teachers to stay in contact with their trainers and peers that they have met at the Workshops.

Water Quality For Freshwater Organisms

An Educator's Reference Desk Lesson Plan

Author: Robert Brosa, Highland Park High School, Topeka, KS

Date: May 1994

Grade Level(s): 8, 9, 10, 11, 12

Subject(s):

- Science/Environmental Education

OVERVIEW:

In modern day society, there are many types and sources of pollution which directly affect the environment. One sucl type of pollution, which is becoming even more predominate through the construction of nuclear power plants, is that 'hermal pollution. Power plants use vast amounts of water which are converted to steam by the thermonuclear . 'ion. This steam is used to turn the blades of the turbines which turns the generators producing the electricity. The ho. water resulting from condensed steam is partially cooled in specially designed towers before it is released again ir the environment by means of a reservoir or stream. The temperature of the return water is great enough to raise the temperature of the body of water several degrees. Such increases in temperature could greatly affect the organisms living in the water.

PURPOSE: The purpose of this activity is to demonstrate to students the effect increased water temperature has on tl amount of dissolved oxygen found in water and in turn upon the gill beat rate of fish.

OBJECTIVES: Students will be able to:

1. Describe the proper procedure for observing and recording data.
2. Describe how to use the Winkler method for O2 determination in water.
3. Demonstrate how to graph and interpret data.
4. Discuss what effect increased temperature has on the amount of dissolved oxygen in water and in turn upon the gill beat rate of fish.

ACTIVITIES:

Equipment needed (for each lab group): cold aerated pond water, 800 ml beaker, minnow, hot plate, Celsius thermometer, ring stand, cork, stirring rod, Hach Dissolved Oxygen test kit, data table, graph paper.

v 1:

Step #1 - Place 600 ml. of cold (5 degrees Celsius), well aerated pond water into a 600 ml beaker.

Step #2 - Place minnow into beaker and set on hot plate.

Step #3 - Suspend Celsius thermometer by means of a ring stand and cork in center of beaker.

Step #4 - Allow minnow to quiet down and take the gill beat rate by counting the movement (beat) of the opercu which covers the gills. Take the count for 30 sec. and multiply by 2 to obtain rate per minute and then record c table of results on work sheet. (By taking the average of 2 or 3 counts you may be more accurate.)

Step #5 - Turn on hot plate and heat water slowly while gently stirring. Take a count of the next gill beat rate whe temperature is at 10 degrees Celsius and record data. (You will need to stop the stirring when the beat rate is taken. double beaker with surrounding water may be used if water heats too quickly.)

Step #6 - Repeat steps 4 and 5 at 15, 20, 25, and 30 degrees Celsius, recording your data each time. If the minnow begins to float at the surface or wildly thrash about immediately return to cold water as we do not intend for it to d

Step #7 - Take the recorded data and plot on graph: Gill Beat Rate vs. Water Temperature.

Day 2:

Step #1 - Same as step #1 above.

Step #2 - Without placing minnow into beaker use the cold water sample and your Hach water test kit to determine t amount of dissolved oxygen in parts per million (ppm). Instructions are contained within each kit. All data will ne be recorded on your worksheet.

Step #3 - Return the amount of water lost from testing to beaker. Place beaker on hot plate, stir gently, and remov sample for testing when it reaches 10 degrees Celsius.

Step #4 - Repeat Step #3 and test the amount of dissolved oxygen at 15, 20, 25, and 30 degrees Celsius. (If test ki in short supply or you do not have enough time to make a test at each 5 degree interval, each lab group may be ass only a few and the data taken and averaged for the entire class.)

Step #5 - Make a graph of Dissolved Oxygen (ppm) vs. Water Temperature.

Step #6 - Study each of the graphs which you have made and from your analysis write your conclusion.

RESOURCES/MATERIALS NEEDED: All explained above.

TYING IT ALL TOGETHER:

The balance of nature, as we often hear, is a very delicate one. Each organism has its own specific tolerance level c many different environmental and human imposed factors. The oxygen level of water is but one of many factors that will determine what species will be present of survive in a freshwater ecosystem. In today's society we need to be m aware of how we effect that balance of nature and weigh carefully the results of our actions and decisions.

May 1994

These lesson plans are the result of the work of the teachers who have attended the Columbia Education Center's Summer Workshop. CEC is a consortium of teacher from 14 western states dedicated to improving the quality of education in the rural, western, United States, and particularly the quality of math and science Education. CEC uses Big Sky Telegraph as the hub of their telecommunications network that allows the participating teachers to stay in contact with their trainers and peers that they have met at the Workshops.

Outdoor Education

An Educator's Reference Desk Lesson Plan

Author: John A. Cooper, Mooreland Elementary, Mooreland, OK

Date: May 1994

Grade Level(s): 4, 5, 6

Subject(s):

- Science/Environmental Education

OVERVIEW:

The key element to a successful environmental conservation program is education. The younger the student becomes informed about conservation, the easier it is to encourage continued study. This program stresses the "hands-on" ›roach. If the program is exciting and challenging to students, they will learn whether they realize it or not.

The program at every turn has the student's best interest as a basis. This reasoning is supported by responses received not only from students but also their parents. Evidence of the success of our program is in the readiness of our studen to attempt and learn new concepts of the environment and its natural resources.

The concept of outdoor education is not a new idea to education; however, our program over the past two years has involved 220 students and the idea was new to them. Orienteering, soil and water conservation, forestry, minerals, wildlife, and basic first-aid are disciplines of study in our program.

PURPOSE:

Living in a small farming community, many of our students have a basic understanding of outdoor education. However, we also have students who have very little contact with the natural environment outside city limits. This program is designed to enhance the knowledgeable students awareness as well as introduce inexperienced students to various facets of their natural environment. We believe this exposure will emphasize the importance of conservation and create an interest in nature and conserving the natural environment.

OBJECTIVES:

1. To help students better identify different types of trees, grasses, and soils found in our area.
2. To help students identify and understand wildlife, habitat, and conservation ideas.
3. To help students understand the importance of soil and water conservation.
4. To help students understand the importance of basic first-aid.
5. To introduce and increase students' proficiency in the use of a directional compass in the art of orienteering.
6. Engage students' ability in problem solving situations.
7. Help students understand the importance of team concept and cooperation.
8. Increase self-reliance and confidence in completing a difficult and seemingly unattainable goal.

ACTIVITIES:

The activities which follow are intended to help student attain the previous list of goals as well as a better appreci and understanding of the environment.

1. Students will participate in a one (1) week course of instruction on the proper use and interpretation of a directional compass. This encompasses the use of cardinal, inter-cardinal, and degrees of direction in dete the proper course of transit.
2. Students will participate in a one (1) day field trip conducted on 160 acres of land with a wide variety of te
3. Students will be divided into four groups and will attend four 45 minute classes on the following areas; so water conservation, forestry, wildlife identification and conservation, and first-aid. These classes are conduc by individuals trained and working in their respective field. Our program each year has the three basic clas soil and water conservation, forestry, and wildlife identification and conservation. The fourth course is determined by the interest of the students.
4. The afternoon will be spent in navigating orienteering courses designed for each grade level using the skil developed in the one week preparation course presented in the classroom and on the playground. These co range in length from 3/4 of a mile to 1 1/2 miles. The fourth grade course is designed to use cardinal directio the fifth grade course is designed for cardinal and inter- cardinal directions; while the sixth grade course is degrees. Using this basic plan for the courses, the students progress each year to a more challenging cours thus increase their proficiency in the use of a compass.

RESOURCES/MATERIALS NEEDED:

YOUR BEST RESOURCES ARE YOUR OWN IMAGINATION AND THE IMAGINATIONS OF YOUR STUDENTS!!!!

TYING IT ALL TOGETHER:

This program not only involves students and teachers in our school but students and teachers from other communit The patrons in our community are as eager to attend the outdoor education program as are our students. This yea had 106 students involved, and 39 sponsors were present. The sponsors range from parents and grandparents to p in the community that just love to be around young people. This is a program that will not only have students work together but will encourage the support and interest of the community. Through hard work, dedication, and coop with the community, this program will continue to grow and prosper.

May 1994

These lesson plans are the result of the work of the teachers who have attended the Columbia Education Center's Summer Workshop. CEC is a consortium of teacher from 14 western states dedicated to improving the quality of education in the rural, western, United States, and particularly the quality of math and science Education. CEC uses Big Sky Telegraph as the hub of their telecommunications network that allows the participating teachers to stay in contact with their trainers and peers that they have met at the Workshops.

Everybody Needs a Clean Environment

An Educator's Reference Desk Lesson Plan

Submitted by: Jeanne Guthrie
Email: rjguthrie@kc.rr.com
School/University/Affiliation: Retired teacher

Date: May 7, 2003

Grade Level: 4, 5, 6, 7, 8

Subject(s):

- Science/Environmental Education
- Language Arts/Literature/Children's Literature
- Language Arts/Writing

ration: 8 or more class periods depending on the abilities of the students and the availability of computers and rch materials

Description: Our earth is fragile and becoming more polluted each day. How will we protect it for future generations It is interesting to note that our recognition of Earth Day started with the efforts of one man, U.S. Senator Gaylord Nelson of Wisconsin! While we may not make such a recognizable contribution, each of us can make a difference in protecting our environment. We need a clean environment, free of pollutants in the air, water, and land. This lesson w give students the opportunity to research ways to "reduce, reuse, and recycle" by creating a book, "Everybody Needs Clean Environment" based on the pattern in the book, Everybody Needs a Rock by Byrd Baylor.

Goals:
NCTE/IRA Standards for the English Language Arts :

- 4. Students adjust their use of spoken, written and visual language to communicate with a variety of audiences and for different purposes.
- 5. Students employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences for a variety of purposes.
- 6. Students apply knowledge of language structure, language conventions, media techniques, figurative langua and genre to create, critique, and discuss print and non-print texts.
- 7. Students conduct research on issues and interests by generating ideas and questions, and by posing problems They gather, evaluate, and synthesize data from a variety of sources.
- 8. Students use a variety of technological and information resources to gather and synthesize information and t create and communicate knowledge.

nal Science Educational Standards :
Science in personal and social perspective / Content Standard F:

- Students will be aware of changes in the environment (3-4);

- Students will be aware of populations, resources, and the environment (5-8);
- Students will be aware of environmental quality (9-12)

Objectives:

1. Students will be aware of the pollution that exists in/on our earth.
2. Students will use the Internet to research forms of pollution.
3. Students will follow the pattern of Everybody Needs a Rock by Byrd Baylor to create rules for "reducing, reusing, and recycling."
4. Students will edit for punctuation, spelling, and usage.
5. Students will write to inform an audience.

Materials:

- computers with Internet access
- paper, pencils and other materials for writing/illustrating
- Everybody Needs a Rock by Byrd Baylor
- Clean Environment Task
- Clean Environment Graphic Organizer
- Clean Environment Form for Writing Rules
- Clean Environment Rubric

  Handouts in .pdf format; requires free Adobe Acrobat Reader.

  Click the icon to obtain the free Reader.

Procedure:

Teacher Preparation:
Locate the book, Everybody Needs a Rock by Byrd Baylor in the Easy section of the library. Run off copies of tl Task, Rubric, Graphic Organizer, and Form. Bring in texts, articles, and videos that might be informative to studen researching the pollution in the world.

Instruction and Activities:

Day 1:
Begin by finding out what students know about pollution. Let them brainstorm the many kinds of pollution. After a has been generated, ask students if they can group these into categories (Air, Water, Soil, Hazardous Waste, Noise, Animal Extinction, etc.) Tell students that they will be doing research in each of these areas to find out what can done to "reduce, reuse, and recycle" in order to have a cleaner environment for ourselves and for those who come a us. Tell them that before they begin, you want to review the Task and the Rubric so that they will understand exactl what is expected of them during the study. Hand them out, and go over them as a class. As a homework assignme t and depending on the age of the students, you could have them bring in articles from the newspaper that mention pollution anywhere on the earth.

Day 2:
If students have brought in articles about pollution, briefly go over these and add any new information to the list tha was brainstormed on the first day. Tell the class that before you hand them the Graphic Organizer that will be u record research data, you are going to read them a little book. Ask them to listen to how the pattern of the book be used for an assignment on a clean environment. Read Everybody Needs a Rock by Byrd Baylor. Point out that th Form they will use will allow them to follow the pattern of the book. (If the book is not available, go directly to t Form, reading it and discussing how students will be finding 10 rules that people can follow to have a cleaner environment.) Hand out the Form for the books students will be creating. Explain that the rules might be different fo

each student, depending on what they each feel is important and obtainable by the average citizen, including themselves. Either list or make copies of the Internet sites for students to begin their research. If computers are not ·ilable for all students, research can be made in small groups with each student recording his/her own data. Let ·nts begin their data collection.

Days 3-5:
Students should continue their research. Some could use texts or articles collected.

Days 6-7:
Students should begin their "Everybody Needs a Clean Environment" books using the Form that has been provided. Students should be reminded that the rules will be the topic sentences, but the detail sentences in the rest of the paragraph should explain how the rule could be accomplished. Remind students that the Rubric explains the need for correct punctuation, spelling and usage when writing for an audience. Encourage students to illustrate their rules with drawings or pictures. Inform them that they will be presenting their books to the class.

Day 8:
Sharing day. Let students present their books to their classmates. Ask students to look for similarities in the rules. Poi out that each person can contribute to the cleaning up of the earth by "reducing, reusing, and recycling."

Lesson Extensions:
Have students share their books with other classes. Ask the local library to showcase the books. Read the books on Earth Day.

Assessment: Teacher observation, class discussions, and the Rubric are all forms of assessment.

·ful Internet Resources:
· carta Encyclopedia Article: Pollution
http://www.encarta.msn.com/encnet/refpages/RefArticle.aspx?refid=761570933

* Hazardous Waste
http://www.scorecard.org/

* EPA: Air Now (air pollution)
http://www.epa.gov/airnow/

* EPA: Nonpoint Source Pollution (water pollution)
http://www.epa.gov/region4/water/nps/

* Wastes - Kids Page
http://www.epa.gov/epaoswer/osw/kids/index.htm

* Recycling Information
http://directory.google.com/Top/Science/Environment/
Pollution_Prevention_and_Recycling/Recycling_Information

* Environmental Issues
http://directory.google.com/Top/Society/Issues/Environment/Pollution

·TE/IRA Standards for the English Language Arts
h··//www.ncte.org/standards/standards.shtml

* National Science Education Standards (NSES)
http://books.nap.edu/html/nses/

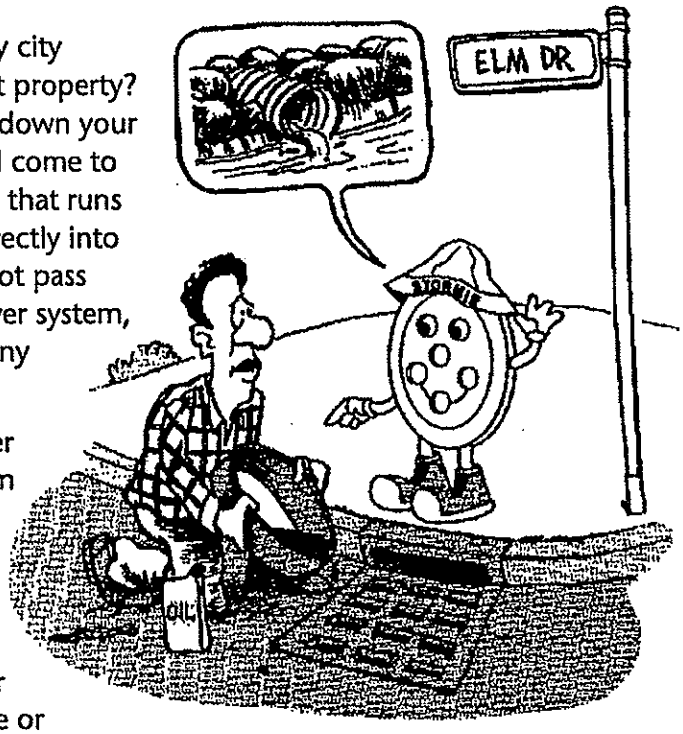
Special Comments: While the book by Byrd Baylor sets the pattern, it is not necessary to have because the patt been completed on the form given.

Storm Drain Stenciling

How You Can Prevent Water Pollution

A SERIES OF WATER QUALITY FACT SHEETS ABOUT STORMWATER RUNOFF

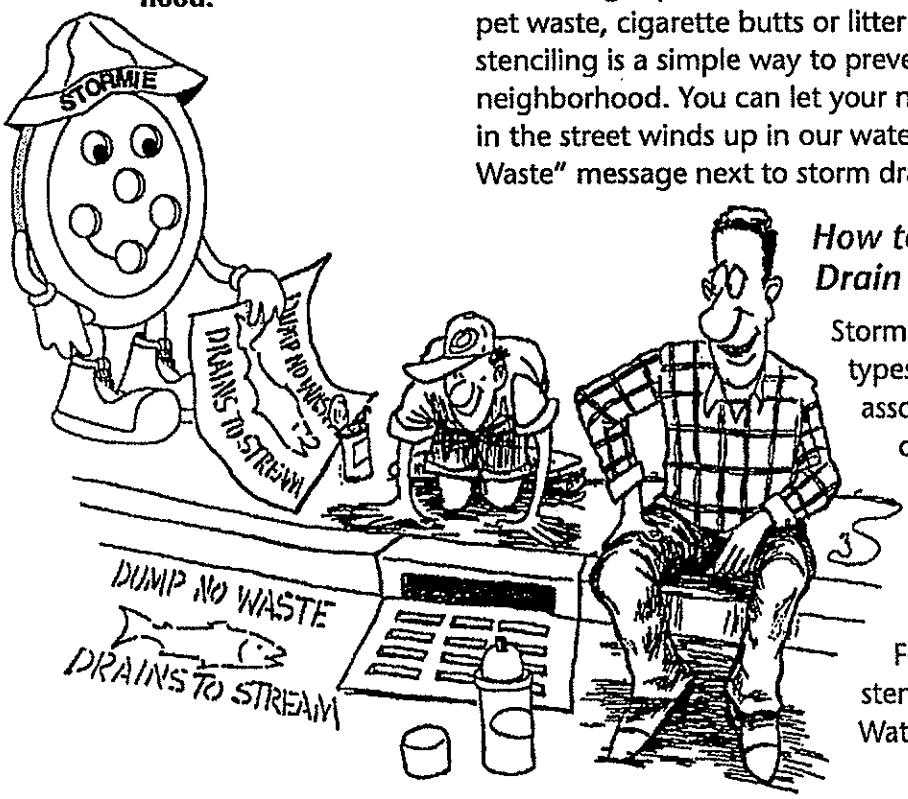
Did you know that every city street is like waterfront property? It's true. Just take a walk down your street. Before long, you'll come to a storm drain. Any water that runs down this drain flows directly into our waterways. It does not pass through the sanitary sewer system, and it does not receive any kind of treatment.



This means that whatever we put down these storm drains winds up in the lakes and streams where we go fishing, boating and swimming.

People who would never dream of polluting a lake or stream might pour antifreeze, fertilizer, paint or used motor oil, or toss pet waste, cigarette butts or litter down storm drains. Storm drain stenciling is a simple way to prevent this kind of pollution in your neighborhood. You can let your neighbors know that anything dumped in the street winds up in our waterways by stenciling a "Dump No Waste" message next to storm drains.

Storm drain stenciling is one way to help prevent runoff pollution in your neighborhood.



How to Sign Up for Storm Drain Stenciling

Storm drain stenciling is a great activity for all types of organizations from neighborhood associations to scout groups to service clubs. By participating, the members of your group will become more aware of the close link between our streets and waterways. And you will leave behind a reminder for others.

For more information about storm drain stenciling in your community, contact Water Action Volunteers, 608/264-8948.

It All Adds Up

We've cleaned up most of the big sources of water pollution like industries and sewage treatment plants. Now much of the pollution in our lakes and streams comes from small, scattered sources. Stenciling the storm drains in your neighborhood may seem like a small thing to do for clean water, but it is important.

It's up to each of us to reduce the pollution that comes from our cars, streets, driveways and yards. Together, our actions will add up to cleaner water for us and for our children.

MAKING YOUR MARK – SOME PRACTICAL ADVICE

Getting permission

You must have permission before stenciling storm drains. You or the sponsor can get permission from the local Department of Public Works. To stencil storm drains on private property (for example, in parking lots for businesses or apartments), you need permission from the property owner.

Organizing your teams

Before you start, take a careful look at the area your group will cover. Divide the area into routes and assign a team to each route so no storm drain goes unstenciled. If you have a large area to cover, have someone do a "quality check" to be sure all drains were stenciled. Assign another person to collect, clean up and return the stencil kits.

Telling your story

Send a news release or call your local newspaper, radio or television station announcing when and where your group will be stenciling. News coverage will educate more people about the importance of keeping storm drains clean. Another way to let the neighbors know what you are doing is to hang cards on their front doors explaining the project. Your sponsor has a supply of these cards.

Painting

Fair weather is essential for this project! The pavement must be dry and warm. Check your paint can for specific instructions. Use the wire brush in your kit to clean the area in the gutter next to the storm drain. Then, tape the stencil in place and spray paint the message. Two light coats of paint work better than one heavy coat. The best kind of paint to use is a traffic zone latex. White is the best color because it is the most visible and least likely to fade. Wherever possible, paint on the downhill side of the storm drain. This way your message won't be worn off by flowing water or covered by debris and leaves. A stencil's lifespan depends on use. When paint builds up and blurs the message (typically five to ten stenciling events), discard the stencil.

Stenciling Safety

During a stenciling outing, your group will frequently be in the street. Please follow all traffic safety practices. Wear safety vests or brightly colored clothes and be alert. On busy streets, choose a time of day when there is less traffic. When working with children, assign an adult to each team.

This publication is available from county UW-Extension offices or from Extension Publications, 630 W. Mifflin St., Madison, WI 53703. (608) 262-3346.

A publication of the University of Wisconsin–Extension in cooperation with the Wisconsin Department of Natural Resources.

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GWQ015 Storm Drain Stenciling – How You Can Prevent Water Pollution

DNR WT-531-99

R-09-99-10M-20-S

Editing and design by the Environmental Resources Center, University of Wisconsin–Extension.

WAV Storm Drain Stenciling

"Paint the Town with WAVes"

DESCRIPTION:

Educate your community about stormwater pollution by stenciling the message: "Dump no Waste – Drains to Stream" (or River or Lake) next to storm drains. You may choose to distribute or create fliers that educate the community about stormwater pollution.

OBJECTIVES

By participating in this activity, your group will:

1. Learn about the sources of stormwater pollution.
2. Understand why stormwater pollution is a threat to the environment.
3. Stencil messages next to storm drains to encourage others to be more aware of stormwater pollution.

TIME

It will take approximately one hour for a team of four to six people to stencil 15 storm drains.

AGE

This is a good activity for volunteers ten years and older.

COST

You will need to purchase or borrow all of the required supplies, except for the stencils and door hanger cards. These are available free-of-charge from the Department of Natural Resources Madison office or University of Wisconsin Extension. Call 608-264-8948 to order.

YOU WILL NEED:

Items for 4 to 6 people:

- 1 or 2 stencils
- Door hanger cards/fliers
- A map of the stenciling area
- Parent/guardian permission slips
- A letter of authorization from the Department of Public Works for stenciling
- 2 cans of spray paint – preferably inverted-tip white traffic zone latex paint. (Note: 1 can paints approximately 10 drains.)
- A wire brush to clean the gutter before painting
- Whisk broom and dust pan
- 1or 2 pairs of work gloves
- 1 or 2 bright orange safety vests, or wear brightly colored clothing
- 2 garbage bags – 1 for wet stencils and 1 for garbage such as tape used on the stencils and debris cleaned out of the gutter
- Paper towels or rags*
- Traffic cones or flags for use on busy streets*
- Duct tape and scissors*
- Cardboard box the size of stencil*

* = optional

Everyone can contribute to a storm drain stenciling campaign. This student is from Ladysmith Elementary School in Ladysmith, WI.

BACKGROUND

Why should people be concerned about what enters a storm drain? Because anything that is flushed down a storm drain is not "treated" before it reaches a stream or river. This means that oil, antifreeze, paint, grass clippings, household waste, pet wastes, or any other waste on streets and sidewalks goes directly into a nearby stream, river, or lake.

The next time you wash your car on your driveway, consider where the water goes. The soapy, dirty water runs down the street into the storm sewer. This sewer carries the wash water to a waterbody. In the water, the soap acts like a fertilizer for aquatic plants and causes too much plant growth, which creates problems for fish.

You can help increase awareness of the storm drain connection. Educate your community about stormwater pollution by stenciling the street next to storm drains and distributing door hanger cards.

BEFORE YOU STENCIL

1. Obtain permission.
Get permission to stencil storm drains from the Department of Public Works in your city, village or town. Be sure to ask for a letter of authorization to provide you with proof if you are questioned by a road crew or police officer.

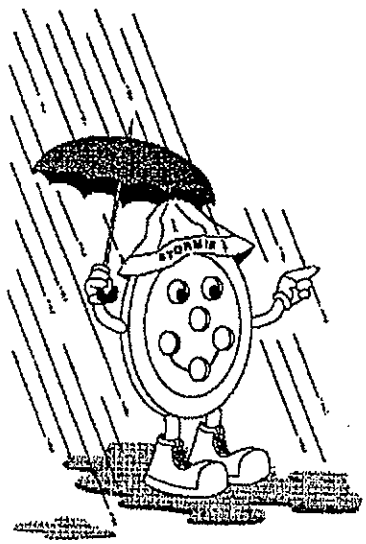
To stencil on private property, contact the landowner, whether the property is a home, business, or apartment complex.

2. Keep weather in mind.
Weather conditions are important for the success of this project. You should choose a day when the pavement is dry and warm. Windy days are not good because the spray paint can drift onto nearby automobiles and debris can be blown onto the painted surface.

3. Divide up the area.
Using a neighborhood map, carefully consider the area your group will stencil. Divide the area into routes and assign a team to each route.

4. Notify the neighborhood.
A day or two before you plan to paint, distribute door hanger cards or fliers explaining the stenciling program. If you can't distribute the information ahead of time, have one or two team members distribute the cards and fliers while others paint.

Examples of a door hanger card and a flier are included with this unit (the flier can be photocopied). If your group is participating in a large storm drain stenciling project, you may want to make your own door hangers, fliers, or posters, using the opportunity to conduct an all-out education campaign.



HOW TO STENCIL

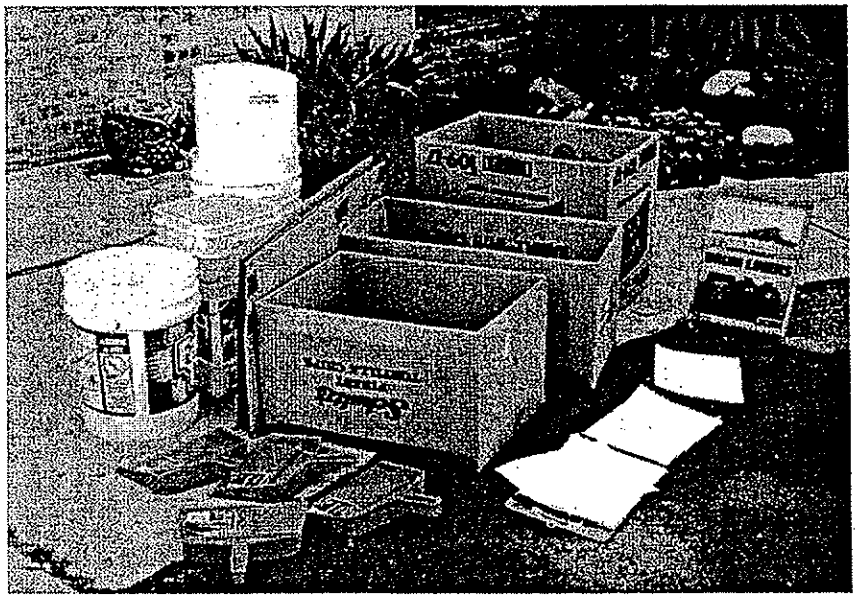
1. Scrub around the drain.
Scrub the street area surrounding the storm drain with the wire brush, and use the whisk broom to sweep dirt into the dust pan. Use your garbage bags to take debris away. Do not sweep dirt and debris into the drain.

2. Put the stencil in place.
Position the stencil in the gutter next to the storm drain inlet where the message will be most visible. Tape or hold the stencil in place. You might place a cardboard box with its bottom removed over the stencil to create a "wall" that contains drifting paint.

3. Paint away.
Spray paint the message, making sure paint doesn't get into the storm drain. Two light coats of paint will work better than one heavy coat. Allow the first coat of paint to dry before applying the second coat. The stenciled messages last for approximately two years on a paved surface.

4. Check for missed drains.
When you're done with the project, have one team member check that all storm drains in your area have been stenciled. It's easy to miss one.

5. Clean up.
Place the used stencils in a plastic bag for transportation. When storing used stencils, allow the paint to dry *before* stacking the stencils. A stencil's lifespan is determined by use. Discard the stencil when the message is blurred by excess paint build-up (typically about ten separate events).



RESOURCES

**Down The Drain* (#645003)
Sunburst
101 Castleton St.
Pleasantville, NY 10570
1-800-321-7511
www.sunburst.com

This 30-minute 3-2-1 CONTACT video takes a close look at something that's easy to take for granted – water. It examines the effects of modern lifestyles on the water cycle, a key to understanding why and how we must preserve this precious resource.

Door hanger cards and stencils

Contact: Kris Stepenuck, Water Action Volunteers Coordinator, at 608-264-8948, or: Carol Holden, DNR Runoff Management Section, Bureau of Watershed Management, at 608-266-0140.

The Water Action Volunteers program is a cooperative effort between the University of Wisconsin -Extension and the Wisconsin Department of Natural Resources. For more information about the WAV program, please contact Kris Stepenuck, Water Action Volunteers Coordinator

AT: DNR, WT/2,
P.O. Box 7921
Madison, WI 53707
(608) 264-8948

OR: Environmental Resources Center
216 Agriculture Hall, 1450 Linden Drive
Madison, WI 53706-1562
(608) 265-3887
kris.stepenuck@ces.uwex.edu

WAV materials revised Summer, ©2001.

Paint the Town with WAVES!

Storm Drain Stenciling Order Form

Please check on the WAV website to see if there is a local stencil distributor in your county or city before completing this form. These local contacts have stencils and oftentimes other supplies on hand to help your group have a successful project.

PLEASE PRINT!

Name _____

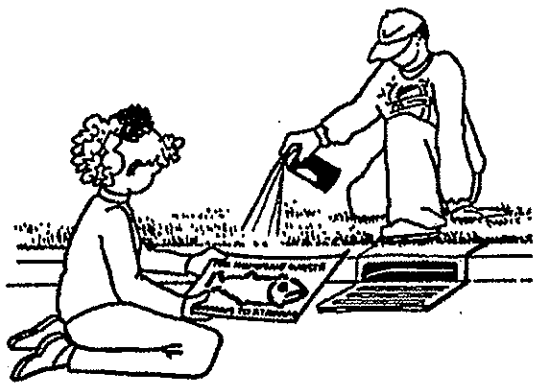
Address _____

City/State/Zip _____

Phone _____

County _____

STENCILS Circle One	How many Circle one
River	1 2 3 4 5
Lake	1 2 3 4 5
Stream	1 2 3 4 5



HAND OUTS

	How many
Door Hanger Cards (1 packet = 250 cards)	_____

Return this form to:

Kris Stepenuck
Water Action Volunteers
DNR, WT/2
101 S. Webster St., PO Box 7921
Madison, WI 53707

Paint the Town with WAVES!

Storm Drain Stenciling Report

Name _____

Organization _____

Address _____

City _____ State ____ Zip _____

Phone _____ County _____

Email _____

How many people participated in the activity?*

Youth:	_____	**Asian:**	_____
Adult:	_____	**African American:**	_____
		Caucasian:	_____
Male:	_____	**Hispanic:**	_____
Female:	_____	**American Indian:**	_____

* This information will be used to help to fine tune a nondiscriminatory educational outreach program.

Date of stenciling project: _____

Where did you stencil? _____

How many drains did you stencil? _____

Please send this form to: Kris Stepenuck, DNR, WT/2, 101 S. Webster, PO Box 7921, Madison, WI 53707 or email the completed form to kris.stepenuck@ces.uwex.edu

Please send copies of photos, newspaper clippings or any other information about your stenciling project!

Working with Your City Government

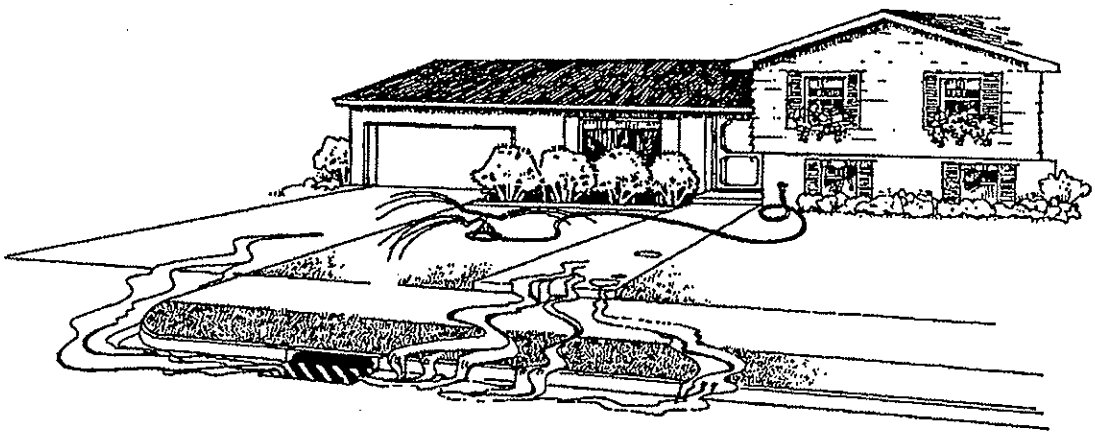
Sometimes it is necessary to speak directly to your City Board to get permission to stencil storm drains. This is a great opportunity for you and your group to learn more about city government and decision making. Other groups have given presentations to their City Boards to gain permission to stencil. Below are a few suggestions for a presentation:

- Spray the stencil onto a piece of tag board so the City Board can see what the stencils will look like on the streets.

- Ask your students or younger members of your group to participate in the presentation.

- Explain what causes stormwater pollution (runoff from yards, parking lots etc.), and then explain that stenciling is a way to educate the community and will build awareness of stormwater pollution. Educational materials for you to hand out are available for free (see http://www1.uwex.edu/ces/pubs/).

- Storm Drain Stenciling is a great community-building activity.



WATER ACTION VOLUNTEERS is a cooperative program between the Department of Natural Resources and the University of Wisconsin - Cooperative Extension. For more information call 608-264-8948 or 608-265-3887.

SAMPLE PRESS RELEASE

Paint the Town with WAVes

Keep an eye out for groups of kids and adults roaming the streets with cans of spray paint. They are part of an education campaign to remind all of us that storm water pollution begins at the drain on our streets. The Water Action Volunteers program, a cooperative program between the WI Department of Natural Resources and the University of Wisconsin-Extension, provides free stencils to individuals and groups who want to volunteer an afternoon to paint the message: Dump No Waste: Drains to River (or Stream or Lake).

In most communities around Wisconsin, rain or snowmelt washes down streets, parking lots, driveways, sidewalks, yards, and roofs into the drain at the curb. The water enters a series of pipes which collect water from other neighborhoods, finally dumping directly into a nearby lake, stream, river, or wetland.

Stormwater is not cleaned before it empties into our waterways. This means that lawn care bi-products (including grass clippings), automobile products such as antifreeze or oil, and other chemicals can enter the water through the storm sewers. Soil from yards and construction sites or farm fields can turn water cloudy or turbid. Cloudy water makes it difficult for fish to see and feed, and soil particles can act like sandpaper against fish gills, causing them harm. Closed swimming beaches are often the result of large rainstorms because the water washes pet waste and other waste down storm drains. These wastes may contain bacteria that are harmful to humans.

We can help protect our water by using lawn case chemicals sparingly, recycling automobile bi-products, and tossing pet waste in the garbage. A message next to the storm drain is a simple reminder of what we can do to prevent storm water pollution. Join the stenciling campaign by contacting: **(enter a contact name, phone number, date and time of stenciling project).**

DON'T FORGET!

- Get permission from your city to stencil storm drains.
- Purchase spray paint from your local hardware store or paint store. Look for ***latex traffic marker paint*** or ***inverted tip marker paint***.
- Fact sheets and door hanger cards are available through WAV.
- Keep track of how many people participate and how many drains are stenciled.
- Have fun!

WATER ACTION VOLUNTEERS is a cooperative program between the Department of Natural Resources and the University of Wisconsin - Cooperative Extension. For more information call 608-264-8948 or 608-265-3887.

EXAMPLE
LIABILITY WAIVER

I, the undersigned, being the volunteer involved in the storm drain stenciling project (hereinafter referred to as the "Project") or being the parent or legal guardian of such a volunteer in the Project, in consideration of my or another's participation in the Project, I hereby, for myself and any volunteer for who I am a parent or legal guardian release, discharge, hold harmless, and forever acquit the *State of Wisconsin, the County, the City, the University of Wisconsin-Cooperative Extension, Wisconsin Department of Natural Resources, Water Action Volunteers program, or other local sponsors*, and their officers, agents, representatives and employees from any and all actions, causes of action, claims or any liabilities whatsoever, known or unknown now existing or which may arise in the future, on account of or in any way related to or arising out of participation in the Project.

Further, I assume all liability of any non-participants who accompany me.

Participant's name (please print)_____

Participant's
signature_____

Participant's age_____

Signature of participant's parent or legal guardian_____

Date_____

You must sign the liability waiver to participate!

WATER ACTION VOLUNTEERS is a cooperative program between the Department of Natural Resources and the University of Wisconsin -Cooperative Extension. For more information call 608-264-8948 or 608-265-3887.

APPENDIX U

Additional Funding Opportunities

WATERSHED PROTECTION FUNDING OPTIONS

The major categories of funding sources are:

- Local financing
- Private, nonprofit funding
- State grants
- Federal grants

7.1. Local Financing

- Lake Property Owners

  Lake property owners can prevent or solve some lake problems by individual actions. However, most problems require an organized approach. At the local level, lake associations, community service clubs, town sanitary districts, and lake districts are involved. Table 13 lists some of the differences between the various types of Lake Associations and Lake District.

  - Permanent Conservation Easements

    As a protection mechanism, some lake property owners purchase large acres of land to limit area development. To ensure that conservation values are protected and that the land is not broken into smaller parcels and sold for development, land owners can work with a nonprofit organization to place restrictions, such as limit building, logging, etc., on the present and future land uses. Conservation easements still allow land to be lived on, sold, or passed onto heirs, and permanent conservation easements donated to a nonprofit organization may entitle land owners federal and state tax deductions equal to the easement value. More information on this protection mechanism is yet to come from the Wisconsin DNR.

- Lake Associations

  In 1898, Wisconsin's first lake association was established on Lake Geneva. More organizations concerned with the health of lakes, like the Red Cedar Lakes Association (RCLA), formed. RCLA was incorporated under Chapter 181 of the Wisconsin Statutes and granted federal tax-exempt status under Section 501(c)(3) of the Internal Revenue Code in 1998. Membership dues of the RCLA are voluntary. Under these regulations, RCLA can and has pursued some of the following general management powers:

  - collect membership dues
  - borrow/invest money
  - apply/receive state and other grants
  - acquire property
  - contract for aquatic plan removal
  - purchase sensitive areas

The organization to a lake district may be appropriate when the lake management organization is active in lake protection, when legal certainty is desired, and when long-term lake planning is anticipated. The disadvantages of a lake district are that it's complexity, requirement for a higher degree of maintenance, and its ability to tax all district property owners. The latter is an advantage once formed but result in the most vocal opposition to the formation of the entity.

7.2. Private, Non-Profit Funding

- Wisconsin Wetlands Association (WWA). In 2003, WWA offered more than $6,000 to groups and individuals for the coordination of survey and biological control efforts of Purple Loosestrife within Wisconsin's Great Lakes basin. Small grants (up to $350) were awarded to cover equipment purchase or rental, travel, and volunteer training will be made to local leaders who will coordinate (a) multiple *Galerucella* beetle-raising projects and a volunteer purple loosestrife survey and/or (b) small research projects related to purple loosestrife biological control. These grants are currently under review, may one day include other basins, and funding is currently on hold due to state budgetary changes.

- Commission for Environmental Cooperation (CEC). CEC is a tri-national body (Mexico, Canada and the United States) and created the North American Fund for Environmental Cooperation (FAFEC) in 1995 to provide funding for community-based environmental projects in North America. Non-profit, non-governmental organizations are eligible to apply for grants.

- Environmental Support Center (ESC). The goal for ESC is to improve the U.S. environment by enhancing the health and well-being of local, state, and regional organizations working on environmental issues. ESC offers various training programs and a new environmental loan fund to help environmental groups become better managed and funded. The Environmental Loan Fund is a revolving loan fund intended to stabilize, increase, and diversify an organization's long-term funding base. ESC's loan making has currently been suspended due to funding constraints.

- Foundation Center (FC). The FC publishes directories of funding opportunities, including: (1) *Foundation Directory*, (2) *National Guide to Funding for the Environment and Animal Welfare,* (3) *National Directory of Corporate Giving,* and (4) *FC Search: The Foundation Center's database on CD-ROM.*

- National Fish and Wildlife Foundation (NFWF). A non-profit organization established by congress in 1984, NFWF awards grants for natural resource conservation projects. NFWF awards grants for natural resource conservation projects. NFWF uses its federally appropriated funds to match private sector funds. NFWF's six priority program areas include wetland conservation, conservation education, neotropical migratory bird conservation, fisheries, conservation policy, and wildlife and habitat.

- River Network. River Network works to protect and restore America's rivers. This organization offers publications, fundraising tips, technical assistance, resources, and the opportunity to network with other groups across the country.

- Sustainable Community Network (SCN). SCN focuses on using innovative strategi to make communities' environmentally sound, economically prosperous, and socially equitable.

- Turner Foundation. Turner Foundation, Inc.'s motto is about "working to protect and restore the natural systems that make life possible." This foundation has four grant programs through which it supports national, regional and state-specific work:
  - Water and toxics
  - Energy and transportation
  - Population
  - Habitat

- Natural Resources Foundation of Wisconsin: Habitat Restoration Grant. Program promotes knowledge and enjoyment of natural resources, while inspiring local citizens to take actions that ensure Wisconsin's legacy of responsible stewardship will continue. Due to the State budget shortfall, this program is currently on hold until further notice.

- Boat U.S. Foundation: For Boating Safety and Clean Water. Grants up to $4,000 are available for projects to educate mariners about cleaner boating habits. Grants are open to nonprofit community groups with proposals that address issues such as petroleum pollution prevention, pump out education, and littering prevention.

- Earthwatch Institute Watershed Grants. Research, conservation, and education. Earthwatch Institute engages people worldwide in scientific field research and education to promote the understanding and action necessary for a suitable environment.

- Conservation Alliance Grants. Core 4 Conservation Alliances are public/private partnerships that promote and implement conservation at the local level. Agricultural producers or citizens provide the leadership and partners from government, academic institutions, associations, and businesses provide support. These alliances help to create the local-level successes that advance the national Core 4 Conservation campaign to realize Better Soil and Cleaner Water for our environment, Greater Profits for agriculture, and a Brighter Future for all of us. Alliances in all regions of the country are encouraged to apply for grants up to $2,500 from the Conservation Technology Information Center (CTIC), which coordinates the Core 4 Conservation campaign. These grants will be awarded to qualified alliances based on the application guidelines. Grantees must provide a dollar-for-dollar match with nonfederal funds. In-kind services are acceptable as match.

- Ducks Unlimited. Ducks Unlimited is a world leader in wetland conservation. Matching Aid to Restore State Habitat (MARSH) program creates a positive fundraising atmosphere through the acquisition and enhancement of waterfowl habitat within each state. This reimbursement program provides matching funds and grants public and private agencies and organizations within each state.

- The Conservation Fund. The Conservation Fund, with its one percent fundraising cost and 95 percent program allocation, was recognized as the nation's top environmental nonprofit by a prominent charity watchdog organization. They assist in land conservation, sustainable programs, and leadership training.

- Young Wisconsin Conservationist Program of the Izaak Walton League. The Wisconsin Division of the Izaak Walton League has developed a program to encourage and assist K-12 school classes and organizations to carry out environmental and conservation activities. We will provide up to $200/project in funding for worthwhile projects. This will free them from having to spend valuable time in fundraising.

- National Science Teachers Association. Over the past 12 years, the Toyota TAPESTRY grant program, sponsored by Toyota Motor Sales, U.S.A., Inc. and administered by the National Science Teachers Association, has awarded 552 grants totaling over $5 million to teachers in the United States and U.S. Territories. This year, 50 grants of up to $10,000 each and a minimum of 20 "mini-grants" of $2,500 each are available to K-12 teachers of science. To apply for funding, qualified teachers must write a Toyota TAPESTRY proposal and submit it for receipt at NSTA by a date in January 2004 to be announced later.

  Open to K-12 teachers of science residing in the United States or U.S. territories or possessions. All middle and high school science teachers and elementary teachers who teach some science in the classroom are eligible. "Science teacher" is defined as anyone who spends at least 50% of his/her classroom time teaching science or teaches a minimum of two science classes per day. Elementary teachers who teach science in a self-contained classroom setting or as teaching specialists are eligible.

  Proposals must describe a project including its potential impact on students, and a budget up to $10,000 (up to $2,500 for mini-grants). Toyota TAPESTRY grants will be awarded in three categories:

  - Environmental Science Education
  - Physical Science Applications
  - Literacy and Science Education

7.3. State Grants

State grants are available to assist in surface water management and abate nonpoint source pollution. However, it is generally not a good financial practice to rely totally on grants for a service program. This source of revenue is not dependable and requires constant speculation as to its availability. Grants are useful but should only be used to supplement a planned local revenue source. Examples of some available grants include:

A. Wisconsin Department of Natural Resources (WDNR)

(1) Priority Watershed Program

This program was the Wisconsin Department of Natural Resources largest and oldest nonpoint source pollution control program and is regulated under Wisconsin Administrative Code NR 120. The priority watershed program represented the single largest state funding source. Currently, this program is being phased out as projects come to an end. Funding is now dispersed at a reduced rate to the Counties as part of the Land and Water Conservation Program. Priorities are established by local work groups on a County-by-County basis.

(2) Runoff Management Grants

The Wisconsin DNR is in the process of implementing rulemaking and completing major revisions to a number of Wisconsin Administrative Natural Resource codes to protect and improve the quality of Wisconsin's surface waters. The new and revised codes put into place a system to control pollution of surface waters from nonpoint source in Wisconsin. The DNR offers financial assistance for local efforts to control nonpoint source pollution. These grants support both the implementation of source-area controls to prevent runoff contamination and the installation of treatment systems to remove pollutants from runoff. The main goal of these nonpoint grants is improve the quality of Wisconsin's water resources by decreasing the impacts of nonpoint pollution. These grants are:

- **NR 153 Targeted Runoff Management (TRM) Grant Program**

  TRM grants are competitive financial awards to support small-scale, short-term projects that are completed by local governmental units within 24 months of the start of the grant period. Both urban and rural projects can be funded through a TRM Grant. Dependent on eligibility of a project, the maximum cost-share rate available to TRM grant recipients is 70% of eligible costs, with the total of state funding not to exceed $150,000 in state funding.

  Some project examples include: easements, land acquisitions, stream bank protection projects, wetland construction, detention ponds, design of BMP projects for construction, some cropland protection, livestock waste management practices, and other practices eligible for funding are listed under ch. NR 153 and s. NR 154.04, Wis. Adm. Code. Effective 2005, selected engineering design of structural practices will be eligible for cost sharing and be reimbursable. Land acquisition and design can be reimbursed retroactive after design and parcel appraisal approval by DNR.

TRM grants *may not* be used to fund:

- Projects to control pollution regulated under Wisconsin Law as a point source. This includes activities to meet permit requirements for large livestock feeding operations regulated under ch. NR 243, Wis. Admin Code, and municipal or industrial activities to meet permit requirements under ch. NR 216, Wis. Adm. Code.
- Staffing and/or planning activities.
- Construction site erosion control and post-construction structural BMPs for new development.
- Projects that are not water quality based (such as projects to solve drainage or flooding problems) or for dredging projects.
- Rural projects within Priority Watershed project areas, unless a showing is made that a Priority Watershed funding is inadequate to cover the entire TRM project.

County Land Conservation Departments (LCD) and municipalities (towns, villages, and cities) are the most common applicants. Other applicants include, cities, villages, towns, counties, regional planning commissions, tribal governments, and special purpose districts, such as, lake districts and sewerage and sanitary districts.

- **NR 155 Urban Nonpoint Source Water Pollution Abatement and Storm Water Management Grant Program**

Urban Nonpoint Source and Storm Water Grants promote urban runoff management for existing urban areas, developing urban areas and urban re-development. The primary goals include implementing urban runoff performance standards from Wisconsin Administrative Code NR 151, achieving water quality standards, protecting ground water, minimizing flooding, and helping municipalities meet municipal storm water permit conditions (Wis. Admin. Code NR 216, which is currently being revised).

Eligible projects include storm water detention pond construction, urban stream bank stabilization and land acquisition to increase permeable areas for infiltration. Urban Nonpoint Source Grants can fund 70% of technical assistance, while other cost-share funds are available at 50% of the project cost. The maximum that can be granted for a construction project is $150,000. The maximum that can be granted for a technical assistance project is $100,000.

An urban area meets one of these criteria:

- Has a population density of at least 1,000 people per square mile;
- Has a commercial land use;
- Is the non-permitted portion of a privately owned industrial site; or,
- Is a municipally owned industrial site (regardless of NR 216).

For a storm water planning project to be eligible for funding under this program:

- It must currently be an urban area, or
- Is projected to be urban within 20 years.

(3) Wisconsin DNR Lake Grants

The Wisconsin DNR Lake Grants are influenced by the Wisconsin gas tax revenue. Despite the budgetary changes and cutbacks, the lake grant funding increased from $2.6 to $3.1 million dollars annually.

With a larger budget, the DNR have been directed to create an Aquatic Invasive Species grant program with the new available money. The DNR is also directed by an amendment to write rules for these grants to control these aquatic invasive species. It is proposed that the grants would require 50% match and only local government (i.e. lake and sanitary districts) are eligible, and not lake associations or nonprofit organizations. Eligible planning project activities *may* include:

- Aquatic invasive species monitoring/surveys,
- Development or prevention, control, and restoration plans,
- Educational and training materials, and activities,
- Watercraft inspections,
- Investigation of control methods or prevention techniques.

Final rules for this new grant are expected to be in place the spring 2005. The lake planning and protection grants are available and described below.

a. Lake Planning Grants

Lake planning grants provide funding for the lake management planning process. Qualified applicants are Wisconsin counties, towns, villages, cities, qualified lake associations, town sanitary districts, lake districts, other governmental units as defined in Ch. 66.299, Wisconsin Statutes, tribal units of government, qualified nonprofit conservation organizations. These grants are offered twice annually (February 1 and August 1) for extensive studies and technical planning and there are large and small scale grants.

- Small scale lake planning grants of up to $3,000 are available for obtaining and disseminating basic lake information, conducting education projects, and developing management goals. These grants are ideal for applicants who are just beginning the planning process, education processes, or for activities that supplement an existing plan.

- Large scale lake planning grants up to $10,000 per project (maximum 2 projects per application cycle) are available for larger projects. The in of a large-scale program is to conduct technical studies to help develop elements of or complete comprehensive management plans. The WDNR typically pays for 75% through grant cost share payments not to exceed

$10,000 per project and the applicant may pay 25% (up to $3,000 to $5,000) in local dollars. Diagnostic evaluations of water quality analysis are typically funded activities.

b. Lake Protection and Classification Grants

Lake protection grants provide funding for implementing the recommendations of a management plan. As one progresses from planning to implementation, the costs and the time involved increases. Grants are based on 75% of the total eligible project costs and capped at $200,000 per project, except that grants for regulation or ordinance development projects are limited to $50,000.

Grants will be awarded annually and a priority project list will be prepared each year on a state-wide basis. The grant deadline is annually on May 1. Activities that are acceptable for funding include purchasing property or easements which contribute to the protection or improvement of the natural ecosystem and water quality of a lake; restoring wetlands or lands draining to wetlands; and developing regulations and ordinances to protect lakes and the educational activities necessary for these regulations to be implemented.

(4) Wisconsin River Protection Grants

The Wisconsin River Protection grants are referenced under Chapter 281.70 State Statutes and under ch. NR 195 Wisconsin Administrative Code. Approximately $300,000 was available for annual appropriation in 2003 and is generated from the Wisconsin gas tax. Communities and nonprofit groups can receive state financial help to protect rivers under a project that aims to prevent water quality, fisheries habitat, and natural beauty from deteriorating as homes, recreation, industry, and other land uses increase along rivers. Ineligible projects include: dam repair and operations, purchase of property on which a dam is located unless for the purpose of dam removal, dredging, design, installation, operation or maintenance of sanitary sewers, treatment plants, or onsite sewerage systems, and others listed in application.

a. River Planning Grants

A maximum of $10,000 is available for eligible river planning grant projects. Up to 75% of the project may be reimbursed by the State. The following are eligible activities under the river planning grant program:

- River Organization Development
- Information and Education
- Assessment of Water Quality, Habitat, Use, Watersheds, and Shorelands
- Data Collecting
- Ordinance Development
- Plans and Strategies

b. River Management Grants

A maximum of $50,000 is available for eligible river management grant projects. Up to 75% of the project may be reimbursed as State Share. The following are eligible activities under the river management grant program:

- Acquisition & Easements
- Habitat Restoration
- Pollution control practices
- Ordinance Development
- Activities in Approved Plans

(5) Recreational Boating Facilities Grant Program

The Wisconsin DNR Recreational Boating Facilities Program is a 50/50 grant program. Grant funds can be used for boat landings/docks, sanitary facilities, parking lots, basic landscaping, and security lighting. Repairing an existing ramp is eligible, however, not very competitive with other grant applications. A major scoring criteria this program is introducing handicap accessibility. A boat landing (new or repaired) would require a handicap accessible dock and paced access to the dock from the parking lot. Applications are due quarterly.

(6) Stewardship Grant Program

The Wisconsin DNR provides funding for stewardship projects such as the following:

- Land acquisition
- Trails
- Restrooms
- Parking lots
- Picnic areas
- Handicap accessibility modifications

These funds are generated from the following programs:

1. Knowles-Nelson Stewardship Local Assistance Programs
    a. Aids for the Acquisition and Development of Local Parks (ADLP)
    b. Urban Green Space Grants (UGS)
    c. Urban Rivers Grants (UR)
    d. Acquisition of Development Rights Grants (ADR)

2. Federal Programs
    a. Land and Water Conservation Fund (LAWCON)
    b. Recreational Trails Act (RTA)

Application deadline is May 1 each year. Grants are extremely competitive. The Wisconsin DNR uses a detailed point system to fund the project and land acquisition project score the highest. Land acquisitions involve the following:

- An acquisition brochure must be given out at the first contact with the land owner.
- An appraisal is required by WDNR.

- If the grant is awarded, WDNR will pay on-half of the appraisal value.

B. State Land Trusts and Stewardship Programs

This voluntary program includes a stream bank component and an urban river component. Funds are available to public entities and provide non-profit organizations for property purchases from willing sellers, fencing, easements and public fishing areas. In addition, land trusts take on the permanent management responsibility of these lands and each project has clear public support in the community.

C. River Country Resource Conservation & Development Council, Inc. (RC & D)

The council is a non-profit organization representing 12 counties in rural development issues. It consists of one individual from each county board and one at-large member. The council receives funding from a base grant from the USDA, however being a non-profit, is able to obtain monies from other grant sources. RC & D has limited matching funds available for erosion control projects. Most often these monies are administered through the local County Soil and Water Conservation District. The team is currently focused on assisting the implementation of buffer strips to aid in erosion control projects.

E. Wisconsin Environmental Education Board (WEEB)

The Wisconsin Environmental Education Board (WEEB) was created by 1989 Act 299, becoming law in 1990. One of the Board's responsibilities is to award grants for the development, dissemination, and implementation of environmental education programs.

During the 2004-2005 grant cycle the WEEB anticipates allocating funds in five categories:

- WEEB identified initiatives
- General environmental education grants
- Forestry education grants
- School forest grants
- Mini-grants

7.4. Federal Grants

A. U.S. Army Corps of Engineers (ACOE)

(1) Section 22 Planning Assistance to States Programs

Funds are a 50/50 cost share. The program is administered through state planning (WDNR-Madison). Eligible projects are given to the COE to prepare a cost estimate which is negotiated with the "customer." The "customer" provides 50% cost share in the form of cash. The COE then completes the preliminary design or study.

(2) Aquatic Ecosystem Restoration Program

State, county, local, and tribal governments; and nonprofit conservation organizations are eligible to restore, improve, and protect aquatic habitat for plants, fish, and wildlife. RCLA may have to partner with the townships on this grant. Cost share requires the applicant to provide a 35% match with the financial and technical support up to $5,000,000 per project. Example projects include:

- Modification of dams to improve fish passage
- Removal of dams to improve fish passage
- Streambank stabilization – erosion control
- Reintroduction of more natural meander patterns into streams that have been channelized

B. U.S. Environmental Protection Agency (EPA)

(1) Environmental Education Grant

EPA's Office of Environmental Education supports environmental education projects that enhance the public's awareness, knowledge, and skills to make informed decisions that affect environmental quality. Grants of $25,000 or less in federal funds are awarded in EPA's ten regional offices, and grants over $25,000 are awarded at EPA Headquarters in Washington, D.C. Grantees must provide non-Federal matching funds of at least 25% of the total cost of the grant project. This may be cash or in-kind contributions. Colleges, universities, local and tribal education agencies, state education, environmental agencies, not-for-profit organizations, and non-commercial educational broadcasting entities are eligible to apply.

(2) Clean Lakes Grant

The federal Clean Lakes Grant is the next step in lake restoration following the State Lake Planning Grant Program. The program includes significantly more funding than the state program and can be used for development and implementation of lake restoration plans and activities.

(3) Section 319 – Clean Water Act

Funding through EPA's Section 319 program supports priority watershed projects but is also available for urban Best Management Practices and project implementation coordination. The grants program has a spring application period (May to June). The program is significant in that it funds implementation (i.e. construction) rather than planning efforts or studies. The funds are available as either full or matching funds.

C. U.S. Geological Survey (USGS)

The USGS provides funding for research, water resources data collection, data management, and information transfer activities.

D. U.S. Department of Agriculture (USDA)

(1) Environmental Quality Incentives Program

The Environmental Quality Incentives Program (EQIP) was established to provide a single, voluntary conservation program for farmers and ranchers to address significant natural resource needs and objectives. Nationally, it provides technical, financial, and educational assistance, half of it targeted to livestock-related natural resource concerns and the other half to more general conservation priorities. EQIP is available primarily in priority areas where there are significant natural resource concerns and objectives.

(2) Cooperative Forestry Assistance Programs

The Cooperative Forestry Assistance Act Programs help state foresters or equivalent agencies with forest stewardship programs intended to achieve ecosystem health and sustainability. Assistance is provided through the following programs: *Forest Stewardship Program*, which helps private forest landowners develop plans for sustainable forest management; *Stewardship Incentive Program*, which helps private landowners carry out their stewardship plans; *Economic Action Program*, which helps rural communities and businesses dependent on forest-based resources to become sustainable and self-sufficient; *Urban and Community Forestry Program*, which helps state and private forest resource managers protect against and suppress insects and disease; and *Cooperative Fire Protection Program*, which provides financial and technical assistance to protect state and private lands from wildfire.

(3) Water Quality Special Research Grants Program

This program teams the Cooperative State Research Education and Extension Service (CSREES) with multiple federal agencies. The program is targeted directly to the identification and resolution of agriculture-related degradation of water quality. Eligible proposals provide watershed-based information that can be used to assess sources of water quality impairment in targeted watersheds; develop and/or recommend options for continued improvement of water quality in targeted watersheds; and evaluate the relative costs and benefits associated with cleanup to all responsible sectors (e.g., farming, processing, urban runoff, municipal waste treatments). The program favors proposals that have a clear problem statement and are place-based. In addition, preference is given to projects that coordinate targeted research, education, and cooperative extension activities to minimize any adverse impacts that agricultural, forest, and range management practices, food and agricultural product processing, and/or livestock production systems might have on the nation's water quality.

(4) Water and Waste Disposal Systems for Rural Communities

This program provides monies to provide basic human amenities, alleviate health hazards, and promote the orderly growth of the rural areas of the nation by meeting the need for new and improved rural water and waste disposal facilities. Funds may be used for the installation, repair, improvement, or expansion of a rural water facility, including costs of distribution lines and well pumping facilities. Funds also support the installation, repair, improvement, or expansion of a rural waste disposal facility, including the collection and treatment of sanitary waste stream, storm water, and solid wastes.

E. Wallop-Breaux Funds

The Wallop-Breaux program refers to the 1984 amendments to the Dingell-Johnson program and is named for its primary sponsors, Senator Malcolm Wallop (R-WY) and Senator John Breaux (D-LA). Its formal name is the Aquatic Resources Trust Fund, of which part is used for sport fishing enhancement ($215.3 million, in 1992) and part is used for boating safety in each state ($70 million, in 1992). Wallop-Breaux is an example of a user-pays/user-benefits program, where taxes on activity are strictly reinvested back into the activity's maintenance.

To obtain Wallop-Breaux funds, a state sends a proposal to the U. S. Fish and Wildlife Service office in its region. The project must be "substantial in character and design," but there is no requirement that the project directly benefits sport fishermen. In 1991, 32.4 percent went to surveys and research. The rest of the $12 million a year in administrative money is used for various special projects.

F. Water Quality: A Catalog of Related Federal Programs

This catalog briefly describes water quality related programs that offer financial assistance, as well as technical assistance, planning, or advisory services, studies, and education. To request a copy, see http://www.gao.gov/AIndexFY96/abstracts/rc96173.htm.

G. National Park Service, Department of Interior

The objectives of this program are to provide Federal grants to local governments for the rehabilitation of recreation areas and facilities, demonstration of innovative approaches to improve park system management and recreation opportunities, and development of improved recreation planning.

H. U.S. Department of Fish and Wildlife

County, local, and tribal governments; private landowners; nonprofit conservation organizations are eligible to apply for this federal grant that has the purposes to:

- Restore wetlands, stream and river corridors, and other fish and wildlife habitats important for Federal trust species (threatened and endangered species, anadromous fish, and some marine mammals)

- Develop partnerships to implement these habitat restoration projects
- Demonstrate applied technology for habitat restoration projects to help the public understand and participate in fish and wildlife resource conservation.

The financial and technical assistance typically is $10,000 or less per project. However, sometimes larger projects funded. Depending on the available funds and type of project the cost share varies. The following are example projects:

- Restoration of degraded wetlands
- Stream restoration
- Restoration of endangered or threatened species habitat
- Dam removal