

HARVEYS LAKE TMDL

Prepared by the Pennsylvania Department of Environmental Protection
Water Management Program

March 1, 2002

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Attachments

Attachment A	Phase 1 Clean Lakes Study by Coastal Environmental Services
Attachment B	Carlson's Trophic Status Index paper
Attachment C	Clean Lakes Regulations 40CFR Part 31 and Part 35, Subpart H
Attachment D	Excerpt from PADEP Guidance "Implementation Guidance for Section 95.6 Management of Point Source Phosphorus Discharges to Lakes, Ponds, and Impoundment's"
Attachment E	Princeton Hydro Report (August 2001)
Attachment F	Equal Marginal Percent Reduction (EMPR) Reduction Strategy
Attachment G	Comment and Response Document

TMDL for Harveys Lake

Introduction

This TMDL document for Harveys Lake was completed to address the impairments noted on the PA 1996 303(d) list.

*1996 Section 303(d) Listing for Harveys Lake			
Data Source	Source	Cause	Priority
Clean Lakes Project **	On-site Waste	Nutrients	Medium
Clean Lakes Project	Other nonpoint sources	Suspended Solids	Medium

* There was no change to the listing for Harveys Lake in the PA 1998 303(d) list

**The Clean Lakes Project report was prepared by Coastal Environmental Services through an EPA grant.

The Phase I Diagnostic Feasibility Study conducted by Coastal Environmental in 1994, identified Harveys Lake as impaired due to large algae blooms and localized sedimentation problems. Sediment problems are due to deposition from overland runoff as well as streambank and shoreline erosion. The large algae blooms are due to the excessive nutrients available in the water column in Harveys Lake. The algae blooms are intensified by the lack of large-bodied zooplankton due to over population of alewife, a planktivorous fish.

The inclusion of suspending solids as an impairment to Harveys Lake is not reflective of the entire waterbody. The Clean Lakes Study discusses sediment accumulation as only localized in certain areas around the shoreline of the lake. For example, Page 6 of the study mentions sedimentation near the public boat ramp and the lake outlet and then summarizes that “sediment accumulation in other areas are not of immediate concern.” Also, on Page 11, it states that “Localized sedimentation has also been a problem for Harveys Lake” as it pertained to runoff from the lake road. The study also found in-lake TSS concentrations in the epilimnion and hypolimnion of 1.03 and 1.69 mg/l, respectively. EPA research (Water Quality Criteria; 1972) suggests that TSS concentrations at 25 mg/l and below allow aquatic communities a high level of protection. Since the sediment problems are not occurring within the entire waterbody, including suspended solids within this TMDL is not warranted.

PA does not currently have water quality criteria for nutrients. For this reason, Carlson's Trophic Status Index (TSI) is used as the indicator of lake water quality. TSI analysis is used to determine the necessary phosphorus reduction targets for this TMDL. Since Harveys Lake is a phosphorus limited lake (TN to TP ratio > 20, see Attachment A), the established relationship between in-lake phosphorus concentration and TSI was used to estimate the load reductions required to meet the water quality objectives. A TSI value of 50 is used as the cutoff between a eutrophic and mesotrophic lake, so in this TMDL the target is a TSI value of 50.

Background

Harveys Lake is the largest natural lake, by volume, in the Commonwealth of Pennsylvania and is located in the Borough of Harveys Lake, Luzerne County. It has been a popular recreational lake since the late 1800's and is used for fishing, swimming, and boating. Its shoreline is unusual in that a paved

road encompasses the lake along the shore with most of the homes and cottages located across the roadway, opposite the lake. Harveys Lake has been designated for protection as a Cold Water Fishery (CWF).

Lake studies conducted in the 1980s and early 1990s concluded that the lake is moderately eutrophic. An algae bloom occurred in 1981 that closed the lake to swimming and another bloom occurred in 1990.

The lake is one of the most heavily used lakes in the area.

TMDL Endpoints

Pennsylvania does not currently have numeric water quality criteria for nutrients. For this reason, the Carlson Trophic Status Index (TSI) is used as the indicator of lake water quality (Attachment A). The TSI is a ranking based on three measured parameters, total phosphorus, chlorophyll-a, and Secchi disc (Pa. DEP, 1999).

All pollutant contributions to Harveys Lake are from non-point sources. The TMDL target value for phosphorus is determined by the calculation the water column concentration that is needed to obtain a TSI value of fifty. TSI of fifty (50) represents the boundary condition in Carlson’s index between mesotrophic and eutrophic lakes. Achieving mesotrophic status would be consistent with water quality standards for Harveys Lake.

$$TSI = 14.42 * \ln(1000 * [Total P]) + 4.15$$

Data Compilation

Lake water samples were collected bimonthly from May 1993 to August 1993, and monthly from September 1993 to March 1994. Samples were collected at one station from the surface to the bottom at four-meter intervals and at another station at five-meter intervals. Watershed samples were taken during both wet and dry conditions. All Clean Lakes projects follow the Clean Lakes Program requirements for temporal and spatial sampling, and parameters to be sampled (40 CFR Part 35 Subpart H and 40 CFR Part 31 attached as attachment C). The diagnostic/feasibility study performed in this watershed was a Clean Lakes Phase I study funded under Section 314 of the Federal Clean Water Act. Table 1 shows Lake data used in the TMDL development.

Table 1. Lake data used for TSI computations.

Data	Value	Source
Lake Type	Anoxic	Attached excerpt from Lake Guidance
Lake Status	Regular	There is no special protection designation for this lake
Existing P Conc.	0.031 mg/l	This was the computed average of current sampling in May 2001 and that of the Clean Lakes Phase I.
Hydraulic Residence Time	1,116 days	Info from Phase 1 Lake study(average value)
Surface Area	621.5 acres	Info from Phase 1 Lake study(average value)
Mean Depth	11 meters	Info from Phase 1 Lake study(average value)

Biomonitoring was completed on Harveys Lake and included chlorophyll a, phyto- and zooplankton densities, and an assessment of the fisheries.

Phosphorus was found to be the limiting nutrient in the lake (Attachment A). The lake is eutrophic at present with elevated phosphorus levels.

Derivation of Loading Values and TMDL Computations for Phosphorus

The TMDL was computed by the following methods.

1. An existing TSI and Phosphorus loading were computed using the equations contained in the Lake for Windows program "TSI Only" option (see attachment D, excerpt from the Implementation Guidance for Section 95.6-Management of Point Source Phosphorus Discharges to Lakes, Ponds, and Impoundments showing the Reckhow Models and the TSI equation). Refer to page 11 to the TSI analysis titled, "Current Conditions".

Scenario	In-Lake P concentration	TSI	Load(lb/yr)
Current Conditions	0.031	53.7	1,019
Target TMDL	0.024	50.0	789

Watershed loading values were acquired from the AVGWLF model for various sources including farmland, commercial/residential, forest, groundwater and unpaved roads. The AVGWLF model was calibrated using the total phosphorus load to the lake as calculated by the Lake Model minus an internal load.

The internal load was assumed to be 25% of the total calculated load ($0.25 \times 1,019 = 255$).

While erosion of the shoreline around Harveys Lake is a major contributor of both solids and phosphorus in localized areas, it is not calculated by AVGWLF. Although AVGWLF does calculate a load from streambank erosion, it does not calculate a load from lake shoreline. The phosphorus load contributed to Harveys Lake from the shoreline surrounding the lake and the tributaries to the lake was set to 150 lb/yr.

Harveys Lake also receives phosphorus contributions from on-site septic systems. The estimate of 33 lb/yr was taken from the Phase I Diagnostic/Feasibility Study of Harveys Lake. This study accounted for septic systems within 330 feet of either the lake shoreline or a tributary, per EPA established criteria, and a per capita phosphorus loading coefficient.

Summing all loads from GWLF and the estimated contributions from internal loading, lake shoreline and septic systems discussed above gives a total current load to the lake of 1,019 lbs TP/yr. These loads are shown below in Table 3.

A 10% Margin of Safety (MOS) was initially taken from the computed TMDL Target Load. There are no point sources in the watershed, so the WLA is set to zero.

$$\begin{aligned} \text{TMDL} &= \text{LA} + \text{WLA} + \text{MOS} \\ \text{MOS} &= 0.10 * \text{TMDL Target} \\ \text{MOS} &= 0.10 * 789 = 79 \text{ lbs} \end{aligned}$$

So:

$$\begin{aligned} \text{LA} &= \text{TMDL Target} - (\text{MOS} + \text{WLA}) \\ 710 &= 789 - (79 + 0) \end{aligned}$$

The Equal Marginal Percent Removal (EMPR) method was applied to determine the allowable loads from each source required to meet the TMDL target goal (MOS taken out) of 710 lbs TP/yr. These target loads for each land use along with the percent reduction required to meet them are also shown in Table 3.

Table 3. Annual Phosphorus Loading Values (lb/yr)				
Land Use Category	Area (ac)	TOTAL PHOSPHORUS		
		current load (lb/yr)	TMDL Target (lb/yr)	% reduction annual P load
Farmland	154.7	95	53	44.2
Forest	2841	51	51	0
Developed	499	199	111	44.2
Septic	N/A	33	33	0
Unpaved Roads	2.5	3.4	3.4	0
Internal Loading	N/A	255	142	44.2
Streambank Erosion	N/A	150	84	44.2
Groundwater	N/A	233	233	0
Totals	3,541	1,019	710	30

Tables 4 and 5 provide a summary of the TMDL for total phosphorus.

Table 4. Summary of Calculated Load Reduction		
Parameter	Existing Load (lb/yr)	TMDL Load (lb/yr)
Total Phosphorus	1,019	789

Table 5. Total Maximum Daily Load Breakdown				
Parameter	LA (lb/yr)	WLA (lb/yr)	MOS (lb/yr)	TMDL
Total Phosphorus	710	0	79	789

Consideration of Critical Conditions

It is not practical with existing data and resources to explicitly consider critical conditions in terms of both pollutant loading and in-lake conditions. Such an explicit approach would require continuous model simulation of the watershed and lake. Further, by expressing the TMDLs for nutrients as annual loads, both the storm loads and the dry weather loads have been implicitly included. Given that there is generally a significant lag time between the introduction of nutrients to a waterbody and the resulting impact on beneficial uses, establishing this TMDL using average annual conditions is protective.

Consideration of Seasonal Variation

As stated in the *Critical Conditions* section, annual loads consider both storm and dry weather loads. Algal blooms have been documented to be a problem during the late summer months, generally characterized by drier seasonal conditions, or low flow conditions. Therefore, this TMDL implicitly considers seasonal variation by expressing the load as an annual average. The annual load encompasses both storm flow and dry weather loads associated with different seasons.

Recommendations

TMDLs represent an attempt to quantify the pollutant load that may be present in a waterbody and still ensure attainment and maintenance of water quality standards. The Harveys Lake Watershed TMDLs identify the necessary overall load reductions for those pollutants currently causing use impairments and distribute those reduction goals to the appropriate nonpoint sources. Reaching the reduction goals established by these TMDLs will only occur through changes in current land use practices, including the incorporation of more agricultural “best management practices” (BMPs). BMPs that would be helpful in lowering the amount of sediment and nutrients reaching Harveys Lake Watershed include stream bank fencing, riparian buffer strips, strip cropping, contour plowing, conservation crop rotation, and heavy use area protection, among many others.

The Natural Resources Conservation Service maintains a National Handbook of Conservation Practices (NHCP), which provides information on a variety of BMPs. The NHCP is available online at http://www.ftw.nrcs.usda.gov/nhcp_2.html. Many of the practices described in the handbook could be used on agricultural lands in Harveys Lake Watershed to help limit siltation and nutrient impairments. Determining the most appropriate BMPs, where they should be installed, and actually putting them into practice, will require the development and implementation of a comprehensive watershed restoration plan. Development of any restoration plan will involve the gathering of site-specific information regarding current land uses and existing conservation practices. The required level of detail is outside the scope of this TMDL document and is an activity best accomplished at the local level. Successful implementation of the activities necessary to address current use impairments to Harveys Lake Watershed will require local citizens taking an active interest in the watershed and the enthusiastic cooperation of local landowners.

By developing TMDLs for the Harveys Lake Watershed, the Department has set the stage for local citizens to design and implement restoration plans to correct current use impairments. The Department will support local efforts to develop and implement watershed restoration plans based on the reduction goals specified in the TMDLs. Interested parties should contact the appropriate Watershed Manager in

the Department's North East Regional Office ((570) 826-2368) for information regarding technical and financial assistance currently available. Individuals and/or local watershed groups interested in "fixing" the identified problems in the Harveys Lake Watershed are strongly encouraged to avail themselves of funding sources available through DEP and other state and federal agencies (e.g., Growing Greener or 319 Program).

The recommendations contained in the Phase I Clean Lakes Study completed by Coastal Environmental Services in 1994 will be the basis for remediation activities at Harveys Lake. The following list of tasks have been identified as key elements for restoration of the lake.

Task	Description
1	Fish Survey
2	Fish Stocking
3	Dredging of Boat Launch Area
4	Public Education Program/Nonstructural BMPs
5	Implementation of a Septic Management Program
6	Phase II Monitoring
7	Project Documentation
8	Catch Basin Upgrades
9	Dredging of Outlet Cove
10	Dredging of Northwestern Corner of Lake
11	De-Icing Management
12	Hypolimnetic Aeration

A recommendation was made in the Phase I report that fish surveys and a fish stocking program be implemented to control alewife populations in the lake to reduce nuisance algal blooms. Although we agree that fish surveys are necessary to document any imbalances in the system that may exist, a biomanipulation study detailing potential impacts of stocking non-native game fish in Harveys Lake must be completed before any such stocking takes place. It has been suggested that there are potential risks involved in any biomanipulation process and this may not be beneficial for Harveys Lake.

Replacement of existing catch basins with water quality inlets is highly recommended. A public education program focusing on non-structural BMPs, including alternative landscaping, fertilizing, and pesticide management should be implemented to promote awareness of lake and watershed interactions.

The Clean Lakes Study has identified other sources of nutrient runoff that needs to be addressed. Runoff from residential and commercial land use areas need to be addressed along with other land use categories targeted for load reductions. To support this effort, education of the public concerning nutrient and sediment runoff needs to occur.

Implementation of the remediation plan has begun with the approval of a \$100,000 grant from the Pennsylvania Nonpoint Source Program to the Harveys Lake Environmental Advisory Council and Harveys Lake Borough. This project will begin to implement some of the tasks identified in the restoration plan listed above.

Public Participation

Public notice of the draft TMDL was published in the *Pennsylvania Bulletin* and local newspapers with a 60-day comment period that ended on February 12, 2003. A public meeting was held concurrent to these published notices at the Harveys Lake General Municipal Authority to discuss the proposed TMDL plan. Notice of final plan approval will be published in the *PA Bulletin*.

Current Conditions

LAKE for Windows: Lake TSI Evaluation

Lake Name: Harveys Lake

Type: Anoxic

Status: Regular

**Existing Phosphorus
Concentration (mg/l):** 0.031

Residence Time (days): 1116

Surface Area (acres): 621.5

Mean Depth (meters): 11

Comment: Lake is currently Eutrophic.

Expected TSI: 53.67

Expected Load: 1.64 lb/lake-acre/yr

$$1.64 * 621.5 = 1,019 \text{ lb/yr}$$

TSI 50

LAKE for Windows: Lake TSI Evaluation

Lake Name: Harveys Lake

Type: Anoxic

Status: Regular

**Existing Phosphorous
Concentration (mg/l):** 0.024

Residence Time (days): 1116

Surface Area (acres): 621.5

Mean Depth (meters): 11

Comment: Lake is currently mesotrophic.

Expected TSI: 49.98

Expected Load: 1.27 lb/lake-acre/yr

$1.27 * 621.5 = 789 \text{ lb/yr}$



Princeton
Hydro, LLC
80 Lambert Lane
Lambertville, NJ 08530

6 August 2001

Mr. Edward Kelly, Council President
Borough of Harveys Lake
P.O. Box 60
Harveys Lake, PA 18618

Dear Mr. Kelly:

This letter summarizes the water quality monitoring activities that were conducted at Harveys Lake on 22 May 2001. Harveys Lake had a slightly brownish tinge during the 22 May 2001 sampling event. This color was the result of moderate bloom of diatoms. This was confirmed through an examination of the water samples collected during the 22 May sampling event.

Harveys Lake was already thermally stratified during the 22 May 2001 sampling event. Through the course of the growing season (April through September), the temperature of the surface waters will increase at a higher rate relative to the bottom waters. Eventually, temperature differences became large enough to prevent mixing between the surface and bottom waters as a result of density differences. At Harveys Lake, the surface waters (from the surface to about 13 feet) were separated from the deeper waters (> 26 feet) by a large change in temperature with depth (between 13 and 26 feet). This thermal stratification, a sharp change in water temperature with depth, is displayed in Table 1.

Harveys Lake was well oxygenated (DO concentrations > 4 mg/l) from surface to bottom at both sampling stations. These high DO concentrations, even in the bottom waters which were thermally separated from the surface waters, were the result of low water temperatures and the large amount of water that enters the lake via groundwater. Based on the recorded temperatures and DO concentrations, Harveys Lake provided acceptable habitat for cold-water fish species (i.e. trout) through its entire water column during the 22 May 2001 sampling event.

The pH in Harveys Lake varied from slightly alkaline (7.2 to 7.9) in the bottom waters to highly alkaline (> 8.5) in the surface waters (Table 1). The elevated pH in the surface waters of the lake was the result of high rates of algal productivity (i.e. growth). In spite of these elevated surface water pH readings, the range of pH within Harveys Lake was still considered favorable. The optimal pH range for most aquatic organisms is within 6.0 to 9.0.

Conductivity is a measurement of the capacity of water to carry an electrical current. It can also be used as a measure of dissolved substances (i.e. nutrients) in water. The conductivity of Harveys Lake varied from 0.1988 to 0.2776 mmhos/cm, with the bottom water conductivities being higher than the surface water values (Table 1). Such results are typical, since both dissolved and particulate material will accumulate in the bottom water during thermal stratification. In addition, algae in the surface waters will assimilate dissolved nutrients and contribute toward reducing the conductivity in this portion of the water column.

In-lake, inlet and outlet fecal coliform counts were all below the State standard of 200 colonies per 100 mls of filtered water. However, it should be noted that fecal coliform entering the lake from Inlet 2 (the stream between the Fish Commission Boat Launch and the Harveys Lake Beach Club) was the only sampling station that had a fecal coliform count above 1 colony per 100 mls of filtered water (Table 1). Fecal streptococcus counts were less than 4 colonies per 100 mls of filtered water at all four sampling stations.

The in-lake total phosphorus (TP) concentration measured on 22 May 2001 was 0.014 mg/l (Table 2). This concentration is considered low; based on US EPA criteria, eutrophic (highly productive) lakes tend to have TP concentrations equal to or greater than 0.03 mg/l. Based on Princeton Hydro's in-house database of Mid-Atlantic lakes, TP concentrations greater than 0.06 mg/l typically result in aesthetically displeasing algal blooms. In any event, the Harveys Lake TP concentration was low during the 22 May 2001 sampling event.

In contrast to in-lake TP concentrations, inlet concentrations were moderately high. Inlet 1 and Inlet 2 TP concentrations were 0.028 and 0.33 mg/l, respectively (Table 2). In contrast, outlet TP concentrations were lower than the inlet concentrations. The TP data indicate that a large portion of the phosphorus that fuels algal growth originates from the watershed and is transported to the lake through the inlets. In addition, the lake functions as a "sink" of phosphorus for Harveys Creek, the outlet of Harveys Lake.

The in-lake ortho-phosphorus (OP) concentration was also low. OP represents the dissolved, inorganic phosphorus fraction of the total available phosphorus. If TP represents "food" for algae, OP represents "candy". In other words, the algae will assimilate OP before any other forms of phosphorus.

Nitrate+nitrite-N concentrations were low, while ammonia-N concentrations were moderate. The moderate ammonia-N concentration will decline in the surface waters of Harveys Lake through the course of the summer season, as a result of algal uptake of this nutrient.

Total suspended solids (TSS) represents the amount of “dirt” in the water. TSS concentrations greater than 25 mg/l are considered unacceptable in terms of aesthetics, recreational use and associated ecological impacts. The in-lake, inlet and outlet TSS concentrations were all well below the 20 mg/l threshold. Thus, no negative TSS impacts were identified during the 22 May 2001 sampling event.

A whole lake water sample collected from Harveys Lake revealed that the open water algal community was dominated by diatoms, a group of algae that do not tend to produce surface scums. These algae are considered “good” since some species are a direct source of food for other aquatic organisms. Diatoms tend to bloom in the spring and decline in numbers through the summer. No nuisance blue-green algae were identified in the open waters of Harveys Lake during the 22 May 2001 monitoring event.

Zooplankton are micro-animals that live in the open waters of lakes and ponds. Many zooplankton are a source of food for forage or young game fish. Some types of zooplankton are also herbivorous (eat algae) and thus can provide a natural means of controlling excessive algal growth. Therefore, given the role these organisms play in the aquatic food webs, Princeton Hydro’s monitoring program included sampling for zooplankton.

Based on samples collected from the surface and deep waters during the 22 May 2001 sampling event, rotifers were the dominant type of zooplankton in Harveys Lake. This group of zooplankton tends to feed on bacteria, detritus and each other. In addition, no herbivorous (algae eating) zooplankton were identified in Harveys Lake at this time.

As identified during previous monitoring events of Harveys Lake, the distribution of rooted aquatic plants were limited to immediately along the shoreline due to the lake’s steep bathymetry. In spite of this, there are a few areas within Harveys Lake that are susceptible to high amounts of aquatic plant growth. One of these areas includes the Marina.

During the 22 May 2001 sampling event, a few stands of broad-leaved pondweed (*Potamogeton amphifolius*), fanwort (*Cabomba caroliniana*) and a native species of milfoil (*Myriophyllum exalbescens*) were identified within the Marina area. At this time, none of the identified plant species were at nuisance levels, however, it should be emphasized that fanwort is a highly aggressive, exotic species that can easily attain nuisance levels late in the summer season (i.e. August and September).

In addition to the rooted aquatic plants, a deep water benthic alga was identified along the bottom just beyond or out of the Marina area. This benthic alga was the blue-green alga *Lyngbya sp.* and formed a carpet along the bottom. This alga prefers deeper waters, however, wind, wave and boat action can easily transport these “mats” to the surface where they can become a nuisance in terms of aesthetics and recreation. Princeton Hydro will continue to closely monitor the development of the weed and algal community in and around the Marina, through the course of the summer season.

To summarize, overall water quality conditions in the spring of this year were acceptable in Harveys Lake. While the lake was beginning to thermally stratify, the water column was well oxygenated from surface to bottom. In-lake nutrient and TSS concentrations were generally low, however, elevated TP concentrations entering Harveys Lake, from inlets 1 and 2, indicate that watershed-based activities account for a large proportion of the lake's phosphorus load.

The open waters were dominated by diatoms, a group of algae that blooms in the spring and does not produce surface scums. Algal species that produce surface scums, the blue-green algae, were not identified in Harveys Lake during the 22 May 2001 sampling event. No herbivorous (algae eating) zooplankton were identified in the surface or bottom waters of Harveys Lake. Some potentially nuisance aquatic plants and algae were identified in the Marina area of the lake, however, these organisms did not attain nuisance levels at this time.

Princeton Hydro will continue to closely monitor the water quality of Harveys Lake through the course of the summer season. We are tentatively scheduled to conduct our next in-lake sampling event on 9 August 2001 (this Thursday). As always, if you have any questions or comments to the project feel free to contact our Lambertville office at (609) 397-5335. Thank you for your time.

Sincerely,

Fred S. Lubnow, Ph.D.
Project Manager

c: M. Daley, Harveys Lake Environmental Advisory Council
R. L. Wagner, Division Chief
R. Pitscavage, Northeast Regional Office, PA DEP
B. Lathrop, PA DEP

21-45

TABLE 1

In-situ data collected at Harveys Lake (Station 1) on 22 May 2001

Depth (m)	Temperature (°C)	Dissolved Oxygen (mg/L)	pH (units)	Conductivity (mmhos/cm)
0.5	16.24	10.11	9.00	0.2081
1.0	15.89	10.15	9.02	0.2069
2.0	15.67	10.11	9.00	0.2055
3.0	15.61	10.04	8.95	0.2030
4.0	15.43	10.11	8.86	0.1992
5.0	13.98	11.22	8.90	0.1996
6.0	11.85	12.32	8.90	0.2032
7.0	9.07	12.88	8.52	0.2144
8.0	7.90	12.07	7.39	0.2176
9.0	7.24	10.72	7.24	0.2211
10.	6.99	10.49	7.21	0.2226
11.0	6.84	10.23	7.21	0.2236
12.0	6.56	10.13	7.21	0.2260
13.0	6.55	10.03	7.21	0.2268
14.0	6.42	10.00	7.22	0.2291
15.0	6.36	9.90	7.22	0.2309
16.0	6.34	10.02	7.23	0.2347
17.0	6.24	9.97	7.24	0.2396
18.0	6.17	9.84	7.26	0.2425
19.0	6.11	10.03	7.27	0.2460
20.0	6.10	10.06	7.29	0.2493
21.0	6.04	10.04	7.31	0.2522
22.0	6.02	10.07	7.33	0.2556
23.0	6.00	10.22	7.37	0.2598
24.0	5.98	10.25	7.39	0.2632
25.0	5.95	10.24	7.41	0.2671
26.0	5.90	10.08	7.43	0.2712
27.0	5.90	10.10	7.46	0.2776

Secchi depth = 2.1 meters (fe6.9et)

TABLE 1***In-situ* data collected at Harveys Lake (Station 2) on 22 May 2001**

Depth (m)	Temperature (°C)	Dissolved Oxygen (mg/L)	pH (units)	Conductivity (mmhos/cm)
0.5	15.68	10.84	8.99	0.2075
1.0	15.51	10.71	8.99	0.2059
2.0	15.43	10.70	8.98	0.2047
3.0	15.35	10.69	8.87	0.2010
4.0	15.28	10.56	8.78	0.1990
5.0	14.48	11.11	8.70	0.1988
6.0	12.15	12.79	8.71	0.2037
7.0	8.11	12.81	7.46	0.2154
8.0	7.40	11.82	7.30	0.2196
9.0	7.00	11.49	7.28	0.2233
10.	6.83	11.60	7.29	0.2271
11.0	6.68	11.43	7.31	0.2306
12.0	6.59	11.69	7.35	0.2340
13.0	6.53	11.75	7.38	0.2377
14.0	6.43	12.02	7.43	0.2433
15.0	6.36	12.49	7.70	0.2655

Secchi depth = 2.2 meters (7.3 feet)

TABLE 2**Discrete data collected at Harveys Lake on 22 May 2001**

Parameter	In-lake	Inlet 1	Inlet 2	Outlet
Fecal Coliform (colonies per 100 mls)	1	< 2	20	1
Fecal Streptococcus (colonies per 100 mls)	1	< 4	< 2	< 2
Total Phosphorus (mg / L)	0.014	0.028	0.033	0.016
Ortho Phosphorus (mg / L)	0.010	Not Sampled	Not Sampled	Not Sampled
TKN (mg / L)	0.19	Not Sampled	Not Sampled	Not Sampled
Nitrate+nitrite-N (mg / L)	0.09	Not Sampled	Not Sampled	Not Sampled
Ammonia-N (mg / L)	0.05	Not Sampled	Not Sampled	Not Sampled
Total Suspended Solids (mg / L)	1	5	4	4.5

Comment and Response Document

- Comment:** Please expand the problem definition to elaborate on why nutrients and sediments are a problem in Harveys Lake. Also, discuss how the proliferation of alewife in Harveys Lake has affected the water quality and/or designated use of the lake. The fecal coliform problems should be mentioned, as well, with a brief discussion of how they will be addressed in the future. (1)
- Response:** Comment addressed in document text.
Currently Harveys Lake is not listed on the 303(d) list as being impaired due to fecal coliform. If sufficient data become available to list Harveys Lake as impaired by fecal coliforms, that impairment will be addressed in the future.
- Comment:** It is our understanding that the historical sediment problem in Harveys Lake is localized sediment accumulation rather than total suspended solids (TSS), and that the initial TSS listing in 1996 was probably an administrative error resulting from limited categories for classifying pollution sources. If so, then this should be mentioned. PADEP should discuss whether the sedimentation has impacted the designated use of Harveys Lake. (1)
- Response:** A detailed discussion of this issue appeared in the Introduction section of the TMDL.
- Comment:** Consider including East Fork Harveys Creek in the TMDL analysis. (1)
- Response:** East Fork Harveys Creek has been surveyed and deemed impaired; however, it will not be included in this TMDL report. At this point, the source/cause of the impairment in the East Fork is not well understood. East Fork Harveys Creek on the Section 303(d) list for Organic Enrichment/Low D.O. from natural sources and “other” sources. More time is needed to fully understand the causes of impairment in the East Fork before a TMDL is completed.
- Comment:** Include the official designated use for Harveys Lake. (1)
- Response:** Comment addressed in document text.
- Comment:** Discuss the rationale for selecting a Trophic Status Index (TSI) value of 50 in terms of the current trophic status of the lake and how the future trophic status (TSI = 50) will be expected to meet water quality standards and protect the Lake’s designated use. (1)
- Response:** Comment addressed in document text.
- Comment:** Suggest including the TSI equation as a function of total phosphorus. (1)
- Response:** Comment addressed in document text.
- Comment:** We recognize that PADEP’s listing procedure uses the descriptor “nutrients” as a pollutant cause and that low dissolved oxygen (D.O.) is not listed specifically as an impairment. However, the report should discuss how this TMDL will address any other nutrient-related

problems in Harveys Lake, such as low D.O. conditions, to the extent they are not naturally occurring. (1)

Response: The comment does not correctly state Pennsylvania's listing procedure. If dissolved oxygen problems are documented (i.e. D.O. concentrations below criteria in the surface mixed layer), the lake is listed for a D.O. impairment. However, no oxygen depletion in the epilimnion was documented in Harveys Lake; therefore, the TMDL will not speculate as to how D.O. will be affected by the nutrient reductions prescribed by the TMDL.

Comment: Include the results of the May 2001 sampling and any other sampling efforts since 1994. Present a data summary for TN, TP, chlorophyll-a, dissolved oxygen, and any other relevant parameters. Mention for what the samples were analyzed. (1)

Response: Attached as an appendix

Comment: Discuss the derivation of the Margin of Safety (i.e. 10% of the total TMDL estimate). It may be confusing where the TMDL target goal is alternately listed as 710 and 789 lb/yr. (1)

Response: Comment addressed in document text.

Comment: Explain the connection between the estimates of current/future TSI as determined using the LAKE model and the current/future watershed loading estimates from the AVGWLF model. Show the units on the LAKE loads shown on pages 9-10 (lb/ac/yr) and show the conversion to lb/yr in Table 2. (1)

Response: Comment addressed in document text.

Comment: Explain why no phosphorus reductions are targeted for the low and high intensity development land use areas. (1)

Response: Document has been changed to address this comment.

Comment: Discuss how follow-up monitoring will be performed to track the effectiveness of control measures. (1)

Response: Current section 319 grant projects on Harveys Lake include monitoring plans.

Comment: Who will be responsible for full funding and implementing control measures? Although not required for nonpoint source-only TMDLs, can PADEP provide reasonable assurances that these control measures will achieve the targeted phosphorus load reductions and resolve the sedimentation problems? (1)

Response: PADEP provides grant funding for implementation of TMDLs through a variety of programs.

Comment: As part of the Phase I Diagnostic / Feasibility Study of Harvey's Lake (Coastal 1994), the Unit Areal Loading (UAL) model was used to quantify the non-point source (NPS) pollutant loads originating from surface runoff. In contrast, the AVGWLF model, developed by the Pennsylvania State University, was used to model surface runoff as part of the development of the TMDL. The more detailed components of the AVGWLF model (i.e. unpaved roads, streambank erosion) have the capacity to provide a more detailed assessment of the watershed-based sources of NPS. Thus, the selection of the AVGWLF model was a good choice in developing the TMDL for Harvey's Lake. (2)

Response: Thank you.

Comment: It was estimated as part of the Phase I study that approximately 200 to 300 homes within the Harveys Lake watershed have on-site wastewater disposal systems (i.e. septic systems). However, as based on criteria established by USEPA, only those septic systems that are located within 330 feet of either the lake shoreline or an associated tributary are considered to be net sources of phosphorus for the lake. Based on these criteria, only 20 septic systems can be considered as net sources of phosphorus for the lake. Thus, based on these conditions, the septic contribution to Harveys Lake was estimated to be 33 lbs per year. In contrast, the phosphorus load calculated for the Harveys Lake TMDL was 100 lbs per year. This estimate may be based on including all of the existing septic systems within the watershed, instead of those located within 330 feet of the shoreline or an associated tributary. (2)

Response: AVGWLF uses an empirical calculation based on total number of systems in the watershed and an assumption regarding the percentage of those systems that are not functioning properly. The TMDL has been adjusted to reflect the more detailed conditions under which a system is considered a net source of phosphorus to the lake.

Comment: Another issue of concern was the phosphorus load originating from the various types of land within the watershed. Under the TMDL analysis high intensity development, which was assumed to be commercial land accounted for only 2% of the land area and less than 0.05% of the annual surface runoff phosphorus load. This estimated phosphorus load, originating from land with impervious surfaces, seems unusually low. Another important component to the on-site conditions within the Harveys Lake watershed is that the vast majority of the commercial and residential land is located immediately adjacent to the lake. Such conditions exacerbate the impact of the NPS pollutant loads generated from these land types, since this is little or no opportunity of reducing these loads prior to them entering the lake. (2)

Response: One drawback to the AVGWLF model is that it has no spatial component associated with any given landuse. The model estimates the area of each land use, but the location of those areas are not taken into account. Your point regarding the commercial and residential land being directly adjacent to the lake is valid and appreciated, adjustments were made to account for discrepancies between model estimates of the area and phosphorus contribution of commercial and residential land in the Harveys Lake watershed.

Comment: One component of the draft TMDL that was not addressed in the Phase I study was streambank erosion. Based on existing conditions, this component of the watershed was required and should be included in the overall implementation plan for the lake and watershed. Also, the internal load calculated under the TMDL was similar to the internal load calculated under the Phase 1 study. In addition, the selected TMDL endpoint of the phosphorus TSI for the lake certainly seems appropriate, as does the targeted reduction of approximately 200 lbs of phosphorus per year. However, I strongly feel that the bulk of the watershed-based phosphorus is originating from developed land and not farmland. (2)

Response: Thank you for the supporting comments. We have addressed your concerns regarding the loads contributed by different land uses in the revised TMDL document.

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