Penn Lake Water Quality Summary
February, 2010

Penn Lake, Luzerne County, was sampled by Rocco Casarella with assistance from Pa. DEP staff. Sampling was conducted through the Pennsylvania Department of Environmental Protection's Citizens' Volunteer Monitoring Program (CVMP) in April, August and October, 2009. Penn Lake is classified as a High Quality Cold Water Fishery (HQ-CWF) according to PA Code, Ch. 93 standards. Wright Creek is the inlet and outlet. The lake covers 51 acres and sheds approximately 5.8 square miles. At full pool its maximum depth is 18 feet with an average of ~ 8 feet. Penn Lake is an impoundment with a storage capacity of 188 million gallons and a detention time of ~42 days. The dam number is PA 40-28.

Nutrients

Nitrogen: TN levels averaged 0.18 mg/l and were well below the PA benchmark of 0.887 mg/l. Problematic levels of TN in PA lakes are considered to be greater than 0.6 mg/L. Nitrogen is not a concern.

Phosphorus: The mean total phosphorus concentration was 0.012 compared to the state average of 0.034 mg/L. Only two samples were above the detection limit (See TP TSI). Typically, phosphorus is made available by ongoing human inputs or is bound in the sediments and released under anoxic conditions in stratified lakes.
These levels indicate a lake that has barely eased into a mesotrophic state. Under conducive weather conditions, TP concentrations of >0.03 mg/l will produce nuisance macrophyte or algal growth. In Penn Lake, dense, intermittent bladderwort patches likely had much of the phosphorus bound in the vegetation.

Autotroph production in most PA lakes is limited by phosphorus availability. Lakes with N:P ratios >15 indicate a phosphorus-limited system. Penn Lake averaged a ratio of 15, a situation that barely warrants designation. Either nutrient will encourage algal and plant growth if more is introduced but the relative abundances indicate a slightly phosphorus-limited lake.

Chlorophyll-a: Chlorophyll levels were extremely low for three samples and undetectable for the other three. Generally, Chl-a levels >0.01 mg/l can produce noticeable algal scums.

Dissolved oxygen (DO), temperature, pH, conductivity profiles: Dissolved oxygen (DO) profiles from surface to bottom at 1m intervals were recorded in the morning during the sampling events. Dissolved oxygen levels below 3.0mg/L limit usable fish habitat and can be very stressful to other aquatic organisms. The spring DO profile was suspicious and should be re-sampled while summer profiles show stratification below 3 meters. A properly functioning meter will probably show that DO concentrations are healthy in the spring.

All pH measurements were healthy in the spring and summer, ranging from 6.09 to 7.10. Fall readings were low and should also be re-sampled. Likewise, pH values will probably be healthy with a function meter.
High pH, generally 9 or greater, indicates a very productive system and an algae bloom. If sustained, high pH levels are stressful to fish and other aquatic organisms just as acidic situations can harm aquatic populations. Often, pH values around 9 indicate high phytoplankton productivity due to over-abundant nutrients.

Conductivity measures the ion concentration in water, e.g., dissolved salts and minerals. Levels were low in Penn Lake.

Alkalinity, Total Suspended Solids (TSS),Total Dissolved Solids (TDS): Alkalinity, a measure of calcium carbonate/buffering capacity, in the lake averaged 1.5 mg/l, which is the 2nd lowest measurement recorded in over 220 PA lakes sampled. Aquatic systems with an alkalinity greater than 20 mg/l are more capable of adequately buffering acidic inputs.

TSS test results were all below detection limits. TDS values were also very low with a mean of 73.4 mg/l.

Macrophytes/Plankton: Summer plankton levels were very low with species concentrations in all groups at less than 0.04 individuals per ml. The plankton community composition (14 species) was good but abundance was low. Overall numbers should improve with time to nourish the fish population as it becomes established. Phytoplankton numbers were low, in part, because nutrient levels were low and much of what had been available was bound in the bladderwort. Bladderwort is a carnivorous plant and contributed to low zooplankton counts as did the lack of phytoplankton forage. Plant diversity was good but abundance was skewed. A proportionate representation of submerged, emergent and floating plants is desirable. In Penn, bladderwort is a formidable threat to the lake ecosystem if left unabated. However, over-management can open the door for algal blooms.
A final plant list will be sent when it is received from the Morris Arboretum at UPenn.

Carlson's Trophic State Index (TSI's): The trophic state of a lake refers to its nutrient richness, where it stands along the production continuum. The indicating chemical and physical parameters are nutrients and water transparency. To lake managers, Carlson's TSI values in the 30's are considered to be oligotrophic (nutrient poor), values in the 40's are mesotrophic (moderately enriched), values in the 50's are considered eutrophic (enriched), and those above 65 are considered hypereutrophic (highly enriched). The TSI values for TP and Chl-a were 40.0 and 35.6 respectively. These values indicate an oligotrophic system. The low TSS, TDS and phytoplankton concentrations and water depth at the inlet site account for the omission of a $TSI_{secchi.}$ value, which would have also indicated an oligotrophic lake if actual readings would have been possible.

Conclusion/Recommendations: The overall water quality of Penn Lake is good and this can be maintained with community education, vigilance and even policy. With healthy

lake parameters at present, measures should be taken to preserve and even improve lake quality. In-lake characteristics should not be over-managed and best management practices for the watershed and properties need to be strictly implemented to prevent degradation which can happen abruptly and can be extremely costly and difficult to reverse. Though nutrients are not a major concern, all potential sources must be minimized and the lake safeguarded in several ways. Septic systems are no longer an issue which is a huge benefit so other sources of nutrients like fertilizers, detergents, illegal disposal of liquids and sedimentation should be addressed. Riparian vegetation is an asset to any water body and serves as protection for the lake and its critter inhabitants. The more native lakeside vegetation, the healthier the lake will be. Aquatic vegetation coverage of 15-20% coverage (submerged, emergent, floating) is ideal. Floating and emergent vegetation is a vital resource and should be protected unless clear, unfavorable growth is observed. Unfortunately, today's, human-perceived aesthetics trump the integrity of many lakes and that which is in the best interest of future generations. Conflicting interests can and should find compromise.

*** Two separate meters malfunctioned over the sampling period. Readings for October pH and April DO are inaccurate and new profiles should be taken in 2010 for closure to this sampling. Arrangements can be made with DEP staff.

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