# Phosphorus Fact Sheet

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| Description: | total phosphorus represents a measure of both suspended and soluble (dissolved) forms of phosphorus, reported in milligrams per liter (parts per million) as phosphorus. |
| Importance: | phosphorus is one of the major nutrients needed for plant growth. It is often considered the "limiting" nutrient in NYS lakes, for biological productivity (as defined by algae) is often limited if phosphorus inputs are limited. Since excessive algae growth often leads to reduced water clarity and degraded water quality perception, many lake management plans are centered on phosphorus controls. Phosphorus limitation is assumed when phosphorus to nitrogen ratios exceed 25 (on a molar basis), although this simplified assessment should be accompanied by other analyses to determine factors that most affect algae growth. |
| How Measured: | total phosphorus is analyzed from the surface (1.5 meter grab) sample collected in CSLAP with the use of a Kemmerer bottle and transferred to a collapsible container and labeled sample aliquot bottles. Sample bottles were pre-acidified prior to 2004, but subsequent analyses showed that this was unnecessary if samples were kept cold (39ºC) shortly after collection and continuously until analysis within 28 days. Hypolimnetic (deepwater) samples are collected at a depth of 1.5 meters from the lake bottom in thermally stratified lakes. Phosphorus is analyzed using a spectrophotometer with a 10cm cuvette. |
| Detection Limit: | 0.0007 mg/l (prior to 2002, detection limit = 0.002 mg/l) |
| Range in NYS: | undetectable (< 0.0007 mg/l) to 2.0 mg/l; 93% of readings fall between 0.005 mg/l and 0.075 mg/l (5-75 ppb). |
| WQ Standards: | the existing state guidance value for total phosphorus is 0.020 mg/l to protect contact recreation in Class B and higher lakes; this will likely be modified as part of the nutrient criteria development process. New guidance values will probably reflect differences in both regional water quality characteristics and lake uses. |
| Trophic Assessment: | New York State's trophic assessments differ slightly from the standard Carlson assessment criteria. Total phosphorus readings exceeded 0.020 mg/l in New York State and 0.024 mg/l using the Carlson indices, are considered *eutrophic*, or highly productive. Readings below 0.010 mg/l in New York State, and 0.012 mg/l using the Carlson indices, are considered *oligotrophic*, or highly unproductive. Lakes in the intermediate range are considered *mesotrophic*. The differences between the New York State and Carlson criteria are discussed in Chapter 3.4. |

# Chlorophyll *a* Fact Sheet

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| Description: | Chlorophyll is the photosynthetic pigment found in green plants, and chlorophyll *a* is the primary pigment found in freshwater algae. It constitutes 0.1-3.4% of the phytoplankton (algal) biomass and is a measure of primary productivity. The chlorophyll *a* analysis is much less time consuming than counting algal cells under a microscope, the most accurate measure of planktonic phytoplankton biomass in a lake. |
| Importance: | chlorophyll *a* is a measure of primary planktonic lake productivity and is closely related to both phosphorus and water transparency. Therefore, it is both a response variable to changes in phosphorus and a stressor to changes in water transparency. This makes it a critical trophic indicator and a representation of the building blocks for the entire ecological community in lakes. Since it measures only planktonic algae, however, it is not a good indicator of floating algae scums, benthic (bottom dwelling) algae, or epiphytes (algae growing on plants). |
| How Measured: in CSLAP | chlorophyll *a* is analyzed from the surface (1.5 meter grab) sample collected with the use of a Kemmerer bottle and transferred to a collapsible container. 100ml are filtered through a 0.45 µ, 47 mm diameter mixed ester filter, placed in a labeled glass vial, and wrapped in aluminum foil. Once received by the laboratory, a chloroform-methanol extractant is added in anticipation of centrifugation and analysis with a spectrophotometer. |
| Range in CSLAP: | undetectable (< 0.01 µg/l) to 1020 µg/l; 88% of readings fall between 1 µg/l and 50 µg/l. |
| WQ Standards: | there are no water quality standards or guidance values for chlorophyll *a* in New York State. Guidance values will probably be implemented as part of the nutrient criteria development process; these values will probably reflect differences in both regional water quality characteristics and lake uses. |
| Trophic Assessment: | New York State's trophic assessments differ slightly from the standard Carlson assessment criteria. Chlorophyll *a* readings exceeded 8 µg/l in NYS and 6.4 µg/l using the Carlson indices, are considered *eutrophic*, or highly productive. Readings below 2 µg/l in New York State, and 2.6 µg/l using the Carlson indices, are considered *oligotrophic*, or highly unproductive. Lakes in the intermediate range are considered *mesotrophic.* The differences between the New York State and Carlson criteria are discussed in Chapter 3.4. |

# Water Clarity Fact Sheet

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| Description: | a measure of the transparency of the water, as measured by the depth of disappearance of a 20cm black and white disk, using a method developed in the mid 1860s by Pietro Angelo Secchi and standardized through nearly all lake monitoring programs. |
| Importance: | in lakes with low color and rooted macrophyte ("weed") levels, water clarity is related to algal productivity and the greenness of water. Water clarity is closely related to public perception of lake conditions, and is a trigger for the development of lake restoration and protection plans. Water transparency also influences the depth of macrophyte growth, the depth of the thermocline (the zone separating the surface warm water and deeper cold waters), and in turn is influenced by dissolved organic matter (natural water color), and suspended inorganic turbidity, primarily sediment and silt. |
| How Measured: in CSLAP | Secchi disk transparency is computed as the average of the depth at which the Secchi disk disappears from sight from the lake surface and the depth at which the disk reappears, both measured to the nearest 0.1 meter. Samplers are instructed to take readings from the shady side of the boat (if available) and not to use viewscopes or polarized lenses. |
| Detection Limit: | limited only by size of disk. Larger disks are used in very (>20m) clear water—not needed in NYS. |
| Range in NYS: | 0.1 meters to 16 meters; 93% of readings fall between 1 meter and 8 meters. |
| WQ Standards: | none in New York State, although numeric water clarity guidance values will likely be developed as part of the nutrient criteria development process. The state Department of Health requires 4 feet (=1.2 meters) of water clarity in three locations to site a new swimming beach, although this is not a DOH requirement for maintaining the beach. |
| Trophic Assessment: | New York State's trophic assessments differ slightly from the standard Carlson assessment criteria. Water clarity readings less than 2 meters, both within NYS and using the Carlson indices, are considered *eutrophic*, or highly productive. Readings exceeding 5 meters in New York State, and 4 meters using the Carlson indices, are considered *oligotrophic*, or highly unproductive. Lakes in the intermediate range are considered *mesotrophic*. The differences between the New York State and Carlson criteria are discussed in Chapter 3.4 |
| Nomenclature: | The terms *water clarity* and *water transparency* (or *Secchi disk transparency*) are used interchangeably throughout this report. |

# $NO_x$ (Nitrate + Nitrite) Fact Sheet

**Description:** Nitrogen is a nutrient necessary for plant growth and can act as a limiting nutrient in some lakes, particularly in the spring and early summer. Nitrate ($NO_3$) is the form of nitrogen most readily available for biological uptake, including uptake by algae. It is more easily detected as $NO_x$, or nitrate + nitrite. Nitrite ($NO_2$) is rarely found in surface waters, and can be created as an intermediate step in denitrification, the conversion of nitrate into nitrogen gas in the absence of oxygen.

**Importance:** nitrate can be a limiting nutrient for some forms of green algae and may be an important nutrient in some regions of the state, such as Long Island. Nitrate can be an important component of wastewater, stormwater, fertilizers, and soil erosion. Therefore, it can be an indirect surrogate for pollutant loading to lakes, although elevated nitrate readings may be natural in some parts of the state. Nitrite can be toxic to aquatic life, though it readily converts to nitrate (or other forms of nitrogen) in the presence of oxygen.

**How Measured: in CSLAP** $NO_x$ is analyzed from the surface (1.5 meter grab) sample collected with the use of a Kemmerer bottle and transferred to a collapsible container and pre-labeled sample aliquot bottles. Deepwater $NO_x$ samples were only collected during the 2002 CSLAP sampling season. $NO_x$ is analyzed using a spectrophotometer.

**Detection Limit:** 0.005 mg/l $NO_x$, 0.003 mg/l $NO_2$ (prior to 1988, $NO_x$ detection limit = 0.05 mg/l; from 1988 to 2002, $NO_x$ detection limit = 0.02 mg/l)

**Range in CSLAP:** undetectable (< 0.005 mg/l) to 3.9 g/l; 87% of readings are less than 0.1 mg/l.

**WQ Standards:** the narrative standard for nitrogen is "none in amounts that will result in growths of algae, weeds and slimes that will impair the waters for their best usages." No water quality standard exists for $NO_x$. The state water quality standard for nitrate is 10 mg/l, to protect babies from methamoglobonemia. The state water quality standard for nitrite is 20 µg/l to protect trout (in waterbodies classified for trout survival or spawning), 100 µg/l to protect (other) aquatic life, and 1 mg/l to protect human health (potable water).

**Trophic Assessment:** New York State does not use $NO_x$ (or the components $NO_3$ or $NO_2$) in its trophic assessments. Samples are evaluated only against the state water quality standards.

# Ammonia Fact Sheet

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| Description: | Ammonia is a micronutrient and a form of nitrogen (and hydrogen) represented by the formula $NH_3$. It is produced from nitrogen gas by nitrogen fixation and through the degradation of organic matter, found in wastewater, and generated through several biological processes. |
| Importance: | ammonia is toxic to aquatic organisms and (to a much lesser extent) humans at concentrations occasionally found in lake water, particularly at high pH or in the absence of oxygen (such as occasionally found in the bottom waters of productive lakes). High ammonia readings may also be a sign of other forms of pollution and indicate persistent problems with ammonia (lack of oxygen). |
| How Measured: in CSLAP | total $NH_3$ is analyzed from the surface (1.5 meter grab) sample collected with the use of a Kemmerer bottle and transferred to a collapsible container and pre-labeled sample aliquot bottles. Deepwater NH3 samples were collected during the 2002 and 2009 CSLAP sampling seasons. $NH_3$ is analyzed using a spectrophotometer. |
| Detection Limit: | 0.004 mg/l $tNH_3$ (total ammonia) |
| Range in NYS: | undetectable (< 0.004 mg/l) to 4.1 mg/l; 70% of surface readings are between 0.01 mg/l and 0.1 mg/l, and 24% of samples are less than 0.01 mg/l. |
| WQ Standards: | the narrative standard for nitrogen is “none in amounts that will result in growths of algae, weeds and slimes that will impair the waters for their best usages.” The state water quality standard for total $NH_3$ is 2.0 mg/l for potable water supplies. The standard for unionized ammonia is a function of pH and temperature, and is quantified within a matrix found in the published state water quality standards. It is as low as 0.7 µg/l at 0ºC at a pH of 6.5. |
| Trophic Assessment: | New York State does not use $NH_3$ in its trophic assessments. Samples are evaluated only against the state water quality standards. |

# Total Nitrogen Fact Sheet

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| Description: | total nitrogen is the sum of all component forms of nitrogen—NOx (= $NO_3$ + $NO_2$) + total Kjeldahl nitrogen (or TKN, = $tNH_3$ + organic nitrogen). It can also be computed as an independent laboratory analysis, without first analyzing the nitrogen components. It is often a construct to compute nitrogen to phosphorus ratios, and is essentially equivalent to total dissolved nitrogen (= TDN) in most freshwater lake systems. |
| Importance: | total nitrogen can be compared directly to total phosphorus to evaluate which nutrient may be limiting algae growth. Comparing variations in total nitrogen and the component forms may also provide insights as to the potential sources of nitrogen. |
| How Measured: in CSLAP | total nitrogen is analyzed from the surface (1.5 meter grab) sample collected with the use of a Kemmerer bottle and transferred to a collapsible container and pre-labeled sample aliquot bottles. Samples were analyzed for TDN prior to 2008, but split samples on several CSLAP lakes in 2008 demonstrated that TDN and TN results were comparable. TN samples were analyzed in 2008 and 2009, and will be the primary means for evaluating total nitrogen after 2009. Deepwater total dissolved nitrogen samples were collected during the 2002 sampling season. Total nitrogen is analyzed using a spectrophotometer. |
| Detection Limit: | 0.05 mg/l TN or 0.04 mg/l TDN |
| Range in CSLAP: | undetectable (< 0.05 mg/l) to 5.2 mg/l; 92% of surface readings are between 0.1 mg/l and 1.0 mg/l. |
| WQ Standards: | the narrative standard for nitrogen is “none in amounts that will result in growths of algae, weeds and slimes that will impair the waters for their best usages.” There are no state numeric water quality standards or “translator” guidance value for total nitrogen. |
| Trophic Assessment: | New York State does not use total nitrogen in its trophic assessments. Some other states include total nitrogen in their trophic classifications. One such assessment considered by some researchers to be applicable in a variety of lake systems, using National Eutrophication Survey data in Florida, indicated that readings exceeded 0.75 mg/l are typical of *eutrophic*, or highly productive lakes, while readings below 0.35 mg/l are typical of *oligotrophic*, or highly unproductive lakes. Lakes in the intermediate range would be considered *mesotrophic*, or moderately productive. However, as noted above, New York State does not use total nitrogen to assess lakes for trophic condition, mostly because algae growth in nearly all New York state lakes is not nitrogen limited. |

# True Color Fact Sheet

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| Description: | true color is a laboratory analysis used as a simple surrogate for dissolved organic carbon, since primary constituents of dissolved organic carbon—tannic and fulvic acids—impart a brownish color to water in direct proportion to their concentration in water. It involves either filtering or centrifuging a water sample and analyzing the filtrate. True color differs from apparent color, which includes suspended components, including algae and sediment, and dissolved components, including dissolved organic and inorganic matter. |
| Importance: | dissolved color can strongly influence water transparency, particularly in the absence of algal or inorganic turbidity (and color can significantly alter the light transmission in water, further limiting algae growth). However, this component of water clarity is not strongly linked to public water quality perception, since dissolved color is often "natural" in many lakes, particularly softwater, high elevation lakes in the northwestern Adirondacks, Catskills and other regions in the state overlying organic soils. Thus it is associated with *dystrophic* rather than *eutrophic* lake systems. Changes in color can also indicate changes in runoff patterns to lakes, but can be negatively correlated to conductivity, since dissolved organic matter is often comprised of neutrally charged particles that do not carry current. |
| How Measured: in CSLAP | true color is analyzed from the surface (1.5 meter grab) sample collected with the use of a Kemmerer bottle and transferred to a collapsible container. Approximately 100ml of lake water is filtered through a 0.45μ mixed ester filter, and the filtrate is transferred to pre-labeled sample aliquot bottles. Color samples are visually compared to a scaled set of standards created from a platinum-cobalt solution. |
| Detection Limit: | 1 platinum color units (ptu) prior to 2002; 2 ptu since 2002 |
| Range in CSLAP: | undetectable (< 1 ptu) to 289 ptu. 75% of surface readings are between 5 ptu and 30 ptu, and 40% of surface samples have true color less than 10 ptu. |
| WQ Standards: | there are no state water quality standards for true color. The state narrative water quality standard for color of 15 platinum color units applies to only potable groundwater. |
| Trophic Assessment: | New York State exempts any lake with color greater than 30 ptu from a strict application of the trophic criteria due to the strong influence of high water color on water transparency. Lakes with less than 30 ptu true color are considered "clearwater" lakes and can be characterized by the traditional trophic indicators (water clarity, True color, and total phosphorus). Color readings less than 10 ptu are probably not visible to the casual observer. |

# pH Fact Sheet

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| Description: | pH is the abbreviation for "powers of hydrogen", and is a mathematical construct that characterizes the acidity of water on a simple scale. It is the negative logarithm of the hydrogen ion concentration, and is measured on a 14 point scale, from 0 (very highly acidic) to 14 (nearly highly basic). The effective scale for most waterbodies is 4 to 10, with 7 considered neutral (equal concentrations of hydrogen and hydroxide ions). |
| Importance: | the survival of most aquatic organisms is strongly dependent on pH. Many aquatic organisms do not properly function in water with pH below 6.5 or above 8.5, although impacts in low pH are better understood. This sensitivity of aquatic organisms to pH also reflects the sensitivity of some chemical compounds to pH—the sensitivity of fish to low pH water is a function of aluminum compounds, which can clog gills once certain forms of aluminum predominate at lower pH values. Other compounds, such as ammonia, are more highly toxic at elevated pH. |
| How Measured: in CSLAP | pH is analyzed from the surface (1.5 meter grab) sample collected with the use of a Kemmerer bottle and transferred to a collapsible container and labeled sample aliquot bottles. pH is more accurately measured directly in the field, since a number of factors (such as headspace in a sample bottle) introduce "contaminants" that change pH between collection and analysis. Laboratory pH is usually fairly accurate for most lakes with moderate to high buffering capacity, and is measured with a benchtop pH meter with buffer standards bracketing the expected range. |
| Detection Limit: | not applicable |
| Range in CSLAP: | 4.40 to 9.85; 89% of readings fall between pH 6.5 and 8.5, corresponding to the state water quality standards. |
| WQ Standards: | the state water quality standards require pH to be above 6.5 and below 8.5. |
| Water Quality Assessment: | pH readings are evaluated against the state water quality standards. In addition, lakes are classified by acidity status. Lakes with pH less than 6 are considered strongly acidic, and lakes with pH readings between 6 and 6.5 are considered weakly acidic. Lakes with pH greater than 8 are considered alkaline, and lakes with pH between 7.5 and 8 are considered weakly alkaline. Lakes with pH between 6.5 and 7.5 can be considered circumneutral. |

# Conductivity Fact Sheet

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| Description: | Specific conductance is the temperature-corrected analysis of conductivity, with measures the electrical current that passes through water, and is used to estimate the number of ions (charged particles). Current is carried by ions, so specific conductance is an indirect measure of the presence of dissolved solids such as chloride, nitrate, sulfate, phosphate, sodium, magnesium, calcium, and iron. |
| Importance: | Conductivity is not a measure of pollution per se—some lakes naturally have high conductivity—and conductivity is not directly related to eutrophication or other indicators of water quality problems. However, changes (increases) in conductivity can be an indication of changing runoff to a lake, either through changing flow rates or increases in erodible material in the flow. Since these materials can often bring pollutants or change biological habitat, changes in conductivity can be an indication of pollution problems. It is somewhat related to both the hardness and alkalinity (acid-buffering capacity) of the water and may influence the degree to which nutrients remain in the water. |
| How Measured: in CSLAP | Specific conductance is analyzed from the surface (1.5 meter grab) sample collected with the use of a Kemmerer bottle and transferred to a collapsible container and labeled sample aliquot bottles. It is measured in the laboratory using a conductivity meter comparing a sample to the conductivity of a known solution of potassium chloride (KCl) and corrected to 25ºC. Specific conductance is more accurately measured directly in the field using a conductivity bridge, although conductivity in many lakes is fairly stable. |
| Detection Limit: | 1 µmho/cm |
| Range in CSLAP: | undetectable (<1 µmho/cm) to 2540 µmho/cm; 93% of readings fall between 26 µmho/cm and 400 µmho/cm. |
| WQ Standards: | there are no specific conductance (or conductivity) standards in New York State. |
| Water Quality Assessment: | conductivity readings are not evaluated against any state water quality standards. Conductivity is related to hardness, since many of the same cations (calcium, magnesium, etc.) that contribute to hardness also contribute to conductivity (and are found in similar proportions to other metals that also contribute to conductivity). Lakes with conductivity below 100 µmho/cm can be considered softwater lakes, and lakes with conductivity above 300 µmho/cm have hard water. |

# Calcium Fact Sheet

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| Description: | calcium is a trace metal closely associated with limestone geology and strongly buffered, alkaline lakes. |
| Importance: | calcium can be considered a surrogate for alkalinity, or buffering capacity—lakes with high calcium levels are generally immune to swings in pH due to acid rain or other acidic inputs to lakes. Calcium is also a micronutrient required by freshwater mussels to grow their shells, and calcium may be one of the most significant limiting factors to colonization by zebra mussels. It is temporally stable in most lake systems, so it is analyzed in only two samples per year, although calcium levels may vary significantly spatially within a lake, due to inputs from concrete or limestone leaching. Open water calcium levels may be significantly lower than those measured near developed shorelines, thus underestimating the potential for "microhabitats" for zebra mussels. |
| How Measured: in CSLAP | calcium is analyzed from the surface (1.5 meter grab) sample collected with the use of a Kemmerer bottle and transferred to a collapsible container. Once received in the laboratory, it is immediately acidified with nitric acid. Calcium is analyzed using the atomic absorption spectrophotometric method. |
| Detection Limit: | 0.3 mg/l. Calcium was not analyzed through CSLAP prior to 2002. |
| Range in CSLAP: | undetectable (< 0.3 mg/l) to 56.1 mg/l. 68% of surface readings are between 5 mg/l and 30 mg/l, and 20% of surface samples have calcium readings in excess of 25 mg/l. |
| WQ Standards: | there are no state water quality standards for calcium. |
| Water Quality Assessment: | calcium readings in CSLAP are evaluated for susceptibility for zebra mussel infestation. The calcium levels required to support zebra mussel shell growth is approximately 25 mg/l. However, open water sampling (as conducted through CSLAP) may indicate calcium levels lower than those measured along developed shorelines—some CSLAP lakes with open water calcium levels as low as 12 mg/l have been found to support zebra mussels, due to higher localized calcium readings. It is assumed that lakes with calcium levels above 20 mg/l, or those with known localized presence of zebra mussels or mussel veligers are susceptible to zebra mussel colonization. |

# Iron and Manganese Fact Sheets

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| Description: | iron and manganese are trace metals commonly found in lake water, and is more likely to be concentrated in bottom waters |
| Importance: | iron and manganese, usually found in soluble form, are found at low levels in most surface waters. Ferrous iron and manganese can concentrate in hypolimnetic (bottom) waters under anoxic (absence of oxygen) conditions. When iron and manganese levels exceed the state water quality standard, these can stain laundry, dishes, and household fixtures red, brown or yellow, and can impart an iron taste to water. Once exposed to oxygen, iron and manganese can settle as a reddish brown to black precipitate. |
| How Measured: in CSLAP | iron and manganese are analyzed from the bottom (1.5 meter grab off the lake bottom) sample collected with the use of a Kemmerer bottle and transferred to a collapsible container. Once received in the laboratory, it is immediately acidified with nitric acid. Iron is analyzed using the atomic absorption spectrophotometric method. |
| Detection Limit: | 0.06 mg/l for iron and 0.1 mg/l for manganese. Iron and manganese were not analyzed through CSLAP prior to 2008. |
| Range in CSLAP: | undetectable to 10.9 mg/l for iron and 4.9 mg/l for manganese. 18% of bottom iron readings and 2% of bottom manganese readings have been below the analytical detection limit, and 42% of bottom iron and manganese readings are in excess of 0.3 mg/l and 0.5 mg/l, respectively, the state water quality standards. |
| WQ Standards: | the state water quality standard for iron is 0.3 mg/l as total iron and 0.5 mg/l as total manganese, applicable to potable water supplies (and groundwater). |
| Water Quality Assessment: | iron and manganese readings in CSLAP are evaluated to determine lake susceptibility for taste and odor problems, particularly for those lakes with deep water intakes. Elevated deepwater iron and manganese levels are usually an indication of persistent deepwater oxygen deficits, and may be indicative of susceptibility to fish kills of coldwater species, elevated levels of hazardous chemicals such as ammonia, hydrogen sulfide, and arsenic, and other water quality problems. |

# Lake Perception Fact Sheet

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| Description: | lake perception can be evaluated semi-quantitatively (using a standardized scale) to assess how the lake looks, aquatic plant populations, and recreational suitability. |
| Importance: | public perception of lakes is a critical component of lake management. Public dissatisfaction with (or desire to protect) the condition of the lake is frequently a strong impetus for the development of management, protection, or restoration plans for a lake, and often informs the desire to fund and implement management actions. Lake perception is often closely linked to measurable water quality or lake indicators, affording the opportunity to gauge progress and success, and to conduct cost-benefit analyses of specific management activities. Standardized scales can provide opportunities for comparison from year to year and across regional and state boundaries, since most New England and Upper Midwestern states use the same standardized tool for assessing lake perception. |
| How Measured: in CSLAP | lake perception is evaluated via a 4 question survey. The first and third questions relate to the physical condition of the lake (how it looks) and the recreational condition of the lake, respectively. These are graded on a 5 point scale, ranging from most favorable (1) to least favorable (5). The second question relates to the aquatic plant coverage in the lake, ranging from not visible (1) to densely covering the entire lake surface (5). The last question asks survey respondents to identify which factor(s) adversely affect recreational assessments. The surveys are completed during each sampling session prior to data or sample collection, to minimize bias. |
| Detection Limit: | not applicable |
| Range in CSLAP: | 1 to 5 for all survey questions. 76% of all respondents described their lake as “not quite crystal clear” or having “definite algal greenness”. 77% of all respondents said aquatic plants were visible from or grew to the lake surface, but not densely. 72% of survey respondents reported their lake as “excellent” or “slightly impaired” for recreational uses. However, these assessments varied widely regionally and from lake to lake. |
| WQ Standards: | no water quality standards or guidance values exist for lake perception. However, these data will likely be used to help determine the appropriate water clarity, chlorophyll *a* and total phosphorus readings to protect recreational uses of lakes, as part of the nutrient criteria development process. |
| Trophic Assessment: | the proposed guidance values for water clarity, chlorophyll *a*, and total phosphorus will likely be developed to prevent “impaired” conditions (as defined by the recreational perception survey data) at a frequency of greater than 10%-25% of the summer recreational season. |

## Arsenic Fact Sheet

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| Description: | arsenic is a trace metal commonly found in groundwater in the western US and parts of the midwest and New England, but can be concentrated in the bottom waters of lakes |
| Importance: | arsenic is a carcinogen (cancer-causing contaminant) once used in pesticides and wood-preserving products, but also naturally occurring in some parts of the state. It is tasteless and odorless, but can lead to significant short- and long-term health effects. Arsenic can be released from lake bottom sediments under anoxic conditions. |
| How Measured: in CSLAP | arsenic is analyzed from the bottom (1.5 meter grab off the lake bottom) sample collected with the use of a Kemmerer bottle and transferred to a collapsible container. It is only analyzed from lakes exhibiting deepwater oxygen depletion. Once received in the laboratory, it is immediately acidified with nitric acid. Arsenic is analyzed using the atomic absorption spectrophotometric method. |
| Detection Limit: | 0.67 µg/l. Arsenic was not analyzed through CSLAP prior to 2008. |
| Range in CSLAP: | undetectable (<0.67 µg/l) to 4.1 µg/l. 38% of bottom readings have been below the analytical detection limit, and none of bottom samples have arsenic readings in excess of 10 µg/l, the federal maximum (allowable) contaminant level, or MCL (the present state water quality standard is listed below). |
| WQ Standards: | the state maximum (allowable) contaminant level, or MCL is 10 µg/l, applicable to municipal water systems that serve at least 25 people. While it does not explicitly apply to raw water supplies, including lakes, water quality data from lakes provide an indication of susceptibility of water supplies using raw lake water. |
| Water Quality Assessment: | arsenic readings in CSLAP are evaluated to determine lake susceptibility for human health problems, particularly for those lakes with deep water intakes. Elevated deepwater arsenic levels are also an indication of persistent deepwater oxygen deficits. |

# Phycocyanin Fact Sheet

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| Description: | phycocyanin is a blue pigment that accounts for up to 20% of the proteins in cyanobacteria (the “blue” in blue-green algae) that can be detected with fluorometers |
| Importance: | if phycocyanin can be accurately measured and if it is a representative surrogate for cyanobacteria, a rapid measurement tool can provide immediate feedback about the relative presence of cyanobacteria and the potential presence of algal toxins, since the latter are only produced by cyanobacteria. However, the accuracy of this measurement has not been consistently demonstrated (results may not be comparable across individual fluorometers) and results may not be closely related to chlorophyll levels or other measurements of algal biomass |
| How Measured: in CSLAP | phycocyanin is analyzed from the surface (1.5 meter depth grab) pH sample collected with the use of a Kemmerer bottle and transferred to a collapsible container, as well as from skim bloom samples submitted to NYSDOH and UFI since 2009 and SUNY ESF starting in 2011. Once received in the laboratory, sample aliquots are run for phycocyanin and (starting in 2011) chlorophyll *a* , respectively, in the two chambers in the hand-held phycocyanin detector |
| Detection Limit: | 1 unit. The hand-held detector is calibrated weekly and the detection limit is generated against solid and artificial phycocyanin standards. |
| Range in CSLAP: | undetectable (< 1 unit) to 2170 in open water samples and 3,340,000 units in skimmed bloom samples. 24% of open water samples had phycocyanin levels above 100 units, a threshold (described below) that might correspond to susceptibility for cyanobacteria. |
| WQ Standards: | no water quality standards exist for phycocyanin. Phycocyanin readings below 80-100 units have not been associated with harmful levels of algal toxins, and while readings above this threshold do not necessarily lead to the production of toxins, this threshold can be used as a preliminary screen for susceptibility for blue green algae and production of algal toxins |
| Water Quality Assessment: | phycocyanin readings in CSLAP are evaluated to determine lake susceptibility for cyanobacteria and algal toxin production. This tool has limited use due to inconsistency in results amongst fluorometers (separate fluorometers are used by NYSDOH and UFI/ESF) and a relationship between phycocyanin, cyanobacteria, and algal toxins that is not consistent or statistically robust. However, these data do provide some measure of susceptibility to blooms (most often associated with cyanobacteria) and the potential for algal toxins production |

# Algal Toxins Fact Sheet

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| Description: | toxins produced by cyanobacteria under certain conditions are measured in CSLAP open water samples and skim bloom samples. Many toxins can be produced; the three most common toxins—Microcystis-LR (since 2009), anatoxin-a, and cylindrospermposin (starting in 2011)—are measured in open water and bloom samples in some lakes |
| Importance: | algal toxins can affect the health of swimmers through ingestion and dermal (skin) exposure of water and perhaps aerosol particulates near contaminated water, and perhaps through the consumption of fish exposed to these toxins. |
| How Measured: in CSLAP | algal toxins are measured from open water (1.5 meter grab off the lake bottom) samples collected with the use of a Kemmerer bottle and transferred to a collapsible container, and skim bloom samples by NYSDOH. Starting in 2011, SUNY ESF will measure algal toxins from membrane filters containing 200ml of open water samples and from raw water from blooms. NYSDOH measures algal toxins using ELISA (enzyme-linked immunosorbent assay) testing. For the SUNY ESF testing, bloom samples were immediate freeze-dried overnight and extracted 50% methanol using ultrasound. Microcystins hepatotoxins were determined using the protein phosphatase inhibition assay (PPIA). The other toxins and confirmation of microcystin activity are measured by LCMS (liquid chromatography-mass spectrometry). |
| Detection Limit: | detection limits are somewhat variable, but for microcystis-LR, the detection limit for both NYSDOH and SUNY ESF testing is approximately 0.01 µg/l. For anatoxin-a and cylindrospermposin, detection limits for SUNY ESF are approximately 0.4 µg/l and 0.1 µg/l, respectively. |
| Range in CSLAP: | for microcystis-LR, undetectable to 4.96 µg/l for open water samples and 8834 µg/l for bloom samples, as of 2010. 35% of open water samples and 11% of bloom samples exhibited undetectable levels of microcystis-LR, and 12% of the open water and 49% of the bloom samples had microcystis-LR levels above the WHO threshold for protecting drinking water (=1 µg/l). None of the open water samples and 23% of the bloom samples had microcystis-LR levels above the preliminary state threshold for swimming beaches (=20 µg/l). |
| WQ Standards: | the World Health Organization (WHO) criteria for protecting drinking water for microcystis-LR is 1 µg/l. The preliminary criteria used by the NYSDOH for reopening swimming beaches is 20 µg/l microcystis-LR. No federal or state criteria have yet been established for anatoxin-a and cylindrospermposin. |
| Water Quality Assessment: | NYSDEC continues to work with NYSDOH, SUNY ESF, and others to determine the most appropriate use of open water and bloom algal toxin data to assess lakes. The WHO and NYSDOH thresholds cited above are presently used in these assessments. |