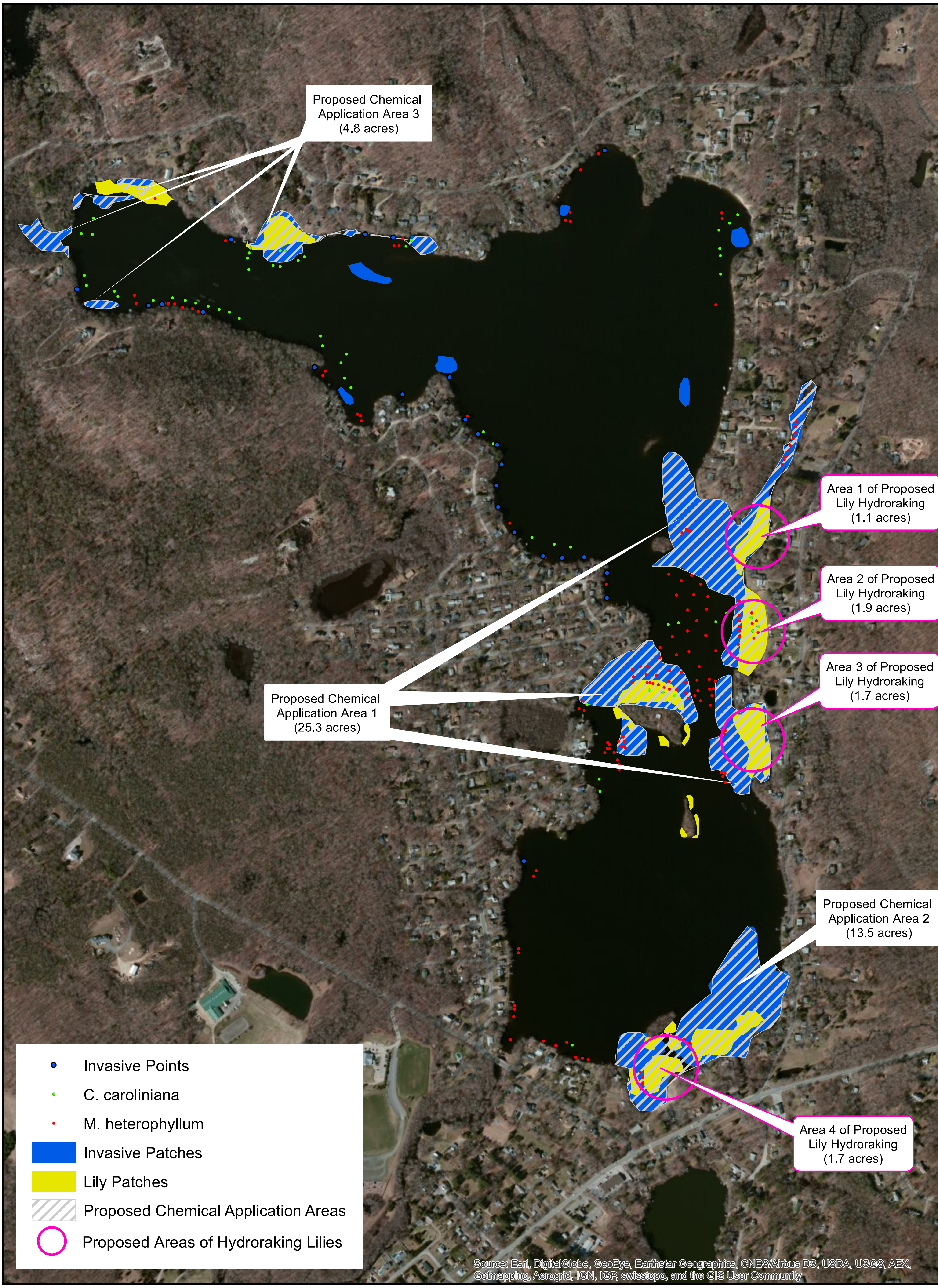
Figure 1

Invasive Plant Species Locations



New England Environmental, Inc.
Environmental Consulting

15 Research Drive
Amherst, MA 01002
(p) 413.256.0202

NEE

www.neeinc.com

Figure 2
Proposed Managment Areas

Rogers Lake
Lyme & Old Lyme, CT

04 Mar 2015

NEE Job # 14-4467

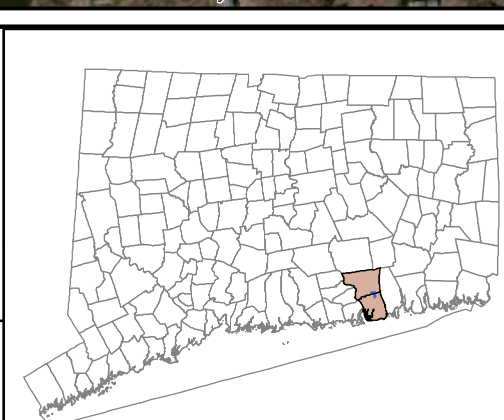
Data Source: Office of Geographic Information (MassGIS)

30 cm Color Digital Ortho Image 2008/2009
Digital Parcel Standard, Level 3

87,000 0 174,000 Miles

N

Latitude 41° 21' 36" N
Longitude 72° 18' 4" W



APPENDIX A

Community Education Pamphlet Example

LESSON 5

How does watershed health affect me?

Healthy watersheds generally have good soil and land quality, which leads to better water quality in the streams, lakes and rivers that they feed.

Better water quality makes Iowa's waterways a better place to have fun:

- Boating is more enjoyable in clean water.
- Swimming is safer when bacteria levels are low.
- Hiking, picnicking and bird watching in parks that surround many Iowa lakes is enhanced by good water quality.
- Fish thrive in lakes with good water quality, making fishing even better.
- Attracting visitors to Iowa's lakes and rivers has economic benefits for nearby towns.
- Outdoor activities associated with water and parks (like canoeing, waterskiing, hiking and biking) can have health benefits for participants.

LESSON 6

What can I do?

Clean water starts with you – it's up to each of us to make changes individually and to come together in groups to make a difference.

You can rally others in your community to create a watershed improvement project, which helps people make changes on the land for better water quality. See www.iowadnr.gov/water/watershed/ for more information on starting a project.

You can also help at home by learning about rain gardens and stormwater, by never dumping anything down a storm drain, by adopting a creek and planting trees along the banks, or by cleaning up after yourself after an outdoors trip.

For more information about watersheds:

- www.iowadnr.gov/water/watershed/
- www.iowadnr.gov/other/mapping.html
- www.iowaagriculture.gov/waterresources.asp
- www.epa.gov/owow/watershed/

Watersheds 101

Making changes on the land for better water

A Publication of the Iowa Department of Natural Resources

Watershed Improvement Program
Iowa Department of Natural Resources
502 E. 9th St.; Des Moines, IA 50319
www.iowadnr.gov/water/watershed/

The publication of this document has been funded by the Iowa Department of Natural Resources through a grant from the U.S. Environmental Protection Agency under the Federal Nonpoint Source Management Program (Section 319 of the Clean Water Act). Federal and State laws prohibit employment and/or public accommodation (such as access to services or physical facilities) discrimination on the basis of age, color, creed, disability (mental and/or physical), gender identity, national origin, pregnancy, race, religion, sex, or sexual orientation. If you believe you have been discriminated against in any program, activity or facility as described above, or if you desire further information, contact the Iowa Civil Rights Commission, 1-800-457-4416, or write to Iowa DNR, Wallace State Office Building, 502 E. Ninth St., Des Moines, Iowa, 50319.

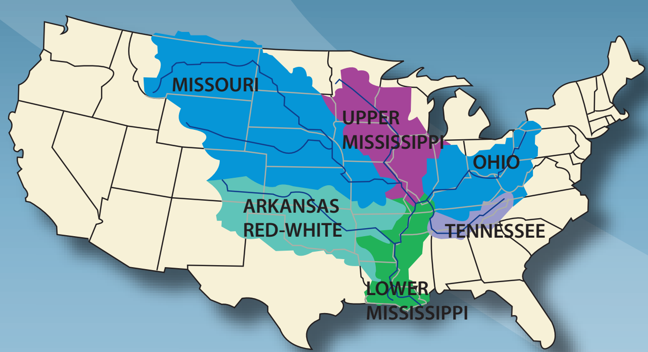
clean water *starts with you.*

IOWA DNR WATERSHED IMPROVEMENT

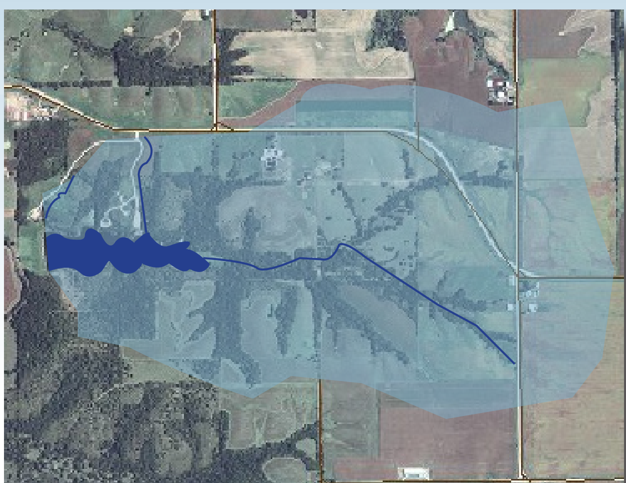
LESSON 1

What is a watershed?

A watershed is all of the land that drains water into a particular point, usually a stream, lake or river.



Watersheds can be found in all shapes and sizes. They can cover entire states or regions like the Mississippi River watershed above, or they can be as small as a few city blocks or farm fields, like the aerial photograph below. The shaded areas of color on the map above represent the Mississippi River watershed.



The shaded area shows the watershed, or the land that drains into the stream, in blue.

LESSON 2

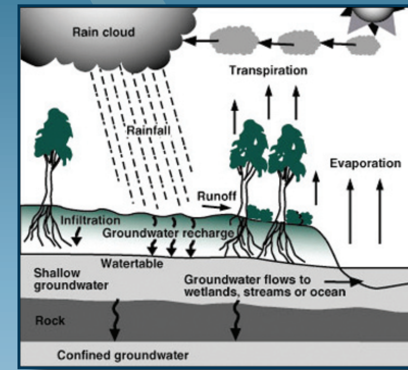
How does water get from the land into streams, lakes and rivers?

Most of us have seen streams filled to the tops of their banks during storms. But how often do we think about how all that water gets there?

When it rains, the soil absorbs some of the water. Whatever the soil cannot absorb travels along the land, becoming runoff. This runoff will likely end up in the nearest stream, lake or river. The runoff carries with it soil particles, oil and dissolved substances, including fertilizers and pesticides, taking them into the nearest waterbody.

Water that is absorbed by the soil may be used by plants or it may enter the groundwater system. Groundwater flows like a very slow underground river, often ending up in a nearby stream.

The soil, sand and rocks that the groundwater flows through can act as a filter, removing pollutants from the water. However, if the soil is contaminated, the filter may no longer function properly, making it a concern for the many Iowans that use groundwater for drinking.



Source: Australian Water and Rivers Commission

LESSON 3

How do cities affect watersheds?

How land is used in urban areas can affect water quality in a number of ways:

- Parking lots, buildings, roads and driveways keep runoff from soaking into the soil. Water runs off these surfaces, often carrying oil, fertilizer, bacteria and pesticides into streams without treatment.
- Fertilizers used on lawns and golf courses may end up in streams and lakes through runoff.
- Wastewater treatment plants contribute nutrients to waterways. They sometimes overflow, allowing untreated wastewater to enter a stream.
- Underground storage tanks for chemicals, such as gasoline, may rupture, leaking into groundwater.
- Aquatic habitats in urban streams are often highly modified and degraded due to channel straightening, culverts and concrete basins.

LESSON 4

How do farms affect watersheds?

Land uses in rural areas affect water quality in other ways:

- Fertilizers and pesticides from crop fields are often found in runoff in rural areas.
- Septic systems that are not properly constructed or maintained can send bacteria into streams.
- Cattle in pastures often have direct access to streams, trampling the streambank, leading to erosion.
- Surface runoff from crop fields may carry large amounts of soil, causing field erosion and may fill in lakes, rivers and streams with soil.
- Livestock waste may reach streams in runoff, causing algae blooms and bacteria problems.
- Storage tanks for chemicals like pesticides and fertilizers may rupture, causing fish kills and contaminating groundwater.

APPENDIX B

Water Quality Monitoring QAPP

PROJECT DESCRIPTION

Rogers Lake is currently being assessed for water quality and plant control measures to manage populations of *Cabomba caroliniana* and *Myriophyllum heterophyllum*. A recent analysis of water quality, which was also to include an assessment of the effectiveness of plant control measures, identified a gap in the ecological data. That gap was the lack of contemporary water quality data from Rogers Lake. The main purpose of this study is to fill the knowledge gap as it relates to the current state of the lake's water quality.

This quantitative water quality assessment will provide the following information:

1) The concentration of oxygen of the water at every meter from the surface to the bottom.
2) The pH, conductivity, and specific conductance of the water at every meter from the surface to the bottom.
3) The total phosphorus and orthophosphate concentrations of the surface and hypolimnetic waters.
4) The alkalinity, ammonia, nitrite, nitrate, and total kjeldahl nitrogen concentrations of the surface and hypolimnetic waters.
5) To determine water clarity.
6) To evaluate the biomass of genera of phytoplankton community.
7) To evaluate all the aforementioned factors on a monthly basis from May to October of 2014 and in subsequent years.
8) Finally, a standard protocol for obtaining those aforementioned data.

SITE DESCRIPTION

Rogers Lake is a 260-acre water body that spans the municipalities of Lyme and Old Lyme, CT. The watershed feeding this lake is about 4800 acres; it is comprised of moderate residential development. Furthermore, this lake is compromised due to the presence of the non-native species (*Cabomba caroliniana* and *Myriophyllum heterophyllum*). Also, this lake may be at risk for cultural eutrophication (Figure 1).

Rogers Lake is classified as oligotrophic to mesotrophic according to their average phosphorus concentrations. However with the increasing rate of human influence and potential productivity of non-native plant species in this system, the future health of this lake is at risk. The trending of lakes toward more eutrophic conditions as a result of internal enrichment processes (plant productivity and senescence) characterizes the need for understanding the relative chemical dynamics of the lake. Finally, to restore the system to a more natural state it is imperative to understand the seasonal water chemistry of the lake and develop a management plan from those data.

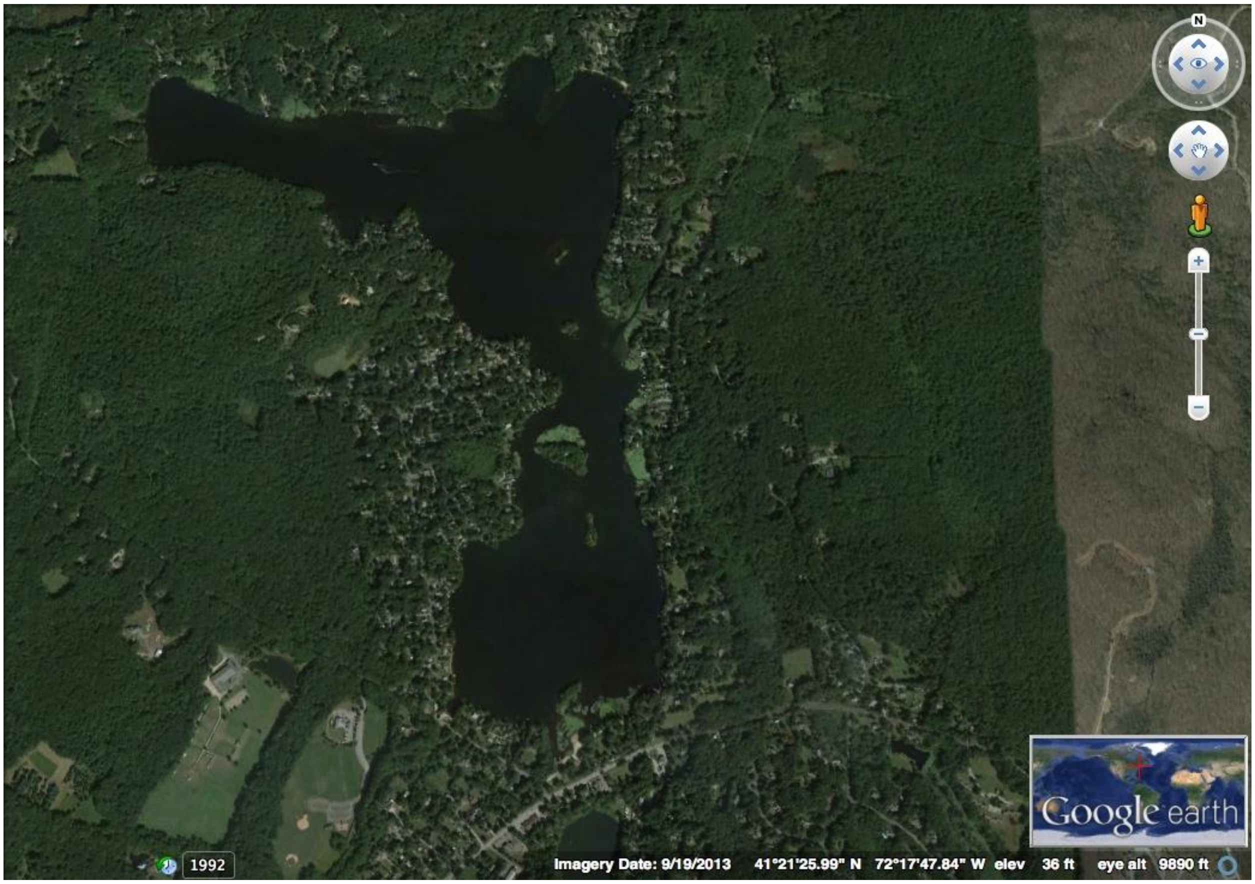


Figure 1: Aerial imagery of Rogers Lake (Lyme and Old Lyme, CT)

RESPONSIBLE AGENCIES AND PARTICIPATING ORGANIZATIONS

The responsible agencies are The Towns of Lyme and Old Lyme, CT. This study is being developed and conducted by New England Environmental, Inc. (NEE). NEE is comprised of a variety of environmental professionals including Limnologist and Plant Ecologist, Mark June-Wells, Ph.D. and is based in Amherst, Massachusetts.

PROJECT ORGANIZATION ROLES AND RESPONSIBILITIES

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Amherst, MA 01002
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Fax: (413)-256-1092

PERMIT REQUIREMENTS

No permits are required for water chemistry assessments or the collection of abiotic data.

HISTORY, PREVIOUS STUDIES, AND REGULATORY INVOLVEMENT

Rogers Lake is being targeted for this assessment because it has suffered cultural eutrophication and invasion by state priority non-native plant species. Non-native plant species are known to act as internal phosphorus sources and compromise the recreational value of water bodies.

A few in-lake studies have been conducted in recent years. They are:

1) Diagnostic and Feasibility Study of Rogers Lake – Aquatic Control Technologies and Northeast Aquatic Research LLC. (2002)
    a. Addressed strategies for plant and nutrient management protocols.
2) Rogers Lake Aquatic Plant Management Plan – Northeast Aquatic Research LLC. (2012)
    a. Addressed plant community characteristics and plant management protocols.

PROJECT DATA QUALITY OBJECTIVES

1) To establish a sample point for evaluating water chemistry using a GPS system (repeatable).

2) To establish a set of data collection protocols including all of the important variables (comprehensive and precise).
3) To determine the seasonal dynamics of water chemistry variables on a yearly basis (comparable).
4) Create a database of water chemistry assessments that can be used in the management decision-making process (relevant).

QUESTIONS TO BE ANSWERED

1) What are the temperature/oxygen dynamics of the lake?
2) How much phosphorus is present in the epilimnion and hypolimnion?
3) How much nitrogen is present in the epilimnion and hypolimnion?
4) How much phosphorus is loading into the hypolimnion from the hydro-soil?
5) Are the oxygen dynamics associated with hypolimnetic nutrient loading?
6) What are the baseline pH, conductivity, specific conductance, and alkalinity of the lake?
7) What is the oxygen demand of the lake?
8) How does the phytoplankton community change throughout the season?
9) Are there risks for significant algal blooms including harmful blue green algal blooms?
10) How does the water chemistry vary throughout the season?
11) Is the water chemistry changing throughout the years and what are possible reasons?

GENERAL CATEGORIES OF INFORMATION REQUIRED TO ANSWER QUESTIONS

This assessment is aimed at understanding the dynamics of the water chemistry and the phytoplankton community. The analysis will include the following data types:

1) Sample Point (point)
2) Water Chemistry (continuous)
3) Phytoplankton (count)

SPECIFIC MEASUREMENTS AND CRITERIA OF ASSESSMENT

To meet the purposes and questions of this study the following specific measurements will be taken:

1) One sample point in the deepest portion of the lake.
    a. Using a Garmin GPS unit with ~13ft resolution.
2) At this point, the dissolved oxygen (mg/L and %), pH, conductivity, and specific conductance will be measured with an YSI professional meter.
    a. These variables will be assessed at 0.5m, 1m, and every subsequent meter to the bottom of the lake (~18m).
3) At this point, the total phosphorus, orthophosphate, ammonia, nitrite, nitrate, TKN, alkalinity, and algae community of the surface waters will be assessed:
    a. Depth
        i. Grab samples will be taken at 0.5m by hand.
    b. Processing
        i. These samples will be stored at 3°C and delivered to a state approved laboratory for analysis.
    c. Reporting
        i. Laboratory reports will be processed by NEE's Limnologist. Those data will be compiled into an excel spreadsheet and saved in The Cloud.

4) At this point, total phosphorus, orthophosphate, ammonia, nitrite, nitrate, TKN, and alkalinity will be assessed:
    a. Depth
        i. Grab samples will be taken at 17.5m (bottom) with the use of a Van Dorn sampler.
    b. Processing
        i. These samples will be stored at 3°C and delivered to a state approved laboratory for analysis.
    c. Reporting
        i. Laboratory reports will be processed by NEE's Limnologist. Those data will be compiled into an excel spreadsheet and saved in The Cloud.
5) At this point a Secchi measurement will be taken.
    a. This will be done with a standard Secchi Disk.
6) Timing
    a. Monthly from May to October.

REPRESENTATIVENESS OF DATA

The field sampling protocol was designed to evaluate the water chemistry throughout the full depth of each water body. It has been widely accepted in literature that this type of design well suited to achieve that goal. Furthermore, these designs allow for relatively rapid assessments and do not require large monetary inputs making them ideal for baseline and comparative data collection.

The specific data that will be collected during this initiative will provide the following characteristics of the water quality:
1) Oxygen dynamics.
2) Nutrient dynamics.
3) Acidity and buffering capacity of the lake.
4) Algal community dynamics.
5) Oxygen vs. nutrient relationships.
6) Nutrient vs. algae relationships.
7) Internal vs. external loading assessment.

Based on those outcomes, which will be derived with the use of statistical techniques, these data are pertinent to the goals of The Towns of Lyme and Old Lyme goals and, representative of the dynamics of the water chemistry including yearly change with repeated assessments.

DATA ANALYSIS PROCEDURES

To answer the questions and fulfill the purposes of this study, statistical modeling techniques will be used following the data collection protocol. Since no control sites or comparison lakes will be used, mathematical modeling techniques will be used to characterize the water quality of Rogers Lake. Given the focus of this study and the goals of The Towns of Lyme and Old Lyme, the lack of cross-lake comparisons or that of control sites should not be viewed as study weaknesses.

The types of models will be selected using an assessment technique known as Akaike Information Criteria (AIC) and can include log, polynomial, exponential or linear models. Though the mathematical influences of the log, polynomial, and exponential models can be confounding to some, the purpose of these models is to explain the patterns of water quality and graphically display the results. Therefore, the results associated with model development will be understandable to all invested parties.

COMPARABILITY OF MODELS AND DATA

The primary purpose of this initiative is to develop a data set and results database that is comparable over temporal scales. All portions of this study are comparable. Those data collected are, in themselves, comparable using simple assessment techniques. Furthermore, the models are also comparable to newly developed models by a competent statistician. The result is an unparalleled comparability that is built into this initiative.

COMPLETENESS AND PRECISION OF DATA

No technique is without a level of uncertainty. The presented technique is widely accepted in the scientific literature. Based on this principles we assert that the completeness of data collected during this initiative should be satisfactory.

Precision of data collection depends, primarily, on the questions requiring answers. Given that the questions being addressed by this study are targeting the dynamics of the 'in-lake' water quality of Rogers Lake, the use state approved laboratories that have proven levels of accuracy and precision are an important part of this protocol. The state approved laboratories use techniques that are standard protocols and widely accepted as the most reliable contemporary techniques. However, the addition of additional sampling points and increased temporal resolution could enhance this study but would inflate the cost substantially. It would be advantageous to incorporate more resolution in future initiatives if monies are available.

ACCURACY OF DATA AND MODELS

The accuracy of the data point position is assumed to be high (~13ft resolution).

The accuracy of laboratory results are assumed to be high based on the level of QC/QA required by state approval boards.

Data model accuracy is a relative estimation because they are theoretical and can vary based on what factors are measured. The only way to increase accuracy of statistical models is to increase the number or frequency of abiotic factors measured. However, increasing the number of important factors would increase cost of this study significantly. Moreover, the models developed during this initiative can be manipulated later as more data becomes available to further increase their accuracy. Following this study, the models will have suitable accuracy to satisfy the purposes and questions presented in the earlier text.

DATA AND MODEL ACCEPTANCE CRITERIA

Data collected during this initiative will be accepted using a variety of criteria, which are listed below:

1) GPS
    a. A minimum of 5 satellites available during point logging.
2) Water Chemistry
    a. Laboratory Samples

        i. State approved laboratory.
        ii. The use of calibration curves.
    b. YSI Measurements
        i. Bi-annual machine calibration.
        ii. Stable measurements prior to data logging.
3) Models will be accepted using the AIC and Permutation Tests. The model with the highest level of significance and the lowest AIC will be used.

DATA AND MODEL REVIEW

Data will be assessed by NEE's Limnologist, Mark June-Wells, Ph.D. He has significant experience in data QC/QA and statistical analysis. He will assess the data structure and confirm its reliability.

Mark June-Wells, Ph.D. will conduct the data analysis and model building. Therefore, his experience in these areas will allow him to make decisions about model reliability.

DATA BASE MANAGEMENT

Databases developed and results obtained during this initiative will be stored on cloud servers and made available to all invested parties.

STUDY DESIGN

To meet the purposes and questions of this study the following specific measurements will be taken:

1) One sample point in the deepest portion of the lake.
    a. Using a Garmin GPS unit with ~13ft resolution.
2) At this point, the dissolved oxygen (mg/L and %), pH, conductivity, and specific conductance will be measured with an YSI professional meter.
    a. These variables will be assessed at 0.5m, 1m, and every subsequent meter to the bottom of the lake (~18m).
3) At this point, the total phosphorus, orthophosphate, ammonia, nitrite, nitrate, TKN, alkalinity, and algae community of the surface waters will be assessed:
    a. Depth
        i. Grab samples will be taken at 0.5m by hand.
    b. Processing
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    a. Depth
        i. Grab samples will be taken at 17.5m (bottom) with the use of a Van Dorn sampler.
    b. Processing

        i. These samples will be stored at 3°C and delivered to a state approved laboratory for analysis.
    c. Reporting
        i. Laboratory reports will be processed by NEE's Limnologist. Those data will be compiled into an excel spreadsheet and saved in The Cloud.
5) At this point a Secchi measurement will be taken.
    a. This will be done with a standard Secchi Disk.
6) Timing
    a. Monthly from May to October.
7) Data will be logged on field data sheets.
8) Data will be analyzed for structural properties and models will be developed using R.

EQUIPMENT

1) GPS Unit
2) PFD's
3) First Aid Kit
4) YSI Meter
5) Secchi Disk
6) Sample Bottles
7) Van Dorn Sampler
8) Data Sheets

FIELD DATA DOCUMENTATION

All data will be collected on data sheets that will be retained at NEE. All collected data will be logged on sheets that identify the GPS location.

MODIFICATIONS TO STUDY DESIGN

We do not anticipate any modifications to the presented study design.

APPENDIX C

Vegetation Monitoring QAPP

PROJECT DESCRIPTION

Rogers Lake is currently being assessed for water quality and plant control measures to manage populations of *Cabomba caroliniana* and *Myriophyllum heterophyllum*. A recent analysis of water quality, which was also to include an assessment of the effectiveness of plant control measures, identified a gap in the ecological data. That gap was the lack of contemporary plant data from Rogers Lake, which made the assessment of plant control measures difficult. The main purpose of this study is to fill the knowledge gap as it relates to the composition of the plant community within the lake and to assess the scope of plant invasion.

The quantitative plant assessment will provide the following information:

1) Inventory of all aquatic plant species in Rogers Lake.
2) Determine the relative abundances of each species in the lake.
3) Model the distribution of each species as they relate to depth and light.
4) Determine the distribution of non-native plant species in the lakes.
5) Map the distribution of non-native plant species.
6) From those data, make recommendations on plant control.

SITE DESCRIPTION

Rogers Lake is a 260-acre water body that spans the municipalities of Lyme and Old Lyme, CT. The watershed feeding this lake is about 4800 acres; it is comprised of moderate residential development. Furthermore, this lake is compromised due to the presence of the non-native species (*Cabomba caroliniana* and *Myriophyllum heterophyllum*). Also, this lake may be at risk for cultural eutrophication (Figure 1).

Rogers Lake is classified as oligotrophic to mesotrophic according to their average phosphorus concentrations. However with the increasing rate of human influence and potential productivity of non-native plant species in this system, the future health of this lake is at risk. The trending of lakes toward more eutrophic conditions as a result of internal enrichment processes (plant productivity and senescence) characterizes the need for understanding the relative structure of this aquatic plant community. Finally, to restore the system to a more natural state it is imperative to understand the scope of the aquatic invasive plant problem and develop a management plan from those data.

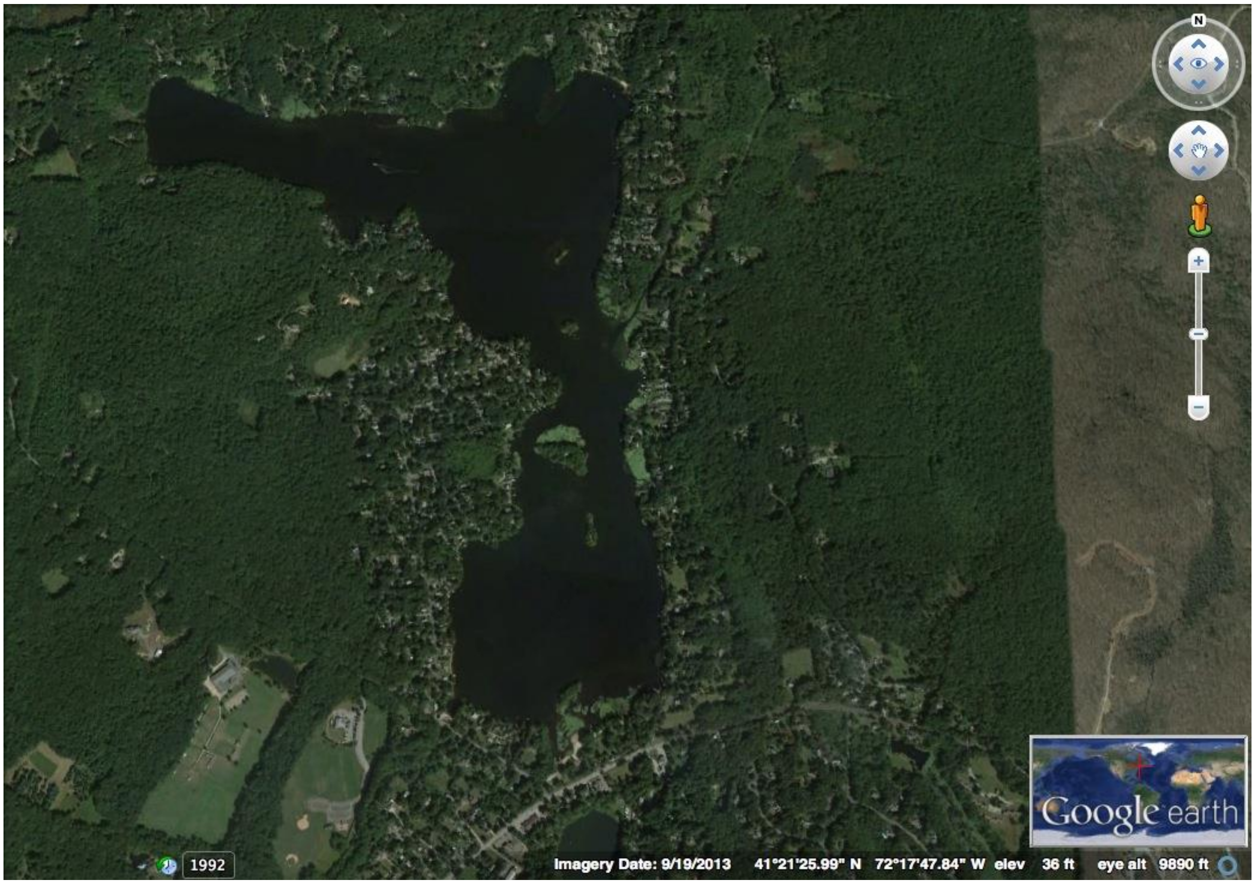

Figure 1: Aerial imagery of Rogers Lake (Lyme and Old Lyme, CT)

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PERMIT REQUIREMENTS

No permits are required for aquatic plant assessments or collection of abiotic data.

HISTORY, PREVIOUS STUDIES, AND REGULATORY INVOLVEMENT

Rogers Lake is being targeted for this assessment because it has suffered cultural eutrophication and invasion by state priority non-native plant species. Non-native plant species are known to act as internal phosphorus sources and compromise the recreational value of water bodies.

A number of in-lake studies have been conducted in recent years. They are:

1) Diagnostic and Feasibility Study of Rogers Lake – Aquatic Control Technologies and Northeast Aquatic Research LLC. (2002)
    a. Addressed strategies for plant and nutrient management protocols.
2) Rogers Lake Aquatic Plant Management Plan – Northeast Aquatic Research LLC. (2012)
    a. Addressed plant community characteristics and plant management protocols.

PROJECT DATA QUALITY OBJECTIVES

1) To establish a random-block-design using georeferenced points (repeatable).

2) To establish a 'species-level' inventory of plants residing in each lake (comprehensive and precise).
3) To determine the mathematical distribution/abundances of species in each lake as they relate to soil-type, light, and depth (comparable).
4) Create a database of plant species distributions and abundances that can be used in management decision-making processes (relevant).

QUESTIONS TO BE ANSWERED

1) What plant species are present in the lake?
2) What level of plant diversity exists in the water body?
3) What are the abiotic preferences of each resident species?
4) How does diversity relate to the measured abiotic preferences?
5) What is the abundance and distribution of each non-native species?
6) As per the data set, what are potential strategies for managing non-native species reliably and responsibly?

GENERAL CATEGORIES OF INFORMATION REQUIRED TO ANSWER QUESTIONS

This assessment is aimed at understanding the structure of the aquatic plant community and its future dynamics. The analysis will include the following data types:

1) Geo Grid (points)
2) Abiotic (continuous)
3) Plant Abundance (Rank)

SPECIFIC MEASUREMENTS AND CRITERIA OF ASSESSMENT

To meet the purposes and questions of this study the following specific measurements will be taken:

1) 25 georeferenced points per lake.
    a. Using a Trimble GPS unit with ~1m resolution.
2) At each point, plants will be sampled using a grapple.
    a. Species will be identified following Crow and Hellquist 2000 - *Aquatic and wetland plants of northeastern North America I/II. Madison (WI): University of Wisconsin Press.*
    b. Each plant species' abundance will be logged using a rank abundance technique. The following classifications will be used:
        i. 0 – Absent
        ii. 1 – Rare
        iii. 2 – Present
        iv. 3 – Abundant
        v. 4 – Dominant
        vi. 5 – Monoculture
3) At each point, the following abiotic variables will be measured:
    a. Depth
        i. Measured with a weighted tape.
    b. Light
        i. Calculated from depth, the Secchi depth, and the solar constant using the following formula:

1. $I_z = e^{(-kz)} * I_o$ where I_z = intensity at depth (z), e is Euler's number, k is the attenuation coefficient of light in water (1.7) multiplied by the secchi depth for the lake, z is the depth, and I_o is the solar constant (340w/m^2).

REPRESENTATIVENESS OF DATA

The field sampling protocol was designed to evaluate the plant community structure throughout the full extent of each water body. It has been widely accepted in literature that random-block designs are well suited to achieve that goal. Furthermore, these designs allow for relatively rapid assessments and do not require large monetary inputs making them ideal for baseline data collection. Current literature also notes that these techniques are capable of deriving small-scale abiotic/plant trends when coupled with specific statistical techniques. Finally, these types of techniques are suitable to develop baseline inventories and distributions for future comparisons.

The specific data that will be collected during this initiative will provide the following characteristics of the plant community:

1) Plant abundance assessments
2) Plant distribution assessments
3) Plant diversity assessments

Based on those outcomes, which will be derived with the use of statistical techniques, these data are pertinent to the goals of The Towns of Lyme and Old Lyme goals and, representative of the structure of the plant community including changes in structure with repeated assessments.

DATA ANALYSIS PROCEDURES

To answer the questions and fulfill the purposes of this study, statistical modeling techniques will be used following the data collection protocol. Since no control sites or comparison lakes will be used, mathematical modeling techniques will be used to characterize the plant communities of Rogers Lake. Given the focus of this study and the goals of The Towns of Lyme and Old Lyme, the lack of cross-lake comparisons or that of control sites should not be viewed as study weaknesses.

The types of models will be selected using an assessment technique known as Akaike Information Criteria (AIC) and can include log, polynomial, exponential or linear models. Though the mathematical influences of the log, polynomial, and exponential models can be confounding to some, the purpose of these models is to explain the pattern of plant distribution and graphically display the results. Therefore, the results associated with model development will be understandable to all invested parties.

COMPARABILITY OF MODELS AND DATA

The primary purpose of this initiative is to develop a data set and results database that is comparable over temporal scales. All portions of this study are comparable. Those data collected are, in themselves, comparable using simple assessment techniques. Furthermore, the models are also comparable to newly developed models by a competent statistician. The result is an unparalleled comparability that is built into this initiative.

COMPLETENESS AND PRECISION OF DATA

No technique is without a level of uncertainty. The presented technique is widely accepted in the scientific literature and has been shown to meet the mathematical threshold of sampling energy vs. detection limits; in simpler terms, this technique has been shown to detect 99% of species present. Furthermore, it has been shown to detect 99% of the variability in a system. It should be noted that the sampling number (n=25 per lake) was not arbitrarily denoted. That amount of sampling was selected based on sampling efforts vs. detection of species in lakes of similar size. Based on these principles we assert that the completeness of data collected during this initiative should be satisfactory.

Precision of data collection depends, primarily, on the questions requiring answers. Given that the questions being addressed by this study are targeting the dynamics of the 'in-lake' plant communities of Rogers Lake, the precision of data collected during this initiative is suitable. We are interested in developing distributions of species in each lake and relating those distributions to basic abiotic parameters. Therefore, point assessments are ideal for this type of plant community analysis. The only lack of precision that would be advantageous to increase is that of sediment characterization. However, the addition of chemical assessments to this study would inflate the cost substantially and would then not be possible. It would be advantageous to incorporate those analyses in future studies. To develop the inventory and the baseline structural properties of plant communities in these lakes, the current level of precision is suitable.

ACCURACY OF DATA AND MODELS

The accuracy of data point position is assumed to be high (=1m resolution).

The accuracy of plant identification is completely dependent on the skill of the individual conducting the research. The limnologist (Mark June-Wells, Ph.D.) has professional training in plant identification and holds a degree in plant community ecology, which requires an expert-level ability to identify plant species. Accuracy of plant identification are assumed to be high during this study.

Data model accuracy is a relative estimation because they are theoretical and can vary based on what factors are measured. The only way to increase accuracy of statistical models is to increase the number of abiotic factors measured. However, increasing the number of important factors would increase cost of this study significantly. Moreover, the models developed during this initiative can be manipulated later as more data becomes available to further increase their accuracy. Following this study, the models will have suitable accuracy to satisfy the purposes and questions presented in the earlier text.

DATA AND MODEL ACCEPTANCE CRITERIA

Data collected during this initiative will be accepted using a variety of criteria, which are listed below:

1) GPS
    a. A minimum of 5 satellites available during point logging.
2) Plant Data
    a. Field and laboratory agreement of plant identification.
    b. Two independent observers agreeing upon the rank abundance at each point.
3) Depth Data
    a. Two measurements at each point (average the two).
4) Light Data
    a. Two independent people conduct light calculations.
5) Soil Data

a. Agreement between two independent observers classifying the sediment type.

Models will be accepted using the AIC and Monte Carlo Permutation Test. The model with the highest level of significance and the lowest AIC will be used.

DATA AND MODEL REVIEW

Data will be assessed by NEE's Limnologist, Mark June-Wells, Ph.D. He has significant experience in data QC/QA and statistical analysis. He will assess the data structure and confirm its reliability.

Mark June-Wells, Ph.D. will conduct the data analysis and model building. Therefore, his experience in these areas will allow him to make decisions about model reliability.

DATA BASE MANAGEMENT

Databases developed and results obtained during this initiative will be stored on cloud servers and made available to all invested parties.

STUDY DESIGN

The Quantitative Plant Study will be conducted in early July, when aquatic vegetation has reached its peak. All data will be collected over three and will adhere to the following protocol:

1) 25 or more points will be randomly chosen and will be evenly divided among the following depth classes: *(if depth does not afford the use of 5 depth classes, the number of samples will be modified to allow for even data point distribution. The total number of points will be as close to 25 as possible.)*
    a. 0-1m
    b. 1-2m
    c. 2-3m
    d. 3-4m (if available)
    e. 4-5m (if available)
2) At each point, water depth will be measured twice using a weighted tape and averaged.
3) At each point, a soil sample will be collected and classified by the two observers.
4) At each point, plants will be sampled with a grapple, identified by NEE's Limnologist, and given rank abundances by the two observers. (Identifications will be confirmed in the laboratory)
5) At noon, a Secchi measurement will be taken at the deepest point of the lake.
6) Data will be logged on field data sheets.
7) Data will be analyzed for structural properties and models will be developed using R.

EQUIPMENT

1) GPS Unit
2) PFD's
3) First Aid Kit
4) Sample Bags
5) Data Sheets

FIELD DATA DOCUMENTATION

All data will be collected on data sheets that will be retained at NEE. All collected species will be logged with sheets that identify the GPS location.

MODIFICATIONS TO STUDY DESIGN

We do not anticipate any modifications to the presented study design.