2012 National Lakes Assessment
Field Operations Manual
The intention of the 2012 National Lakes Assessment (NLA 2012) project is to provide a comprehensive “State of the Lakes” assessment for lakes, ponds, and reservoirs across the United States. The complete documentation of overall project management, design, methods, and standards is contained in companion documents, including:

- 2012 National Lakes Assessment: Quality Assurance Project Plan (EPA 841-B-11-006)
- 2012 National Lakes Assessment: Site Evaluation Guidelines (EPA 841-B-11-005)
- 2012 National Lakes Assessment: Laboratory Operations Manual (EPA 841-B-11-004)

This document (Field Operations Manual) contains a brief introduction and procedures to follow at the base location and on-site, including methods for sampling water chemistry (grabs and in situ), phytoplankton, zooplankton, sediment (diatoms and mercury), algal toxins, benthic macroinvertebrates, and physical habitat. These methods are based on both the guidelines developed and followed in the Western Environmental Monitoring and Assessment Program (Baker, et. al., 1997) and methods employed by several key states that were involved in the planning phase of this project. Methods described in this document are to be used specifically in work relating to the NLA 2012. All Project Cooperators should follow these guidelines. Mention of trade names or commercial products in this document does not constitute endorsement or recommendation for use. Details on specific methods for site evaluation and sample processing can be found in the appropriate companion document.

The suggested citation for this document is:

# TABLE OF CONTENTS

NOTICE ..................................................................................................................................................... III
TABLE OF CONTENTS ...................................................................................................................................... V
LIST OF TABLES ............................................................................................................................................... X
LIST OF FIGURES ........................................................................................................................................... X
ACRONYMS/ABBREVIATIONS ........................................................................................................................ XII

## 1.0 BACKGROUND ................................................................................................................................. 1

1.1 SELECTION OF SAMPLING LOCATIONS ....................................................................................... 1
1.2 SELECTION AND DESCRIPTION OF SURVEY INDICATORS ....................................................... 2

### 1.2.1 Trophic Status and Water Quality Indicators ........................................................................... 2
1.2.1.1 Chlorophyll-a ......................................................................................................................... 2
1.2.1.2 Secchi Disk Transparency .................................................................................................... 3
1.2.1.3 Vertical Profile Measurements ............................................................................................... 3
1.2.1.4 Water Chemistry and Associated Measurements ................................................................. 3

### 1.2.2 Ecological Integrity Indicators ................................................................................................... 3
1.2.2.1 Littoral and Benthic Macroinvertebrate Assemblage .............................................................. 3
1.2.2.2 Macrophyte Assemblage ....................................................................................................... 3
1.2.2.3 Physical Habitat Characterization .......................................................................................... 3
1.2.2.4 Phytoplankton Assemblage .................................................................................................. 4
1.2.2.5 Sediment Diatom Assemblage .............................................................................................. 4
1.2.2.6 Sediment Mercury .............................................................................................................. 4
1.2.2.7 Zooplankton Assemblage .................................................................................................... 4

### 1.2.3 Human Use Indicators .............................................................................................................. 5
1.2.3.1 Algal toxins (microcystin) .................................................................................................. 5
1.2.3.2 Triazine Pesticide Screen ................................................................................................. 5

### 1.2.4 Other Indicators / Lake Characteristics .................................................................................. 5

## 2.0 LOGISTICS ......................................................................................................................................... 7

2.1 ROLES AND CONTACT INFORMATION ...................................................................................... 7
2.2 KEY INFORMATION AND MATERIALS ........................................................................................ 9

### 2.2.1 Site Maps ................................................................................................................................. 9
### 2.2.2 Forms (Paper or Electronic) .................................................................................................. 9
  2.2.2.1 Field Forms ......................................................................................................................... 10
  2.2.2.2 Tracking Forms ................................................................................................................. 10
### 2.2.3 Equipment and Supplies ........................................................................................................ 10
  2.2.3.1 Request Form ...................................................................................................................... 10
  2.2.3.2 Base Kit ............................................................................................................................ 11
  2.2.3.3 Site Kit ............................................................................................................................. 11
  2.2.3.4 Field Crew Supplied Items ............................................................................................. 11
### 2.2.4 Other Resources ..................................................................................................................... 11
  2.2.4.1 Quick Reference Guide ................................................................................................... 11
  2.2.4.2 Site Evaluation Guidelines .............................................................................................. 11
  2.2.4.3 Quality Assurance Project Plan ....................................................................................... 11
  2.2.4.4 Lab Operations Manual ................................................................................................. 12

## 3.0 DAILY FIELD ACTIVITIES SUMMARY ...................................................................................... 13

3.1 SAFETY AND HEALTH ................................................................................................................... 13

### 3.1.1 General Considerations ........................................................................................................ 13
  3.1.1.1 Recommended Training ................................................................................................. 13
  3.1.1.2 Communications ........................................................................................................... 13
  3.1.1.3 Personal Safety ............................................................................................................ 13
| 3.1.1.4  | Sampling Equipment | 14 |
| 3.1.2   | Safety Equipment   | 14 |
| 3.1.2.1 | Safety Guidelines for Field Operations | 14 |
| 3.2     | RECORDING DATA AND OTHER INFORMATION | 15 |
| 3.2.1   | Paper Field Forms | 16 |
| 3.2.2   | Electronic Field Forms | 18 |
| 3.3     | SAMPLING SCENARIO | 18 |

| 4.0     | BASE SITE ACTIVITIES | 22 |
| 4.1     | PREDEPARTURE ACTIVITIES | 22 |
| 4.1.1   | Daily Itineraries and Site Packets | 22 |
| 4.1.2   | Instrument Checks and Calibration | 24 |
| 4.1.2.1 | Multi-probe Meter Performance Test | 24 |
| 4.1.2.2 | Global Positioning System Use and Battery Check | 24 |
| 4.1.2.3 | Electronic Data Capture Device Battery Check (if applicable) | 25 |
| 4.1.3   | Equipment and Supply Preparation | 25 |
| 4.1.4   | General Equipment and Supplies for All Activities | 26 |
| 4.2     | LAKE VERIFICATION | 26 |
| 4.2.1   | Lake Verification at the Launch Site | 26 |
| 4.2.2   | Locating Index Site | 27 |
| 4.2.3   | Equipment and Supply List | 28 |
| 4.3     | POST SAMPLING ACTIVITIES | 28 |
| 4.3.1   | Equipment Cleanup and Check | 28 |
| 4.3.2   | Shipment of Samples and Forms | 29 |
| 4.3.3   | Communications | 30 |

| 5.0     | INDEX SITE ACTIVITIES | 31 |
| 5.1     | TEMPERATURE, DO, AND pH PROFILE | 31 |
| 5.1.1   | Summary of Method | 31 |
| 5.1.2   | Equipment and Supplies | 31 |
| 5.1.2.1 | Multi-Probe Sonde | 31 |
| 5.1.2.2 | Temperature Meter | 32 |
| 5.1.2.3 | DO Probe | 32 |
| 5.1.2.4 | pH Meter | 32 |
| 5.1.2.5 | Conductivity | 32 |
| 5.1.2.6 | Index Profile Form | 32 |
| 5.1.3   | Depth Profile Procedure | 32 |
| 5.2     | SECCHI DISK TRANSPARENCY | 34 |
| 5.2.1   | Summary of Method | 34 |
| 5.2.2   | Equipment and Supplies | 34 |
| 5.2.3   | Procedure for Determining Secchi Transparency | 34 |
| 5.3     | WATER SAMPLE COLLECTION AND PRESERVATION | 35 |
| 5.3.1   | Summary of Method | 35 |
| 5.3.2   | Equipment and Supplies | 35 |
| 5.3.3   | Sampling Procedure | 36 |
| 5.4     | DISSOLVED CARBON | 38 |
| 5.4.1   | Summary of Method | 38 |
| 5.4.2   | Equipment and Supplies | 38 |
| 5.4.3   | Sampling Procedure | 39 |
| 5.5     | ZOOPLANKTON COLLECTION | 40 |
| 5.5.1   | All Lakes | 40 |
| 5.5.1.1 | Summary of Method | 40 |
| 5.5.1.2 | Equipment and Supplies | 40 |
| 5.5.1.3 | Sampling Procedure | 41 |
5.5.2  Resample Lakes (NLA 2007 Protocol) ............................................................................................................. 43
5.5.2.1  Summary of Method ................................................................................................................................. 43
5.5.2.2  Equipment and Supplies .......................................................................................................................... 44
5.5.2.3  Sample Collection and Processing Procedure ......................................................................................... 44
5.6  SEDIMENT MERCURY, DIATOMS, AND DATING SAMPLE COLLECTION ....................................................... 45
5.6.1  Summary of Method ........................................................................................................................................ 45
5.6.2  Equipment and Supplies ................................................................................................................................ 46
5.6.3  Sampling Procedure .................................................................................................................................... 47
5.6.3.1  Sediment Core Sample Collection ........................................................................................................ 47
5.6.3.2  Sediment Core Processing ....................................................................................................................... 48
5.6.3.3  Bottom Sample Collection (Natural Lakes Only) .................................................................................. 49
5.6.3.4  Diatom Sample Collection .................................................................................................................... 49
5.7  MACROPHYTE OBSERVATION - MAXIMUM DEPTH OF COLONIZATION ...................................................... 50
6.0  LITTORAL AND SHORELINE ACTIVITIES ..................................................................................................... 51
6.1  PHYSICAL HABITAT CHARACTERIZATION ..................................................................................................... 51
6.1.1  Summary of Method ........................................................................................................................................ 51
6.1.2  Equipment and Supplies ................................................................................................................................ 52
6.1.3  Locating the Physical Habitat Stations and Defining the Shoreline Boundary .......................................... 52
6.1.3.1  Base Site Activities ................................................................................................................................ 52
6.1.3.2  Littoral and Shoreline Activities ............................................................................................................ 52
6.1.3.3  Shoreline and Station Location Adjustments ......................................................................................... 53
6.1.3.4  Identifying Relocated and New Stations on the Form ............................................................................. 55
6.1.4  Establishing the Physical Habitat Plot ......................................................................................................... 55
6.1.4.1  Physical Habitat Plot Dimensions ......................................................................................................... 55
6.1.5  General Observations .................................................................................................................................... 55
6.1.6  Estimate Substrate Characteristics .............................................................................................................. 56
6.1.7  Estimate Aquatic Macrophyte Cover .......................................................................................................... 57
6.1.8  Estimate Fish Habitat Cover ....................................................................................................................... 57
6.1.9  Estimate the Cover and Type of Riparian and Drawdown Zone Vegetation .................................................. 58
6.1.9.1  Canopy Vegetation (greater than 5 m high) ............................................................................................. 58
6.1.9.2  Understory Vegetation (5m to 0.5m high) ................................................................................................. 58
6.1.9.3  Ground Cover (lower than 0.5m high) ...................................................................................................... 58
6.1.9.4  Considerations for Drawdown conditions ............................................................................................ 59
6.1.10  Record Evidence of Human influence .................................................................................................. 59
6.1.11  Invasive Plants and Invertebrates .............................................................................................................. 60
6.2  MACROPHYTE ASSEMBLAGE CHARACTERIZATION .................................................................................. 60
6.2.1  Summary of Method ...................................................................................................................................... 60
6.2.2  Equipment and Supplies ............................................................................................................................. 61
6.2.2.1  Rope Sampler ........................................................................................................................................... 61
6.2.3  Locating the Macrophyte Transects ............................................................................................................. 61
6.2.3.1  Transect Placement ................................................................................................................................ 61
6.2.3.2  Stopping a Transect ................................................................................................................................. 61
6.2.3.3  Point Placement Along the Transect ....................................................................................................... 63
6.2.4  Macrophyte Assemblage Characterization ................................................................................................. 64
6.2.4.1  Data Collection ....................................................................................................................................... 64
PLANT GROWTH FORM KEY (SEE FIGURE 6.7 FOR ILLUSTRATIONS) .......................................................... 66
6.2.4.2  Estimating Maximum Depth of Plant Colonization (MDC) ................................................................ 67
6.2.4.3  Optional Enhancements .......................................................................................................................... 68
6.3  LITTORAL CHLOROPHYLL-A, ALGAL TOXIN, AND PHYTOPLANKTON SAMPLE COLLECTION .............. 70
6.3.1  Summary of Method ...................................................................................................................................... 70
6.3.2  Equipment and Supplies ............................................................................................................................. 70
6.3.3  Sampling Procedure ................................................................................................................................... 70
6.4  BENTHIC MACROINVERTEBRATE SAMPLING ............................................................................................. 71
6.4.1  Summary of Method .................................................................................................................................... 71
# Table of Contents

## Chapter 6: Equipment and Supplies
6.4.2 Sampling Procedure .......................................................... 71
6.4.3 Site Selection and Sample Collection ............................... 72
6.4.3.1 Sample Processing in the Field ................................. 72

## Chapter 7: Field Quality Control
7.0 FINAL LAKE ACTIVITIES .................................................... 75
7.1 GENERAL LAKE ASSESSMENT ........................................... 76
7.1.1 Lake/Catchment Site Activities and Disturbances Observed 76
7.1.2 General Lake Information .............................................. 76
7.1.3 Shoreline Characteristics .............................................. 76
7.1.4 Qualitative Macrophyte Survey ...................................... 78
7.1.5 Waterbody Character .................................................... 79
7.1.6 Qualitative Assessment of Environmental Values .......... 79
7.2 PROCESSING THE CHLOROPHYLL-A SAMPLES .............. 80
7.2.1 Equipment and Supplies .............................................. 80
7.2.2 Procedures for Processing the Chlorophyll-a Samples .... 80
7.3 PRESERVATION OF SAMPLES ........................................... 81
7.4 PREPARATION OF SAMPLES FOR SHIPPING .................. 81
7.5 DATA FORMS AND SAMPLE INSPECTION ...................... 81
7.6 LAUNCH SITE CLEANUP ................................................... 82

## Chapter 8: Field Quality Control
8.0 FIELD QUALITY CONTROL ................................................. 83
8.1 REPEAT SAMPLING ............................................................ 83
8.2 FIELD EVALUATION AND ASSISTANCE VISITS .............. 83
8.2.1 General Information .................................................... 83
8.2.2 Preparation Activities .................................................. 84
8.2.3 Field Day Activities .................................................... 84
8.2.4 Post Field Day Activities ............................................ 85
8.2.5 Summary ................................................................. 85

## Chapter 9: Literature Cited ................................................... 87

## Appendix A: Contacts .......................................................... 89

## Appendix B: Equipment & Supplies ....................................... 93

### Base Kit ........................................................................... 95
### Site Kit ............................................................................ 96
### Forms & Labels .............................................................. 97
### Field Crew Supplied Equipment ....................................... 97
### Boat Equipment List ....................................................... 99

## Appendix C: Sample Field Forms ....................................... 101

<table>
<thead>
<tr>
<th>Verification</th>
<th>103</th>
</tr>
</thead>
<tbody>
<tr>
<td>Index Profile (Front)</td>
<td>104</td>
</tr>
<tr>
<td>Index Profile (Back)</td>
<td>105</td>
</tr>
<tr>
<td>Index Sample Collection (Page 1 of 3)</td>
<td>106</td>
</tr>
<tr>
<td>Index Sample Collection (Page 2 of 3)</td>
<td>107</td>
</tr>
<tr>
<td>Index Sample Collection (Page 3 of 3)</td>
<td>108</td>
</tr>
<tr>
<td>Littoral Sample Collection</td>
<td>109</td>
</tr>
<tr>
<td>Physical Habitat (Front)</td>
<td>110</td>
</tr>
<tr>
<td>Physical Habitat (Back)</td>
<td>111</td>
</tr>
<tr>
<td>Macrophyte Assemblage Characterization (Front)</td>
<td>112</td>
</tr>
<tr>
<td>Macrophyte Assemblage Characterization (Back)</td>
<td>113</td>
</tr>
<tr>
<td>Invasive Plants and Invertebrates (Front)</td>
<td>114</td>
</tr>
<tr>
<td>Section</td>
<td>Page</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Invasive Plants and Invertebrates (Back)</td>
<td>115</td>
</tr>
<tr>
<td>Assessment (Front)</td>
<td>116</td>
</tr>
<tr>
<td>Assessment (Back)</td>
<td>117</td>
</tr>
<tr>
<td>Site and Sample Status/Water Chemistry Lab Tracking</td>
<td>118</td>
</tr>
<tr>
<td>Tracking - Batch Samples to GLEC</td>
<td>119</td>
</tr>
<tr>
<td>Tracking - Packets</td>
<td>120</td>
</tr>
<tr>
<td>Appendix D: Shipping Guidelines</td>
<td>121</td>
</tr>
<tr>
<td>General Shipping Guidelines</td>
<td>122</td>
</tr>
<tr>
<td>Tracking Forms</td>
<td>122</td>
</tr>
<tr>
<td>Shipping Addresses</td>
<td>122</td>
</tr>
<tr>
<td>Appendix E: Field Evaluation &amp; Assistance Visit Checklist</td>
<td>125</td>
</tr>
<tr>
<td>Appendix F: Invasive Plants and Invertebrates</td>
<td>141</td>
</tr>
</tbody>
</table>
LIST OF TABLES

Table 1.1 Summary table of indicators ............................................................................................................... 6
Table 2.1 Personnel to call for specific types of questions and support needs.................................................. 7
Table 2.2 Contact information ............................................................................................................................. 8
Table 3.1 Guidelines for recording field measurements and tracking information. ........................................ 16
Table 4.1 Instrument checks and calibration ....................................................................................................... 25
Table 4.2 Stock solutions, uses, and methods for preparation. ........................................................................... 25
Table 4.3 Equipment and supplies – all activities .............................................................................................. 26
Table 4.4 Equipment and Supplies – lake verification ....................................................................................... 28
Table 5.1 Equipment and supplies – temperature, pH, and DO profiles .......................................................... 31
Table 5.2 Equipment and supplies – Secchi disk transparency. ......................................................................... 34
Table 5.3 Equipment and supplies – water samples ......................................................................................... 35
Table 5.4 Equipment and supplies – dissolved carbon .................................................................................... 38
Table 5.5 Equipment and supplies – zooplankton collection. ......................................................................... 41
Table 5.6 Equipment and supplies – zooplankton collection (NLA 2007 method). ........................................... 44
Table 5.7 Equipment and supplies – sediment core sample. ........................................................................... 46
Table 5.8 Equipment and supplies – physical habitat assessment. ................................................................. 52
Table 5.9 Equipment and supplies – invasive plants and invertebrates. ............................................................ 60
Table 5.10 Equipment and supplies – macrophyte assemblage characterization ... ................................. 61
Table 5.11 Equipment and supplies – littoral chlorophyll-a, phytoplankton (cyanobacteria), and algal toxin samples. ........................................................................................................................ 70
Table 5.12 Equipment and supplies – benthic macroinvertebrate collection ................................................... 72
Table 6.1 Site activities and disturbances observed during final lake assessment. ........................................ 76
Table 6.2 Hydrologic lake type observed during final lake assessment ........................................................... 78
Table 7.1 Shoreline characteristics observed during final lake assessment .................................................... 78
Table 7.2 Equipment and supplies – chlorophyll-a processing ...................................................................... 80
Table 8.1 Equipment and supplies – field audits. ............................................................................................... 84
Table 8.2 Summary of field evaluation and assistance visit information. .................................................... 85
Table 0.1 Sample preservation, packaging, and holding times. ................................................................. 122

LIST OF FIGURES

Figure 2.1 Sample site maps .............................................................................................................................. 9
Figure 3.1 Daily operations summary ................................................................................................................. 19
Figure 3.2 Location of sample collection points and physical habitat (PHab) stations. ................................... 20
Figure 4.1 Overview of base site activities ....................................................................................................... 22
Figure 5.1 Secchi disk diagram (EPA, 1991). ................................................................................................. 34
Figure 5.2 Integrated water sampler device (MPCA). .................................................................................... 36
<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.3</td>
<td>Procedure for using the integrated sampler device to collect depth integrated samples.</td>
<td>37</td>
</tr>
<tr>
<td>5.4</td>
<td>Wisconsin net and collection bucket diagram</td>
<td>41</td>
</tr>
<tr>
<td>5.5</td>
<td>Sediment core sample summary</td>
<td>45</td>
</tr>
<tr>
<td>5.6</td>
<td>Sediment core sample summary - detail</td>
<td>46</td>
</tr>
<tr>
<td>5.7</td>
<td>Illustration of the core tube and sectioning apparatus</td>
<td>47</td>
</tr>
<tr>
<td>6.1</td>
<td>Dimensions and layout of a physical habitat station</td>
<td>51</td>
</tr>
<tr>
<td>6.2</td>
<td>Examples of rake sampler used for macrophyte assemblage characterization</td>
<td>61</td>
</tr>
<tr>
<td>6.3</td>
<td>Transect placement (dotted lines) and sampled portions of those transects (solid lines)</td>
<td>62</td>
</tr>
<tr>
<td>6.4</td>
<td>Sample point placement in a deep lake</td>
<td>63</td>
</tr>
<tr>
<td>6.5</td>
<td>Point placement on a transect that ends before 6 points are sampled</td>
<td>64</td>
</tr>
<tr>
<td>6.6</td>
<td>Plant Growth Form Key</td>
<td>66</td>
</tr>
<tr>
<td>6.7</td>
<td>Macrophyte Growth Form Guide</td>
<td>69</td>
</tr>
<tr>
<td>6.8</td>
<td>Littoral sampling of chlorophyll-a, phytoplankton (cyanobacteria), and algal toxins.</td>
<td>71</td>
</tr>
<tr>
<td>6.9</td>
<td>D-frame net (500 µm mesh) used for collecting benthic macroinvertebrates</td>
<td>71</td>
</tr>
<tr>
<td>7.1</td>
<td>Final lake activities summary</td>
<td>75</td>
</tr>
<tr>
<td>Abbreviation</td>
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1.0 BACKGROUND

This manual describes field protocols and daily operations for crews to use in the 2012 National Lakes Assessment. The NLA 2012 is a statistical assessment of the condition of our nation’s lakes, ponds, and reservoirs (subsequently referred to in this manual as “lakes”) and is designed to:

- Assess the condition of the nation’s lakes.
- Establish a baseline to compare future surveys for trends assessment and evaluate change in condition since the 2007 National Lakes Assessment (US EPA 2009).
- Help build State and Tribal capacity for monitoring and assessment and promote collaboration across jurisdictional boundaries.

This is one of a series of water surveys being conducted by states, tribes, the U.S. Environmental Protection Agency (EPA), and other partners. In addition to lakes, partners will also study coastal waters, wadeable streams, rivers, and wetlands in a revolving sequence. The purpose of these surveys is to generate statistically-valid reports on the condition of our nation’s water resources and identify key stressors to these systems.

The goal of the NLA 2012 is to address two key questions about the quality of the nation’s lakes, ponds, and reservoirs:

- What percent of the nation’s lakes are in good, fair, and poor condition for key indicators of trophic state, ecological health, and human use (recreation)?
- What is the relative importance of key stressors such as nutrients and pathogens?

The NLA 2012 is designed to be completed during the summer growing season before lake turnover (June through September). Field crews will collect a variety of measurements and indicators from an “index site” located at the deepest point of the lake (or in the middle of the lake if the lake is deeper than 50 meters) and document conditions of the littoral zone and shoreline from stations around the lake.

1.1 Selection of Sampling Locations

EPA selected sampling locations using a probability based survey design (e.g., Stevens and Olsen 2004). Sample surveys have been used in a variety of fields (e.g. election polls, monthly labor estimates, forest inventory analysis) to determine the status of population or resources of interest using a representative sample of relatively few members or sites. Using this survey design allows data from the subset of sampled lakes to be applied to the larger target population and assessments with known confidence bounds to be made.

With input from the states and other partners, EPA used the following framework to guide the site selection process:

- The National Hydrography Dataset (NHD) was used to derive a list of lakes for potential inclusion in the NLA 2012.
- For purposes of this survey “lakes” refers to natural and man-made freshwater lakes, ponds, and reservoirs greater than 1 hectare (approximately 2.5 acres) in the conterminous U.S., excluding the Great Lakes.
- Mine ponds, retention basins, cooling ponds, and saline lakes due to salt water intrusion were
excluded from this study. For more information on the site exclusion criteria refer to the 2012 National Lakes Assessment: Site Evaluation Guidelines (EPA 841-B-11-005).

- The sample size was set to include 1,000 lake sampling events.

The result was the inclusion of 904 discrete lakes, with 96 of the lakes to be scheduled for revisits. Of these, 398 lakes are resample lakes from NLA 2007. An “oversample” list of additional lakes was also generated to allow for replacement of non-target or otherwise unsampleable sites. The oversample list will also accommodate any state wishing to conduct a state scale survey.

Lakes selected for the NLA 2012 are distributed among six size class categories and are spatially distributed across the lower 48 states and nine aggregated Omernik Level 3 ecoregions.

Related NLA 2012 documents include the following:

- 2012 National Lakes Assessment: Quality Assurance Project Plan (EPA 841-B-11-006)
- 2012 National Lakes Assessment: Site Evaluation Guidelines (EPA 841-B-11-005)
- 2012 National Lakes Assessment: Laboratory Operations Manual (EPA 841-B-11-004)

These documents are available at: [http://www.epa.gov/owow/lakes/lakessurvey](http://www.epa.gov/owow/lakes/lakessurvey).

### 1.2 Selection and Description of Survey Indicators

As part of the indicator selection process, EPA and the NLA 2012 Steering Committee evaluated indicators used in NLA 2007, refined methodologies, and identified new indicators for NLA 2012. The Steering Committee, comprised of state representatives from each of the EPA regions, provided advice and recommendations to the Agency on matters related to the NLA 2012. Key screening and evaluation criteria included indicator applicability on a national scale, the ability of an indicator to reflect various aspects of ecological condition, and cost-effectiveness (e.g., Kurtz et al, 2001). EPA used the Committee’s recommendations to refine methods and develop final documents.

The remainder of this section briefly describes the indicators that the NLA 2012 will use to assess trophic status, ecological integrity, human use value, and lake characteristics (also see Table 1.1). Some indicators provide a basis for evaluating more than one category. For example, an assessment of phytoplankton allows for an examination of ecological integrity and trophic status, and to a certain extent, human use.

#### 1.2.1 Trophic Status and Water Quality Indicators

Lakes are classified according to their trophic state. “Trophic” means nutrition or growth. A eutrophic (“well-nourished”) lake has high nutrients and high plant growth. An oligotrophic lake has low nutrient concentrations and low plant growth. Mesotrophic lakes fall somewhere in between eutrophic and oligotrophic lakes.

Three variables, chlorophyll, total phosphorus, and Secchi transparency, are most often used to estimate biomass and define the trophic state of a particular lake. Other variables are measured in conjunction with the trophic state variables to supplement and enhance understanding of lake processes that affect primary productivity.

##### 1.2.1.1 Chlorophyll-a

Chlorophyll is the pigment that allows plants (including algae) to use sunlight to convert simple molecules into organic compounds via the process of photosynthesis. Of the several kinds of chlorophyll, chlorophyll-a is the predominant type found in green plants and algae. Measuring chlorophyll-a concentrations in water is a surrogate for actually measuring algae biomass and it is used to estimate
trophic status.

1.2.1.2  *Secchi Disk Transparency*
A Secchi disk is a black and white patterned disk commonly used to measure the clarity of water based on the distance the disk can be seen when it is lowered into the water column. The Secchi disk measurement is used to estimate the euphotic zone depth in the field which is generally defined as two-times the Secchi disk depth.

1.2.1.3  *Vertical Profile Measurements*
Depth profiles for temperature, pH and dissolved oxygen (DO) are taken with a calibrated water quality probe meter or multi-probe sonde from the index site in each lake. This information is used to determine the extent of stratification and the availability of the appropriate temperature range and level of DO necessary to support aquatic life.

1.2.1.4  *Water Chemistry and Associated Measurements*
Water chemistry measurements are used to determine the acidic conditions, trophic state and nutrient enrichment, and water chemistry type.

1.2.2  *Ecological Integrity Indicators*
Ecological integrity describes the ecological condition of a lake based on different assemblages of the aquatic community and their physical habitat. The indicators include plankton (phytoplankton and zooplankton), benthic macroinvertebrates, diatoms, and the physical habitat of the shoreline and littoral zones.

1.2.2.1  *Littoral and Benthic Macroinvertebrate Assemblage*
Benthic macroinvertebrates are bottom-dwelling animals without backbones (“invertebrates”) that are large enough to be seen with the naked eye (“macro”). Examples of macroinvertebrates include: crayfish, snails, clams, aquatic worms, leeches, and the larval and nymph stages of many insects, including dragonflies, mosquitoes, and mayflies. Populations in the benthic assemblage respond to a wide array of stressors in different ways so that it is often possible to determine the type of stress that has affected a macroinvertebrate assemblage (e.g., Klemm et al., 1990). Because many macroinvertebrates have relatively long life cycles of a year or more and are relatively immobile, the structure and function of the macroinvertebrate assemblage is a response to exposure of present or past conditions. For the NLA, the benthic macroinvertebrate assemblage occupying the littoral zone will be assessed, rather than the profundal assemblage occupying the deeper regions of lakes.

1.2.2.2  *Macrophyte Assemblage*
The abundance and type of aquatic macrophyte growth are commonly cited as major concerns of state and individual lake managers. Where submerged aquatic macrophytes are abundant, they can dominate habitat structure, fishability, recreational use and nutrient dynamics in lakes. Consequently, whole Lake evaluations of submerged aquatic macrophytes provide critical information about a lake’s ecological integrity, as well as impacts of stressors such as habitat impairment, eutrophication, and invasive species.

1.2.2.3  *Physical Habitat Characterization*
The characterization of shoreline and littoral zone (the nearshore areas of a lake) physical habitat (PHab)
conditions serves three purposes. First, habitat information is essential to the interpretation of expected lake ecological condition in the absence of human disturbance (anthropogenic impacts). Second, the habitat evaluation is a reproducible, quantified estimate of habitat condition, serving as a benchmark against which to compare future habitat changes that might result from anthropogenic activities. Third, the specific selections of habitat information collected aid in the diagnosis of probable causes of ecological degradation in lakes.

In addition to information collected in the field by the shoreline and littoral surveys, the physical habitat description of each lake includes many map-derived variables such as lake surface area, shoreline length, and shoreline complexity. Furthermore, an array of information, including watershed topography and land use, supplements the physical habitat information. The shoreline and littoral characterization concentrates on information best derived "on the ground". As such, these results provide the linkage between large watershed-scale influences and those influences that directly affect aquatic organisms day to day. Together with water chemistry, the habitat measurements and observations describe the variety of physical and chemical conditions that are necessary to support biological diversity and foster long-term ecosystem stability. These characteristics of lakes and their shorelines are the very aspects that are often changed as a result of anthropogenic activities.

1.2.2.4 **Phytoplankton Assemblage**
Phytoplankton are plant microorganisms that float in the water, such as certain algae, and are the primary source of energy in most lake systems (e.g., Schriver et al. 1995). Phytoplankton are highly sensitive to changes in ecosystems (e.g., turbidity and nutrient enrichment).

1.2.2.5 **Sediment Diatom Assemblage**
Diatoms are a group of microscopic algae that have silicon dioxide cell walls and are commonly preserved in lake sediments. This indicator is unique in its ability to indicate past conditions in the lake and its basin based on species-specific environmental requirements (e.g., Dixit et al. 1992, Smol 2012). In addition, environmental variables (e.g., alkalinity, total P, conductivity, etc.) have been inferred using diatom-based predictive models. When possible we will date the sediment so that we are able to identify the time of deposition.

1.2.2.6 **Sediment Mercury**
Mercury is found in many rocks, including coal. When coal is burned, mercury is released into the environment. Mercury in the air eventually settles into water or is washed into water. Once deposited, certain microorganisms can change it into methylmercury, a highly toxic form that builds up in fish, shellfish, and animals that eat fish. Fish and shellfish are the main sources of methylmercury exposure to humans.

Mercury exposure at high levels can harm the brain, heart, kidneys, lungs, and immune system of people of all ages. Birds and mammals that eat fish are more exposed to mercury than other animals in aquatic ecosystems. Similarly, predators that eat fish-eating animals may be highly exposed. At high levels of exposure, methylmercury's harmful effects on these animals include death, reduced reproduction, slower growth and development, and abnormal behavior. Mercury information collected from the NLA 2012 will allow scientists to better predict the impacts of mercury deposition on a watershed.

1.2.2.7 **Zooplankton Assemblage**
Zooplankton are animal microorganisms that consist of crustaceans (e.g., copepods and cladocerans), rotifers ("wheel-animals"), pelagic insect larvae (e.g., phantom midges), and aquatic mites. The zooplankton assemblage constitutes an important element of the food web, where zooplankton transfer
energy from algae (primary producers) to larger invertebrate predators and fish. The zooplankton assemblage responds to environmental stressors such as nutrient enrichment and acidification (e.g., Stemberger and Lazorchak 1994, Dodson et al. 2005). The effects of these environmental stressors on zooplankton can be detected through changes in species composition, abundance, and body size distribution.

1.2.3 Human Use Indicators

Human use indicators address the ability of the lake population to support recreational uses such as swimming, fishing and boating. The protection of these uses is one of the requirements of the Clean Water Act under 305(b). The extent of algal toxins (microcystins) and triazine pesticides will serve as the primary indicators of human use.

1.2.3.1 Algal toxins (microcystins)

*Microcystis* and other cyanobacteria are microscopic organisms found naturally at low concentrations in freshwater systems. Under optimal conditions (such as high light and calm weather, usually in summer), these algae occasionally form blooms, or dense aggregation of cells, that float on the surface of the water forming a thick layer or “mat.” At higher concentrations, blooms may be so dense that they resemble bright green paint that has been spilled in the water. These blooms potentially affect water quality as well as human health (*Microcystis* produces microcystin, a potent liver toxin) and natural resources. Decomposition of large blooms can lower the concentration of DO in the water, resulting in hypoxia (low oxygen) or anoxia (no oxygen). Sometimes, this results in fish kills. The blooms can also be unsightly, often floating at the surface in a layer of decaying, odiferous, gelatinous scum.

Although the likelihood of people being affected by a cyanobacteria bloom is low, minor skin irritation can occur with contact, and gastrointestinal discomfort can also occur if water from a bloom is ingested. People recreationally exposed (e.g., personal watercraft operators) to cyanobacteria blooms have also reported minor skin irritation. Health problems may occur in animals if they are chronically exposed to fresh water with *Microcystis* or other cyanobacteria present. Just as livestock and domestic animals can be poisoned by drinking contaminated water, fish and bird mortalities have been reported in water bodies with persistent cyanobacteria blooms.

1.2.3.2 Triazine Pesticide Screen

Triazine pesticides are herbicides used to control the growth of weeds. Although applied to the land, these chemicals can enter lakes via transport in water (e.g., runoff, groundwater) or atmospheric transport. This screen will provide information about the occurrence and concentration of triazine pesticides in water samples from lakes across the nation.

1.2.4 Other Indicators / Lake Characteristics

Observations and impressions about the lake and its surrounding catchment by field crews will be useful for ecological value assessment, development of associations and stressor indicators, and data verification and validation.
**Table 1.1 Summary table of indicators**

<table>
<thead>
<tr>
<th>Indicator Type</th>
<th>Indicator</th>
<th>Specifications/Location in Lake</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Trophic Indicators</strong></td>
<td>Vertical profile measurements (DO, Temperature, pH)</td>
<td>Desktop Evaluation X Index Site</td>
</tr>
<tr>
<td></td>
<td>Secchi Disk transparency</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Water chemistry (NH₄, NO₃), major anions and cations, alkalinity (ANC)</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>DOC, TSS, silica, conductivity</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Nutrients</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Chlorophyll-α (and see human use)</td>
<td>X</td>
</tr>
<tr>
<td><strong>Ecological Integrity</strong></td>
<td>Phytoplankton assemblage</td>
<td>Integrated water sample J station</td>
</tr>
<tr>
<td></td>
<td>Zooplankton assemblage (composition, structure, and size distribution)</td>
<td>Vertical tow (2 mesh sizes) through water column</td>
</tr>
<tr>
<td></td>
<td>Benthic macroinvertebrate assemblage</td>
<td>10 physical habitat stations</td>
</tr>
<tr>
<td></td>
<td>Sediment diatom assemblage</td>
<td>Sediment core</td>
</tr>
<tr>
<td></td>
<td>Sediment dating (natural lakes only)</td>
<td>Sediment core</td>
</tr>
<tr>
<td></td>
<td>Physical habitat characterization</td>
<td>Sediment core</td>
</tr>
<tr>
<td></td>
<td>Macrophyte assemblage characterization</td>
<td>Sediment core</td>
</tr>
<tr>
<td><strong>Human use</strong></td>
<td>Sediment Mercury</td>
<td>Sediment core</td>
</tr>
<tr>
<td></td>
<td>Chlorophyll-α density</td>
<td>J station</td>
</tr>
<tr>
<td></td>
<td>Phytoplankton (cyanobacteria)</td>
<td>J station</td>
</tr>
<tr>
<td></td>
<td>Triazine pesticide screen</td>
<td>Integrated water sample</td>
</tr>
<tr>
<td></td>
<td>Algal toxins (microcystins)</td>
<td>Integrated water sample</td>
</tr>
<tr>
<td><strong>Other Indicators</strong></td>
<td>Lake area</td>
<td>Using GIS and used in target lake population selection</td>
</tr>
<tr>
<td></td>
<td>Basin morphometry</td>
<td>Using GIS</td>
</tr>
<tr>
<td></td>
<td>Characteristics of watershed</td>
<td>Using GIS and verified by state agencies</td>
</tr>
</tbody>
</table>

**BACKGROUND**

2.0 LOGISTICS

2.1 Roles and Contact Information

Effective communication between Field Crews, U.S. Environmental Protection Agency (USEPA) coordinators, and NLA 2012 contractor support staff is essential for the survey to proceed with maximum efficiency and to ensure collection of high quality data. This section provides:

1) A general description of the roles of key NLA 2012 personnel in providing logistical and technical support to the Field Crews
2) Flow of communication between Field Crews and these individuals (i.e., who to call for specific types of questions or support needs)
3) Contact information

The **EPA Headquarters Project Management Team** consists of the Project Leader, Alternate Project Leaders, and Project QA Lead. The Team is responsible for overseeing all aspects of the project and ensuring technical and quality assurance requirements are properly carried out. The Team is the final authority on all decisions regarding field sampling, site evaluation, site replacement, and laboratory analysis.

The **EPA Regional Coordinators** are the primary USEPA point of contact for Field Crews operating in their Region. Field Crews should direct all technical and logistical questions to their EPA Coordinator, who will work with the EPA HQ Team to resolve the issue. Field Crews should also work with their EPA Coordinator to schedule an *Assistance Visit* to occur within the first two weeks of field sampling. An Assistance Visit is part of the Quality Assurance component of the NLA 2012 QAPP. To meet the requirements of the QAPP, each Field Crew will allow an EPA employee or contractor to observe that crew sampling for one day. The Assistance Visit is used to confirm the protocols are implemented as intended and to suggest corrective actions, if needed, to the Field Crew’s sampling approach.

The **Information Management Coordinator** tracks the Field Crew’s sampling schedules to provide packets of forms for each site scheduled to be sampled, and to track the location of each NLA 2012 sample that involves post-processing. Field crews are responsible for providing the Information Management Coordinator with their sampling schedule before sampling occurs and filing a status report after each site visit.

The **Field Logistics Coordinator** is responsible for tracking the Field Crew’s sampling activities and overall progress throughout the field season, ensuring that requests for supplies and equipment are filled, and assisting Field Crews with questions concerning field logistics, equipment, and supplies as they arise during the field season. The Field Logistics Coordinator will also review submitted status and tracking forms to ensure that the correct samples have been taken and that those samples are being sent to the labs in an appropriate timeframe.

Table 2.1 Personnel to call for specific types of questions and support needs.

<table>
<thead>
<tr>
<th>Personnel</th>
<th>Call</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPA Regional Coordinators</td>
<td>First, to ask any questions about NLA, including questions on field protocols</td>
</tr>
<tr>
<td></td>
<td>Grant questions</td>
</tr>
<tr>
<td></td>
<td>Schedule Field Assistance Visit</td>
</tr>
<tr>
<td>EPA HQ Project Management Team</td>
<td>Ask questions about site access, site evaluation, and site replacement</td>
</tr>
</tbody>
</table>
Ask questions about shipping locations and sample handling procedures
Ask questions about Field Methods
Ask questions about Survey Design
Ask questions about QA procedures
Ask questions about Lab Methods
If you can’t reach Regional Coordinator, IM Coordinator, or Field Logistics Coordinator
If you are unsure who to call

Personnel  

**Information Management Coordinator**  
Order field forms or site kits  
Submit a status report  
Notify EPA about change in sampling schedule  
Ask questions about submitting data packet  
If EPA Regional Coordinator directs you to them

**Contract Logistics Coordinator**  
Order replacement items for site kits, base kits, or miscellaneous supplies  
Ask questions about shipping contract, or to order more shipping forms  
If EPA Coordinator directs you to them
If you can’t reach an EPA HQ or Regional Coordinator and it is an urgent question

**Table 2.2 Contact information**

<table>
<thead>
<tr>
<th>Title</th>
<th>Name</th>
<th>Contact Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPA HQ Project Lead</td>
<td>Amina Pollard, OW</td>
<td><a href="mailto:pollard.amina@epa.gov">pollard.amina@epa.gov</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td>202-566-2360</td>
</tr>
<tr>
<td>EPA HQ Project QA Lead</td>
<td>Sarah Lehmann, OW</td>
<td><a href="mailto:lehmann.sarah@epa.gov">lehmann.sarah@epa.gov</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td>202-566-1379</td>
</tr>
<tr>
<td>EPA HQ Logistics Lead</td>
<td>Marsha Landis, OW</td>
<td><a href="mailto:landis.marsha@epa.gov">landis.marsha@epa.gov</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td>202-564-2858</td>
</tr>
<tr>
<td>Contract Field Logistics Coordinator</td>
<td>Chris Turner, GLEC Inc.</td>
<td><a href="mailto:cturner@glec.com">cturner@glec.com</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td>715-829-3737</td>
</tr>
<tr>
<td>Information Management Coordinator</td>
<td>Marlys Cappaert, SRA International Inc.</td>
<td><a href="mailto:cappaert.marlys@epa.gov">cappaert.marlys@epa.gov</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td>541-754-4467</td>
</tr>
<tr>
<td></td>
<td></td>
<td>541-754-4799 (fax)</td>
</tr>
<tr>
<td>Regional EPA Coordinators</td>
<td>Hilary Snook, Region 1</td>
<td><a href="mailto:snook.hilary@epa.gov">snook.hilary@epa.gov</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td>617-918-8670</td>
</tr>
<tr>
<td></td>
<td>Jim Kurtenbach, Region 2</td>
<td><a href="mailto:kurtenbach.james@epa.gov">kurtenbach.james@epa.gov</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td>732-321-6695</td>
</tr>
<tr>
<td></td>
<td>Frank Borsuk, Region 3</td>
<td><a href="mailto:borsuk.frank@epa.gov">borsuk.frank@epa.gov</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td>304-234-0241</td>
</tr>
<tr>
<td></td>
<td>Marion Hopkins, Region 4</td>
<td><a href="mailto:hopkins.marion@epa.gov">hopkins.marion@epa.gov</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td>404-562-9481</td>
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<tr>
<td></td>
<td>Mari Nord, Region 5</td>
<td><a href="mailto:nord.mari@epa.gov">nord.mari@epa.gov</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td>312-886-3017</td>
</tr>
<tr>
<td></td>
<td>Mike Schaub, Region 6</td>
<td><a href="mailto:schaub.mike@epa.gov">schaub.mike@epa.gov</a></td>
</tr>
</tbody>
</table>
### 2.2 Key Information and Materials

#### 2.2.1 Site Maps

Site maps have been provided to assist in the site evaluation process. Three maps are available: an aerial image, topographic map, and road map, see Figure 2.1. These maps provide an overlay of the NHD waterbody layer with the coordinate and label for the lake, if available. Each site is symbolized by the panel the lake is considered within: NLA 2007 site, NLA 2007 revisit site, NLA 2012 site, and NLA 2012 revisit site. Other important information that may assist in site evaluation is included on the map including: county, state, EPA region, latitude, longitude, class, ownership, and lake area. These maps will be helpful in the planning and preparation for visiting and sampling a particular NLA 2012 site. These maps will become part of your site packet. See more information on the site packet in Section 4.1.

![Figure 2.1 Sample site maps.](image)

#### 2.2.2 Forms (Paper or Electronic)

Forms are the key to data collection and tracking for the NLA 2012. This year, we have developed
electronic forms as well as paper forms. These electronic forms should streamline data collection. Field crews will have the option of using paper or electronic forms.

2.2.2.1 Field Forms
Field forms are the primary documents where we record measures, observations, and collection information during the course of the field day. Additional information regarding specifics of data entry is contained in Section 3.2.

- **Paper Field Forms:** A paper field form packet for each site will be provided by the NARS IM Coordinator if you have elected to use paper field data collection. You will need to add these forms to the site packet (see Section 4.1) prior to going in the field. After a site is sampled, the completed NLA 2012 paper field forms are checked for completeness and organized sequentially into a Data Packet. The Data Packets from several sites are batched together and sent every 1-2 weeks to the NARS IM Center and accompanied by a data tracking form (see Section 2.2.2.2) to track which data packets have been shipped. Extra paper field forms will be provided to field crews to serve as backup copies in case of lost forms or problems with electronic field forms.

- **Electronic Field Forms:** This form of data collection can be collected through 3 platforms: an iOS, Android or a Windows portable electronic device (tablets, phones). This will require a field crew to download or install the developed Application (or “App”) onto the device. The field forms will be optimized for tablet devices. Once downloaded and the App launched, the field forms will be split into sections or “form-lets” for easier data entry. It is important for a field crew to familiarize themselves with the App prior to field sampling. In addition, all data must be submitted through one device (even if multiple devices are used in the field).

2.2.2.2 Tracking Forms
Tracking forms describe the status and location of all samples collected during NLA 2012. Field crew leaders will typically transmit these forms electronically to the NARS IM Center at specified times and you will pack hard copies in shipping containers with the samples. See APPENDIX D: SHIPPING GUIDELINES for more information.

- **Site and Sample Status/WRS Tracking:** Transmitted within 24 hours of sampling or visiting a site to report on the status of the site (e.g. sampleable or not), to record the Sample ID numbers, and to indicate the status of all samples collected at the site (immediate shipment and batch shipments). This also serves as the tracking form for sample shipped to the WRS lab.

- **Tracking – Packets:** Accompany packets that are batched together from multiple sites and shipped every 1 or 2 weeks. These are sent to the NARS IM Center.

- **Batch Samples to GLEC:** Accompany samples that are batched together from multiple sites and shipped every 1 or 2 weeks. Whenever batched samples are shipped to their designated lab for analysis, the appropriate tracking form, which lists the Sample ID numbers for all samples packed in a shipping container, is included in the shipping package and is also transmitted electronically to the NARS IM Center.

2.2.3 Equipment and Supplies

2.2.3.1 Request Form
Field Crews will submit requests for field forms, labels and site kits via an electronic request form. This form will be submitted to the NARS Information Management (IM) Coordinator who will ensure that the request reaches the appropriate entity. Crews must submit sampling schedules at or before the time of
submitting request forms. Crews should submit the request form at least 2 weeks prior to their desired sampling date.

2.2.3.2 Base Kit
The Base Kit is comprised of the subset of durable equipment and supplies needed for NLA 2012 sampling that is provided by USEPA through the Field Logistics Coordinator. Typically one Base Kit is provided to each Field Crew and contains some of the equipment that is used throughout the field season. See APPENDIX B: EQUIPMENT & SUPPLIES for a list of the items provided by USEPA in the Base Kit. We anticipate that this equipment will be available for use in future NLA efforts.

2.2.3.3 Site Kit
A Site Kit contains the subset of consumable supplies (i.e., items used up during sampling or requiring replacement after use) provided by USEPA through the Field Logistics Coordinator. The site kit will contain all the sample bottles and labels necessary for sampling a single lake. A new Site Kit is provided for each site sampled. See APPENDIX B: EQUIPMENT & SUPPLIES for the consumable items that will be provided by USEPA.

2.2.3.4 Field Crew Supplied Items
The field crew will also supply particular items for the field sampling day. These might include supplies from the previous 2007 NLA, typical field equipment (like a GPS), or boat equipment. See APPENDIX B: EQUIPMENT & SUPPLIES for the items that the field crew will need to provide.

2.2.4 Other Resources

2.2.4.1 Quick Reference Guide
Field crews will receive a NLA 2012 Quick Reference Guide (QRG) containing tables and figures summarizing field activities and protocols from the NLA 2012 Field Operations Manual (FOM). The QRG is meant to be used in the field to give NLA 2012 Field Crews a list of the required sampling protocols at each lake. While comprehensive, the steps contained in this QRG are not as detailed as the descriptions found within the NLA 2012 FOM. The user is assumed to have attending Field Training and completely read and understood the FOM before using this QRG at a field site. This waterproof handbook will be a field reference used by field crews after completing a required field training session. The field crews are also required to keep the FOM available in the field for reference and for possible protocol clarification.

2.2.4.2 Site Evaluation Guidelines
The NLA 2012 Site Evaluation Guidelines (SEG) outlines the process to compile the final list of candidate lakes for sampling. The process includes locating a candidate lake, evaluating the lake to determine if it meets the criteria for inclusion in the target population and is accessible for sampling, and if not, replacing it with an alternate candidate lake.

2.2.4.3 Quality Assurance Project Plan
Large-scale and/or long-term monitoring programs such as those envisioned for national surveys and assessments require a rigorous Quality Assurance program that can be implemented consistently by all participants throughout the duration of the monitoring period. QA is a required element of all EPA-sponsored studies that involve the collection of environmental data (USEPA 2000a, 2000b). Field crews will be provided a copy of the NLA 2012 Quality Assurance and Project Plan (QAPP). The QAPP contains more detailed information regarding QA/QC activities and procedures associated with general field
operations, sample collection, measurement data collection for specific indicators, and data reporting activities. For more information on the project level Quality Assurance procedures, refer to the NLA 2012 QAPP.

2.2.4.4 Lab Operations Manual
The methods used for the laboratory sample analysis is available in the NLA 2012 Lab Operations Manual (LOM).
3.0  DAILY FIELD ACTIVITIES SUMMARY

This section presents a general overview of the activities that a field crew conducts during a typical 1-day sampling visit to a lake. The following sections include general guidelines for safety and health, recording data and using standardized field data forms and sample labels.

3.1  Safety and Health

Collection and analysis of samples can involve significant risks to personal safety and health. This section describes recommended training, communications, safety considerations, safety equipment and facilities, and safety guidelines for field operations. All field crews should develop a safety plan according to the requirements of their organization.

3.1.1  General Considerations

Important considerations related to field safety are listed below. It is the responsibility of the group safety officer or project leader to ensure that the necessary safety courses are taken by all field personnel and that all safety policies and procedures are followed. Sources of information regarding safety-related training include the American Red Cross (1979), the National Institute for Occupational Safety and Health (1981), U.S. Coast Guard (1987) and Ohio EPA (1990).

3.1.1.1  Recommended Training

- First aid
- Cardiopulmonary resuscitation (CPR)
- Vehicle safety (e.g., operation of 4-wheel drive vehicles, trailer towing and maneuvering)
- Boating and water safety (if boats are required to access sites)
- Field safety (weather, personal safety, orienteering, site reconnaissance prior to sampling)
- Equipment design, operation, and maintenance
- Handling of chemicals and other hazardous materials

3.1.1.2  Communications

A communications plan to address safety and emergency situations is essential. All field personnel need to be fully aware of all lines of communication. Field personnel should have a daily check-in procedure with their supervisor for safety. An emergency communications plan should include contacts for police, ambulance, fire departments, hospitals, and search and rescue personnel. Here are some items to address:

- Check-in schedule
- Sampling itinerary (vehicle used & description, time of departure & return, travel route)
- Contacts for police, ambulance, hospitals, fire departments, search and rescue personnel
- Emergency services available near each sampling site and base location
- Cell (or satellite) phone number, if possible

3.1.1.3  Personal Safety

Proper field clothing should be worn to prevent hypothermia, heat exhaustion, sunstroke, drowning, or other dangers. Field personnel should be able to swim, and a personal flotation device (PFD) must be used. Chest waders made of rubberized or neoprene material and suitable footwear must always be
worn with a belt to prevent them from filling with water in case of a fall. Here are some personal safety items to address:

- Field clothing and other protective gear including lifejackets for all crew members
- Medical and personal information (allergies, personal health conditions)
- Personal contacts (family, telephone numbers, etc.)
- Physical exams and immunizations

3.1.1.4 Sampling Equipment

Persons using sampling equipment should become familiar with the hazards involved and establish appropriate safety practices prior to using them. Make sure all equipment is in safe working condition. If boats are used to access sampling sites, personnel must consider and prepare for hazards associated with the operation of motor vehicles, boats, winches, tools, and other incidental equipment. Boat operators should be familiar with U.S. Coast Guard rules and regulations for safe boating contained in the pamphlet, "Federal Requirements for Recreational Boats," available from a local U.S. Coast Guard Director or Auxiliary or State Boating Official (U.S. Coast Guard, 1987). As dictated by specific state regulations, all boats with motors should have fire extinguishers, boat horns, life jackets, flotation cushions, and flares or communication devices.

Many hazards lie out of sight in the bottoms of lakes, rivers and streams. Broken glass or sharp pieces of metal embedded in the substrate can cause serious injury if care is not exercised when walking or working with the hands in such environments. Infectious agents and toxic substances that can be absorbed through the skin or inhaled may also be present in the water or sediment. Personnel who may be exposed to water known or suspected to contain human or animal wastes that carry causative agents or pathogens must be immunized against tetanus, hepatitis, typhoid fever, and polio. Biological wastes can also be a threat in the form of viruses, bacteria, rickettsia, fungi, or parasites.

3.1.2 Safety Equipment

Appropriate safety apparel such as waders, gloves, safety glasses, etc. must be available and used when necessary. First aid kits, fire extinguishers, and blankets must be readily available in the field. Cellular or satellite telephones and/or portable radios should be provided to field crews working in remote areas for use in case of an emergency. Supplies such as anti-bacterial soap and an adequate supply of clean water or ethyl alcohol must be available for cleaning exposed body parts that may have been contaminated by pollutants in the water.

3.1.2.1 Safety Guidelines for Field Operations

General safety guidelines for field operations are presented below. Personnel participating in field activities on a regular or infrequent basis should be in sound physical condition and have a physical examination annually or in accordance with Regional, State, or organizational requirements. All surface waters and sediments should be considered potential health hazards due to potential toxic substances or pathogens. Persons must become familiar with the health hazards associated with using chemical fixing and/or preserving agents. Chemical wastes can be hazardous due to flammability, explosiveness, toxicity, causticity, or chemical reactivity. All chemical wastes must be discarded according to standardized health and hazards procedures (e.g., National Institute for Occupational Safety and Health [1981]; U.S. EPA [1986]).

During the course of field research activities, field crews may observe violations of environmental regulations, may discover improperly disposed hazardous materials, or may observe or be involved with an accidental spill or release of hazardous materials. In such cases it is important that the proper actions
be taken and that field personnel do not expose themselves to something harmful. The following guidelines should be applied:

1. First and foremost, protect the health and safety of all personnel. Take any necessary steps to avoid injury or exposure to hazardous materials. If you have been trained to take action such as cleaning up a minor fuel spill during fueling of a boat, do it. However, you should always err on the side of personal safety.

2. Field personnel should never disturb or retrieve improperly disposed hazardous materials from the field to bring back to a facility for “disposal.” To do so may worsen the impact, may incur personal liability or liability for the crew members and their respective organizations, may cause personal injury, or may cause unbudgeted expenditure of time and money for proper treatment and disposal of the material. However, it is important not to ignore environmental incidents. Notify the proper authorities of any incident of this type so that they may take the necessary actions to properly respond to the incident.

3. For most environmental incidents, the following emergency telephone numbers should be provided to all field crews: State or Tribal department of environmental quality or protection, U.S. Coast Guard, and the U.S. EPA regional office. In the event of a major environmental incident, the National Response Center may need to be notified at 1-800-424-8802.

Specific Safety Guidelines are below:

- Two persons must be present during all sample collection activities, and no one should be left alone while in the field.
- Minimize exposure to lake water and sediments as much as possible. Use gloves if necessary, and clean exposed body parts as soon as possible after contact.
- All electrical equipment must bear the approval seal of Underwriters Laboratories (UL) and must be properly grounded to protect against electric shock.
- Use heavy gloves when hands are used to agitate the substrate during collection of benthic macroinvertebrate samples.
- Use appropriate protective equipment (e.g., gloves, safety glasses) when handling and using hazardous chemicals.
- Persons working in areas where poisonous snakes may be encountered must check with the local Drug and Poison Control Center for recommendations on what should be done in case of a bite from a poisonous snake.
- Any person allergic to bee stings, other insect bites, or plants (i.e., poison ivy, oak, sumac, etc.) must take proper precautions and have any needed medications handy (e.g., an “Epi-Pen”).
- Protect yourself against the bite of deer or wood ticks because of the potential risk of acquiring pathogens that cause Rocky Mountain spotted fever, Lyme disease, and other diseases.
- Be familiar with the symptoms of hypothermia and know what to do in case symptoms occur. Hypothermia can kill a person at temperatures much above freezing (up to 10°C or 50°F) if he or she is exposed to wind or becomes wet.
- Be familiar with the symptoms of heat/sun stroke and be prepared to move a suffering individual into cooler surroundings and hydrate immediately.
- Handle and dispose of chemical wastes properly. Do not dispose of any chemicals in the field.

3.2 Recording Data and Other Information

All samples need to be identified and tracked, and associated information for each sample must be
recorded. It is imperative that field and sample information be recorded accurately, consistently, and legibly. The cost of a sampling visit coupled with the short index period severely limits the ability to resample a lake if the initial information recorded was inaccurate or illegible. There are two forums for collecting sample data, as mentioned in Section 2.2.2, paper field forms and electronic field forms. Whichever format your field crew chooses to utilize, see below for important information pertaining to data entry for each of these forms.

### 3.2.1 Paper Field Forms

The NLA 2012 data and tracking forms are formatted so that the data you record can be scanned into a data entry system. It is important that field data and sample information are recorded accurately, consistently, and legibly. General guidelines for recording field measurements are presented in Table 3.1. More detailed instructions for filling out specific forms are provided in each protocol chapter of this manual.

- **Official Data Forms** – The NARS IM Center will provide all forms for use in the NLA 2012. These forms will be provided in the Field Form Packet for each site. It is important to use only the forms provided by the NARS IM Team and not photocopies or other printouts, because they are formatted for to be read by the digital data scanners. Data not recorded on the official NLA 2012 Field Forms are unusable.

- **Site Number, Date, and Page Numbers**: Field forms will arrive without any site information completed, and each field crew must complete the header area of each page with the appropriate information (e.g., site ID, Date, Crew ID, etc). If any of this information is incorrect or omitted, it may be impossible to connect data or samples to a particular site, resulting in lost data.
  - The Site ID is NOT preprinted on the forms or on the labels and tags.
  - The Sample ID numbers ARE preprinted on sample labels and tags. Thus, it is vital to ensure that you correctly enter the Sample ID numbers in the correct areas on the field forms. It is also essential that you correctly enter the Site ID and Date on the labels and tags, along with any other required information for the specific sample.
  - Record the date sampling is initiated wherever it is requested.

- **Form Instructions** – Carefully follow all instructions on each data form. Consult the appropriate protocol chapter, if you have questions not answered by the form instructions, about how to record data for a particular form.

- **Confirmation Bubbles** – Most NLA forms have confirmation bubbles to indicate the meaning of blank data fields or unfilled data bubbles. Read these statements carefully and fill in the bubbles as requested to confirm exactly what empty data fields or unfilled data bubbles on a particular form mean. Completing the confirmation bubbles is critical to note that a data element was not observed at the site, rather than overlooked by the Field Crew.

- **Data Flags and Comments** – There is space on all forms to flag data for which additional information or explanation may be needed.

| Table 3.1 Guidelines for recording field measurements and tracking information. |
|-----------------------|-------------------------------|
| **ACTIVITY**          | **GUIDELINES**                |
| Field Measurements    |                               |
| Data Recording        | • Record observations and measurement values only on official NLA paper field forms (water-resistant) or electronic field forms. |
|                       | • Use a writing instrument that leaves clear, dark text (e.g. a No. 2 pencil for field forms) |
or a water and smear proof fine-point indelible marker for labels as appropriate) to record information.

- If you make an error when recording data and changes are required, it is best to cross out the error with a single horizontal line and rewrite the correct information. Use a flag if there isn’t enough room in the data field and write the correct information in the comments section.
- Complete all header information and record all data and sample id information requested on each form.
- Use the correct Crew ID that was assigned during field training.
- Use the formats specified.
- Print legibly (and as large as possible). Clearly distinguish letters from numbers (e.g., 0 versus O, 2 versus Z, 7 versus T or F, etc.), but do not use slashes (i.e. lines drawn through the character). Printing in capital letters enhances legibility.
- For data that is recorded by filling in a data bubble, be certain to keep markings inside the circle while completely filling the bubble.
- In cases where information is to be recorded repeatedly on a series of lines (e.g., physical habitat characteristics), do not use "ditto marks" (”) or a straight vertical line. Record the information that is repeated on the first and last lines, and then connect these using a wavy vertical line.
- When recording comments, print legibly. Make notations in comments field only; avoid marginal notes. Be concise, but avoid using abbreviations or "shorthand" notations. If you run out of space, attach a sheet of paper with the additional information, rather than trying to squeeze everything into the space provided on the form.
- Do not doodle on the forms, including the margins.

| Data Qualifiers (Flags) | Use only defined flag codes and record on data form in appropriate field.  
|                         | K = No measurement or observation made.  
|                         | U = Suspect measurement; re-measurement not possible.  
|                         | F_n = Miscellaneous flags (n=1, 2, etc.) assigned by a field crew during a particular sampling visit.  
|                         | Explain reason for using K or U flags and define F_n flag in the comments section of the data form. Ensure the F_n numbers are unique on the data form and matched to the flag definition. F_n flags and definitions are not linked from one form to the next, so definitions need to be rewritten on each sheet whenever necessary. |

| Sample Collection Information | Record that each sample has been collected on the appropriate data form. Be sure to record the Sample ID number from labels and tags in the appropriate fields on the data forms using the format requested on each data form. |

| QA and Tracking |  |
Before Leaving Site:
Review of Data Forms and Comparison of Sample Labels and Data Forms

- Review all data forms for accuracy, completeness, and legibility.
- Review all sample labels for accuracy, completeness, and legibility.
- Verify that the information recorded on the sample labels and tags is consistent with all Sample IDs listed on all data forms and on tracking form.
- Confirm that the forms have been reviewed by recording your initials in the “Reviewed by” field in the upper right corner of each form.

Before Shipping Data Packets and Samples:
Review of Data Packets, Sample Labels and Tracking Forms

- The Field Crew Leader must review the completed Data Packet before its transfer to the NARS IM Center to ensure it is complete and all data forms are consistent, correct, and legible.
- Complete all tracking forms required for all samples being shipped. Review tracking forms for consistency, correctness, and legibility.
- Compare labels and tags on samples with the Sample IDs recorded on the tracking form for accuracy, completeness, and legibility before shipping samples and transmitting the tracking forms to the NARS IM Center.

3.2.2 Electronic Field Forms

Many of the above guidelines will be followed for Electronic field forms. Additional data checks are built into the application which will not allow particular data to be entered if certain conditions are not met. But despite those checks, it is important to note that the field crew is responsible for the data entered and must be careful to make sure the data entered is accurate for the site.

3.3 Sampling Scenario

Field methods for the NLA 2012 are designed to be completed in one field day for most lakes. Depending on the time needed for both the sampling and traveling for that day, an additional day may be needed for pre-departure and post-sampling activities (e.g., cleaning equipment, repairing gear, shipping samples, and traveling to the next lake). Remote lakes with lengthy or difficult approaches may require more time to gain access to the lake, and field crews will need to plan accordingly.

A field crew typically will consist of at least two people. Two people are always required in the boat together to execute the sampling activities and to ensure safety. Any additional crew members may either remain on shore to provide logistical support or be deployed in a second boat to assist in data collection. Figure 3.1 and Figure 3.2 present a daily field sampling scenario showing how the work load may be split between crew members. Each field crew should define roles and responsibilities for each crew member to organize field activities efficiently. Minor modifications to the sampling scenario may be made by crews; however the sequence of sampling events presented in Figure 3.1 cannot be changed and is based on the need to protect some types of samples from potential contamination and to minimize holding times once samples are collected. The following sections further define the sampling sequence and the protocols for sampling activities.

NOTE: When sampling large lakes (lakes > 10,000 hectares), field crews may omit the physical habitat and benthic macroinvertebrate sampling efforts altogether, and phytoplankton (cyanobacteria), chlorophyll-a, and algal toxin samples will be collected near the launch site.
Verify lake as target and determine launch site. Set up staging area.

Prepare forms equipment, and supplies

Calibrate multi-probe meter

Load equipment and supplies on to boat

Locate index site and anchor boat
(deepest point of lake; for lakes > 50 m near center of lake)

Measure Secchi depth

Collect integrated water samples #1 and #2
(phytoplankton, chlorophyll-a, algal toxin, nutrients, triazine)

Collect integrated water samples #3 and #4
(water chemistry)

Collect sediment using corer
(top slice: diatoms, mercury; bottom slice: diatoms, mercury, dating)

Conduct 1 MDC Transect on the way to 1st Littoral Station

Locate and travel to physical habitat stations

Conduct habitat characterizations

Measure macrophyte characteristics

Sample benthic macroinvertebrates

Collect chlorophyll-a, phytoplankton, and algal toxin at station J

Conduct additional MDC Transects as needed

Return to shore

Preserve benthic sample and prepare for transport

Check and prepare zooplankton, phytoplankton, dissolved carbon and algal toxin samples for transport

Filter chlorophyll-a samples

Check and prepare water and sediment samples for transport

Clean and organize equipment for loading

Inspect and clean boat, motor, and trailer to prevent transfer of nuisance species and contaminants

Review data forms for completeness

Report to field logistics coordinator and information management coordinator

Figure 3.1 Daily operations summary

DAILY FIELD ACTIVITIES SUMMARY

The field crew arrives at the lake in the early morning to complete the sampling in a single day. The sampling sequence is to:

1. verify lake, calibrate equipment, locate and travel to the index site
2. conduct depth profile measurements of DO, temperature, and pH
3. take Secchi disk transparency depth measurement
4. use the integrated sampler to collect water chemistry, chlorophyll-a, triazine pesticide screen, algal toxin, nutrient, and phytoplankton samples
5. collect dissolved carbon and water isotope samples (at selected lakes)
6. collect zooplankton samples
7. collect sediment core sample for sediment mercury, diatoms, and dating

Figure 3.2 Location of sample collection points and physical habitat (PHab) stations.

The field crew arrives at the lake in the early morning to complete the sampling in a single day. The sampling sequence is to:

1. verify lake, calibrate equipment, locate and travel to the index site
2. conduct depth profile measurements of DO, temperature, and pH
3. take Secchi disk transparency depth measurement
4. use the integrated sampler to collect water chemistry, chlorophyll-a, triazine pesticide screen, algal toxin, nutrient, and phytoplankton samples
5. collect dissolved carbon and water isotope samples (at selected lakes)
6. collect zooplankton samples
7. collect sediment core sample for sediment mercury, diatoms, and dating
8. conduct physical habitat characterization around the margin of the lake at ten littoral zone stations (A,B,C,D,E,F,G,H,I,J)
9. conduct macrophyte assemblage characterization at every other littoral zone station (A,C,E,G,I)
10. collect benthic samples at ten littoral zone stations (A,B,C,D,E,F,G,H,I,J)
11. collect samples at the J physical habitat station for chlorophyll-α, algal toxins, and phytoplankton
12. filter 2 chlorophyll-α samples (one each from index and J physical habitat station)
13. preserve and prepare all samples for shipment
14. review field forms (electronic or paper)
15. report sampling event
16. ship time-sensitive samples (water chemistry, nutrients, chlorophyll-α, and sediment mercury)
4.0 BASE SITE ACTIVITIES

Field crews are to conduct a number of activities at their base site (i.e., office or laboratory, camping site, or motel). These include tasks that must be completed both before departure to the lake site and after return from the field (Figure 4.1). Close attention to these activities is required to ensure that the field crews know:

1. where they are going
2. that access is permissible and possible
3. that equipment and supplies are available and in good working order to complete the sampling effort
4. that samples are packed and shipped appropriately

**Figure 4.1 Overview of base site activities**

### 4.1 Predeparture Activities

Predeparture activities include developing daily itineraries, checking and calibrating instruments, preparing equipment and supplies, and lake verification. Procedures for these activities, which will take place at your office or laboratory, camping site, or motel, are described in the following sections.

#### 4.1.1 Daily Itineraries and Site Packets

The Field Crew Leader is responsible for developing daily itineraries and a site packet. A site packet contains information key to the planning and preparation for visiting and sampling a particular NLA site. Development of site packets should have been initiated during site evaluation and reconnaissance (See NLA 2012 Site Evaluation Guidelines). However, the field crew may need to gather additional
information for the site packet during preparation for the sampling visit. Also, it is the responsibility of the field crew to obtain access permissions and any needed permits as part of developing the site packet. Prior to a field crew traveling to a NLA site for sampling, the information for the site packet must be gathered and reviewed.

This entails compiling maps, contact information, copies of permission letters, and access instructions. The Field Crew Leader must be sure to lay out the physical habitat (PHab) stations on a site map before the sampling day (see Section 6.1.3). Additional activities include confirming the best access routes, calling the landowners or local contacts, and confirming lodging plans. Changes in the itinerary during the week, such as cancelling a sampling day, must be relayed by the Field Crew Leader to the NLA 2012 Field Logistics Coordinator as soon as possible. The site packet may include the following documents:

- **Field forms** (paper or electronic)
- **Site maps**: Provided by EPA HQ Team, see section on Site Maps.
- **Other Maps, Imagery, or GIS Data**: Any other maps, aerial photos, GIS data, or sources of information compiled by Field Crews and/or their partners that could be helpful to sampling the NLA sites.
- **Land Ownership Status, Requirements and Permissions for Access**:
  - Landowner identity and contact information.
  - Results of communication with landowners.
  - Documentation of permission to access private land.
  - Permissions for crossing private lands to reach sites located on public lands.
  - For public land, response of relevant agency to notification that you will be accessing a site, and, if needed, permissions to do so.
- **Permits**: Any permits or documentation required for site access, or for data collection activities or sample/specimen collection.
- **Information for Accessing the Site**:
  - Contact information for landowners.
  - Notes about whether landowner(s) want to be informed when Field Crew is on site.
  - Contact information for individuals who must be available to open gates or allow entry to a site, and the time and location for meeting them.
  - Notes on locked gates, pets, livestock, or other things that could impede access.
  - Notes about active hunting, farming, mining, or other activities on or near the site.
  - Current conditions that could prevent access (e.g., high water, forest fires).
- **Site Evaluation Notes**:
  - Site Evaluation notes, annotated aerial photos, sketch map, and completed field evaluation form that can aid with planning for accessing or sampling a site.
- **Driving and Hiking Routes to the Site**:
  - Detailed driving directions may be obtained from the NLA Google Earth files.
  - Results from the Site Evaluation may include driving directions and notations about site access or logistically challenging conditions on the site, which can be useful in relocating the site or helpful in anticipating special circumstances.
- **Preliminary Plan for Establishing Physical Habitat Stations**: As part of the base location
activities to prepare for field work, review aerial photos and maps of the site and make a plan for laying out the PHab stations. This plan should be included in the Site Packet.

- Any other site specific information useful to the Field Crew.

### 4.1.2 Instrument Checks and Calibration

Test and calibrate instruments prior to sampling. You can calibrate instruments and probes prior to departure for the lake site or at the lake, with the exception of the DO probe (NOTE: some newer instruments may allow for calibration independent of altitude). Because of the potential influence of altitude, calibrate the DO probe at the lake site. Field instruments include a multi-probe unit for measuring temperature, DO, and pH and a Global Positioning System (GPS) receiver. Field crews should have access to backup instruments if any instruments fail the manufacturer performance tests or calibrations.

#### 4.1.2.1 Multi-probe Meter Performance Test

Test and pre-calibrate the multi-probe meter prior to departure from the base site, following either the SOP developed for the instrument of the manufacturer’s calibration and maintenance procedures. Field crews should perform a QC check of the pH meter calibration (and conductivity meter calibration, if this optional measurement is taken). Field crews will have to prepare or purchase their own QC solution.

#### 4.1.2.2 Global Positioning System Use and Battery Check

A GPS unit is used to locate the launch, index site and each station for the physical habitat stations and macrophyte transects. Therefore, it is imperative that the Field Crew understands how to operate their GPS unit.

The Global Positioning System (GPS) uses signals sent from multiple orbiting satellites to a ground-based sensor in order to fix a position on the earth. Position accuracy depends on the Position Dilution of Precision (PDOP) which is a measure of the geometry of the satellite spread over the location of the observer. Low PDOP values represent more advantageous satellite geometry and give better positional accuracy (wider spread of satellites for more definitive triangulation). For NARS a target PDOP < 10 is preferred.

GPS uses many alternative mathematical models to describe the spherical shape of the earth and each is a separate Datum. Commonly used datums include NAD27 CONUS, NAD83, and WGS84. Each represents a different interpretation of the shape of the earth. The NARS standard is NAD83. Thus, all GPS units should be switched to this standard as part of their pre field-use set up. Crews should confirm that the NAD83 datum is being used when the GPS is turned on prior to data collection. If the GPS is not set for NAD83 and the unit cannot be changed readily, note the datum used on the data forms for later conversion.

GPS devices use a variety of units for position designation based on an imaginary latitude and longitude coordinate grid system laid across the earth (degrees, minutes, seconds, or degrees and decimal minutes, and UTM’s (a metric system). The NARS standard is decimal degrees for reporting all GPS positions.

Refer to the GPS user’s manual to provide specific instructions on setting the Datum, coordinate system, and units to NLA standards.

Turn on the GPS receiver and check the batteries prior to departure. Replace batteries immediately if a battery warning is displayed.
4.1.2.3  **Electronic Data Capture Device Battery Check (if applicable)**

Turn on the electronic device and check the batteries prior to departure. Charge immediately if a battery warning is displayed and charge fully to ensure enough battery for a full field day. Battery packs are often available for these devices if that is a concern.

**Table 4.1 Instrument checks and calibration**

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Preparation</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPS Unit</td>
<td>Check the batteries prior to departure</td>
</tr>
<tr>
<td></td>
<td>Ensure map datum is set to NAD83</td>
</tr>
<tr>
<td></td>
<td>Perform manufacturer checks as necessary to ensure accuracy</td>
</tr>
<tr>
<td>Multi-parameter Probe</td>
<td>Calibrate per manufacturer guidelines (Dissolved Oxygen to be calibrated at lake)</td>
</tr>
<tr>
<td></td>
<td>Check the batteries prior to departure</td>
</tr>
<tr>
<td></td>
<td>Perform QC Check as directed by manufacturer and/or lab protocols (field crews will supply QC check solution)</td>
</tr>
<tr>
<td>Electronic Data Capture Device (Optional)</td>
<td>Check the batteries prior to departure</td>
</tr>
<tr>
<td></td>
<td>Ensure NLA Data collection Application is installed and functioning</td>
</tr>
</tbody>
</table>

4.1.3  **Equipment and Supply Preparation**

Check your inventory of supplies and equipment prior to departure using the equipment and supplies checklists provided in the Appendix; use of the lists is strongly recommended. Pack meters, probes, and sampling gear in such a way as to minimize physical shock and vibration during transport. If necessary, prepare stock preservation solutions as described in Table 4.2. Follow the regulations of the Occupational Safety and Health Administration (OSHA).

**Table 4.2 Stock solutions, uses, and methods for preparation.**

<table>
<thead>
<tr>
<th>Solution</th>
<th>Use</th>
<th>Preparation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bleach (1%)</td>
<td>Clean nets, other gear, and inside of boat.</td>
<td>Add 40 mL bleach to 3,600 mL distilled water.</td>
</tr>
<tr>
<td>Lugol's</td>
<td>Preservative for phytoplankton samples.</td>
<td>Lugol’s will be supplied with base kit. If preparation is needed: Dissolve 100 g KI in 1 L of distilled water. Dissolve 50 g iodine (crystalline) in 100 mL glacial acetic acid. Mix these two solutions. Remove any precipitates. Store in the dark.</td>
</tr>
<tr>
<td>95% Ethanol</td>
<td>Preservative for benthic invertebrate samples and zooplankton samples.</td>
<td>No preparation needed (use stock solution as is).</td>
</tr>
</tbody>
</table>

Refuel vehicle(s) and conduct maintenance activities the night before a sampling trip. Check trailer lights, turn signals, and brake lights before departure. In addition, inspect your vehicles, boats, and trailers every morning before departure. Pay particular attention to the trailer hitch, electrical connections, tie downs, tire pressure, and the overall condition of the boats.

Label and package the sample containers into site kits prior to departure (except for sediment mercury and chlorophyll A labels). Container labels should not be covered with clear tape until all information is completed during sampling at the lake. Store an extra kit of sampling supplies (Cubitainers®, bottles, glass fiber filters, foil, gloves, forms, pencils, permanent markers, and labels) in the vehicles. Inventory these extra supply kits prior to each lake visit. Be sure to order field sampling site kits well in advance (2 week minimum) by submitting the electronic request form.
4.1.4 General Equipment and Supplies for all Activities

Table 4.3 indicates equipment and supplies that will be used for all activities.

<table>
<thead>
<tr>
<th>Type</th>
<th>Item</th>
<th>Quantity</th>
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</thead>
<tbody>
<tr>
<td>Forms</td>
<td>NLA 2012 Verification</td>
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</tr>
<tr>
<td></td>
<td>NLA 2012 Assessment (front &amp; back)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>NLA 2012 Index Site Profile (front &amp; back)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>NLA 2012 Index Site Sample Collection (pages 1-3)</td>
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<td></td>
<td>NLA 2012 Physical Habitat Assessment (front &amp; back)</td>
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<td></td>
<td>NLA 2012 Macrophyte Assessment (front &amp; back)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>NLA 2012 Littoral Site Sample Collection (front &amp; back)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>NLA 2012 Invasive Plants &amp; Invertebrates</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>NLA 2012 Tracking – Site &amp; Sample Status</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>NLA 2012 Tracking – Batched Samples to GLEC</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>NLA 2012 Tracking – Packets</td>
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<tr>
<td>Reference</td>
<td>NLA 2012 Field Operations Manual (FOM)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>NLA 2012 Quick Reference Guide (QRG)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>NLA 2012 Quality Assurance Project Plan (QAPP)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>NLA 2012 Site Evaluation Guidelines (SEG)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>NLA 2012 Fact Sheets</td>
<td>10</td>
</tr>
<tr>
<td>Documentation</td>
<td>Clipboard</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Pencils (#2, for data forms)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Permanent markers (fine tip, for most labels)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Labels</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Field Notebook (optional)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Tape strips (3M, pack) (to cover sample labels)</td>
<td>As needed</td>
</tr>
<tr>
<td>Collection</td>
<td>Access permission documents/permit (if required)</td>
<td>1</td>
</tr>
</tbody>
</table>

4.2 Lake Verification

4.2.1 Lake Verification at the Launch Site

You must verify that you are at the correct lake and whether it meets the criteria for sampling. Confirming that you are at the correct lake is based on map coordinates, locational data from the GPS when possible, and any other evidence such as signs or conversations with local residents. Record locational coordinates for the lake on the Verification form. If GPS coordinates are obtained, check the GPS box and record the latitude, longitude, and the type of satellite fix (2D or 3D) for the launch site. All coordinates will be recorded in the NAD 83 datum. Compare the map coordinates given on the lake spreadsheet for the lake with the GPS coordinates displayed for the launch site, and verify that you are at the correct lake. [Note: The map coordinates in the spreadsheet represent the “labeling point” in NHD and may not be near either the index site or the launch site.] This can be confirmed via other methods (e.g., map, landowner confirmation) that the correct sample lake has been located. If GPS coordinates are not available, do not record any information, but try to obtain the information at a later time during the visit. A fix may be taken at any time during a lake visit and recorded on the form by flagging the launch site coordinates and providing a comment.

Record directions to the lake and a description of the launch site on the Verification form regardless of whether the site is sampled or not. This information is very important and will be used in the future if the lake is revisited by another sampling crew. Provide information about signs, road numbers, gates,
landmarks, and any additional information you feel will be useful to another sampling crew in relocating this lake. It is also helpful to describe the distance traveled (miles) between turns. Also describe the launch site on the same form. For example: Can the boat be launched with a trailer? Are there fees? Is the launch paved or does it consist of soft sand? What landmarks are at the launch? Owing to privacy concerns, do not record landowner contact information (e.g., name, address, phone, email address) on the field data form.

In addition to or in the absence of an accurate GPS reading, use as many of the following methods as possible to verify the site:

- Obtain confirmation from a local person familiar with the area.
- Identify confirming roads and signs.
- Compare lake shape to that shown on a topographic map (USGS 7.5 minute map or equivalent).
- Determine lake position relative to identifiable topographic features shown on the map.

If the lake shape on the USGS topographic map does not correspond with the actual lake shape from your site map, and you cannot verify the lake by any other means, check "Not Verified" and provide comments on the Verification Form. At each lake, evaluate whether or not the lake meets the NLA operational definition of a “lake”:

- ≥ 1 ha in total surface area
- ≥ 1000 square meters of open water
- ≥ 1 meter in depth
- Not saline (due to salt water intrusion or tidal influence)
- Not used for aquaculture, disposal-tailings, mine-tailings, sewage treatment, evaporation, or other unspecified disposal use

If the lake does not meet this definition, check "non-target" in the lake sampled section on the middle of the Verification form and provide an explanation for not sampling the lake. Add any additional explanation as required. (For complete details on the Site Evaluation process, refer to the companion document Site Evaluation Guidelines [EPA 841-B-06-003]).

Record the names of each crew member on the Verification form.

Regardless of whether the lake is sampled or not, the field crew must fill out and submit a Verification form for every lake that is visited.

4.2.2 Locating Index Site

Go to the deepest point in the lake to locate the index site (or middle of the lake for reservoirs). If the deepest point exceeds 50 m in depth, do not establish the index site at this location; instead just go as close to the middle of the lake as you can without exceeding 50 m in depth. The procedure below outlines sonar operation and procedures for finding the index site. For reservoirs, the index site is located near the mid-point of the reservoir rather than at the deepest point, which may be near the dam. Once in the general area, use the sonar unit to locate the deepest point (≤ 50 m). When an acceptable site is located, anchor the boat. Lower the anchor slowly to minimize disturbance to the water column and sediment. Determine the coordinates of the index site by GPS (if satellite coverage is available) and record on the Index Profile form. In addition, check the GPS fix box to indicate the type of satellite fix (2D or 3D) for the index site coordinates. If satellite coverage is not available at that time, try again before leaving the index site. The following is the procedure to be used:
1. Operate sonar unit according to manufacturer’s specific operating procedures. If possible, depth readings should be made and recorded in metric units (be sure to specify units on the **Index Profile** form).

2. Use the sonar in the area expected to be the deepest. Spend no more than 30 minutes searching for the deepest point; the maximum depth for the index site is 50 meters.

3. Anchor the boat.

4. Determine the coordinates using GPS. Record GPS coordinates on the **Index Profile** form.

### 4.2.3 Equipment and Supply List

Table 4.4 is the checklist for equipment and supplies required to conduct protocols described in this section. It is similar to but may be somewhat different from the checklist that is used at a base site to assure that all equipment and supplies are taken to and available at the lake. Field crews should use the checklist presented in this section to assure that the equipment and supplies are organized and available on the boat in order to conduct protocols correctly and efficiently.

**Table 4.4 Equipment and Supplies – lake verification.**

<table>
<thead>
<tr>
<th>Type</th>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form</td>
<td>NLA 2012 Verification</td>
<td>1</td>
</tr>
<tr>
<td>Collection</td>
<td>Depth Finder (hand-held or boat mounted sonar)</td>
<td>1</td>
</tr>
<tr>
<td>Collection</td>
<td>GPS unit (with manual, reference card, extra battery)</td>
<td>1</td>
</tr>
<tr>
<td>Collection</td>
<td>Anchor (with 75 m line or sufficient to anchor in 50 m depth)</td>
<td>1-2</td>
</tr>
</tbody>
</table>

### 4.3 Post Sampling Activities

Upon return to the launch site after sampling, review all labels and completed data forms for accuracy, completeness, and legibility and make a final inspection of samples. If information is missing from the forms or labels, the Field Crew Leader provides the missing information. The Field Crew Leader initials all paper field forms after review. If using electronic forms, the Field Crew Leader will need to confirm that they have reviewed forms prior to submission. Other post sampling activities include: sample filtering, inspection and cleaning of sampling equipment, inventory and sample preparation, sample shipment, and communications.

#### 4.3.1 Equipment Cleanup and Check

You must inspect all equipment, including nets, boat, and trailer, and clean off any plant and animal material. This effort ensures that introductions of nuisance species such as Eurasian watermilfoil (*Myriophyllum spicatum*) and zebra mussels (*Dreissena polymorpha*) do not occur between lakes. Prior to leaving a lake, drain all bilge water or live wells in the boat. Inspect, clean, and handpick plant and animal remains from vehicle, boat, motor, and trailer that contact lake water. Inspect and remove any remnants of vegetation or animal life. Before moving to the next lake, if a commercial car wash facility is available, thoroughly clean vehicle, boat, and trailer (hot water pressurized rinse – no soap). Rinse equipment and boat with 1% bleach solution to prevent spread of exotics. Procedures are below.

1. Clean for biological contaminants (e.g., Eurasian water milfoil, zebra mussels, and alewife):
   a. Prior to departing from a lake, drain all bilge water from the boat.
   b. At the lake, inspect motors, boat, and the trailer for evidence of plant fragments especially in or near the propeller and water intakes. Remove all plant fragments.
   c. At the lake or base site, dry out and inspect nets and buckets and remove any remnant vegetation or animal life. Disinfect gear with 1% bleach solution.
d. If a commercial car wash facility is available, thoroughly clean vehicle and boat (hot water pressurized rinse—no soap).

2. Clean and dry other equipment prior to storage:
   a. Rinse chlorophyll-\(\alpha\) collection bottles three times with distilled water after each use.
   b. Rinse graduated cylinders, bulk water sampling containers and other sampling devices three times with distilled water after each use.
   c. Briefly soak zooplankton nets in a 1% bleach solution and dry after each use. Do not dry in sunlight because the mesh is photosensitive.
   d. Clean core sampler, sectioning apparatus, and siphon thoroughly with tap water and bottle brush at the base site.
   e. Rinse coolers with water to clean off any dirt or debris on the outside and inside.

3. Inventory equipment and supply needs and request supplies via the electronic request form (forms or site kits) or from the Field Logistics Coordinator (other items).

4. Remove multi-probe meter and GPS from carrying cases and set up for predeparture checks and calibration. Examine the oxygen membranes for cracks, wrinkles, or bubbles. Replace if necessary.

5. Recharge/replace batteries as necessary.

6. Recheck field forms from the day's sampling activities. Make corrections and completions where possible, and initial each form after review.

4.3.2 Shipment of Samples and Forms
You must ship or deliver time-sensitive samples (i.e., water chemistry, nutrients, chlorophyll-\(\alpha\), and sediment mercury) to the appropriate analytical laboratories as soon as possible after collection. This means the samples will be overnighted. Other samples may be shipped or delivered in batches provided they can be adequately stabilized (i.e., preserve or freeze, according to specifications). Report all sample shipments to the NARS IM Coordinator (by transmitting/faxing the appropriate tracking forms) as soon as possible so that the analytical laboratories can be notified to receive samples and they can be tracked if they do not arrive when expected.

Field crews are to fill out one sample tracking form for each sample shipment. As previously mentioned, some samples will be sent individually to analytical labs, while others will be sent in batches. On each sample tracking form, the following information must be recorded:

- Airbill or package tracking number
- Date sample(s) were sent
- Site ID where each sample was collected
- Sample type code:
  - BENT – Benthic macroinvertebrates
  - CHEM – Chemistry
  - CARU – Dissolved carbon (unacidified)
  - CARP – Dissolved carbon (pre-acidified)
  - CHLX – Chlorophyll-\(\alpha\) (index)
  - CHLL – Chlorophyll-\(\alpha\) (littoral)
  - ISOT – Dissolved Carbon isotope
  - MICX – Algal toxin (microcystins, index)
  - MICL – Algal toxin (microcystins, littoral)
  - NUTS – Nutrient
30 BASE SITE ACTIVITIES

- PHYX – Phytoplankton (index)
- PHYL – Phytoplankton (littoral)
- SEDD – Sediment dating
- SEDT – Sediment diatoms (top)
- SEDB – Sediment diatoms (bottom)
- SEDH – Sediment mercury (top)
- SEDG – Sediment mercury (bottom)
- TRIA – Triazine Pesticide Screen
- ZOCN – Zooplankton coarse (150 micron mesh)
- ZOFR – Zooplankton fine (80 micron mesh, 2007 resample lakes)
- ZOCR – Zooplankton coarse (243 micron mesh, 2007 resample lakes)
- ZOFN – Zooplankton fine (50 micron mesh)

- Date when the sample(s) was collected
- Site visit number (e.g., 1 for first visit, 2 for revisit)
- Sample ID number preprinted on label
- Number of containers for each sample
- Any additional comments

See APPENDIX D: SHIPPING GUIDELINES for further information.

4.3.3 Communications

The Field Crew Leader must review all data forms for consistency, correctness, and legibility before transferring them to the NARS IM Center. Each field crew leader must submit a Site and Sample Status/WRS Tracking to the NARS IM Center (typically via email or fax) after each site visit (whether the site is sampled or not). General communications information, including contact information for the NARS IM Center is outlined in Section 2.1.
5.0 INDEX SITE ACTIVITIES

You will collect several different measurements and indicators at the index site (as described in Table 1.1): a temperature, DO, and pH depth profile, Secchi transparency, chlorophyll-\(a\), phytoplankton, algal toxins, water chemistry, nutrients, triazine, and zooplankton samples, and a sediment core. A detailed description of the individual elements is provided below.

5.1 Temperature, DO, and pH profile

5.1.1 Summary of Method

Use a multi-parameter water quality meter (or sonde) to measure temperature, DO, and pH at predefined depth intervals. Calibrate the sonde probes as necessary and check the calibration against an independent quality control check sample if possible. Record weather and water conditions. Measurement intervals are based on the site depth. Lower the sonde into the water and record the vertical profile of temperature, DO, and pH at the predetermined depth intervals. Once the profile is completed, make another DO measurement at the surface and compare it to the initial reading to see if the probe is functioning correctly and holding calibration. If the lake is thermally stratified, note the top and bottom of the metalimnion based on the temperature readings (usually a change of \(\geq 1\) °C per meter of depth).

The meters and probes are delicate; take care to avoid putting the probe into contact with the bottom sediments. An accurate measure of the site depth will help prevent this from occurring.

5.1.2 Equipment and Supplies

Table 5.1 Equipment and supplies – temperature, pH, and DO profiles.

<table>
<thead>
<tr>
<th>Type</th>
<th>Item</th>
<th>Quantity</th>
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<td><strong>Form</strong></td>
<td>NLA 2012 Index Profile</td>
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</tr>
<tr>
<td><strong>Collection:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water column depth</td>
<td>Depth Finder (hand-held or boat mounted sonar)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Sounding line (50 m, calibrated, marked in 0.5 m intervals) with clip OR</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Rod (calibrated) for very shallow lakes</td>
<td>1</td>
</tr>
<tr>
<td><strong>Collection:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Profile measurements &amp;</td>
<td>Multi-parameter water quality meter (with temperature, pH, and DO probes)</td>
<td>1</td>
</tr>
<tr>
<td>calibration</td>
<td>Sounding line (50 m, calibrated, marked in 0.4 m intervals) with clip</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Squirt bottle (1 L Nalgene) – De-ionized (DI)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Squirt bottle (1 L Nalgene) – lake water</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Calibration cups</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Calibration and quality control check standards</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Barometer or elevation chart to use for calibration</td>
<td>1</td>
</tr>
</tbody>
</table>

5.1.2.1 Multi-Probe Sonde

The multi-probe sonde must be heavy enough to minimize wobbling as it is lowered and raised in the water column. Also, the instrument must be stabilized prior to taking a reading. Experiment with the sonde prior to sampling and add weight to the cable if needed. Some State or Tribal agencies may want to attach additional probes to the sonde and collect profile data on other parameters. While not required for the NLA 2012, including this data is not discouraged, and the Index Profile form is designed to capture these additional data.
5.1.2.2 Temperature Meter
Check the accuracy of the sensor against a thermometer (a non-mercury type is recommended) that is traceable to the National Institute of Standards (NIST) at least once per sampling season. The entire temperature range encountered in the NLA 2012 should be incorporated in the testing procedure and a record of test results kept on file.

5.1.2.3 DO Probe
Calibrate the DO probe prior to each sampling event (Note: some newer instruments and probes may not require this). It is recommended you calibrate the probe in the field against an atmospheric standard (ambient air saturated with water, or water saturated with air for optical probes) prior to launching the boat. In addition, manufacturers typically recommend periodic comparisons with a DO chemical analysis procedure (e.g., Winkler titration) to check accuracy and linearity. Small “mini-Winkler” titration kits are suitable for this check and can be taken into the field.

5.1.2.4 pH Meter
Calibrate the pH electrode prior to each sampling event in accordance with the manufacturer’s instructions and your organization’s existing standard operating procedure (SOP). Conduct a quality control check with a different standard to verify the calibration and periodically evaluate instrument precision (see Section 4.1.2.1). Ideally, the check standard should be similar in ionic strength to the lake water samples you will be measuring. Standard buffer solutions used to calibrate electrodes may not be representative of typical lake waters.

5.1.2.5 Conductivity
A field conductivity measurement is optional for the NLA 2012. If the Field Crew opts to take conductivity measurements, the conductivity meter must be calibrated prior to each sampling event. Calibrate the meter in accordance with the manufacturer’s instructions. Note whether the values recorded have been temperature corrected to 25 °C by the meter.

5.1.2.6 Index Profile Form
Use the Index Profile form to record the following:
- Use the top portion of Page 1 to record environmental conditions observed at the site and the depth of the lake at the index site.
- Use the remaining portion of page 1 to record your calibration information. Documentation includes the instrument’s manufacturer and model number (e.g., YSI 600XL with 650 display), identification number, QCS values (for pH and conductivity, if available), and the instrument readings. The purpose of the ID number is to track which instrument provided the data, in the event that it is later discovered that the unit was operating in error; it will likely be an internal reference number or code supplied by the entity conducting the field sampling.
- The profile table is on the back of the form. It includes columns to record depth, DO, pH and temperature (as well as optional conductivity) and a column to indicate the location of the metalimnion based on temperature changes. It also contains a “Flag” column to note a problem or other conditions of interest.
- The comment section is used to report on “Flagged” measurements or other conditions of note.

5.1.3 Depth Profile Procedure
These are the step-by-step procedures for measuring temperature, pH, and DO profiles at the index site.
1. Calibrate Instrument
   a. Check meter and probes and calibrate according to manufacturers specifications.
   b. Enter calibration information on the front of the Index Profile form.

2. Record Site Conditions:
   a. Observe site conditions and fill out the “Site Conditions” portion of the Index Profile form. Conditions to be reported include:
      i. Precipitation (“None,” “Light,” or “Heavy”)
      ii. Surface conditions (“Flat,” “Ripples,” “Choppy,” or “Whitecaps”)
   b. Presence or absence of odor or scum. (Choice of “Yes” or “No” plus space to describe the odor or scum if present)

3. Determine Site Depth:
   a. Accurately measure the depth using a sounding line or other means and record on the Index Profile form.
   b. Indicate method used.

4. Determine Measurement Intervals:
   a. The number of readings and the depth intervals taken depends on the site depth. Below is a list of rules for determining the intervals:
      i. The profile will always begin with a measurement just below the surface.
      ii. The last (deepest) measurements will always be at 0.5 m above the bottom.
      iii. If the site is < 3.0 m deep, record measurements beginning just below the surface and at 0.5 m intervals, until 0.5 m above the bottom.
      iv. If the depth is between 3.0-20 m, record beginning just below the surface and then at 1.0 m intervals through 20 m (or until reaching 0.5 m above the bottom).
      v. If the depth exceeds 20 m, record beginning just below the surface, then at 1.0 m intervals until you reach 20 m, then at 2 m intervals until 0.5 m above the bottom or the maximum depth of 50 m is reached. You will need to take measurements at least every meter within the metalimnion.
   b. Using the above rules, record the intervals for the profile in the Depth column of the Index Profile form.

5. Measure Temperature, DO, and pH:
   a. Lower the sonde in the water and measure the vertical profile of temperature, DO and pH at the predetermined depth intervals. Be careful not to let the probe touch the bottom.
   b. Record the measurements on the form.
   c. Flag any measurements that the crew feels needs further comment or when a measurement cannot be made.
   d. Use the flag codes on the form and the comment box found on the second page.

6. Duplicate Surface DO Measurement
   a. When the profile is completed, take another measurement at the surface, record it, and compare it to the initial surface reading.
   b. Mark ‘Yes’ or ‘No’ on the form if the second DO reading is within 0.5 mg/L of the initial surface reading. This provides information regarding measurement precision and possible calibration drift during the profile.
      i. If measurement is not within 0.5 mg/L, verify your calibration.
      ii. If DO is found to be out of calibration, re-calibrate and re-record DO measures on a backup form.

7. Determine the Metalimnion:
a. If the lake is thermally stratified, note the top and bottom of the metalimnion in the Metalimnion column.
b. For standardization purposes, the metalimnion has been defined in the protocol as an area where water temperature changes at least 1 degree per meter.
c. If you suspect that the metalimnion exists but does not change at the specified rate, estimate the top and bottom of the metalimnion as best you can, flag the data form, and explain.

5.2 Secchi Disk Transparency

5.2.1 Summary of Method
A Secchi disk is a black and white patterned disk used to measure a lake’s clarity (see Figure 5.1). Take the reading on the shady side of the boat, without sunglasses, hat, or other viewing aids. Record the depths where the disk disappears when descending and reappears when retrieving.

Figure 5.1 Secchi disk diagram (EPA, 1991).

5.2.2 Equipment and Supplies
Table 5.2 Equipment and supplies – Secchi disk transparency.

<table>
<thead>
<tr>
<th>Type</th>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form</td>
<td>NLA 2012 Index Sample Collection</td>
<td>1</td>
</tr>
<tr>
<td>Collection</td>
<td>Meter stick (cm)</td>
<td>1</td>
</tr>
<tr>
<td>Collection</td>
<td>Secchi Disk (20 cm diameter)</td>
<td>1</td>
</tr>
<tr>
<td>Collection</td>
<td>Sounding line (50 m, calibrated, marked in 0.5 m intervals) with clip</td>
<td>1</td>
</tr>
</tbody>
</table>

5.2.3 Procedure for Determining Secchi Transparency
Because different people measuring Secchi transparency at the same site may obtain different results (due to differences in vision and interpreting disk disappearance and reappearance), it is recommended that one crew member conduct Secchi disk measurements at all lakes.

If the lake is shallow and the water clear, the Secchi disk might reach the bottom and still be visible. If this is the case, it is important to not stir up the bottom sediments while anchoring the boat. Move the boat away from the anchor before taking the reading. If the disk is visible at the bottom of the lake, indicate this on the form.

States that wish to take additional measurements for comparisons using a view scope are encouraged to do so after completing the Secchi disk measurements following the NLA protocols.
The following procedure is to be followed:

1. Confirm that the lowering line is firmly attached to the Secchi disk.
2. Remove sunglasses and hat. Also, do not use view scopes or other visual aids. If wearing prescription sunglasses, temporarily replace them with regular clear lens prescription glasses.
3. Lower the Secchi disk over the shaded side of the boat until it disappears.
4. Read the depth indicated on the lowering line. If the disappearance depth is <1.0 meter, determine the depth to the nearest 0.05 meter by marking the line at the nearest depth marker and measuring the remaining length with a tape measure. Otherwise, estimate the disappearance depth to the nearest 0.1 meter. Record the disappearance depth on the form.
5. Lower the disk a bit farther and then slowly raise the disk until it reappears and record the reappearance depth on the form, using the same level of precision as before.
6. Calculate the euphotic zone depth by multiplying the depth where the disk reappears by 2. Record this value on the form.
7. Note any conditions that might affect the accuracy of the measurement in the comments field.

5.3 Water Sample Collection and Preservation

5.3.1 Summary of Method

Collect water samples using an “integrated sampler”- based on a design by the Minnesota Pollution Control Agency (MPCA), see Figure 5.2. The device is a PVC tube 6.6 feet (2 meters) long with an inside diameter of 1.24 inches (3.2 centimeters) fitted with a stopper plug on one end and a valve on the other. The device allows collection of water from the upper two meters of the water column (within the euphotic zone). If the euphotic zone is < 2.0m deep (as calculated in the Secchi Disk Transparency section of the form), lower the integrated sampler only to the depth of the euphotic zone, and take additional grab samples as necessary to collect the total volume needed for the samples.

Remove the rubber stopper and rinse the sampler by submerging it in the lake three times. With the valve open and the stopper off, slowly lower the sampler into the water as vertically as possible until the upper end is just below the surface (or you have reached the depth of the euphotic zone if it is <2 m). Cap and slowly raise the sampler. Close the valve when the bottom is near the surface. Dispense the contents of the sampler into a 4 L Cubitainer®.

5.3.2 Equipment and Supplies

Table 5.3 provides the equipment and supplies needed to collect water samples at the index site.

<table>
<thead>
<tr>
<th>Type</th>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form</td>
<td>NLA 2012 Index Sample Collection</td>
<td>1</td>
</tr>
<tr>
<td>Collection: Water Sample</td>
<td>Integrated sampler device (MPCA design)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Funnel</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Gloves (latex/nitrile, non-powdered)</td>
<td>1</td>
</tr>
<tr>
<td>Storing &amp; Preservation</td>
<td>Cubitainer® (4L) – water chemistry</td>
<td>1</td>
</tr>
</tbody>
</table>
### Sampling Procedure

Assuming the euphotic zone is ≥ 2 meters; collect four integrated water samples (Figure 5.3). Samples #1 and #2 are to be transferred from the sampler to the 4 L Cubitainer®, mixed thoroughly, and poured off into one 2 L sample bottle for chlorophyll-a filtering, one 1 L sample bottle for phytoplankton processing, one 500 mL bottle for the algal toxins sample, one 250 L sample bottle for nutrients, and one 60 mL bottle for the triazine sample. Samples #3 and #4 are to be transferred from the sampler to the 4 L Cubitainer® for the water chemistry sample. If the euphotic zone is less than 2 meters, only collect water from the euphotic zone and increase the number of grab samples accordingly.

![Figure 5.2 Integrated water sampler device (MPCA).](image-url)

#### INDEX SITE ACTIVITIES

<table>
<thead>
<tr>
<th>Material</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDPE bottle (60 mL, white, wide-mouth) – triazine</td>
<td>1</td>
</tr>
<tr>
<td>HDPE bottle (250 mL, brown, wide-mouth) – nutrients</td>
<td>1</td>
</tr>
<tr>
<td>HDPE bottle (500 mL, white, wide-mouth) – algal toxins</td>
<td>1</td>
</tr>
<tr>
<td>HDPE bottle (1 L, white, narrow-mouth) – phytoplankton</td>
<td>1</td>
</tr>
<tr>
<td>Poly bottle (2 L, brown, labeled INDEX) – chlorophyll A</td>
<td>1</td>
</tr>
<tr>
<td>H₂SO₄ ampoules – nutrients</td>
<td>1-2</td>
</tr>
<tr>
<td>pH paper – nutrients</td>
<td>1</td>
</tr>
<tr>
<td>Wet ice</td>
<td>As needed</td>
</tr>
<tr>
<td>Lugol’s solution (250 mL bottle)</td>
<td>5-10 mL</td>
</tr>
<tr>
<td>Cooler</td>
<td>1</td>
</tr>
</tbody>
</table>
5.3.3.1.1 Sample Collection

1. Make sure all necessary data had been written on the sample labels and labels are completely covered with clear tape.
2. Put on surgical gloves (non-powdered). Do not handle any food, drink, sunscreen, or insect repellent until after samples have been collected.
3. Rinse each water sample collection container with surface water 3 times.
4. Remove the rubber stopper cap and open the valve on the bottom end of the sampler. Rinse by submerging it three times in the lake and draining. Do this on the opposite side of the boat you plan to sample from. Do not take samples near the motor.
5. Slowly lower the sampler into the lake as vertically as possible. Stop when the upper end is just below the surface. If the euphotic zone is < 2.0 m deep (as calculated in the Secchi Disk Transparency section of the form), the integrated sampler will be lowered only to the depth of the euphotic zone; additional samples will be taken to collect the volume needed for the samples (8 L total).
6. Cap the upper end with the rubber stopper firmly and slowly raise the sampler.
7. When the bottom of the sampler is near the surface, reach underneath and close the valve on the bottom end.
8. Lift the sampler into the boat, keeping it as vertical as possible. When possible, move the containers to a shaded area of the boat to avoid exposing the sample to direct sunlight when dispensed.
9. Pour the contents of sample #1 and sample #2 into the 4 L Cubitainer® and mix well.
10. Fill the 2 L brown bottle (labeled Index Chlorophyll) from the 4 L Cubitainer®. This is the chlorophyll sample, which will be filtered on shore (see Section 7.2.2). Place on ice until filtration can be initiated.

11. Fill the 1 L phytoplankton bottle from the 4 L Cubitainer®, allowing enough headspace to add at least 5 mL of preservative.

12. Fill the 500 mL bottle from the 4 L Cubitainer®. This is the algal toxin sample. Place the bottle in the cooler with sealed 1-gal plastic bags of ice.

13. Fill the 250 mL bottle from the 4 L Cubitainer®. This is the nutrient sample.

14. Fill the 60 mL bottle from the 4 L Cubitainer®. This is the triazine sample.

15. Pour the contents of sample #3 and sample #4 from the integrated sampler into the 4 L Cubitainer®.

5.3.3.1.2 Sample Preservation

1. For the phytoplankton sample, add 5 mL of Lugol’s solution to the 1 L phytoplankton bottle. Cap the bottle and invert until well mixed. The sample should resemble the color of weak tea. If needed, add additional Lugol’s 2-3 mL at a time.

2. For the nutrients sample, add acid from an ampoule to the water to stabilize the sample. Test the acidity level of the water with litmus paper. You need to ensure that the water has a pH <2. If not, add another ampoule of acid until the litmus test of the water indicates that the sample has the appropriate acidity. In most cases one ampoule will be sufficient. Place the bottle in the cooler with sealed 1-gal plastic bags of ice. Dispose of ampoule properly.

3. Place all samples in the cooler with ice.

5.4 Dissolved Carbon

5.4.1 Summary of Method

At selected lakes, field crews will collect separate water samples from near the surface of the lake for the analysis of dissolved carbon dioxide (CO₂), methane (CH₄), dissolved inorganic carbon (DIC), and water stable isotopes. The results will be used to assess dissolved carbon concentrations and hydrologic conditions in lakes across the nation and will contribute to the USGS Land Carbon project.

5.4.2 Equipment and Supplies

Table 5.4 Equipment and supplies – dissolved carbon.

<table>
<thead>
<tr>
<th>Type</th>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form</td>
<td>Index Sample Collection</td>
<td>1</td>
</tr>
<tr>
<td>Collection</td>
<td>Serum bottles:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>un-acidified (blue tape for CO₂ and CH₄)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>pre-acidified (pink tape for DIC)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Water isotope bottle (10mL)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Poly syringe (60mL) with attached 3-way stopcock</td>
<td>1</td>
</tr>
</tbody>
</table>

a A list of the specific site identifiers for the selected lakes for dissolved carbon and water isotope sample collection is available on the NARS Sharefile (https://sharefile.com/).
5.4.3 Sampling Procedure

Use a syringe to collect two bubble-free water samples from a few centimeters below the lake surface. Use a fresh needle for each sample (one needle is a spare). Collect the unacidified samples first, and then the acidified samples. Also collect one 10 mL bubble-free sample for water isotopes. Store the samples on ice, but avoid freezing them.

If lake water conditions are bad (e.g., very turbulent) and you are concerned about injecting the sample while at the index site, you will follow steps 1 through 6 as described in the procedure below. You will ensure that there are no bubbles in the filled syringe, seal the water sample in the syringe by turning the stopcock, and place the filled syringe in the ice-filled cooler. Once you arrive in less turbulent waters (littoral/shoreline stations) or to shore, you will follow the remaining steps (7 through 15) in this procedure to transfer the water into the appropriate sample bottles. It is important that you transfer the water from the syringe to the sample bottles as soon as possible to reduce the likelihood of contamination.

The following procedure is to be followed:

1. Make sure that the EPA NLA 2012 tracking labels are affixed properly and that they are completely covered with clear tape.
2. Put on gloves.
3. There are 2 serum bottles per site. One bottle has blue tape on it – this bottle is not acidified and is for CO₂ and CH₄ analysis. The other bottle has pink tape on it – this bottle is pre-acidified, and is for DIC and/or ¹³C-DIC analysis.
4. Fill the un-acidified bottle first and use a fresh needle on each bottle, as described below.
5. With a 3-way stopcock attached to the 60 mL syringe, draw in about 10 mL of water from a few cm below the water surface. Expel water from the syringe underwater to rinse it. Repeat rinse, eliminating bubbles from the syringe and expelling the water in the syringe under water, so that you can draw in bubble-free water for the sample (next step).
6. Carefully (i.e., pull the plunger slowly) fill the syringe with lake water. If bubbles get in the syringe, hold the syringe upright (plunger down), and tap the side of the syringe to dislodge the bubbles so they rise to the tip of the syringe. Then expel the resulting air pocket using the syringe plunger. Once bubbles are removed, close the stopcock to prevent air exchange with the sample.
7. Attach the 0.45 µm syringe filter to the luer tip on the 3-way stopcock on the syringe. Make sure the connection is tight by using the locking ring on the 3-way stopcock to secure the filter.
8. Attach the needle to the tip of the 0.45 µm filter. Make sure connection is tight. Push it on as hard as it can possibly go.
9. While pointing the syringe up, open the stopcock and push the plunger to expel air from the filter and needle. Once 5 mL of water has passed through the filter and needle, insert the needle into the first serum bottle through the stopper, and inject 15 mL of water into the bottle. The amount does not have to be exact, but please try to aim for 14-16 mL.
NOTE: While injecting sample water into the bottles, it is best to have the syringe pointed up. When removing the needle from the serum stopper, having the serum bottle upside down on top of the syringe needle would mean that gas cannot follow the needle as it is removed and escape to the atmosphere.

10. After injecting 15 mL of water into the bottle, keep pressure on the syringe plunger and hold the base of the needle firmly while you remove the syringe/needle from the bottle. If the needle comes out of the syringe and the sample is exposed to air, the sample has been compromised. Write “BAD” on this bottle. Move on to the next step (or if this is the second bottle, then sampling is over).

11. Replace the plastic cover for the needle. Change needle and repeat the procedure (steps 8-10) with the acidified bottle (with the pink tape on it).

12. After filling both serum bottles, remove the needle and use the syringe and filter to fill the 10 mL bottle for water stable isotopes by filtering water directly from the syringe into the bottle. The bottle needs to be filled completely with no bubbles. If necessary, more lake water can be collected from several centimeters below the surface using the syringe. Fill the bottle completely (creating a convex meniscus) and carefully screw on the cap. Turn the bottle upside down to make sure there are no bubbles. If necessary, the bottle can be opened and re-filled with filtered lake water to ensure that there are no bubbles.

13. The syringes can be reused indefinitely, and do not have to be rinsed again for the second dissolved carbon sample or for the isotope sample.

14. Please don’t let the serum bottles or water isotope vials freeze. Ideally they should then be kept in a refrigerator until they are shipped. Please pack them carefully, as they can break in transit.

15. Pack the serum bottles, isotopes bottle, used needles, and filter back into the package. Place the entire package on ice for shipment.

5.5  Zooplankton Collection

5.5.1  All Lakes

5.5.1.1  Summary of Method
Collect two vertical samples using a fine mesh (50 µm) and coarse mesh (150 µm) Wisconsin nets with collection bucket attached at the cod end. Each net is slowly lowered over the side of the boat into the water. The net is retrieved back to the surface at a slow, steady rate. Lift the net out of the water; rinse it from the outside to free organisms from the side of the net, and to concentrate them in the collection bucket. Transfer the sample from the bucket to a 125 mL sample container. Narcotize the organisms with carbon dioxide and preserve each sample with 95% ethanol. You will repeat the procedure with the other net on the opposite side (or end) of the boat. The cumulative tow length for each net is 5m. In shallow lakes, multiple tows with each net are required to achieve the cumulative tow length. The objective is to sample a sufficient volume of water to obtain at least 300 organisms per sample from all but the most oligotrophic lakes.

5.5.1.2  Equipment and Supplies
Table 5.5 provides the equipment and supplies needed to collect a zooplankton sample. Figure 5.4 is an
illustration of the Wisconsin nets and collection buckets.

**Table 5.5 Equipment and supplies – zooplankton collection.**

<table>
<thead>
<tr>
<th>Type</th>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form</td>
<td>Index Sample Collection</td>
<td>1</td>
</tr>
<tr>
<td>Collection</td>
<td>Plankton net (50 µm) and collection bucket</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Plankton net (150 µm) and collection bucket</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Sounding line (50 m, calibrated, marked in 0.5 m intervals) with clip</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Funnel</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Squirt bottle (1 L Nalgene) – de-ionized (DI)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Squirt bottle (1 L Nalgene) – lake water</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>CO₂ (Alka seltzer) tablets</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Pail (narcotization chamber)</td>
<td>1</td>
</tr>
<tr>
<td>Storing &amp; Preservation</td>
<td>HDPE bottle (125 mL, white, wide-mouth)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Ethanol (95%)</td>
<td>1</td>
</tr>
</tbody>
</table>

**Figure 5.4 Wisconsin net and collection bucket diagram.**

5.5.1.3 *Sampling Procedure*

The procedures for collecting and processing zooplankton samples are presented below.

5.5.1.3.1 *Sample Collection*

1. Determine and record the number of tows required to achieve the standard cumulative 5 m tow on the **Index Sample Collection** form.
   
   a. For lakes deeper than 7 m, you will take a 5 m tow.
   
   b. For lakes with a depth less than 7 m, you will determine and record the number of tows that will be required to achieve a standard cumulative 5 m tow. For example, if the lake is 6 meters deep, you will take two 2.5 m tows.
<table>
<thead>
<tr>
<th>Depth of lake (m)</th>
<th>Depth of Tow</th>
<th>Number of Tows</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>5 m</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>2.5 m</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>2.5 m</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>2.5 m</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>1 m</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>1 m</td>
<td>5</td>
</tr>
<tr>
<td>1 - 2</td>
<td>0.5 m</td>
<td>10</td>
</tr>
</tbody>
</table>

c. The zooplankton collection methods vary slightly depending on the number of tows required to achieve a standard cumulative 5 m tow.

   i. If the number of tows = 1: follow steps 2 through 14 described below.
   
   ii. If the number of tows ≥ 2: follow steps 2 through 13 described below. After step 13, you will pour the contents of the collection bucket into a clean (i.e., DI rinsed) 1-gallon pail. While taking care not to tip the zooplankton sample in the pail, you will repeat steps 2 through 13 for the second tow. Add the contents of the collection bucket from the second tow to the pail. You will continue to take zooplankton tows and add samples from the collection bucket into the pail until you reach your target number of tows (2, 5, or 10). Pour the contents of the pail into the collection bucket to filter out some of the excess water. Rinse the bucket with DI water and pour the contents of this rinse into the collection bucket with the zooplankton sample. Once the zooplankton sample has been filtered down to an appropriate volume in the collection bucket, you will continue on to step 14.

2. Prior to each use, carefully clean and thoroughly rinse the interior of the plankton nets and buckets with DI water.

3. Carefully inspect the nets and buckets for holes or tears.

4. Attach the collection buckets to the “cod” end of the nets and secure. Make sure you attached the correct bucket to the correct net (i.e., the mesh sizes match).

5. Attach the bridled end of the plankton net to a 0.25” calibrated line with markings every 0.5 m (you can use the line for the Secchi disk).

6. Carefully and slowly lower the first net in a constant upright position over the side of the boat.

7. Continue lowering the net to the correct depth (remember to account for the length of the bridles). If more than one tow is needed, be sure to take additional tows from different locations around the boat.

8. Retrieve the net by pulling back to the surface at a steady rate (0.3 m or 1 ft/s) without stopping.

9. Once at the surface, slowly dip the net up and down in the water without submersing the net mouth to rinse contents into the collection bucket.

10. Complete the rinsing of the net contents by spraying lake water against the outside of the net with a squirt bottle or similar tool. Be careful not to splash or squirt lake water into the net mouth, or additional organisms may be collected.

11. If additional rinsing is needed on the interior of the net, use a squirt bottle with DI water only to avoid introducing additional organisms.
12. Once all organisms have been rinsed into the collection bucket, hold the collection bucket in a vertical position, and carefully remove the bucket from the net.

13. Concentrate the contents of the collection bucket by swirling the collection bucket without spilling the contents. Excess lake water will filter out of the bucket from the screened sides.

14. Repeat steps 5-13 with the second net on the opposite side (or end) of the boat.

5.5.1.3.2 Sample Processing

1. Set the collection bucket in a pail filled half full with lake water to which 2 CO$_2$ (alka-seltzer) tablets have been added. Ensure that the organisms in the collection bucket are submerged in the water, but be careful not to submerge the top of the collection bucket, or sample loss will occur. The CO$_2$ narcotizes the zooplankton to relax their external structure prior to preservation in 95% ethanol. This facilitates taxonomic identification. Wait until zooplankton movement has stopped (usually about 1 min).

2. Check the sample label on the bottle to verify which sample has been collected (coarse or fine mesh). Record the sample ID number and check on the form that it is preserved.

3. Use small volumes of DI water from a squirt bottle to rinse the contents of the mesh net collection bucket into the 125 mL polyethylene bottle. Rinse the collection bucket with DI water three to four times or until the majority of zooplankton have been removed without allowing the bottle to fill more than half full (~60-70 mL of sample and rinse water combined). After the zooplankton has been transferred and the sample bottle is half full with sample and rinsate, fill the bottle to the shoulder with 95% ethanol. Use a funnel if necessary.

4. In some cases, the volume of zooplankton collected in the collection bucket may exceed 125 mL. Do not try to force the entire sample into a single bottle, or the preservative will not function properly and the sample may be lost. In such cases, fill the first bottle half full, and then use a second bottle to preserve the additional amount of sample. Use an “extra jar” label (i.e., one with no sample number printed on it). Complete the label, and print in the sample number assigned to the first container on the label of the second container. On the form, record a “2” in the “No. Jars” field.

5. Record the sample ID number and check on the form that it is preserved.

6. Verify that all information on the labels and the form is complete and correctly recorded.

7. Repeat steps 1-6 for the second sample collected.

5.5.2 Resample Lakes (NLA 2007 Protocol)

At the resample site lakes you sample in a state, collect additional zooplankton samples following the protocol used in NLA 2007 (different net design, mesh sized, and cumulative tow length). Results from this set of samples will be compared to the NLA 2007 zooplankton samples and potentially serves as a means to calibrate the 2012 and 2007 results.

5.5.2.1 Summary of Method

Collect two vertical samples using the fine mesh (80 µm) and coarse mesh (243 µm) Wisconsin nets from NLA 2007. The sampling procedure differs for these samples compared to those described in section 5.5.1.3, in that a single tow is taken of the entire index site water column, for both the 80 µm and 243 µm nets. Nets are lowered to within 0.5 m of the bottom and then pulled vertically. Additionally, when the depth of the index site is less than 2 m and the Secchi disk can be seen at the bottom, a second tow is made and the samples combined (cumulative tow length equals 3 m or less).
5.5.2.2  Equipment and Supplies

Table 5.6 provides the equipment and supplies needed to collect a zooplankton sample using the NLA 2007 protocol.

Table 5.6 Equipment and supplies – zooplankton collection (NLA 2007 method).

<table>
<thead>
<tr>
<th>Type</th>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form</td>
<td>Index Sample Collection</td>
<td>1</td>
</tr>
<tr>
<td>Collection</td>
<td>Plankton net (80 µm) and collection bucket</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Plankton net (243 µm) and collection bucket</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Sounding line (50 m, calibrated, marked in 0.5 m intervals) with clip</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Funnel</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Squirt bottle (1 L Nalgene) – de-ionized (DI)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Squirt bottle (1 L Nalgene) – lake water</td>
<td>1</td>
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<tr>
<td></td>
<td>CO₂ (Alka seltzer) tablets</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Pail (narcotization chamber)</td>
<td>1</td>
</tr>
<tr>
<td>Storing &amp; Preservation</td>
<td>HDPE bottle (125 mL, white, wide-mouth)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Ethanol (95%)</td>
<td>1</td>
</tr>
</tbody>
</table>

5.5.2.3  Sample Collection and Processing Procedure

5.5.2.3.1  Sample Collection

1. Record the Site ID and date on the sample label. Record the length of tow (normally calculated by subtracting 0.5 m from the water depth) on the labels.

2. Prior to each use, carefully clean and thoroughly rinse the interior of the plankton nets and buckets with DI water.

3. Carefully inspect the nets and buckets for holes or tears.

4. Attach the collection buckets to the “cod” end of the nets and secure. Make sure that the mesh sizes of the net and bucket match.

5. Attach the bridled end of the plankton net to a 0.25 inch calibrated line with markings every 0.5 m (you can use the line for the Secchi disk, if necessary).

6. Carefully and slowly lower the first net in a constant upright position over the side of the boat.

7. Continue lowering the net until the mouth of the net is 0.5 meters above the lake bottom (remember to account for the length of the bridle). If the depth is < 2 m and the Secchi disk could be seen at the bottom, a second 1.5 m tow is made and the samples combined (cumulative tow length=3 m).

8. Retrieve the net by pulling back to the surface at a steady constant rate without stopping (0.3 m or 1 ft per second).

9. Once at the surface, slowly dip the net up and down in the water without submersing the net mouth and help rinse contents into the collection bucket.

10. Complete the rinsing of the net contents by spraying water against the outside of the net with a squirt bottle or similar tool. Be careful not to splash or squirt lake water into the net mouth, or additional organisms may be collected.

11. If additional rinsing is needed on the interior of the net, use a squirt bottle with DI water only to avoid introducing additional organisms.
12. Once all organisms have been rinsed into the collection bucket, hold the collection bucket in a vertical position and carefully remove the bucket from the net.
13. Concentrate the contents of the collection bucket by swirling the bucket without spilling the contents. Excess lake water will filter out of the bucket from the screened sides.
14. Repeat steps 5-13 with the second net on the opposite side (or end) of the boat.
15. Follow the sample processing procedure outlined in section 5.5.1.3.2.

5.6 Sediment Mercury, Diatoms, and Dating Sample Collection

5.6.1 Summary of Method
Use a gravity-type sediment corer to collect an intact sediment core at the index site and then slice off the top and bottom of the core for analysis in the laboratory. The lab will use trace-metal clean techniques to analyze sediment from the top and bottom slices. The results will be used to assess current and past conditions of mercury loading and diatom frustule abundance and composition across the nation. The bottom core sample (collected from natural lakes only) will be dated (using lead-210) to allow for estimates of the approximate age of the bottom of the core. By including sediment aging, this investigation will provide a general indication of the rate of change of two key indicators for our nation’s lakes.

Figure 5.5 Sediment core sample summary.
5.6.2 Equipment and Supplies

Table 5.5 provides the equipment and supplies needed to collect a sediment core sample. Figure 5.7 is an illustration of the gravity corer (68 mm diameter and 60 cm long core tube) and sectioning apparatus. Core tubes will be marked at 45 cm.

Table 5.7 Equipment and supplies – sediment core sample.

<table>
<thead>
<tr>
<th>Type</th>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form</td>
<td>Index Sample Collection</td>
<td>1</td>
</tr>
<tr>
<td>Collection: Sediment Core</td>
<td>Corer head (gravity, with cable and messenger)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Core tube</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Sectioning tube (6 cm, 2.5 in ID, line marked 2 cm from bottom of tube)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Sectioning stage</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Extruder rod</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Spatula (1.5 inch plastic putty knife)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Syringe (60 mL) with tubing siphon overlying water</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Core plug</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Screwdriver</td>
<td>1</td>
</tr>
<tr>
<td>Collection: Sediment Mercury</td>
<td>Kit: Sediment Mercury pre-cleaned supplies in ziploc bag:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Transfer Pipette (plastic)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>- Screw top jar (125 mL, plastic)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Gloves (latex/nitrile, non-powdered)</td>
<td>2-3 pairs</td>
</tr>
<tr>
<td></td>
<td>Scoopula</td>
<td>1</td>
</tr>
<tr>
<td>Storage &amp; Preservation: Sediment Diatoms</td>
<td>Screw top jar (15 mL, plastic)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>in reservoirs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 in natural lakes</td>
</tr>
<tr>
<td>Storage: Sediment Dating</td>
<td>Screw top jar (60 mL, plastic)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(natural lakes only)</td>
</tr>
</tbody>
</table>
5.6.3 Sampling Procedure

Collect a 45 cm long sediment core from undisturbed sediments at or near the index site and section off 2 cm of sediment from the top (at all lakes) and bottom (at natural lakes only) of the core sample for analysis. Sediment from the top will be used for the following samples: mercury and diatoms. Samples from the bottom of the core (natural lakes only) will be used for the following samples: mercury, diatoms and dating analysis.

In natural lakes, the composition and texture of the bottom will vary from lake to lake and, in some lakes, it will be impossible to get a 45 cm core because the bottom is too rocky, the sediments are too dense, or, if it is a shallow lake, there are macrophytes covering the bottom. It is essential that the GPS coordinates be recorded and the collection location be marked on the Index Sample Collection form.

If you collect a core less than 45 cm long on your first try, move to another location near the index site to find an area with a softer bottom. In addition, you can experiment with getting improved penetration by adding additional weight (if available) to the corer, and/or by releasing the corer further above the sediments. If a 45 cm core sample cannot be collected from natural lakes after attempting at least three locations, process the last core that you obtained. The procedures for collecting and processing sediment cores are presented below.

If you collect a core longer than 45 cm long, as long as there is water on top of the sediment core, this will be acceptable for use.

Figure 5.7 Illustration of the core tube and sectioning apparatus.

5.6.3.1 Sediment Core Sample Collection

1. Wear surgical gloves at all times during sample collection to protect yourself from any potential contaminants in the sediments, and to prevent contamination of the sample from trace mercury on the skin of the sampling crew.

2. If the bottom has been disturbed during the initial depth determination or for any other reason, move at least 5 m to take the core. It is critical that the corer strikes undisturbed surface sediments.
3. Insert the core tube into the sampling housing apparatus and tighten the hose clamp screws to secure the tube. Ensure the messenger is attached to the sampler line. Set the release mechanism.

4. Slowly lower the corer through the water column until the bottom of the core tube is just touching the sediment surface. Raise the corer 1 m and while maintaining a slight tension on the line, lower the corer allowing it to settle into the bottom substrate. Immediately after the corer drops into the sediments, maintain line tension to prevent the corer from tilting and disturbing the core sample. (Keep in mind that the goal is to obtain a core 45 cm in length. If this core length is not obtained the first time, the operation might need to be repeated at a new location using additional weights on the corer (if available) and/or a greater release height in order to improve penetration and obtain a longer core. If the core length exceeds the length of the core tube, the operation might need to be repeated at a new location using less weight on the corer and/or a shorter release height.)

5. Trip the corer by releasing the messenger weight so that it slides down the line. Keeping the line vertical and keeping tension on the line will help ensure that the messenger reaches the sampler and trips the mechanism.

6. Slowly raise the corer back to the surface, until the top of the core tube and rubber seal are just under the water.

7. While keeping the seal under water, slowly tilt the corer until you can reach under the surface and plug the bottom of the corer with a corer tube plug. To do this without disturbing the water-sediment interface, you cannot tilt the corer more than 45 degrees. (This is a fairly difficult operation and corer tube plugs are easily lost. Be sure to have spares available at all times.)

8. Keeping your hand under the corer tube plug, raise the corer into the boat in a vertical position. Stand the corer in a large tub to prevent contaminating the boat with sediment material.

5.6.3.2 Sediment Core Processing

1. Measure the length of the core to the nearest 0.1 cm and record the interval on the Index Sample Collection form and on the two sample labels. Determine the intervals by:
   a. Top Slice Interval: 0 to 2 cm
   b. Bottom Slice Interval: Calculate using the formula where L equals total length: (L-2) to (L-4) cm

1. Put gloves on. Record the Site ID, date, and collection intervals on sediment core sample labels. Prepare containers and attach the labels to two plastic containers (for diatoms), one 60 mL screw top plastic jar (for sediment dating), and plastic jars (for sediment mercury). Cover labels with tape. IMPORTANT: only handle sediment mercury containers with clean gloved hands, and keep the containers in the provided plastic bags whenever possible.

   - The pre-washed “sampling kit” for the sediment sample will be provided in a resealable plastic bag. Do not open the bag until you are ready to collect the sediment sample, and make sure the contents of the kit do not come into contact with anything other than the sediment sample.

2. Detach the core tube from the corer. One crew member should hold the sampler in a vertical position while the second person dismantles the unit.
3. Position the extruder under the corer tube plug at the base of the coring tube. Supporting both the core tube and the extruder in a vertical position, **slowly** lower the coring tube onto the extruder until the sediment is approximately 1 cm below the top of the tube.

4. Remove the water above the sediment core by using a syringe with tube so that the surface sediments are not disturbed.

5. Secure the sectioning stage onto the top of the coring tube. Place the Plexiglas sectioning tube (marked with a line 2 cm from the bottom) on the stage directly over the coring tube. **Slowly** extrude the sediment core into the sectioning tube until the top of the sediment reaches the 2 cm line on the sectioning tube. Slide the sectioning tube onto the flat part of the stage and scrape the top 2 cm section of sediment into a clean 125 mL container labeled for the top interval sediment mercury sample (a clean reusable plastic spatula may be used to aid in transferring the sample to the container).

6. Recap sediment mercury sample cup and return to bags.

5.6.3.3 **Bottom Sample Collection (Natural Lakes Only)**

7. Before collecting the bottom section, remove the stage and sectioning tube and rinse in lake water. Also rinse the spatula, gloved hands and any other implements that have come in contact with the sediment. This procedure prevents contamination of the bottom sediment layer with diatoms from the top portion of the core. This step is critical because a small amount of sediment contains millions of diatoms that would contaminate the population structure needed to compare environmental conditions depicted by top and bottom core samples.

8. Continue extruding the sample, discarding the central portion of the sediment in the tube, until the bottom of the corer tube plug is approximately 7 cm (3 inches) from the top of the coring tube.

9. Rinse any sediment from your gloved hands. Re-affix the sectioning stage and sectioning tube to the top of the coring tube. Extrude the sample into the sectioning tube until the bottom of the stopper reaches the lower black line at the top of the coring tube (6 cm from the top of the tube). Section the extruded sediment (approximately 1 cm) and discard.

10. Rinse the sectioning tube with lake water. Without removing the sectioning stage from the coring tube, slightly tilt the tube and wash the stage with a small amount of water from a squirt bottle. Make sure the rinse water runs off the stage and not into the coring tube with sediment. Extrude the sample until the top of the sediment is at the 2 cm mark on the sectioning tube. Slide the sectioning tube onto the flat part of the stage.

11. Cut off 1/3 of the sample and transfer to the sediment mercury container, 125 mL plastic container. Transfer the remaining sediment into the 60 mL screw top container for sediment dating. Discard the remaining 2 cm.

5.6.3.4 **Diatom Sample Collection**

1. Retrieve the mercury sample container from the bag with clean, gloved hands. Remove the lid. Using the transfer pipette, homogenize the sediment in the 125 mL container, transfer 5 mL sample from the mercury container to the diatom container.

2. The sediment remaining in the 125 mL container is the sediment mercury sample. Recap and replace the sediment mercury container in the bag. Seal. Place the mercury sediment sample on ice immediately and keep cold until shipment.
3. If you collected sediment from the bottom of the core, repeat this sub-sampling process for the bottom sediment sample. Note: If the sediment is too firm to homogenize with the pipette, use the spatula included in the base kit.

4. Place containers in a cooler with bags of ice.

5. Rinse the corer, spatula, coring device, and sectioning apparatus thoroughly with lake water. Rinse with tap water at the next base site. After cleaning the core tube, cover the ends with the orange caps and place it into a plastic bag.

5.7 Macrophyte Observation - Maximum Depth of Colonization

After sampling the index site, you will check the lake for the presence of macrophytes by estimating the maximum depth of colonization (MDC) along one transect as you head in toward shore (e.g., your first littoral/shoreline station). You will follow the protocol described in 6.2.4.2, where you move the boat from the index site to an appropriate depth and use the rake to sample for macrophyte presence at one meter increments along a transect. You will record your observations on the Macrophyte Assemblage Characterization form.
6.0 LITTORAL AND SHORELINE ACTIVITIES

To better understand the character of near-shore habitats and conditions, travel to 10 evenly spaced physical habitat (PHab) stations around the lake and document conditions and characteristics observed within a defined plot area. The full array of measurements and sampling described in this chapter include:

- measures or observations of littoral, shoreline, draw-down zone, and riparian physical habitat cover and structure at the 10 PHab stations;
- observations of invasive plants and macroinvertebrates;
- sampling of benthic macroinvertebrates at each of the 10 stations and composited as a single sample; and
- collection of water samples at the last PHab station for chlorophyll-α cell density, phytoplankton, and algal toxins (microcystins).

It should be noted that for lakes with a surface area of greater than 10,000 ha (defined as large lakes), the crews do not have to travel to the PHab stations and perform physical habitat assessments, benthic macroinvertebrate, or macrophyte sampling due to the increased level of effort required to travel around these large lakes. However, we encourage crews to complete the physical habitat characterizations on large lakes. Additionally, water samples for the above three indicators are collected near the boat launch at these large lakes.

6.1 Physical Habitat Characterization

6.1.1 Summary of Method

The approximate locations of the 10 lake shore stations are determined prior to the sampling visit and marked on the Site Map. Figure 3.1 displays the placement and distribution of PHab stations around the lake. Within each PHab station, you will set up a plot as shown in Figure 6.1. The plot measures 15m wide, and includes a littoral plot extending 10m out from the shoreline, a drawdown zone plot (newly added to the NLA 2012 methods) extending inland from the shoreline to the normal high-water level, a 1m shoreline zone plot at the shore just above the present water line, and a 15m wide riparian plot that begins at the normal high water mark and extends 15m landward. The drawdown zone plot extends a variable distance inland depending on the degree of drawdown and, if it is negligible, can be ignored if the lake is at its normal high water mark.

Figure 6.1 Dimensions and layout of a physical habitat station.
As described below, you will record observations from each of the zones on the Physical Habitat Characterization form.

### 6.1.2 Equipment and Supplies

Table 6.1 provides the equipment and supplies needed to locate the PHab stations and conduct the physical habitat characterization.

**Table 6.1 Equipment and supplies – physical habitat assessment.**

<table>
<thead>
<tr>
<th>Type</th>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form</td>
<td>NLA 2012 Verification</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>NLA 2012 Physical Habitat Characterization</td>
<td>12</td>
</tr>
<tr>
<td>Collection</td>
<td>Depth Sounder (hand-held or boat mounted sonar)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Sounding rod (3 m, marked in 0.1 m increments, calibrated, PVC)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>GPS unit (with manual, reference card, extra battery)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Rangefinder (for estimating horizontal drawdown)</td>
<td>1 (optional)</td>
</tr>
<tr>
<td></td>
<td>Clinometer (for use as a level to measure vertical drawdown)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>7.5m telescoping fibreglass surveyors rod (round x-section) (for measuring vertical drawdown)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Binoculars (for making observations of distant riparian)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Map wheel or string (for measuring shoreline distances on site map)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Anchor (with 75 m line or sufficient to anchor in 50 m depth)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Buoy (for marking observation point)</td>
<td>1</td>
</tr>
</tbody>
</table>

### 6.1.3 Locating the Physical Habitat Stations and Defining the Shoreline Boundary

#### 6.1.3.1 Base Site Activities

It is important that you set up PHab stations beforehand in the office to minimize bias in site selection and to ensure efficient location of stations once at the lake.

1. Using a lake map, select a random starting point on the lake outline. Any reasonable method may be used: select the starting point (e.g. tossing a coin on the map, place a compass on the map in the center of the lake and find due north), this is your “A” station.

2. It is important that the remaining nine stations be located at equal distances around the lake (see Figure 3.2). These will be your “B” through “J” stations. Field crews can do this manually (by either using a string to trace the perimeter of the lake, which can then be straightened and marked in equal intervals, or by using a map wheel) or electronically (with GIS or other digital mapping tools) to measure the perimeter of the lake and dividing by 10.

3. Using a GIS or other digital mapping tool application to locate the coordinates of the ten stations that can then be entered as GPS waypoints greatly facilitates correctly locating PHab stations by boat in the field, especially on large lakes.

4. Mark the physical habitat stations on a site map.

**Note:** In revisit lakes (see 8.1 for more information), you will re-randomize and relocate the physical habitat sites. We re-randomize the sites because we use the revisit data to examine variability of the entire lake assessment.

#### 6.1.3.2 Littoral and Shoreline Activities

Using the site maps and GPS, proceed by boat around the lake, locate, and stop at each of the 10 PHab
stations. Position the boat at a distance of 10 m, anchor if necessary, and make the semi-quantitative measurements on the Physical Habitat Characterization (PHab) form. Complete a separate PHab form for each station.

Make every reasonable attempt to record physical habitat observations and measurements for all 10 PHab stations. Where this is impossible, record flags as specified in Table 3.1 Guidelines for recording field measurements and tracking information. Remember, numbered “F” flags pertain to the front and back side of each individual form (e.g., you can assign an F1 flag to mean something different at different habitat stations). Similarly, “F” flags do not carry over from one form to the next, so all “F” flags entered on a form must be defined on that same form.

6.1.3.3 Shoreline and Station Location Adjustments

Once in the field, you may encounter situations that require you to modify the shoreline and/or station location(s) from the intended locations marked on the site map. If this occurs, make the corrections and adjustments on the PHab form and note the reasons on the comments section of the form. The general guidelines for locating or modifying the location of the littoral and shoreline stations are summarized below.

1. Locate station using maps, aerial photos, or GPS units.
2. Define shore as either the current waterline OR the boundary between open water and the edge of dense vegetation (terrestrial, wetland, or emergent vegetation) or extensive very shallow water (shoreline defined by limit for navigating your boat).
3. If the shoreline observed in the field differs from the mapped shoreline: mark “Station Relocated” and enter a comment on the PHab Form stating the apparent reason (e.g., drought, flooding, dredging).
4. If a PHab station is lost because of shoreline changes: mark “Station Relocated” at the top of the PHab Form, and position one or more new stations at approximately equal intervals.
5. If a station is eliminated, mark the “Station Dropped” box.
6. If the shoreline observed in the field differs radically from the site map and you are sure you are at the correct lake, sketch a map of the lake or use one of the maps from your site packet. Use a string to measure the new outline, divide it into 10 equal parts, and lay out the 10 station locations.

6.1.3.3.1 Islands

Islands may be an additional source of shoreline habitat on a lake and we will account for them by adding island physical habitat stations. Island stations are in addition to the A-J stations. The guidelines for adding island stations follow:

- If the shoreline of an island makes up 10-20% of the lake’s shoreline, add one PHab station (A-K)
- If the shoreline of an island makes up more than 20% of the lake’s shoreline, add one more PHab station (A-L)
- Island stations are designated by marking the “Is it an island?” bubble on the form, by a new station letter (K, L, etc), and by marking the island location and station on a site map.

6.1.3.3.2 Ambiguous Shorelines

The shoreline is defined as the interface between “lake-like” conditions and riparian or wetland conditions. In most cases, the shoreline will be easily identified as the current waterline. In some
instances, however, the shoreline might not be obvious. Listed below are some general situations and rules that should be applied to them.

- If there has been a significant drop in lake level due to drought, dam repair, or other reasons, shallow areas may be exposed that are usually covered with water. In this case, consider the current waterline as shoreline for the purposes of this survey, not the normal waterline.
- If there are extensive very shallow areas or shoals, consider the shoreline to be the boundary between the shallow area and deeper open water, as defined by ease of access by a small sampling boat.
- If access to the true shoreline is prevented by an area of dense aquatic or terrestrial vegetation, consider the shoreline to be the boundary between the vegetation and deeper open water. Again define the operational shoreline by ease of access by small sampling boat.
- If a river or stream enters a lake, the shoreline begins where no flow is visible.

6.1.3.3.3  Actual shoreline is different than appears on the map

The goal of the physical habitat survey is to characterize the lakeshore based on observations of conditions at 10 evenly spaced PHab sites around the lake. Adjustments to station locations might be needed if the field crew runs into unusual conditions or problems. Below are some rules concerning modifications to the station location(s).

- If only a small portion of the shoreline differs and it does not affect, or only slightly affects, a PHab site location, sketch the lake shoreline on the site map and reposition the station (if needed).
- If the difference causes a contraction of the shoreline and a PHab station location is lost, sketch the lake shoreline on the site map and make a decision to (a) keep the station, relocate it on the revised shoreline map and adjust some or all other stations in order to keep stations evenly spaced around the lake (i.e., keep 10 stations), or (b) eliminate the station altogether (i.e., reduce the number of stations).
- If the difference causes an expansion of the shoreline, the crew should sketch the lake shoreline on the site map and make a decision to (a) add one or more stations, mark them on the revised shoreline map and adjust some or all other stations if needed so they are evenly spaced around the lake (i.e., designate more than 10 stations), or (b) adjust the stations so that they are evenly spaced around the lake (i.e., keep 10 stations).
- If the Site Map does not in any way match the lake shoreline, draw a new sketch map approximating the shoreline, and re-establish the 10 PHab stations. A quick way to locate 10 evenly-spaced PHab stations is to: (a) lay a piece of string on the lake perimeter, (b) pick up the string, measure it, and mark out 10 equal parts, and (c) lay the string back on the perimeter and use the marks to locate the 10 sites on the map.

6.1.3.3.4  PHab Station is inaccessible

- If a PHab station is inaccessible, you must make a decision to (a) relocate the station and adjust some or all other stations so that they are evenly spaced around the lake (i.e., keep 10 stations), or (b) eliminate the station altogether (i.e., reduce the number of stations). The size of the lake will help drive this decision.
- Draw all adjustments to the shoreline based on field observations directly on the Site Map and explain the adjustments in the comments section of the PHab Form.
6.1.3.4 Identifying Relocated and New Stations on the Form

Use the following notations when recording station location modifications.

- If you relocate a station, note the new location on the Site Map and check the appropriate original station letter (e.g., “C”) on that form. In addition, check the box for the station letter on the PHab form and check the box for “Station Relocated.”
- If a station is lost and cannot be replaced, cross out the original station location on the pre-printed Site Map and check the box for “Station Dropped” on the PHab form.
- If you add one or more stations, indicate the nearest station locations on the Site Map, and fill in the box for “New Station” on a blank PHab form.

6.1.4 Establishing the Physical Habitat Plot

You will establish a plot for physical habitat characterization at each PHab station. You will make most observations and measurements of the shoreline from the boat at the observation point 10 m from shore (estimated by eye). Limit observations at each station to the area that is within the defined plot dimensions. After setting plot dimensions, you may need to move around within the littoral plot to see or probe the bottom or even go onto shore to make observations.

6.1.4.1 Physical Habitat Plot Dimensions

You will identify up to four distinct zones within each physical habitat plot (Figure 6.1), where you estimate the zone dimensions by eye.

6.1.4.1.1 Littoral

This within lake zone is a fixed size that is 15m wide along the shoreline and 10m out into the lake.

6.1.4.1.2 Shoreline

The shoreline zone is a fixed 15m wide strip along the shore just above the present water line and 1 m inland. The shoreline boundary is defined as the approximate interface between "lake-like" conditions and riparian or wetland conditions. In cases where the lake shoreline is not obvious (e.g., where there is evidence of large seasonal change in lake level) define the shoreline as the current waterline. In cases where the lake shoreline is not visible, define the lake shoreline as the approximate boundary between open water and swamp or marsh conditions into which your boat could not easily move.

6.1.4.1.3 Drawdown

When present, the drawdown zone plot has a fixed width (15 m) but a variable extent inland determined by your judgment and measurement of the horizontal drawdown distance from the shore to the normal high water mark at the station.

6.1.4.1.4 Riparian

The riparian zone is a fixed size that runs 15m parallel to the shoreline and extends 15m from the normal high-water mark inland.

6.1.5 General Observations

Note: At the PHab station J, collect samples from the water column (Sections 6.3 and 6.4) before conducting the habitat characterization at that station.

Begin the physical habitat characterization with general observations.

1. Set up your plot within your physical habitat station
2. Measure and record the lake depth 10 m from the shore at each PHab station (observation point). Note the new location on the PHab form if the point has to be relocated for some reason.

3. Note on the PHab form whether there is shoreline flooding. If so, estimate the depth and the horizontal distance of flooding. A lake at normal high-water level at the time of sampling will have zeros entered for flood height and distance.

4. Note on the PHab form whether there is drawdown. If so, estimate and record the vertical (height) and the horizontal (distance) distances between the present lake level and the normal high water line. Your measurement or estimate of horizontal drawdown distance will set the inland extent of the drawdown portion of the PHab field plot. The vertical height is measured using the clinometer as a level in combination with the survey pole, or by visual estimation. Similarly, the horizontal distance up the bank between current lake level and the evidence of the normal high water level is usually done using a laser range finder. A lake at normal high-water level at the time of sampling will have zeros entered for both drawdown height and horizontal distance. Also record the bank angle description that best reflects the current shoreline that is dominant within your field of vision in the shoreline plot
   - Near vertical/undercut (>75 degrees),
   - steep (>30 to 75 degrees; need hands to climb up)
   - gradual, (5 to 30 degrees; can walk up)
   - flat (< 5 degrees)

5. Record the presence or absence of water surface scums, algal mats, or oil slicks within the littoral zone.

6.1.6 Estimate Substrate Characteristics
You will use semi-quantitative categories to estimate cover for substrate types and also for fish habitat cover, aquatic macrophytes, and terrestrial vegetation. The categories are as follows:
   - 0 = absent (0% cover)
   - 1 = sparse (<10% cover)
   - 2 = moderate (10 – 40% cover)
   - 3 = heavy (40 – 75% cover)
   - 4 = very heavy (>75% cover)

When estimating cover mixtures of more than one class might all be given sparse (1), moderate (2), or heavy (3) ratings. One dominant class with no clear subdominant class might be ranked very heavy (4) with all the remaining classes either sparse (1) or absent (0). Two dominant classes with more than 40 percent cover can both be given a 3.

6. Estimate the areal cover of bottom substrate types and particle size classes observed within the littoral and the shoreline zones. Cover categories range from absent to very heavy. Record all observations by filling in the appropriate bubbles on the PHab form. In most cases these estimates can be made from the boat.
   - If the bottom substrate is not visible, you should probe the bottom beneath the boat with the sounding rod (you may have to move closer to shore if you are too deep to use the rod). Soft sediment can be brought to the surface for examination. Hard sediments can be "felt"
with the sounding rod. Sandy substrate can be "felt" or "heard" by twisting the sounding rod and detecting grittiness. Estimating cover of various substrate types will typically require multiple probes within the littoral plot. If you have to move into shallow water to use the sounding rod to observe sediment characteristics, flag the observation and record the depth where you observed the sediment.

- If the bottom is covered with materials other than mineral substrates, choose “Woody Debris”, “Organic (leaf pack, detritus)”, or “Vegetation/Other”.
- If the substrate is concealed and remote sampling is not possible, use "Not observed" flag (K).

7. Record sediment color within the littoral zone. Select "None" or “Other” if the sediment does not match one of the color categories options on the PHab form.

8. Record sediment odor within the littoral zone. For sediment odor, the choices are "H₂S" (sulfurous, rotten egg), "Anoxic" (sewage odor), "Chemical" (strong odor like turpentine, paint, etc.), "Oil", or “Other” (including musty, organic, and fishy odors). If "Other" is indicated, explain the observation in the comment section of the form.

6.1.7 Estimate Aquatic Macrophyte Cover

9. Note and record whether macrophytes extend lake-ward from the observation point.

10. Estimate the areal cover of submerged, emergent (has erect portions above the water surface), floating (either rooted or non-rooted vegetation), and total macrophytes within the littoral zone. Cover categories range from absent to very heavy, as described in Estimate Substrate Characteristics. As for substrate, estimating aquatic macrophyte cover may require multiple probes within the littoral plot. Record all observations by filling in the appropriate bubbles on the PHab form. In most cases these estimates should be made from the boat.

- If you cannot see or probe the bottom, move closer to shore and note your new location with a flag.

6.1.8 Estimate Fish Habitat Cover

Estimate the areal cover of potential fish habitat observed within the littoral and, when present, drawdown zone(s). These features are within or partially within the water and conceal fish from aquatic and terrestrial predators such as large fish, otters, kingfishers, and osprey. Cover categories range from absent to very heavy, as described in Estimate Substrate Characteristics. Record all observations by filling in the appropriate bubbles on the PHab form. In most cases these estimates can be made from the boat. Estimating fish habitat cover may require multiple probes within the littoral plot.

11. Estimate and record cover for the following fish habitat types:

- Aquatic and Inundated Herbaceous Vegetation: Submerged, floating, or emergent live aquatic or non-woody herbaceous plants
- Woody Debris/Snags: Inundated or partially inundated dead trees, branches, or rootwads with diameter >0.3 m (1 ft)
- Woody brush/woody debris: Inundated dead or living woody vegetation <0.3 m diameter.
- Inundated Live Trees: Inundated portions of trees >0.3 m in diameter
- Overhanging Vegetation: <1 m from the water surface (do not include higher overhanging vegetation, which might provide perches for birds such as kingfishers)
Ledges or Sharp Dropoffs: Overhanging banks, submerged rock shelves, and steep sloping rock walls

Boulders: Larger than basketball size

Human Structures: Docks, barges, houseboats, swimming platforms, tires, car bodies, and habitat enhancement structures (e.g., log rafts)

Note: In the drawdown zone you will estimate the potential fish cover (e.g., what cover would there be if the drawdown zone were inundated – i.e., part of the littoral zone). The potential fish cover estimates are made only if there is a visible drawdown zone. For the observations, the question is “What cover would there be if the drawdown zone were inundated --- i.e., part of the littoral zone.” Then, for example, a bunch of dried aquatic macrophytes would be “Aquatic and Inundated Herbaceous Veg.” --- So would newly-grown terrestrial grasses. Cyprus trees left “high and dry” would qualify as “Inundated Live Trees >0.3m dia.” Overhanging vegetation rooted above the drawdown zone could be “Overhanging Veg. within 1m of the Surface”.

6.1.9 Estimate the Cover and Type of Riparian and Drawdown Zone Vegetation

You will estimate the areal cover of different types of vegetation in the riparian and, when present, drawdown zone(s). Vegetation cover is divided into three layers, which are described below. Note that individual plants can contribute cover to more than one layer. Similarly note that some things other than vegetation are possible entries for the "Ground Cover" layer (e.g., water or barren ground).

6.1.9.1 Canopy Vegetation (greater than 5 m high)

12. Record the type of vegetation in the canopy as deciduous, coniferous, broadleaf evergreen, or mixed, where mixed is defined as a segment where at least 10% of the areal coverage is made up of the alternate vegetation type.

13. Estimate the areal cover of big (trunk >0.3 m diameter at breast height) and small (trunk <0.3 m diameter at breast height) trees. Cover categories range from absent to very heavy, as described in Estimate Substrate Characteristics. Record all observations by filling in the appropriate bubbles on the PHab form.

6.1.9.2 Understory Vegetation (5m to 0.5m high)

14. Record the type of vegetation in the understory as deciduous, coniferous, broadleaf evergreen, or mixed, where mixed is defined as above.

15. Estimate the areal cover of woody shrubs and saplings and tall herb grasses, and forbs. Cover categories range from absent to very heavy, as described in Estimate Substrate Characteristics. Record all observations by filling in the appropriate bubbles on the PHab form.

6.1.9.3 Ground Cover (lower than 0.5m high)

16. Estimate the areal cover of woody shrubs and saplings and tall herb grasses, and forbs; herbs, grasses and forbs; standing water or inundated vegetation; and barren, bare dirt, or buildings. Cover categories range from absent to very heavy, as described in Estimate Substrate Characteristics. Record all observations by filling in the appropriate bubbles on the PHab form.
6.1.9.4 Considerations for Drawdown conditions

Drawdown Zone vegetation entries are located to the right of Riparian Zone Vegetation on the field form. They are filled out only if there is a drawdown zone. Unlike the case with potential fish cover, record these vegetation estimates just as you see them --- i.e., Do not in this case imagine that the drawdown zone is under water. For Example: There must be water on the ground (e.g., puddles) to have an entry for “standing water or inundated vegetation” in the drawdown zone. Trees and other vegetation are simply that --- they are not entered as “standing water or inundated vegetation. Newly-grown grasses <0.5m high are entered under “Herbs, Grasses, & Forbes” Newly-grown brush is entered according to its size class and whether it is woody or not. Large trees rooted above the drawdown zone can contribute cover over the drawdown zone. Dried aquatic macrophyte vegetation cover is entered under “Herbs, Grasses, & Forbes” with comment that it is dried aquatic macrophytes. There may be a lot of zeros for vegetation in the drawdown zone.

6.1.10 Record Evidence of Human influence

17. You will record any observations of human influences within the riparian and drawdown zones within the physical habitat plot. When a drawdown zone is present, human influences within the littoral plot are recorded in the drawdown portion of the field form. When there is no drawdown zone, littoral entries are included in the riparian zone portion of the form. Within each zone, observations are recorded as not present (0), present outside and/ or adjacent to (P), or present within (C) the area. Record all observations by filling in the appropriate bubbles on the PHab form.

- In the littoral zone, “adjacent” is defined as found within a hypothetical plot of equal size to the right or left of the sampling plot. This plot will be 10m deep by 15m wide.
- In the drawdown zone, when present, “adjacent” is defined as found within a hypothetical plot of equal size to the right or left of the drawdown plot. This plot will be variable in depth, depending on the size of the drawdown zone, but will always be 15m wide.
- In the riparian zone, “adjacent” is defined as found within a hypothetical plot of equal size to the right, left, or behind of the sampling plot. This plot will be 15m deep by 15m wide.

Do not mark "P" in either of the zones if it is marked “C” in the other zone. Human Disturbances absent (0) and within-plot (C) are straightforward. For Present but outside or adjacent to the plots (P), use these guidelines:

a) A disturbance is marked "P" if the disturbance is seen entirely outside of any of the plot zones, but is adjacent to (i.e., abutting left or right hand side of the entire Littoral-Drawdown-Riparian plot and is within 15m on either side).

b) A disturbance is marked "P" if the disturbance is seen entirely outside of any of the plot zones, but is visible looking on-shore through the three plot zones (Littoral, Drawdown, and Riparian).

c) So, a single disturbance might be marked "P" in both the Riparian-Littoral and the Drawdown zones.

d) If there is a drawdown plot, the presence of a human influence item WITHIN THE LITTORAL PLOT is recorded as “C” in the DRAWDOWN portion of the field form.
e) If there is NO DRAWDOWN PLOT (i.e., the riparian plot abuts on the water, then human
disturbances in the littoral plot are recorded by entering “C” in the Riparian portion of
the field form).

**Note:** Typically only Docks/Boats, Landfill/Trash, and maybe Buildings (boathouses) will be
commonly observed within the drawdown plot and its adjacent littoral area. For example,
if a boat is laying aground in the Drawdown Zone, mark it "C" in the Drawdown Zone. A
boat anchored offshore in the littoral zone is also marked “C” for the drawdown plot,
because the littoral zone in this case abuts the littoral zone. However, if there is no
drawdown zone, all littoral disturbance items are included on the riparian zone portion of
the form.

### 6.1.11 Invasive Plants and Invertebrates

Record if any invasive plant or invertebrate species listed in Table 6.2 have been observed within the
habitat plot. Check the boxes on the **Invasive Plants and Invertebrates** form for any species observed
within the littoral, shoreline, or riparian plots. Please see APPENDIX F: INVASIVE PLANTS AND
INVERTEBRATES.

#### Table 6.2 Invasive plants and invertebrates.

<table>
<thead>
<tr>
<th>Plants</th>
<th>Invertebrates</th>
</tr>
</thead>
<tbody>
<tr>
<td>curlyleaf pondweed</td>
<td>water starwort</td>
</tr>
<tr>
<td>common reed</td>
<td>water hyacinth</td>
</tr>
<tr>
<td>Eurasian watermilfoil</td>
<td>yellow floatingheart</td>
</tr>
<tr>
<td>purple loosestrife</td>
<td>European pepperwort</td>
</tr>
<tr>
<td>Russian-olive</td>
<td>alligatorweed</td>
</tr>
<tr>
<td>reed canarygrass</td>
<td>European waterstarwort</td>
</tr>
<tr>
<td>Canada thistle</td>
<td>giant salvinia</td>
</tr>
<tr>
<td>multiflora rose</td>
<td>water fern</td>
</tr>
<tr>
<td>narrowleaf cattail</td>
<td>water-chestnut (European)</td>
</tr>
<tr>
<td>Brazilian waterweed</td>
<td>tamarisk</td>
</tr>
<tr>
<td>brittleleaf naiad</td>
<td>deeprooted sedge</td>
</tr>
<tr>
<td>parrot feather milfoil</td>
<td>Japanese or giant knotweed</td>
</tr>
<tr>
<td>mimosa</td>
<td>miramar weed</td>
</tr>
<tr>
<td>hydriila</td>
<td>Brazilian peppertree</td>
</tr>
<tr>
<td>zebra or quagga mussel</td>
<td>rusty crayfish</td>
</tr>
<tr>
<td>Asian clam</td>
<td></td>
</tr>
</tbody>
</table>

### 6.2 Macrophyte Assemblage Characterization

#### 6.2.1 Summary of Method

Macrophyte depth, density, growth form, and maximum depth of plant colonization will be estimated
using the following rapid assessment protocol. Macrophyte data will be recorded at individual sample
points stratified by lake depth and lying along transects. You will characterize macrophyte assemblages
at five transects in each lake. Transects will run perpendicularly from shore, extending through the
midpoint of every other PHab station to ultimately reach up to halfway across the lake. Sampling points
will be placed along each sampling transect at water depths of 0.5 m and 1 m, and will continue
lakeward along the transect with additional points placed at every additional meter of depth gained.
Single rake tows using a double-sided rake sampler will be taken at each point on the transect.
6.2.2 Equipment and Supplies

Table 6.3 indicates the equipment and supplies needed for the macrophytes assemblage characterization.

Table 6.3 Equipment and supplies – macrophyte assemblage characterization

<table>
<thead>
<tr>
<th>Type</th>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form</td>
<td>Macrophyte Assemblage Characterization</td>
<td>1</td>
</tr>
<tr>
<td>Collection</td>
<td>Rake sampler attached to rope</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Depth finder</td>
<td>1</td>
</tr>
</tbody>
</table>

The rake samplers are each constructed of two rake heads welded together, bar-to-bar, to form a double-sided rake head. The rake head is 13.8 inches (35 centimeters) long, with approximately 14 tines on each side. You will attach this double-sided rake head to a rope; this rake head should also be weighted (Figure 6.2).

![Figure 6.2 Examples of rake sampler used for macrophyte assemblage characterization.](image)

6.2.2.1 Rope Sampler

To make the rake sampler shown in the photograph, we removed the handles from 2 standard bow rakes (available at most hardware stores), and welded the rake heads together bar-to-bar. If welding is not an option, the rake heads may be attached to one another with either hose clamps or cable ties. The rope sampler pictured here has a short piece of steel tubing welded to the rake head to serve as a handle through which 40 feet of rope is attached. Attach this rake head to a \( \geq 14 \) m rope. In order to ensure a quick vertical descent to the lake bottom, attach a light weight (\( \sim 5 \) lb) to the rake head, away from the tines. For depth recording, mark the rope in one meter increments.

6.2.3 Locating the Macrophyte Transects

6.2.3.1 Transect Placement

Place transects perpendicularly to the shoreline, running through the PHab anchor point and ending halfway across the lake (midpoint between starting and directly opposite shores).

Place a minimum of 6 points per transect stratified by water depth, with the first point at 0.5m depth \( \pm 0.2 \) m, the second at 1m depth \( \pm 0.2 \) m, then continuing lakeward at regular 1m depth intervals until one of stop criteria apply.

6.2.3.2 Stopping a Transect

Due to varying lake morphometry, it will sometimes make sense to stop sampling before the transect ends at the halfway point. For example, on very deep lakes, it is not necessary to sample beyond the littoral zone. On very large lakes, it is impractical to sample the entire transect length even if it is entirely...
littoral. If any one of the following stop criteria is met during sampling, take a rake tow and end the transect. **If the minimum 6 points have not been sampled, turn 180 degrees and distribute the remaining points evenly while heading along the transect back to shore.**

6.2.3.2.1 Stop Criteria

A. Transect reaches halfway to the opposite shore (Figure 6.3). On a lake less than 7m deep that is likely 100% littoral, transects are typically sampled to the halfway point.

![Figure 6.3 Transect placement (dotted lines) and sampled portions of those transects (solid lines).](image)

B. Littoral-profundal transition occurs, putting you deeper than the maximum depth of macrophyte colonization (Figure 6.3, Figure 6.4). Two sample points without plants suggest the littoral-profundal transition, in which case the transect is ended in 7m of water, after the 8th point is sampled.

  a. Do not stop sampling until you are reasonably certain you have exceeded the maximum depth of plant colonization (as identified in 5.7). You may use visual observations while on the lake as well as information collected on any PHab transects.

  b. If you are reasonably certain you have reached the maximum depth of plant colonization, you can stop the transect after two consecutive points without macrophytes.

Caution: it is not uncommon to sample two points without macrophytes near shore (e.g. due to wave scour), but have submerged macrophytes growing in deeper water.
C. 9 minutes have passed at slow-no-wake speed with no additional points sampled.
   a. In large, shallow systems, depth may not increase to allow for the placement of additional depth-stratified points, but traveling all the way out to the halfway point may be time-prohibitive.
   b. Nine minutes traveling at slow-no-wake speed (~3-4 mph) is approximately 1000 m. This defines a maximum transect length as determined by travel time.

In summary:
1. Sample along each transect until you reach the midpoint; if you have at least 6 sample points, STOP.
2. If you hit the littoral-profundal transition (two consecutive samples having no plants present) before you get to the midpoint and:
   ▪ you have at least 6 sample points, STOP
   ▪ you do not have at least 6 sample points, turn 180 degrees and distribute the remaining points evenly along the transect back to shore
3. If you exceed the maximum transect length as defined in Section 6.2.3.2.1, STOP.

6.2.3.3 Point Placement Along the Transect
Points are placed along the length of the transect and are stratified by depth. A minimum of 6 points will be sampled per transect, regardless of lake morphometry or clarity. Use a depth finder to determine point placement. Place points within ±0.2m of the designated depth target.

A. Place the first point on the transect in 0.5m (±0.2m) water depth. Choose a location that is as close to the PHab anchor point as possible.
B. Moving lakeward, sample the second point on the transect when depth increases to 1 m (+0.2 m) water depth.

C. Sample the third point on the transect in 2 m (+0.2 m) of water.

D. Sample the fourth point on the transect in 3 m (+0.2 m) of water. Continue taking points at each 1 m increase of water depth until one of the stop criteria applies.
   a. If you have not already, take a rake tow at that location. If you have not sampled 6 points, turn around 180 degrees and face back toward shore.
   b. If you do not find plants at the end of the transect, and you are beyond the maximum depth of macrophyte colonization: Return to the greatest depth that you have observed plants on that lake (visually or at any transect).
   c. Sample points along the transect toward shore, aiming for an even spatial distribution until you reach the minimum total of 6 points in that transect (Figure 6.5). After reaching halfway to the other shore, the fourth sample point is taken in 3 m of water. Since the minimum 6 points per transect has not been satisfied, the field worker turns and travels back to shore along the transect. Two additional points evenly distributed along the transect are sampled on the return trip.

Figure 6.5 Point placement on a transect that ends before 6 points are sampled.

6.2.4 Macrophyte Assemblage Characterization

6.2.4.1 Data Collection

At each point, record depth, density of plants on the rake, density of filamentous algae on the rake, and plant growth forms present.

A. Navigate to the first PHab plot, anchor, and complete existing NLA methodology (characterization of physical habitat, cover, etc,..., as well as collection of macroinvertebrates).

B. Navigate to the first macrophyte transect sample point (water depth at 0.5 m).
a. Toss the rake-on-a-rope sampler until it rests on the sediment surface. (See Appendix 1 for constructing a rake sampler. You will see the rope go slack when the rake hits the bottom. Record depth to the nearest 0.1m.

b. You will drag the rake sampler along the substrate for a linear meter, using short tugs on the rope.

c. With a smooth and continuous motion, you will pull the rake sampler back up into the boat. Do not stop and start movement, or the plants may fall off the rake head.

d. Record plant rake density, including macrophytes, Charophytes, and moss (rankings from 0 through 3 as described below). Include in your estimations any macrophytes that are dislodged by the rake, touched by the rake, or floating at the surface in the 1-m long strip that you rake, even if they are not collected on the rake head.

   0. No plants present
   1. Less than 25% of the rake is full
   2. 25% to 100% of the rake is full
   3. 100% of the rake is full (no tines visible)

e. Record filamentous algae rake density on the same scale (0-3) if the filamentous algae presence is obvious. Very small amounts of filamentous algae may be present in nearly all rake tows, so only record filamentous algae as present if there would be enough to roll into an approximately nickel-sized ball.

f. If vegetation is present:

   i. Use the Growth Form Key (Figure 6.6) to determine growth form of all plants sampled with the rake, floating at the surface, or touched by the rake even if they do not detach or if they fall off the rake head. This is particularly relevant when sampling emergents or free floating plants.

   ii. Do not count filamentous algae as a species, in the plant density rating, or in determining maximum depth of plant colonization.
g. Invasives
   i. If an invasive species listed on your Invasive Plants and Invertebrates Form is seen or sampled on the macrophyte transect, record the species as present at that PHab plot and flag it as observed outside of the PHab plot.

<table>
<thead>
<tr>
<th>Plant Growth Form Key</th>
<th>(see Figure 6.7 for illustrations)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. a. Plant stems extending above or leaves visible on the surface of the water, submersed leaves absent ................................................................. 2.</td>
<td></td>
</tr>
<tr>
<td>1. b. Submersed leaves present, floating leaves present or absent ................................................................. 4.</td>
<td></td>
</tr>
<tr>
<td>2. a. Floating leaves absent, leaves and/or stem extending above water ................................................................. EMERGENT</td>
<td></td>
</tr>
<tr>
<td>2. b. Leaves floating on or just under the water’s surface ........................................................................... 3.</td>
<td></td>
</tr>
<tr>
<td>3. a. Leaves free floating, neither rooted to bottom nor attached to tuber ................................................................. FREE FLOATING</td>
<td></td>
</tr>
<tr>
<td>3. b. Plant rooted in sediment or attached to tuber ................................................................. FLOATING LEAF</td>
<td></td>
</tr>
<tr>
<td>4. a. Bladders present, borne on leaves or root-like branches ................................................................................ SUBMERSED – BLADDERWORT</td>
<td></td>
</tr>
<tr>
<td>4. b. No bladders present ................................................................................................................................. 5.</td>
<td></td>
</tr>
<tr>
<td>5. a. Plant small and free floating, stem not apparent (Lemna trisulca) ................................................................. FREE FLOATING</td>
<td></td>
</tr>
<tr>
<td>5. b. Plant not as above ................................................................................................................................. 6.</td>
<td></td>
</tr>
<tr>
<td>6. a. Submersed plants having short stature (&lt; 20cm) and compact growth form. Leaves originating from a single point at the base of the plant (basal) or plant consisting of short stalk with no apparent leaves ...................................... SUBMERSED – COMPACT</td>
<td></td>
</tr>
<tr>
<td>6. b. Plants with well-developed stems or leaves extending into the water column. Leaves originating at the base or on stems (opposite, alternate, or whorled) ........................................................................... 7.</td>
<td></td>
</tr>
<tr>
<td>7. a. Submersed leaves fine, less than 1 mm wide. If dissected, leaflets each less than 1 mm wide ................................................................. SUBMERSED – FINE</td>
<td></td>
</tr>
<tr>
<td>7. b. Submersed leaves broad, over 1 mm wide ............................................................................................ SUBMERSED – WIDE</td>
<td></td>
</tr>
</tbody>
</table>

Figure 6.6 Plant Growth Form Key
C. Sample remaining points (minimum of 6 per transect).
   a. Visually select a navigation point on the opposite shore in the direction of the transect and navigate slowly lakeward.
   b. Use a sonar unit to assess depth.
   c. Take samples stratified appropriately by depth (at 0.5 and 1m, thereafter every meter, ensure you are within ±0.2m of each depth target).
   d. Sample until one of the stop criteria applies.
   e. NOTES
      i. If a sample point is inaccessible due to an obstacle (e.g. swim area, dock, watercraft) move the point off the transect to the nearest possible accessible area in that depth range. Rake as close to the original point as possible (i.e. immediately adjacent to the swim area or under the edge of the dock) so that the impact of disturbance is captured. If equidistant, move the transect to the right (facing shore). Resume sampling along the transect as soon as possible.
      ii. If depth along the transect begins to decrease during sampling, continue on until either greater depths are encountered or one of the stop criteria applies (e.g., always sample points deeper than your previous point).
      iii. Similarly, if an island intersects the transect, simply stop, navigate around the island, then resume sampling on other side, travelling along the original transect line until depth increases enough to place the next sample point.
      iv. If transects are placed in channels attached to the lake, inlets, or outlets, sample as usual, keeping the transect perpendicular to the shore of the channel and running it out to the channel midpoint.

6.2.4.2 Estimating Maximum Depth of Plant Colonization (MDC)

In situ measurements of nutrient concentrations and water clarity tend to fluctuate over the course of a growing season. The use of single-event sampling data from a seasonally dynamic variable includes a significant risk of misrepresenting environmental conditions. Submersed aquatic plants reflect cumulative environmental conditions by integrating, for example, water clarity conditions over a long-term seasonal scale. Maximum depth of colonization (MDC) is one metric we can use to capture integrated information about lake water clarity.

A. MDC is equal to the deepest depth at which plants are found.
   a) To ensure an accurate estimation, the littoral-profundal transition must be sampled at least five times at each site.

B. If the index station is over 12 m deep, begin your first MDC transect there prior to starting your macrophyte transects.
   a) Check depth. If depth is over 12m, begin transect and skip to step d. If depth is less than 12m, take a rake sample.
   b) If macrophytes occur, note this on the datasheet and go to the first PHab location for sampling.
   c) If macrophytes do not occur, navigate to shore in the direction of your first PHab location.
   d) As depths approach 12m, take a rake sample to look for the presence of macrophytes, and then again with every meter in depth lost. Stop when plants are observed, recording the depth to the nearest 0.1 meter.
C. Following your macrophyte transects, if you still have not sampled the littoral-profundal transition five times, navigate back to the index station and complete as many additional transects as necessary to estimate MDC, navigating in several different directions (i.e., north, south, west, east).
   a) If your index station had macrophytes present, and a deeper basin is present on the lake (e.g. you are sampling the index station on a reservoir) once the macrophyte transects are completed, you can complete any additional MDC transects needed at the deep basin, provided it is not too close to a dam and is safe to sample.
   b) Complete as many transects as needed to estimate MDC on at least five transects (including the PHab transects and your initial MDC transect).
   c) The deepest depth encountered with plants growing during the entire survey is the lake’s MDC.

6.2.4.3 Optional Enhancements

A. Sample macrophytes at all 10 PHab locations. Ten transects will yield a more complete picture of the macrophyte community in a given lake. When sampling all ten transects, you are likely to pick up an additional growth form of macrophytes on one of every three lakes sampled. It is also less likely that MDC transects will need to be used, which may compensate for some of the added time to sample the optional five transects (~50 minutes).

B. Estimate of species richness
   a. Record the number of morphologically distinct species on each rake tow. At the end of the survey, record the number of morphologically distinct species encountered lakewide.
      i. It is not necessary to have detailed taxonomic knowledge to do this – just count the number of plants that appear to be different. Those with taxonomic knowledge should sample from this perspective and lump cryptic species (e.g. duckweeds, thin-leaf pondweeds).
      ii. For the lakewide count, simply place each newly encountered macrophyte into a bucket with water or a ziplock bag kept in a cooler, and count at the end of the day.
Figure 6.7 Macrophyte Growth Form Guide
6.3 Littoral Chlorophyll-a, Algal Toxin, and Phytoplankton Sample Collection

6.3.1 Summary of Method
Prior to collecting physical habitat and macroinvertebrate samples at the “J” habitat station, collect water samples for chlorophyll-α, phytoplankton, and algal toxins. These consist of grab samples collected at about 0.3 m below the water surface from a point within the littoral plot that is 1 m deep.

6.3.2 Equipment and Supplies
Table 6.4 provides the equipment and supplies needed for field operations to collect, chlorophyll-α, phytoplankton (cyanobacteria), and algal toxin samples at the “J” habitat station.

<table>
<thead>
<tr>
<th>Type</th>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form</td>
<td>Littoral Site Sample Collection</td>
<td>( \text{as needed} )</td>
</tr>
<tr>
<td>Documentation</td>
<td>Labels: algal toxins, phytoplankton (cyanobacteria), chlorophyll A</td>
<td>3</td>
</tr>
<tr>
<td>Collection</td>
<td>Poly bottle (2 L, brown, labeled LITTORAL) – chlorophyll A, algal toxins, phytoplankton (cyanobacteria)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Gloves (latex/nitrile, non-powdered)</td>
<td>1 pair</td>
</tr>
<tr>
<td>Storing and preserving</td>
<td>HDPE bottle (1 L, white, narrow-mouth) – phytoplankton (cyanobacteria)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>HDPE bottle (500 mL, white, wide-mouth) – algal toxins</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Wet ice</td>
<td>As needed</td>
</tr>
<tr>
<td></td>
<td>Lugol’s solution</td>
<td>5-10 mL</td>
</tr>
<tr>
<td></td>
<td>Cooler</td>
<td>1</td>
</tr>
</tbody>
</table>

6.3.3 Sampling Procedure
Collect two 2 L grab samples from 0.3 m below the water surface using a 2 liter brown bottle (labeled Littoral Chlorophyll). The first grab will be used to fill bottles for the phytoplankton (cyanobacteria, 1-L bottle) and algal toxins (500 mL bottle) samples. The second grab will be used for the chlorophyll-α sample and will be taken to shore for filtering.

1. Make sure the container for phytoplankton and algal toxins samples have completed labels attached and that the labels are completely covered with clear tape.
2. Put on surgical gloves (non-powdered). Do not handle any food, drink, sunscreen, or insect repellant until after the water samples have been collected.
3. Move slowly within the littoral plot until you locate a point that is 1m deep.
4. Rinse the brown poly bottle and cap three times with small volumes of lake water. Discard each rinse on the opposite side of the boat.
5. Fill the 2 L brown poly bottle by inverting and submerging to a depth of 0.3 m below the water surface, avoiding surface scum, vegetation, and substrates. Point the mouth of the container away from the body or boat. Right the bottle allowing it to fill completely and raise it up through the water column. Cap tightly and mix contents thoroughly.
6. Fill the 1 L phytoplankton sample container from the 2L brown bottle, allowing enough headspace to add 5 mL of Lugol’s solution. Add 5 mL of Lugol’s solution to the 1 L phytoplankton bottle. Cap the bottle and invert until well mixed. The sample should resemble the color of weak tea. If needed, add additional Lugol’s 2-3 mL at a time.
7. Fill the 500 mL algal toxin container from the 2 L bottle. Cap tightly. Place the bottle in the cooler on wet ice.
8. Fill the 2L brown bottle a second time using the procedure in step 5. Cap tightly. This is the littoral chlorophyll sample, which will be filtered on shore (see Section 7.2.1). Place the bottle in the cooler on wet ice.
9. Immediately after sample is collected, place in cooler to minimize exposure to light and place on ice until filtration can be initiated.

![Image of sampling process]

**Figure 6.8** Littoral sampling of chlorophyll-a, phytoplankton (cyanobacteria), and algal toxins.

### 6.4 Benthic Macroinvertebrate Sampling

#### 6.4.1 Summary of Method
Benthos are collected using a semi-quantitative sampling of multiple habitats in the littoral zone of lakes using a 500 µm mesh D-frame dip net (Figure 6.9). Sample collection is stratified on the following specific habitat types: rocky/cobble/large woody debris; macrophyte beds; organic fine mud or sand; and leaf packs.

![Image of D-frame net]

**Figure 6.9** D-frame net (500 µm mesh) used for collecting benthic macroinvertebrates.

#### 6.4.2 Equipment and Supplies
Table 6.5 provides the equipment and supplies needed for field operations to collect benthic
macrinvertebrates.

### Table 6.5 Equipment and supplies – benthic macroinvertebrate collection.

<table>
<thead>
<tr>
<th>Type</th>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form</td>
<td>Littoral Site Sample Collection Form</td>
<td>1</td>
</tr>
<tr>
<td>Documentation</td>
<td>Labels: Benthic samples</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Scissors</td>
<td>1</td>
</tr>
<tr>
<td>Collection</td>
<td>Kick net (500 µm D-shaped, modified) with 4 foot handle</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Spare net(s) and/or spare bucket assembly for end of net</td>
<td>As needed</td>
</tr>
<tr>
<td></td>
<td>Bucket (5 gallon capacity, plastic)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Sieve bucket (500 µm)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Watchmakers’ forceps</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Squirt bottle (1 L Nalgene) – lake water</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Spoon (stainless steel)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Funnel</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>HDPE bottle (1 L, white, wide-mouth)</td>
<td>1 or more</td>
</tr>
<tr>
<td></td>
<td>Ethanol (95%)</td>
<td>2 gal</td>
</tr>
<tr>
<td></td>
<td>Gloves (latex/nitrile, non-powdered, box)</td>
<td>2 pair</td>
</tr>
<tr>
<td>Storing and preserving</td>
<td>Cooler</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Plastic electrical tape</td>
<td>As needed</td>
</tr>
</tbody>
</table>

### 6.4.3 Sampling Procedure

#### 6.4.3.1 Site Selection and Sample Collection

The process for selecting the PHab stations is described in Section 6.1 Physical Habitat. All benthic samples should be collected from the dominant habitat type within the 10 m x 15 m littoral zone component of each of the 10 PHab stations (Figure 3.2). The sampling process is described below.

**NOTE:** At station J, collect samples from the water column (sections 6.3 and 6.4) before collecting the benthos sample.

#### 6.4.3.2 Sample Processing in the Field

Use a 500-µm mesh sieve bucket placed inside a larger bucket full of lake water while sampling to carry the composite sample as you travel around the lake. Once the composite sample from the collections from the 10 stations is sieved and reduced in volume, store in a 1 L jar and preserve with 95% ethanol. Multiple jars may be required if detritus is heavy. If more than one jar is used for a composite sample, use the “extra jar” label provided; record the SAME sample ID number on this “extra jar” label. The sample ID number is also recorded with a lead pencil (No. 2) on a waterproof label that is placed inside each jar. If a sample requires more than one jar, make sure the correct number of jars for the sample is recorded on the Littoral Sample Collection form. Record information for each composite sample on the form.

Check to be sure that the pre-numbered adhesive label is on the jar and covered with clear tape. Place the samples in a cooler or other secure container for transporting and/or shipping to the laboratory (See APPENDIX D: SHIPPING GUIDELINES).

#### 6.4.3.2.1 Benthic macroinvertebrate sampling

1. After locating the sample site according to procedures described in the physical habitat section, identify the dominant habitat type within the plot from the classifiers below:
2. After identifying the dominant habitat type, use the D-frame dip net (equipped with 500-µm mesh) to sweep through 1 linear meter of the dominant habitat type at a single location within the 10 m x 15 m littoral zone sampling area, making sure to disturb the substrate enough to dislodge organisms.

- If the dominant habitat is rocky/cobble/large woody debris it may be necessary to exit the boat and disturb the substrate (e.g., overturn rocks, logs) using your feet while sweeping the net through the disturbed area.
- Because a dip-net is being used for sampling, the maximum depth for sampling will be approximately 1m (the length of the dip-net handle); therefore, in cases in which the depth of the lake quickly drops off, it may be necessary to sample in the nearest several meters to the shore.

3. After completing the 1m sweep, remove all organisms and debris from the net and place them in a bucket following sample processing procedures described in the following section.

4. Proceed to the next sampling station and repeat steps 1-3. The organisms and detritus collected at each station on the lake should be combined in a single bucket to create a single composite sample for the lake. After sampling at all 10 stations is completed, process the composite sample in the bucket according to procedures described in the following section. One to five bottles should be sufficient to hold the composited sample from each lake.

- If there is a large amount of debris accumulating in the composite sample, remove debris between sampling stations, after the debris is inspected, picked, and/or washed to ensure no organisms are lost.
- If your first collection results in too much debris, discard it, move location within the same habitat station, and take another sample.
- It is recommended that crews carry a sample bottle containing a small amount of ethanol with them to enable them to immediately preserve larger predaceous invertebrates such as hellgrammites and water beetles. Doing so will help reduce the chance that other specimens will be consumed or damaged prior to the end of the field day.

6.4.3.2.2 Preparing composite samples for benthic macroinvertebrates

1. Pour the entire contents of the bucket through a sieve (or into a sieve bucket) with 500 µm mesh size. Remove any large objects and wash off any clinging organisms back into the sieve before discarding.

2. Using a wash bottle filled with lake water, rinse all the organisms from the bucket into the sieve. This is the composite sample for the lake.

3. Estimate the total volume of the sample in the sieve and determine how large a jar will be needed for the sample (1 L) and how many jars will be required.

4. Fill in a sample label with the Site ID and date of collection. Attach the completed label to the jar and cover it with a strip of clear tape. Record the sample ID number for the composite sample on the Sample Collection Form. For each composite sample, make sure the number on the form
matches the number on the label.

5. Wash the contents of the sieve to one side by gently agitating the sieve in the water. Wash the sample into a jar using as little water from the wash bottle as possible. Use a large-bore funnel if necessary. If the jar is too full, pour off some water through the sieve until the jar is not more than half full, or use a second jar if necessary. Carefully examine the sieve for any remaining organisms and use watchmakers’ forceps to place them into the sample jar.

6. If a second jar is needed, fill in a sample label that does not have a pre-printed ID number on it. Record the ID number from the pre-printed label prepared in Step 4 in the “SAMPLE ID” field of the label. Attach the label to the second jar and cover it with a strip of clear tape. Record the number of jars required for the sample on the Sample Collection Form. **Make sure the number you record matches the actual number of jars used.** Write “Jar N of X” on each sample label using a waterproof marker (“N” is the individual jar number, and “X” is the total number of jars for the sample).

7. Place a waterproof label inside each jar with the following information written with a number 2 lead pencil:
   - Site ID
   - Collectors initials
   - Type of sampler and mesh size used
   - Number of stations sampled
   - Name of lake
   - Date of collection
   - Jar N of X (see above)

8. Completely fill the jar with 95% ethanol (no headspace). It is very important that sufficient ethanol be used, or the organisms will not be properly preserved. Existing water in the jar should not dilute the concentration of ethanol below 70%. **NOTE:** Prepared composite samples can be transported back to the vehicle before adding ethanol if necessary. In this case, fill the jar with lake water, which is then drained using the net (or sieve) across the opening to prevent loss of organisms, and replaced with ethanol at the vehicle.

9. Replace the cap on each jar. Slowly tip the jar to a horizontal position, then gently rotate the jar to mix the preservative. Do not invert or shake the jar. After mixing, seal each jar with plastic tape.

10. Store labeled composite samples in a container with absorbent material that is suitable for use with 70% ethanol until transport or shipment to the laboratory.
7.0 FINAL LAKE ACTIVITIES

Prior to leaving the lake, make a general visual assessment of the lake and its surrounding catchment. This assessment is based on the collective observations of all crew members. The objective of the lake assessment is to record field crew observations of catchment and lake characteristics that are useful for future data interpretation, ecological value assessment, development of associations, and verification of stressor data. These observations and impressions are extremely valuable.

In addition, review all data forms and sample labels for completeness, accuracy, and legibility. Make sure all samples are labeled, sealed, and properly preserved. Activities described in this section are summarized in Figure 7.1.

![Figure 7.1 Final lake activities summary](image-url)
7.1 General Lake Assessment

Complete the Assessment (Front) form at the end of lake sampling, recording all observations from the lake that were noted during the course of the visit by all crew members. This form is designed as a template for recording pertinent field observations. It is by no means comprehensive, and any additional observations should be recorded in the comments section. The form consists of five major sections: 1) Lake/Catchment Site Activities and Disturbances Observed, 2) General Lake Information, 3) Shoreline Characteristics, 4) Qualitative Macrophyte Survey, and 5) Qualitative Assessment of Environmental Values.

7.1.1 Lake/Catchment Site Activities and Disturbances Observed

Record any of the sources of potential stressors listed in Table 7.1 on the Site Assessment form, that were observed while on the lake, while driving or walking through the lake catchment, or while flying over the lake and catchment. For activities and stressors that you observe, rate their abundance or influence as low (L), moderate (M), or heavy (H) on the line next to the listed disturbance. Leave the line blank for any disturbance not observed. The distinction between low, moderate, and heavy will be subjective. For example, if there are two to three houses on a lake, circle "L" for low next to "Houses." If the lake is ringed with houses, rate it as heavy (H). Similarly, a small patch of clear-cut logging on a hill overlooking the lake would rate a low ranking. Logging activity right on the lake shore, however, would get a heavy disturbance ranking. The section for “Lake Site Activities and Disturbances Observed” includes residential, recreational, agricultural, industrial, and lake management categories.

7.1.2 General Lake Information

Observations regarding the general characteristics of the lake are described in Table 7.2. Record these observations on the Lake Assessment Form. The hydrologic lake type is a very important variable for defining subpopulations for acidic deposition effects. Note any flight hazards that might interfere with either low-altitude fly-overs by aircraft (for future aerial photography or videography) or landing on the lake for sampling purposes (either by float plane or helicopter). When estimating the intensity of motor boat usage, in addition to the actual number of boats observed on the lake during the visit, use other observations such as the presence of boat houses, docks, and idle craft.

7.1.3 Shoreline Characteristics

Shoreline characteristics of interest during the final lake assessment are described in Table 7.1. Record observations related to this portion of the assessment on the Assessment (Front) form. To estimate the extent of major vegetation types, limit the assessment to the immediate lake shoreline (i.e., within 20 m of the water). Also estimate the percentage of the immediate shoreline that has been developed or modified by humans.

Table 7.1 Site activities and disturbances observed during final lake assessment.

<table>
<thead>
<tr>
<th>Residences</th>
<th>Presence of any houses and residential buildings around the lake.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintained Lawns</td>
<td>Presence of any maintained lawns around the lake.</td>
</tr>
<tr>
<td>Construction</td>
<td>Presence of any recent construction in the immediate area around the lake or signs of recent sedimentation events (depositional fans).</td>
</tr>
<tr>
<td>Pipes/Drain</td>
<td>Presence of any pipes or drains feeding into or out of the lake. If known, record the type of activity with which the pipe is associated (e.g., storm sewer, plant intake) in the &quot;Comments&quot; section on Side 2.</td>
</tr>
</tbody>
</table>
Observe lake activities or disturbances listed and record as L (low), M (moderate), or H (heavy) intensity on Side 1 of the Assessment form (except as noted below):

<table>
<thead>
<tr>
<th>Activity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dumping</td>
<td>Any evidence of landfill or dumping around the lake, including garbage pits and informal dumping of large amounts of trash or cars and appliances along roads or lakeshore. This does not include small amounts of litter. If informal dumping areas exist, note that they are informal sites in the &quot;Comments&quot; section on Side 2.</td>
</tr>
<tr>
<td>Roads</td>
<td>Presence of any maintained roads in the immediate area around the lake.</td>
</tr>
<tr>
<td>Bridges/Causeways</td>
<td>Presence of any bridges or causeways across or in the immediate vicinity of the lake.</td>
</tr>
<tr>
<td>Sewage Treatment</td>
<td>Presence of sewage treatment facility.</td>
</tr>
<tr>
<td>Hiking Trails</td>
<td>Presence of formal hiking trails around the lake.</td>
</tr>
<tr>
<td>Parks, Campgrounds</td>
<td>Presence of organized public or private parks, campgrounds, beaches or other recreational areas around the lake.</td>
</tr>
<tr>
<td>Primitive Parks, Camping</td>
<td>Presence of informal or primitive parks, camping areas, beaches or other recreational areas (e.g., swimming holes) around the lake.</td>
</tr>
<tr>
<td>Resorts</td>
<td>Level of resort activity; this could include motels, resorts, golf courses, and stores.</td>
</tr>
<tr>
<td>Marinas</td>
<td>Presence of any marinas.</td>
</tr>
<tr>
<td>Trash/Litter</td>
<td>Relative abundance of trash or litter around the lake.</td>
</tr>
<tr>
<td>Surface Films, Scum or Slicks</td>
<td>Relative abundance of surface films, scum, or slicks on the lake.</td>
</tr>
<tr>
<td>Cropland</td>
<td>Presence of cropland.</td>
</tr>
<tr>
<td>Pasture</td>
<td>Presence of pastures.</td>
</tr>
<tr>
<td>Livestock Use</td>
<td>Presence of livestock use.</td>
</tr>
<tr>
<td>Orchards</td>
<td>Presence of orchards.</td>
</tr>
<tr>
<td>Poultry</td>
<td>Presence of poultry operations.</td>
</tr>
<tr>
<td>Feedlot</td>
<td>Presence of feedlot or concentrated animal feeding operations.</td>
</tr>
<tr>
<td>Water Withdrawal</td>
<td>Any evidence of water withdrawal from the lake.</td>
</tr>
<tr>
<td>Industrial Plants</td>
<td>Any industrial activity (e.g., canning, chemical, pulp) around the lake or in the catchment. Describe the type of industry in the &quot;Comments&quot; section on Side 2.</td>
</tr>
<tr>
<td>Mines/Quarries</td>
<td>Any evidence of mining or quarrying activity in the catchment or around the lake.</td>
</tr>
<tr>
<td>Oil/Gas Wells</td>
<td>Any evidence of oil or gas wells in the catchment or around the lake.</td>
</tr>
<tr>
<td>Power Plants</td>
<td>Presence of any power plants.</td>
</tr>
<tr>
<td>Logging</td>
<td>Any evidence of logging or fire removal of trees in the lake area.</td>
</tr>
<tr>
<td>Evidence of Fire</td>
<td>Any evidence of forest fires in the lake area.</td>
</tr>
<tr>
<td>Odors</td>
<td>Presence of any strong odors.</td>
</tr>
<tr>
<td>Commercial</td>
<td>Any commercial activity (e.g., convenient stores, shopping centers, restaurants) around the lake or in the catchment.</td>
</tr>
<tr>
<td>Liming</td>
<td>Any evidence of liming activities.</td>
</tr>
<tr>
<td>Chemical Treatment</td>
<td>Presence of any chemical treatment facilities.</td>
</tr>
<tr>
<td>Angling Pressure</td>
<td>Estimate of the intensity of fishing activity in the lake.</td>
</tr>
<tr>
<td>Drinking Water Treatment</td>
<td>Presence of any drinking water treatment facilities.</td>
</tr>
<tr>
<td>Macrophyte Control</td>
<td>Any evidence of dredging or other activities to control macrophyte growth; describe these in the &quot;Comments&quot; section on Side 2.</td>
</tr>
<tr>
<td>Water Level Fluctuations</td>
<td>Any evidence of water level fluctuations due to lake management.</td>
</tr>
</tbody>
</table>
Observe lake activities or disturbances listed and record as L (low), M (moderate), or H (heavy) intensity on Side 1 of the Assessment form (except as noted below):

| Fish Stocking | Any evidence of fish stocking in the lake. |

Record any other oddities observed or additional information for any specific activity in the "Comments" section on Side 2.

Table 7.2 Hydrologic lake type observed during final lake assessment.

<table>
<thead>
<tr>
<th>Hydrologic Lake Type</th>
<th>Note if there are any stream outlets from the lake, even if they are not flowing. If no lake outlets are observed, record the lake as a seepage lake. If the lake was created by a manmade dam (not that a dam is present just to raise the water level), record the lake as a reservoir. Otherwise record the lake as a drainage lake.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outlet Dams</td>
<td>Note the presence of any dams (or other flow control structures) on the lake outlet(s). Differentiate between artificial (man-made) structures and natural structures (beaver dams).</td>
</tr>
<tr>
<td>Low Elevation Flight Hazards</td>
<td>If there are any hazards (above tree level) that would interfere with low elevation aircraft flights or landing on the lake, check &quot;Yes;&quot; otherwise check &quot;No.&quot; Examples include radio towers or power lines.</td>
</tr>
<tr>
<td>Motor Boat Density</td>
<td>Record your impression of the density of motor boat usage on this lake (high or low). If there is a restriction on the size of motor boat engines, check &quot;Restricted.&quot; If motor boats are banned, check &quot;Banned.&quot; Consider the day of the week and weather in your assessment as well as the number of boathouses, idle craft. Count jet skis and any other motorized craft, which could stir up the lake, as motor boats.</td>
</tr>
<tr>
<td>Swimmability</td>
<td>Record a subjective impression about the aesthetics of swimming in this lake (swimmability) along the range of &quot;good&quot; to &quot;not swimmable.&quot;</td>
</tr>
<tr>
<td>Lake Level Changes</td>
<td>Examine the lake shoreline for evidence of lake level changes (e.g., bathtub ring). If there are none, check &quot;zero;&quot; otherwise try to estimate the extent of vertical changes in lake level from the present conditions based on other shoreline signs.</td>
</tr>
</tbody>
</table>

Table 7.3 Shoreline characteristics observed during final lake assessment.

<table>
<thead>
<tr>
<th>Check percent of shoreline characteristics:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest Deciduous, coniferous, or mixed forest, including sapling vegetation.</td>
</tr>
<tr>
<td>Grass Meadows, lawns, or other open vegetation.</td>
</tr>
<tr>
<td>Shrub Shrub vegetation</td>
</tr>
<tr>
<td>Wetland Forested and non-forested wetlands (submerged terrestrial vegetation).</td>
</tr>
<tr>
<td>Bare Ground Non-vegetated areas such as beaches, sandy areas, paved areas, and exposed rock.</td>
</tr>
<tr>
<td>Agriculture Cropland, orchard, feedlot, pastureland, or other horticultural activity.</td>
</tr>
<tr>
<td>Shoreline Modifications Actual shoreline that has been modified by the installation of riprap, revetments, piers, or other human modifications.</td>
</tr>
<tr>
<td>Development Immediate shoreline area developed by human activity; include lawns, houses, stores, malls, marinas, golf courses, or any other human-built land use.</td>
</tr>
</tbody>
</table>

7.1.4 Qualitative Macrophyte Survey

Aquatic macrophytes (aquatic plants large enough to be seen without magnification) are important indicators of lake trophic status. The most important indicator for this survey is the percentage of the entire lake area (not just near the shore) covered with macrophytes, as perceived by observers. For both "emergent/floating" and "submergent" coverage, choose one of the four percentage groupings (0-25%, 25-50%, 50-75%, 75-100%), on the Assessment (Front) form. In some cases, it will be fairly easy to estimate the percentage from observations made at the PHab stations. In other cases, it will be an
educated guess, especially if the water is turbid. After recording the areal percentage of macrophyte coverage, record the density of the plants in the observed macrophyte beds as absent, sparse, moderate, or high. Record your estimates on the Assessment (Front) Form.

7.1.5 Waterbody Character
Rate the waterbody character which is the physical habitat integrity of the waterbody and is largely a function of riparian and littoral habitat structure, volume change, trash, turbidity, slicks, scums, color, and odor. The NLA 2012 attempts to define water body character through two attributes: degree of human disturbance and aesthetics. Rate each of these attributes on a scale of 1 to 5. For development, give the lake a "5" if it is pristine, with no signs of any human disturbance. A "1" would indicate that a lake is highly disturbed; for example, the entire lake is ringed with houses, seawalls, docks, etc. For aesthetics (whether the lake is appealing or not) base the decision on any factors about the lake that disturb you (trash, algal growth, weed abundance, overcrowding). Circle the number that best describes your opinion about how suitable the lake is for recreation and aesthetic enjoyment today:

- Enjoyment is nearly impossible.
- Level of enjoyment is substantially reduced.
- Enjoyment is slightly impaired.
- There are very minor aesthetic problems; it is otherwise excellent for swimming, boating, and enjoyment.
- It is beautiful and could not be any nicer.

7.1.6 Qualitative Assessment of Environmental Values
The primary goal of this study is to assess three major ecological values with respect to lakes: trophic state, ecological integrity, and human use. Based on your field experience, record your own assessment of these values on the Assessment (Front) form. Write comments on these values in this section.

- **Ecological integrity** is the ability to support and maintain a balanced, integrated, adaptive community with a biological diversity, composition, and functional organization comparable to natural lakes of the region. Record your overall impression of the "health" of the biota in the lake. Note any possible causes of impairment. The presence of higher order consumers (fish-eating birds and mammals) is an indication of a healthy food web and should be noted here. Similarly, the absence of an organism that you might expect to see is an important observation.

- **Trophic state** is the rate or amount of phytoplankton and macrophytes produced or present in a lake. Give your visual impression of the trophic status as oligotrophic (little or no biomass in the lake water), mesotrophic (intermediate amounts of biomass in the lake water), eutrophic (large amounts of biomass in the lake water), or hypereutrophic (choked lake, with more biomass than water). Give your overall impression of algal abundance and general type (e.g., filamentous). List any observed potential nutrient sources to the lake (e.g., septic tanks and agricultural runoff).

- **Suitability for human use** is the ability to support recreational uses such as swimming, fishing, and boating. Record your overall impression of the lake as a site for recreation. Note any possible causes of impairment. Note the presence or absence of people using the lake for recreational activities.

Use the comments section on the Assessment (Front) form to note any other pertinent information about the lake or its catchment. Here the Field Crew can record any observations that may be useful for
future data interpretation.

7.2 Processing the Chlorophyll-α Samples

7.2.1 Equipment and Supplies

Table 7.4 provides the equipment and supplies needed to process the two Chlorophyll-α samples (one each from the index site and J site).

Table 7.4 Equipment and supplies – chlorophyll-α processing.

<table>
<thead>
<tr>
<th>Type</th>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form</td>
<td>Index Sample Collection</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Littoral Sample Collection</td>
<td>1</td>
</tr>
<tr>
<td>Documentation</td>
<td>Labels: Chlorophyll A samples</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Outer Chlorophyll A bag</td>
<td>1</td>
</tr>
<tr>
<td>Processing</td>
<td>Poly bottle (2 L, brown, labeled INDEX)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Poly bottle (2 L, brown, labeled LITTORAL)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Centrifuge tube (50 mL, screw top) in ziploc bag</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Filter forceps (flat blade)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Filtration chamber (with filter holder)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Filtration flask (with silicone stopper and adapter)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Filtration pump (hand vacuum)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Gloves (latex/nitrile, non-powdered, box)</td>
<td>1 pair</td>
</tr>
<tr>
<td></td>
<td>Graduated cylinder (250 mL)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Squirt bottle (1 L Nalgene) – de-ionized (DI)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Test tube holder</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Whatman 0.7 µm GF/F glass fiber filter</td>
<td>2</td>
</tr>
<tr>
<td>Storing and preserving</td>
<td>Cooler</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Electrical tape</td>
<td>As needed</td>
</tr>
<tr>
<td></td>
<td>Foil squares</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Zip top bags (1 qt)</td>
<td>2</td>
</tr>
</tbody>
</table>

7.2.2 Procedures for Processing the Chlorophyll-α Samples

The procedures for processing two chlorophyll-α samples are presented below. Whenever possible, sample processing should be done in subdued light, out of direct sunlight.

1. Put on surgical gloves.
2. Place a glass fiber filter in the filter holder apparatus with the grid side down. Do not handle the filter with bare hands; use clean forceps.
3. From the Index site chlorophyll-α sample, shake the bottle to homogenize the sample, measure and pour 250 mL of water into the filter holder, replace the cap, and pump the sample through the filter. Take care not to exceed 7 inches of Hg in the vacuum gauge on the filtration pump. If 250 mL of lake water will not pass through the filter, change and discard the filter, rinse the apparatus with DI water, and repeat the procedures using 100 mL of lake water. NOTE: If the water is green or turbid, use a smaller volume to start with.
4. Observe the filter for visible color. If there is visible color, proceed; if not, repeat steps 3 & 4 until color is visible on the filter or until a maximum of 2,000 mL have been filtered. Record the actual sample volume filtered on the Sample Collection Form and on the sample label.
Rinse the graduated cylinder and upper portion of the filtration apparatus thoroughly with DI water to include any remaining cells adhering to the sides and pump through the filter. Monitor the level of water in the lower chamber to ensure that it does not contact the filter or flow into the pump.

6. Disconnect the upper portion of the filter apparatus from the lower portion. Remove the filter from the holder with clean forceps. Avoid touching the colored portion of the filter. Fold the filter in half, with the colored side folded in on itself.

7. Place the folded filter into a 50 mL screw-top centrifuge tube and cap. Record the sample volume filtered on a chlorophyll-α label and attach it to the centrifuge tube (do not cover the volume markings on the tube). Ensure that all written information is complete and legible. Cover with a strip of clear tape. Double check that the “total volume of water filtered” on the Sample Collection forms matches the total volume recorded on the sample label. Wrap the tubes in aluminum foil and place both in a re-sealable plastic bag. Place the completed outer label on the outside of the bag. Place this bag between two small bags of ice in a cooler.

6. Remove the filter holder silicone stopper and adapter from the filtration flask. Pour off water from the bottom chamber.

9. Rinse filter chambers with DI water.

10. Repeat steps 2 through 8 for the littoral site sample.

11. Thoroughly rinse the graduated cylinder and both brown sample collection bottles and caps with tap water and store for next sample event.

7.3 Preservation of Samples

Preserve the samples as specified in the Shipping Guidelines. Record the preservation information on the index and littoral sample collection forms.

7.4 Preparation of Samples for Shipping

General information is available in section 4.3.2 Shipment of Samples and Forms. Information is also available in APPENDIX D: SHIPPING GUIDELINES.

General steps that apply to samples are the following:

- Purge the Cubitainer® container of any air bubbles, seal the cap tightly and wrap electrical tape clockwise around the cap. Place the Cubitainer® in a cooler with sealed 1-gal plastic bags of ice.
- Seal all pertinent caps tightly.
- Wrap electrical tape clockwise around the cap, and then place the bottle in the cooler with sealed 1-gal plastic bags of ice. Note: do not tape the sediment mercury or dissolved carbon samples. These samples should not be removed from their respective bags after collection.

7.5 Data Forms and Sample Inspection

After the Assessment form is completed, the Field Crew Leader reviews all of the data forms and sample labels for accuracy, completeness, and legibility. This will be done whether you are using electronic field forms or paper forms. The other crew member inspects all sample containers and packages them in preparation for transport, storage, or shipment.
Ensure that all required data forms for the lake have been completed. Confirm that the Site ID, crew ID, and date of visit are correct on all forms. On each form, verify that all information has been recorded accurately, the recorded information is legible, and any flags are explained in the comments section. Ensure that written comments are legible, with no "shorthand" or abbreviations. After reviewing each form initial the upper right corner of each page of the form. If using an electronic form, no initials are necessary.

Ensure that all samples are labeled, all labels are completely filled in, and each label is covered with clear plastic tape. Make sure that all sample containers are properly sealed.

### 7.6 Launch Site Cleanup

Load the boat on the trailer and inspect the boat, motor, and trailer for evidence of weeds and other macrophytes. Clean the boat, motor, and trailer as completely as possible before leaving the launch site. Inspect all nets for pieces of macrophyte or other organisms and remove as much as possible before packing the nets for transport. Pack all equipment and supplies in the vehicle and trailer for transport; keep them organized as presented in the equipment checklists (APPENDIX B: EQUIPMENT & SUPPLIES). Lastly, be sure to clean up all waste material at the launch site and dispose of or transport it out of the site if a trash can is not available.
8.0 **FIELD QUALITY CONTROL**

Standardized training and data forms provide the foundation to help assure that data quality standards for field sampling are met. These methods for field sampling and data collection are the primary guidelines for all cooperators and field crews. In addition, repeat sampling and field evaluation and assistance visits will address specific aspects of the data quality standards for the NLA 2012.

8.1 **Repeat Sampling**

Approximately 10% of the target sites visited will be revisited during the same field season by the same field crew that initially sampled the lake. The repeat visit sites were selected by taking the first 96 lakes (10% of the lakes) from the entire draw of lakes for the survey. A list of revisit sites will be provided to each State by the EPA Regional Lakes Coordinator. In many cases, the revisit lakes will be those that were initially sampled in the NLA 2007. Because of the selection process, some states may have a large number of repeat sample sites, while other states may not have any. If a site selected for repeat sampling is dropped, then the alternate assigned to replace it should be revisited. The primary purpose of this “revisit” set of sites is to provide variance estimates that can be used to evaluate the survey design for its potential to estimate status and detect trends in the target population of lakes. The revisit will include the full set of indicators and associated parameters. The time period between the initial (Visit 1) and repeat visit (Visit 2) to a lake should be as long as possible.

8.2 **Field Evaluation and Assistance Visits**

No national program of accreditation for field work currently exists. For this reason, a rigorous program of field evaluation and assistance visits has been developed to support the NLA 2012.

8.2.1 **General Information**

Evaluation and assistance visits will be conducted with each field crew early in the sampling and data collection process, if possible, and corrective actions will be conducted in real time. These visits provide both a quality check for the uniform evaluation of the data collection methods and an opportunity to conduct procedural reviews, as required, minimizing data loss due to improper technique or interpretation of field procedures and guidance. Through uniform training of field crews and review cycles conducted early in the data collection process, sampling variability associated with specific implementation or interpretation of the protocols will be significantly reduced. The visit also provides the field crews with an opportunity to clarify procedures and offer suggestions for future improvements based on their sampling experience preceding the visit. The field evaluations, while performed by a number of different supporting collaborator agencies and participants, will be based on the uniform training, plans, and checklists. This review and assistance task will be conducted for each unique field crew collecting and contributing data under this program; hence no data will be recorded to the project database that was produced by an ‘unaudited’ process or individual.

The field evaluations will be based on the evaluation plan and field evaluation checklist. The checklist is included in APPENDIX E: FIELD EVALUATION & ASSISTANCE VISIT CHECKLIST.

One or more designated EPA or Contractor staff members who are qualified (i.e., have completed training) in the procedures of the NLA 2012 field sampling operations will visit trained state, tribal, contractor, and EPA field sampling crews during sampling operations on site. If membership of a field crew changes, and at least two of the members have not been evaluated previously, the field crew must be evaluated again during sampling operations as soon as possible to ensure that all members of the
field crew understand and can perform the procedures.
The purpose of this on-site visit will be to identify and correct deficiencies during field sampling operations. The process will involve the following preparation steps and field day activities.
Additionally, conference calls with crews may be held approximately every two weeks to discuss issues as they come up throughout the sampling season.

8.2.2 Preparation Activities
1. Each Field Crew Evaluator will schedule an assistance visit with their designated crews in consultation with the QA Officer, Regional NLA Coordinator, and respective Field Sampling Crew Leader. Evaluators should be prepared to spend additional time in the field if needed (see below). Ideally, each Field Crew will be evaluated within the first two weeks of beginning sampling operations, so that procedures can be corrected or additional training provided, if needed.
2. Each Field Crew Evaluator will ensure that field crews are aware of their visit plans and all capacity and safety equipment will be provided for the Field Crew Evaluator.
3. Each Field Crew Evaluator will need to bring along the following in Table 8.1.

Table 8.1 Equipment and supplies – field audits.

<table>
<thead>
<tr>
<th>Type</th>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form</td>
<td>APPENDIX E: FIELD EVALUATION &amp; ASSISTANCE VISIT CHECKLIST (sent from EPA HQ)</td>
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</tr>
<tr>
<td>Documentation</td>
<td>NLA 2012 Field Operations Manual</td>
<td>1</td>
</tr>
<tr>
<td>Documentation</td>
<td>NLA 2012 Quality Assurance Project Plan</td>
<td>1</td>
</tr>
<tr>
<td>Documentation</td>
<td>Clipboard</td>
<td>1</td>
</tr>
<tr>
<td>Documentation</td>
<td>Pencils (#2, for data forms)/Pen</td>
<td>1</td>
</tr>
<tr>
<td>Documentation</td>
<td>Field notebook (optional)</td>
<td>1</td>
</tr>
<tr>
<td>Gear</td>
<td>Field gear (e.g., protective clothing, sunscreen, insect repellent, hat, water, food, backpack, cell phone)</td>
<td>As needed</td>
</tr>
</tbody>
</table>

8.2.3 Field Day Activities
1. The Field Crew Evaluator will review the Field Evaluation and Assistance Visit Checklist with each crew during the field sampling day and establish and plan and schedule for their evaluation activities for the day.
2. The Field Crew Evaluator will view the performance of a field crew through one complete set of sampling activities as detailed on the Field Evaluation and Assistance Visit Checklist.
   - Scheduling might necessitate starting the evaluation midway on the list of tasks at a site, instead of at the beginning. In that case, the Field Crew Evaluator will follow the crew to the next site to complete the evaluation of the first activities on the list.
   - If the field crew misses or incorrectly performs a procedure, the Field Crew Evaluator will note this on the checklist and immediately point this out so the mistake can be corrected on the spot. The role of the Field Crew Evaluator is to provide additional training and guidance so that the procedures are being performed consistent with the FOM, all data are recorded correctly, and paperwork is properly completed at the site.
3. When the sampling operation has been completed, the Field Crew Evaluator will review the results of the evaluation with the field crew before leaving the site (if practicable), noting
positive practices and problems (i.e., weaknesses [might affect data quality]; deficiencies [would adversely affect data quality]). The Field Crew Evaluator will ensure that the field crew understands the findings and will be able to perform the procedures properly in the future.

- The Field Crew Evaluator will review the list and record responses or concerns from the field crew, if any; on the Field Evaluation and Assistance Visit Checklist (this may happen throughout the field day).
- The Field Crew Leader will sign the Field Evaluation and Assistance Visit Checklist after this review.

### 8.2.4 Post Field Day Activities

1. The Field Crew Evaluator will review the Field Evaluation and Assistance Visit Checklist that evening and provide a summary of findings, including lessons learned and concerns.
   - If the Field Crew Evaluator finds major deficiencies in the field crew operations (e.g., less than two members, equipment, or performance problems) the Field Crew Evaluator must contact the EPA NLA 2012 Project Lead. The EPA NLA 2012 Project Lead will contact the EPA NARS QA Project Officer to determine the appropriate course of action.

2. The Field Crew Evaluator will retain a copy of the Field Evaluation and Assistance Visit Checklist and submit a copy to the NARS IM Center.

3. The EPA NLA 2012 Project Lead and EPA NARS QA Project Officer or authorized designee will review the returned Field Evaluation and Assistance Visit Checklist, note any issues, and check off the completion of the evaluation for each field crew.

### 8.2.5 Summary

Table 8.2 summarizes the plan, checklist, and corrective action procedures.

Table 8.2 Summary of field evaluation and assistance visit information.

<table>
<thead>
<tr>
<th>Field Evaluation Plan</th>
<th>The Field Crew Evaluator:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Arranges the field evaluation visit in consultation with the QA Officer, Regional NLA Coordinator, and respective Field Sampling Crew Leader, ideally within the first two weeks of sampling</td>
</tr>
<tr>
<td></td>
<td>• Observes the performance of a crew through one complete set of sampling activities</td>
</tr>
<tr>
<td></td>
<td>• Takes note of errors the field crew makes on the checklist and immediately point these out to correct the mistake</td>
</tr>
<tr>
<td></td>
<td>• Reviews the results of the evaluation with the field crew before leaving the site, noting positive practices, lessons learned, and concern</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Field Evaluation Checklist</th>
<th>The Field Crew Evaluator:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Observes all pre-sampling activities and verifies that equipment is properly calibrated and in good working order, and protocols are followed</td>
</tr>
<tr>
<td></td>
<td>• Checks the sample containers to verify that they are the correct type and size, and checks the labels to be sure they are correctly and completely filled out</td>
</tr>
<tr>
<td></td>
<td>• Confirms that the field crew has followed NLA protocols for locating the lake and determining the index site on the lake</td>
</tr>
<tr>
<td></td>
<td>• Observes the index site sampling, confirming that all protocols are followed</td>
</tr>
<tr>
<td></td>
<td>• Observes the littoral sampling and habitat characterization, confirming that all protocols are followed</td>
</tr>
<tr>
<td></td>
<td>• Records responses or concerns, if any, on the Field Evaluation and Assistance Checklist</td>
</tr>
</tbody>
</table>

| Corrective Action | If the Field Crew Evaluator’s findings indicate that the Field Crew is not performing the procedures correctly, safely, or thoroughly, the Evaluator must continue working with this Field |


| **Procedures**       | Crew until certain of the crew’s ability to conduct the sampling properly so that data quality is not adversely affected.  
|                     | • If the Field Crew Evaluator finds major deficiencies in the Field Crew operations the Evaluator must contact the EPA NLA 2012 Project Lead. |
9.0 LITERATURE CITED


Criteria Development for Phytoplankton and Macroinvertebrate Assemblages for Three Lake Classes. Vermont Department of Environmental Conservation. Waterbury, VT.


Ohio EPA. 1990. *Ohio EPA Fish Evaluation Group Safety Manual*. Ohio Environmental Protection Agency, Ecological Assessment Section, Division of Water Quality Planning and Assessment, Columbus, Ohio.


APPENDIX A: CONTACTS
<table>
<thead>
<tr>
<th>Title</th>
<th>Name</th>
<th>Contact Information</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EPA HQ Project Lead</strong></td>
<td>Amina Pollard, OW</td>
<td><a href="mailto:pollard.amina@epa.gov">pollard.amina@epa.gov</a>&lt;br&gt;202-566-2360&lt;br&gt;EPA Wetlands, Oceans, and Watersheds&lt;br&gt;1200 Pennsylvania Ave NW (4503T) Washington, DC 20460</td>
</tr>
<tr>
<td><strong>EPA HQ NARS QA Lead</strong></td>
<td>Sarah Lehmann, OW</td>
<td><a href="mailto:lehmann.sarah@epa.gov">lehmann.sarah@epa.gov</a>&lt;br&gt;202-566-1379&lt;br&gt;EPA Wetlands, Oceans, and Watersheds&lt;br&gt;1200 Pennsylvania Ave NW (4503T) Washington, DC 20460</td>
</tr>
<tr>
<td><strong>EPA HQ Logistics Lead</strong></td>
<td>Marsha Landis, OW</td>
<td><a href="mailto:landis.marsha@epa.gov">landis.marsha@epa.gov</a>&lt;br&gt;202-564-2858&lt;br&gt;EPA Wetlands, Oceans, and Watersheds&lt;br&gt;1200 Pennsylvania Ave NW (4503T) Washington, DC 20460</td>
</tr>
<tr>
<td><strong>Contract Field Logistics Coordinator</strong></td>
<td>Chris Turner, GLEC, Inc.</td>
<td><a href="mailto:cturner@glec.com">cturner@glec.com</a>&lt;br&gt;715-829-3737</td>
</tr>
<tr>
<td><strong>NARS Information Management Coordinator</strong></td>
<td>Marlys Cappaert, SRA International Inc.</td>
<td><a href="mailto:cappaert.marlys@epa.gov">cappaert.marlys@epa.gov</a>&lt;br&gt;541-754-4467&lt;br&gt;541-754-4799 (fax)</td>
</tr>
<tr>
<td><strong>EPA Regional NLA Coordinators</strong></td>
<td>Hilary Snook, Region 1</td>
<td><a href="mailto:snook.hilary@epa.gov">snook.hilary@epa.gov</a>&lt;br&gt;617-918-8670&lt;br&gt;EPA Region 1&lt;br&gt;11 Technology Drive&lt;br&gt;North Chelmsford, MA 01863</td>
</tr>
<tr>
<td></td>
<td>Jim Kurtenbach, Region 2</td>
<td><a href="mailto:kurtenbach.james@epa.gov">kurtenbach.james@epa.gov</a>&lt;br&gt;732-321-6695&lt;br&gt;EPA Region 2&lt;br&gt;2890 Woodbridge Avenue&lt;br&gt;Edison, NJ 08837</td>
</tr>
<tr>
<td></td>
<td>Frank Borsuk, Region 3</td>
<td><a href="mailto:borsuk.frank@epa.gov">borsuk.frank@epa.gov</a>&lt;br&gt;304-234-0241&lt;br&gt;EPA Region 3&lt;br&gt;1060 Chapline Street, Suite 303&lt;br&gt;Wheeling WV 26003</td>
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<tr>
<td></td>
<td>Marion Hopkins, Region 4</td>
<td><a href="mailto:hopkins.marion@epa.gov">hopkins.marion@epa.gov</a>&lt;br&gt;404-562-9481&lt;br&gt;EPA Region 4&lt;br&gt;61 Forsythe Street SW&lt;br&gt;Atlanta, GA 30303</td>
</tr>
<tr>
<td></td>
<td>Mari Nord, Region 5</td>
<td><a href="mailto:nord.mari@epa.gov">nord.mari@epa.gov</a>&lt;br&gt;312-886-3017&lt;br&gt;EPA Region 5</td>
</tr>
<tr>
<td>NAME</td>
<td>EMAIL</td>
<td>PHONE</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>----------------------------</td>
<td>---------------</td>
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<tr>
<td>Mike Schaub, Region 6</td>
<td><a href="mailto:schaub.mike@epa.gov">schaub.mike@epa.gov</a></td>
<td>214-665-7314</td>
</tr>
<tr>
<td>Gary Welker, Region 7</td>
<td><a href="mailto:welker.gary@epa.gov">welker.gary@epa.gov</a></td>
<td>913-551-7177</td>
</tr>
<tr>
<td>Kris Jensen, Region 8</td>
<td><a href="mailto:jensen.kris@epa.gov">jensen.kris@epa.gov</a></td>
<td>303-312-6237</td>
</tr>
<tr>
<td>Jeff McPherson, Region 8</td>
<td><a href="mailto:mcpherson.jeffrey@epa.gov">mcpherson.jeffrey@epa.gov</a></td>
<td>303-312-7752</td>
</tr>
<tr>
<td>Sue Keydel, Region 9</td>
<td><a href="mailto:keydel.susan@epa.gov">keydel.susan@epa.gov</a></td>
<td>415-972-3106</td>
</tr>
<tr>
<td>Lil Herger, Region 10</td>
<td><a href="mailto:herger.lillian@epa.gov">herger.lillian@epa.gov</a></td>
<td>206-553-1074</td>
</tr>
</tbody>
</table>
APPENDIX B: EQUIPMENT & SUPPLIES
**Base Kit**

A Base Kit will be provided to the field crews for all sampling sites that they will go to. Some items are sent in the base kit as extra supplies to be used as needed.

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<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottle brush</td>
<td>1</td>
<td>Sediment Core</td>
</tr>
<tr>
<td>Centrifuge tube (50 mL, screw top) - extras</td>
<td>2</td>
<td>Chlorophyll A</td>
</tr>
<tr>
<td>Core plug</td>
<td>2</td>
<td>Sediment Core</td>
</tr>
<tr>
<td>Corer head (gravity, with cable and messenger)</td>
<td>1</td>
<td>Sediment Core</td>
</tr>
<tr>
<td>Coring tube</td>
<td>1</td>
<td>Sediment Core</td>
</tr>
<tr>
<td>Electrical tape*</td>
<td>1</td>
<td>General</td>
</tr>
<tr>
<td>Filtration chamber (with filter holder)</td>
<td>5</td>
<td>Chlorophyll A</td>
</tr>
<tr>
<td>Filtration flask (with silicone stopper and adapter)</td>
<td>1</td>
<td>Chlorophyll A</td>
</tr>
<tr>
<td>Filter forceps (flat blade)</td>
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<td>Chlorophyll A</td>
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<tr>
<td>Foil squares (package)*</td>
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<td>Chlorophyll A</td>
</tr>
<tr>
<td>Funnel</td>
<td>1</td>
<td>Water samples</td>
</tr>
<tr>
<td>Gloves (latex/nitrile, non-powdered, box)</td>
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<td>General</td>
</tr>
<tr>
<td>Graduated cylinder (250 mL)</td>
<td>1</td>
<td>Chlorophyll A</td>
</tr>
<tr>
<td>HDPE bottle (125 mL, white, wide-mouth) – extras</td>
<td>6</td>
<td>Zooplankton</td>
</tr>
<tr>
<td>HDPE bottle (1 L, white, wide-mouth) – extras</td>
<td>6</td>
<td>Benthics</td>
</tr>
<tr>
<td>H₂SO₄ (ampoules) – extras</td>
<td>5</td>
<td>Nutrients</td>
</tr>
<tr>
<td>Integrated sampler device (MPCA design)</td>
<td>1</td>
<td>Water Samples</td>
</tr>
<tr>
<td>Kick net (500 μm D-shaped, modified) with 4 foot handle</td>
<td>1</td>
<td>Benthics</td>
</tr>
<tr>
<td>Kit: Dissolved carbon supplies in ziploc bag:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Poly syringe (60mL) with attached 3-way stopcock</td>
<td>2</td>
<td>Dissolved Carbon</td>
</tr>
<tr>
<td>Lugol's solution (250 mL bottle)</td>
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<td>Phytoplankton</td>
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<td>Meter stick (cm)</td>
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<td>Secchi</td>
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<td>Packing tape (roll)*</td>
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<td>Pail (narcotizing chamber)</td>
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<td>Zooplankton</td>
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<tr>
<td>pH paper (box)*</td>
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<td>Nutrients</td>
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<tr>
<td>Pipette with bulb</td>
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<td>Phytoplankton</td>
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<td>Plankton net (50 μm)</td>
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<td>Zooplankton</td>
</tr>
<tr>
<td>Plankton net (150 μm)</td>
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<td>Zooplankton</td>
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<tr>
<td>Poly bottle (2 L, brown, labeled INDEX)</td>
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<td>Chlorophyll A</td>
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<tr>
<td>Poly bottle (2 L, brown, labeled LITTORAL)</td>
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<td>Algal Toxins</td>
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<td>Phytoplankton (cyanobacteria)</td>
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<td>Rubbermaid action packer</td>
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<td>General</td>
</tr>
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### APPENDIX B: EQUIPMENT & SUPPLIES

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<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scoopula (plastic)</td>
<td>5</td>
<td>Sediment</td>
</tr>
<tr>
<td>Secchi disk (20 cm diameter) with weight</td>
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<td>Secchi</td>
</tr>
<tr>
<td>Sieve bucket (500 µm)</td>
<td>1</td>
<td>Benthics</td>
</tr>
<tr>
<td>Small tote with lid</td>
<td>1</td>
<td>General</td>
</tr>
<tr>
<td>Sounding line (50 m, calibrated, marked in 0.5 m intervals) with clip</td>
<td>1</td>
<td>Depth</td>
</tr>
<tr>
<td>Secchi</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benthics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zooplankton</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spatula (2.5 inch, plastic, putty knife)</td>
<td>1</td>
<td>Sediment Core</td>
</tr>
<tr>
<td>Spoon (stainless steel)</td>
<td>1</td>
<td>Benthics</td>
</tr>
<tr>
<td>Squirt bottle (1 L Nalgene) – for de-ionized (DI)</td>
<td>1</td>
<td>General</td>
</tr>
<tr>
<td>Squirt bottle (1 L Nalgene) – for lake water</td>
<td>1</td>
<td>General</td>
</tr>
<tr>
<td>Surveyor’s tape (50m)</td>
<td>1</td>
<td>Physical Habitat</td>
</tr>
<tr>
<td>Syringe (60 mL) with tubing siphon overlying water</td>
<td>1</td>
<td>Sediment Core</td>
</tr>
<tr>
<td>Tape strips (3M, pack)*</td>
<td>2</td>
<td>General</td>
</tr>
<tr>
<td>Test tube holder</td>
<td>1</td>
<td>Chlorophyll A</td>
</tr>
<tr>
<td>Watchmaker’s forceps</td>
<td>1</td>
<td>Benthics</td>
</tr>
<tr>
<td>Whatman 0.7 µm GF/F glass fiber filter (box)</td>
<td>1</td>
<td>Chlorophyll A</td>
</tr>
<tr>
<td>Zip top bags (1 gal, box)*</td>
<td>1</td>
<td>General</td>
</tr>
<tr>
<td>Zip top bags (1 qt, box)*</td>
<td>1</td>
<td>General</td>
</tr>
<tr>
<td>Vacuum filtration pump</td>
<td>1</td>
<td>Chlorophyll A</td>
</tr>
</tbody>
</table>

*Items may need to be replenished by field crews during field season

### Site Kit

A Site Kit will be provided to the field crews for each sampling site. Please call the Field Logistics Coordinator well in advance of field sampling to request the Site Kits. Each site kit will also include necessary coolers and shipping supplies for all samples collected. Some items may not be used at all sites and should be held until the end of the field season. These site kits include:

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cubitainer® (4L)</td>
<td>1</td>
<td>Water Chemistry</td>
</tr>
<tr>
<td>Centrifuge tube (50 mL, screw top) in ziploc bag</td>
<td>2</td>
<td>Chlorophyll A</td>
</tr>
<tr>
<td>CO2 (Alka seltzer) tablets</td>
<td>2 packets</td>
<td>Zooplankton</td>
</tr>
<tr>
<td>Cooler liners</td>
<td>1 per cooler</td>
<td>General</td>
</tr>
<tr>
<td>Kit: Dissolved carbon supplies in ziploc bag:</td>
<td></td>
<td>Dissolved Carbon</td>
</tr>
<tr>
<td>Serum bottles:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>un-acidified (blue tape for CO₂ and CH₄)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>pre-acidified (pink tape for DIC)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Water isotope bottle (10mL)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Syringe filter (0.45 µM)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Needles</td>
<td>3 (1 is spare)</td>
<td></td>
</tr>
<tr>
<td>Kit: Sediment Mercury pre-cleaned supplies in ziploc bag:</td>
<td></td>
<td>Sediment Mercury</td>
</tr>
<tr>
<td>Transfer pipette tip (plastic)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Screw top Jar (125 mL, plastic)</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>FedEx Overnight shipping labels</td>
<td>2</td>
<td>WRS Samples</td>
</tr>
</tbody>
</table>
APPENDIX B: EQUIPMENT & SUPPLIES

Chilled Batched Samples

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td>FedEx Ground shipping label</td>
<td>1</td>
<td>Non-chilled Batched Samples</td>
</tr>
<tr>
<td>FedEx Express shipping labels</td>
<td>1</td>
<td>Data Packs</td>
</tr>
<tr>
<td>HDPE bottle (60 mL, white, wide-mouth)</td>
<td>1</td>
<td>Triazine</td>
</tr>
<tr>
<td>HDPE bottle (125 mL, white, wide-mouth)</td>
<td>2-4</td>
<td>Zooplankton</td>
</tr>
<tr>
<td>HDPE bottle (250 mL, brown, wide-mouth)</td>
<td>2</td>
<td>Nutrients</td>
</tr>
<tr>
<td>HDPE bottle (500 mL, white, wide-mouth)</td>
<td>2</td>
<td>Algal Toxins (index &amp; littoral)</td>
</tr>
<tr>
<td>HDPE bottle (1 L, white, narrow mouth)</td>
<td>2</td>
<td>Phytoplankton (cyanobacteria) (index &amp; littoral)</td>
</tr>
<tr>
<td>HDPE bottle (1 L, white, narrow-mouth)</td>
<td>2</td>
<td>Benthics</td>
</tr>
<tr>
<td>H₂SO₄ ampoules</td>
<td>1</td>
<td>Nutrients</td>
</tr>
<tr>
<td>Screw top jar (60 mL, plastic)</td>
<td>2</td>
<td>Sediment Dating</td>
</tr>
<tr>
<td>Screw top jar (15 mL, plastic)</td>
<td>2</td>
<td>Sediment Diatoms</td>
</tr>
</tbody>
</table>

**Forms & Labels**

Field forms (paper or electronic) and labels will be supplied by the NARS IM Center.

**Item**

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field forms packet:</td>
<td>1 General</td>
<td>General</td>
</tr>
<tr>
<td>NLA 2012 Verification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NLA 2012 Index Profile (front &amp; back)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NLA 2012 Index Sample Collection (pages 1-3)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NLA 2012 Littoral Sample Collection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NLA 2012 PHAB (front &amp; back)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NLA 2012 Macrophyte Assemblage Characterization (front &amp; back)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NLA 2012 Invasive Plants &amp; Invertebrates</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NLA 2012 Assessment (front &amp; back)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NLA 2012 Tracking – Site &amp; Sample Status/Water Chemistry Lab Tracking</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NLA 2012 Tracking – Batched Samples to GLEC (one for each site)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NLA 2012 Tracking – Packets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labels packet (for samples)</td>
<td>1</td>
<td>General</td>
</tr>
</tbody>
</table>

**Field Crew Supplied Equipment**

This equipment will need to be supplied by the field crew.

**Item**

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access permission documents/permit</td>
<td>1</td>
<td>Site Evaluation</td>
</tr>
<tr>
<td>Barometer or elevation chart to use for calibration</td>
<td>1</td>
<td>Calibration</td>
</tr>
<tr>
<td>Binoculars</td>
<td>1</td>
<td>Physical Habitat</td>
</tr>
<tr>
<td>Bleach (or bleach alternative)</td>
<td>1</td>
<td>General</td>
</tr>
<tr>
<td>Buckets (5 gallon capacity, plastic)</td>
<td>2</td>
<td>Benthics</td>
</tr>
<tr>
<td>Access instructions</td>
<td>1</td>
<td>Site Evaluation</td>
</tr>
<tr>
<td>Buoy (for marking observation point)</td>
<td>1</td>
<td>Physical Habitat</td>
</tr>
<tr>
<td>Calibration cups and standards (for multi-parameter meter)</td>
<td>1</td>
<td>Calibration</td>
</tr>
<tr>
<td>Calibration QC check solution (for multi parameter meter, pH and conductivity)</td>
<td>1</td>
<td>Calibration</td>
</tr>
<tr>
<td>Item</td>
<td>Qty</td>
<td>Usecase</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>-----</td>
<td>------------------</td>
</tr>
<tr>
<td>Clinometer</td>
<td>1</td>
<td>Physical Habitat</td>
</tr>
<tr>
<td>Clipboard</td>
<td>1</td>
<td>General</td>
</tr>
<tr>
<td>Depth Finder (hand-held or boat mounted sonar)</td>
<td>1</td>
<td>Index Site Profile</td>
</tr>
<tr>
<td>Electronic data capture devices (tablet/phone/computer) with NARS App and extra battery pack (if needed)</td>
<td>1-2</td>
<td>General</td>
</tr>
<tr>
<td>Ethanol (95%)</td>
<td></td>
<td>Benthics</td>
</tr>
<tr>
<td>Extruder rod (1 ¼ in. PVC, 75 cm long)</td>
<td>1</td>
<td>Sediment Core</td>
</tr>
<tr>
<td>Field gear (e.g., protective clothing, sunscreen, insect repellent, hat, water, food, backpack, cell phone)</td>
<td></td>
<td>General</td>
</tr>
<tr>
<td>Field notebook (optional)</td>
<td>1</td>
<td>General</td>
</tr>
<tr>
<td>Field thermometer (not mercury)</td>
<td>1</td>
<td>General</td>
</tr>
<tr>
<td>GPS unit (with manual, reference card, extra battery)</td>
<td>1</td>
<td>Site Verification Physical Habitat</td>
</tr>
<tr>
<td>Kick net (500 µm D-shaped, modified) with 4 foot handle (back-up)</td>
<td>1</td>
<td>Benthics</td>
</tr>
<tr>
<td>Laser rangefinder (for estimating drawdown)</td>
<td>1</td>
<td>Physical Habitat</td>
</tr>
<tr>
<td>Map wheel or string (for measuring shoreline distances on site map)</td>
<td></td>
<td>Physical Habitat</td>
</tr>
<tr>
<td>Multi-parameter water quality meter (with temperature, pH, and DO probes)</td>
<td>1</td>
<td>Index Site Profile</td>
</tr>
<tr>
<td>Net(s) and/or bucket assembly for end of net (back-up)</td>
<td>1</td>
<td>Benthics</td>
</tr>
<tr>
<td>Permanent marker (fine tip, for labels)</td>
<td>1</td>
<td>General</td>
</tr>
<tr>
<td>Pencils (#2, for data forms)</td>
<td>2</td>
<td>General</td>
</tr>
<tr>
<td>Pen</td>
<td>1</td>
<td>General</td>
</tr>
<tr>
<td>Plankton net (80 µm, NLA 2007 design)</td>
<td>1</td>
<td>Zooplankton</td>
</tr>
<tr>
<td>Plankton net (243 µm, NLA 2007 design)</td>
<td>1</td>
<td>Zooplankton</td>
</tr>
<tr>
<td>Rake sampler (pole or rope)</td>
<td>1</td>
<td>Macrophyte</td>
</tr>
<tr>
<td>Scissors</td>
<td>1</td>
<td>General</td>
</tr>
<tr>
<td>Screwdriver</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sectioning stage</td>
<td>1</td>
<td>Sediment Core</td>
</tr>
<tr>
<td>Sectioning tube (6 cm, 2.5 in ID, line marked 2 cm from bottom of tube)</td>
<td>1</td>
<td>Sediment Core</td>
</tr>
<tr>
<td>Shipping tape</td>
<td>1</td>
<td>Shipping</td>
</tr>
<tr>
<td>Site maps (set of 3)</td>
<td>1</td>
<td>Site Evaluation</td>
</tr>
<tr>
<td>Sounding rod (3 m, marked in 0.1 m increments, calibrated, PVC)</td>
<td>1</td>
<td>Physical Habitat</td>
</tr>
<tr>
<td>Surveyors rod</td>
<td>1</td>
<td>Physical Habitat</td>
</tr>
<tr>
<td>Tub (shallow) or dish pan</td>
<td>1</td>
<td>Sediment Core</td>
</tr>
</tbody>
</table>
APPENDIX B: EQUIPMENT & SUPPLIES

## Water
- Water (deionized)  General
- Water (lake)  General
- Wet Ice  Shipping

## Boat Equipment List

This is suggested boat equipment.

<table>
<thead>
<tr>
<th>Item</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Anchor (with 75 m line or sufficient to anchor in 50 m depth)</td>
<td></td>
</tr>
<tr>
<td>Boat horn</td>
<td></td>
</tr>
<tr>
<td>Boat plug (extra)</td>
<td></td>
</tr>
<tr>
<td>Bow/stern lights</td>
<td></td>
</tr>
<tr>
<td>Emergency tool kit</td>
<td></td>
</tr>
<tr>
<td>Fire extinguisher</td>
<td></td>
</tr>
<tr>
<td>First aid kit</td>
<td></td>
</tr>
<tr>
<td>Gas Can</td>
<td></td>
</tr>
<tr>
<td>Hand bilge pump</td>
<td></td>
</tr>
<tr>
<td>Life jackets</td>
<td></td>
</tr>
<tr>
<td>Motor</td>
<td></td>
</tr>
<tr>
<td>Oars or paddles</td>
<td></td>
</tr>
<tr>
<td>Second anchor for windy conditions and littoral sampling (w/ 75m line)</td>
<td></td>
</tr>
<tr>
<td>Sonar unit</td>
<td></td>
</tr>
<tr>
<td>Spare prop shear pin</td>
<td></td>
</tr>
<tr>
<td>Type IV PFD (throwable life saving device)</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX C: SAMPLE FIELD FORMS
Verification
## Index Profile (Front)

### NLA 2012 INDEX PROFILE (Front)

**Site ID:** NLA2012-  
**Date:**  
**Time of Arrival at Index Site (h/m):**  
**Coordinates:**  
**INDEX SITE:**  
**Latitude:**  
**Longitude:**  
**Precipitation:** NO LIGHT HEAVY  
**Type of GPS Fix:** 2D 3D  
**Odor:** YES NO  
**Scum:** YES NO  
**Index Site Depth (m):**  
**Method Used:** LINE SONAR POLE ESTIMATE  
**Comments:**

### CALIBRATION INFORMATION

**Instrument manufacturer and model:**  
**Instrument ID number:**  
**Operator:**

### TEMPERATURE

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Reading (°C)</th>
<th>Sensor Reading (°C)</th>
<th>Comments</th>
</tr>
</thead>
</table>

### DO

<table>
<thead>
<tr>
<th>DO</th>
<th>Elevation (m)</th>
<th>Barometric Pressure (mm Hg)</th>
<th>Calibration Value</th>
<th>Displayed Value</th>
<th>Flag</th>
</tr>
</thead>
</table>

### pH

<table>
<thead>
<tr>
<th>pH</th>
<th>Calibration Verified with Quality Control Sample (QCS)</th>
<th>QCS Description</th>
<th>QCS True</th>
<th>QCS Measured</th>
<th>Flag</th>
</tr>
</thead>
</table>

### CONDUCTIVITY

<table>
<thead>
<tr>
<th>Conductivity</th>
<th>Calibration Verified with Quality Control Sample (QCS)</th>
<th>QCS Description</th>
<th>QCS True (µS/cm @25°C)</th>
<th>QCS Measured (µS/cm @25°C)</th>
<th>Flag</th>
</tr>
</thead>
</table>

### Flag Codes:

- K = No measurement or observation made
- U = Suspect measurement or observation
- P1, P2, etc. = Misc. flags assigned by field crew

**Flag:**  
**Comments:**  
**Review by:**  
**Reviewed by (initial):**  
**03/21/2012**  
**NLA Profile**  
**9149175365**
### NLA 2012 INDEX PROFILE (Back)

**Site ID:** NLA2012-  
**Date:** / / 2012

**Dissolved Oxygen, Temperature, and pH Profile**

- **Intervals:** Surface to 20 m = every 1 m; 20-50 m = every 2 m; last reading 0.5 m above bottom.  
- **Metalimnion:** The region of the profile where the temperature changes at the rate of 1 °C or greater per meter of depth. Indicate the depth of the top of the metalimnion with a 'T', and the bottom of the metalimnion (when the rate change becomes less than 1 °C per meter) with a 'B'. After the metalimnion is encountered, take readings every 1 m until bottom of the metalimnion is reached.

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>O₂ (mg/L)</th>
<th>Temp. (°C)</th>
<th>pH</th>
<th>Cond. (µS/cm)</th>
<th>Metalimnion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XX.X</td>
<td>XX.X</td>
<td>XX.X</td>
<td>XX.</td>
<td>XX.X</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>O₂ (mg/L)</th>
<th>Temp. (°C)</th>
<th>pH</th>
<th>Cond. (µS/cm)</th>
<th>Metalimnion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Is the Duplicate O₂ reading within 10.5 mg/L of the initial surface reading?**  
- **YES**  
- **NO**

**Calibration Verified:**  
- **YES**  
- **NO**

<table>
<thead>
<tr>
<th>Flag</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Flag codes:**  
- K = No measurement or observation made  
- U = Suspect measurement or observation  
- F1, F2, etc. = misc. flags assigned by field crew. Explain all flags in comment sections.

03/21/2012 NLA Profile

3682175361
## Index Sample Collection (Page 1 of 3)

### NLA 2012 INDEX SAMPLE COLLECTION (Page 1 of 3)

**Site ID:** NLA2012-

**Date:** __/__/2012

**SECCHI DISK TRANSPARENCY**

*NOTE:* If euphotic zone depth is < 2 m (secchi < 1 m), take multiple "short" integrated samples.

<table>
<thead>
<tr>
<th>Depth Disk Disappears</th>
<th>Depth Disk Reappears</th>
<th>Comments</th>
<th>Clear to Bottom</th>
</tr>
</thead>
<tbody>
<tr>
<td>(m)</td>
<td>(m)</td>
<td></td>
<td>○</td>
</tr>
</tbody>
</table>

**DEPTH OF INTEGRATED SAMPLE (TYPICALLY 2 M)**

__m__

**CHEMISTRY (CHEM)**

(Target Volume = 4L)

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Comments</th>
<th>NoSampleCollected</th>
</tr>
</thead>
</table>

**ALGAL TOXIN (Microcystin) (MICX)**

(Target Volume = 500mL)

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Comments</th>
<th>NoSampleCollected</th>
</tr>
</thead>
</table>

**TRIAZINE PESTICIDE SCREEN (TRIA)**

(Target Volume = 60mL)

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Comments</th>
<th>NoSampleCollected</th>
</tr>
</thead>
</table>

**NUTRIENTS (NUTS)**

(Target Volume = 250mL)

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Number of Ampoules</th>
<th>pH</th>
<th>Comments</th>
<th>NoSampleCollected</th>
</tr>
</thead>
</table>

**PHYTOPLANKTON (PHYX)**

(Target Volume = 1000mL)

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>L poles</th>
<th>Comments</th>
<th>NoSampleCollected</th>
</tr>
</thead>
</table>

**CHLOROPHYLL-a (CHLX)**

(Target Volume = 1000mL; max vol = 2000 mL)

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Volume Filtered (mL)</th>
<th>Comments</th>
<th>NoSampleCollected</th>
</tr>
</thead>
</table>

Use comment section to explain: Suspect measurement, observations or no measurements taken.

---

03/21/2012 NLA Index Sample Collection

8410616646
### Index Sample Collection (Page 2 of 3)

#### NLA 2012 INDEX SAMPLE COLLECTION (Page 2 of 3)

**Site ID:** NLA2012-  
**Date:** ___/___/2012

**Dissolved Carbon (unacidified) (CARU)**  
(Target Volume = 15mL)  
No Sample Collected

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Dissolved Carbon (pre-acidified) (CARP)**  
(Target Volume = 15mL)  
No Sample Collected

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Dissolved Carbon Isotope (ISOT)**  
(Target Volume = 10mL)  
No Sample Collected

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Zooplankton Coarse (150 micron mesh) (ZOCN)**  
No Sample Collected

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Length of tow</th>
<th>Number of Jars</th>
<th>Narcotized (CO2)</th>
<th>Pre-Served (ETCH)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Zooplankton Fine (50 micron mesh) (ZOFN)**  
No Sample Collected

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Length of tow</th>
<th>Number of Jars</th>
<th>Narcotized (CO2)</th>
<th>Pre-Served (ETCH)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Zooplankton Coarse (243 micron mesh) (ZOCR)**  
No Sample Collected

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Total length of Tow (m)</th>
<th>Number of Jars</th>
<th>Narcotized (CO2)</th>
<th>Pre-Served (ETCH)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Zooplankton Fine (60 micron mesh) (ZOFR)**  
No Sample Collected

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Total length of Tow (m)</th>
<th>Number of Jars</th>
<th>Narcotized (CO2)</th>
<th>Pre-Served (ETCH)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Use comment section to explain: Suspect measurement, observations or no measurements taken.

**Date:** 03/21/2012  
**NLA INDEX Sample Collection**  
**7910616640**
## Index Sample Collection (Page 3 of 3)

![Index Sample Collection Form](image)

**SEDIMENT CORE SAMPLES**
(Target Core Length = 45cm)

<table>
<thead>
<tr>
<th>Decimal/Degrees</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Index</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAD 83</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Length of Core:</th>
<th>Bottom of Core:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SEDIMENT MERCURY TOP (SEDH)**
(Target Volume = 50mL)

- Sample ID
- Comments
- No Sample Collected

**SEDIMENT DIATOMS TOP (SEDT)**
(Target Volume = 5mL)

- Sample ID
- Comments
- No Sample Collected

**SEDIMENT DATING (SEDD)**
(Target Volume = 40mL)

- Sample ID
- Comments
- No Sample Collected

**SEDIMENT MERCURY BOTTOM (SEDG)**
(Target Volume = 20mL)

- Sample ID
- Comments
- No Sample Collected

**SEDIMENT DIATOMS BOTTOM (SEDB)**
(Target Volume = 5mL)

- Sample ID
- Comments
- No Sample Collected

Use comment section to explain: Suspect measurement, observations or no measurements taken.

---

03/21/2012  NLA Index Sample Collection

---
Littoral Sample Collection

![Sample Form Image]

**BENTHIC MACROINVERTEBRATES (BENT)**
- No Sample Collected

**STATIONS**
- **SUBSTRATE CODES:**
  - R: Rocky/Cobble/Woody debris
  - M: Macrophyte beds
  - F: Fine sediments
  - L: Leaf Pack
  - O: Other
- **COLLECTION CODES:**
  - B: Boat
  - W: Wading

<table>
<thead>
<tr>
<th>Sub</th>
<th>Coll</th>
<th>Flag</th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>M</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>F</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>L</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

**CHLOROPHYLL-a (CHLL)**
- (Target Volume = 1000mL; max vol = 2000 mL)
  - No Sample Collected

**PHYTOPLANKTON (PH/L)**
- (Target Volume = 100mL)
  - No Sample Collected

**ALGAL TOXIN (Microcystin) (MICL)**
- (Target Volume = 500mL)
  - No Sample Collected

---

*Use comment section to explain: Suspect measurement, observations or no measurements taken.*
Physical Habitat (Front)

### NLA 2012 PHAB (Front)

**Site ID:** NLA12-  
**Date:** ___ / ___ / 2012  
**Reviewed by:** [Initials]

**Station:** A  
**Is it an Island?** Yes  
**Dropped:** No  
**Station Relocated:** Yes  
**New Station (K, L, etc.):** [Blank]

**Depth at Station:** [Blank]  
**NAD 83 (Decimal Degrees):** [Blank]  
**LAT:** [Blank]  
**LONG:** [Blank]

**Shoreline Flooding:**  
- Depth: [Blank] (m)  
- Horizontal Dist: [Blank] (m)

**Drawdown:**  
- Height: [Blank] (m)  
- Dist: [Blank] (m)  
- Bank Angle (see diagram below):
  - Flats (<5°)  
  - Gradual (5-30°)  
  - Steep (30-75°)  
  - Neat vertical (over 75°)

**Littoral Zone**  
- Surface Film Type:  
  - None  
  - Scum  
  - Algae  
  - Oily  
  - Other
- Substrate Odor:  
  - None  
  - H2S  
  - Anaerobic  
  - Oily  
  - Chemical  
  - Other
- Substrate Color:  
  - Black  
  - Gray  
  - Brown  
  - Red  
  - Other

**Substrate**  
- Littoral Bottom:  
  - Absent (<9%)  
  - Sparse (10-20%)  
  - Moderate (20-40%)  
  - Heavy (40-70%)  
  - Very Heavy (>70%)

**Aquatic Macrophytes**  
- Littoral:  
  - Present  
  - Absent

**Fish Cover**  
- Littoral:  
  - Aquatic and Inundated Herbaceous Veg.  
  - Woody Deciduous/Deciduous > 0.3 m Dia.  
  - Woody Deciduous/Deciduous < 0.3 m Dia. (alive or dead)  
  - Inundated Live Trees > 0.3 m Dia.  
  - Overhanging Veg. within 1 m of Surface  
  - Ledges or Sharp Dropoffs  
  - Brokers  
  - Human Structures - Docks, Landings, etc.

**Flag Codes:**  
- K: No measurement made  
- U: Suspect measurement  
- P1, P2: etc. = misc. flags assigned by each field crew

**Observation Station:**  
- 15 m  
- 15 m  
- 15 m  
- 15 m  
- 15 m  
- 15 m

**Flag:** 248431.5782
### Physical Habitat (Back)

#### NLA 2012 PHAB (Back)

**Site ID:** NLA12-

**Date:** [___] / [___] / 2012

**STATION:**
- O A
- O B
- O C
- O D
- O E
- O F
- O G
- O H
- O I
- O J
- NEW STATION (K, L, etc.):

<table>
<thead>
<tr>
<th>Canopy (&gt;5m)</th>
<th>Riparian</th>
<th>Drawdown</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 = Absent (5%)</td>
<td>1 = Sparse (&lt;10%)</td>
<td>2 = Moderate (10-40%)</td>
</tr>
<tr>
<td>3 = Heavy (40-75%)</td>
<td>4 = Very Heavy (&gt;75%)</td>
<td></td>
</tr>
<tr>
<td>Broadleaf/ Evergreen</td>
<td>Mixed</td>
<td>Broadleaf/ Evergreen</td>
</tr>
<tr>
<td>Coniferous</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Deciduous</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Mixed</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

**Understory (0.5-5m):**

<table>
<thead>
<tr>
<th>Riparian</th>
<th>Drawdown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broadleaf/ Evergreen</td>
<td>Mixed</td>
</tr>
<tr>
<td>Coniferous</td>
<td>O</td>
</tr>
<tr>
<td>Deciduous</td>
<td>O</td>
</tr>
<tr>
<td>Mixed</td>
<td>O</td>
</tr>
</tbody>
</table>

**Ground Cover (<0.5m):**

<table>
<thead>
<tr>
<th>Riparian</th>
<th>Drawdown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broadleaf/ Evergreen</td>
<td>Mixed</td>
</tr>
<tr>
<td>Coniferous</td>
<td>O</td>
</tr>
<tr>
<td>Deciduous</td>
<td>O</td>
</tr>
<tr>
<td>Mixed</td>
<td>O</td>
</tr>
</tbody>
</table>

#### Human Influence

<table>
<thead>
<tr>
<th>Riparian</th>
<th>Drawdown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buildings</td>
<td>O</td>
</tr>
<tr>
<td>Commercial</td>
<td>O</td>
</tr>
<tr>
<td>Park Facilities/ Man-made beach</td>
<td>O</td>
</tr>
<tr>
<td>Docks/ Boats</td>
<td>O</td>
</tr>
<tr>
<td>Wells, dikes or outfalls</td>
<td>O</td>
</tr>
<tr>
<td>Trash/ Landfill</td>
<td>O</td>
</tr>
<tr>
<td>Roads or Railroads</td>
<td>O</td>
</tr>
<tr>
<td>Power Lines</td>
<td>O</td>
</tr>
<tr>
<td>Fine Crops</td>
<td>O</td>
</tr>
<tr>
<td>Forestry</td>
<td>O</td>
</tr>
<tr>
<td>Other (Flag and explain in comments)</td>
<td>O</td>
</tr>
</tbody>
</table>

**Flag codes:**
- K = No measurement made.
- U = Suspect measurement.
- FLF2, etc. = misc. flags assigned by each field crew.

**Flag codes:**

08/21/2012 NLA Phab (Back)
Macrophyte Assemblage Characterization (Front)

![Image of Macrophyte Assemblage Characterization form]

The form includes columns for Site ID, Date, Phor. Plot, Point, Depth, Plant Presence, Plant Density, Fish, Algae, Macrophyte Growth Form, Fill if MDC reached, and Comments.
Macrophyte Assemblage Characterization (Back)

<table>
<thead>
<tr>
<th>Site ID: NLA2012-</th>
<th>Date: _____ / _____ / 2012</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Phab Plot</th>
<th>Point</th>
<th>Depth</th>
<th>Plant Rate</th>
<th>Fl. Algae Density</th>
<th>Macrophyte Growth Form</th>
<th>Fill if MDC reached</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>6</td>
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<td>7</td>
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<td>8</td>
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<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>10</td>
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<td>11</td>
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<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Daspest Part of Lake: _______ (m)

Plants observed: Y N

If yes, stop, lake is 100% littoral

Depth at which plants observed

Direction:

MDC 1
MDC 2
MDC 3
MDC 4
MDC 5

03/21/2012 NLA Macrophyte Assemblage Characterization

87042393878
## Invasive Plants and Invertebrates (Front)

<table>
<thead>
<tr>
<th>STATIONS</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPECIES</td>
<td>Mark if observed</td>
<td>Mark if observed</td>
<td>Mark if observed</td>
<td>Mark if observed</td>
<td>Mark if observed</td>
<td>Mark if observed</td>
</tr>
<tr>
<td>None observed</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Curly leaf pondweed</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Common reed</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Eurasian watermilfoil</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Purple loosestrife</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Russian olive</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Reed canarygrass</td>
<td>O</td>
<td>O</td>
<td>O</td>
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<td>O</td>
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</tr>
<tr>
<td>Canada thistle</td>
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<td>O</td>
<td>O</td>
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<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Multiflora rose</td>
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<td>O</td>
<td>O</td>
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<td>O</td>
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<tr>
<td>Narrowleaf cattail</td>
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<td>O</td>
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</tr>
<tr>
<td>Brazilian waterweed</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
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<tr>
<td>Brittle leaf milfoil</td>
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<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
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</tr>
<tr>
<td>Parrot feather milfoil</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Mimosa</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Hydrilla</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Water starwort</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Water hyacinth</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Yellow floatingheart</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>European pepperwort</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Alligator weed</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>European waterstarwort</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Giant salvinia</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Water fern</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Water chestnut (European)</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Tamarisk</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Deeprased sedge</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Japanese or giant knotweed</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Miramar weed</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Brazilian propoer</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Zebra or quagga mussel</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Asian clam</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Rusty crayfish</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

**Flag Codes:**

- U: Suspect measurement or observation.
- P1, P2, etc.: Flags assigned by field crew.
- **Important:** Explain all flags in comments section.

**Field Notes:**

- NLA 2012 Invasive Plants and Invertebrates
- 03/21/2012
- NLA Invasive Plants and Invertebrates
- NLA2012-
Invasive Plants and Invertebrates (Back)

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<td>Mirror weed</td>
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Flag | Comments
--- | ---

Flag codes: U = Suspect measurement or observation; F1, F2, etc. = misc. flags assigned by field crew. Explain all flags in comments section.

03/21/2012  NLA Invasive Plants and Invertebrates
### NLA 2012 ASSESSMENT (Front)

**Site ID:** NLA2012-

**Date:** __/__/2012

#### LAKE/CATCHMENT SITE ACTIVITIES AND DISTURBANCES OBSERVED

(Severity: Blank=Not observed, L=Low, M=Moderate, H=High)

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<td>○ MiningQuarries</td>
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<td>○ Reactors</td>
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#### GENERAL LAKE INFORMATION

- **Hydrologic Lake Type:** ○ Reservoir ○ Drainage (outlets present) ○ Seepage (no outlets observed)
- **Outlet Dam:** ○ None ○ Artificial ○ Natural
- **Low Elevation Flight Hazards:** ○ Yes ○ No
- **Motor Boat Density:** ○ High ○ Low ○ Restricted ○ Banned
- **Swimability:** ○ Good ○ Fair ○ Not Swimable
- **Lake Level Changes:** ○ Zero ○ Elevation Change = ___

#### SHORELINE CHARACTERISTICS (% of shoreline)

- **Forest:** ○ Rare (<5%) ○ Sparse (5 to 25%) ○ Moderate (26 to 75%) ○ Extensive (>75%)
- **Grass:** ○ Rare (<5%) ○ Sparse (5 to 25%) ○ Moderate (26 to 75%) ○ Extensive (>75%)
- **Shrub:** ○ Rare (<5%) ○ Sparse (5 to 25%) ○ Moderate (26 to 75%) ○ Extensive (>75%)
- **Wetland:** ○ Rare (<5%) ○ Sparse (5 to 25%) ○ Moderate (26 to 75%) ○ Extensive (>75%)
- **Bare Ground:** ○ Rare (<5%) ○ Sparse (5 to 25%) ○ Moderate (26 to 75%) ○ Extensive (>75%)
- **Agriculture:** ○ Rare (<5%) ○ Sparse (5 to 25%) ○ Moderate (26 to 75%) ○ Extensive (>75%)
- **Shoreline Mods (docks, riprap):** ○ Rare (<5%) ○ Sparse (5 to 25%) ○ Moderate (26 to 75%) ○ Extensive (>75%)
- **Development (Residential & Urban):** ○ Rare (<5%) ○ Sparse (5 to 25%) ○ Moderate (26 to 75%) ○ Extensive (>75%)

#### QUALITATIVE MACROPHYTE SURVEY

- **Emergent/floating coverage (% Lake Area):** ○ <5% ○ 5 to 25% ○ 26 to 75% ○ >75%
- **Submerged coverage (% Lake Area):** ○ <5% ○ 5 to 25% ○ 26 to 75% ○ >75%
- **Macrophyte Density:** ○ Absent ○ Sparse ○ Moderate ○ High

#### WATERBODY CHARACTER

- **Pristine:** ○ 6 ○ 4 ○ 3 ○ 2 ○ 1 (Highly Disturbed)
- **Appealing:** ○ 6 ○ 4 ○ 3 ○ 2 ○ 1 (Unappealing)

**Date:** 03/21/2012

**NLA Assessment**

**ID:** 2481024922
### Qualitative Assessment of Environmental Values

**Ecological Integrity:**
- [ ] Excellent
- [ ] Good
- [ ] Fair
- [ ] Poor

**General Assessment:**

**Wildlife Observed:**

**Trophic State:**
- [ ] Oligotrophic
- [ ] Mesotrophic
- [ ] Eutrophic
- [ ] Hypereutrophic

**Visual Assessment:**

**Algal Abundance & Type:**

**Nutrient Sources:**

**Other:**

**Recreational Value:**
- [ ] Excellent
- [ ] Good
- [ ] Fair
- [ ] Poor

**Conditions and Local Contacts:**

**Observations (e.g., accessibility, boating, fishing, swimming, health concerns):**

### Comments

---

**Date:** 03/21/2012  
**NLA Assessment**  
**Site ID:** NLA2012-  
**Reviewed by:** Initials  
**Reviewed by (initial):**
Site and Sample Status/Water Chemistry Lab Tracking

NLA 2012 SITE AND SAMPLE STATUS/WATER CHEMISTRY LAB TRACKING

Site ID: NLA2012- Visit: 0102 Date Collected: 01/01/2012
State of Site Location: Crew:

Shipped by: FedEx UPS Hand Delivery Other:
Airbill/Tracking Number: Date Sent: 01/01/2012

Site Status - Is Site Sampleable?
○ YES - Proceed to Sample Status
○ NO - Select ONE reason from list below and skip Sample Status:
  ○ Not Visited
  ○ Inaccessible
  ○ Not Target
  ○ Other:

Sample Status - Water Chemistry Lab Samples

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Sample Status - Batch Samples

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Field Form Status Field Data Submission via: ○ Electronic APP ○ Paper Forms

Water Chemistry Lab Completed by Lab Send completed forms to: Tracking Related Inquiries:
Attn: Phil Monaco, Dynamac c/o U.S. EPA
1350 SE Goodnight Ave
Corvallis, OR 97333
Phone: 541-754-4720
Email: monaco.phil@epamail.epa.gov

Date Received: 01/01/2012
Received by:

EMAIL: sampletracking@epa.gov
FAX: 541-754-4637
VOICE MESSAGE CENTER: 541-754-4663

03/21/2012 NLA Tracking - Site and Sample Status

Sampletracking@EPA.gov
Phone: 541-754-4467
Michelle Goer
Phone: 541-754-4793

0303519337
Tracking – Batch Samples to GLEC

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Batch Lab: Great Lakes Environmental Center
739 Hastings Street, Traverse City, MI 49686
Phone: 231-941-2230
Email: NLA2012@glec.com

Send completed forms to:
EMAIL: sampletracking@epa.gov
FAX: 541-754-4637
VOICE MESSAGE CENTER: 541-754-4663

Tracking Related Inquiries:
Marys Cappaert
Phone: 541-754-4467
Michelle Gover
Phone: 541-754-4793

03/21/2012 NLA Tracking - Batched
## Tracking - Packets

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</tr>
<tr>
<td></td>
<td></td>
<td>O2</td>
<td></td>
</tr>
</tbody>
</table>

## Packet Lab

<table>
<thead>
<tr>
<th>Atttn: Marlys Cappaert</th>
</tr>
</thead>
<tbody>
<tr>
<td>c/o USEPA - WED Division</td>
</tr>
<tr>
<td>200 SW 35th St</td>
</tr>
<tr>
<td>Corvallis, OR 97333</td>
</tr>
<tr>
<td>Email: <a href="mailto:cappaert.marlys@epa.gov">cappaert.marlys@epa.gov</a></td>
</tr>
</tbody>
</table>

**Completed by Lab**

- **Date Received:** [ ]/[/][ ]
- **Received by:** [ ]

**Send completed forms to:**

- **EMAIL:** sampletracking@epa.gov
- **FAX:** 541-754-4637
- **VOICE MESSAGE CENTER:** 541-754-4663

**Tracking Related Inquiries:**

- **Marlys Cappaert**
  - **Phone:** 541-754-4467
- **Michelle Gover**
  - **Phone:** 541-754-4793

---

**NLA Tracking - PACKS 08/21/2012**

7419180000
APPENDIX D: SHIPPING GUIDELINES
General Shipping Guidelines

Before shipping, it is very important to preserve each sample as directed in the sample collection portion of the appropriate chapter in the NLA 2012 FOM. General directions for sample processing, shipping and tracking are found below:

- Preserve the samples as specified for each indicator before shipping.
- Be aware of the holding times for each type of sample (Error! Reference source not found.).
- Always line the cooler with a large, 30-gallon plastic bag.
- Surround the jars with crumpled newspaper, vermiculite, or other absorbent material.

When ice is used for shipment:

- Ensure that the ice is fresh before shipment.
- Contain the ice separately within numerous 1-gallon re-sealable plastic bags.
- White or clear bags will allow for labeling with a dark indelible marker. Label all bags of ice as “ICE” with an indelible marker to prevent misidentification by couriers of any leakage of water as a possible hazardous material spill.
- Place samples and bags of ice inside the cooler liner and seal the cooler liner.
- Secure the cooler with strapping tape.

Tracking Forms

A Tracking Form must be filled out to accompany each sample shipment. Be very careful to fill in the information correctly and legibly, especially the label number, Site ID, and Sample ID numbers. Use the codes on the bottom of the form to indicate sample type. The Tracking Form is to be placed in a resealable plastic bag and included inside the shipping container. Seal the shipping container. Submit the Sample Tracking Form to the NARS IM Center to indicate that samples will be in transit to the lab.

Shipping Addresses

USEPA Lab, Corvallis, Oregon (Water Chemistry, Nutrients, Chlorophyll-a)
Attn: Phil Monaco, Dynamac
c/o U.S. EPA
1350 SE Goodnight Ave
Corvallis, OR 97333

USEPA Data Management Center, Corvallis Oregon (Data Packet)
Attn: Marlys Cappaert, SRA
c/o U.S. EPA, NHEERL-WED
200 S.W. 35th Street
Corvallis, OR 97333

Great Lakes Environmental Center (All other samples)
739 Hastings Street
Traverse City, MI 49686
## Sample preservation, packaging, and holding times.

<table>
<thead>
<tr>
<th>LAB / Chilled Batch Sample Lab</th>
<th>SAMPLE TYPE</th>
<th>SAMPLE ID</th>
<th>LOCATION</th>
<th>SAMPLE TARGET VOLUME</th>
<th>CONTAINER</th>
<th>PREPARATION/PRESERVATION</th>
<th>SHIPPING FRAME</th>
<th>PACKAGING FOR SHIPPING</th>
</tr>
</thead>
<tbody>
<tr>
<td>WRS Lab - Corvallis, OR</td>
<td>Water chemistry (raw, unfiltered site water)</td>
<td>CHEM Index</td>
<td>4 L</td>
<td>Cubitainer (4 L)</td>
<td>Wet ice in field</td>
<td>Immediate (lab arrival within 24 hours of sampling)</td>
<td>WRS Cooler with wet ice OVERNIGHT</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nutrients</td>
<td>NUTS Index</td>
<td>250 mL</td>
<td>HDPE bottle (250 mL, brown, wide-mouth)</td>
<td>Acid ampoule pH paper check Wet ice in field</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chlorophyll-a</td>
<td>CHLX Index Collection</td>
<td>2 L</td>
<td>Poly bottle (2 L, brown, labeled INDEX)</td>
<td>Wet ice in field</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Stain on filter – max 2 L filtration</td>
<td>centrifuge tube (50 mL), in zip-top bag</td>
<td>Wet ice in field (after filtration)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chlorophyll-a</td>
<td>CHLX Index Collection</td>
<td>2 L</td>
<td>Poly bottle (2 L, brown, labeled LITTORAL)</td>
<td>Wet ice in field</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Stain on filter – max 2 L filtration</td>
<td>centrifuge tube (50 mL), in zip-top bag</td>
<td>Wet ice in field (after filtration)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sediment mercury</td>
<td>SEDH Index Top</td>
<td>60 mL (majority of top slice)</td>
<td>Screw top jar (125 mL, plastic)</td>
<td>Wet ice in field</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sediment mercury</td>
<td>SEDG Index Bottom</td>
<td>20 mL (portion of bottom slice)</td>
<td>Screw top jar (125 mL, plastic)</td>
<td>Wet ice in field</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chilled Batch Sample Lab (GLEC – Traverse City, MI)</td>
<td>Algal toxins</td>
<td>MICX Index</td>
<td>500 mL</td>
<td>HDPE bottle (500 mL, white, wide-mouth)</td>
<td>Wet ice in field</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dissolved CO₂ and methane (unacidified)</td>
<td>CARU Index (selected lakes)</td>
<td>15 mL</td>
<td>Serum bottle (blue tape)</td>
<td>Wet ice in field</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dissolved CO₂ and methane (pre-acidified)</td>
<td>CARP Index (selected lakes)</td>
<td>15 mL</td>
<td>Serum bottle (pink tape)</td>
<td>Wet ice in field</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dissolved Carbon Isotope</td>
<td>ISOT Index (selected lakes)</td>
<td>10 mL</td>
<td>Bottle (10mL)</td>
<td>Wet ice in field</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Phytoplankton</td>
<td>PHYX Index</td>
<td>1 L</td>
<td>HDPE bottle (1 L, white narrow mouth)</td>
<td>Lugol’s added in field</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Phytoplankton</td>
<td>PHYL Littoral</td>
<td>1 L</td>
<td>HDPE bottle (1 L, white, narrow mouth)</td>
<td>Wet ice in field</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sediment dating</td>
<td>SEDD Index Bottom (natural lakes only)</td>
<td>40 mL</td>
<td>Screw-top jar (60 mL)</td>
<td>Wet ice in field</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample Type</td>
<td>Identification Code</td>
<td>Container Type</td>
<td>Container Volume</td>
<td>Preservation Method</td>
<td>Shipping Guidelines</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------------------------</td>
<td>---------------------</td>
<td>-------------------------</td>
<td>------------------</td>
<td>-------------------------</td>
<td>----------------------------------------------------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sediment diatoms</td>
<td>SEDT Index Top</td>
<td>5 mL</td>
<td>Jar (15 mL)</td>
<td>Wet ice in field</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SEDB Index Bottom</td>
<td>5 mL</td>
<td>Jar (15 mL)</td>
<td>Wet ice in field</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Triazine screen</td>
<td>TRIA Index</td>
<td>50 mL</td>
<td>HDPE bottle (60 mL, white, wide-mouth)</td>
<td>Wet ice in field</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benthic invertebrates</td>
<td>BENT Littoral</td>
<td>All organisms in grabs</td>
<td>HDPE bottle (1 L, white, wide-mouth)</td>
<td>95% ethanol added in field</td>
<td>As soon as possible after site sampled (Batch no longer than 2 weeks)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zooplankton (coarse – 150 µm)</td>
<td>ZOCN Index</td>
<td>Vertical tow(s) 5 meter total length</td>
<td>HDPE bottle (125 mL, white, wide-mouth)</td>
<td>95% ethanol added in field</td>
<td>Non-Chilled Batched Cooler with absorbent material No Ice GROUND</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zooplankton (coarse – 50 µm)</td>
<td>ZOFN Index</td>
<td>Vertical tow(s) 5 meter total length</td>
<td>HDPE bottle (125 mL, white, wide-mouth)</td>
<td>95% ethanol added in field</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zooplankton (coarse – 243 µm)</td>
<td>ZOCR Index (2007 revisit only)</td>
<td>Vertical tow from 0.5m to surface</td>
<td>HDPE bottle (125 mL, white, wide-mouth)</td>
<td>95% ethanol added in field</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zooplankton (coarse – 80 µm)</td>
<td>ZOFR Index (2007 revisit only)</td>
<td>Vertical tow from 0.5m to surface</td>
<td>HDPE bottle (125 mL, white, wide-mouth)</td>
<td>95% ethanol added in field</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zooplankton (coarse – 80 µm)</td>
<td>Data packet</td>
<td>All completed data forms</td>
<td>Envelope</td>
<td>Checked by crew leader and put in order Copy or scan all forms for your records</td>
<td>Batch up to 2 weeks Provided envelope</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

WED – Corvallis, OR
APPENDIX E: FIELD EVALUATION & ASSISTANCE VISIT CHECKLIST
## 2012 National Lakes Assessment: Field Evaluation and Assistance Visit Checklist

### Evaluation Date(s):

### Evaluator(s):

<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lake Site ID:</th>
<th>Lake Name:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Field Crew ID:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

### Field Crew Members:

<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Other Observers Present During Evaluation:

<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## BASE SITE ACTIVITIES

### Global Positioning System Receiver

<table>
<thead>
<tr>
<th>Were the batteries checked?</th>
<th>Y</th>
<th>N</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Was a re-initialization check required?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Were other tests or checks required as recommended in operating manual?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### Multi-Probe

<table>
<thead>
<tr>
<th>Was the electrode stored properly?</th>
<th>Y</th>
<th>N</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Were the meter red lines, zeroes, readings steady?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Membrane inspection: temperature, DO and pH checks conducted correctly before using?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was the DO calibration done at the lake (in accordance with 3.1.2)?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Field Operations Manual</td>
<td>APPENDIX E: FIELD EVALUATION &amp; ASSISTANCE VISIT CHECKLIST</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------</td>
<td>----------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Was the multi-probe calibrated for pH and conductivity at the base location or before traveling to the site (whichever is appropriate for the unit)?</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Were pH and conductivity (if measured) checked for performance against a QCCS solution (at the beginning of the week whenever sampling is occurring, as described in the field manual, minimum of 2x, before first and after last lake sampled)?</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td><strong>Containers/Labels</strong></td>
<td>Were labels affixed to containers when required?</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Were labels completed where feasible and appropriate (before or after collection) using a permanent marker (pencil for benthos inside jar label) and covered with clear tape?</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td><strong>Preservatives and Other Solutions</strong></td>
<td>Were stock preservatives prepared if required (recipes available)?</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Were the benthic invertebrate and zooplankton preservatives ready for transport?</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Was the preservative for phytoplankton ready for transport?</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Was dry ice present?</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Was the pH/conductivity quality control check sample solution ready for transport?</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td><strong>Other Equipment and Supplies</strong></td>
<td>Was the current version of the Lake Visit Checklist used at the base location?</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Was the Supply Needs List sent or phoned in to “home base” or directly to the Field Logistics Coordinator?</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Were additional “custom” items added to the checklist?</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Were equipment and supplies clean, in verified working order, and organized for transport?</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td><strong>Site Information and Access</strong></td>
<td>Were individual site packets, including directions to the site and topographic maps, available and organized?</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Was the site access information/permission letter available?</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Was the landowner contacted prior to site visit?</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Were other key contact persons notified (e.g., Regional Coordinator, State or Tribal contacts)?</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td><strong>Vehicle</strong></td>
<td>Was the tire pressure checked and OK?</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Was the fuel level checked and OK?</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Were the vehicle lights, turn signals, and brake lights checked?</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Were there any operational problems?</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Were emergency kit-jumper cables, first aid kit, etc. available?</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Was there an extra set of keys for the vehicle available and with a different person?</td>
<td>Y</td>
<td>N</td>
</tr>
</tbody>
</table>
## Boat

<table>
<thead>
<tr>
<th>Question</th>
<th>Y</th>
<th>N</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Was the trailer and hitch inspected prior to departing to the site to ensure that the trailer was securely fastened?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Were the electronic connection and brake lights for the trailer checked?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the boat(s) in good working order and inspected before departure?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was there any additional emergency equipment (e.g., shovel, fire extinguisher, etc.)?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Were PFDs available for all passengers?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Conductivity (OPTIONAL)

<table>
<thead>
<tr>
<th>Question</th>
<th>Y</th>
<th>N</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Was the QC check conducted correctly before field measurement, using a DI water rinse, rinse bottle, and test bottle of QC solution?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the measured conductivity of QCC solution recorded?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does the crew understand what to do in case of an unacceptable QC check?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the temperature of the solution recorded (if meter does not provide temperature-corrected values)?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the QC solution recently replaced? (2-3 weeks)?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the conductivity measurement made at a representative location within the stream (near X-site, flowing water, mid-depth, etc.)?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was a measured conductivity value recorded correctly on the field form?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Were the meter and probe stored correctly after use?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## NOTES

### LAKE VERIFICATION

#### Lake Verification at the Launch Site

<table>
<thead>
<tr>
<th>Question</th>
<th>Y</th>
<th>N</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Was the site information sheet available for the lake?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Were the lake coordinates recorded on the verification form?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was a detailed description of the final part of the route to the lake recorded?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the lake classified correctly (e.g., target vs. non-target vs. inaccessible)?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the Verification Form completed for sites not visited and for sites visited but not sampled?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was a rough sketch of lake outline available for Side 2 of verification form?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Lake Verification at the Index Site Location

<table>
<thead>
<tr>
<th>Question</th>
<th>Y</th>
<th>N</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does the map sketch of the lake outline include shoreline station locations and launch site location?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the lake verified via GPS coordinates or map information and recorded on the verification form?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was the lake evaluated to see if it meets study requirements (e.g., &gt; 1 m deep)?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was the deepest point, or index location, (&lt; 50 m) determined using sonar or bathymetric map?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Were the GPS coordinates of index location recorded on the form?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Were photographs of the site taken (if appropriate)?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was the index site location marked on the lake outline map?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
</tbody>
</table>

## INDEX SITE SAMPLING

### Temperature, Dissolved Oxygen, and pH

<table>
<thead>
<tr>
<th>Question</th>
<th>Y</th>
<th>N</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Was the depth measured at the index location, and the intervals calculated before probe was placed in the water?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Were the site conditions properly recorded?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was the probe calibrated during the initial site activities?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was an operation manual available for the meter?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Were the measurements at each depth interval conducted and recorded according to the protocol on the Lake Profile Form?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Did the probe touch the bottom of the lake?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was a duplicate reading taken at the surface after the profile was completed?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was the probe stored correctly after the measurement?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Were the top and bottom of the metalimnion marked on the form where the water temperature changes 1 degree per meter?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### Secchi Disk Transparency

<table>
<thead>
<tr>
<th>Question</th>
<th>Y</th>
<th>N</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Was the Secchi disk being used the black and white patterned disk?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Were the calibrated sounding line visibly marked in half meter intervals?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
</tbody>
</table>
**Water Sample Collection and Preservation**

<table>
<thead>
<tr>
<th>Question</th>
<th>Y</th>
<th>N</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Were gloves worn?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the integrated sampler rinsed three times at the index point?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the euphotic zone correctly defined by the crew based on Secchi depth measurements?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the euphotic zone calculated on lake index site sample collection form?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>If the euphotic zone &lt; 2 m, was the sample collected from within the euphotic zone only?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Were labels for all containers securely attached and covered with clear tape?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the lake ID correctly labeled on each container?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the Cubitainer® expanded by water pressure, not by inflating or pulling apart sides?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Were fingers kept away from the inner surface of the cap and container opening during sample collection?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the first Cubitainer® mixed thoroughly before pouring off into the 2 L bottle for chlorophyll-α filtration, 1 L bottle for phytoplankton, and 500- mL bottle for the microcystin sample?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Are the sample jars clearly labeled for each indicator?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Were approximately 10mL of Lugol’s added to the 1 L bottle for phytoplankton preservation?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the sample a “weak-tea” color?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>For the microcystin sample, was the 500 mL bottle filled with water from the 4 L Cubitainer®?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>For microcystin sample, was the bottle placed in the cooler with wet ice?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the Cubitainer® placed in dark plastic bag?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the Cubitainer® placed in a cooler or in a black gallon bag on ice until the site work was complete?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Zooplankton Sample Collection**

<table>
<thead>
<tr>
<th>Question</th>
<th>Y</th>
<th>N</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Were the mesh sizes clearly marked on the two Wisconsin nets and buckets (80μm and 243 μm)?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Were the nets inspected before use for holes or tears?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Were the nets each attached to a line visibly marked every 0.5 m?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the net carefully lowered through the water in an upright position?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the net stopped 0.5 m from the bottom?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Appendix E: Field Evaluation & Assistance Visit Checklist

<table>
<thead>
<tr>
<th>Question</th>
<th>Y</th>
<th>N</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>If the lake is &lt; 2m deep and the Secchi disk was visible at the bottom of the lake, was a second tow conducted?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was the net pulled to the surface at a steady, constant rate (about 1 ft or 0.3 m/second)?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>At the surface, was the net dipped into the water to rinse organisms to the cod end?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was the outside of the net carefully rinsed at the surface with a squirt bottle or similar tool?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was the second net towed from the other side of the boat or the opposite end?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was the lake ID pre-recorded on the sample label?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was the mesh size (80 μm or 243 μm) used on the jar?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Were the samples collected from each net mesh size treated as two, unique samples (different sample ID numbers)?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Did the 500 mL bottle contain the CO₂ tablets?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was EtOH water used to rinse the zooplankton from the net into the sample bottle?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>If the volume of zooplankton in the bucket exceeded 125 mL, was a second jar used?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>If so, were the jars labeled properly? (i.e., Extra jar, and 2 of 2 added)</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was approximately 80 mL of ethanol added to the jar?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was the length of the tow recorded on the label and sample collection form?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was the lid wrapped in electrical tape?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was this procedure followed separately, for each net?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was the Sample Collection Form completed correctly for zooplankton? Does the information on the form match the information on the label for each sample?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### Sediment Diatom and Mercury Sample Collection

<table>
<thead>
<tr>
<th>Question</th>
<th>Y</th>
<th>N</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Were the containers properly labeled for top, bottom, and sediment cores?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was the corer cleaned from the last site visit and rinsed with tap water after arrival to this lake site?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Were gloves (powder-less) worn throughout this procedure?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was the core extruded from an area of undisturbed sediments?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was the core 35 cm to 45 cm in length?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was the water-sediment interface maintained while placing the stopper in the bottom of the corer?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was the corer kept in a vertical position while the slices were extracted?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was the total length of the core measured to the nearest 0.1 cm?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was the water at the top of the core carefully removed with a siphoning tube, so the top sediments were not disturbed?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was the crew careful to ensure that the sampling kit did not come in contact with anything</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
</tbody>
</table>
### APPENDIX E: FIELD EVALUATION & ASSISTANCE VISIT CHECKLIST

<table>
<thead>
<tr>
<th>Question</th>
<th>Y</th>
<th>N</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>other than the sediment sample?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the sediment from the center of the core (for mercury analysis)</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>transferred to the vial without rinsing?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the sediment sample placed immediately on dry ice?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was the top 1 cm of the core transferred to the sample container labeled “TOP?”</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was the interval recorded on the Sample Collection Form?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>For natural lakes, was the sectioning apparatus rinsed before the bottom slice was extracted?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>For natural lakes, was the sediment extruded until the bottom of the stopper was 5 cm from the top of the coring tube? Was the tube marked at 5 cm?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>For natural lakes, were the next 2 cm extruded and discarded?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>For natural lakes, was the next 1 cm extruded and kept as the “BOTTOM” slice?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was this interval correctly recorded on the Sample Collection Form?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Were the labels secured with clear plastic tape?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was the corer cleaned and rinsed with lake water after all samples were collected?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### NOTES

<table>
<thead>
<tr>
<th>Physical Habitat Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Site Selection and Location</strong></td>
</tr>
<tr>
<td>Were habitat sites selected randomly and distributed evenly around the lake perimeter?</td>
</tr>
<tr>
<td>Were habitat sites located accurately (using GPS, lake outline, or topography) and the plots properly lain out?</td>
</tr>
<tr>
<td>Were habitat sites adjusted reasonably and only when necessary?</td>
</tr>
<tr>
<td>Was the lake outline map on the verification form marked appropriately for the adjusted stations?</td>
</tr>
<tr>
<td>Was an observation vantage point established at 10 m off the shore and on centerline of the plot?</td>
</tr>
<tr>
<td>Was the water depth at 10 m off shore measured with a sounding or sonar and recorded accurately (including units)?</td>
</tr>
</tbody>
</table>

### Bottom Substrates

| Were bottom substrates visually observed or probed with a sounding pole throughout | Y | N | N/A |
### APPENDIX E: FIELD EVALUATION & ASSISTANCE VISIT CHECKLIST

**littoral plot?**
- Were the categories of bottom substrates interpreted correctly? [Y] [N] [N/A]
- Did the categorical levels of bottom substrates potentially add up to 100%? [Y] [N] [N/A]

**Aquatic Macrophytes**
- Were aquatic macrophytes correctly categorized and characterized? [Y] [N] [N/A]
- Was the total macrophyte coverage consistent with coverage in the individual categories? [Y] [N] [N/A]

**Fish Cover**
- Were the elements of fish cover properly identified and quantified? [Y] [N] [N/A]

**Riparian vegetation**
- Were the canopy, understory, and ground cover correctly and completely characterized? [Y] [N] [N/A]
- Were the vegetative types consistent with coverage categories? [Y] [N] [N/A]

**Shoreline Substrate Zone**
- Were the shoreline substrates in the first landward meter properly identified and quantified? [Y] [N] [N/A]

**Human Influence**
- Were the human influences properly identified within or near the plot? [Y] [N] [N/A]

**Littoral Fish Macrohabitat**
- Were all fields completed? [Y] [N] [N/A]
- Were selections consistent with information on front of form? [Y] [N] [N/A]

**Bank Features**
- Was the bank angle correctly interpreted in the first landward meter and recorded? [Y] [N] [N/A]
- Was the high water mark correctly identified? [Y] [N] [N/A]
- Were the horizontal and vertical distances from the current waterline correctly estimated or measured and recorded (in meters)? [Y] [N] [N/A]

**Invasive Species**
- Were the species correctly marked or "none observed" marked in both the littoral and riparian columns? [Y] [N] [N/A]

**Whole Form**
- Were the site and date information complete? [Y] [N] [N/A]
- Was one habitat form completed per station (additional forms included for new sites, e.g., islands)? [Y] [N] [N/A]
- Were data flags used appropriately and explained adequately throughout the form? [Y] [N] [N/A]
- Was the form reviewed and initialed? [Y] [N] [N/A]
- Were the comments legible? [Y] [N] [N/A]
## APPENDIX E: FIELD EVALUATION & ASSISTANCE VISIT CHECKLIST

### Benthic Macroinvertebrate Sample Collection

<table>
<thead>
<tr>
<th>Question</th>
<th>Y</th>
<th>N</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>After locating the sample site, was the dominant habitat type identified within the plot?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was a D-frame dip net (equipped with 500 µm mesh) used to sweep through 1 linear meter of the dominant habitat type at a single location within the 10 m x 15 m littoral zone sampling area, making sure to disturb the substrate enough to dislodge organisms?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>If the dominant habitat is rocky/cobble/large woody debris, did the crew member conducting the sampling exit the boat and disturb the substrate (e.g., overturn rocks, logs) using his/her feet while sweeping the net through the disturbed area?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>After completing the 1-meter sweep, were organisms and debris removed from net and placed in a bucket?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Were the organisms and detritus collected at each station on the lake combined in a single bucket to create a single composite sample for the lake?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### NOTES

### FINAL LAKE ACTIVITIES

#### General Lake Assessment

<table>
<thead>
<tr>
<th>Question</th>
<th>Y</th>
<th>N</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Were any of the sources of potential stressors recorded that were observed while on the lake, while driving or walking through the lake catchment, or while flying over the lake and catchment?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>For activities and stressors that the crew observed, was their abundance or influence listed as low (L), moderate (M), or heavy (H) rated on the line next to the listed disturbance?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the box on the assessment forms checked to denote blanks as zeros?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the section “Lake Site Activities and Disturbances Observed” completed including residential, recreational, agricultural, industrial, and lake management categories?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Were observations regarding the general characteristics of the lake recorded?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the hydrologic lake type recorded?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Were flight hazards noted that might interfere with either low-altitude fly-overs by aircraft (for future aerial photography or videography) or landing on the lake for sampling purposes (either by float plane or helicopter)?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>When estimating the intensity of motor boat usage, in addition to the actual number of boats observed on the lake during the visit, were other observations such as the presence of boat houses, docks, and idle craft recorded?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Were all six characteristics estimated and the section “General Lake Information” completed?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Question</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>----</td>
<td>----</td>
<td>-----</td>
</tr>
<tr>
<td>When the extent of major vegetation types was estimated, was the assessment limited to the immediate lake shoreline (i.e., within 20 m of the water)?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was the percentage of the immediate shoreline that has been developed or modified by humans estimated?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Were all eight shoreline categories completed and the section “Shoreline Characteristics” estimated?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was the areal percentage of macrophyte coverage for the three categories estimated and the section “Qualitative Macrophyte Survey” completed?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was the waterbody character rated?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was the waterbody character defined using degree of human development and aesthetics attributes?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Were the three ecological values (i.e., trophic state, ecological integrity, and recreation) assessed?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>For ecological values, was the overall impression of the &quot;health&quot; of the biota in the lake recorded and any possible causes of impairment noted?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>For trophic status, was a visual impression of the trophic status including overall impression of algal abundance and general type provided?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>For trophic status, were any observed potential nutrient sources to the lake listed?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>For recreation, was the overall impression of the lake as a site for recreation recorded?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>For recreation, were possible causes of impairment, or the presence or absence of people using the lake for recreational activities recorded?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was the comments section used on the Lake Assessment Form to note any other pertinent information about the lake or its catchment?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### NOTES

- Processing the Chlorophyll-α Sample

<table>
<thead>
<tr>
<th>Question</th>
<th>Y</th>
<th>N</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Were surgical gloves worn?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was a glass fiber filter placed in the graduated filter holder apparatus?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was the filter handled with forceps?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Were 250 mL of water poured into the filter holder, the cap replaced, and the sample pumped through the filter?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>If 250 mL of lake water did not pass through the filter, was the filter changed, the apparatus rinsed with DI water, and the procedures repeated using 100 mL of lake water?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
</tbody>
</table>
### APPENDIX E: FIELD EVALUATION & ASSISTANCE VISIT CHECKLIST

<table>
<thead>
<tr>
<th>Step Description</th>
<th>Y</th>
<th>N</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Was the upper portion of the filtration apparatus rinsed thoroughly with DI water to include any remaining cells adhering to the sides and pumped through the filter?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the level of water monitored in the lower chamber to ensure that it did not contact the filter or flow into the pump?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the filter observed for visible color?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>If there was not, did the process proceed until color was visible on the filter or until a maximum of 2,000 mL were filtered?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the actual sample volume filtered recorded on the Sample Collection Form and on the sample label?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the bottom portion of the apparatus removed and the water poured off from the bottom?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the filter removed from the holder with clean forceps?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the filter folded in half, with the colored side folded inward?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the folded filter placed into a 50 mL steam-top centrifuge tube and caped?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the sample volume filtered recorded on a chlorophyll label and attached to the centrifuge tube?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was all written information complete and legible?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the label covered with a strip of clear tape?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does the “total volume of water filtered” on the Sample Collection Form match the total volume recorded on the sample label?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was the tube wrapped in aluminum foil and placed in a self-sealing plastic bag?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was this bag placed between two small bags of ice in a cooler?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Were the filter chambers rinsed with DI water?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### NOTES

Data Forms and Sample Inspection

<table>
<thead>
<tr>
<th>Step Description</th>
<th>Y</th>
<th>N</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>After the Lake Assessment Form was completed, did the Field Crew Leader review all of the data forms and sample labels for accuracy, completeness, and legibility?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did the other crew member inspect all sample containers and packages in preparation for transport, storage, or shipment?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did the crew ensure that all required data forms for the lake were completed?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was it confirmed that the LAKE-ID and date of visit are correct on all forms?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### APPENDIX E: FIELD EVALUATION & ASSISTANCE VISIT CHECKLIST

<table>
<thead>
<tr>
<th>Checklist</th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>On each form, was it verified that all information was recorded accurately, the recorded</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>information was legible, and any flags were explained in the comments section?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was it ensured that written comments are legible, with no &quot;shorthand&quot; or abbreviations?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>After reviewing each form, was the upper right corner of each page of the form initialed?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Was it ensured that all samples were labeled, all labels are completely filled in, and each</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>label was covered with clear plastic tape?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Were all sample containers checked to ensure that they were properly sealed?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Will the coolers be shipped with fresh bags of ice in cooler; ice bags labeled as &quot;ICE&quot;?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Will the coolers be shipped by overnight courier ASAP after collection (generally the next</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>day)?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>If samples will be held after collection, will they kept cold and in darkness?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Were the Wisconsin nets and buckets rinsed at least three times with the DI water?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**NOTES**

<table>
<thead>
<tr>
<th>Checklist</th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
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</thead>
<tbody>
<tr>
<td>Launch Site Cleanup</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Were the boat, motor, and trailer inspected for evidence of weeds and other macrophytes?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Were the boat, motor, and trailer cleaned as completely as possible before leaving the</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>launch site?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Were all nets inspected for pieces of macrophyte or other organisms and as much as</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>possible was removed before packing the nets for transport?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Were all equipment and supplies packed in the vehicle and trailer for transport and kept as</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>organized as presented in the equipment checklists?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was all waste material at the launch site cleaned up and disposed of or transported it out</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>of the site if a trash can is not available?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTES**

<table>
<thead>
<tr>
<th>Checklist</th>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miscellaneous</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do the crew members know the Communications Center phone number by heart, is the number is saved in cell phone, or do they know the location of number in Field Ops Manual?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
<tr>
<td>Do the crew members have suggestions/problems concerning the sampling Procedures, forms, lodging, logistics, etc.?</td>
<td>Y</td>
<td>N</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### Areas of Strength

- [ ] 
- [ ] 
- [ ] 
- [ ]

### Areas of Concern

- [ ] 
- [ ] 
- [ ] 
- [ ]

Was the crew debriefed on the results of the evaluation by the evaluator? | Y | N | N/A |

**COMMENTS OF THE CREW BEING EVALUATED**

- [ ] 
- [ ] 
- [ ] 
- [ ]
<table>
<thead>
<tr>
<th>SIGNATURES</th>
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</thead>
<tbody>
<tr>
<td>Evaluator</td>
<td>Date</td>
</tr>
<tr>
<td>Field QC Officer (if assigned)</td>
<td>Date</td>
</tr>
<tr>
<td>Field Crew Member</td>
<td>Date</td>
</tr>
<tr>
<td>Field Crew Member</td>
<td>Date</td>
</tr>
<tr>
<td>Field Crew Member</td>
<td>Date</td>
</tr>
<tr>
<td>Field Crew Member</td>
<td>Date</td>
</tr>
<tr>
<td>Field Crew Member</td>
<td>Date</td>
</tr>
</tbody>
</table>
APPENDIX F: INVASIVE PLANTS AND INVERTEBRATES
<table>
<thead>
<tr>
<th>Common name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>curlyleaf pondweed</td>
<td><em>Potamogeton crispus</em> L.</td>
</tr>
<tr>
<td>common reed</td>
<td><em>Phragmites australis</em> (Cav.) Trin. ex Steud.</td>
</tr>
<tr>
<td>Eurasian watermilfoil</td>
<td><em>Myriophyllum spicatum</em> Linnaeus</td>
</tr>
<tr>
<td>purple loosestrife</td>
<td><em>Lythrum salicaria</em> L.</td>
</tr>
<tr>
<td>Russian-olive</td>
<td><em>Elaeagnus angustifolia</em> L.</td>
</tr>
<tr>
<td>reed canarygrass</td>
<td><em>Phalaris arundinacea</em> L.</td>
</tr>
<tr>
<td>Canada thistle</td>
<td><em>Cirsium arvense</em> (L.) Scop.</td>
</tr>
<tr>
<td>multiflora rose</td>
<td><em>Rosa multiflora</em> Thunb. ex Murr.</td>
</tr>
<tr>
<td>narrowleaf cattail</td>
<td><em>Typha angustifolia</em> L.</td>
</tr>
<tr>
<td>Brazilian waterweed</td>
<td><em>Egeria densa</em> Planch.</td>
</tr>
<tr>
<td>brittleleaf naiad</td>
<td><em>Najas minor</em> All.</td>
</tr>
<tr>
<td>parrot feather milfoil</td>
<td><em>Myriophyllum aquaticum</em> (Vell.) Verdc.</td>
</tr>
<tr>
<td>mimosa</td>
<td><em>Albizia julibrissin</em> Durazz.</td>
</tr>
<tr>
<td>hydrilla</td>
<td><em>Hydrilla verticillata</em> (L. f.) Royle</td>
</tr>
<tr>
<td>water starwort</td>
<td><em>Myosoton aquaticum</em> (L.) Moench</td>
</tr>
<tr>
<td>water hyacinth</td>
<td><em>Eichhornia crassipes</em> (Mart.) Solms</td>
</tr>
<tr>
<td>yellow floatingheart</td>
<td><em>Nymphoides peltata</em> (Gmel.) Kuntze</td>
</tr>
<tr>
<td>European pepperwort</td>
<td><em>Marsilea quadrifolia</em> L.</td>
</tr>
<tr>
<td>alligatorweed</td>
<td><em>Alternanthera philoxeroides</em> (Mart.) Griseb.</td>
</tr>
<tr>
<td>European waterstarwort</td>
<td><em>Callitriche stagnalis</em> Scop.</td>
</tr>
<tr>
<td>giant salvinia</td>
<td><em>Salvinia molesta</em> D. S. Mitchell</td>
</tr>
<tr>
<td>water fern</td>
<td><em>Salvinia minima</em> Baker</td>
</tr>
<tr>
<td>water-chestnut (European)</td>
<td><em>Trapa natans</em> L.</td>
</tr>
<tr>
<td>tamarisk</td>
<td><em>Tamarix</em> spp. L.</td>
</tr>
<tr>
<td>deeprooted sedge</td>
<td><em>Cyperus enteririanus</em> Boeckl.</td>
</tr>
<tr>
<td>Japanese or giant knotweed</td>
<td><em>Fallopia japonica</em> or <em>F. sachalinensis</em></td>
</tr>
<tr>
<td>miramar weed</td>
<td><em>Hygrophila polysperma</em> (Roxb.) T. Anders.</td>
</tr>
<tr>
<td>Brazilian peppertree</td>
<td><em>Schinus terebinthifolius</em> Raddi</td>
</tr>
<tr>
<td>zebra or quagga mussel</td>
<td><em>Dreissena polymorpha</em> or <em>D. rostriformis bugensis</em></td>
</tr>
<tr>
<td>Asian clam</td>
<td><em>Corbicula fluminea</em></td>
</tr>
<tr>
<td>rusty crayfish</td>
<td><em>Orconectes rusticus</em></td>
</tr>
</tbody>
</table>
SHORELINE/RIPARIAN SPECIES

Purple loosestrife (*Lythrum salicaria* L.)
- Square, woody stem and opposite or whorled leaves. Leaves are lance-shaped, stalkless, and heart-shaped or rounded at the base.
- Plants are usually covered by a downy pubescence.
- Loosestrife plants grow 4-10 feet high and produce a showy display of magenta-colored flower spikes throughout much of the summer.
- Flowers have five to seven petals.
- Invades many wetland types, including freshwater wet meadows, tidal and non-tidal marshes, river and stream banks, pond edges, reservoirs, and ditches.

Knotweed (*Polygonum aviculare*)
- Resembles a grass with long, dark green leaves when germinating. Later forms a flat mat up to 2 feet in diameter on slender wiry stems.
- Papery sheath at each node that gives stems a knotted or swollen appearance.
- The leaves are alternate; small, narrowly oval; dull, bluish green; up to 1¼ inches long and 1/3 inch wide.
- Flowers are small, borne in clusters in leaf axils. The buds are purplish opening to white to yellow flowers during June through October. Germinates in early spring; grows through autumn.

Flowering rush (*Butomus umbellatus*)
- Flowers grow in umbrella shaped clusters; each individual flower has 3 whitish pink petals.
- Produce flowers in very shallow water or on dry sites.
- Green stems that resemble bulrushes but are triangular in cross section.
- Erect leaves; leaf tips may be spirally twisted.
- Grows to about 3 feet in height.
Common reed (*Phragmites australis*)
- **Appearance:** Common reed is a tall, perennial grass that can grow to heights of 15 ft. (4.6 m) or more. Broad, pointed leaves arise from thick, vertical stalks.
- **Foliage:** Leaves are 6-23.6 in. (15-60 cm) long, 0.4-2.4 in. (1-6 cm) wide, flat and glabrous.
- **Flowers:** The flower heads are dense, fluffy, gray or purple in color and 5.9-15.7 in. (15-40 cm) long.
- **Flowering:** Occurs from July to October.
- **Fruit:** The seeds are brown, light weight, and about 0.3 in. (8 mm) long.

Russian olive (*Elaeagnus angustifolia L.*)
- Russian-olive is a small, usually thorny shrub or small tree that can grow to 30 feet in height.
- Stems, buds, and leaves have a dense covering of silvery to rusty scales.
- Leaves are egg or lance-shaped, smooth margined, and alternate along the stem.
- Highly aromatic, creamy yellow flowers appear in June/July and later replaced by clusters of abundant silvery fruits.

Reed canary grass (*Phalaris arundinacea*)
- **Appearance:** Reed canary grass is a cool-season perennial grass that grows to 6 ft. (1.7 m) tall. Reed canary grass is variable in morphology, so characteristics may depend upon the habitat.
- **Foliage:** Leaf blades are flat, 1-4 ft. (0.3-1.2 m) long, up to 0.75 in. (1.9 cm) wide, glabrous and taper gradually.
- **Flowers:** The spreading flower/seed heads arise from hairless stems and can be green, purple, or brown in color and usually 3-6 in. (7.6-15.2 cm) in length. Flowering occurs from May to July.
- **Fruit:** The inflorescence color changes from green to purplish to tan as the seeds mature.
Multiflora rose (*Rosa multiflora*)

- **Appearance:** Multiflora rose is a multi-stemmed, thorny, perennial shrub that grows up to 15 ft. (4.6 m) tall. The stems are green to red arching canes which are round in cross section and have stiff, curved thorns.
- **Foliage:** Leaves are pinnately compound with 7-9 leaflets. Leaflets are oblong, 1-1.5 in. (2.5-3.8 cm) long and have serrated edges. The fringed petioles of multiflora rose usually distinguish it from most other rose species.
- **Flowers:** Small, white to pinkish, 5-petaled flowers occur abundantly in clusters on the plant in the spring.
- **Fruit:** Fruit are small, red rose hips that remain on the plant throughout the winter.

Canada thistle (*Cirsium arvense* L.)

- Canada thistle is an herbaceous perennial with erect stems 1½-4 feet tall, prickly leaves and an extensive creeping rootstock.
- Stems are branched, often slightly hairy, and ridged. Leaves are simple, lance-shaped, irregularly lobed with spiny, toothed margins and are borne singly and alternately along the stem.
- Fragrant, rose-purple to lavender, or sometimes white flower heads appear from June through October, and occur in rounded, umbrella-shaped clusters.

Mimosa (*Albizia julibrissin*)

- **Appearance:** Mimosa is a small tree that grows from 10 to 50 ft. (3-15.2 m) in height. It often has multiple trunks.
- **Foliage:** It has delicate-looking, bi-pinnately compound leaves that resemble ferns. Leaves close in the evening (nyctinastic movement).
- **Flowers:** Flowering occurs in early summer, when very showy, fragrant, pink flowers develop in groups at the ends of the branches. The flowers are sometimes called powder puffs.
- **Fruit:** Fruit are flat, 6 in. (15.2 cm) long seed pods that develop in the late summer.
Tamarisk or Salt Cedar (*Tamarix ramosissima*)
- Most saltcedars, or tamarisks, are deciduous shrubs or small trees growing to 12-15 feet in height and forming dense thickets.
- Saltcedars are characterized by slender branches and gray-green foliage. The bark of young branches is smooth and reddish-brown. As the plants age, the bark becomes brownish-purple, ridged and furrowed.
- Leaves are scale-like, about 1/16 inch long and overlap each other along the stem. They are often encrusted with salt secretions.
- Pink to white flowers appear in dense masses on 2-inch long spikes at branch tips from March to September.

Deeprooted Sedge (*Cyperus entnerianus*)
- A robust grass-like plant that grows up to 40” tall. Rhizomes deeply set, thick,ark purple to black leaf bases.
- Leaves basal, glossy, and flat or V-shaped.
- Leaf bases dark purple to black.
- Inflorescence terminal, with 5-11 elongate rays, ending in densely clustered spikelets.

LITTORAL SPECIES

Curly pondweed (*Potamogeton crispus* L.)
- Plants may grow up to 2 meters long. Very abundant from April to June.
- Leaves are 3 cm to 10 cm long, broad, linear and finely toothed, with undulated (curly) margins.
- Leaves are dark green with a reddish hue and have small teeth along the margins. Arranged alternately or slightly opposite on flattened, branched stems.
- Flowering occurs late spring-early summer; Plants begin to die-off in midsummer after vegetative buds are produced.
Zebra Mussel (*Dreissena polymorpha*)
- < 50 mm
- Color patterns vary; may be striped or have dark or light colored shells and no stripes
- Typically found attached to objects, surfaces, or each other by threads underneath the shells
- Forms dense mats that clog industrial water intakes and discharge pipes

Eurasian watermilfoil (*Myriophyllum spicatum* L.)
- Stems grow to the water surface, usually extending 3 - 10, but as much as 33, feet in length. Frequently forms dense mats.
- Long, slender, branching, hairless stems become leafless toward the base. Feathery appearance
- New plants may emerge from each node (joint) on a stem, and root upon contact with mud.
- Grayish-green leaves, finely divided, occur in whorls of 3-4 along stem, with 12-16 pairs of fine, thin leaflets about 12 inches long
- Small yellow, 4-parted flowers on a spike that projects 2-4 inches above the water surface.

Hydrilla (*Hydrilla verticillata*)
- Forms dense colonies and can grow to the surface in water over 20 feet deep.
- Branches profusely; extends across surface forming thick mats.
- Leaves are blade-like about 1/8- 3/8 inch long with small tooth margins and spines on the underside of the midrib which make them feel rough.
- Leaves are usually 4 to 8 in a whorl.
Brazilian Waterweed (*Egeria densa* Planch)
- Stems are elongate, slender, 2-3 mm thick, single or sparingly branched
- Leaves mostly in whorls of 4 at sterile nodes
- Leaves are nearly linear, very finely toothed on the margins, 1.4-2.5 cm long, 1.6-5.0 mm wide
- Flowers are 1.2-1.8 cm wide, unisexual Plants grow submersed, rooted in the substrate.
- Found in streams, ponds, lakes, and constructed lagoons (both still and flowing water)

European water chestnut (*Trapa natans* L)
- Upper floating leaves are diamond-shaped with toothed edges
- Leaves occur in clusters up to 20 inches across. Leafy stalks are inflated, spongy, up to 3 inches long
- 1/3 inch long flowers, solitary, white to light purple. Black, 4-horned, nut-like fruit is 1 inch wide and develops under water
- Found on quiet waters, forms extensive floating mats on water surface

Water Hyacinth (*Eichhornia crassipes*)
- Usually floats free in large masses but may be rooted in the mud.
- The plants may range from a few inches to as much as 3 feet in height.
- The leaves are 10-20 cm across, supported above the water surface by long, spongy and bulbous stalks
- They have slender rootstocks with rosettes of leaves and dark, fibrous, branching roots dangling beneath the plant. Flowers may be blue, violet, or white and are usually quite showy.
Parrotfeather (*Myriophyllum aquaticum*)
- Rooted, submerged (growing below the water) plants
- Bright green, stiff, feather-like foliage ("fir-tree-like") that can extend up to 1 foot above water’s surface.
- Alternate or whorled leaves finely divided into many threadlike leaflets.
- Stem is stout and sparingly branched
- White flowers

Yellow floating heart (*Nymphoides peltata*)
- Perennial, water lily-like plant that carpets the water surface with long-stalked, heart-shaped leaves.
- Showy five-petaled yellow flowers occur on long stalks and rise a few inches above water surface.
- Leaves average 3 to 10 cm in diameter
- The fruit capsule is 2.5 cm long and contains numerous seeds. The seeds are oval and flat (about 3.5 mm long) and hairy along their outer edges.

Giant salvinia (*Salvinia molesta*)
- Small free-floating plant that grows in clusters and develops into dense, floating mats or colonies in quiet water.
- The floating leaves are oblong (0.5 to 1.5 inches long) with a distinct midrib along which the leaf may fold forming a compressed chain-like appearance.
- Upper surfaces of green leaves are covered with rows of white, bristly hairs.
- Leaf hairs have a single stalk that divides into four branches that reconnect at the tip, giving the hair a cage-like or egg-beater appearance.
- Underwater the leaves are modified into small root-like structures. The entire plant is only about 1 to 2 inch in depth.
Miramar weed (*Hygrophila polysperma*)
- Perennial aquatic herb with squarish stems ascending to creeping, mostly submersed, usually rooted in substrate; also roots freely at floating nodes.
- Leaves opposite, to 8 cm (3 in) long (aerial leaves smaller) and to 2 cm (0.8 in) wide, usually broader toward tip; sessile, with bases joined at node by ciliated flanges of tissue, the cilia (hairs) easily observed, to 1.5 mm long.
- Flowers small, solitary in uppermost leaf axils, nearly hidden by leaves, calyx 5-lobed, corolla bluish white, 2-lipped; 2 fertile stamens. Fruit a narrow capsule, splitting lengthwise to release tiny round seeds.
- **NOTE:** May be confused with small, opposite-leaved natives sometimes found submersed, such as *Ludwigia repens* and *Diodia* spp., but these without flanges at nodes (*Ludwigia*) or with flat-bristled flanges (*Diodia*). The native marsh species, *Hygrophila lacustris* (Schlecht. & Cham.) Nees is larger (aerial leaves to 15 cm long) and erect in habit, with larger flowers in axillary clusters along upper stems.

Narrowleaf cattail (*Typha angustifolia* L.)
- Similar to broad-leaved cattail (*T. latifolia*) except that the staminate and pistillate portions of the spike are separated by 2 cm. or more of bare stem, the leaves are deep green and, overall, the plant is less robust. Also, the leaves typically extend beyond the spike. *T. angustifolia* generally occurs in deeper water than *T. latifolia*.
- *T. angustifolia* has long, slender, green stalks topped with brown, fluffy, sausage-shaped flowering heads.
- The spike is medium to dark brown.
- The basal leaves are thin with parallel veins running their long, narrow length. The leaves are 4-12 mm wide when fresh, 3-8 mm wide when dry.

Spiny naiad (*Najas minor*)
- Spiny naiad is a submersed aquatic plant found in slow-moving streams, ponds and Lakes that also may be referred to as slender, brittle, European or bushy naiad.
- Heavily-branched stems of the plant may reach up to 4 feet in length.
- Leaves are opposite, alternate or whorled around the stem and form “tufts” at the growing tip, giving the plant a bushy appearance. Leaves are thin, strap-shaped, 1-1.5 in long, serrated and arch backwards.
- Leaves are stiff and maintain their shape out of the water.
- **NOTE:** Spiny naiad may be confused with native slender naiad. Serrations (spines) on spiny naiad are visible to the naked eye, whereas spines on slender naiad are only visible under significant magnification.
Water starwort (*Myosoton aquaticum* L.) **Synonyms:** giant chickweed or water chickweed

- This adventive perennial plant is 2”-24” tall, branching occasionally. The stems are erect or spreading, and more or less hairy. The opposite leaves are up to 2” long and 1” across.
- Single flowers may develop from the leaf axils of the upper stems, while the remaining flowers occur in small clusters at the end of stems. Each flower is about ½” across when it is fully open, consisting of 5 white petals. Each flower is replaced by a seed capsule that is ovoid.
- The root system is fibrous and produces rhizomes, which enables this plant to form vegetative colonies.

**European pepperwort** (*Marsilea quadrifolia*)

- *Marsilea quadrifolia* is a fern growing to 0.2 m. The plant requires moist or wet soil and can *grow in water*.

**Alligatorweed** (*Alternanthera philoxeroides*)

- Alligatorweed is a perennial, mat-forming member of the Amaranth family.
- Stems are distinctly jointed and are hollow except at the nodes. The stems are light green in color with faint darker green parallel lines extending from one node to the base of the next.
- Leaves are oval to lance-shaped, have a prominent midrib, and are arranged opposite along the stem.
- Small, clover-like, white flowers are borne on short stalks attached in the leaf axils near the end of the stems. Flowering occurs from late April through October.

**European or Pond waterstarwort** (*Callitriche stagnalis*)

- Slender stems reach to the surface and form floating mats of leaves, which are often round to spoon-shaped but are variable in morphology. Plants are loosely rooted to the bottom with narrow underwater leaves and/or broadened floating leaves arranged in pairs along thin stems.
- Pond water-starwort usually has spoon-shaped floating leaves crowded at the stem-tip, whereas autumnal water-starwort has only narrow, underwater leaves.
- **Leaf:** Opposite. Narrow submersed leaves (up to 10 mm wide) with one rounded leaf tip are sometimes present. Oval or spoon-shaped floating leaves are up to 10 mm wide and are joined by tiny ridges at the base.
- **Stem:** Usually branched, rising to surface or sprawling.
- **Flower:** Tiny flowers lack sepals and petals and are located at the leaf bases on minute stalks. 2-4 tiny whitish bracts emerge from the flower base.
Water fern or Water spangles (*Salvinia minima*)
- Free floating, rootless aquatic fern. Horizontal, branching rhizomes float just below the water surface and produce, at each node, two floating to emergent leaves, and a third, submersed leaf that is dissected into filaments.
- Floating leaves are orbicular to oval in shape, with heart shaped bases and rounded to notched tips. Leaf length ranges from 0.4 to 2.0 cm.
- Smaller, orbicular leaves lie flat on the water surface; larger leaves become elongated and fold upright on the midrib.

Rusty crayfish (*Orconectes rusticus*)
- Adults generally 3-5 inches (7.5-13 cm) long (nose to tail)
- Claws larger and smoother than other crayfish; usually without wart-like white bumps.
- Claws with oval gap when closed; no distinct thin slit or notch present.

Asian clam (*Corbicula fluminea*)
- Size<50 mm
- A small light-colored bivalve with shell ornamented by distinct, concentric sulcations, anterior and posterior lateral teeth with many fine serrations.
- The shell is ovate and deep at the hinge.
- Dark shell morphs exist but are limited to the southwestern United States.
- The inside of the shell is layered with polished, light purple nacre.