

## Title Page

# Quality Assurance Project Plan

for

The Volunteer Lake Monitoring Program: A Component of  
the Indiana Clean Lakes Program

Contract # 91225

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### ***List of Appendices & Tables***

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### ***List of Acronyms***

IDEM – Indiana Department of Environmental Management

INCLP – Indiana Clean Lakes Program

LOM – Lab Operations Manual

O'Neill School – O'Neill School of Public and Environmental Affairs

### ***Distribution List***

| Title                                                                             | Name                                    | Contact Information                                                                                                                                             |
|-----------------------------------------------------------------------------------|-----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| IDEM Project Manager                                                              | Timothy Neher                           | Watershed Management<br>Section<br>Indiana Department of<br>Environmental Management<br>100 North Senate Avenue<br>MC 65-44 Shadeland<br>Indianapolis, IN 46204 |
| O'Neill School Project<br>Manager                                                 | Sarah Powers                            | sarellis@iu.edu<br>1315 East 10 <sup>th</sup> Street<br>Bloomington, IN 47405                                                                                   |
| O'Neill School Project<br>Lead, Laboratory Manager<br>and Quality Control Officer | Lab Manager<br>Volunteer<br>Coordinator | 1315 East 10 <sup>th</sup> Street<br>Bloomington, IN 47405                                                                                                      |
| Project Staff                                                                     | Indiana University<br>students          | QAPP distributed during training                                                                                                                                |
| Volunteer Lake Monitors                                                           | Citizen Scientist                       | Stored in local drive folders,<br>distributed during training, and<br>posted online.                                                                            |

## 1.0 Project Task/or Organization

### 1.1 Key Personnel

Program Director, Sarah Powers

1315 East Tenth Street, Bloomington, IN 47405;

Program Director works with IDEM Project Officer to ensure project goal achievement, submits quarterly progress reports, establishes program policies; approves all purchases; budgets supplies; and oversees hiring personnel.

Volunteer Coordinator, Megan Gokey

1315 East Tenth Street, Bloomington, IN 47405; 812-855-1600 [mgokey@iu.edu](mailto:mgokey@iu.edu)

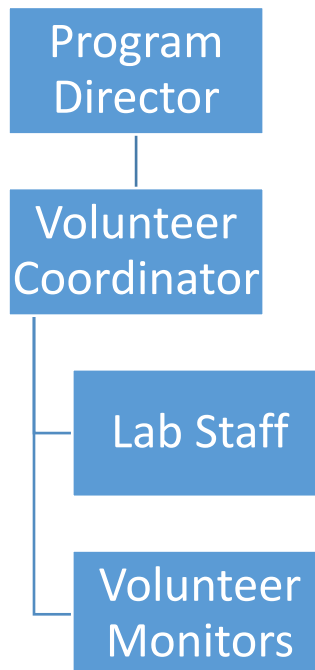
Oversees volunteer monitoring program; prepares end of grant reports; ensures laboratory quality assurance and quality control standards are met; handles day-to-day communications with volunteers; reviews all data storage; volunteer recruitment; updating training manuals; volunteer annual reporting.

Laboratory Staff, Students or recent graduates of Indiana University

1315 East Tenth Street, Bloomington, IN 47405; 812-855-1600 [inclp@iu.edu](mailto:inclp@iu.edu)

Conduct volunteer trainings; data management; shipping supplies; sample logging; sample analysis; website updates; check in volunteer samples upon arrival in lab; analyze TP, TN, and Chl-a samples.

### 1.2 Project Organization Chart



## **2.0 Special Training Needs/Certification & Qualifications**

Volunteer Coordinator trains lab staff to assist with daily tasks.

Documentation of training of lab staff for lab analysis protocols are in CLP LOM and the QAPP associated with the program (INCLP 2019 QAPP).

Volunteer coordinator or project coordinator train all volunteers.

## **3.0 Problem Definition/Background**

### ***3.1 Problem Statement***

The Volunteer Lake Monitoring Program is a component of the Indiana Clean Lakes Program funded by a Section 319 grant through the Indiana Department of Environmental Management's (IDEM's) Office of Water Quality.

The Volunteer Lake Monitoring Program complements IDEM's lakes monitoring efforts by providing more environmental data than would otherwise be possible given limited resources and jurisdiction. In addition to public lakes and reservoirs, volunteers also monitor a number of private lakes that the State may not be able to access. For this program, a group of citizen volunteers are equipped and trained to monitor water clarity. A smaller number of these volunteers collect samples for analysis of total phosphorus and chlorophyll *a* by the Limnology laboratory. While volunteers do not sample as intensively as the States does during a simple sampling event, they do collect data on a regular basis, every year. Such consistent data gathering can be quite useful in detecting changes in water quality.

### ***3.2 Historical & Background Information***

The program began in 1989 with 368 Secchi disk transparency measurements made on 52 lakes by 45 citizen volunteers. In 1992, we added an 'Expanded Volunteer Program' in which selected volunteers were further equipped and trained to collect water samples for total phosphorus and chlorophyll *a*. The Limnology laboratory analyzes water samples. SWCD throughout the state, house temperature and oxygen meters

Volunteer recruitment occurs using a variety of ways including, 1) social media, 2) the annual Indiana Lake Management Conference, 3) word-of-mouth, and 4) announcements online. Additional targeted recruitment occurs for lakes that have long-term data sets to minimize data gaps. Although some trained volunteers last only one season, many volunteer lake monitors have been active for over 10 years.

In an independent analysis of our volunteer monitoring data, Limno-Tech, Inc. concluded that there was no statistical difference between volunteer data and the data collected in our Indiana CLP Lake Water Quality Assessment Program.

## **4.0 Process Design**

### **4.1 Study Site Description**

Study sites include lakes with a committed volunteer to participate in the program.

## **5.0 Quality Objectives & Criteria for Measurement Data**

### **5.1 Goal Statements & Objective Statements**

Goal Statement 1: To provide data for a larger number of lakes than the State is able to monitor in a given season

The O'Neill School will continue the VLMP that expands the more through analysis in the CLP program to samples over the course of the growing season for multiple years. The volunteers collect repeated measures over time keeping a more consistant record on individual lakes rather than a snapshot of the state as a whole.

Goal Statement 2: Increase public awarmenss of the importance of Indiana's Lakes through active engagment in monitoring efforts

The O'Neill School will work to increase the number of lakes monitored consistantly in Indiana.

### **5.2 Study Site**

Volunteers in the program monitor natural and manmade lakes – both public and private throughout the state of Indiana. (Volunteer interest determines the lakes in the program. The Citizen Scientist leads the effort. Once we have a lake in the program and the volunteer retires, we work with local groups to recruit another.)

### **5.3 Sampling Design**

Volunteer lake monitors collect water transparency readings using a standard Secchi disk every two to four weeks from April through October annually. Volunteers also collect monthly water samples for total phosphorus and chlorophyll *a* analysis by the IU O'Neill School laboratory during the summer months. Volunteers have access to eight temperature and dissolved oxygen (D.O.) meters at selected SWCD offices throughout Indiana.

The data collected by volunteers expands our understanding of water quality on Indiana's lakes and allows for long term trend analysis on individual lakes (Goal 1)

All new volunteers are trained by O'Neill staff, volunteers replacing volunteers are trained by the volunteer they are taking over for. O'Neill staff then conduct a site visit with the new volunteer to perform on site assistance visits to answer additional questions. The training, volunteer monitoring manual, and program web site ([clp.indiana.edu](http://clp.indiana.edu)), all serve to enhance the volunteer's understanding of sampling techniques and lake ecology and management (Goal 2).

## 5.4 Study Timetable

The sample schedule is as follows below. Challenges associated with the schedule include volunteers collecting out of the timeline of sample dates. In order to correct for this we allow some of the volunteers to continue to collect expanded samples into the month of September to complete 4 summer sample events.

**Table 1: Study Schedule**

| <b>Activity</b>                                  | <b>Start Date</b> | <b>End Date</b> |
|--------------------------------------------------|-------------------|-----------------|
| Secchi disk transparency monitoring              | April             | November        |
| Expanded monitoring (total phos & chl <i>a</i> ) | May               | August          |
| Temp. & dissolved oxygen profiles                | April             | November        |
| Expanded sample analysis                         | June              | December        |
| Annual Questionnaire                             | November          | March           |

## **6.0 Data Quality Indicators (*for Measurement Data*)**

### **6.1 Precision**

For Secchi disk readings, individual variation is too great to assign precision values. Volunteers receive the same training in how to take reading prior to beginning monitoring activities. At the beginning of each monitoring season, we recommend that volunteers review the techniques for collecting measurements as well as review the online simulator for Secchi depth monitoring linked our website. In addition, volunteers sample from the same lake location each time, at certain times of the day, and on bright days.

Dissolved oxygen and temperature meters are calibrated each time used by trained volunteers. SWCD perform regular maintenance according to manufacturer's instructions after training from CLP staff. Volunteer coordinator contacts all SWCDs annually to check meter status and supply needs.

O'Neill School staff train volunteers to ensure precision in sample collection and handling. Volunteers collect from the same sample location each time they sample a waterbody to ensure consistency.

CLP QAPP includes precision in analytical methods used to analyze water samples for total phosphorus and chlorophyll *a*.

### **6.2 Accuracy and or Bias**

For Secchi disk readings, individual variation is too great to assign values for accuracy. Volunteers receive the same training in how to take reading prior to beginning monitoring activities. At the beginning of each monitoring season, we recommend that volunteers review the techniques for collecting measurements as well as review the online simulator for Secchi depth monitoring linked our website.

With proper calibration and use of the YSI Model 550A or YSI Pro20 or YSI Pro20 meters, the accuracy of in-situ measurements is equivalent to that stated in the equipment specifications, which is  $\pm 0.2$  °C and  $\pm 0.2$  mg/L dissolved oxygen. The level of accuracy is sufficient to serve the program's data quality needs.

Accuracy of collected water samples is expected to be high from standard sample bottle cleaning (total phosphorus sample bottles are acid-washed) and by the use of cautious sampling techniques by volunteers. The Volunteer Coordinator and lab staff prepare all samples and ship to volunteers. Staff train volunteers to rinse the integrated sampler, collection/pouring pitcher, Nalgene filtering apparatus, and graduated cylinder following each sampling event. Volunteers ship samples to the O'Neill school and staff check samples in, note shipping date and time, as well as, time, date, and temperature at time of arrival.

CLP QAPP includes accuracy in analytical methods used to analyze water samples for total phosphorus and chlorophyll *a*.

### 6.3 Completeness

Any additional data that the volunteers collect will add to our greater understanding of lake conditions in Indiana. However, to standardize the Secchi depth measurements, we determine mean values for the summer (July and August) season and use these means to compare lake changes from year-to-year and compare lakes. A minimum of two July or August Secchi disk transparency measurements are required to calculate a mean summertime value.

The range of volunteer participation in the Program is great. Participation can range from a volunteer making only one Secchi depth measurement during a year, to another volunteer who makes 20 Secchi depth measurements, collects 4 total phosphorus and chlorophyll samples, and measures 5 profiles. Regardless of the intensity of participation, all volunteers receive the same letters, announcements, information, and summary reports, and have access to the web site. All levels of engagement have equal educational opportunities from O'Neill staff and equal access to resources.

**Table 2: Data Quality Indicators**

| Parameter                | Precision    | Accuracy                      | Sensitivity           |
|--------------------------|--------------|-------------------------------|-----------------------|
| Secchi disk transparency | Not assessed | No QA standards are available |                       |
| Total Phosphorus         | $\pm 2$ S.D. | $\pm 10\%$                    | 0.010 mg/L            |
| Chlorophyll a            | Not assessed | No QA standards are available | 0.50 micrograms/liter |
| Temperature              | Not assessed | $\pm 0.2$ °C                  | 0 °C                  |
| Dissolved Oxygen         | Not assessed | $\pm 0.2$ mg/L                | 0 mg/L                |

### 6.4 Representativeness

The measurements collected are the best representative measures for trophic status of lakes. These indicators are used to help classify lakes based on Carlson's TSI. Volunteer data is comparable with CLP data.

### 6.5 Comparability

Methods are common and EPA approved as recommended in Standard Methods, 22<sup>nd</sup> Edition (APHA, 2012). Volunteer-collected data stand on their own and are not compared with the more quantitative data collected by INCLP staff, although independent analysis has concluded that the data are comparable.

### 6.6 Sensitivity

Measurement range of reliable readings of measuring devices and lab protocols are found in table 2. Full procedures are documented in the INCLP LOM (INCLP 202025 LOM and QAPP).

## 7.0 Non Direct (Secondary Data)

No secondary data is used in this monitoring program.

## 8.0 Monitoring Requirements

### 8.1 Monitoring Methods

Volunteers measure Secchi disk transparency using a conventional black and white eight-inch diameter disk attached to a tape graduated in tenths of feet. The volunteer lowers the disk into the water, from the shady side of the boat, until it is no longer visible. It is then lowered some more and raised until it again becomes visible. The volunteer records the midpoint between these two measurements as the Secchi depth in feet and tenths of feet. Volunteers collect qualitative data about lake use with the measurement (Appendix A).

Volunteers collect water sample from a designated lake location using an integrated pipe sampler. This sample is poured into a pitcher and used to filter chlorophyll- a and fill total phosphorus sample bottles.

Chlorophyll-a:

A specific amount of lake water is filtered through a Whatman GF/F filter using a Nalgene PSF filter holder with receiver. The volunteer determines the minimum amount of water to filter the Secchi disk measurement as follows.

| Secchi depth (ft) | Volume of water (mls) |
|-------------------|-----------------------|
| <1                | 50                    |
| >1 to 1.5         | 100                   |
| >1.5 to 2.5       | 200                   |
| >2.5 to 3.5       | 300                   |
| >3.5 to 6         | 500                   |
| >6 to 9           | 800                   |
| >9 to 16          | 1000                  |
| >16               | 1500                  |

The sample will be stored in the volunteer's home freezer compartment in the dark at less than zero °C until shipped in an insulated container overnight to the limnology laboratory (Chlorophyll a –SM 10200H, APHA 2012).

Total phosphorus and Total Nitrogen: Volunteers will collect a raw water sample and place in 125 mL acid washed Nalgene sample bottle. The sample will be stored in the volunteer's home freezer compartment in the dark at less than zero °C until shipped. The volunteer will ship samples in an insulated container overnight to the limnology laboratory (Total Phosphorus –SM 4500-P J2011 APHA 2012).

For temperature and dissolved oxygen profile measurement, the volunteer will contact the nearest SWCD office having an YSI Model 550A or YSI Pro20 meter to make an appointment to use it. The SWCD staff will ensure that the meter is operating properly before the volunteer picks it up. The volunteer will follow written instructions to calibrate the meter using the air calibration chamber built into the meter each time prior

to collecting data. Volunteers record temperature as degrees Centigrade; dissolved oxygen is recorded as mg/L. (Appendix A) These measurements follow the Temperature-SM2550B2 and Dissolved Oxygen EPA 360.1 methods.

**Table 3: Sampling Procedures**

| Parameter                | Sampling Frequency        | Sampling Method                                                                                                                                                                                                                                                                                                                                                                                                  | Sample Container           | Sample Volume | Holding Time         |
|--------------------------|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|---------------|----------------------|
| Secchi disk transparency | Bi-weekly<br>April – Nov. | Secchi disk transparency is measured using a conventional black and white eight-inch diameter disk attached to a tape graduated in tenths of feet. The disk is lowered into the water, from the shady side of the boat, until it is no longer visible. It is then lowered some more and raised until it again becomes visible. The midpoint between these two measurements is recorded as the Secchi disk depth. | NA                         | NA            | NA                   |
| Total Nitrogen           | Monthly<br>May – August   | Water sample s are collected using a 6-foot long integrated pipe sampler                                                                                                                                                                                                                                                                                                                                         | HDPE<br>Nalgene            | 125 ml        | 28 days<br>or frozen |
| Total phosphorus         | Monthly<br>May – August   | Water sample s are collected using a 6-foot long integrated pipe sampler                                                                                                                                                                                                                                                                                                                                         | HDPE<br>Nalgene            | 125 ml        | 28 days<br>or frozen |
| Chlorophyll a            | Monthly,<br>May - August  | Water samples are collected using a 6-foot long integrated pipe sampler. Sample is filtered in the field using a Nalgene PSF filtering apparatus with a Whatman GF/F filter and a Nalgene hand-operated vacuum pump. Filters are saved.                                                                                                                                                                          | HDPE<br>Nalgene-<br>opaque | 30 ml         | 2 months<br>- frozen |
| Temperature              | Optional, as able         | YSI Model 550A or YSI Pro20 Oxygen and Temperature meter with submersible probe. The probe is lowered into the water to depth and measurements are taken according to manufacturer's instructions at one-meter intervals                                                                                                                                                                                         | NA                         | NA            | NA                   |
| Dissolved Oxygen         | Optional, as able         | YSI Model 550A or YSI Pro20 Oxygen and Temperature meter with submersible probe. The probe is lowered into the water to depth and measurements are taken according to manufacturer's instructions at one-meter intervals                                                                                                                                                                                         | NA                         | NA            | NA                   |

## 8.2 Site Description

Lake location can be found on the INCLP website. <https://clp.indiana.edu/>

## 8.3 Field QC Activities

During training of volunteers, we collect side-by-side samples to demonstrate proper techniques.

## 9.0 Analytical Requirements

### 9.1 Analytical Methods

Chlorophyll-a is processed using a acetone extraction method including phyophytin correction and measured using a spectrophotometer (INCLP 2022 LOM).

Total phosphorus is analyzed using a alkaline persulfate digestion process and read on an Seal Analytical discrete analyzer model AQ400 (INCLP 2022 LOM).

Total nitrogen is analyzed using a alkaline persulfate digestion process and read on an Seal Analytical discrete analyzer model AQ400 (INCLP 2022 LOM).

See INCLP LOM for futher details on processes.

**Table 4: Analytical Procedures**

| Parameter        | Analytical Method                 | Performance Range or Detection Limits | Units |
|------------------|-----------------------------------|---------------------------------------|-------|
| Chlorophyll-a    | Chlorophyll a –SM 10200H          | 0.50 mg/L                             | mg/L  |
| Total Phosphorus | Total Phosphorus –SM 4500-P J2011 | 0.010 µg/L                            | mg/L  |
| Total Nitrogen   | Total Nitrogen –SM U.S. EPA 353.2 | 0.030 mg/L                            | mg/L  |

### 9.2 Analytical QC Activities

Please see the INCLP QAPP for quality control process (INCLP 2019 QAPP).

## 10.0 Sample Handling and Custody Requirements

Sample bottles are prenumbered prior to leaving the lab. Post collection and freezing, sample are shipped to the lab overnight in styrofoam mailers. Once received, lab staff check in samples documenting time and date shipped and time, date, volume sample filtered, and temperature of samples when received. See Appendix B for custody form.

## 11.0 Testing, Inspection Maintenance and Calibration

Expanded volunteers rinse out their sampling equipment both before and after each sampling event. Dissolved oxygen is calibrated prior to each measurement using manufactures instructions and the SWCD staff maintains the YSI Model 550A or YSI Pro20 meters by replacing the membranes every two months or as needed.

## **12.0 Assessment/Oversight/Data Quality Assessment & Decision Rules**

### ***12.1 Data Quality Indicators***

#### **Precision**

Field:

Regular maintenance of the YSI Model 550A or YSI Pro20 meters will help ensure the precision of these meters. Maintenance records compiled by the SWCDs will be evaluated annually. Frayed and worn out Secchi disks and tapes will be replaced as needed to ensure good visual sighting. Since Secchi disk measurements are dependent primarily upon the visual acuity of the observer, we have little opportunity under the scope of this Program to evaluate this.

Laboratory:

See the approved INCLP QAPP for details.

#### **Accuracy/Bias**

Field: see 'Precision' section above

Laboratory:

See the approved Clean Lakes Program QAPP for details.

#### **Completeness**

Volunteers who make one or fewer Secchi disk transparency measurements per July/August period will not be listed in statewide summaries. Any other amount of data (Secchi disk transparency, total phosphorus, chlorophyll *a*, and temperature/oxygen profiles) collected by the volunteers will meet the goals of this Program.

### ***12.2 Corrective Action***

The Volunteer Coordinator will review all data submitted by volunteers. Whenever any inconsistencies (extremely high or low readings; data that do not make limnological sense; wrong date, etc.) are noted in volunteer-collected data, the volunteer is contacted, the problem evaluated, and corrections made. Typical corrections include: additional training, date corrections, and decimal placement errors.

Corrective actions to correct laboratory problems are detailed in the INCLP QAPP

## **13.0 Performance and System Audits**

IDEM reserves the right to conduct external performance and/or systems audits of any component of this study.

## **14.0 Data Review, Verification, Validation and Reconciliation with DQIs.**

### ***14.1 Data Review and Verification***

#### **Data Reduction**

Volunteers in this program do not participate in data reduction. Data collected using the YSI Model 550A or YSI Pro20 meter is read directly from the instrument and requires no further reduction. Light transmission measurements using a Secchi disk also requires no reduction, and volunteers do not analyze the water samples they collect.

#### **Data Analysis**

The Limnology lab analyzes all data and samples collected by volunteers. Staff follow INCLP QAPP procedures regarding data analysis.

#### **Data Review**

Volunteers review the data entered online prior to submission and again at the end of the season when annual reports are sent out. Once data are received by the O'Neill School, the Volunteer Coordinator further reviews the data, looking for any missing data and for inconsistencies in the data or sampling protocol.

#### **Data Reporting**

All raw data and data analysis results generated, as part of this grant project are submitted in an electronic format with the Final Report to the IDEM Project Manager or Quality Assurance Manager. The format will be compatible with the software currently used by IDEM.

## **15.0 References**

APHA 2012. Standard Methods for the Examination of Water and Wastewater, 22 nd ed., Method 4500-P J2011, Persulfate Method for Simultaneous Determination of Total Nitrogen and Total Phosphorus (2012).

APHA 2012. Standard Methods for the Examination of Water and Wastewater, 22 nd ed., Method 10200 h.1.b and 10200 h.2.b, Chlorophyll Pigment Extraction and Spectrophotometric Determination of Chlorophyll (2012).

EPA Method 360.1. Dissolved Oxygen.

USGS 2003. USGS WRIR 03–4174: Methods of Analysis by the U.S. Geological Survey National Water Quality Laboratory-Evaluation of Alkaline Persulfate Digestion as an Alternative to Kjeldahl Digestion for Determination of Total and Dissolved Nitrogen and Phosphorus in Water. Methods I-2650-03 (total dissolved nitrogen and total dissolved phosphorus) and I-4650-03 (total nitrogen and total phosphorus).

INCLP. 2019. Lab Operations Manual (LOM) for the Indiana Clean Lakes Program. O'Neill School of Public and Environmental Affairs, Indiana University, Bloomington, Indiana.

INCLP. 2019 . Quality Assurance Project Plan (QAPP) for Indiana Clean Lakes Program O'Neill School of Public and Environmental Affairs, Indiana University, Bloomington Indiana.

## **Appendices**

### ***Appendix A: Volunteer Lake Monitoring Manual***

All parts can be found online at <https://clp.indiana.edu/volunteer-data/index.html>

## ***Appendix B: Expanded Sample Custody Log***

| EMPT<br>Y<br>BOTT<br>LES<br>SHIP<br>PED? | MO<br>NTH | SAM<br>PLE<br>ID | LAK<br>E<br>NA<br>ME | LA<br>KE<br>ID | COU<br>NTY   | VOLUN<br>TEER:<br>LAST<br>NAME | VOLUN<br>TEER:<br>FIRST<br>NAME | DATE<br>SAM<br>PLED | DAT<br>E<br>BOT<br>TLES<br>SHIP<br>PED | DATE<br>RECEI<br>VED | SAM<br>PLE<br>TEM<br>P.<br>(°C)<br>(UPO<br>N<br>ARRI<br>VAL) | CHLORO<br>PHYLL-A<br>VOLUME<br>FILTERED<br>(ML) | CHARACT<br>ERISTIC<br>NAME | ACIDIF<br>IED?<br>(YES/<br>NO)<br>150 µL<br>H <sub>2</sub> SO <sub>4</sub> | RES<br>ULTS | FLA<br>GS | VOLUN<br>TEER<br>COMM<br>ENTS | LAB<br>COMM<br>ENTS | DAT<br>E(S)<br>FOLL<br>OW<br>UP<br>ON<br>MISS<br>ING<br>INFO | GENE<br>RAL<br>NOTE<br>S |
|------------------------------------------|-----------|------------------|----------------------|----------------|--------------|--------------------------------|---------------------------------|---------------------|----------------------------------------|----------------------|--------------------------------------------------------------|-------------------------------------------------|----------------------------|----------------------------------------------------------------------------|-------------|-----------|-------------------------------|---------------------|--------------------------------------------------------------|--------------------------|
| 5/3/2<br>019                             | May       | 4152             | Ada<br>ms            | 60<br>3        | Lagra<br>nge | Koop                           | Christo<br>pher                 |                     |                                        |                      |                                                              | NA                                              | Total<br>Phosphor<br>us    |                                                                            |             |           |                               |                     |                                                              |                          |
| 5/3/2<br>019                             | May       | 4152             | Ada<br>ms            | 60<br>3        | Lagra<br>nge | Koop                           | Christo<br>pher                 |                     |                                        |                      |                                                              |                                                 | Chlorophy<br>ll-a          | NA                                                                         |             |           |                               |                     |                                                              |                          |
| 5/3/2<br>019                             | June      | 4153             | Ada<br>ms            | 60<br>3        | Lagra<br>nge | Koop                           | Christo<br>pher                 |                     |                                        |                      |                                                              | NA                                              | Total<br>Phosphor<br>us    |                                                                            |             |           |                               |                     |                                                              |                          |
| 5/3/2<br>019                             | June      | 4153             | Ada<br>ms            | 60<br>3        | Lagra<br>nge | Koop                           | Christo<br>pher                 |                     |                                        |                      |                                                              |                                                 | Chlorophy<br>ll-a          | NA                                                                         |             |           |                               |                     |                                                              |                          |
| 5/3/2<br>019                             | May       | 4154             | Bas<br>s             | 11<br>15       | Stark<br>e   | Wooler<br>y                    | Phillip                         |                     |                                        |                      |                                                              | NA                                              | Total<br>Phosphor<br>us    |                                                                            |             |           |                               |                     |                                                              |                          |
| 5/3/2<br>019                             | May       | 4154             | Bas<br>s             | 11<br>15       | Stark<br>e   | Wooler<br>y                    | Phillip                         |                     |                                        |                      |                                                              |                                                 | Chlorophy<br>ll-a          | NA                                                                         |             |           |                               |                     |                                                              |                          |
| 5/3/2<br>019                             | June      | 4155             | Bas<br>s             | 11<br>15       | Stark<br>e   | Wooler<br>y                    | Phillip                         |                     |                                        |                      |                                                              | NA                                              | Total<br>Phosphor<br>us    |                                                                            |             |           |                               |                     |                                                              |                          |
| 5/3/2<br>019                             | June      | 4155             | Bas<br>s             | 11<br>15       | Stark<br>e   | Wooler<br>y                    | Phillip                         |                     |                                        |                      |                                                              |                                                 | Chlorophy<br>ll-a          | NA                                                                         |             |           |                               |                     |                                                              |                          |

