Water Quality Analysis of The Gila

New Mexico Adventures in
Supercomputing Challenge
Final Report
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Team 026
Cliff High School

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Table of Contents

Executive Summary

Eutrophication is a process in which high levels of Nitrogen and Phosphorus create algae growths or blooms. These blooms, promoted mainly by phosphates, lead to oxygen depletion in the water system. In turn, oxygen depletion results in the killing of fish due to suffocation. This process is actually a natural one, normally taking thousands of years to occur; however, mankind has found a way to speed this process up, similar to an evolutionary catalyst. This catalyst had been produced by increasing the levels of phosphates in a watershed i.e. the dumping of laundry detergents (a high phosphate substance) into water bodies.

By monitoring levels of Nitrogen and Phosphorus, hydrologists are able to predict this condition in an attempt to reverse the effect. However, one problem arises with hydrology. While working in the field, hydrologists sometimes cannot test N and P levels in water at the time of collection. This can hinder test results because N and P levels change with time. The most efficient time for testing these levels is with twenty-four hours of collection.

This project was designed to allow hydrologists to test the levels of Nitrogen and Phosphorus in a collected sample after the 24-hour period. Hydrologists are often in the field for long periods of time and are not able to test their samples within the 24-hour period that is needed for accurate results. The program would then allow hydrologists to collect water samples and test them at a later date than that at which that sample was collected. The program was designed for an ideal testing scenario, which can be seen in appendix 1.

The project began with a pilot test, testing different variables to determine if these would affect the results. The variables tested included, temperature, conductivity, and pH. These tests were done at the San Francisco Hot Springs near Glenwood, New Mexico. Even the slightest change in these variables could hinder the data of the large-scale tests done with the samples taken from the Gila River near Riverside, New Mexico. These samples were tested numerous times for levels of N and P in Cliff Schools science lab using a spectrophotometer provided my the New Mexico Department of Game and Fish.

Introduction:

Eutrophication is a process in which high levels of Nitrogen and Phosphorus create huge algae growths, or blooms. These blooms, promoted mainly by phosphates, lead to oxygen depletion in the water system. In turn, oxygen depletion results in the killing of fish due to suffocation. This process is actually a natural one, normally taking thousands of years to occur; however, mankind has found a way to speed this process up, similar to an evolutionary catalyst. This catalyst had been produced by increasing the levels of phosphates in a watershed i.e. the dumping of laundry detergents (a high phosphate substance) into water bodies.

In the Great Lakes, along with many other lakes and watershed throughout the world, eutrophication has caused many native species to disappear, from native fish to a wide variety of macroinvertebrates. With the dying of native species, the need of replacement arises. Therefore, many species, both fish and macroinvertebrates, are occasionally replaced by species more tolerant and resistant to the new conditions. Thus, a means to control this problem was obviously apparent in the Great Lakes, and other threatened watersheds.

By monitoring levels of Nitrogen and Phosphorus, hydrologists are able to predict this condition in an attempt to reverse the effect. However, one problem arises with hydrology. While working in the field, hydrologists sometimes cannot test N and P levels in water at the time of collection. This can hinder test results because N and P levels change with time. The most efficient time for testing these levels is with twenty-four hours of collection.

Project Description:

This project was designed to allow hydrologists to test the levels of Nitrogen and Phosphorus in a collected sample after the 24-hour period. Hydrologists are often in the field for long periods of time and are not able to test their samples within the 24-hour period that is needed for accurate results. The program would then allow hydrologists to collect water samples and test them at a later date than that at which that sample was collected. The program was designed for an ideal testing scenario, which can be seen in appendix 1.

Processes and Procedures:

The project began with a pilot test, testing different variables to determine if these would affect the results. The variables tested included, temperature, conductivity, and pH. These tests were done at the San Francisco Hot Springs near Glenwood, New Mexico. Even the slightest change in these variables could hinder the data of the large-scale testing.

Then the collection of samples from the Gila River began. This sample would then be used as our large-scale test, being tested numerous times. The water was tested at the time of collection for mg/l of Nitrogen and Phosphorus. The samples collected were then tested for mg/l of Nitrogen and Phosphorus again at 24 and 48 hours after collection. Accurate testing is done within 24 hours of collection. After 24 hours, levels of Nitrogen and Phosphorus in a sample begin to change. This process was done repeatedly. Therefore, the testing was divided into three parts:

1. Pilot Test
2. Water Collection
3. Spectrophotometer Testing

The spectrophotometer testing was then sub-divided into three more parts. These parts being:

1. Testing before 24 hours
2. Testing after 24 hours, between 24 and 48 hours
3. Testing after 48 hours, between 48 and 72

The spectrophotometer testing was done using the DR/2000 Spectrophotometer, supplied by the New Mexico Department of Game and Fish. To conduct the actual tests, a “cook book recipe” was followed; the Department of Game and Fish also supplied this. To view the spectrophotometer methods, see appendices 2 and 3.

The Program:

The program was written in the Java computer language. The program uses the if/else statements after gathering information from the user to decide which question the program will ask next. An if/else statement takes a condition and if its true continues the program inside the if statement. If the condition is false it continues the program at the beginning of the else statement. The while statement was used as well to make sure that the user inserts data that could be processed with out an illegal operation occurring, so the while statement takes a condition and as long as the condition is true it will do what is in the while statement. But if the condition is false then the program will ask the question over again. See Appendix 5 to see the program.

The values n1Value, n2Value, p1Value, and p2Value are not the correct values. They are merely placeholders until the true values are inserted. The real values were taken from an average of the values we got from averaging the actual values. To get the values after day one and day two for each element, nitrogen and phosphorus, data was taken from a range of actual values after each day. Each value did not raise and so in the program some pluses may be changed to minuses to accommodate each scenario.

Results:

The spectrophotometer read on average of .86 for the constant nitrogen, the range was from 0.3-1.4 with the median at 1.1. After 24 hours the average nitrogen level was raised to 1.09, the range was 0.7-1.3 with a median of .6. When the water samples were tested after 48 hours, the nitrogen level went to 1.03, with a range of .8-1.2 and a median of .6.

As for phosphorous, when the water samples were tested at a constant, the average was .90 with a range of 0. After 24 hours the average of the phosphorous was .179, the range was 0.1-0.23 with a median of 0.13. Water samples tested after 48 hours showed an average phosphorous level of.296, with a range of 0.2-0.48 with a median of .28.

Conclusion:

Using a Java application, the determined mathematical model, and the data gathered from the Gila watershed, the program will potentially produce an input – output figure for Nitrogen and Phosphorus levels tested after the limited 24 hour period. This allows hydrologists to obtain accurate test results from the time of collection at the time of testing.

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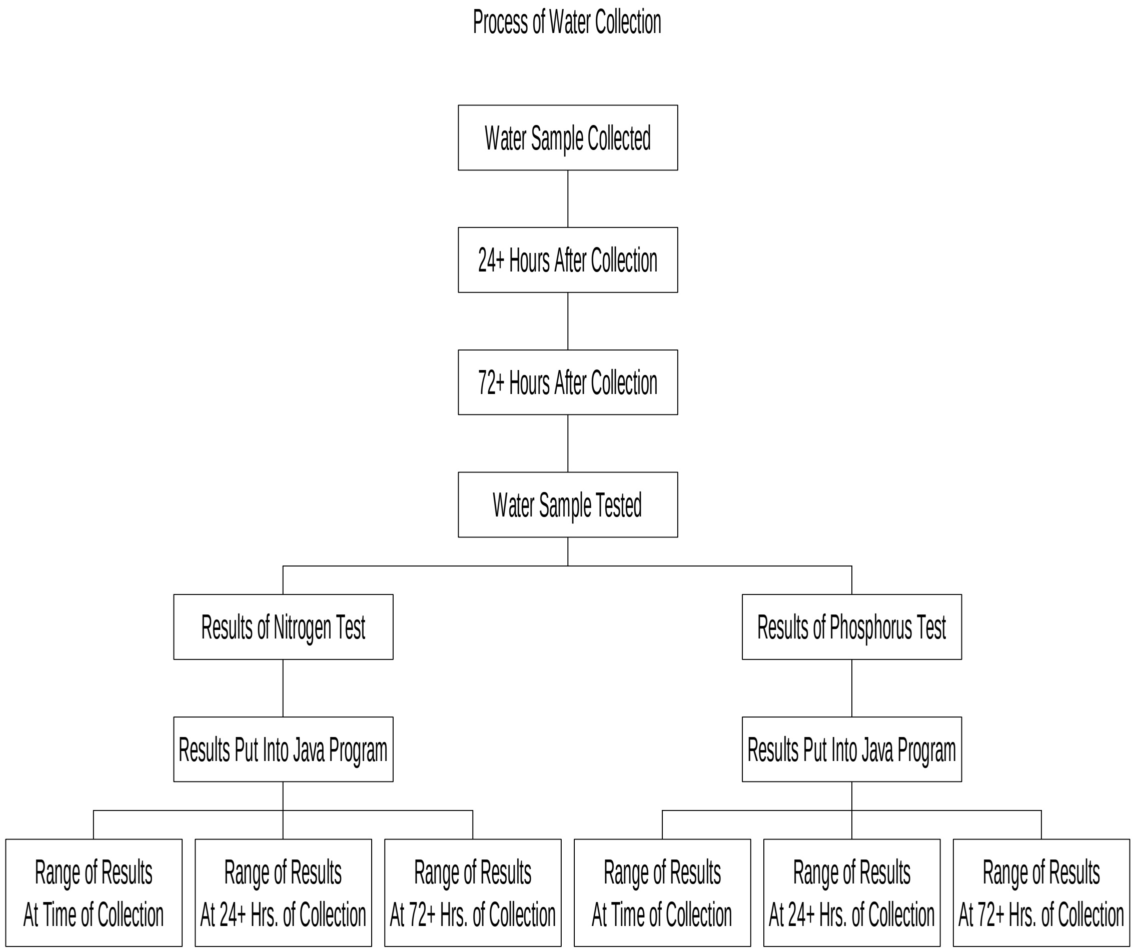
- Mr. Berry F. Estes – Author, Handbook for Computer Projects: Guidelines for Selection and Development of a Computer Project and the Preparation of the Written Report
- Mrs. Gaylene Agnew – Teacher, Cliff High School, Computer Sciences
- Mrs. Joy Garcia – Teacher, Cliff High School, Physics and Biology II

Appendix 1

Flow Chart: Process of Water Collection, Ideal Scenario



Appendix 2

Spectrophotometer Method: Nitrogen

1. Enter the stored program number for high range nitrate nitrogen (NO_3^--N)- powder pillows. Press: **3 5 5 READ/ENTER**. The display will show: **DIAL nm TO 500**
2. Rotate the wavelength dial until the small display shows: **500 nm**.
3. Press: **READ/ENTER**. The display will show: **mg/ 1 N NO_3^- H**.
4. Fill a sample cell with 25 mL of sample.
5. Add the contents of one NitraVer 5 Nitrate Reagent Powder Pillow to the cell (the prepared sample). Stopper.
6. Press: **SHIFT TIMER**. Shake the cell vigorously until the timer beeps in one minute.
7. When the timer beeps, press: **SHIFT TIMER**. A 5-minute reaction period will begin. *Note: An amber color will develop if nitrate is present*
8. Fill another sample cell with 25 mL of sample (the blank).
9. When the timer beeps, the display will show: **mg/ 1 N NO_3^- H**. Place the blank into the cell holder. Close the light shield.
10. Press: **ZERO**. The display will show: **WAIT** then: **0.0 mg/ 1 N NO_3^- H**.
11. Remove the stopper. Place the prepared sample into the cell holder. Close the light shield.
12. Press: **READ/ENTER**. The display will show: **WAIT** then the result in mg/ L nitrate nitrogen (NO_3^--N) will be displayed.

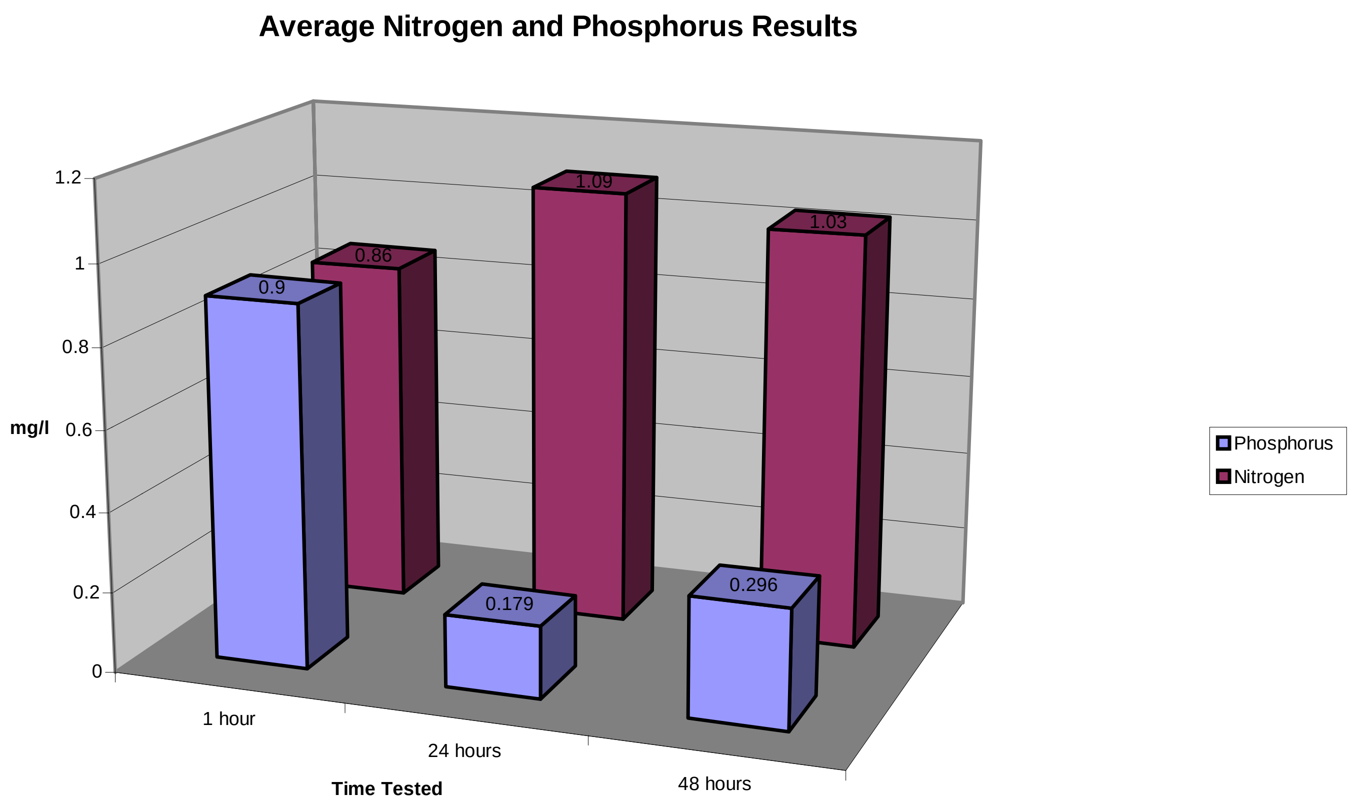
Appendix 3

Spectrophotometer Method: Phosphorus

1. Enter the stored program number for reactive phosphorus powder pillows.

   Press: 4 9 6 READ/ENTER for units of mg/ L P. The display will show: **DIAL nm TO 890**.
2. Rotate the wavelength dial until the small display shows: 890 nm
3. Press: **READ/ENTER**. The display will show: **mg/ l P PV**.
4. Fill a sample cell with 25 mL of sample.
5. Add contents of one potassium persulfate Powder Pillow. Mix vigorously for 1 minute.
6. Add the contents of one PhosVer 3 phosphate Powder Pillow to the sample cell (the prepared sample). Swirl immediately to mix. *Note: A blue color will form if a phosphate is present*
7. Press: **SHIFT TIMER**. A 2-minute reaction period will begin.
8. Fill another sample cell with 25 mL of sample. Place it into into the cell holder.
9. When the timer beeps, the display will show: **mg/ l P PV**. Press**: ZERO**. The display will show: **WAIT** then: **0.00 mg/ l P PV**.
10. Place the prepared sample into the cell holder. Close the light shield.
11. Press: **READ/ENTER**. The display will show: **WAIT** then the results in mg/ L P will be displayed.

Appendix 4



Average Nitrogen and Phosphorus Results
mg/l
1.2
1
0.8
0.6
0.4
0.2
0
0.9
0.86
1.09
1.03
0.179
0.296
1 hour
24 hours
48 hours
Time Tested
Phosphorus
Nitrogen

Appendix 5

Actual Syntax of Program

```
import javax.swing.JOptionPane;

public class Practice {
    public static void main(String args[]){
        String kn1; //user int for nitro first time
        String kn2; // user int for nitro second time
        String kp1; // user int for phos first time
        String kp2; // user int for phos second time
        String k; //user input for if it is nitro of phos
        int conN1, conN2, conP1, conP2;//results after strings are converted
        int resultN1, resultN2, resultP1, resultP2;//Results after items are
athrimitized
        int n1Value = 1;//Value Nitro after day one must be timesed by
        int n2Value = 2;//Value Nitro after day two must be timesed by
        int p1Value = 1;//Value Phos after day one must be timesed by
        int p2Value = 2;//Value phos after day two must be timesed by
        int endResult;
        k = JOptionPane.showInputDialog(null, "Which are you Testing Nitrogen
or Phosphorus? (n=Nitrogen and p=Phosphorus)");
        while (k == n, k == p){///while (k == n, k == p) {
            if (k == n){
                kn1 = JOptionPane.showInputDialog(null, "How many days since
water was collected 1 or 2?")
                while (knl == 1, 2){//while (knl == 1, 2){
                if (knl == 1){
                    kn2 = JOptionPane.showInputDialog(null, "What is the
value?");
                    conN1 = Integer.parseInt(kn2); //converts kn2 to an int
                    resultN1 = conN1 * n1Value;
                    endResult = conN1 + resultN1;
                    JOptionPane.showMessageDialog(null, "Your result should
be" + endResult);
                }//end of if knl =1 IFF
                else {//else of if knl = 1 IFF
                    kn2 = JOptionPane.showInputDialog(null, "What is the
value?");
                    conN2 = Integer.parseInt(kn2); //converts kn2 to an int
                    resultN2 = conN2 * n2Value;
                    endResult = conN2 + resultN2;
                    JOptionPane.showMessageDialog(null, "Your result should
be" + endResult);
                }//end of ELSE knl=1
                }//end of WHILE knl=1,2
            }//End of k = n if
            else {//else for k = n IFF
            while (k == n, k == p){//while (k == n, k == p){
            if (k == p){
                kp1 = JOptionPane.showInputDialog(null, "How many days since
water was collected 1 or 2?")
                while (kpl = 1, 2){//while (kpl = 1, 2){
                if (kpl == 1){
```

```
                    kp2 = JOptionPane.showInputDialog(null, "What is the
value?");
                    conP1 = Integer.parseInt(kp2); //converts kn2 to an int
                    resultP1 = conP1 * p1Value;
                    endResult = conP1 + resultP1;
                    JOptionPane.showMessageDialog(null, "Your result should
be" + endResult);
                }//end of if knl =1 IFF
                else {//else of if knl = 1 IFF
                    kp2 = JOptionPane.showInputDialog(null, "What is the
value?");
                    conP2 = Integer.parseInt(kp2); //converts kn2 to an int
                    resultP2 = conP2 * p2Value;
                    endResult = conP2 + resultP2;
                    JOptionPane.showMessageDialog(null, "Your result should
be" + endResult);
                }//end of ELSE knl=1
                }//end of WHILE knl=1,2
            }//End of k = n if
            }//end of ELSE from k=n
        }//End of While
    } //end of first while
        System.exit(0);
    }//end of method main
   } //End class practice
```