Black Lake Special District

Black Lake Special District Work Session
Thursday, February 5, 2015 • 5:30 pm • 1520-A Irving St, Tumwater

MINUTES

1. Roll Call

2. Approval of Agenda

3. Public Communication
   (Estimated Time: 0-30 Minutes, Sign-up Sheets are provided)
   During this portion of the meeting, citizens may address the Board for up to 3 minutes regarding items related to Special District business. In the event testimony exceeds 30 minutes, the Commission will allow for additional testimony to be taken at the end of the meeting for those who signed up at the beginning of the meeting and did not get an opportunity to speak during the allotted 30-minutes.

4. Informational Materials (No Action Required)
   Attachments: *January 15, 2015 Regular Meeting Minutes*
   Financials

5. Black Lake Monitoring Program
   a. Herrera Proposal – Rob Zisette
      Attachment: *Black Lake Phosphorus and Algae Control Plan Proposal*
   b. Tetratech Proposal – Harry Gibbons
      Attachment: *Tetratech Proposal*

6. BLSD Organizational Framework

7. BLSD Calendar of Activities

8. February Public Meeting Planning

9. Warrant Requests
   Attachment: *OrgSupport Invoice #855*
   Commissioner Bonfield Reimbursement

10. Reports and Referrals

11. Continued Public Communication
    (If needed for those who signed up earlier and did not get an opportunity to speak during the allotted 30 minutes.)

12. Adjournment of Public Meeting

Next Meetings:

Regular Meeting, Thursday, February 19, 2015 6:30pm (Black Lake Bible Camp)
Work Session, Thursday, March 5, 2015, 5:30pm (OrgSupport office)

Black Lake Special District

Thursday, January 15, 2015 • 5:30 pm • 1520-A Irving St, Tumwater

MINUTES

1. Roll Call

   Commissioner Stintzi called the meeting to order at 5:35 pm.

   Present: Lake Stintzi
   Vernon Bonfield
   John Henkle

2. Approval of Agenda

   Commissioner Henkle moved approval of the Agenda of the January 15th Meeting, second by Commissioner Bonfield; passed unanimously.

3. Public Communication –
   a. Mr. Fancher testified that the blue green algae is still visible in the lake.
   b. Tim Erickson distributed draft language for a bill request (S-0441.1/15). *OrgSupport will prepare a fact sheet – new language for RCW 85.38 because water quality issues have created a need for appropriate lake management by local communities.* Special districts create a specific special district option for citizens across the state to take control of improving water quality in local communities. Currently, there is a need for lake water quality management, but a district that wishes to maintain a lake's quality they must identify as a flood control district, or a diking district, which creates rules and procedures that are not applicable to a water quality improvement and management. There is currently no language in statute that allows for the creation of a special district for lake water quality. Currently a lake water quality district has to choose one of these options (diking district, drainage district, diking drainage and/or sewerage improvement district, intercounty diking and drainage, flood control district), none of which are appropriate for lake water quality management. This bill request clarifies language and provides a framework for water quality management by a special district. This special district type will provide for more community based water quality funding and management.

4. Approval of Minutes

   Attachments: *December 18, 2014 Regular Meeting Minutes*
   January 6, 2015 Work Session Meeting Minutes

   Commissioner Henkle moved approval of the minutes of the December 18th Meeting and the January 6th work session, as presented, second by Commissioner Bonfield; passed unanimously.

5. Lake Monitoring Program Development / Tetratech proposal
   a. The commissioners reviewed the Tetratech proposal. Tetratech is able to begin monitoring within 30 days of notice. Core samples can be taken at a later time. A second bid could be requested from Aquatechnex, though pricing would be comparable.
   b. *OrgSupport will contact the WA State Department of Ecology and the Department of Natural Resources to learn if they provide testing and/or lab services for lake monitoring and will report back at the February work session.*
   c. The commissioners agreed that *Commissioner Stintzi will contact Aquatechnex to learn if they can offer a competitive bid for a water quality study, core samples, and lab work. OrgSupport will include the two phosphorus study bids in the February work session packet for review and contractor selection.*

6. Approval of Minutes

   Attachments: *November 20, 2014 Regular Meeting Minutes*

Black Lake Special District

December 4, 2014 Work Session Meeting Minutes

Commissioner Bonfield moved approval of Item 6, November 20, 2014 Regular Meeting Minutes and December 4, 2014 Work Session Minutes, second by Commissioner Henkle; passed unanimously.

7. Warrant Requests

   Attachments: *OrgSupport Invoice #826*

   Commissioner Henkle moved approval of item 7, Warrant Requests, as presented, second by Commissioner Stintzi; passed unanimously.

8. Reports and Referrals
   a. The commissioners reviewed a draft postcard for the public meeting scheduled for February 19th. The postcard will be upsized to the larger size to accommodate more information and will mail February 1st. The postcard must call out the new location at the camp to facilitate guests finding the space (in the tabernacle). The postcard will include a heading calling attention to what attendees will learn and bullets on: plans for algae study and control, weed harvesting permit and timing, applications for grants, special district organization, meeting with county on ditch/lake water levels, herbicide activities, and a special update from Save Black Lake Coalition. On the front of the postcard: Learn about 2015 plans and activities to improve Black Lake!! The bullets used on the postcard will frame the agenda for the meeting plus a special update from Save Black Lake Coalition.
   b. *OrgSupport will contact Lake Stintzi by January 21st to create a list of data points to request from Geodata. OrgSupport will request the data from Geodata immediately following receipt of the information from Commissioner Stintzi.*
   c. Black Lake Bible Camp is willing to take the harvested weeds from the East side of the lake when harvesting happens.
   d. Commissioner Stintzi reported the local harvester is trying to sell his equipment and is not planning to continue providing services.

9. Continued Public Communication – None.

10. Adjournment of Public Meeting

    Commissioner Stintzi adjourned the meeting at 7:30 pm.

Next Meetings:
Work Session, Thursday, February 5, 5:30 pm (OrgSupport office)
Regular Meeting, Thursday, February 19, 6:30pm (Black Lake Bible Camp)

HERRERA

January 30, 2015

Lake Stintzi
Black Lake Special District
120 State Avenue NE, #303
Olympia, WA 98501

Subject: **Black Lake Phosphorus and Algae Control Plan**

Dear Lake,

Herrera Environmental Consultants (Herrera) is pleased to submit the enclosed proposal for the Black Lake Phosphorus and Algae Control Plan. As you know, Black Lake is a highly valued resource that recently has been impaired by toxic algae (cyanobacteria) due to excessive inputs of phosphorus. The Black Lake Sewer District (BLSD) recognizes the need to protect recreational uses of the lake that have been restricted due to these blooms. It is unfortunate that your grant application to the Washington State Department of Ecology for this plan was not completed in time, despite our valiant efforts. However, I am very pleased that the BLSD recognizes the importance of such a plan and has decided to proceed without grant funds.

Our proposal includes a project approach that is similar to the grant application approach, which optimized use of existing resources and applied sound scientific principles that we have successfully used for other lakes in the Pacific Northwest. We have included Northwest Hydraulic Consultants on our project team because they recently developed a phosphorus model for the Black Lake watershed. Our team will update the model to improve estimates of watershed sources of phosphorus, and include phosphorus cycling within the lake to predict the amount of phosphorus control needed to prevent algae blooms.

The Herrera team includes subject experts with extensive experience in applied limnology for lake management, watershed management, and modeling. I will manage the project with help from fellow limnologist Joy Michaud and other staff located in our Olympia office. Our team members have conducted similar lake management studies and performed complex water quality technical analyses for projects throughout the Pacific Northwest. The team will draw upon this extensive practical experience to evaluate management alternatives and to develop an adaptive management plan for Black Lake.

The enclosed package describes the project team, our detailed project approach, and the project schedule and budget. We recognize that BLSD has limited funds to develop and implement a phosphorus and algae control plan. We are very excited about this project and are willing to modify our project approach and reduce the project budget as needed. Funding constraints will also be an important factor when we develop and analyze phosphorus control alternatives. Please feel free to contact me at (206) 787-8262 or rzisette@herrerainc.com with any questions regarding the enclosed proposal, or to further discuss our services.

Sincerely,
Herrera Environmental Consultants, Inc.

RM Zisette

Rob Zisette
Principal/Project Manager

Statement of Qualifications

Black Lake is a highly valued resource that recently has been impaired by toxic algae (cyanobacteria) due to excessive inputs of phosphorus. The Black Lake Sewer District (BLSD) recognizes the need to protect recreational uses of the lake that have been restricted due to these blooms. BLSD needs a highly qualified consulting firm to quantify the phosphorus sources and develop a plan to cost-effectively reduce amounts of phosphorus and algae growth in the lake.

Herrera is one of very few firms in the Pacific Northwest to specialize in lake studies. While we are a small firm by industry standards, we have four professional limnologists on staff as well as many other staff who have lake sampling and data evaluation experience. Herrera has been a regional expert in the technical aspects of comprehensive lake and watershed management, since 1980. Herrera's staff of lake specialists has been involved in many of the significant lake and reservoir research projects in the region, including several projects in Thurston County. We have developed numerous studies to support lake projects, and actively participate in regional and national associations to improve our understanding of lakes and reservoirs.

Herrera's lake management and restoration related projects have included:

- Development and implementation of comprehensive lake water quality monitoring plans designed to accurately measure, quantify, and ultimately lead to recommendations for the control of pollutants discharged to lakes and their tributaries.
- Development of hydrologic and nutrient budgets for numerous lakes in the Pacific Northwest, including evaluation of internal nutrient cycling, sediment core data, and diurnal relationships.
- Detailed evaluations of aquatic plants, phytoplankton, zooplankton, periphyton, benthic invertebrate, aquatic invasive species (AIS)and fish communities for various lake management projects
- Restoration of lakes using various in-lake treatments (aluminum sulfate, calcium hydroxide, aeration, dilution/flushing, and dredging), watershed controls (stormwater management and source control of development and agriculture), and aquatic plant control (physical, mechanical, chemical, and biological techniques)

Our team of scientists and lake managers has extensive skills of the type needed for this project as well as the practical experience needed to ensure success. Our team also includes staff located close to Black Lake in our Olympia office.

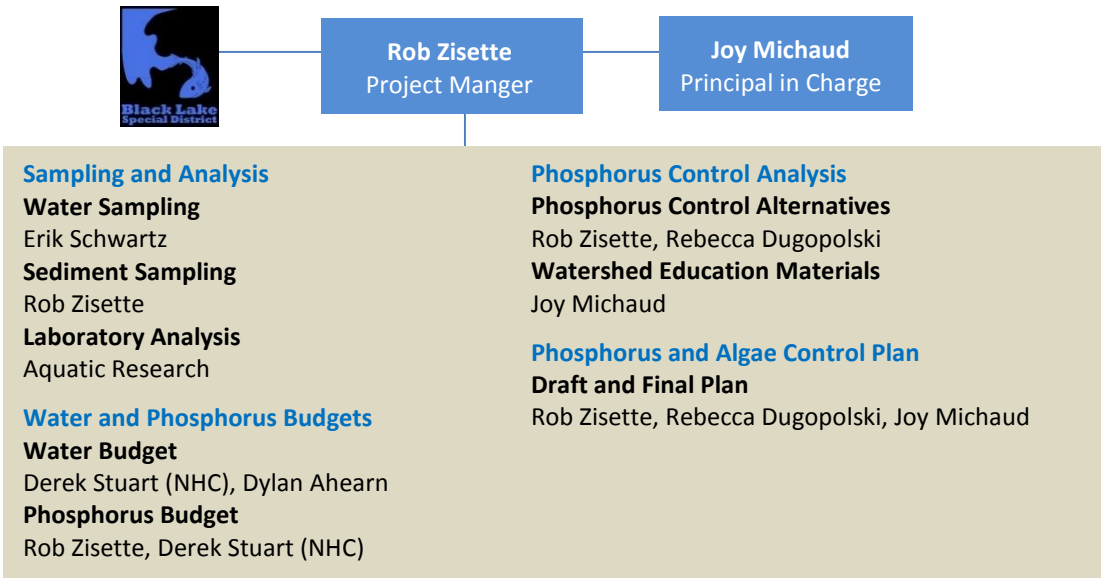
In addition to our own staff, we have included **Northwest Hydraulic Consultants (NHC)** on our team to assist with watershed modeling. NHC is an internationally recognized consulting firm specializing in water resources. NHC's areas of expertise include stream and river restoration, bank stabilization, fisheries engineering, fluvial geomorphology and sediment transport, floodplain management, numerical modeling, hydrology, water-quality, stormwater management, and field services. NHC is a regional leader in hydrology and water-quality watershed modeling applications with local experience in the Black Lake basin directly applicable to the Black Lake Phosphorus and Algae Control Plan.

Project Team

The Herrera team includes subject experts with extensive experience in applied limnology for lake management, watershed management, and modeling. This experience has included assessment and evaluation of a wide diversity of lake management activities, including phosphorus inactivation with aluminum sulfate, dredging, dilution, flushing, aeration, and aquatic invasive species control. Our team members have conducted similar lake management studies and performed complex water quality technical analyses for projects throughout the Pacific Northwest. The team will draw upon this extensive practical experience to evaluate management alternatives and to develop an adaptive management plan for Black Lake

The key staff listed on the following organization chart were carefully selected because they have direct experience with the identified lake management activities. Qualifications of key staff are summarized below and resumes are available upon request.

Graphic 1. Organization of Project Team



Rob Zisette | *Aquatic Science Principal (Herrera - Seattle)*

Rob Zisette has 33 years of project management experience on complex surface water and lake management, projects including lake restoration, aquatic plant management studies, and stormwater management plans. He has developed and implemented monitoring and quality assurance project plans for various water and sediment quality investigations. Rob has identified nutrient sources, developed water and nutrient budgets, assessed plankton and aquatic plant communities, and evaluated lake and aquatic plant management techniques for numerous lakes in the Pacific Northwest. He has developed phosphorus and algae control plans that include the use of alum (aluminum sulfate and sodium aluminate buffer) to inactivated phosphorus in lakes. He is currently evaluating lake and sediment phosphorus conditions in Green Lake to develop a third alum treatment plan for Seattle Parks and Recreation.

Joy Michaud | *Water Resources Principal (Herrera - Olympia)*
Joy Michaud, head of our Olympia office, has over 30 years of water resources experience. Joy has designed and managed technical studies of lakes, streams, drinking water, and stormwater systems. Her lake and reservoir projects have involved development of water and nutrient budgets, restoration studies, research on zooplankton dynamics and sediment phosphorus chemistry, aquatic plant management, and evaluation of lake sediment dredging projects. Joy has facilitated and coordinated the work of many technical advisory groups and citizen committees formed to carry out various resource protection-related tasks, which includes over 25 citizen groups established to address lake concerns. Facilitation has included goal setting, problem solving, and consensus building tasks to aid development of technical protocols and management plans. In addition to direct experience, she has completed an intensive training course on effectively managing public meetings and advisory groups.

Erik Schwartz | *Fisheries Biologist (Herrera - Olympia)*
Erik Schwartz has over 10 years of experience in natural resource science and planning with expertise in fisheries, habitat assessment, and regulatory compliance. His skills include population monitoring and habitat evaluation, protection, and restoration for aquatic and terrestrial species. Erik has extensive field data collection experience including biological data sampling, water quality sampling, stream and shoreline habitat assessment, and habitat monitoring. He has had a lead role in data management and database administration to meet specific fisheries and environmental monitoring project data management needs. Erik has been primary author and coauthor of technical reports and papers with a range of subjects including fisheries research, biological assessments for Endangered Species Act compliance, impact analysis for a habitat conservation and management plans, and alternatives analysis regarding fish and wildlife habitat.

Dylan Ahearn, PhD | *Associate Scientist (Herrera - Seattle)*
Dylan Ahearn has 12 years of experience studying the environmental ramifications of human alteration to aquatic systems. He has expertise in the biogeochemical assessment of surface and subsurface waters, hydrologic analysis of urban and river-floodplain systems, geomorphic surveying, and nutrient spiraling measurement and analysis. Dylan has designed studies, collected data, and conducted detailed pollutant loading assessments for over 50 stormwater treatment structures (e.g., wet ponds, swales, filter strips, green roofs, pervious pavement, and proprietary systems) in the Puget Sound area. Through his work monitoring lakes, floodplains, streams, groundwater, and urban runoff, Dr. Ahearn has gained a detailed and practical knowledge of monitoring methods that he has shared with the classes that he teaches on the topic.

Rebecca Dugopolski | *Environmental Engineer (Herrera - Seattle)*
Rebecca Dugopolski is an environmental engineer specializing in water quality and limnology. She has been working at Herrera for over seven years since she completed her Masters research on an aluminum sulfate treatment of Green Lake, Washington. Her research project involved weekly analysis of water quality sediment core analysis to determine the phosphorus speciation and aluminum content after the alum treatment of Green Lake. Her lake projects at Herrera include developing a spill transport model for Chester Morse Lake, developing a nutrient loading model to evaluate the impact of salmon passing the Landsburg dam on the water quality of Lake Youngs, conducting monitoring in Lake Steilacoom following a calcium hydroxide treatment, evaluating aluminum sulfate treatment options for Lake Steilacoom, and conducting stormwater monitoring in tributaries to Lake Whatcom and Lake Samish. Rebecca also has experience preparing Quality Assurance Project Plans (QAPPs) to meet Washington Department of Ecology requirements and managing stormwater monitoring projects to evaluate emerging stormwater treatment technologies.

Derek Stuart | *Associate Engineer (NHC - Seattle)*

Derek Stuart has 15 years of experience providing specialized surface water hydrology, hydraulics, and water quality modeling and analysis. He has played a key role in over one hundred projects involving stream, lake, and river systems. Those projects have involved: the analysis of observed and simulated flow and water quality data to support watershed planning studies, geomorphic assessments, pollutant source and transport characterization, development of stormwater code and policy, municipal NPDES permit support, LID technology guidance, GIS applications, and hydrometric data collection. Prior to coming to NHC, Derek gained a water quality and hydrology background from research affiliated with the University of Washington. He is currently focusing his work on assisting clients with the application of computer models to evaluate stream hydrology and water quality problems and goals.

Project Approach

The Black Lake Phosphorus and Algae Control Plan will identify the measures needed to reduce both internal and external nutrient loading to Black lake, and control the production of cyanobacteria and toxic algal blooms. Black Lake has high nutrient levels that result in cyanobacteria blooms. These blooms have occurred in most years since routine lake monitoring began in 1992. Toxic algae monitoring since 2010 shows that microcystin is the primary cyanotoxin of concern, with 25 percent of the algae samples exceeding the State public health guideline of 6 ppb and reaching a maximum microcystin level of 669 ppb. To protect public health, advisory signs have been regularly posted since 2001 in the public access and swimming areas.

Water quality data collected by Thurston County Public Health since 1992 shows that Black Lake is eutrophic due to high phosphorus concentrations exceeding a summer average of 200 ppb in the bottom waters, which mix with surface waters at fall turnover and trigger cyanobacteria blooms. The Thurston County Regional Planning Council recently selected the Black Lake Basin for the 'Guiding Growth – Healthy Watersheds Project', to develop a watershed management strategy for improving water quality through development regulations and rights, and protection of sensitive areas.

A 2013 survey of basin residents showed that nearly 70 percent are concerned about water quality. The Black Lake Basin project also resulted in development of an HSPF hydrologic model to identify water inflow/outflow rates at Black Lake that included estimates of phosphorus loadings. However, additional water and sediment phosphorus data are needed to accurately model the lake phosphorus budget and determine watershed impacts on Black Lake. The Black Lake Special District (BLSD) is committed to improving water quality in Black Lake by supplementing Thurston County's model with the phosphorus data needed to identify internal and external phosphorus sources, and effectively control toxic cyanobacteria blooms and protect public health.

The goals of this project are to identify the best methods of controlling internal and external nutrients and to develop a plan that guides implementation of nutrient control actions in Black Lake. The project will meet these goals by 1) developing a nutrient budget that documents the amount and sources of nutrient loading which cause cyanobacteria blooms in the lake, 2) analyzing the lake bottom sediments and evaluating the efficacy of a whole-lake sediment inactivation alum treatment, 3) analyzing methods to control the remaining external loading, and 4) developing an approved algae control plan to clean up Black Lake.

Task 1 – Water and Phosphorus Budgets

In order to control cyanobacteria blooms in Black Lake, it is necessary to reduce the amount of phosphorus in the lake that is available for algal growth. Lake monitoring data show much higher summer average concentrations of total phosphorus in anoxic bottom waters (40-190 ppb in hypolimnion) than surface waters (20-40 ppb in epilimnion). Phosphorus in the epilimnion comes from 1) internal loading from the lake sediments to the hypolimnion (bottom waters) that then diffuses or is mixed into the upper waters, 2) direct diffusion from shallow sediments within the epilimnion, and 3) external loading from the watershed. The trophic state index has been consistently in the eutrophic range (50-60) and is higher for chlorophyll than total phosphorus or Secchi depth, suggesting that vertical migration of cyanobacteria (*Anabaena* and *Aphanizomenon*) up into the epilimnion may serve as an additional mechanism for internal loading. The current contributions of both internal and external loading must be determined to evaluate the effects of sediment phosphorus inactivation and external source control methods on the phosphorus concentrations and toxic algae in the epilimnion.

To evaluate the effectiveness of algae control alternatives for Black Lake, it is necessary to develop water and phosphorus budgets for the lake. The water budget will determine the volume of water flowing into and out of the lakes over the course of multiple years. The phosphorus budget will document the seasonal timing and the amount of phosphorus coming from both watershed and internal sources. This requires measuring phosphorus concentrations of water flowing into the lake and at various depths within the lake over a one-year period to supplement existing data and to calibrate the existing phosphorus loading model.

Subtask 1A – Sampling and Analysis Plan. Herrera will prepare a Sampling and Analysis Plan in accordance with Ecology's guidelines for preparing quality assurance project plans. This plan will describe sample locations and methods of sample collection, sample analysis, and data analysis for the water and nutrient budgets, and will include quality control objectives and procedures to insure data of known accuracy are collected. Herrera will prepare a draft plan for review by BLSD and a final plan that addresses comments by BLSD on the draft plan.

Subtask 1B. Water Quality Monitoring. Herrera will assist BLSD with monitoring of total nutrients and algae concentrations in the lake, total phosphorus (TP) and suspended solids (TSS) in inflow streams, and TP in groundwater for one year. Lake monitoring will be performed monthly from May 2015 through April 2016. Thurston County Environmental Health will monitor the lake during summer months (May through October). BLSD will attend summer monitoring to learn procedures and then monitor the lake during winter months (November through April). Lake monitoring will include measuring Secchi depth and profiles of field parameters (temperature, dissolved oxygen, pH, and conductivity) at the existing in-lake deep monitoring station. Water samples will be collected near the lake surface and bottom for analysis of total phosphorus (all year) and total nitrogen (summer only). Composite samples from the epilimnion will be analyzed for chlorophyll *a* and algae identification (summer only).

BLSD will collect grab water samples from the three inflow locations during 10 events (four base flow and six storm flow) throughout the monitoring year (May 2015 through April 2016). Surface water samples will be analyzed for TP and TSS for calibration of the existing HSPF model, as recommended by the modeling report (NHC 2014).

BLSD will collect grab water samples from three groundwater wells on two occasions (one summer and one winter). Analysis of the lake, stream, and groundwater samples will be performed by Aquatic Research, Inc., an Ecology-certified laboratory in Seattle.

Herrera will coordinate sampling by BLSD and Thurston County and analysis of those samples by analytical laboratories to insure high quality data are collected as planned. Herrera will train BLSD representatives on the collection of lake and stream samples by demonstrating proper sample collection and handling procedures during up to two lake and stream sampling events. Herrera will coordinate shipment of samples by BLSD to the laboratory (Aquatic Research), and will coordinate additional laboratory analyses needed for samples collected by Thurston County as specified in the sampling and analysis plan.

Subtask 1C - Water Budget. Herrera and NHC will develop a water budget in monthly time steps over the course of three years. The three years will be selected to represent the range of trophic conditions observed historically in the lake. The HSPF model of the basin recently developed by NHC will be used by NHC to calculate inflow and outflow volumes for each month at the following locations:

- Outflow from the north lake basin to Black Lake Ditch
- Inflow from each of three streams: Kenneydell Park stream (east), unnamed stream (southeast), and Dempsey Creek (south)
- Inflow from 11 nearshore sub-basins

- Inflow of groundwater east of the lake
- Outflow of groundwater west of the lake

The model will calculate lake storage volume from bathymetry and level data, and direct precipitation and evaporation volumes from local meteorological data. Model uncertainty will be qualitatively evaluated for each water component and the HSPF model will not be calibrated for this project.

Subtask 1D – Phosphorus Budget. Herrera will develop phosphorus budgets for three years using the data collected in sub-tasks 1B and 1C. The phosphorus budget will be a two-layer seasonal mass balance model similar to those used for other lakes in the Puget Sound region. The model will be used to quantify the contribution of external and internal phosphorus sources that feed cyanobacteria growth in the lake based on relationships between phosphorus and chlorophyll, and will allow Herrera to evaluate the effectiveness of alternatives for controlling internal and external sources in Tasks 2 and 3.

Deliverables and Schedule

1. Prepare draft and final Sampling and Analysis Plan by April 30, 2015.
2. Monitor lake TP, TN, chlorophyll, algae, and vertical profiles monthly for six summer months, and monitor lake TP and vertical profiles for six winter months at two depths at the deep lake station from May 2015 through April 2016.
3. Monitor inflow TP and TSS during six base flow events and six storm flow events at three stream locations from May 2015 through April 2016.
4. Calculate water budget components (lake storage, surface inflows, surface outflow, ground water inflow/outflow, and direct precipitation/evaporation) for three years representing a range of trophic conditions by June 2016.
5. Develop a monthly mass balance model to identify the sources and fates of phosphorus in the lake by June 2016.

Task 2 – Lake Sediment Phosphorus Control Analysis

Vertical profiles and samples of water quality in Black Lake collected since 1992 show that the cyanobacteria blooms occur at fall turnover when the lake layers mix, clearly indicating that they are caused by internal loading from lake sediments. Task 1, as described above, will result in development of a phosphorus budget to determine the current level of internal phosphorus loading from the sediments. Unless this internal phosphorus cycling is controlled, there will continue to be toxic cyanobacteria blooms in Black Lake.

A whole-lake aluminum sulfate (alum) treatment may be the most effective method of controlling internal phosphorus loading in Black Lake. A detailed analysis of the sediments in the lake is required to determine the potential effectiveness of such an alum treatment. Under Task 2, Herrera will collect and analyze sediment cores to measure the concentrations of phosphorus fractions and other variable in the lake sediments. These data will be used to determine if an alum treatment is the best method to inactivate sediment phosphorus and to calculate the dose of alum needed for sediment inactivation.

Subtask 2A - Sediment Monitoring. Herrera will collect sediment cores from four locations in the lake to include two locations within each of the two lake basins. The sediment cores will be collected in hypolimnion region of the lake below a depth of 5 meters (16 feet), which represents approximately 75 percent of the lake surface area. Each sediment core will be partitioned into seven depth intervals down to 40 cm (0-2.5, 2.5-5, 5-10, 10-15, 15-20, 25-30, and 35-40 cm). Depth intervals from two cores will be

composited into one set for each lake basin, and a total of 14 depth-interval samples will be analyzed for the following parameters:

- Mobile (reactive) phosphorus
- Organic phosphorus
- Iron bound phosphorus
- Aluminum bound phosphorus
- Calcium bound phosphorus
- Total iron
- Percent solids
- Percent volatile solids (organic content)

Analysis of the sediment cores will be performed by Aquatic Research, Inc., an Ecology-certified laboratory in Seattle.

Subtask 2B – Sediment Phosphorus Inactivation Evaluation. Herrera will use the results of the sediment core analysis to evaluate the potential effectiveness of sediment inactivation through an alum treatment or a Phoslock® treatment. If either type of treatment is judged to be cost effective, Herrera will develop specifications for implementing such a treatment. This will include estimates for the recommended type and quantity of materials, areal distribution, material and application costs, potential vendors/contractors, and monitoring and permitting necessary for the treatment. The potential need for a buffer (sodium aluminate) to protect lake water pH during an alum treatment will also be evaluated.

Deliverables and Schedule

1. Collect and process four sediment cores from Black Lake, and analyze the 14 depth intervals for five phosphorus fractions and additional parameters by September 2015.
2. Prepare a written analysis of the effectiveness of a potential alum or Phoslock® treatment, and calculate the dose of alum and Phoslock® and associated costs needed to inactivate phosphorus in the lake sediments by December 2015.

Task 3 –Watershed Phosphorus Control Analysis

The recently developed watershed phosphorus model (NHC 2014) estimated annual phosphorus loadings for each sub-basin of Black Lake using areal phosphorus loading rates for each type of land use from the literature and measurements of phosphorus loadings from specific land uses within the Green River watershed (Herrera 2007). Watershed TP and TSS data collected for this project in Task 1 will be used to increase accuracy of the phosphorus loading model.

The watershed phosphorus model predicted a 14 percent reduction in the current phosphorus loading for either of the three watershed restoration/protection scenarios developed for the Guiding Growth – Healthy Watersheds Project (NHC 2014). Therefore, additional surface water source control reductions may be necessary to significantly reduce toxic cyanobacteria blooms in Black Lake. The Phosphorus and Algae Control Plan (Task 4) may need to include additional measures to control phosphorus that will continue to reach the lake. Potential methods to control watershed phosphorus sources will be evaluated that include an alum injection system, and periodic water column-stripping of phosphorus by alum or Phoslock® treatments of the lake.

Educational materials and approaches to address nonpoint sources of nutrients in the Black Lake watershed will be compiled and submitted to BLSD for distribution to watershed residents. These materials will be developed by Thurston County Regional Planning as part of the Guiding Growth – Healthy Watersheds Project. Additional materials will be obtained from Thurston County Environmental Health

and other sources as appropriate. Herrera will prepare a summary of watershed phosphorus monitoring results obtained in Task 1 that includes recommendations for additional source investigation and control in monitored or unmonitored drainage basins.

Subtask 3A – External Phosphorus Control Evaluation and Preliminary Design. Herrera will evaluate alternatives for controlling external loading from various streams, stormwater outfalls, and ground water. Alternatives will include an alum injection system located either at stream mouths or in the main body of the lake, and periodic water column-stripping of phosphorus by alum or Phoslock® applications to the lake. Alternatives will be evaluated for effectiveness, cost, and maintenance requirements. Herrera will recommend a preferred alternative for control of watershed phosphorus sources and will prepare preliminary design plans (10%) of the preferred alternative.

Subtask 3B – Educational Materials for External Phosphorus Control. Herrera will compile educational materials and approaches to address nonpoint sources of phosphorus in the Black Lake watershed using Best Management Practices (BMPs). These materials will be selected from existing sources, including Thurston County Regional Planning and Thurston County Environmental Health, and will be submitted to BLSD via email for distribution to watershed residents. Herrera will prepare a summary of watershed phosphorus monitoring results obtained in Task 1 that includes recommendations for additional source investigation and control in monitored or unmonitored drainage basins.

Deliverables and Schedule

1. Prepare a written analysis and recommendations for controlling watershed phosphorus loading from inlet streams, stormwater outfalls, and ground water by July 2016.
2. Develop preliminary design plans for the recommended alternative by August 2016.
3. Compile and distribute recommended actions to address nonpoint sources of nutrients in the lake watershed by September 2016.

Task 4 – Phosphorus and Algae Control Plan

The purpose of this project is to develop an implementable and cost-effective plan for reducing phosphorus to control toxic cyanobacteria blooms in Black Lake. The plan will address both internal loading from the lake sediments and external loading from the watershed based on information obtained for Tasks 1 through 3. The plan will be completed by December 2016 to allow at least three months for preparing contractor specifications, obtaining necessary permits, and selecting contractors for implementation of the plan by April 2017.

Herrera will prepare the Black Lake Phosphorus and Algae Control Plan to include recommendations for potential sediment inactivation by either alum or Phoslock® to address internal loading, and recommendations for the best method or combination of methods to control the continued external nutrient loading from the watershed. The plan will also include recommendations for additional phosphorus source tracking and BMPs to control phosphorus loading from key basins within the watershed.

Subtask 4A - Draft Plan. Herrera will prepare a draft phosphorus and algae control plan with recommended measures, schedules, and costs. Herrera will present the draft plan to BLSD at a meeting to discuss and receive comments on the draft plan.

Subtask 4B - Final Plan. Herrera will revise the plan as needed to address comments on the draft plan. Herrera will then prepare the final Black Lake Phosphorus and Algae Control Plan.

Deliverables and Schedule

1. Develop a draft plan with recommendations for controlling phosphorus loading and toxic cyanobacteria blooms by October 2016.
2. Present the draft plan at a meeting in November 2016.
3. Prepare a final plan by December 2016.

Task 5 – Project Management and Contract Administration

Herrera will develop a detailed scope of work, schedule, and cost estimate for review and approval by BLSD. Roles and responsibilities of each staff person and subconsultant will be clearly defined. Rob Zisette will be the project manager and primary author of the project deliverables. Joy Michaud will serve as principal-in-charge providing overall quality assurance review of the deliverables. Rob will also provide reports on project progress and budget on a monthly basis, and communicate any potential concerns or issues for resolution with BLSM. Herrera will submit monthly invoices to BLSD with details on all labor and expenses associated with each project task.

Deliverables and Schedule

1. Monthly invoices and progress reports

Project Schedule and Budget

Our proposed project schedule and budget are presented in the following table.

	Schedule		Budget			
Task	**Begin**	**End**	**Herrera**	**NHC**	**Laboratory**	**Total**
Task 1A	3/1/15	4/30/15	$5,897	$310	$0	$6,207
Task 1B	5/1/15	4/15/16	$5,724	$0	$1,170	$6,894
Task 1C	4/15/16	6/30/16	$2,489	$2,480	$0	$4,969
Task 1D	4/15/16	6/30/16	$5,981	$5,890	$0	$11,871
Task 2A	8/1/15	9/15/15	$5,228	$0	$1,960	$7,188
Task 2B	9/15/15	12/15/15	$4,890	$0	$0	$4,890
Task 3A	7/1/16	8/30/16	$5,280	$0	$0	$5,280
Task 3B	8/30/16	9/30/16	$1,586	$0	$0	$1,586
Task 4A	8/30/16	11/15/16	$10,408	$310	$0	$10,718
Task 4B	11/15/16	12/15/16	$2,757	$0	$0	$2,757
Task 5	3/1/15	12/15/16	$2,703	$0	$0	$2,703
Totals	-	-	**$52,945**	**$8,990**	**$3,130**	**$65,065**

Similar Projects

The Herrera team has been involved in many lake management projects in the Puget Sound Basin that are similar to Black Lake. Project examples and references are summarized below.

Vancouver Lake Management Plan *(2009-2013)* | *Vancouver Lake Watershed Partnership*

Contact: Jeff Schnabel, Project Manager, 360.397.2121 x4583, jeff.schnabel@clark.wa.gov
Relevance: Management of cyanobacteria problems

Herrera assisted with development of a 5-year research plan for the Vancouver Lake Watershed Partnership to enhance the understanding of Vancouver Lake for development of a management plan to reduce cyanobacteria blooms that impair recreational use and habitat conditions. Herrera's scientists provided technical input to the research objectives, approach, priorities, costs, and schedule for the following components of the research plan: water dynamics, nutrients, sediment, food web interactions, toxic contaminants, fish and wildlife habitat, and lake and watershed modeling. Herrera developed a system for ranking lake management objectives identified by stakeholders, and identified potential lake and watershed management options to address cyanobacteria issues in the lake. Herrera's senior limnologist, Rob Zisette, serves as the lake expert at Partnership meetings, and assisted USGS in developing the water and nutrient budget for the lake management plan. Herrera used these and other study results to develop preferred management strategies for further evaluation and design.

Green Lake Management Plan and Alum Treatment *(1992-present)* | *Seattle Parks and Recreation*

Contact: Kevin Stoops, Retired Project Manager, kbstoops55@gmail.com; Kathleen Conner, Current Project Manager, 206.615.1299, Kathleen.Conner@seattle.gov
Relevance: Management of cyanobacteria algae problems

Herrera, with Rob Zisette as the lead scientist and project manager, has been involved in evaluation and management of Green Lake since the early 1990s. Initially, Herrera monitored Green Lake and its watershed, developed the water and nutrient budgets, conducted diurnal studies of internal phosphorus loading, educated the public on effects of an aluminum sulfate (alum) treatment, and prepared aquatic plant harvesting specifications. In response to cyanobacteria blooms in the early 2000s, Herrera provided planning, permitting, engineering, and monitoring services to support an alum treatment of Green Lake. This included determining the best approach to treating the lake with alum. Herrera conducted water quality monitoring during and after the 2004 alum treatment, and prepared reports of those findings. Herrera continued to provide limnological support by collecting and evaluating sediment core data, developing a bioturbation model to predict impacts of carp on internal loading of phosphorus, designing and implementing a stormwater monitoring program, tracking sources of phosphorus and fecal coliform in a key drainage basin, and mapping aquatic plants in the lake. Herrera recently completed a detailed evaluation of phytoplankton-nutrient relationships, algae scum and toxin monitoring data, and cyanobacteria monitoring and lake closure protocols. Currently, Herrera is conducting additional study of sediment phosphorus conditions to design and prepare contractor specifications for another alum treatment expected to occur in the spring of 2016.

Lake Steilacoom Calcium Oxide and Alum Treatment Studies *(2008-2010)* | *City of Lakewood*

Contact: Greg Vigoren, Surface Water Division Manager, 253.983.7795, Gvigoren@cityoflakewood.us
Relevance: Management of cyanobacteria problems

Lake Steilacoom is a small eutrophic lake located in the City of Lakewood that has experienced excessive algae growth and toxic blooms of cyanobacteria (bluegreen algae). In 2008, Herrera designed and implemented a water quality monitoring program to provide independent evaluation of a calcium oxide (lime) treatment by inactivating bioavailable phosphorus with calcium. Treatment goals and procedures were developed in consultation with stakeholders, and Herrera prepared a QAPP in accordance with Ecology requirements. Monitoring results were compared to historical data and treatment objectives in a report that evaluated the effectiveness of this innovative treatment for other soft-water lakes in western Washington. In 2010, Herrera evaluated the feasibility of using aluminum sulfate (alum) to inactivate bioavailable phosphorus and prevent toxic algae blooms as part of an algae control grant. Herrera compiled historical data, described lake and watershed conditions, analyzed external and internal phosphorus loadings to the lake, developed alum treatment design criteria and dose requirements, evaluated alternative alum treatment methodologies, identified permitting requirements and environmental benefits, and prepared conceptual designs and cost estimates for two preferred alternatives. Herrera prepared a feasibility analysis that recommended installation of a microfloc injection system in the lake for continuous phosphorus inactivation and water quality improvement, and presented the study findings at state and national lake management conferences.

Additional relevant lake projects by Herrera limnologists that addressed cyanobacteria problems include:

- **Capitol Lake Adaptive Mangement Plan and Dredging Analysis** | *Washington Department of Enterprise Services*
- **Lake Youngs Limnology Studies and Expert Panel Workshop** | *Seattle Public Utilities*
- **Roslyn Lake Modeling and Alternatives Analysis** | *City of Portland, OR*
- **Lake Sammamish Water Quality Management Plan** | *King County, WA*
- **Twin Lakes Water Quality and Aquatic Plant Assessment** | *Twin Lakes Homeowners Association*
- **Lake Sawyer Stormwater Impact Analysis** | *Diamond Coalition*
- **Lake Burien Data Analysis** | *Lake Burien Shore Club*
- **Union River Reservoir Monitoring and OperationEvaluation** | *City of Bremerton*
- **Lake Oswego Stormwater On-Call Services** | *City of Lake Oswego*
- **Lake Whatcom Surface Water Impact Assessment** | *Whatcom Water District #10*
- **Bass Canal Aeration Study** | *City of Ocean Shores*

Hydrologic Modeling in Support of Watershed-Based Land Use Planning

Black Lake, Thurston County, Washington

Client
Thurston County Planning Department
Allison Osterburg
360.754.3355 x7011
osterba@co.thurston.wa.us

Project Completion
December 2014

Project Services
Hydrologic modeling
Water quality modeling
Watershed management
Land use alternatives analysis
EPA-approved modeling
QAPP development

Benefits
The study provides a scientific basis for land use policies, zoning, regulations, restoration, and incentives that protect and restore aquatic habitat and beneficial uses.

Provided a tool for estimating pollutant loads to Black Lake, Woodard Creek, and McLane Creek

Black Lake Outlet, Looking Downstream

The Thurston County Planning Department secured a series of grants from US-EPA to apply best available science to guide land use planning, zoning regulation, restoration and protection projects, and stormwater codes in order to preserve and restore aquatic habitat and beneficial uses of lakes, streams and near shore areas of Puget Sound.

NHC was contracted by the County to provide the scientific foundation for establishing the current hydro-ecological status of selected streams and estimating the future status under different urban growth and land management options. To accomplish this task, NHC selected three pilot basins representing a typical range of county-wide stream habitat and water quality values and conditions. One of those basins was the area tributary to Black Lake. HSPF models of both flow and key water quality parameters were then developed and calibrated using GIS data sets and available monitoring data. Subsequently, these models were used to hindcast pristine basin hydrologic regime and estimate changes to flow regime and water quality under future urban growth and land management practices.

Both synthesized BIBI and pollutant loading statistics calculated from model simulation results were used to characterize and compare the existing and potential future hydro-ecological status in these basins. Average annual load per acre of upstream drainage was used as the metric for nitrogen and phosphorus. The frequency of violation of water quality standards were the metrics used for temperature and fecal coliform counts. These comparisons of different planning strategies will support recommendations by planning staff to policy makers related to growth management, resource protection, and restoration.

TETRA TECH

MEMORANDUM

TO:	Brian Wilmovsky
FROM:	Harry Gibbons
SUBJECT:	Black Lake water quality monitoring proposal
Cc:	
DATE:	December 18, 2014

Scope Overview

This monitoring proposal was developed to help the Black Lake LMD formulate a long-term adaptive management program for Black Lake. The scope of work describes the specific activities that need to be performed in order to aid in the understanding of the lake's current condition and what is needed to enhance and maintain lake water quality and limit the occurrence and intensity of cyanobacterial blooms in the lake.

The primary goals of this proposed monitoring effort are to:

1) Collect baseline data for assessment of the lake's environmental health and to provide a long-term database for potential management decisions in the future, and

2) Provide specific monitoring data for Black Lake that will allow the development of a water balance and phosphorus budget models that will help prioritize future management efforts.

Therefore, the specific objective of this scope of work is to collect data from the lake, its inlets, and outlet for phosphorus, nitrogen, temperature, dissolved oxygen (DO), pH, Secchi disk (water transparency), chlorophyll *a* (chl *a*), and phytoplankton. A specific scope of work is outlined below. Cost estimates for these tasks will be assembled after refinement of general monitoring and lake management goals.

Detailed Work Tasks:

Monitoring

Described below are the specific sampling tasks proposed for the monitoring program. Sampling events will occur monthly October through March and twice monthly April through September.

The following tasks will be performed during each sampling event:

Lake Monitoring

During each sampling event water quality samples will be taken at three lake stations. Station 1 is in the mid southern third of the lake, Station 2 is the mid lake station, and Station 3 is the mid northern third of

the lake. At each station specific samples will be taken at a depth of 1 meter below the lake surface, mid water column depth, and at 1 meter above the bottom of the lake. The water samples will be analyzed for TP (total phosphorus), SRP (soluble reactive phosphorus), TN (total nitrogen), NO_2+NO_3-N (nitrite and nitrate nitrogen), NH_3-N (ammonia nitrogen), chl-*a* (photosynthetic pigment chlorophyll-*a*), and phytoplankton (identification and abundance). Water transparency will be determined with a Secchi disc on each sampling occasion at each station as will DO (dissolved oxygen), pH, specific conductivity, and temperature that will be determined at meter depth intervals on each sampling date.

Inlet and Outlet Monitoring

The outflow from the Black Lake is complex so both the Black River headwater outlet from the lake (that is partially blocked by beaver dams) and the Black Lake Ditch flowing to Percival Creek will be monitored for outflow volume using data loggers. Four of the intermittent inflow streams will be monitored during five storm events. Water quality samples will be taken during each storm sampling event within the inlet channels to the Black Lake for TP, SRP, TN, NH_3-N, NO_2+NO_3-N, DO, temperature, pH, and conductivity. When possible (depending on water depth), flow will also be taken in this channel using a Marsh McBirney Flo-Mate 2000 and USGS top-setting wading rod.

Record Water Levels

Data loggers at the outlets to Black Lake and the lake itself will be installed to provide water level information through the study period at 30 minute intervals.

Assumptions:

- Laboratory testing will be performed at a quality lab, such as Aquatic Research, Inc. that can meet the low level nutrient detection requirement of this program. Phytoplankton samples will be analyzed at a qualified phytoplankton laboratory, such as Water Environmental Services, Inc. A detailed QAPP will be prepared prior to any sampling and analysis that will define the detailed sampling and laboratory protocols needed to provide valid data for this program.

Water Quality Technical Memorandum

To define the lake's water quality, a technical memorandum presenting the data in tabular and graphical form will be prepared. Water quality and phytoplankton data will be assessed in the context of similar monitoring data from previous years as available to determine if trends exist. This assessment will highlight observations and conclusions learned from previous monitoring results and focus on the relationships between water quality parameters and phytoplankton production as well as species community structure. It will also identify potential environmental risks to water quality or other problems that require management response for Black Lake. A water and phosphorus budget model will be developed and used to determine what if any management alternatives should be considered to enhance and maintain water quality and meet the overall management goals for the lake. From this analysis future monitoring program needs will be defined as will management directives.

Black Lake Cost Estimate Description

Two separate cost estimates have been prepared for Black Lake. The first Volunteer Monitoring with Consultant Assistance, outlines the estimated costs if Black Lake was to purchase all of the needed sampling equipment and perform all sampling. A day of consultant led sampling training is included in the estimate.

In the first estimate, the Lake Monitoring Lab Costs table outlines the costs of all laboratory sample analyses as quoted in the December 18th tech memo from Tetra Tech to Brian Wilmovsky. This cost is consistent between the two different cost estimate documents. The Equipment Costs table gives costs of the needed sampling equipment. If purchased Black Lake would own the equipment and be responsible for maintenance. The location each item can be found for purchase is also included. Boat costs are not included in this table. The Inlet and Outlet Monitoring Lab Costs table describes lab costs associated with stormwater sampling in inlets and outlets to the lake. This cost is also consistent between the two different cost estimate documents. The Level Logger Equipment Costs table shows the cost of purchasing 3 level loggers to place in the outlets and in Black Lake. The Training Costs and Consultant Fees table shows the costs associated with a day of training and a day of level logger installation in addition to data management, analysis, and reporting costs. The Mileage Costs table shows mileage costs associated with the GSA mileage rate.

The second estimate, Full Consultant Costs, details cost estimates associated with the use of consultant owned equipment and with consultants performing all sampling activities. Lake Monitoring and Inlet and Outlet Lab Monitoring Costs are consistent with the first cost estimate document. Mileage Costs are based on all sampling trips. The Consultant Costs table describes costs associated with two consultants performing all sampling. Consultant costs could be lowered if Black Lake would like to provide one sampling member and the consultant team provides one member. The Rental Equipment table gives the cost of the consultant using their own equipment to perform sampling and is based on a daily or monthly rental rate. If a boat is provided by Black Lake the estimated boat rental cost could be subtracted.

Sediment sampling was not included in either estimate but would require an additional 16 hours of sampling and 20 hours for data analysis plus around $12,000 in lab analysis costs. Sediment sampling and analysis total costs would be around $20,000-$25,000.

Below are the two separate cost estimates. The Full Consultant Costs estimate totals $113, 653, while the Volunteer Monitoring with Consultant Assistance estimate totals $80,251. Please let us know if you have additional questions.

Volunteer Monitoring with Consultant Assistance

Lake Monitoring Lab Costs

Station Name	Depth Samples	Sampling Frequency October-March	Sampling Frequency April-September	TP Cost	SRP Cost	TN Cost	NO2 +NO3 Cost	Ammonia N Cost	Chl a Cost	Phytoplankton Cost
Station 1	3	6	12	15	15	25	15	15	30	125
Station 2	3	6	12	15	15	25	15	15	30	125
Station 3	3	6	12	15	15	25	15	15	30	125
Total Lake Monitoring Lab Costs	$38,880									

Full Consultant Costs

Lake Monitoring Lab Costs

Station Name	Depth Samples	Sampling Frequency October-March	Sampling Frequency April-September	TP Cost	SRP Cost	TN Cost	NO2 +NO3 Cost	Ammonia N Cost	Chl a Cost	Phytoplankton Cost
Station 1	3	6	12	15	15	25	15	15	30	125
Station 2	3	6	12	15	15	25	15	15	30	125
Station 3	3	6	12	15	15	25	15	15	30	125
Total Lake Monitoring Lab Costs	$38,880									

Volunteer Monitoring with Consultant Assistance

Inlet and Outlet Monitoring Lab Costs

Stormwater Stream Monitoring Site	Number of Storm Events	Samples per Storm Event	TP Cost	SRP Cost	TN Cost	NO2 +NO3 Cost	Ammonia N Cost
1	5	3	15	15	25	15	15
2	5	3	15	15	25	15	15
3	5	3	15	15	25	15	15
4	5	3	15	15	25	15	15
Total Stormwater Monitoring Lab Cost	$3,825						

Full Consultant Costs

Inlet and Outlet Monitoring Lab Costs

Stormwater Stream Monitoring Site	Number of Storm Events	Samples per Storm Event	TP Cost	SRP Cost	TN Cost	NO2 +NO3 Cost	Ammonia N Cost
1	5	3	15	15	25	15	15
2	5	3	15	15	25	15	15
3	5	3	15	15	25	15	15
4	5	3	15	15	25	15	15
Total Stormwater Monitoring Lab Cost	$3,825						

Volunteer Monitoring with Consultant Assistance

Equipment Costs

Equipment Name	Equipment Cost	Purchasing Location
pH, DO, Temp, Conductivity Probe	9,000	Hach Hydrolab
Secchi Disk	30	Forestry Supply
Van Dorn	230	Forestry Supply
Flow Meter and Wading Rod	1305	Forestry Supply
Total Lake Monitoring Equipment Costs	$10, 565	

Level Logger Equipment Costs

Number of Loggers	Costs Per Logger
3	1350
Total Level Logger Equipment Costs	$4050

Full Consultant Costs
Rental Equipment Costs

Rental Equipment	Cost of Rental per Day	Cost of Rental per Month	Equipment Quantity	Rental Time Period	Total Rental Equipment Cost
Boat	85		1	18	1530
Hydrolab (Multi-parameter probe	85		1	23	1955
Level Loggers		100	3	12	1200
Secchi Disk and Van Dorn	5		1	18	90
Flow Meter and Wading Rod	65		1	5	325
Total Rental Equipment Costs	$5,100				

Volunteer Monitoring with Consultant Assistance
Training Costs and Consultant Fees

Lake Monitoring Training Cost	Rate	Hours	Totals
Environmental Engineer	100	6	600
Aquatic Scientist	75	6	450
Stormwater Sampling Training Cost			
Environmental Engineer	100	6	600
Aquatic Scientist	75	6	450
Level Logger Training and Install Cost			
Environmental Engineer	100	8	800
Aquatic Scientist	75	8	600
Data Management, Analysis, Reporting			
Environmental Engineer	100	40	4000
Aquatic Scientist	75	80	6000
Senior Limnologist	230	40	9200
Total Cost of Training and Consultant Fees	$22,700		

Personnel	Rate	Lake Monitoring Hours/ Day	Number of Trips	Inlet and Outlet Monitoring Hours/ Day	Number of Trips	Level Logger Installation and Maintenance Hours/ Day	Number of Trips	Data Management, Analysis, Reporting	Cost per Person
Environmental Engineer	100	10	18	12	5	8	2	40	29600
Aquatic Scientist	75	10	18	12	5	8	2	80	25200
Senior Limnologist	230							40	9200
Total Consultant Cost		$64,000							

Volunteer Monitoring with Consultant Assistance
Training Mileage Costs

Miles for 3 Visits	Cost Per Mile
420	.55
Total Mileage Costs	$231

Total Cost with Volunteer Monitoring and Consultant Assistance: $80,251

Total Costs with Full Consultant Fees: $113,653

Full Consultant Mileage Costs

Trip Miles	Number of Trips	Cost per Mile
140	24	.55
Total Mileage Costs	$1,848	

TRAVELERS

00287 -L2

NICHOLSON & ASSOCIATES
118 W PINE ST
CENTRALIA WA 98531

Account Bill

Account No. 3656W0191
Date of This Bill 12/22/14

TOTAL BALANCE
$122.00
MINIMUM DUE
$122.00

CP 01 6640 G6640LKQ 14354 00287 P1

VERNON BONFIELD
PO BOX 7905
OLYMPIA WA 98507

PAYMENT MUST BE RECEIVED BY:
JANUARY 11, 2015

ACCOUNT BILLING SUMMARY

POLICY	TYPE	POLICY PERIOD	MIN. DUE	BALANCE
0106198383 S	Surety	11/13/14	$122.00	$122.00
TOTAL BALANCE			$122.00	$122.00

TRANSACTIONS SINCE LAST STATEMENT

Total Transactions (See Transaction Detail Section)	+122.00
TOTAL BALANCE	$122.00

TRANSACTION DETAIL

POLICY NUMBER 0106198383 S Surety	
11/13/14 Change	122.00
TOTAL TRANSACTIONS	$122.00

CONTINUED ON NEXT PAGE

Please detach the payment coupon and mail with your payment in the enclosed envelope to:
TRAVELERS CL REMITTANCE CENTER, PO BOX 660317, DALLAS, TX 75266-0317.

648842H 2014356 8279 371 0HE772

Payment Coupon

Make checks payable to: TRAVELERS

NICHOLSON & ASSOCIATES
VERNON BONFIELD

3656W0191

Include Account Number on the check.

☐ Change of Address? Place an "X" here. Print changes on reverse side.

PAYMENT MUST BE RECEIVED BY
JANUARY 11, 2015

TOTAL BALANCE
$122.00
MINIMUM DUE
$122.00
AMOUNT ENCLOSED

TRAVELERS CL REMITTANCE CENTER
PO BOX 660317
DALLAS, TX 75266-0317

99333635362330313931403939393994000012200000012200000

OrgSupport
120 State Avenue NE
Olympia, WA 98501

Invoice

Date	Invoice #
2/1/2015	855

Bill To
Black Lake Special District 120 State Avenue NE, #303 Olympia, WA 98501

Description	Qty	Rate	Amount
Contract Services - February	1	2,500.00	2,500.00
Printing B&W	207	0.10	20.70
Printing Color	12	0.25	3.00
Stamps	3	0.49	1.47
Geodata Mailing List Update	1	13.06	13.06
Office Supplies - 1099 Forms	1	1.69	1.69
		Total	$2,539.92