2024

Institute for Watershed Studies Lake Whatcom Project Intern

Joey (Christopher Adam) Lane
Western Washington University

COLLEGE OF THE ENVIRONMENT

WESTERN WASHINGTON UNIVERSITY
MAKE WAVES.

Internship Title: Institute for Watershed Studies Lake Whatcom Project

Organization Worked For: WWU Institute for Watershed Studies

Student Name: Joey Lane

Internship Dates: 10/03/23 3/15/24

Faculty Advisor Name Dr. Rebecca Bunn

Department ESCI

STUDENT SIGNATURE ___  _____

DATE: 03/19/2024

Institute for Watershed Studies

Lake Whatcom Watershed Monitoring

Joey Lane

Contents

Introduction

Over the course of my internship at the WWU Institute for Watershed Studies I worked on the Lake Whatcom project, a long-term water quality monitoring program for the City of Bellingham. We focused on the Lake Whatcom watershed, sampling the lake and tributaries monthly and analyzing water samples to determine seasonal and long-term water chemistry and biological changes. My role as a research assistant included collecting water samples from the lake and tributaries, performing extensive laboratory analysis to generate water quality data, conducting hydrological monitoring, and maintaining lab safety and functionality through weekly chores.

Duties & Responsibilities

Through work at IWS I have since become a proficient and capable field sampler for a variety of water quality parameters. My first weekly task was to collect flow rate measurements for Smith and Austen creeks, major tributaries feeding Lake Whatcom. Our team of two spent every Thursday afternoon waste deep in the creeks, using a hydrological probe (Sontek Flowtracker 2) to track the volume of runoff contributed to Lake Whatcom from Smith and Austen creeks (Fig 1). We also learned to collect data from auto loggers installed at each site that monitor the height of the creeks every 15 minutes. I became very comfortable with my equipment, software, and procedures to consistently collect high-quality stream flow data.

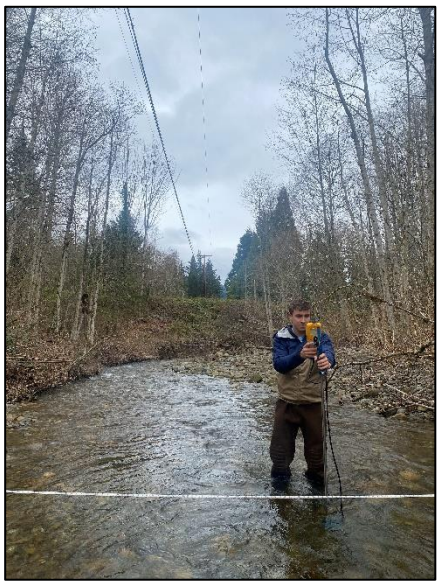

Figure 1: Hydrological monitoring at Smith Creek in fall 2023.

Throughout the rainy season, IWS deploys autosamplers to collect water samples from Olsen, Smith, and Carpenter creeks autonomously which allows the lab to track the water quality of those terms over the course of a storm event. This season we had an exceptional number of high-rainfall events which kept us very busy. It also gave me the opportunity to learn how to program, deploy, and retrieve high-tech pieces of equipment. With the help and mentorship of Carmen Archambault and Tessa Beaver, I learned common issues related to operating in high-flow scenarios. During one storm event in February, heavy rains melted snow from the high reaches of the watershed and drained rapidly down the creeks, nearly flooding some basins. Large pieces of debris rushed down the creeks and snagged both autosampler intake tubes and transducer cables that were operating concurrently to collect stormwater samples (Fig 2). Fortunately, our team was able to act quickly to untangle and reset the samplers, ultimately retrieving enough samples with minimal damage to equipment to produce water quality data for the event. Improvising and acting quickly in these scenarios is a valuable skill I have developed through my internship experience.

Figure 2: Extremely high flows at Olsen (top) and Smith (bottom) Creeks during January generated debris flows that snagged sampling lines and nearly resulted in lost data.

The most exciting times at IWS were lake sample weeks. On a calm, unseasonable warm February morning, the lake team and I packed for a day of lake sampling, triple checking our supplies and carefully labelled containers that would soon contain valuable information about the chemistry of Lake Whatcom, Bellingham's drinking water source. We hitched the boat to the truck and loaded the bed full of coolers, plankton traps, probes, and safety gear. Out on the lake, we travelled to site 22, located in basin two, the shallowest of all three basins in Lake Whatcom.

At each site, we collected water quality samples at depth intervals reaching the bottom, bacteria samples from the bottom and surface, total organic carbon samples from varying depths, and dissolved oxygen samples from random depths as a quality control measure. We took *in situ* measurements of specific conductance, pH, and dissolved oxygen using a YSI data sonde to generate depth profiles for each parameter. The complexity of sampling methods and the rigorousness of quality assurance measures taught me appropriate attention to detail and to

examine each step of the procedure not only for how to perform it, but why. I asked many questions and am now highly informed about the reasons behind the many specific measures we take on board to produce the highest quality data possible. I learned how to operate new sampling equipment such as the Van Dorn Sampler and Schindler Plankton Trap while operating safely in a collaborative marine setting (Fig 3). This field experience was highly enriching to my understanding of sampling procedure, quality assurance, quality control, and how to record and log data professionally.

Figure 3: (Right) Carmen and Ali performing sampling duties at Site 21. (Left) Collection of depth profiles with the YSI data sonde at site 21.

Once the fieldwork was successfully completed, all samples (except bacteria, which belong to the city) were brought back to the lab for analysis. My roles in sample processing and analysis were very diverse. I was given the responsibility to perform independent laboratory analysis of water samples for dissolved oxygen using the Winkler method, alkalinity via titration, chlorophyll-a and phycocyanin (filtering, grinding, and reading) using fluorometry, turbidity, pH, and conductivity. I was also tasked with preparing total organic carbon and nutrient samples for analysis using a Lachat Autoanalyzer (Fig 4). Once I had completed the protocol, I uploaded the new data into the monthly lab data Excel sheet. On top of research, I also helped the team with maintaining lab cleanliness and washing bottles, a lengthy process involving multiple reagents depending on the specific use of each sample bottle.

Figure 4: Processed total phosphorous and nitrogen sample aliquots in the autoclave.

As my personal project for the quarter, I undertook to compile years of microbiological images into a useful identification key for use in the microscope

lab. This key will be useful to those conducting plankton counts after each sampling date, reducing the need for them to sift through months of photos and feedback from our local plankton expert. Instead, the information will be presented concisely and clearly, much like that of a field guide.

Outcomes

As a result of my work at the Institute for Watershed Studies, I have aided in generating months of continuous data informing the City of Bellingham about the water chemistry changes and potential issues of Lake Whatcom. We contributed data to the decades-long monitoring program that will be used in the annual Lake Whatcom Water Quality Report. One finding of interest was the decline in dissolved oxygen concentrations in the hypolimnion of Basin 2, the basin from which Bellingham's drinking water is drawn. Water samples from this region emitted a noticeable rotten-egg-like smell upon processing and the data revealed low dissolved oxygen concentrations. The smell originated from the oxidative phosphorylation by microbes that used sulfur instead of oxygen as an electron acceptor. This event was concerning because it indicated low dissolved oxygen concentrations which contributes to poor conditions for aquatic health, leading eventually to reduced water quality and the presence of unpleasant sulfur dioxide in the water. Thanks to our research the city has identified this trend as a potential concern for drinking water standards in the future.

Continued monitoring of Lake Whatcom tributaries is contributing data to help identify sources of nutrients entering the lake, a current issue causing eutrophication events in summer. Our work is informing which tributaries (and hence which region of the watershed) are contributing to this problem so that action can be taken to reduce the risk to aquatic and human health. One example of such actions is the phosphorous treatment center installed on the north shore of Lake Whatcom near the Silver Beach area to treat phosphorous-rich runoff before it is discharged into the lake. Data from our lab informs such projects.

My work also helped generate data to model the effects of storm systems on Lake Whatcom tributaries. Our stormwater project has collected water quality and flow volume data for three tributaries to identify trends in water quality related to high flows brought on by heavy rainfall events.

Assessment

The Lake Whatcom project is well established but continues to evolve with new students and supervisors. We are always finding ways to improve, like improving training for pipetting or standardizing the bottle-washing procedure. The lab recently achieved state accreditation to analyze for total organic carbon, a new parameter we can add to our growing list of water quality capabilities.

IWS gave students like me an appropriate amount of freedom and trust to perform our duties on our own while maintaining a sturdy foundation of support where we could direct any questions or concerns. Carmen, Angela, and Joan were always available as mentors and pushed us to continue improving our skills through practice. I was exposed to many different techniques

ranging from collecting 75-meter-deep water samples to macerating chlorophyll-a samples. At every step of the way, I took advantage of the knowledge that surrounded me and pushed myself to better understand the work I was doing and learn how to improve in each task. I believe I contributed greatly to the success of our research by using good lab technique, being open to constructive criticism, paying attention to detail, and being willing and excited to learn.

Over the course of the internship, I learned a variety of applicable skills I intend to use in my career outside of academics. I learned how to operate safely and effectively in a professional-style environmental science lab. Skills such as data management, attention to detail, accountability, and teamwork were all enhanced through my internship experience. Some of the most valuable hard skills I have gained are the actual lab procedures for water quality analysis, procedures I am now very familiar with and can add to my environmental field experience. Sampling and fieldwork in general are also highly valued skills in the environmental sector and I intend to use these experiences to attain a professional position after graduation. I gained an understanding about how governmental bodies contract out projects such as drinking water research and how to appropriately behave under such circumstances. I learned how to maintain a chain of custody report, how to communicate professionally and effectively, and the standard at which real-world science is conducted.

Appendix I

Verification of Completion

Joey Lane

From: Carmen Archambault
Sent: Tuesday, March 19, 2024 9:43 AM
To: Joey Lane
Subject: Re: Completion of Internship

Hi Joey,

Thanks for the inquiry. You have indeed met the required 150 hours of work with IWS per your internship agreement.

Many thanks for all your hard work and great attitude.

Best,
Carmen

Carmen Archambault
Research Technologist 3
Institute for Watershed Studies
Western Washington University
516 High Street, Bellingham WA 98225 | MS9069
welchc2@wwu.edu | 360-650-7510 | Message me on Teams

From: Joey Lane <lanej9@wwu.edu>
Sent: Friday, March 15, 2024 8:47 AM
To: Carmen Archambault <welchc2@wwu.edu>
Subject: Completion of Internship

Hi Carmen,

Can you please send me an official email confirming I have met the required 150 hours to complete my internship with IWS? Thanks!

Joey Lane

Appendix II

Acknowledgements

I would like to extend my thanks to Carmen Archambault, Joan Pickens, Angel Strecker, and Emily Flarry for providing me with a highly engaging learning environment and for accepting me into the IWS family. Thank you to my coworkers for always maintaining a positive work culture and for helping me to learn important skills for my career. My experience wouldn't be what it was without support from all of you.

Appendix III

Internship hours summary

	Date	Hours Worked	Task
Fall Quarter	9/28/2023	3.75	Post processing Lake Whatcom water quality samples for TP/TN
	9/29/2023	1	Washing/turning over bottle for acid soaking
	10/2/2023	5.25	Washing bottles, reading alkalinities of Lake Whatcom tributaries samples
	10/4/2023	1	Washing bottles, turnign over acid soaking bottles
	10/5/2023	4.25	Hydrologic monitoring Smith & Austen creek
	10/9/2023	4	Post Processing Lake Whatcom water quality samples : Filter chlorophyll
	10/11/2023	2.5	Lab prep, calibrate benchtop pH meter, turbidometers, conductivity meter
	10/12/2023	3	Hydrologic monitoring Smith & Austen creek
	10/18/2023	3	Lab prep, wash bottles, calibrate benchtop equpment, prep data entry books
	10/23/2023	4	Water sample processing for Nitrate & Ammonium
	10/26/2023	3.5	Hydrologic monitoring Smith & Austen creek
	11/2/2023	4	Hydrologic monitoring Smith & Austen creek
	11/6/2023	3	Lab prep, calibrate benchtop pH meter, turbidometers, conductivity meter, prepare notebooks
	11/9/2023	5	Hydrologic monitoring Smith & Austen creek, wash & acid soak LW water quality bottles
	11/13/2023	2	Grind chlorophyll-a, check autoclave for TP/TN vials
	11/30/2023	3	Hydrological monitoring and data retreival Smith & Austen Creeks
	12/4/2023	4	Compile algae identification photos into ID document
	12/6/2023	3	Prepare lab for lake sampling post processing. Process stormwater samples for TP/TN
	12/7/2023	3	Analyze dissolved oxygen concentration for lake whatcom samples site 31,32
	12/12/2023	3.25	Calibrate bentop equipment. Lake Day Post processing TP/TN, pour alkalinities.
	12/14/2023	7	Hydrological monitoring/data retreival Smith Creek, bottle washing, career prep talk, pack for tribs
	Total Fall	72.5	
Winter Quarter	1/9/2024	3	Wash and acid soak bottles, lab chores
	1/11/2024	7	Collect ISCO samplers, Stormwater TP/TN post processing, LW Algae guide
	1/16/2024	7	Phycocyanin extraction, filtering, and fluorometry, dishes
	1/23/2024	3	Lab chores, testing thermometers for accuracy.
	1/24/2024	3	All hands meeting, LW algae guide
	1/25/2024	5.75	Deploy auto samplers for storm event, flip bottles, algae project
	1/26/2024	2	Algae guide
	1/28/2024	4.25	Stormwater retreival and post-processing
	1/29/2024	4	Stormwater retreival and post processing
	1/30/2024	3	Wiser Lake TP/TN, dishes
	2/1/2024	4.5	Stormwater TSS, Algae project
	2/6/2024	3	Lake post
	2/7/2024	3	Dissolved Oxygen titration, pipette training
	2/8/2024	8	Lake Whatcom Sampling & Post processing, algae project
	2/13/2024	3	Tributaries post processing
	2/14/2024	3	Dissolved Oxygen Analysis, Flip bottles
	2/15/2024	5	Alkalinity block 2
	2/20/2024	3.5	Grind chlorophyll-a, algae ID guide project
	2/22/2024	6.25	Tributaries Alks
	2/27/2024	4	Read chlorophyll-a sites 11,21,22
	2/29/2024	5	Grind phycocyanin samples from Wiser Lake, set stormwater samplers on smith and carpenter creek
	3/5/2024	5.75	Lab prep and bottle washing, post processing for tributaries sampling
	Total Winte	96	