### Thesis Prospectus 2022-23

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**Author’s Note:**

1. Working title of your thesis[[1]](#endnote-1).

*Analyzing the current status of public and private riparian land cover in Washington State*

1. In 250 words or less, summarize the key background information needed to understand your research problem and question.

Riparian buffers are considered one of the most effective means of improving the health of salmon in addition to other ecosystem services including water quality improvement and flood mitigation (Shaw, 2018; Broadmeadow & Nisbet, 2004; WDFW, 2020). Currently, there are no state-wide standardized regulations for riparian management zones (RMZs) in salmon-bearing watersheds. In January 2022, the Lorraine Loomis Act, HB 1838, was proposed in the Washington State Legislature to enhance and protect salmon habitat throughout the state. This act would create a standard for defining RMZs and establishing the infrastructure, funding, and regulatory goals in their restoration and management (Lorraine Loomis Act, 2022). Implementation of voluntary riparian habitat restoration is universally complicated by participation levels of private landowners, especially of agricultural land (Yu & Belcher, 2011). The public hearing for the bill was controversial, with many agricultural landowners and representatives in opposition (WA State Legistature, 2022), pushing the bill to be taken up again during the 2023 legislative session.

If passed, the Lorraine Loomis Act recommends an assessment for all of Washington’s historically salmon-bearing watersheds and mandates the creation of a publicly accessible mapping system for the analysis of RMZs based on Site Potential Tree Height at 200 years (SPTH200), established as the best standard by the Department of Fish and Wildlife (Lorraine Loomis Act, 2022; WDFW, 2020). Comprehensive reviews of research on riparian buffer size reveals complex findings and recommendations (Wenger 1999; Hickey & Doran 2004). Using GIS (Geographic Information Systems) and aerial imagery for mapping and analyzing riparian zones improves upon other methods to measure buffers, estimate land use and land cover (Mason & Maclean 2007; Solomons 2015), and allows for flexible interactivity in exploring possibilities, which could be an important tool for negotiation.

1. State your research question(s).
* ***What percentage of riparian management zones in Washington State, as defined by the Department of Fish and Wildlife’s guidelines, and compared to a less restrictive width of 50’, are in riparian habitat land cover versus other land cover types on both private and public lands?***
* ***How much land in these zones is currently protected from development by federal, state, county, or municipal mandates, as well as conservation zoning or easements?***
* ***How has land cover in the riparian management zones changed temporally?***
1. Situate your research problem within the relevant literature. What is the theoretical and/or practical framework of your research problem?

Determining the size of riparian buffers is a controversial point in creating policy regulations. While numerous studies have shown that larger buffer widths that mimic historic conditions support a wide array of ecosystem services, including filtering pollutants and nutrient run-off for better water quality (Anbumozhi et al., 2005; Mayer et al., 2005), providing snags and wood debris that is necessary for many aquatic species’ habitats, including salmon (McDade et al., 1990), reducing stream temperatures (Davies & Nelson, 1994; Fogel et al., 2022) and providing wildlife habitat, buffer widths are difficult to apply in a generalized sense, as individual riparian sites have many distinct characteristics that impact habitat conditions (Wenger, 1999; WDFW, 2020). However, to apply policy regulations to a site-specific level is not very cost-effective or plausible to meet overall goals (Wenger, 1999; Tiwari et al., 2016). As a result, those who have reviewed the best available science normally recommend a method of guidance or regulation that is adaptable by offering a prescriptive buffer width that can also be site-specific. Site Potential Tree Height (SPTH) is one method that was devised in 1993 by the Forest Ecosystem Management Assessment Team (FEMAT) for managing federal lands in the Northwest, in part to protect endangered species like the 14 species of salmon currently listed in Washington State (WA Governor’s Office, 2020; Reeves et al, 2018). SPTH is used based on the Site Index (SI) or potential height of a native tree in a specific subset bioregion, soil type, and ground slope, at 100 or 200 years of age (FEMAT, 1993). While some criticism of using SPTH lumps it with generalized buffer standards, it is based on historical site-specific forest data, and is the closest measure we might have to mimic old growth forests of the Northwest pre-colonialism.

Washington State’s Department of Fish and Wildlife (WDFW), for its Priority Habitats and Species Program, adopted the FEMAT federal guidelines for SPTH to 200 years in its most recently updated Riparian management guide in the two-volume series, “Riparian Ecosystems” (WDFW, 2020). These policy guidelines however, do not match actual practice in Washington State, other than forested lands protected under the Department of Natural Resources (DNR) by the Forest and Fish Laws of 1999 which integrated SPTH into its regulatory Habitat Conservations Plan in 2005, but to 100 years (DNR, 2005). Other State regulatory laws aim to protect riparian areas, including the Growth Management Act, the Shoreline Management Act, the Department of Ecology’s Water Quality Program, Department of Fish and Wildlife’s Hydraulic Project Approval, and the Shorelands and Environmental Assistance Program (Kassakian & Carr, 2022). However, only occasionally do these include prescriptions of riparian buffers, and most are established on a county level, with no consistent regulation as to width or size. This inconsistency, followed most often on a county rather than watershed level (as recommended by scientific review of riparian science (Lee et al., 2004; Mayer et al., 2005)), as well as the lack of coordination and funding for voluntary or regulated projects, may be a major impediment in making progress for endangered salmon population growth.

While progress has been made with enhanced riparian buffers on federal and forested lands, agricultural and developed lands are mostly regulated at these local or regional levels. Research on landowners’ attitudes and willingness to participate in voluntary riparian management programs highlights longstanding conflicts. Attitudes seem to be largely knowledge and value-based, more so than economic reasoning or awareness of programs that support funding for riparian restoration on private lands (Yu & Belcher, 2011; Liebert et al., 2022). Buffer guidelines are based on science with end goals to protect fish and wildlife (Belcher et al., 1997; WDFW, 2020), water quality and human health, or prevent flooding (Verdonschot & Verdonschot, 2022). In practice, however, the amount of land required is often more than private landowners are willing to take out of agricultural or other use. Many Washington state farmers and their advocates have expressed unwillingness to follow a regulation of SPTH-wide buffers, for this reason. Interestingly, a nationwide research survey of small, medium, and large organic farms, found that farms less than 40 acres were the most likely to participate in riparian buffer restoration (Liebert et al, 2022). This seems to reinforce that lack of participation is based more on values, knowledge, and perceptions than actual impacts on land.

Taking this and recent policy-making attempts for standardizing riparian buffers in Washington State into consideration, this research project aims to provide useful data for assessing impacts on both public and private sectors by measuring land cover and land use within riparian zones in Washington State. By using SPTH-defined zones, we can emulate recent policy goals, but can also look at the impact of using other definitions, such as best practice recommendations for 100-foot buffers to mitigate pollution and agricultural runoff (WDFW, 2020), flooding (Daigneault et al., 2016), or using other significant factors, like connectivity (Fogel et al., 2022). Wildlife habitat has been shown to need even larger buffers, depending on type of species being protected, but is beyond the scope of this project. There have been some claims that agricultural lands in relation to riparian buffers have not been as fully researched for impacts of width, and that some evidence shows positive impacts with buffers as small as 15 meters (Mayer et al., 2005). While this measure could also be included for comparison, most research shows the impacts of smaller buffers are shorter term and only support some end-goals, like filtering some agricultural runoff (Mayer et al., 2005; Wenger, 1999; WDFW 2020).

1. Explain the significance of this research problem. Why is this research important? What are the potential contributions of your work? How might your work advance scholarship?

 Providing the public and policymakers with current and accurate land use and land cover data in riparian management zones, while assessing the progress of re-establishment of riparian buffers, requires measuring the size of riparian buffers and identifying areas that are lacking in relation to the Department of Fish and Wildlife’s recommendation for best practice scientific standard in RMZs. A project using GIS analysis, emulating elements of the policy requirements in the Lorraine Loomis Act, would be timely as a tool for policy makers prioritizing key areas for restoration and/or management, as well as a basis for negotiating with, and providing funding for, private landowners and municipalities who have not yet established riparian buffers meeting the standards.

 As there is still controversy for best management practices related to riparian buffer size in terms of practical application, GIS mapping using high resolution aerial imagery allows for precision and flexibility in measurements and zoning, and a way to synthesize information, like location of conservation easements or differentiating public from private lands in aggregation, with riparian buffers and land use analysis. Adding to this body of application and research helps with growth, accuracy, and sensitivity in a growing field.

1. Summarize your study design[[2]](#endnote-2). If applicable, identify the key variables in your study. What is their relationship to each other? For example, which variables are you considering as independent (explanatory) and dependent (response)?

First, using model threshold percentage goals of riparian buffer, at 100% and 80%, the percentage of land cover would be calculated that already meets riparian standards within multiple prescribed riparian management zone (RMZs) widths along streams and rivers in Washington State. These would be based on the Department of Fish and Wildlife’s riparian management best practice science guidelines for salmon spawning and water quality (WDFW, 2020), which include the buffer width based on Site Potential Tree Height at 200 years (SPTH200), the 100-foot minimum as recommended for a pollution buffer, and for comparison, a smaller 50-foot zone. These widths should include the widths of the streams, channel migration zones (CMZs), and the reach of 100-year floodplains where data is available (WDFW, 2020). Because buffer widths are not generalized, other than the 100-foot minimum, data will be used to create associated polygons for different zones based on SPTH200, Department of Natural Resources stream-type designations, and watershed-level boundary designations. Since other factors like length of buffers and connectivity have had statistical significance for desired outcomes, these may be included as measures for further analysis.

Land cover map imagery layers and datasets will be used and defined using federal and state designations and include specifics in relation to agricultural land use. From this analysis, percentages of distinct types of land cover other than riparian in RMZs will also be collected and shared in the results to support further research and policy planning. The maps and data produced, when coupled with additional state data sets regarding water quality and temperature, salmon populations and pathways, and other prioritization factors, can be analyzed statistically to support identification of particularly vulnerable areas for prioritization. A temporal analyses of land use land cover (LULC) change using these maps and analyses may also be incorporated, since LULC change data and imagery are available from federal and state resources. This may be an especially useful analysis for policy makers seeking to understand the effectiveness of riparian restoration over time.

Second, an analytical comparison between public and private lands would be run for both overall acreage and percentage of riparian buffer in aggregate (to maintain privacy of landowners) and exclude tribal lands unless requested or permission is granted, as is recommended in Washington and tribal policies (WDFW, 2020; Lorraine Loomis Act, 2022). This information will be broken down for the state, but also by watershed and county. As a subset of data in this analysis, publicly available records that show land in RMZs which are **protected from development by federal, state, county, or municipal mandates, as well as conservation zoning or easements, will be incorporated into map layers using polygons. They will be measured as a percentage of total acreage and subset of the overall percentage of riparian land cover in public and private lands.**

*Variables of measurement*

The first key step in the analysis would be to **delineate riparian management zone (RMZs) widths and polygons and determine acreage** **totals** within these zones along streams in Washington State using hydrologic map layers and datasets. Measurements, to remain consistent with current Washington State and federal practice, would be in feet width and acreage using geospatial data marcated and analyzed through the “Buffer” and “Tabulate Area” tools on ArcGIS maps.

**Percentages of different land covers within these buffer zones** would then be determined by creating “Joins” or “Unions” of geospatial layers and their data of land cover available from federal and state sources. These unified datasets would be used to measure the acreage of each land cover type in each RMZ polygon using the “Tabulate Area Tool” in ArcGIS, then dividing by total acreage within the delineated RMZs to get a ratio for each land cover type. Since most natural land cover types are considered riparian habitat, these will also be grouped to **find a total percentage of riparian land cover.** All land cover types as defined in the National Land Cover Database (NLCD) will be used except for open water (due to redundancy), permanent ice/snow (due to non-existence in this region), and dwarf scrub, sedge herbaceous, lichen, and moss (all limited to Alaska as dominant land covers), and additional land cover breakdowns will be used for agricultural lands based on USDA designations, especially through the National Agricultural Imagery Program (NAIP). Further canopy analysis in R or ArcGIS may be possible if time allows for a higher level of accuracy/identification.

The **percentage of riparian land cover within the designated RMZ polygons and buffers at different widths** will be calculated and those numbers will be divided by the total acreage including the other land covers to get a percentage estimating current intact riparian land cover for each water buffer area.

Finally, **percentages of different land covers based on their location on public or private land, as well as conserved land** would be calculated using map layers for public lands and conserved lands overlayed on the land use/land cover and RMZ buffer map layers and determining the amounts of different land covers within the overlap of the public land and RMZ polygons using the “Tabulate Area Tool” in ArcGIS.Tribal lands will not be included by creating polygons that will be entered for exclusion when running analyses tools in ArcGIS Pro. Private landowner data will be extracted by subtracting the public data from the total acreage within the RMZs.

1. Describe the data that will be the foundation of your thesis. Will you use existing data, or gather new data (or both)? Describe the process of acquiring or collecting data[[3]](#endnote-3).

The main method of data collection for this project is by using available “authoritative” ArcGIS mapping layers and publicly available datasets (shapefiles, geodatabases, and data tables for “Joins”), from state and federal agencies. While I will be using data that is already available, the synthesis and calculations will be unique and are not currently available to this extent.

Necessary ArcGIS map layers, geodata, or other data tables needed to make this assessment include:

1. Detailed searchable base layer map with landmarks and geological data
2. County boundaries
3. Watershed boundaries
4. Public lands layers, including federal lands from the USGS, and from the Washington Recreation and Conservation Office (WA RCO, 2019)
5. Native lands layer from USGS
6. Hydrologic layer(s) from Washington DNR and the National Hydrologic Layer from USGS
7. Channel Migration Zone data or maps as available
8. 100-year flood projections map layer from FEMA
9. Data or map layers relevant to current applied programs (rather than recommendations) for buffer widths, and relevant watershed level boundaries or polygons if necessary for some buffer widths
10. SPTH layer and data table from the Department of Fish and Wildlife (WDFW, n.d.)
11. Land Cover from the National Land Cover Database (Multi-Resolution Land Characteristics Consortium (U.S.), 2019) and also the USDA’s National Agricultural Imagery Program (NAIP). They also have a LU/LC change layer that could be relevant for temporal comparisons.
12. (Unless geodata can be found) Aggregated table of conserved lands in Washington State with location data to add as a “join” to a map layer and polygons created from it.
13. Created layers with the new RMZ buffers delineated using the SPTH layer data, a 100’ buffer, 100-year flood buffers, and current or minimum buffers using join data and/or polygons and incorporating data from the hydrologic layers including stream types to be more realistic and less generalized.
14. Created layer that specifically excludes all land cover type delineation besides riparian cover polygons
15. If there is an output product, other layers may be added for ease of use as a tool.
16. Summarize your methods of data analysis. If applicable, discuss any specific techniques, tests, or approaches that you will use to answer your research question.

Calculations will be assessed using ESRI’s “Buffer” and “Tabulate Area” tools in ArcGIS Pro, further calculated into acreage totals and percentages, as well as analyzed, by downloading and using csv and Excel tables. Further statistical testing and analyses may be conducted in R or another relevant analytical environmental program. Analysis will include associated output tables/spreadsheets of percentage areas by land cover type in the four defined buffer areas, by public versus private land, and currently conserved lands. Due to the theoretical “full population” nature of this study, complex statistical analyses are less helpful, and we can test the hypotheses with actual numbers. Any standard error data related to mapping layers will be mentioned in the results, and may be especially relevant considering the current level of accuracy in stream mapping.

1. Address the ethical issues[[4]](#endnote-4) raised by your thesis work. Include issues such as risks to anyone involved in the research, as well as specific people or groups that might benefit from or be harmed by your thesis work, perhaps depending on your results. List any specific reviews you must complete first (e.g., Human Subjects Review or Animal Use Protocol Form).

It is not necessary for me to complete any specific reviews. However, this thesis work is grounded in subject matter that is controversial, as well as being emotional for a variety of stakeholders. It is also directly and indirectly related to treaty rights for federally recognized tribes in Washington State. While scientific research and best practices are embedded in policy related to riparian management in Washington State, it cannot be denied that the socio-economic climate impacts policy applications.

My goal is to present research, data, and analysis that may aid parties in practical application for policy enactments. However, data can be interpreted differently based on the biases and goals of the user. There is a possibility that the data or analysis I present may support certain stakeholders in ways that would counteract others’ goals.

Bias and the oppressive history of scientific research is important to recognize with any topic directly impacting indigenous people. One way I aim to mitigate some bias is to consult with researchers experienced in Community Based Research methods. Washington State tribes have been leaders regarding riparian management policy and ArcGIS mapping analyses, and my thesis was inspired by these projects. I may be limited from completing a fully participatory community-based project but would like to reduce harm or bias as much as I am able.

1. List specific research permits[[5]](#endnote-5) or permissions you need to obtain before you begin collecting data (e.g. landowner permissions, agency permits).

Currently, I am unaware of any special permissions I need. I am using publicly accessible map layers and data and am aggregating private and public land so individual landowners are not highlighted. I will not include tribal land data without prior permission (at this time I intend not to include this data). If usage issues of data or map layers arise, I will do my due diligence to obtain permission or find a similar alternative that is available to the public.

1. Reflect on how your positionality as a researcher could affect your results and how you will account for this in the research process[[6]](#endnote-6).

Implicit bias makes it difficult for me to represent the main stakeholders I perceive as participating in making, and most effected by, policy regarding riparian management: tribes, agricultural landowners (especially those using conventional farming practices), policymakers, and nonprofit conservation groups. I am of European descent, grew up outside of Washington, and have never owned my own land. I have almost exclusively studied and practiced agriculture with small to medium scale sustainable or organic farming methods, while working in the related collaborative food system. I have never participated directly in riparian restoration or conservation efforts and have little related on-the-ground experience. Finally, I have never participated in government level policy making.

In addition to seeking ways to mitigate harm towards Washington’s tribes, as mentioned in response to Question 9, many farmers have perceived themselves as being potentially harmed economically by enactment of riparian management regulations, with the possibility of impacting the wider food system in Washington State and nationally. Priorities and livelihoods of individuals or communities may also conflict with priorities for protecting habitat and species, regardless of larger ecosystem benefits. As such, any overall analysis may be weighed towards one priority or another. A way to mitigate bias in this matter is to try to present the research results from different priority perspectives.

1. Provide at least a rough estimate of the costs associated with conducting your research, if any.  Provide details about each budget item so that the breakdown of the final cost is clear.

In order to manage this project from home using ArcGIS Pro, it was necessary for me to buy a laptop with high quality processing capabilities. This cost about $2050. The laptop has been used since purchase for schoolwork related to the MES program about 98% of the time.

If I have the opportunity, I may consider attending a short-term class, workshops, or conferences related to the subject matter. It has come to my attention that I need to learn Arcade, Python, and/or SQL languages to succeed with ArcGIS Pro. While some courses and workshops are free, based on previous experiences, this may be in the range of $50-500 depending on the context and whether travel is involved. Because of time constraints, it is unlikely I would participate in more than a couple of educational experiences.

Lastly, if time allows, I would be interested in riparian site visits, for both better understanding of my subject matter, and for documentation/final presentation purposes. [While on-the-ground truthing is ideal in many GIS research projects, that is beyond the scope of these visits.] This might require transportation costs and access fees (e.g. park fees). I believe this would cost $100 or less.

In total, without including lost time at work (I will need to reduce my hours drastically during the thesis process, which can be a loss of $100-200/wk), the costs are roughly $2500.

1. Provide a detailed working outline of your thesis.

Working Outline for Thesis

2022-23

**Cover page** – Title and Author – includes “A thesis Submitted in partial fulfillment of the requirements for the degree Master of Environmental Studies The Evergreen State College June 2020” in a block at bottom

**copywrite page**

**Thesis approval page**

**Abstract:** [below is something I wrote for RDQM, revised, just as a place holder – this will change substantially]

ABSTRACT: This project will use ArcGIS map layers and analysis tools to delineate riparian management zones (RMZs) along Washington State watersheds’ rivers and streams, including the use of “best science” recommendations by the Washington Department of Fish and Wildlife (WDFW). This includes buffers based on Site Potential Tree Height to 200 years (SPTH200) and 100’ minimum pollution buffers, using channel migration zones (CMZs) and 100-year floodplains, when able, as the basis for channel width. Mapping layers will also be used to determine acreage within these zones of different land covers, and then calculate percentages of the total land area within the zones. This information will then be further subdivided by public versus private land for analysis.

**Table of Contents [Example provided, as basis for outline]:**

**TABLE OF CONTENTS**

Abstract…………………………………………………………………………………...iv

List of Figures……………………………………………………………………………vii

List of Tables……………………………………………………………………………viii

Acknowledgements……………………………………………………………………….ix

SECTION I………………………………………………………………………………..1

CHAPTER 1: INTRODUCTION…………………………………………………………1

 Positionality……………………...………………………………………………..1

Riparian management: the science………………………………………………..2

 Riparian management: the policy…………………………………………………6

CHAPTER 2: LITERATURE REVIEW….……………………………………………..10

Introduction………………………………………………………………………………10

 Riparian buffers: impacts and ecosystem services………………….……….…...11

 Riparian management zones: size, vegetation, connectivity………….….……...15

 Federal riparian management……...………………………………………..........21

 Riparian land in conservation……...…...…………………………………...…...24

The Endangered Species Act, treaty rights, and salmon protection...…………...25

 Washington State riparian management policy and practice………………….....28

 Agriculture: economic impacts, voluntary versus regulated participation……....32

 Development and land use changes in the riparian zone…....…………...………36

 GIS methodologies in riparian science and management……………………......40

 Washington State riparian-related GIS research…………………….…………...41

Conclusion……………………………………………………………………………….43

SECTION II……………………………………………………………………………...47

CHAPTER 3: RESEARCH MANUSCRIPT

Abstract...………………………………………………………………………………...47

Introduction………………………………………………………………………………48

Methods...………………………………………………………………………………...50

Mapping standards and parameters…………………………..……...…………...51

Buffer Widths, CMZs, Flood Zones and ArcGIS Buffer Tool……...…………...51

Map and data Joins: SPTH200 and pollution zone, dryland riparian, stream type, salmon-bearing streams, 50-foot comparison……..…………………......……....52

 Land Cover/Land Use definitions and polygon layers….……..………………...54

 Watershed level mapping………………………………………………………...56

 Private, public, and conserved land aggregation…………………………..….....58

 Tabulate Area analyses…………..………………………….…………………...59

 Temporal LU/LC analyses…………..…………………………………………...59

 R analyses………………………..………………………….…………………...60

Results...……..…………………………………………………………………………..61 Variability in Buffer Widths throughout state…………………………………...62

 Riparian totals by Watershed………..…………………………………………...63

 Private Lands……………………………………………..……………………...70

 Public Lands……………………………………………………………………...74

 Conserved Lands……….………………………………………………………...78

 Other land use/land cover by Watershed………..…..…………………………...80

 Temporal LU/LC changes in 3 sample watersheds……………………………...85

 Testing of Hypothesis and R Analyses Results……..…………………………...89

 Salmon and stream temperature data comparison to totals………….…………...92

Discussion...……………………………………………………………………………...94 How are we doing and how have things changed?…….………………………...95

 Private versus public……...…………………………………………….………..96

 Agroecology?…………………..………………………………………………...97

 ????????????…………………..…………………………………….…………...98

Conclusion...……………………...……………………………………………………...99

CHAPTER 4: APPENDICES

Maps …………………………………….……………………………………..……...101

ArcGIS Analysis Tools Results……………………………………....…………….…..135

ArcGIS Workflow, parameters, standards and metadata……………………………….140

Source list of map layers and datasets……..…………………………………..…….…142

Literature Cited………………………..……………………………………………..…143

1. Provide a specific work plan and a timeline for each of the major tasks in the work plan. Be as realistic and specific as you can at this point, including the deadlines for Spring quarter.

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| --- | --- | --- |
| **Riparian Buffers WA State GIS** |  |  |
| TESC MES Thesis |  |  |  |  |
| Danielle Lazarus, Thesis Reader John Withey | Project Start: | Mon, 12/5/2022 |  |
|  | Display Week: | 1 |  |  |
|   |   |   |   |  |
| **TASK** | **PROGRESS** | **START** | **END** |  |
| **Phase 1 FALL - Lit Review, Prospectus, Poster Presentation** |   |   |   |  |
| Literature Review Draft - OVERDUE | 60% | 11/1/22 | 12/8/22 |  |
| Register for Winter Classes Monday 12/5 9am | 0% | 12/5/22 | 12/5/22 |  |
| Make or pickup food for potluck on Tuesday | 0% | 12/6/22 | 12/6/22 |  |
| Prepare for Poster Presentation - Present Tuesday 6-7pm | 75% | 11/28/22 | 12/6/22 |  |
| Make plans for meeting with John Withey specifically related to thesis (versus class) | 0% | 12/6/22 | 12/18/22 |  |
| Final Prospectus - Due 12/9 | 0% | 11/20/22 | 12/8/22 |  |
| Final Self and Faculty Evaluations for CSDM and and ArcGIS courses  | 0% | 12/4/22 | 12/9/22 |  |
| Look into related Funding opportunities/Conferences/Classes/Jobs - and Apply | 0% | 12/10/22 | 1/14/23 |  |
|  |  |  |  |  |
| **Data Collection** |   |   |   |  |
| Contact any agencies/individuals that may help focus my tasks | 0% | 11/28/22 | 12/18/22 |  |
| Find and do an online course in at least one programming language related to ArcGIS - ideally one I can get a certificate for | 0% | 12/9/22 | 1/14/23 |  |
| Create a workflow/plan using related ArcGIS/ESRI/Washington State templates (find first - have some from Mike already) | 0% | 1/9/22 | 1/14/23 |  |
| Make sure have all data, layers, and perameters needed to start my first set of watershed calculations | 50% | 11/30/22 | 1/14/23 |  |
| Prepare map layers and data beforehand - check permissions, create maps where needed, aggregate/organize map layers and data | 30% | 11/1/22 | 1/14/23 |  |
| Create joins or relates for SPTH and other data polygons (eg. LU/LC, stream types, non-forested riparian areas, width of stream and CMZs, flood zones) | 0% | 12/9/22 | 1/14/23 |  |
| Determine basemap and Coordination projection - do I need to use Washington-based standard, and do I have access? | 10% | 12/9/22 | 1/14/23 |  |
| Watershed Scale Sample of buffer, LULC, and tabulate area analysis & talk to Mike | 50% | 12/9/22 | 1/16/23 |  |
| After completing first watershed accurately, assess time for completion for all. There are 72 watersheds in WA. I'm estimating 1-2hours once I have the basic data joins set up. | 0% | 12/13/23 | 1/16/23 |  |
| Buffer and Tabulate areas based on main criteria for 72 watersheds. May want to incorporate LiDar data for an additional analysis of land cover/help define more accurately. Forest Tools or Canopy analysis in ArcGIS Pro? R? | 0% | 1/16/22 | 3/7/23 |  |
| Necessary or possible to run an ArcGIS or R Canopy analysis on NAIP imagery? Is there other imagery data I might obtain? | 0% | 1/16/23 | 3/7/23 |  |
| download results into Excel tables and analyze | 0% | 2/1/23 | 3/7/23 |  |
| Temporal analyses of LU/LC if time - could choose a few sample watersheds or high-priority (salmon or water quality) | 0% | 2/15/23 | 3/7/23 |  |
| As above, incorporate comparison data for salmon runs and stream temperatures | 0% | 2/1/23 | 3/7/23 |  |
| Run R analyses as relevant and confirm standard error data related to streamlines, land cover and other mapping data | 0% | 1/15/23 | 3/7/23 |  |
| Document/Capture watershed maps and analysis steps with screenshots and static maps. | 0% | 12/9/22 | 3/7/23 |  |
| Organize maps, analyses, and results so easier to do write-up and create tables and figures | 0% | 12/9/22 | 3/24/23 |  |
| Create final maps for Story Maps | 0% | 3/17/23 | 5/15/23 |  |
| Loose Ends/something I'm missing? | 0% | 12/5/22 | 5/1/23 |  |
| **Winter Term Class/Draft Writing/Peer Review/GIS Labs** |   |   |   |  |
| Edit a second draft of Lit Review |   | 3/8/23 | 2/1/23 |  |
| Write Introduction and Positionality for Thesis |   | 3/25/23 | 2/1/23 |  |
| Weekly and Biweekly Classes/GIS Labs Monday (1/16 and 2/20 are Holidays) and Tuesday Eves. Term runs through March 24. |   | 1/9/23 | 3/24/23 |  |
| Write Methods section of paper after determine a workflow that works/successfully perform a sample analysis. Maintain organization of data and results and maps to incorporate into final paper |   | 2/1/23 | 2/15/23 |  |
| Gather my data and maps (pre-organized!) to create tables and figures. |   | 3/7/23 | 3/21/23 |  |
| Write Results and Discussion sections when complete analyses |   | 3/7/23 | 3/21/23 |  |
| Create Appendixes, etc. |   | 3/14/23 | 4/1/23 |  |
| Try to have a complete draft ready by end of Spring Break |   | 3/21/23 | 4/1/23 |  |
| Plan site visits for Spring in case want to capture any images, etcetera for Story Map |   | 1/15/23 | 3/24/23 |  |
| Complete any Peer reviews as come up |   | 1/9/23 | 3/24/23 |  |
| Class Evals |   | 3/12/23 | 3/17/23 |  |
| **Spring Term Final Drafts/Story Map and other Presentation Products/Presentation Prep/Final Steps/Graduation 4/3-6/16** |   |   |   |  |
| First Draft due |   | 3/24/23 | 4/14/23 |  |
| Site Visits/Possible conference or educational experience? [Take photos, etcetera. Drone imagery?!?] |   | 3/24/23 | 5/10/23 |  |
| Revise and share a 2nd draft |   | 4/3/23 | 5/1/23 |  |
| Submit "Request to Present" or "Request to Extend" Form, signed by thesis reader, sent to MES Director |   | 4/3/23 | 5/4/23 |  |
| Apply to jobs :) | 0% | 3/17/23 | forever |  |
| Create a Final Story Map and perhaps printable maps and/or web apps maps. Any additional need for a power point? |   | 3/24/23 | 5/15/23 |  |
| create/write/Practice presentation |   | 5/15/23 | 6/2/23 |  |
| Thesis Presentations Week 8-9 |   | 5/22/23 | 6/2/23 |  |
| Final draft of Thesis Due |   | 5/14/23 | 6/2/23 |  |
| Final signed version of Thesis Due - using Thesis Handbook for formatting, etc. |   | 6/3/23 | 6/9/23 |  |
| Final evals |   | 6/3/23 | 6/9/23 |  |
| Graduate |   | 6/16/22 | 6/16/22 |  |

1. Who (if anyone), beyond your MES thesis reader, will support your thesis (in or outside of Evergreen)? Be specific about who they are and in what capacity they will support your thesis. If you are working with an outside agency or expert, be specific about their expectations for your data analysis or publication of results.

 I will be taking the “Special Topics in GIS” course in the Winter 2023 term, and intend to use that time and Mike Ruth’s expertise to support my thesis work. I believe it will be pivotal in ensuring my methodology is consistent and professional.

 I am also hoping to setup a meeting time with Zoltan Grossman, as his work and research interests intersect with my thesis in 3 ways: riparian management and restoration, geography/GIS and map creation, and collaboration of non-indigenous researchers with tribes.

 Finally, depending on the results of a conversation with Zoltan, and whether I need additional data sets, I may need to reach out to state, tribal, or federal entities. At this time, however, I don’t believe the nature of my research will require intensive communication outside of Evergreen.

1. Provide the 5 most important references you have used to identify the specific questions and context of your topic, help with issues of research design and analysis, and/or provide a basis for interpretation. Annotate these references with notes on how they relate to/will be helpful for your thesis. For any other sources cited in your prospectus in other answers, provide a complete bibliographic citation here as well.

Forest Ecosystem Management Assessment Team. “Forest Ecosystem Management: An Ecological, Economic, and Social Assessment.” Portland, OR: U.S. Department of Agriculture, U.S. Department of the Interior, and the Environmental Protection Agency, July 1993.

 This document was the first to describe and recommend the use of Site Potential Tree Height (SPTH) as the main measurement for delineating riparian buffer zones. It has been used by many conservation plans since and is still highly respected and utilized by government and nonprofit planners as a “best practice” (WDFW 2020). The importance of SPTH is based on “FEMAT curves” which are four key elements in the assessment of riparian ecosystem health: strength of roots, shading of streams/creeks/rivers, litter fall, and coarse wood debris. Site Potential Tree Height essentially means the potential height a native tree will grow in a specific site (including factors like soil and drainage, etc.) by the time it is 200 years old, which is why it is written as SPTH200.

Greenberg, J., & Carson, S. Mapping Riparian Land Use within Agricultural Zones: A Case in Skagit County. *Skagit County Board of Commissioners*, 2010.

I wanted to include this document, as it was an early analysis directly related to both my project and the controversy of perspectives in Skagit County, who’s community voiced some of the most opposition to the Lorraine Loomis Act during the public hearings. I found this document after having determined my own research question, yet it is very similar, and adds the caveat of considering lands already in conservation, which inspired me to want to do the same 14 years later. The GIS Department of Skagit County used aerial imagery to analyze how much land in agricultural and rural zoning was already in riparian habitat, how much already had conservation protections, and how much of current unprotected riparian habitat would qualify for protection? The most interesting conclusion was that using high-resolution images for the analysis presented up to 289 times more accuracy than previous estimates using other methodologies. Because technology has improved since the time of this study, it may not have the most up to date methods for my own research, but it has examples of their land use classifications, and is broken out in a way that can help guide my own research design.

Lorraine Loomis Act, State of Washington, HB1838, Washington State House of Representatives, 67th Legislature, Regular Session (2022).

This Bill was introduced in January 2022, just a few days after major flooding events took place throughout Western Washington. It revolves around regulations for restoration of riparian zones mandatory to improve salmon habitat using the best science available about size of buffer zones and types of plantings. The bill refers to the WDFW two volume series, “Riparian Ecosystems”, and recommends the use of the management practices outlined in the volumes to determine the width of the zones, especially SPTH. The bill was controversial because of perceptions of how it would impact agricultural fields and private landowners. It specifically tasks Washington State with creating GIS mapping similar to what I would attempt in this project, but on a smaller scale.

Washington Department of Fish and Wildlife (WDFW). “Riparian Ecosystems, Volume 2: Management Recommendations.” Priority Habitats and Species Document of the Washington Department of Fish and Wildlife. Olympia: Habitat Program, Washington Department of Fish and Wildlife, December 2020.

Background for recommendations and scientific measurements related to restoration of riparian zones in the State of Washington for salmon habitat restoration, water quality, and other ecosystem services. It references several online mapping tools, and outlines the main method of determining RMZ width, which can best be summarized as using SPTH200 while respecting the regulatory need to maintain a minimum of a 100ft buffer for a pollution zone. SPTH200 can vary depending on the site, but most old growth forest stands in Western Washington have trees in the range of 100-240ft (Fox 2003). Wetland regulations also need to be taken into consideration. This is a key resource for the framework and methodology in designing an ArcGIS layered map for this research project.

Snohomish Conservation District. “Action Plan for Riparian Protection and Restoration for the Stillaguamish Confluence, French Creek, and Lower/Middle Pilchuck River.” Washington State: Integrated Riparian Stewardship in the Stillquamish and Snohomish Basins, October 24, 2017.

Appendix C of this Plan contains the Methodology used as a partial model for elements of the methods and goals of my project, using layers and shapefiles in ArcGIS to determine how much riparian land cover already exists inside of desired buffer zones. They used a "100ft" buffer layer around waterways through ArcGIs. I will look to emulate several of their methods, but using map layers that already exist, and improving the 100ft buffer by using it as a minimum, but exceeding it where the SPTH200 is wider, as recommended by WDFW. They calculated “percentage” land cover in the buffer zones that were “appropriate” riparian habitat. While this will be hard to define, I am hoping that the aid of land cover map layers will help appropriately determine percentages. A key factor will be determining how I can draw out percentages land cover in my research design.

Wenger, S. *A review of the scientific literature on riparian buffer width, extent and vegetation*. Institute of Ecology, University of Georgia, 1999.

This is a widely cited review, which analyzed the scientific research up to that time studying the impacts of buffer size and plant types. Considering this level of citation, it is important to consider how this document has been used to justify buffer recommendations since. One thing to note is that the results of the studies analyzed showed that over the long-term wider buffers were more effective, and that up to 300 feet may be the most effective for wildlife, however, buffers as little as 15 feet wide can have some impact. Slope, in addition to wetlands, seem to be important in relation to buffer width. As mentioned in other papers, research leans towards a complexity that would require looking at each site-specific environment independently, and this is almost impossible to apply on a policy level. As such, the conclusions by the author for recommendations for Georgia are more conservative and homogenized for broad application. Coupled with a more recent review, this resource can give me more pointed resources for my own background literature review.

**Bibliography**

Anbumozhi, V., Radhakrishnan, J., & Yamaji, E. (2005). Impact of riparian buffer zones on water quality and associated management considerations. *Ecological Engineering*, *24*(5), 517–523.

Belcher, J., Billings, J., Thorud, D., Duncan, D., Nichols, B., & Zuiches, J. (1997). *Department of Natural Resources Final Habitat Conservation Plan*. Washington Department of Natural Resources.

*BLM National Public Land Survey System Polygons—National Geospatial Data Asset (NGDA)*. (n.d.). [Map]. Retrieved November 8, 2022, from <https://gbp-blm-egis.hub.arcgis.com/datasets/blm-national-public-land-survey-system-polygons-national-geospatial-data-asset-ngda/about>

Broadmeadow, S., & Nisbet, T. R. (2004). The effects of riparian forest management on the freshwater environment: A literature review of best management practice. *Hydrology and Earth System Sciences*, *8*(3), 286–305.

Chapman, M., Satterfield, T., & Chan, K. M. A. (2020). How value conflicts infected the science of riparian restoration for endangered salmon habitat in America’s Pacific Northwest: Lessons for the application of conservation science to policy. *Biological Conservation*, *244*, 108508.

Daigneault, A., Brown, P., & Gawith, D. (2016). Dredging versus hedging: Comparing hard infrastructure to ecosystem-based adaptation to flooding. *Ecological Economics*, *122*, 25–35.

Davies, P., & Nelson, M. (1994). Relationships between riparian buffer widths and the effects of logging on stream habitat, invertebrate community composition and fish abundance. *Marine and Freshwater Research*, *45*(7), 1289.

DNR. (2005). *Forest Practices Habitat Conservation Plan | WA - DNR*. Washington Department of Natural Resources.

FEMA. (n.d.). *FEMA Flood Map Service Center* [Webmap Using: ArcGIS by esri]. Federal Emergency Management Agency. Retrieved April 26, 2022, from <https://msc.fema.gov/portal/search#searchresultsanchor>

FEMAT. (1993). *Forest Ecosystem Management: An Ecological, Economic, and Social Assessment*. U.S. Department of Agriculture, U.S. Department of the Interior, and the Environmental Protection Agency.

Fogel, C. B., Nicol, C. L., Jorgensen, J. C., Beechie, T. J., Timpane-Padgham, B., Kiffney, P., Seixas, G., & Winkowski, J. (2022). How riparian and floodplain restoration modify the effects of increasing temperature on adult salmon spawner abundance in the Chehalis River, WA. *PLOS ONE*, *17*(6), e0268813.

Graziano, M. P., Deguire, A. K., & Surasinghe, T. D. (2022). Riparian Buffers as a Critical Landscape Feature: Insights for Riverscape Conservation and Policy Renovations. *Diversity*, *14*(3), Article 3.

Hickey, M. B. C., & Doran, B. (2004). A Review of the Efficiency of Buffer Strips for the Maintenance and Enhancement of Riparian Ecosystems. *Water Quality Research Journal*, *39*(3), 311–317.

Kassakian, J., & Carr, A. M. (2022). *Evaluation of Riparian-Related Programs in Washington State: Summary of Preliminary Findings*. Plauche & Carr LLP.

Lee, P., Smyth, C., & Boutin, S. (2004). Quantitative review of riparian buffer width guidelines from Canada and the United States. *Journal of Environmental Management*, *70*(2), 165–180.

House Bill 1838, State of Washington, HB1838, Washington State House of Representatives, 67th Legislature, Regular Session (2022).

Liebert, J., Benner, R., Bezner Kerr, R., Björkman, T., De Master, K. T., Gennet, S., Gómez, M. I., Hart, A. K., Kremen, C., Power, A. G., & Ryan, M. R. (2022). Farm size affects the use of agroecological practices on organic farms in the United States. *Nature Plants*, *8*(8), 897–905.

Mason, L., & Maclean, A. L. (2007). *GIS modeling of riparian zones utilizing digital elevation models and flood height data: An intellegent approach.* ASPRS 2007 Annual Conference, Tampa, Florida.

Mayer, P. M., Reynolds, S. K., & Canfield, T. J. (2005). *Riparian buffer width, vegetative cover, and nitrogen removal effectiveness: A review of current science and regulations* (EPA/600/R-05/118). US Environmental Protection Agency.

McDade, M. H., Swanson, F. J., McKee, W. A., Franklin, J. F., & Sickle, J. V. (1990). Source distances for coarse woody debris entering small streams in western Oregon and Washington. *Canadian Journal of Forest Research*, *20*(3), 326–330.

Multi-Resolution Land Characteristics Consortium (U.S.), & Esri. (2019). *USA NLCD Land Cover* [Webmap Using: ArcGIS by esri]. Multi-Resolution Land Characteristics Consortium.

Reeves, G., Olson, D. (“Dede”) H., Wondzell, S., Bisson, P., Gordon, S., Long, J. W., & Furniss, M. (2018). Chapter 7: The aquatic conservation strategy of the northwest forest plan—A review of the relevant science after 23 years. *In: Spies, T.A.; Stine, P.A.; Gravenmier, R.; Long, J.W.; Reilly, M.J., Tech. Coords. 2018. Synthesis of Science to Inform Land Management within the Northwest Forest Plan Area. Gen. Tech. Rep. PNW-GTR-966. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 461-624.*, *966*, 461–624.

Shaw, J. L. (2018). *The Effectiveness of Forested and Hedgerow Riparian Buffers for Buffering Water Temperature and Improving Fish Habitat in Agricultural Waterways in Western Washington* [Master’s Thesis, Western Washington University].

Solomons, A. (2015). *Field Validation of LiDAR-based Predictions of Riparian Buffer Zones* [All Theses]. Graduate School of Clemson University.

*SPTH/SitePotentialTreeHeightPublic (MapServer)*. (n.d.). [Map]. Retrieved October 14, 2022, from <https://gispublic.dfw.wa.gov/arcgis/rest/services/SPTH/SitePotentialTreeHeightPublic/MapServer>

SSHIAP. (n.d.). *Northwest Indian Fisheries Commission*. Retrieved November 1, 2022, from <https://nwifc.org/about-us/habitat/sshiap/>

Tiwari, T., Lundström, J., Kuglerová, L., Laudon, H., Öhman, K., & Ågren, A. M. (2016). Cost of riparian buffer zones: A comparison of hydrologically adapted site-specific riparian buffers with traditional fixed widths. *Water Resources Research*, *52*(2), 1056–1069.

Verdonschot, P. F. M., & Verdonschot, R. C. M. (2022). The role of stream restoration in enhancing ecosystem services. *Hydrobiologia*.

WA Governor’s Office. (2020). *State of Salmon in Watersheds Executive Summary 2020* (State of the Salmon Report). Governor’s Salmon Recovery Office, Recreation and Conservation Office. [stateofsalmon.wa.gov](https://doi.org/stateofsalmon.wa.gov)

WA State Legistature. (2022, January 19). *Public Hearing of the House Rural Development, Agriculture & Natural Resources Committee—TVW: HB 1893—Protecting, restoring, and maintaining habitat for salmon recovery.* [Government]. <https://tvw.org/video/house-rural-development-agriculture-natural-resources-committee-2022011365/>

Washington Recreation and Conservation Office. (2019). *Public Lands Inventory Polygon Layer* [ArcGIS]. Recreation and Conservation Office. <https://geoduck.maps.arcgis.com/home/item.html?id=d296b58b0eae485fba2c55ab90e5908d>

WDFW. (n.d.). *High Resolution Change Detection* [Webmap Using: ArcGIS by esri]. Washington State Department of Fish and Wildlife. Retrieved April 26, 2022, from [https://geo.wa.gov/datasets/wdfw::high-resolution-change-detection-1/explore](https://geo.wa.gov/datasets/wdfw%3A%3Ahigh-resolution-change-detection-1/explore)

WDFW. (2020a). *RIparian Ecosystems, Volume 1: Science Synthesis and Management Implications*. Habitat Program, Washington Department of Fish and Wildlife.

WDFW. (2020b). *Riparian Ecosystems, Volume 2: Management Recommendations* (Priority Habitats and Species Document of the Washington Department of Fish and Wildlife). Habitat Program, Washington Department of Fish and Wildlife.

Wenger, S. (1999). *A REVIEW OF THE SCIENTIFIC LITERATURE ON RIPARIAN BUFFER WIDTH, EXTENT AND VEGETATION* (p. 59) [Scientific Review]. Institute of Ecology, University of Georgia.

Yu, J., & Belcher, K. (2011). An Economic Analysis of Landowners’ Willingness to Adopt Wetland and Riparian Conservation Management. *Canadian Journal of Agricultural Economics/Revue Canadienne d’agroeconomie*, *59*(2), 207–222.

1. You are not locked into this title; we want you to identify the main point or topic of your thesis. [↑](#endnote-ref-1)
2. You might discuss selection of case studies, sampling methods, experimental design, and/or specific hypotheses you will test. You should also address any specialized knowledge or skills that are necessary to complete the research. [↑](#endnote-ref-2)
3. If you are planning to use existing data, explain the specific source, contact information, arrangement with collaborating agencies, and expectations about use of data and final products of your research. If you are planning to gather new data, describe specific methods, time, place, and equipment that will be required. [↑](#endnote-ref-3)
4. If you’re not sure where to start, consult a ‘Code of Ethics’ or other similar document from an academic society in an applicable field of study. [↑](#endnote-ref-4)
5. If you are collecting ANY samples or data, even observational data, on public lands (city, county, state and/or federal) it is your responsibility to find out the permit requirements BEFORE you collect data. Conducting research with tribal members/on tribal lands will have different and additional requirements. [↑](#endnote-ref-5)
6. Your *positionality as a researcher* refers to the fact that one’s “…beliefs, values systems, and moral stances are as fundamentally present and inseparable from the research process as [one]’s physical, virtual, or metaphorical presence when facilitating, participating and/or leading the research project…” (The Weingarten Blog 2017). [↑](#endnote-ref-6)