DEPARTMENT OF
NATURAL RESOURCES

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MEMORANDUM

DATE: October 20, 2025

TO: Forest Practices Board

FROM: Maggie Franquemont, Forest Practices Policy Program Manager MWF

SUBJECT: Western Washington Type Np Buffer Rulemaking

At your November 12, 2025 meeting, I will share the the results of the public review process and request the Board to consider the decision to adopt the western Washington Type Np buffer rule with a delayed effectiveness date of August 31, 2026. The delayed effectiveness date is selected to coincide with seasonal low flows and will allow staff to update the relevant forms and guidance; develop training materials; train agency staff, TFW partners, and other interested parties; and avoid confusion with implementation of the new water typing rule.

At your November meeting, staff will present the proposed rule, the Concise Explanatory Statement (CES) and a summaries of the Cost Benefit Analysis (CBA), and the Small Business Economic Impact Statement (SBEIS) – attached to this memo.

In June 2025, the Board approved initiation of the public review process for the western Washington Type Np buffer rule. Staff filed the CR 102 Notice of Proposed Rulemaking which was published in the state register on June 27, 2025. The Board held four public meetings across western Washinton (Longview, Sedro-Woolley, Port Angeles, and Olympia) to receive public comment. All Board members had the opportunity to attend and receive public comments.

The CES outlines the history of rule development and summarizes the comments received along with responses. There were no changes to the rule language as a result of the public comments received. Additionally, there were no changes to the CBA or SBEIS from the preliminary versions the Board received in May 2025. The Board did not receive any timely comments on the SEPA determination of non-significance.

In addition to the documents listed above, the following items are for the Board's review and consideration:

1. Long-term Forest Practices Applications (LTAs)

   LTAs are an option for small forest landowners and provide flexibility regarding when they conduct forest practices by allowing them to have an active forest practices application that is valid from 4 to 15 years. Under WAC 222-20-016(4)(b), when the Board considers new or amended rules to achieve resource protection objectives, staff must analyze the effects of existing approved LTAs on the public resources the amended rule intends to protect. The intent of the western Washington Type Np buffer rule is to protect water quality so that is the resource our review focused on.

   As of October 21,2025, our records show 17 approved LTAs in western Washington that contain Type Np streams and an additional 32 approved LTA in western Washington that

have harvest boundaries within 50 feet of a Type N stream. Staff will present the results of our analysis at your November meeting with the recommendation that the Board will not need to request DNR to condition existing approved LTAs to meet the goals of the new rule.

2. Rule implementation Plan

As required by RCW 34.05.328, DNR staff have prepared an implementation plan to be placed in the rule making file by November 12, 2025. This document covers the methods by which DNR plans to implement and enforce the rule, inform the public about the rule, promote voluntary compliance, and evaluate the rule for effectiveness. The implementation plan outlines in detail why DNR has requested a delayed effectiveness date of August 31, 2026. Key considerations for a delayed effectiveness date include:

- Aligning the new rule implementation with seasonal low flows
- Ensuring there is adequate time for training and public outreach, and
- Avoiding potential conflicts with the water typing rule implementation.

3. Board Manual Sections 23 & 7

Board Manual 23: Staff have begun working on a draft of Board Manual 23 part 3 which will contain guidance for determining the Np/Ns break. Staff began work from where the 2019 workgroup left off and are working to integrate additional information. The current BM 23 workgroup is scheduled to resume regular meetings on November 13, 2025. Staff plan to have BM 23 ready for Board approval well before the proposed delayed effectiveness date.

Board Manual 7: Additional guidance on setting up Type Np buffers and riparian management zones will be necessary with the new rule. Staff will begin working with a stakeholder workgroup on Board Manual 7 in early 2026 and plan to have BM 23 ready for Board approval well before the proposed delayed effectiveness date.

I look forward to discussing these items with you at your November 12th meeting. If you have any questions, feel free to contact me at maggie.franquemont@dnr.wa.gov

MVF/

c: Saboor Jawad, Forest Practices Division Manager
Tami Miketa, Acting Assistant Division Manager Policy & Services
Terry Pruit, Assistant Attorney General and Board Attorney

Attachments:

1. Concise Explanatory Statement and Written Comments
2. Proposed Western Washington Type Np Buffer Rule Language
3. Mitigation Considerations
4. Cost Benefit Analysis
5. Small Business Economic Impact Statement

STATE OF WASHINGTONPO Box 47012
FOREST PRACTICES BOARD **Olympia, WA 98504-7012**

As required by
the Administrative Procedure Act
Chapter 34.05 RCW

CONCISE EXPLANATORY STATEMENT AND RESPONSIVENESS SUMMARY FOR THE ADOPTION OF CHAPTER 222-30, Timber Harvesting

Prepared by:
Maggie Franquemont

10/29/2025

CONCISE EXPLANATORY STATEMENT

1. INTRODUCTION

Reason for adopting the rule:

The purpose of this rulemaking is to increase the riparian buffer width and length requirements for non-fish bearing perennial streams (Type Np) on forest land subject to the Forest Practices Act (76.09 RCW) in western Washington to ensure the buffers protect water quality and other aquatic resources from potential temperature increases.

- WAC 222-30-021 – removes reference to Type Np and Type Ns buffer protections from the rule.
- WAC 222-30-0211 – new section specifically for western Washington Type Np and Type Ns buffer protections created using the language removed from WAC 222-30-021, amends the language removed from WAC 222-30-021 to change the buffer requirements on Type Np streams.

Intended to accomplish the policies stated in RCW 76.09.010, including but not limited to achieving compliance with applicable requirements of federal and state law with respect to nonpoint sources of water pollution from forest practices. This rulemaking of the Forest Practices Board is based on recommendations resulting from the scientifically based adaptive management process (RCW 76.09.370(6)) for adjustments to the forest practices that are not meeting resource objectives. and based on authorities granted to the Board under RCW 76.09.040.

Background:

The Forest Practices Board (Board) is an independent state agency created under RCW 76.09.030(1). To meet legislative intent, the Board has adopted rules that are collectively referred to as the Forest Practices Rules under the authority granted in RCW 76.09.040.

A. Riparian Strategy

The forest practices rules have two broad strategies: a) a riparian strategy that outlines protections measures on surface waters, wetlands, and adjacent areas; and b) an upland strategy which includes measures to be applied outside aquatic and riparian environments.

The Board's riparian strategy aims to restore riparian functions to high levels and to maintain those functions once restored (WAC 222-30-010(2)).[1] In addition to restoring and protecting riparian functions, the Board has also established resource objectives for forest practices rules that apply to the riparian strategy (WAC 222-12-045(2)). These objectives ensure that forest practices rules:

1. Support harvestable levels of salmonids,
2. Support the long-term viability of other covered species, and
3. Meet or exceed water quality standards (including protection of designated uses, narrative, and numeric criteria and antidegradation)

[1] Riparian functions include bank stability, recruitment of woody debris, leaf litter fall, nutrients, sediment filtering, and shade.

Forest practices rules that pertain to water quality (3 above) are adopted or amended only after the Board reaches agreement with the Department of Ecology (Ecology) as is outlined in RCW 76.09.040(b). The process of seeking the agreement of Ecology is not elsewhere defined. The Board, however, has relied on expert testimony of Ecology and the designee of the director of Ecology on the Board on matters pertaining to water quality and the interpretation of water quality rules that are adopted by reference in forest practices rules.

B. Rulemaking History

In 1999 the legislature directed the Board to adopt rules to implement the Adaptive Management Program (AMP) described in the Forests and Fish Report (FFR) to make adjustments to forest practices that are not achieving resource objectives[2]. Initial resource objectives were identified in Schedule L-1 of the Forests and Fish Report.[3] For water temperature, Schedule L-1 identified the narrative resource objective of providing cool water which was to be measured with the performance target of meeting current and anticipated water quality standards. A key question identified in the FFR was whether forest practices prescriptions described in the FFR would produce forest conditions that would achieve the performance targets. For water temperature, the key question identified in the FFR was whether the prescriptions in the FFR would meet current and anticipated water quality standards.

When the forest practices rules implementing the Forests and Fish Report were adopted in 2001, it was unknown whether the prescriptions in the FFR for Type Np waters that were adopted as rule would be effective at protecting water quality in those waters. The Final Environmental Impact Statement (FEIS) for the forest practices rules explained that there was a moderate to high degree of uncertainty over whether the Type Np water rule would be effective in maintaining water temperature.[4] Given that uncertainty, beginning in 2002, the AMP developed studies to assess the effectiveness of the rules for type Np waters.

The Board's Type Np rulemaking is rooted in recommendations emerging from the AMP.

C. Adaptive Management Process.

Directly relating to the Type Np rulemaking are two AMP studies[5] that tested the effectiveness of existing Type Np rules for riparian functions. These are: 1-Effectinvess of Experimental Riparian Buffers on Perennial Non-fish-bearing Streams on Competent Lithologies (Hard Rock Phase I and II extended monitoring); and 2- Effectiveness of Forest Practices Buffer Prescription on Perennial Non-fish-bearing Streams on Marine Lithologies (Soft Rock). The results were delivered to the AMP's Timber Fish and Wildlife Committee (TFW Policy). This committee is mandated by rule to consider the findings of the AMP's scientific research and to make recommendations to the Board based on those findings. Both studies triggered TFW Policy's review function. Below is a summary of the AMP process:

- TFW Policy received the findings package of Hard Rock Phase I at their July 2018 regular meeting. Among its findings, the study identified increases in the water temperature in Np

[2] RCW 76.09.370
[3] Forests and Fish Report, Appendix L, Adaptive Management 82 (1999)
[4] *FEIS on Alternatives for Forest Practices Rules* 3-80 (2001)
[5] The AMP had completed precursor studies in the Np rule-group and other studies that contributed to the policy discussion on Type Np response. These are a series of six studies. Three of these (Hard Rock Phase I and II and the Soft Rock Study) directly pertain to the Board's Np rulemaking.

streams following timber harvests under the forest practices rules. The committee determined, by consensus, that the findings warrant action at their August 2018 meeting and begin to develop alternatives through a committee workgroup.

- The study's principal investigators presented the findings to the Board on May 8, 2019.
- At the same Board meeting, TFW Policy brought forward a consensus recommendation that the findings warrant action and a requested Board approval to form a Technical Type Np Prescriptions Workgroup as supplemental element of the action alternative.
- At their May 9, 2019 special meeting, the Board accepted TFW Policy's recommendation and the amended timeline to address Type Np buffer prescriptions through a TFW Policy workgroup. The Board also approved additional changes to the workgroup charter at their August 2019 meeting.
- Type Np workgroup concluded its work in June 2021 and delivered three recommendations to TFW Policy.
- TFW Policy received the finding packages of both Hard Rock Phase II Extended Monitoring and Soft Rock Study in December of 2021
- TFW Policy initiated discussions on the workgroup alternatives and received additional alternative proposals from committee members. Citing lack of progress and the committee's inability to timely submit a buffer recommendation to the Board, the conservation caucus invoked dispute resolution at TFW Policy's November 2021 meeting.
- The dispute resolution process commenced with stage 1. In March 2022, the conservation caucus moved the dispute to stage 2 which requires mediation.
- Triangle Associates mediated the dispute in stage 2. Mediation occurred in a series of meetings from April to July 2022. On July 20, 2022, TFW Policy concluded the dispute without a consensus and began drafting majority and minority recommendations to the Board.

The TFW Policy dispute over developing riparian management zone (RMZ) alternatives for Type Np waters concluded without consensus on July 20, 2022. Majority and minority recommendations developed during this dispute were delivered to the Board to make the final determination as stated in WAC 22-12-045(h)(ii)(D).

D. Board Determination on Rulemaking

The Board received the majority and minority recommendations in November of 2022. At the November 2022 regular meeting, the Board also received expert testimony from Ecology regarding their interpretation of antidegradation rules and their determination that only the majority recommendation is likely to meet water quality standards. At this meeting, the Board voted to accept the majority report and requested DNR staff to base the draft Type Np rule and subsequent rule analysis on the majority report's recommendations only.

Rulemaking analysis commenced following a timeline established by the Board. The following products were developed and delivered to the Board:

1- The majority's recommendation was translated into draft rule language with the participation and input of TFW caucuses
2- A spatial analysis that summarized the impact of the majority's recommendation in terms of acreage of new riparian buffers and miles of streams that would be impacted
3- A preliminary cost benefit analysis
4- A preliminary small business economic impact statement

5- A review of the proposed rule under the State Environmental Protection Act

In June 2025, the Board approved the filing of the CR102 which started the public review process of the proposed Type Np rule. Public review and comment period for the Type Np rulemaking concluded by August 11, 2025.

Rule Dates:

- The adoption day of the rule will be November 12, 2025.
- The effective date of the rule will be August 31, 2026.

2. DIFFERENCES BETWEEN PROPOSED AND FINAL RULE

There are no differences between the proposed rule and final rule other than editing changes to correct minor typographic errors.

3. SUMMARY OF COMMENTS

This section contains a summary of comments the Board received via the comment period pursuant to RCW 34.05.320. The Board held 4 public hearings to receive verbal comments and accepted written comments. The Board received just over 1100 verbal and written comments. Several of the verbal commentors delivered a written version of their comments following their testimony which were considered together. Many of the written comments were either form letters or slight variations of a form letter. There were no specific suggestions for rule language changes to improve clarity.

This section divides the comments into three categories: support, oppose, and other before categorizing the comments by topic and subtopic. Responses are given where it is appropriate to respond (*in italic font*) following the list of topic and subtopics.

Comments Supporting the Rule:

Over 800 comments supported the rule. Comments supporting the rule addressed the following topics:

A. Confidence in the AMP process and that the Board process for resolving disputes was followed
    - The AMP process was participatory, meaning all sides contributed, accepted or approved study designs, and final reports.
B. Type Np streams are the majority of streams in Western Washington and drain directly into fish-bearing streams. When the current rules were adopted, concerns about the adequacy of buffers existed and documented in Ecology's statements, the water quality assurances, and the biological opinion underpinning the forest practices habitat conservation plan and this rulemaking addresses many of those concerns including:
    - Maintaining water quality for high quality Np streams benefiting downstream resources
    - Protecting aquatic non-fish habitat as well as other habitat benefits Meeting the Clean Water Act assurances milestones
C. Ecology is the authority on the interpretation of water quality standards

D. CMER's findings that the current Np prescriptions are not effectively protecting water from degradation are grounded in sound science
E. Climate change and the role of healthy forest and stream ecosystems into the future
    - The Board to consider site potential tree height at 200 years and apply this width to all RMZs regardless of water types

F. Nearly all comments supporting the rule requested the Board proceed with rulemaking and final adoption

Response: The comments supporting the rulemaking are noted.

Comments Opposing the Rule

Over 450 comments opposed the rule. Comments opposing the rule addressed the following topics & subtopics:

A. AMP Process and studies: several comments raised concerns about the AMP process and the findings of the two science studies. These concerns include:

- The Board initiated rulemaking well before the AMP dispute resolution process was fully completed
- The rule includes elements that were not considered in the AMP such as orphan Np streams
- The AMP process and debate was constrained by DOE's statements on antidegradation water quality standard and that the studies were not designed to test effectiveness with antidegradation water quality standards
- The scope of inference of the science studies is limited because site selection was not probabilistic
- The temperature results were limited in time and space
- The proposed rule disregards key findings of the studies indicating that water quality designated use standards are met
- The AMP did not produce landscape scale studies
- The Np studies did not account for regulatory and operational contexts

Response: The AMP studies showing temperature increases associated with the current Type Np stream buffer prescription were the results of the rigorous process for study design and review required under WAC 222-12-045(2)(c), The findings of the Hard Rock study led to consensus at TFW Policy to form a technical work group to develop and evaluate buffer prescriptions that would address temperature increases.

B. Interpretation of Water Quality Rules: several comments raised concerns or disagreed with the Ecology's interpretation of Tier II antidegradation water quality standards. Issues raised in comments include:

- Type Np rule is not a new action and Tier II analysis only applies to new and expanded actions
- Tier II requirements are met because an adaptive management program exists
- Tier II antidegradation rule is misinterpreted and that 0.3 C measurable change is not an absolute limit but a trigger for further review
- DOE's position that measurable change standard is violated is not consistent with water quality rules
- Treating the 0.3C measurable change standard as a limit is contrary to biological opinions

Response: Ecology's interpretation of the water quality rules is outside the Board's scope of this rulemaking.

C. Board Process: several comments raised concerns about the Board process. These concerns include the following:

- The Board did not allow for alternative analysis and did not approve the minority report to move forward into rulemaking analysis
- The Board did not consider less costly alternatives that can meet water quality standards
- The public process did not provide opportunity to review multiple alternatives
- Board members should not be abstaining from important issues and that less than a majority of Board members advanced the CR102 decision
- The Board did not fully consider all available science and did not make a finding whether current rules are meeting water quality

Response: The Board follows the requirements of the Open Public Meetings Act and the Administrative Procedure Act, guidance in its business reference manual, and the adaptive management program process in WAC 222-12-045 for rules affecting aquatic resources as required under RCW 76.09.370(6).

D. Economic concerns: Additional harvest restrictions will financially impact all levels of timber production

- Landowners: additional harvest restrictions will harm landowners financially, driving them to convert their land to non-forestry uses
- Loggers, foresters, and transporters: an additional loss in timber will negatively impact the amount of work opportunities for everyone involved in the timber industry
- Mills: an additional loss of timber will impact mills' ability to operate profitably potentially leading to additional mills closing thus increasing transportation and operation costs
- Private property: several comments raise concerns regarding the taking of private property without compensation

Response: Regarding the general economic concerns, commenters raised valid concerns regarding economic impacts from the new rule on timber industry, including landowners, foresters, transporters and mills. The Board will consider potential mitigation measures when it considers the rule for final adoption. Additionally, although commenters raised concern of increased conversion as a result of the rulemaking, no significant associate has been found between general regulatory concern and past reported forestland sales. Small forest land with riparian buffers has not sold more frequently compared to other small forest land[6]

E. Concerns regarding the Cost Benefit Analysis (CBA)

- Industrial Economics Inc (IEc) did not accurately measure the number of stream miles impacted
- The benefits were not properly quantified and therefore cannot be balanced against the costs
- The willingness to pay examples given do not relate to Washington or the resources at issue and therefore should not be applied in this case.
- If the willingness to pay amounts given are applied in this case, they do not show that the benefits outweigh the costs
- The regional economic impacts are not considered as part of the overall weighing of benefits and costs

[6] Sergey Rabotyagov, et. al**.,** Washington's Small Forest Landowners in 2020: Status, Trends and Recommendations after 20 years of Forests & Fish, Washington School of Environmental and Forest Sciences 2021) 16

Response:

- *IEc used a variety of data sources including estimates from several spatial analysis reports, DNR GIS layers, and models from both Ecology and the University of Washington to arrive at both the high and low estimations of impacted stream miles. The methodology was designed to focus only on the stream miles that would be impacted by the new rule and intentionally left out Np streams that are managed under a different management system than the Forest Practices Rules.*
- *Under RCW 34.05.328(d), the CBA must take into account both qualitative and quantitative benefits and costs of the proposed rulemaking. The CBA is not required to rely solely on quantitative data. IEc has developed a method with the input of the economic workgroup to weigh qualitative benefits while respecting that not all benefits can be quantified.*
- *The willingness to pay examples used in the CBA reflect similar situations to this rulemaking while recognizing that a study of the exact parameters (location and resources) is not available. The CBA takes this discrepancy into account by not fully extrapolating the numbers used in the studies referenced to this rulemaking. The CBA has clarified that these are examples but not direct comparisons.*
- *Since the willingness to pay examples used in the CBA are not fully extrapolated to reflect the willingness to pay for this rulemaking, it is not accurate to use them as a one-to-one ratio of benefits to costs. This is why the willingness to pay examples are not used in the final weighing of costs and benefits.*
- *The regional economic effects are discussed in Chapter 5 of the CBA. The regional economic effects are prudent to consider because they demonstrate that while the benefits will be felt by society as a whole and the costs are borne predominantly by the timber industry. However, the regional economic effects do not represent an overall change in economic values to society as a whole. Therefore, they are presented separately from the overall weighing of benefits and costs in Chapter 6 because benefits and costs are changes in the economic values to society as a whole.*

F. Specific Recommendations: several comments, while opposing the rule, provided specific recommendations:
    - The Board should send the Type Np rulemaking issue back to the adaptive management program and instruct that program to consider alternatives and provide the program with specific instructions regarding antidegradation water quality standards
    - The Board should stop rulemaking altogether and should not consider adoption
    - The Board should not consider abrupt adoption of the rule but phase it over multiple years and allow alternative revenue generation streams for landowners such as biochar, and other energy products

    Response: These comments are noted.

G. Implementation concerns: Confusion over how the new rule will be implemented based on the rule language

    Response: Implementation concerns will be addressed by training, guidance, and public outreach.

Other Comments

Nine comments neither supported nor opposed the rules but offered other insights for the Board to consider.

Four comments were directly related to the SPEA checklist that the Board approved in June 2025.

> *Response: While the SEPA process is related to this rulemaking these comments are outside the scope of this public comment period.*

One comment pointed out that there are other non-lumber uses for timber and lumber by-products that could offset the costs for landowners. The comment pointed out the biochar, carbon black alternatives, and other forest-derived materials would allow the timber industry to make more money from less timber.

> *Response: This comment is noted.*

One comment suggests that the new rule should only apply to those who do not have a Washington State Designated Forest Land tax classification or are not certified by the American Tree Farm program in order to protect those landowners who are actively managing ecologically friendly forests.

> *Response: The forest practices rules apply to all applicable forestland in Washington, and the Board generally does not have the authority to apply the rules unevenly based on tax designations.*

One comment responded to the Teir II degradation analysis done by Ecology.

> *Response: While the Tier II degradation analysis is related to this rulemaking, this comment is outside the scope of this public comment period.*

Two comments suggested that the Board extend the comment period to ensure agencies and private landowners have sufficient time to review and respond.

> *Response: Based on the number of responses we received from agencies, tribes, local governments, private landowners, and other members of the public we feel that the comment period was adequate for proper review of the rulemaking materials and response via comment.*

4. SUMMARY OF PUBLIC INVOLVEMENT OPPORTUNITIES

- November 30, 2021 – CR 101 filed
    - Information supplied to interested parties on how to participate in rule development.
- November, 2022 – Board approval of the majority proposal
    - Board provides public comment opportunity and receives public comments
- August, 2023: Board considers rescinding the prior decisions: rescinds the prior decision and approves the majority proposal to move forward into rulemaking:
    - Board provides public comment opportunity and receives public comments
- Stakeholder workgroups:
    - Draft rule language workgroup
        - TFW Caucus representatives
    - Economic workgroup
        - TFW Caucus representatives
    - Spatial analysis workgroup
        - TFW Caucus representatives
- June 26, 2025 – CR 102 published in the State Register

- Four public hearings in 2025:
    - Longview, WA – July 23, 2025 at 4pm
        - 67 people attended, 36 commented
    - Sedro-Wooley, WA – July 29, 2025 at 4pm
        - 61 people attended, 35 commented
    - Port Angeles, WA – August 4, 2015 at 4pm
        - 73 people attended, 33 commented
    - Olympia, WA – August 11, 2025 at 4pm
        - 87 people attended, 37 commented

Forest Practices Board
Type Np Water Buffer Rule Making
November 12, 2025

WAC 222-30-021 *Western Washington Type S and F Waters riparian management zones. (1) These rules apply to all ((~~typed~~)) Type S and F Waters on forest land in Western Washington, except as provided in WAC 222-30-023. RMZs are measured horizontally from the outer edge of the bankfull width or channel migration zone, whichever is greater, and extend to the limits as described in this section. See board manual section 7 for riparian design and layout guidelines.

*((~~(1)~~)) (2) **Western Washington RMZs for Type S and F Waters** have three zones: The core zone is nearest to the water, the inner zone is the middle zone, and the outer zone is furthest from the water. (See definitions in WAC 222-16-010.) RMZ dimensions vary depending on the site class of the land, the management harvest option, and the bankfull width of the stream. See tables for management options 1 and 2 below.

None of the limitations on harvest in each of the three zones listed below will preclude or limit the construction and maintenance of roads for the purpose of crossing streams in WAC 222-24-030 and 222-24-050, or the creation and use of yarding corridors in WAC 222-30-060(1).

The shade requirements in WAC 222-30-040 must be met regardless of harvest opportunities provided in the inner zone RMZ rules. See board manual section 1.

(a) **Core zones.** No timber harvest or construction is allowed in the core zone except operations related to forest roads as detailed in this subsection ((~~(1) of this section~~)). Any trees cut for or damaged by yarding corridors in the core zone must be left on the site. Any trees cut as a result of road construction to cross a stream may be removed from the site, unless used as part of a large woody debris placement strategy or as needed to reach stand requirements.

(b) **Inner zones.** Forest practices in the inner zone must be conducted in such a way as to meet or exceed stand requirements to achieve the goal in WAC 222-30-010(2). The width of the inner zone is determined by site class, bankfull width, and management option. Timber harvest in this zone must be consistent with the stand requirements in order to reach the desired future condition targets.

"Stand requirement" means a number of trees per acre, the basal area and the proportion of conifer in the combined inner zone and adjacent core zone so that the growth of the trees would meet desired future conditions. The following table defines basal

area targets when the stand is ((~~one hundred forty~~)) 140 years old.

Site Class	Desired future condition target basal area per acre (at 140 years)
I	325 sq. ft.
II	325 sq. ft.
III	325 sq. ft.
IV	325 sq. ft.
V	325 sq. ft.

Growth modeling is necessary to calculate whether a particular stand meets stand requirement and is on a trajectory towards these desired future condition basal area target. The appropriate growth model will be based on stand characteristics and will include at a minimum, the following components: The number of trees by diameter class, the percent of conifer and hardwood, and the age of the stand. See board manual section 7.

(i) **Hardwood conversion in the inner zone.** When the existing stands in the combined core and inner zone do not meet stand requirements, no harvest is permitted in the inner zone, except in connection with hardwood conversion.

The landowner may elect to convert hardwood-dominated stands in the **inner zone** to conifer-dominated stands. Harvesting and replanting shall be in accordance with the following limits:

(A) Conversion activities in the **inner zone** of any harvest unit are only allowed where all of the following are present:

• Existing stands in the combined core and inner zone do not meet stand requirements ((~~(WAC 222-30-021 (1)(b))~~)) in this subsection;

• There are fewer than ((~~fifty-seven~~)) 57 conifer trees per acre eight inches or larger dbh in the conversion area;

• There are fewer than ((~~one hundred~~)) 100 conifer trees per acre larger than four inches dbh in the conversion area;

• There is evidence (such as conifer stumps, historical photos, or a conifer understory) that the conversion area can be successfully reforested with conifer and support the development of conifer stands;

• The landowner owns ((~~five hundred~~)) 500 feet upstream and ((~~five hundred~~)) 500 feet downstream of the harvest unit;

• The core and inner zones contain no stream adjacent parallel roads;

• Riparian areas contiguous to the proposed harvest unit are owned by the landowner proposing to conduct the conversion activities, and meet shade requirements of WAC 222-30-040 or have a ((~~seventy-five~~)) 75-foot buffer with trees at least ((~~forty~~)) 40 feet tall on both sides of the stream for ((~~five hundred~~)) 500 feet upstream and ((~~five hundred~~)) 500 feet downstream of the proposed harvest unit (or the length of the stream, if less);

• If the landowner has previously converted hardwood-dominated stands, then postharvest treatments must have been performed to the satisfaction of the department.

(B) In addition to the conditions set forth above, permitted conversion activities in the **inner zone** of any harvest unit are limited by the following:

• Each continuous conversion area is not more than ((~~five hundred~~)) 500 feet in length; two conversion areas will be considered "continuous" unless the no-harvest area separating the two conversion areas is at least half the length of the larger of the two conversion areas.

• Type S and F ((~~(Type 1, 2, or 3)~~)) Waters: Up to ((~~fifty~~)) 50 percent of the inner zone area of the harvest unit on one side of the stream may be converted provided that:

♦ The landowner owns the opposite side of the stream and the landowner's riparian area on the opposite bank meets the shade requirements of WAC 222-30-040 or has a ((~~seventy-five~~)) 75-foot buffer of trees at least ((~~forty~~)) 40 feet tall or:

♦ The landowner does not own land on the opposite side of the stream but the riparian area on the opposite bank meets the shade requirements of WAC 222-30-040 or has a ((~~seventy-five~~)) 75-foot buffer of trees at least ((~~forty~~)) 40 feet tall.

• Not more than ((~~twenty-five~~)) 25 percent of the inner zone of the harvest unit on both sides of a Type S or F Water may be converted if the landowner owns both sides.

(C) Where conversion is allowed in the **inner zone,** trees within the conversion area may be harvested except that:

• Conifer trees larger than ((~~twenty~~)) 20 inches dbh shall not be harvested;

• Not more than ((~~ten~~)) 10 percent of the conifer stems greater than eight inches dbh, exclusive of the conifer noted above, within the conversion area may be harvested; and

• The landowner must exercise reasonable care in the conduct of harvest activities to minimize damage to all residual conifer trees within the conversion area including conifer trees less than eight inches dbh.

(D) Following harvest in conversion areas, the landowner must:

• Reforest the conversion area with **conifer** tree species suitable to the site in accordance with the requirements of WAC 222-34-010; and

• Conduct postharvest treatment of the site until the conifer trees necessary to meet acceptable stocking levels in WAC 222-34-010(2) have crowns above the brush or until the conversion area contains a minimum of ((~~one hundred fifty~~)) 150 conifer trees greater than eight inches dbh per acre.

• Notify the department in writing within three years of the approval of the forest practices application for hardwood conversion, if the hardwood conversion has been completed.

(E) **Tracking hardwood conversion.** The purpose of tracking hardwood conversion is to determine if hardwood conversion is resulting in adequate enhancement of riparian functions toward the desired future condition while minimizing the short term impacts on functions. The department will use existing or updated databases developed in cooperation with the Washington Hardwoods Commission to identify watershed administrative units (WAUs) with a high percentage of hardwood-dominated riparian areas and, thus have the potential for excessive hardwood conversion under these rules. The department will track the rate of conversion of hardwoods in the riparian zone: (1) Through the application process on an annual basis; and (2) at a WAU scale on a biennial basis as per WAC 222-30-120 through the adaptive management process which will develop thresholds of impact for hardwood conversion at the watershed scale.

(ii) **Harvest options.**

(A) No inner zone management. When the existing stands in the combined core and inner zone do not meet stand requirements, no harvest is permitted in the inner zone. When no harvest is permitted in the inner zone or the landowner chooses not to enter the inner zone, the width of core, inner and outer zones are as provided in the following table:

No inner zone management RMZ widths for Western Washington

Site Class	RMZ width	Core zone width (measured from outer edge of bankfull width or outer edge of CMZ of water)	Inner zone width (measured from outer edge of core zone)		Outer zone width (measured from outer edge of inner zone)	
			stream width ≤10'	stream width >10'	stream width ≤10'	stream width >10'
I	200'	50'	83'	100'	67'	50'
II	170'	50'	63'	78'	57'	42'
III	140'	50'	43'	55'	47'	35'
IV	110'	50'	23'	33'	37'	27'
V	90'	50'	10'	18'	30'	22'

(B) Inner zone management. If trees can be harvested and removed from the inner zone because of surplus basal area consistent with the stand requirement, the harvest and removal of the trees must be undertaken consistent with one of two options:

(I) **Option 1. Thinning from below.** The objective of thinning is to distribute stand requirement trees in such a way as to shorten the time required to meet large wood, fish habitat and water quality needs. This is achieved by increasing the potential for leave trees to grow larger than they otherwise would without thinning. Thinning harvest under option 1 must comply with the following:

• Residual trees left in the combined core and inner zones must meet stand requirements necessary to be on a trajectory to desired future condition. See board manual section 7 for guidelines.

• Thinning must be from below, meaning the smallest dbh trees are selected for harvest first, then progressing to successively larger diameters.

• Thinning cannot decrease the proportion of conifer in the stand.

• Shade retention to meet the shade rule must be confirmed by the landowner for any harvest inside of ((~~seventy-five~~)) 75 feet from the outer edge of bankfull width or outer edge of CMZ, whichever is greater.

• The number of residual conifer trees per acre in the inner zone will equal or exceed ((~~fifty-seven~~)) 57.

Option 1. Thinning from below.

Site class	RMZ width	Core zone width (measured from outer edge of bankfull width or outer edge of CMZ of water)	Inner zone width (measured from outer edge of core zone)		Outer zone width (measured from outer edge of inner zone)	
			stream width ≤10'	stream width >10'	stream width ≤10'	stream width >10'
I	200'	50'	83'	100'	67'	50'
II	170'	50'	63'	78'	57'	42'
III	140'	50'	43'	55'	47'	35'
IV	110'	50'	23'	33'	37'	27'
V	90'	50'	10'	18'	30'	22'

(II) **Option 2. Leaving trees closest to the water.** Management option 2 applies only to riparian management zones for site class I, II, and III on streams that are less than or equal to ((~~ten~~)) 10 feet wide and RMZs in site class I and II for streams greater than ((~~ten~~)) 10 feet wide. Harvest must comply with the following:

• Harvest is not permitted within ((~~thirty~~)) 30 feet of the core zone for streams less than or equal to ((~~ten~~)) 10 feet wide and harvest is not permitted within ((~~fifty~~)) 50 feet of the core zone for streams greater than ((~~ten~~)) 10 feet wide;

• Residual leave trees in the combined core and inner zone must meet stand requirements necessary to be on a trajectory to desired future condition. See board manual section 7 for calculating stand requirements;

• A minimum of ((~~twenty~~)) 20 conifers per acre, with a minimum ((~~twelve~~)) 12 inch dbh, will be retained in any portion of the inner zone where even-age harvest occurs. These riparian leave trees will be counted towards meeting applicable stand requirements. The number of riparian leave trees cannot be reduced below ((~~twenty~~)) 20 for any reason.

• Trees are selected for harvest starting from the outer most portion of the inner zone first then progressively closer to the stream.

• If (b)(ii)(B)(II) of this subsection results in surplus basal area per the stand requirement, the landowner may take credit for the surplus by harvesting additional riparian leave trees required to be left in the adjacent outer zone on a basal

area-for-basal area basis. The number of leave trees in the outer zone can be reduced only to a minimum of ((~~ten~~)) 10 trees per acre.

Option 2. Leaving trees closest to water.

Site Class	RMZ width	Core zone width (measured from outer edge of bankfull width or outer edge of CMZ of water)	Inner zone width				Outer zone width (measured from outer edge of inner zone)	
	stream width ≤10'	stream width ≤10'	stream width >10'	stream width >10'	stream width ≤10'	stream width ≥10'		
		minimum floor distance		minimum floor distance				
	(measured from outer edge of core zone)	(measured from outer edge of core zone)	(measured from outer edge of core zone)	(measured from outer edge of core zone)				
I	200'	50'	84'	30'	84'	50'	66'	66'
II	170'	50'	64'	30'	70'	50'	56'	50'
III	140'	50'	44'	30'	**	**	46'	**

** Option 2 for site class III on streams >10' is not permitted because of the minimum floor (100') constraint.

(iii) **Where the basal area components of the stand requirement cannot be met** within the sum of the areas in the inner and core zone due to the presence of a stream-adjacent parallel road in the inner or core zone, a determination must be made of the approximate basal area that would have been present in the inner and core zones if the road was not occupying space in the core or inner zone and the shortfall in the basal area component of the stand requirement. See definition of "stream-adjacent parallel road" in WAC 222-16-010.

(A) Trees containing basal area equal to the amount determined in (b)(iii) of this subsection will be left elsewhere in the inner or outer zone, or if the zones contain insufficient riparian leave trees, substitute riparian leave trees will be left within the RMZ width of other Type S or F Waters in the same unit or along Type Np or Ns Waters in the same unit in addition to all other RMZ requirements on those same Type S, F, Np or Ns Waters.

(B) When the stream-adjacent road basal area calculated in (b)(iii) of this subsection results in an excess in basal area (above stand requirement) then the landowner may receive credit for such excess which can be applied on a basal area-by-basal area basis against the landowner's obligation to leave trees in the outer zone of the RMZ of such stream or other waters within the same unit, provided that the number of trees per acre in the outer zone is not reduced to less than ((~~ten~~)) 10 trees per acre.

(C) When the basal area requirement cannot be met, as explained in (b)(iii) of this subsection, the shortfall may be reduced through the implementation of an acceptable large woody debris placement plan. See board manual section 26 for guidelines.

(iv) If a harvest operation includes both yarding and harvest activities within the RMZ, all calculations of basal area for stand requirements will be determined as if the yarding corridors were constructed prior to any other harvest activities. If trees cut or damaged by yarding are taken from excess basal area, these trees may be removed from the inner zone. Trees cut or damaged by yarding in a unit which does not meet the basal area target of the stand requirements cannot be removed from the inner zone. Any trees cut or damaged by yarding in the core zone may not be removed.

(c) **Outer zones.** Timber harvest in the outer zone must leave ((~~twenty~~)) 20 riparian leave trees per acre after harvest. **"Outer zone riparian leave trees"** are trees that must be left after harvest in the outer zone in Western Washington. Riparian leave trees must be left uncut throughout all future harvests:

Outer zone riparian leave tree requirements

Application	Leave tree spacing	Tree species	Minimum dbh required
Outer zone	Dispersed	Conifer	12" dbh or greater
Outer zone	Clumped	Conifer	12" dbh or greater
Protection of sensitive features	Clumped	Trees representative of the overstory including both hardwood and conifer	8" dbh or greater

The ((~~twenty~~)) 20 riparian leave trees to be left can be reduced in number under the circumstances delineated in (c)(iv) of this subsection. The riparian leave trees must be left on the landscape according to one of the following two strategies. A third strategy is available to landowners who agree to a LWD placement plan.

(i) **Dispersal strategy.** Riparian leave trees, which means conifer species with a diameter measured at breast height (dbh) of ((~~twelve~~)) 12 inches or greater, must be left dispersed approximately evenly throughout the outer zone. If riparian leave trees of ((~~twelve~~)) 12 inches dbh or greater are not available, then the next largest conifers must be left. If conifers are not present, riparian leave trees must be left according to the clumping strategy in (c)(ii) of this subsection.

(ii) **Clumping strategy.** Riparian leave trees must be left clumped in the following way:

(A) Clump trees in or around one or more of the following **sensitive features** to the extent available within the outer zone. When clumping around sensitive features, riparian leave trees must be eight inches dbh or greater and representative of the overstory canopy trees in or around the sensitive feature and may include both hardwood and conifer species. Sensitive features are:

(I) Seeps and springs;

(II) Forested wetlands;

(III) Topographic locations (and orientation) from which leave trees currently on the site will be delivered to the water;

(IV) Areas where riparian leave trees may provide windthrow protection;

(V) Small unstable, or potentially unstable, slopes not of sufficient area to be detected by other site evaluations. See WAC 222-16-050 (1)(d).

(VI) Archaeological sites or historic archaeological resources as defined in RCW 27.53.030;

(VII) Historic sites eligible for listing on the National Register of Historic Places or the Washington Heritage Register as determined by the Washington state department of archaeology and historic preservation. See WAC 222-16-050 (1)(f); or

(VIII) Sites containing evidence of Native American cairns, graves or glyptic records as provided for in chapters 27.44 and 27.53 RCW. See WAC 222-16-050 (1)(f).

(B) If sensitive features are not present, then clumps must be well distributed throughout the outer zone and the leave trees must be of conifer species with a dbh of ((~~twelve~~)) 12 inches or greater. When placing clumps, the applicant will consider operational and biological concerns. Tree counts must be satisfied regardless of the presence of stream-adjacent parallel roads in the outer zone.

(iii) **Large woody debris in-channel placement strategy.**

(A) In order to reduce the number of required outer zone trees, a landowner may design a LWD placement plan for department approval consistent with guidelines in board manual sections 5 and 26. Landowners are encouraged to consult with the department and the department of fish and wildlife while designing the plan and prior to submitting a forest practices application.

(B) Reduction of trees in the outer zone must not go below a minimum of ((~~ten~~)) 10 trees per acre.

(C) If this strategy is chosen, a complete forest practices application must include the LWD placement plan.

(iv) **Twenty riparian leave trees must be left after harvest** with the exception of the following:

(A) If a landowner agrees to implement a placement strategy, see (c)(iii) of this subsection.

(B) If trees are left in an associated channel migration zone, the landowner may reduce the number of trees required to be left according to the following:

(I) Offsets will be measured on a basal area-for-basal area basis.

(II) Conifer in a CMZ equal to or greater than six inches dbh will offset conifer in the outer zone at a one-to-one ratio.

(III) Hardwood in a CMZ equal to or greater than ((~~ten~~)) 10 inches dbh will offset hardwood in the outer zone at a one-to-one ratio.

(IV) Hardwood in a CMZ equal to or greater than ((~~ten~~)) 10 inches dbh will offset conifer in the outer zone at a three-to-one ratio.

((~~*(2) **Western Washington protection for Type Np and Ns Waters.**~~

~~(a) An~~ **equipment limitation zone** ~~is a thirty-foot wide zone measured horizontally from the outer edge of the bankfull width of a Type Np or Ns Water where equipment use and other forest practices that are specifically limited by these rules. It applies to all perennial and seasonal streams.~~

~~(i) On-site mitigation is required if any of the following activities exposes the soil on more than ten percent of the surface area of the zone:~~

~~(A) Ground based equipment;~~

~~(B) Skid trails;~~

~~(C) Stream crossings (other than existing roads); or~~

~~(D) Cabled logs that are partially suspended.~~

~~(ii) Mitigation must be designed to replace the equivalent of lost functions especially prevention of sediment delivery. Examples include water bars, grass seeding, mulching, etc.~~

~~(iii) Nothing in this subsection (2) reduces or eliminates the department's authority to prevent actual or potential material damage to public resources under WAC 222-46-030 or 222-46-040 or any related authority to condition forest practices notifications or applications.~~

~~(b)~~ **Sensitive site and RMZs protection along Type Np Waters.** ~~Forest practices must be conducted to protect Type Np RMZs and sensitive sites as detailed below:~~

~~(i) A fifty-foot, no-harvest buffer, measured horizontally from the outer edge of bankfull width, will be established along each side of the Type Np Water as follows:~~

~~Required no-harvest, 50-foot buffers on Type Np Waters.~~

~~Length of Type Np Water from the confluence of Type S or F Water~~	~~Length of 50' buffer required on Type Np Water (starting at the confluence of the Type Np and connecting water)~~
~~Greater than 1000'~~	~~500'~~
~~Greater than 300' but less than 1000'~~	~~Distance of the greater of 300' or 50% of the entire~~

~~Length of Type Np Water from the confluence of Type S or F Water~~	~~Length of 50' buffer required on Type Np Water (starting at the confluence of the Type Np and connecting water)~~
	~~length of the Type Np Water~~
~~Less than or equal to 300'~~	~~The entire length of Type Np Water~~

~~(ii) No timber harvest is permitted in an area within fifty feet of the outer perimeter of a soil zone perennially saturated from a headwall seep.~~

~~(iii) No timber harvest is permitted in an area within fifty feet of the outer perimeter of a soil zone perennially saturated from a side-slope seep.~~

~~(iv) No timber harvest is permitted within a fifty-six foot radius buffer patch centered on the point of intersection of two or more Type Np Waters.~~

~~(v) No timber harvest is permitted within a fifty-six foot radius buffer patch centered on a headwater spring or, in the absence of a headwater spring, on a point at the upper most extent of a Type Np Water as defined in WAC 222-16-030(3) and 222-16-031.~~

~~(vi) No timber harvest is permitted within an alluvial fan.~~

~~(vii) At least fifty percent of a Type Np Waters' length must be protected by buffers on both sides of the stream (2-sided buffers). Buffered segments must be a minimum of one hundred feet in length. If an operating area is located more than five hundred feet upstream from the confluence of a Type S or F Water and the Type Np Water is more than one thousand feet in length, then buffer the Type Np Water according to the following table. If the percentage is not met by protecting sensitive sites listed in (b)(i) through (vii) of this subsection, then additional buffers are required on the Type Np Water to meet the requirements listed in the table.~~

~~Minimum percent of length of Type Np Waters to be buffered when more than 500 feet upstream from the confluence of a Type S or F Water~~

~~Total length of a Type Np Water upstream from the confluence of a Type S or F Water~~	**~~Percent of length of Type Np Water that must be protected with a 50 foot no harvest buffer more than 500 feet upstream from the confluence of a Type S or F Water~~**
~~1000 feet or less~~	~~Refer to table in this subsection (i) above~~
~~1001 - 1300 feet~~	~~19%~~
~~1301 - 1600 feet~~	~~27%~~

Total length of a Type Np Water upstream from the confluence of a Type S or F Water	Percent of length of Type Np Water that must be protected with a 50 foot no harvest buffer more than 500 feet upstream from the confluence of a Type S or F Water
1601 - 2000 feet	33%
2001 - 2500 feet	38%
2501 - 3500 feet	42%
3501 - 5000 feet	44%
Greater than 5000 feet	45%

The landowner must select the necessary priority areas for additional two-sided buffers according to the following priorities:

(A) Low gradient areas;

(B) Perennial water reaches of nonsedimentary rock with gradients greater than twenty percent in the tailed frog habitat range;

(C) Hyporheic and groundwater influence zones; and

(D) Areas downstream from other buffered areas.

Except for the construction and maintenance of road crossings and the creation and use of yarding corridors, no timber harvest will be allowed in the designated priority areas. Landowners must leave additional acres equal to the number of acres (including partial acres) occupied by an existing stream-adjacent parallel road within a designated priority area buffer.

(c) None of the limitations on harvest in or around Type Np Water RMZs or sensitive sites listed in (b) of this subsection will preclude or limit:

(i) The construction and maintenance of roads for the purpose of crossing streams in WAC 222-24-030 and 222-24-050.

(ii) The creation and use of yarding corridors in WAC 222-30-060(1).

To the extent reasonably practical, the operation will both avoid creating yarding corridors or road crossings through Type Np Water RMZ or sensitive sites and associated buffers, and avoid management activities which would result in soil compaction, the loss of protective vegetation or sedimentation in perennially moist areas.

Where yarding corridors or road crossings through Type Np Water RMZs or sensitive sites and their buffers cannot reasonably be avoided, the buffer area must be expanded to protect the sensitive site by an area equivalent to the disturbed area or by providing comparable functions through other management initiated efforts.

Landowners must leave additional acres equal to the number of acres (including partial acres) occupied by an existing stream-

~~adjacent parallel road within a Type Np Water RMZs or sensitive site buffer.~~))

NEW SECTION

WAC 222-30-0211 Western Washington Type Np Water riparian management zones and Type Ns Water riparian protections. These rules apply to all Type Np and Ns Waters on forest land in Western Washington, except as provided in WAC 222-30-023. Riparian management zones (RMZ) are measured horizontally from the outer edge of the bankfull width or channel migration zone, whichever is greater, and extend to the limits as described in this section. See board manual section 7 for guidelines.

(1) An **equipment limitation zone** is a 30-foot wide zone measured horizontally from the outer edge of the bankfull width of a Type Np or Ns Water where equipment use and other forest practices that are specifically limited by these rules. It applies to all nonfish perennial and seasonal streams.

(a) On-site mitigation is required if any of the following activities exposes the soil on more than 10 percent of the surface area of the zone:

(i) Ground based equipment;

(ii) Skid trails;

(iii) Stream crossings (other than existing roads); or

(iv) Cabled logs that are partially suspended.

(b) Mitigation must be designed to replace the equivalent of lost functions, especially prevention of sediment delivery. Examples include water bars, grass seeding, mulching, etc.

(c) Nothing in this section reduces or eliminates the department's authority to prevent actual or potential material damage to public resources under WAC 222-46-030 or 222-46-040 or any related authority to condition forest practices notifications or applications.

(2) **Sensitive site protections along Type Np Waters.** Forest practices must be conducted to protect Type Np Water sensitive sites. The sensitive sites must be identified and protected before establishing the Type Np RMZ as required in subsection (3) of this section. Sensitive sites and their protections are detailed below:

(a) No timber harvest is permitted in an area within 50 feet of the outer perimeter of a soil zone perennially saturated from a headwall seep.

(b) No timber harvest is permitted in an area within 50 feet of the outer perimeter of a soil zone perennially saturated from a side-slope seep.

(c) No timber harvest is permitted within a 56-foot radius buffer patch centered on the point of intersection of two or more Type Np Waters.

(d) No timber harvest is permitted within a 56-foot radius buffer patch centered on a headwater spring or, in the absence of

a headwater spring, on a point at the upper most extent of a Type Np Water as defined in WAC 222-16-030(3).

(e) No timber harvest is permitted within an alluvial fan.

(3) **Riparian management zones (RMZ) protection along Type Np Waters.** Forest practices must be conducted to protect Type Np RMZs as detailed below. Where sensitive site protections as outlined in subsection (2) exceed the no-harvest RMZ requirements in this subsection (3, the wider no-harvest buffer requirement shall apply.

(a) When the topographic basin in which harvest will occur is larger than 30 acres and 85 percent or more of the basin is planned, or reasonably expected, to be harvested within a five-year period, the landowner must designate a two-sided 75-foot no-harvest buffer along the entire stream reach of each Type Np Water.

(b) For all other topographic basins and harvests, a 75-foot no-harvest buffer will be established along both sides of the Type Np Water for the first 600 feet upstream from the confluence of Type S or F Water or, for Type Np streams without an above-ground confluence to a Type S or F Water, the lowest 600-foot length of the isolated stream. Upstream of the first 600 feet of a Type Np Water, the RMZ will be established based on stream bankfull width, as follows:

(i) For each Type Np stream three feet bankfull width or greater, the landowner must identify either a partial management strategy or no cut strategy:

(A) For partial management strategy, the landowner must designate a two-sided 75-foot RMZ along the entire stream reach in the harvest unit, and establish:

(I) A no-harvest buffer measuring 50 feet wide, or contained within the sensitive site protection area as described in subsection (2)(a) through (c) of this section; and

(II) A managed zone, either 25 feet wide measured from outer edge of the no-harvest buffer, or the remaining width from the outer edge of the sensitive site to the outer edge of the 75-foot RMZ where:

• Up to 50 percent of the trees may be harvested with an evenly-spaced distribution of leave trees; and

• Leave trees shall be representative of diameters found within the managed zone, and shall be representative of the tree species distribution within the managed zone.

(B) For no cut strategy, the landowner must designate a two-sided 65-foot no-harvest buffer along the entire stream reach in the harvest unit.

(ii) For each Type Np stream less than three feet bankfull width, the landowner must identify and protect the sensitive sites as detailed in subsection (2) of this section, then designate a two-sided no-harvest 50-foot buffer along the entire stream reach in the harvest unit. Where the outer edge of sensitive sites

protections are less than 50-feet from bankfull width or the alluvial fan, the 50-foot buffer shall apply.

(4) Except for the construction and maintenance of road crossings and the creation and use of yarding corridors, no timber harvest will be allowed in the designated no-harvest buffers. Landowners must leave additional acres equal to the number of acres (including partial acres) occupied by an existing stream-adjacent parallel road within a designated additional buffer.

(5) None of the limitations on harvest in or around Type Np Water RMZs or sensitive sites listed in this section will preclude or limit:

(a) The construction and maintenance of roads for the purpose of crossing streams in WAC 222-24-030 and 222-24-050.

(b) The creation and use of yarding corridors in WAC 222-30-060(1): To the extent reasonably practical, the operation will both avoid creating yarding corridors or road crossings through Type Np Water RMZs or sensitive sites and associated buffers, and avoid management activities which would result in soil compaction, the loss of protective vegetation, or sedimentation in perennially moist areas. Where yarding corridors or road crossings through Type Np Water RMZs or sensitive sites and their buffers cannot reasonably be avoided, the buffer area must be expanded to protect the sensitive site by an area equivalent to the disturbed area or by providing comparable functions through other management-initiated efforts. Landowners must leave additional acres equal to the number of acres (including partial acres) occupied by an existing stream-adjacent parallel road within a Type Np Water RMZs or sensitive site buffer.

DEPARTMENT OF NATURAL RESOURCES

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MEMORANDUM

October 27, 2025

TO: Forest Practices Board
FROM: Donelle Mahan, Assistant Division Manager, Senior Policy Planner, Forest Practices Division
SUBJECT: **Type Np Rule Mitigation Examples for Board Consideration**

The Forest Practices Board (Board) received the draft preliminary Type Np cost benefit analysis (CBA) in the May 14, 2025, meeting packet. Industrial Economics, Incorporated (IEc), who developed the CBA, provided a presentation at the May 14, 2025, Board meeting. In addition to the CBA, the proposed rule also required the preparation of a Small Business Economic Impact Statement (SBEIS, RCW 19.85.030(1)(a)). The SBEIS, delivered alongside the CBA, reported more than minor costs on small businesses requiring the consideration of impact reduction measures. The CBA provided potential mitigation strategies in Chapter 6, Section 6.3.2. page 73 and 74, and in the SBEIS in Section 2.4, page 11 which may alleviate financial costs for small businesses and small forest landowners affected by the new Np rule buffer widths.

The following provides additional discussion of mitigation options and impact reduction measures for the Board's consideration. The list of mitigation strategies provided includes current strategies that small businesses and small forest landowners may use immediately after rule adoption and implementation. Additional strategies that would require further action have also been provided for your consideration.

Background

As part of the SBEIS, the Board must consider ways to reduce the costs imposed on small businesses by the proposed rule that would be legal and feasible in meeting the objectives of the Forest Practices Act including the following methods identified in RCW 19.85.030(2):

(a) Reducing, modifying, or eliminating substantive regulatory requirements;
(b) Simplifying, reducing, or eliminating recordkeeping and reporting requirements;
(c) Reducing the frequency of inspections;
(d) Delaying compliance timetables;
(e) Reducing or modifying fine schedules for noncompliance; or

(f) Any other mitigation techniques including those suggested by small businesses or small business advocates.

To meet that obligation, IEC provided a discussion of potential mitigation strategies to offset financial costs to small businesses and small forest landowners in the draft preliminary CBA and the SBEIS which focused on assistance provided through DNR's Small Forest Landowner Office including its administration of the Forestry Riparian Easement Program. The excerpt from the CBA is provided below for ease in your review of the information.

6.3.2 Cost Mitigation Options

Given this distribution of costs and benefits, decision-makers may consider potential mitigation strategies to alleviate the financial costs, particularly to small businesses and SFLs. Several strategies exist, as described in the Small Business Economic Impact Statement (SBEIS) accompanying the proposed rule. DNR provides significant technical and financial assistance to reduce the burden of compliance with existing Forest Practices rules. In 1999, the Washington State Legislature determined that the regulatory requirements for forestland were "diminish[ing] the economic viability of small forest landowners" and established the Small Forest Landowner Office to serve as a resource and focal point for SFL concerns and policies (RCW 76.13.100). This office provides assistance to eligible SFLs to help them meet the requirements of legislation with significant cost implications. To date, the Small Forest Landowner Office has implemented several programs that reduce the compliance costs for businesses.

The Forestry Riparian Easement Program (FREP), in particular, compensates SFLs for the loss of revenue associated with lost timber harvest in riparian buffer areas by offsetting 90 percent of the timber value in return for granting a 40-year conservation easement. Data provided by a manager of FREP indicates that the program has purchased 500 easements between 2001 and 2023.[68] In the 10 most recent years in the data (2014 through 2023), the program compensated SFLs for lost timber harvest on nearly 2,300 acres. Funding for FREP varies from year to year. This program was originally intended to compensate SFLs for the increased costs associated with the 2001 Forest Practices rules, and it is uncertain whether available funding will increase in order to offset the costs of expanded Np buffer requirements.[69] To the extent that SFLs are able to make use of this program to offset any of the land value losses they experience through this rule, the burden of the rule is transferred back to the state and the taxpayers that financially support and benefit from these programs.

Discussion

While the IEC discussion of mitigation strategies are adequate for purposes of the SBEIS, this memorandum provides additional discussion of cost mitigation options to highlight the importance of reducing costs for small businesses, including small forest landowners, and to stimulate further discussion of options for doing so by the Board. The potential cost mitigation strategies in RCW 19.85.030(2) listed above provide the framework for the discussion below, which explores cost mitigation options the forest practices rules currently provide and future actions that may be feasible and consistent with the objectives of the Forest Practices Act.

(a) Reducing, modifying, or eliminating substantive regulatory requirements;

Alternate Plans: Although reducing and eliminating substantive requirements in the proposed rule would not be consistent with the objectives of the Forest Practices Act, current rules provide for alternate plans which may provide a means to modify the requirements of the proposed rule,

and reduce costs to small business owners, based on site specific conditions, provided the modified requirements are equal in overall effectiveness to the proposed rule. WAC 222-12-0401(6).

(b) Simplifying, reducing, or eliminating recordkeeping and reporting requirements;
Small Forest Landowner Office: DNR assistance to small forest landowners may simplify compliance with the requirements of the proposed rule for small forest landowners. The main standard operating procedure implemented in the Forest Practices Program is proactive engagement prior to a landowner submitting their forest practices application/notification (FPA/N). The small forest landowner or their professional consultant may request assistance from:

- The Forest Practices Division's small forest landowner office's (SFLO) regulation assistance foresters and possible expertise provided by the SFLO fish & wildlife biologist based on specific site conditions, or
- Region Forest Practices Program staff by request for a:
  - Pre-application site visit, or an
  - Interdisciplinary team (ID) site visit led by the forest practices forester responsible for review and approval of FPAs within their geographic area.
    - The forest practices (FP) forester invites the necessary expertise to assist with review of the proposal. Internal expertise may be DNR licensed engineering geology staff, civil engineers, timber, fish, and wildlife (TFW) partner field staff from the Departments of Ecology and Fish & Wildlife, affected tribes, a landowner representative, and city and/or county representatives.
      - The information provided during the ID team visit aids the FP forester in making the best decision on the FPA/N based on the information provided during the site visit.

(c) Reducing the frequency of inspections.
Reducing the frequency of inspections for compliance with rule requirements would not be consistent with the objectives of the Forest Practices Act and would not likely result in significant cost reductions for small businesses including small forest landowners.

(d) Delaying compliance timetables;
Delaying the effective date of the rule – beyond a reasonable timeframe needed for preparation and implementation - would not be consistent with the resource protection objectives of the Forest Practices Act.

(e) Reducing or modifying fine schedules for noncompliance;
The Forest Practices Act and Board policy encourage informal, practical, result-oriented resolution of alleged rule violations. WAC 222-46-010. To effectuate that policy, DNR uses a progressive approach to enforcement that usually begins with consultation and voluntary efforts at compliance and typically reserves civil penalties for more serious infractions. As a result, civil

penalties are not a significant cost for most small forest landowners. Reducing civil penalties would thus not be consistent with the objective of reducing costs or with the resource protection objectives of the Forest Practices Act.

(**f) Any other mitigation techniques including those suggested by small businesses or small business advocates**

1. Expand assistance offered through the small forest landowner office (SFLO). Within the next year after rule implementation, the SFLO staff could review the opportunities for additional training and the creation of manuals/guides to assist small forest landowners with the new Np rule implementation. The new rule once implemented will help inform the tools DNR provides.

2. FREP. As noted by IEC, the Forestry Riparian Easement Program compensates small forest landowners for the loss of revenue associated with lost timber harvest in riparian buffer areas by compensating small forest landowners for 90 percent of the timber value in those areas in return for a 40-year conservation easement. FREP provides a significant mechanism to reduce costs from the proposed rule on small businesses that are small forest landowners, but funding for the program from the Legislature is variable.

The Board may wish to consider seeking additional, dedicated funding from the Legislature for the program to help offset the additional costs imposed by the proposed rule on small forest landowners. To facilitate that objective, DNR could collaborate with TFW partners to go to the Legislature in 2026 and beyond to request additional, dedicated capital funding to purchase easements, assist with applications, and maintain program staff.

3. Tax incentives. Small and large forest landowners could pursue a tax incentive that would decrease the amount of tax paid when a forest practices activity contains an Np buffer. Legislation would be required to create such a tax incentive.

Path Forward

The Board is encouraged to consider the list of cost reduction measures provided above and, through consultation with the regulated community, fully evaluate the feasibility of these and other options to reduce costs on small businesses that may be brought forward through consultation.

c: Saboor Jawad, Forest Practices Division Manager
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IEc

Washington State Type Np Water Buffer Rule

Final Cost-Benefit Analysis

October 24, 2025

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The IEc project managers and lead analysts are Maura Flight, Megan Sheahan, Isabel Holland, and Levi McAtee. The IEc team also included James Shannon and Michelle Toner of Haley & Aldrich.

Acronyms

7DADM	7-day Average Daily Maximum
AMP	Adaptive Management Program
BEA	Bureau of Economic Analysis
BFW	Bankfull Width
CBA	Cost-Benefit Analysis
CMER	Cooperative Monitoring, Evaluation and Research
CWA	Clean Water Act
DNR	Washington Department of Natural Resources
DOR	Washington Department of Revenue
Ecology	Washington State Department of Ecology
EDH	Elevation-Derived Hydrography
ESA	Endangered Species Act
FIA	Forest Inventory and Analysis
FPA	Forest Practices Application
FREP	Forestry Riparian Easement Program
FVS	Forest Vegetation Simulator
GIS	Geographic Information System
GNN	Gradient Nearest Neighbor
HCP	Habitat Conservation Plan
HUC	Hydrologic Units
IEc	Industrial Economics, Inc.
IPaC	Information for Planning and Consultation Database
LEMMA	Landscape Ecology, Modeling, Mapping, and Analysis
LSI	Landslide Susceptibility Index
Mbf	Thousand Board Feet
MMbf	Million Board Feet
NSO	Northern Spotted Owl

RCW	Revised Code of Washington
RMZ	Riparian Management Zone
SBEIS	Small Business Economic Impact Statement
SC-CO_2	Social Cost of Carbon Dioxide
SFL	Small Forest Landowner
SSN	Synthetic Stream Network
TFW	Timber, Fish, and Wildlife
TMDL	Total Maximum Daily Load
Type F	Fish
Type N	Non-fish
Type Np	Non-fish bearing (Type N) perennial (p)
Type Ns	Non-fish bearing (Type N) seasonal (s)
Type Nu	Non-fish bearing (Type N) unknown (u)
Type S	“Shorelines of the state”
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WAC	Washington Administrative Code
WC Hydro	DNR’s Hydrography – Watercourses GIS Open Layer
WDFW	Washington Department of Fish and Wildlife
WFPA	Washington Forest Protection Association
WQI	Water Quality Index
WTP	Willingness to Pay

Executive Summary

This report provides the results of a Cost-Benefit Analysis (CBA) of the Type Np Buffer Rule ("the rule") defined by the Washington Forest Practices Board. The rule would amend WAC 222-30-021(2) by updating the requirements for the width and lengths of Riparian Management Zones (RMZs) adjacent to non-fish bearing perennial steams (Type Np) in western Washington specifically. Riparian buffers are designed to protect water quality, stabilize stream banks, provide habitat for riparian and aquatic species, and maintain stream temperatures.

The primary objective of this rule is to improve temperature protections for Type Np streams in western Washington to achieve compliance with water pollution control laws (RCW 90.48.420, WAC 222-12-010) and meet the overall performance goals of the Forest Practices Habitat Conservation Plan (HCP) and WAC 222-12-045(2)(a)(ii)(C). The strategy to achieve the objective is a rule that expands riparian buffers along Type Np streams relative to baseline conditions in order to prevent an increase in mean 7-day maximum water temperature of 0.3°C or greater from human activities above natural conditions per WAC 173-201A-320, or an increase above specified temperature thresholds on waters designated for aquatic life or else specified in WAC 173-201A-200 and -602.

The Forest Practices Board determined that a CBA is required for the rule pursuant to Revised Code of Washington (RCW) 34.05.328. The objective of the CBA is to provide information to allow the Board to "…[d]etermine that the probable benefits of the rule are greater than its probable costs, taking into account both the qualitative and quantitative benefits and costs and the specific directives of the statute being implemented" (RCW 34.05.328(1)(d)). This report provides the basis for that determination.

SUMMARY OF KEY FINDINGS

- This analysis finds that the probable benefits of the rule are likely greater than the probable costs, considering both quantitative and qualitative benefits and costs as described in Sections ES-3 and ES-4.
- These findings reflect the landscape scale of the analysis across western Washington. It is likely that the relative benefits and costs of the rule differ by site based on site-specific characteristics (e.g., environmental and ecological factors and land management strategies).
- The analysis is subject to uncertainties, in particular regarding the total extent of affected stream in western Washington and the site-specific characteristics of the affected streams and adjacent riparian areas. The high-level finding regarding the weighing of probable costs and benefits takes these uncertainties into consideration as detailed throughout the analysis.
- This analysis emphasizes the significant distributional effects of the rule. That is, the burden of the costs is not evenly shared. Timber landowners, including small forest landowners, and the timber industry bear the major costs of the rule, including substantial reductions in land value and industry economic activity. In contrast, the benefits—including water quality and ecological improvements—are widely distributed across the general public. In light of this finding, Section 6.3 describes potential cost mitigation options.

ES.1 Summary of the Final Rule

The rule would amend the existing Type Np buffer requirements at WAC 222-30-021(2). Under the current rule, a 50-foot, no-harvest buffer must be established based on the length of the Type Np water from the confluence of Type S or F water (i.e., F/N or F/S breakpoint), with additional buffering around sensitive sites. In the amended rule, sensitive sites must be identified and protected before establishing the Type Np RMZ and buffers. For topographic basins larger than 30 acres in which 85 percent or more of the basin is planned to be harvested within a five-year period, landowners must leave a two-sided, 75-foot, no-harvest buffer along the entire stream reach of each Type Np water.

In all other scenarios, landowners must first leave a two-sided, 75-foot, no-harvest buffer for the first 600 feet upstream from the confluence of Type S or F Water, and then evaluate further buffer prescriptions based on bankfull width (BFW) and landowner management strategies. For each Type Np stream of three-foot BFW or greater, the landowner must identify either a partial management strategy or a no-cut strategy. The partial management strategy requires a 75-foot riparian zone, including a 50-foot no-harvest buffer and a 25-foot managed zone where up to 50 percent of trees may be harvested. The no-cut strategy requires a 65-foot no-harvest buffer along the stream reach. For all streams with BFW of less than three feet, landowners are required to leave a 50-foot, continuous no-harvest buffer along the remainder of the stream reach.

The changes in buffer requirements at any specific site are conditional on a range of factors, including Type Np stream length within the landowner-specific harvest unit, and vary based on basin size, planned forest harvest extent, stream BFW, and other forest management strategies. In most cases, the rule increases buffer width and length relative to the current rule. Table ES-1 summarizes requirements of the current rule, final rule, and changes under specific circumstances. Section 1.1 provides more information on the final rule requirements relative to the current rule.

Table ES-1. Changes to Buffer Requirements on Type Np Streams in Western Washington

Rule			Distance upstream of F/N break (feet)			
			<300'	300'-600'	600'-1000'	>1000'
Current Rule (Baseline)		For all Type Np streams (apart from those with sensitive sites)	50' no-harvest buffer	50' no-harvest buffer that is the greater of 300' or 50% of the entire length of the Type Np water		50' no-harvest buffer on the first 500' + additional % of total stream length
Final Rule	Rule Scenario 2	If basin>30 acres and >85% harvest planned within a five-year period	75' no-harvest buffer the entire length of the Type Np Water			
		Incremental change:	*Additional 25' buffer in lengths where buffer is required in the current rule; additional 75' buffer in lengths where no buffer is required in the current rule*			
	Rule Scenario 1A	If basin<30 acres and/or <85% harvest planned within a five-year period + partial management strategy and BFW>3'	75' no-harvest buffer for the first 600' upstream from the confluence		50' no-harvest buffer along the entire stream reach in the harvest unit + additional 25' outer buffer representing 50% harvest zone (partial-harvest zone)	
		Incremental change:	*Additional 25' no-harvest buffer*	*Additional 25' no-harvest buffer, for up to an additional 300'*	*Additional 25' partial harvest buffer, length depends on stream reach length within harvest unit*	
		Scenario 1A, if BFW<3'	75' no-harvest buffer for the first 600' upstream from the confluence		50' no-harvest buffer along the entire stream reach in the harvest unit	
		Incremental change:	*Additional 25' no-harvest buffer*	*Additional 25' no-harvest buffer, for up to an additional 300'*	*No change in buffer width where it was required previously, additional 50' buffer where new buffer required; additional buffer length depends on stream reach length within harvest unit*	
	Rule Scenario 1B	If basin<30 acres and/or <85% harvest planned within a five-year period + no-cut strategy and BFW>3'	75' no-harvest buffer for the first 600' upstream from the confluence		65' no-harvest buffer along the entire stream reach in the harvest unit	
		Incremental change:	*Additional 25' no-harvest buffer*	*Additional 25' no-harvest buffer, for up to an additional 300'*	*Additional 15' no-harvest buffer, length of new buffer depends on stream reach length within harvest unit*	
		Scenario 1B, if BFW<3'	75' no-harvest buffer for the first 600' upstream from the confluence		50' no-harvest buffer along the entire stream reach in the harvest unit	
		Incremental change:	*Additional 25' no-harvest buffer*	*Additional 25' no-harvest buffer, for up to an additional 300'*	*No change in buffer width where it was required previously, additional 50' buffer where new buffer required; additional buffer length depends on stream reach length within harvest unit*	

Note: The buffers and incremental changes described in the above table do not differentiate between the nuances of the current rule, where landowners must consider the total length of each separate Type Np stream system where at least a portion of the system is within their harvest unit, and the final rule, which emphasizes stream length within the landowner-specific harvest unit. Sensitive sites, as outlined in both the current and final rule, are also not accounted for in the buffers and incremental changes outlined above. As such, the changes described above are simplified representations of the final rule.

ES.2 Estimated Changes in Extent of Type Np Buffers

A key input for most rule effect categories in this analysis is the change in acres of no-cut and partial-cut riparian buffers adjacent to Type Np streams in western Washington relative to the current rule baseline. Our approach to quantifying changes in buffer areas relies on geospatial modeling conducted by Four Peaks (Four Peaks 2024a) as well as extrapolation to the ecoregions of western Washington. Given data limitations, we provide both low- and high-end estimates that incorporate assumptions about which forestland is affected by the rule as well as the extent of the Np network. At the high end, we quantify affected Np streams by including all Type Np streams adjacent to forestland subject to Forest Practices rules, and assuming that 94 percent of the Type N stream length for which perennial or seasonal status is unknown (i.e., "unknown" Type N stream, also referred to as "Type Nu") is Type Np. At the low end, we quantify affected Np Streams by limiting the analysis to Np streams adjacent to forestland subject to the Forest Practices rules that do not have other harvest restrictions (e.g., due to unstable slopes or conservation status) absent the rule. Additionally, the low-end estimate assumes 42 percent of the Type Nu streams are Type Np streams.

As presented in Table ES-2, our low-end estimate finds an increase in approximately 67,000 acres of no-harvest buffers and 2,900 acres of partial harvest buffers. At the high end, our analysis finds an increase in approximately 170,000 acres of no-harvest buffers and 8,600 partial harvest buffers. We expect that the actual effect of the rule would fall within this range. This area is equivalent to approximately 0.8 percent to 2.2 percent of all private and municipal forestland in western Washington (8.2 million acres, according to spatial data from Attebury Consultants), and 1.1 to 2.9 percent of the approximately 6.1 million acres of non-Federal and non-tribal forestland covered by the Forest Practices HCP.

Table ES-2. Estimated Increases in Np Buffer Acres Across Western Washington (Acres)

Ecoregion	Low-end: Only "likely harvestable" forestland, 42% Nu are Np		High-end: All "regulated" forestland, 94% Nu are Np	
	No cut	Partial cut	No cut	Partial cut
Cascades	24,127	890	62,462	2,251
Coast Range	32,502	1,274	80,776	3,538
North Cascades	3,799	720	13,435	2,647
Puget Lowland	6,230	61	14,619	143
Willamette Valley	427	4	980	10
Total	67,085	2,949	172,271	8,589

Source and notes: IEc analysis described in Chapter 2 of the main text.

In the sections that follow, this analysis separately presents the probable costs and benefits of the rule (measured in terms of social welfare values, see Sections ES.3 and ES.4) and the regional economic impacts of the rule (measured in terms of economic activity, see Section ES.5). Chapter 5 provides more details about the rationale for analyzing changes in overall societal well-being as well as the distributional effects of a rule, including why they are presented separately in regulatory analysis. While distinct measures and analysis frameworks, both may be relevant for decision making.

ES.3 Summary of Probable Costs and Benefits

We evaluate the *incremental* costs and benefits for the rule by comparing Type Np buffer prescriptions in Washington under two scenarios: the world with the rule and the world without the rule. The world without the rule reflects the regulatory baseline for the analysis. We focus on "social welfare effects," which are measures of "economic efficiency" and reflect changes in societal well-being. The analysis evaluates economic costs and benefits over a 45-year time period between the year the rule would take effect (expected 2025) through 2070. This timeframe is tied to average harvest rotations in western Washington and balances the need to capture the important benefits of the rule that grow over time with the growing uncertainty regarding the socioeconomic and biophysical state of the world over longer timeframes.

This analysis assesses costs and benefits that are "probable" effects of the rule, consistent with RCW 34.05.328. While we attempt to quantify and monetize these effects where possible, several of the important effects of the rule are discussed qualitatively given information limitations. Where data limitations preclude monetizing or quantifying particular categories of costs or benefits, we rely upon available qualitative information to assign a categorical magnitude to all effect categories, as summarized in Table ES-3. Given significant uncertainty in the total extent of Np stream miles in western Washington, which is used as a key input into the total quantified and monetized probable cost and benefit categories, we additionally report our results on a "per stream mile" basis in Table ES-4.

Table ES-3. Summary of Probable Costs and Benefits of the Np Buffer Rule

Incremental costs	Incremental benefits

Major costs
• Decreased forestland values
  ○ Total present value losses of $320 million to $1.0 billion, reflecting added harvest restrictions on 1.1 to 2.9 percent of Forest Practices HCP land in western Washington
  ○ On an annualized basis, these losses are equivalent to $11 to $35 million assuming a 2% discount rate (alternatively, annualized costs are $17 to $54 million assuming a 4.5% discount rate)
  ○ These costs are concentrated among forestland owners in western Washington
Minor costs
• Increased forest harvest operating costs
  ○ At most 16 percent of Np streams abut slopes where cable harvest may become more costly
  ○ Increased costs per thousand board feet (Mbf) are uncertain but likely minor where the rule widens existing buffers, and moderate for areas where buffers do not exist with the current rule and would be required under the rule
  ○ These costs are incurred by a sub-set of forestland owners
	Moderate to major benefits
	• Reduced risk of stream temperature increases
	  ○ Existing evidence and expert review demonstrate that longer and wider buffers are necessary to minimize the risk of stream temperature increases associated with harvest near Np streams
	  ○ Economics literature consistently demonstrates that people value improvements in water quality, regardless of whether they directly use the resource (e.g., for drinking or recreation)
	• Improved habitat conditions for terrestrial riparian wildlife
	  ○ 67,000 to 170,000 additional acres with harvest restrictions, representing 0.4 to 0.9 percent of all forest habitat in western Washington (regardless of owner)
	  ○ Economic valuation literature identifies that the public, including Washington State households, hold substantial value for species conservation and restoration, including through habitat protection
	Minor to moderate benefits
	• Improved habitat conditions for stream-associated amphibians
	  ○ 19,000 to 44,000 Np stream miles with requirements for wider or longer buffers that will protect species from stream temperature increases and improve general habitat quality
	Additional benefits
	• Tribal cultural values: As described in Section 4.4, the cultural importance of these ecosystems to tribes are best communicated by the tribes.
	Negligible to minor benefits
	• Increased habitat conditions for fish downstream of Np streams
	  ○ Increased delivery of organic matter, macroinvertebrates, nutrients, and cooler water, although improved conditions do not persist far downstream
	• Increased carbon sequestration
	  ○ Likely positive effect in reducing atmospheric carbon, although significant uncertainty exists regarding magnitude of this benefit due to influence of timber management practices and uses of the harvested timber on carbon budget
	  ○ On the order of 220,000 to 3.3 million MT CO_2 increase in total carbon sequestered relative to active timber rotation over the first 45 years of rule implementation
	  ○ Reduction in annual atmospheric carbon represents between 0.005 percent and 0.07 percent of all emissions in the state
	  ○ Avoided climate damages associated with increased carbon sequestration experienced at a global level

Notes: This table only includes the probable costs and benefits of the rule, as opposed to the regional economic impacts, to facilitate a comparison in the next section.

Table ES-4. Summary of Probable Rule Effects Per Average Np Stream Mile in Western Washington

Impact Category	Method and Source	Estimate
Land use change per Np stream mile (45 years)		
Number of acres with harvest exclusions	(Total no-cut acres (Table 10) + Half of partial-cut acres (Table 10)) / Total Np miles affected (Table 4)	3.7 – 4.0 acres per Np stream mile
Probable costs per Np stream mile (45 years)		
Decreased forestland values	Total present value of land losses (Table 13) / Total Np miles affected (Table 4)	$17,000 – $23,000 lost land value per Np stream mile
Increased forest harvest operating costs	Portion of Np stream miles adjacent to Np streams with slopes > 35 percent (Table 15)	16 percent of Np stream mile will experience increased costs
Probable benefits per Np stream mile (45 years)		
Reduced risk of stream temperature increases	Qualitative	Qualitative
Improved wildlife habitat quality	Qualitative	Qualitative
Increased carbon sequestration	Total CO_2 reduction (Table 22) / Total Np miles affected (Table 4)	12 – 74 t CO_2-eq per Np stream mile
Tribal cultural values	Qualitative	Qualitative
Regional economic impacts per stream mile (annual)		
Reduction in timber production	Decrease in annual timber harvest (Table 25) / Total Np miles affected (Table 4)	0.7 – 1.3 Mbf per Np stream mile
Job-years	Total job-years lost per year (Table 27) / Total Np miles affected (Table 4)	0.02 – 0.04 total lost jobs per Np stream mile
Wages	Total wages lost per year (Table 27) / Total Np miles affected (Table 4)	$1,300 – $2,400 total lost wages per Np stream mile
Revenue	Total revenue lost per year (Table 27) / Total Np miles affected (Table 4)	$7,700 – $15,000 lost wages per Np stream mile
Timber excise tax revenue	Total revenue lost per year (Table 27) / Total Np miles affected (Table 4)	$16 – $27 lost taxes per Np stream mile

ES.4 Weighing of Probable Costs and Benefits

According to RCW 34.05.328, the objective of the CBA for a rule is to determine whether the probable benefits of the rule outweigh the probable costs, *taking into account both quantitative and qualitative benefits and costs and the specific directives of the statute being implemented*. Based on the information and analysis presented in this CBA, we find that the probable benefits of the rule likely outweigh the probable costs. This determination is based on the following comparison of rule outcomes that we determined are both probable and more than minor:

- The total forestland value losses are likely on the order of $320 million to $1.0 billion. This is a significant cost, all incurred in the first year the rule goes into effect. While these total present value losses are most salient, we also present these losses in annualized terms for comparison with other rule effects that can be expressed in annualized terms. We calculate annualized effects assuming both 2 percent and 4.5 discount rates (reflecting uncertainty in the social discount rate) over the 45-year analysis timeframe.[1] When applying these assumptions, we estimate annualized land value losses on the order of $11 million to $35 million (assuming a 2 percent discount rate); these annualized losses range from $17 million to $54 million (assuming a 4.5 percent discount rate). We focus our weighing of probable costs and benefits on whether the combined benefits are likely to exceed these major costs.

- Based on the available scientific evidence and expert judgment relied upon for developing the rule, the wider and longer Np stream buffers associated with the rule relative to the current rule are required to meet water quality standards. Therefore, the reduced risk of stream temperature increases is a probable benefit of the rule. Because this body of evidence suggests water quality standards cannot be consistently achieved absent this rulemaking, we categorize the reduced risk of stream temperature increases as a moderate to major benefit of the rule. The economic valuation literature demonstrates that people broadly value improvements in water quality, although it is scant on research specific to water temperature. Recent valuation studies identify that these preferences also extend to "non-use" attributes of the water resources, meaning people value water quality improvements even in waterways they do not access for direct use, for example for recreation or drinking water purposes.

- The analysis additionally finds moderate to major benefits to riparian wildlife given the significant increase in riparian forest habitat that will remain undisturbed on account of the buffer requirements. The rule increases habitat availability and reduces habitat fragmentation in areas of high biodiversity and of importance to 85 percent of the terrestrial vertebrate species in Washington. The benefits to stream-associated invertebrates and fish occurring downstream of the Type Np streams affected are less certain and thus are characterized as minor to moderate and negligible to minor level benefits, respectively. Limitations in both the ecological research and economic valuation literature impede our ability to directly compare the combined magnitude of the ecological benefits to species habitat with the land value losses. However, this literature does provide perspective on how people value the protection and conservation of wildlife, including species that depend upon the riparian habitats of Washington State. The species valuation literature demonstrates that the public holds significant value for actions that conserve and protect vulnerable species and their habitats.

- The added riparian buffer improves riparian functions more broadly. The economics literature, while insufficient to monetize the benefits, demonstrates that people value the suite of ecosystem services provided by riparian buffers. To provide context regarding the benefits people derive from riparian ecosystem functions, we consider findings from a study that quantifies the value people hold for

[1] Because land value losses reflect a loss in potential future uses of the land in perpetuity, annualizing over a 45-year timeframe likely *overstates* the annualized effect of land value losses.

widening buffers on private timberland in another setting, specifically in New Brunswick, Canada. As described in Section 4.5, based on the low-end per household value ($7.85) from that study, annualized benefits to Washington residents of the additional riparian habitat protection may be on the order of tens of millions of dollars. Given uncertainty regarding the applicability of the source study to the Np rule context, **we do not include this value as a measure specifically of the benefit of the rule**. However, the values identified through this research on riparian buffers provide empirical support for the positive preferences the public holds for water quality and species protection resulting from riparian habitat protection, even for households distant from the protected riparian area.

- While the economics literature quantifying values people hold for ecosystems and species focuses on surveys of the general population, we recognize the unique relationship and knowledge held by western Washington tribes regarding the riparian habitats benefiting from this rule. Tribes and indigenous communities more broadly value the natural environment as an interconnected and inseparable system. We do not impose a monetized value construct on tribal cultural values in this CBA but emphasize the importance of considering information provided by tribes in decision-making regarding the rule.

- While costs and benefits are likely to vary depending on site-specific factors, this analysis focuses on quantifying the effects of additional Np stream mile buffers at a landscape scale. Accordingly, the costs and benefits are generally scalable. That is, while the total extent of affected Np miles influences the magnitudes of the benefits and costs, the weighing of probable benefits and costs is not materially affected by the total number of Np stream miles affected. We therefore provide information on costs and benefits "per average stream mile" for additional context and perspective, recognizing the uncertainty regarding the total number of Np stream miles affected by the rule.

Given our analysis demonstrating that the effects of the rule on carbon sequestration and on fish habitat downstream of the Np streams are negligible to minor, these effects do not materially factor into the overall finding that the probable benefits of the rule likely outweigh the probable costs.

ES.5 Regional Economic Impacts

The above analysis of the rule's probable costs and benefits considers whether society as a whole is better off, as measured in terms of economic efficiency. It is also prudent to consider the distribution of costs and benefits across specific populations. Regional economic impact analyses demonstrate how specific economic sectors in a given geographic region experience impacts to their business activity due to the rule by measuring changes in the flow of dollars through regional economies. In this report, we estimate the impacts of the rule on regional economic activity stemming from changes in annual timber harvest from the additional acres conserved in the rule-required Np buffers.

To accomplish this, we first estimate the annual reduction in timber harvest volume associated with the forestland removed from timber production presented in Table ES-2. At the low end, we estimate an annual loss in timber harvest on the order of 13,000 Mbf. At the high end, the loss is estimated to be 57,000 Mbf on an annual basis. This lost annual harvest is associated with the range of economic impacts presented in Table ES-5. These losses in job-years and annual wages represent 0.5 percent to 2.1 percent of the total forest product industry in 2021. The high end of this range corresponds directly to the total portion of regulated forestland removed from harvest (see Section ES-2). However, the low end extends beyond the range reported in that same section because we assume only a portion of the harvest is displaced from the region (i.e., that some harvest restrictions in buffer areas are made up for through more intensive harvest in other areas of the state).

Table ES-5. Estimated Annual Regional Economic Impacts by Ecoregion

Ecoregion	Direct Job-Years		Total Job-Years		Total Wages (million$/Year)		Revenue (million $/Year)		Stumpage Taxes (million $/Year)	
	Low	High	Low	High	Low	High	Low	High	Low	High
Cascades	77	351	208	946	$11.9	$54.0	$70.2	$318.9	$0.1	$0.5
Coast Range	29	127	72	314	$5.2	$22.5	$31.7	$138.6	$0.1	$0.5
North Cascades	19	118	45	282	$2.6	$16.4	$16.7	$104.0	$0.0	$0.1
Puget Lowland	25	102	59	242	$3.4	$14.0	$22.1	$91.1	$0.0	$0.1
Willamette Valley	3	10	8	31	$0.4	$1.7	$2.2	$9.0	$0.0	$0.0
Total	153	709	392	1,816	$23.5	$108.6	$143.0	$661.6	$0.3	$1.2
% W WA	*0.5%*	*2.1%*	*0.5%*	*2.2%*	*0.5%*	*2.2%*	*0.5%*	*2.2%*	*0.5%*	*2.5%*

Source: IEc analysis using inputs described in the main text. The low-end estimates reflect only "likely harvestable" forestland, the assumption that 42 percent of Nu streams in WC Hydro at Np, and 43 percent leakage. The high-end estimates reflect all "regulated" forestland, the assumption that 94 percent of Nu streams in WC Hydro are Np, and no leakage.

CHAPTER 1 | Introduction

Washington Administrative Code (WAC) 222-30-021 regulates timber harvest within Riparian Management Zones (RMZs) in western Washington. These regulations include requirements for "riparian buffers," which are areas within a specified distance of the outer edge of a stream in which timber harvest is precluded or restricted. Riparian buffer size varies depending on site characteristics, including whether a stream is known fish habitat (Type F) or not fish bearing (Type N). Riparian buffers on Type N waters are designed to protect water quality, stabilize stream banks, provide habitat for riparian and aquatic species, and maintain stream temperatures. Buffer requirements differ between Type N streams that are perennial (Type Np) and that flow only seasonally (Type Ns). Type Np streams are typically found in the upper watersheds and headwaters in western Washington because they begin at the uppermost point of perennial flow.

In 2018, the Cooperative Monitoring, Evaluation, and Research (CMER) Committee's *Type N Experimental Buffer Treatment Project on Hard Rock Lithologies (Phase 1)* ("Hard Rock Study", McIntyre et al. 2018) determined that the current buffer prescriptions for forest adjacent to Type Np waters were insufficient to ensure that streams consistently meet state water quality standards with regard to stream temperature. Specifically, the water quality standards mandate no temperature increase of 0.3°C or greater (measured by the 7-day maximum temperatures) above natural condition (WAC 173-201A-200, -300-320).[2] As a result, in May 2019, the Forest Practices Board accepted the Timber, Fish, and Wildlife Policy Committee's (TFW Policy) recommendation that action was warranted as a result of these findings and directed TFW Policy to develop a Type Np buffer recommendation for the Board to minimize or prevent temperature increases in streams protected by rule-required riparian buffers (Forest Practices Board 2022).

The 2019 action plan recognized that five additional CMER Type Np studies needed to be completed to complement the Hard Rock Study and better inform a Type Np buffer rulemaking proposal. TFW Policy established a working group to develop buffer options that would 1) minimize the likelihood of exceeding temperature standards in Np streams after harvest; 2) reduce post-harvest withdrawals to maintain a future supply of large wood; and 3) mitigate economic impacts on landowners (Barnowe-Meyer et al. 2021). The working group developed and evaluated seven alternate prescriptions and concluded that three alternatives could best balance the trade-off between stream temperature protections and economic impact, as follows: 1) a 75-foot, two-sided, no-harvest buffer; 2) a site-specific buffer based on effective shade; and 3) an aspect-based buffer based on Np stream orientation.

Based on the findings of the CMER Hard Rock Study (McIntyre et al. 2021), a 2021 CMER Soft Rock Study (Ehinger et al. 2021), and the Technical Type Np Prescription Workgroup report (Barnowe-Meyer et al. 2021), the Forest Practices Board seeks to update the Type Np Water Buffer Rule. In June 2025, the Forest Practices Board defined a proposed rule to update the Np buffer requirements. The proposed rule was made available for public comment in summer 2025; the final rule is consistent with the proposed rule. The Forest Practices Board determined that a Cost-Benefit Analysis (CBA) is required pursuant to Revised Code of Washington (RCW) 34.05.328. The objective of the CBA is to provide information to allow the Board to "…[d]etermine that the probable benefits of the rule are greater than its probable costs, taking into account both the qualitative and

[2] Water bodies can have a more stringent temperature criterion based on absolute 7-day maximum temperatures if they are designated for aquatic life or require special protection for salmonid spawning and egg incubation, or 1-day maximum temperatures if specified under WAC 173-201A-602. The rules also allow for exceptions where Ecology determines that lowering of water quality is necessary and is in the overriding public interest, per WAC 173-201A-320(4).

quantitative benefits and costs and the specific directives of the statute being implemented" (RCW 34.05.328(1)(d)). This report provides the basis for that determination.

1.1 Objective and Description of the Final Rule

The Forest Practices Board is updating the Type Np Water Buffer Rule with a primary objective of improving temperature protections for Type Np streams in western Washington to achieve compliance with water pollution control laws (RCW 90.48.420, WAC 222-12-010) and meet the overall performance goals of the Forest Practices Habitat Conservation Plan (HCP) and WAC 222-12-045(2)(a)(ii)(C). The strategy to achieve the objective is a rule that expands riparian buffers along Type Np streams relative to baseline conditions in order to prevent an increase in mean 7-day maximum water temperature of 0.3°C or greater from human activities above natural conditions per WAC 173-201A-320, or an increase above specified temperature thresholds on waters designated for aquatic life or else specified in WAC 173-201A-200 and -602.

Partial vs. No-Cut Management Strategy

Under proposed revised WAC 222-30-021(2), and for all circumstances in which the basin is greater than 30 acres and 85 percent harvest is planned within a five-year period, the landowner must identify either a "partial-cut" and/or "no-cut" management strategy for each unit to be harvested within fifty horizontal feet of the outer edge of bankfull width (BFW) of the stream.

Partial cutting refers to the removal of a portion of the merchantable volume in a stand of timber to leave an uneven-aged stand of well-distributed residual, healthy trees that will reasonably utilize the productivity of the soil.

Clearcut is a harvest method in which the entire stand of trees is removed in one timber harvesting operation.

Under WAC 222-30-021(2), the current Forest Practices Type Np Water Buffer Rule, a 50-foot, no-harvest buffer must be established based on the length of the Type Np water from the confluence of Shoreline water (Type S) or F water (i.e., F/N or F/S breakpoint), with additional buffering around sensitive sites (for more details on WAC 222-30-021, see Appendix A Figure A-1). At a minimum, the existing rule requires a 300- to 500-foot minimum buffer length upstream of the F/N break and a buffer along 50 percent of the overall stream length.

In amended WAC 222-30-021(2), sensitive sites must be identified and protected before establishing the Type Np RMZ and buffers. For topographic basins larger than 30 acres in which 85 percent or more of the basin is planned to be harvested within a five-year period, landowners must leave a two-sided, 75-foot, no-harvest buffer along the entire stream reach of each Type Np water. In all other scenarios, landowners must first leave a two-sided, 75-foot, no-harvest buffer for the first 600 feet upstream from the confluence of Type S or F Water. For stream length beyond the first 600 feet, a landowner must evaluate buffer prescriptions based on bankfull width (BFW) and landowner management strategies, including either a partial management strategy or a no-cut strategy (see text box above). When BFW is greater than three feet, the partial management strategy requires a 75-foot riparian zone, including a 50-foot no-harvest buffer and a 25-foot managed zone where up to 50 percent of trees may be harvested. The no-cut strategy along streams of the same BFW requires a 65-foot no-harvest buffer along the stream reach. When BFW is less than three feet, landowners are required to leave a 50-foot no-harvest buffer along the stream reach under both management strategies (for more details on the revisions to WAC 222-30-021(2), see Appendix A Figure A-2).

Table 1 describes changes to buffer prescriptions between the current rule and the final rule based on Np stream distance upstream of an F/N break, absent other limitations that restrict or prohibit timber harvest. Under the current rule, landowners must determine the total length of each separate Type Np stream system, where at least a portion of the system is within their harvest unit, and apply a two-sided 50-foot buffer based on stream length.

Under the final rule, buffer widths are based on Type Np stream length within the landowner-specific harvest unit and vary based on basin size, planned forest harvest extent, stream BFW, and other forest management strategies.

In most circumstances (excluding incremental changes marked as "No Change" in Table 1), the rule increases buffer width and length. In particular, under conditions where the basin exceeds 30 acres and significant harvest is planned, the rule requires a uniform 75-foot no-harvest buffer along the entire stream reach. In scenarios where these conditions are not met, and the BFW exceeds three feet, the rule requires a 75-foot buffer for the first 600 feet upstream, with varied buffer lengths beyond this point depending on timber management strategy. Incremental changes generally add 25 feet to the existing buffer width, with additional increases in specific circumstances. Under a partial management strategy, the rule also requires an additional 25-foot buffer (beyond the 50-foot no-harvest buffer) within which up to 50 percent of trees can be harvested (referred to as "partial-harvest buffer" in this document). In areas where the BFW does not exceed three feet beyond the first 600 feet upstream, the rule results in increased length of 50-foot no harvest buffers. Specifically, buffers are required on up to 50 percent of the stream length under the current rule (based on stream length above the confluence of Type S or Type F water) whereas under the final rule would require buffers along the entire Np stream length.

The rule would continue to require additional buffering around sensitive sites (defined as perennially saturated soil zones from headwall seep or side slope seeps, a point of intersection of two or more Type Np waters, a headwater spring, or an alluvial fan), resulting in no change from current requirements at these sites. Table 1 refers to conditions within the final rule (i.e., basins larger than 30 acres in which 85 percent or more of the basin is planned to be harvested within a five-year period) as "rule scenarios," as presented in geospatial analysis performed by Four Peaks (Four Peaks 2024a, see Chapter 2 for details).

Table 1. Changes to Buffer Requirements on Type Np Streams in Western Washington

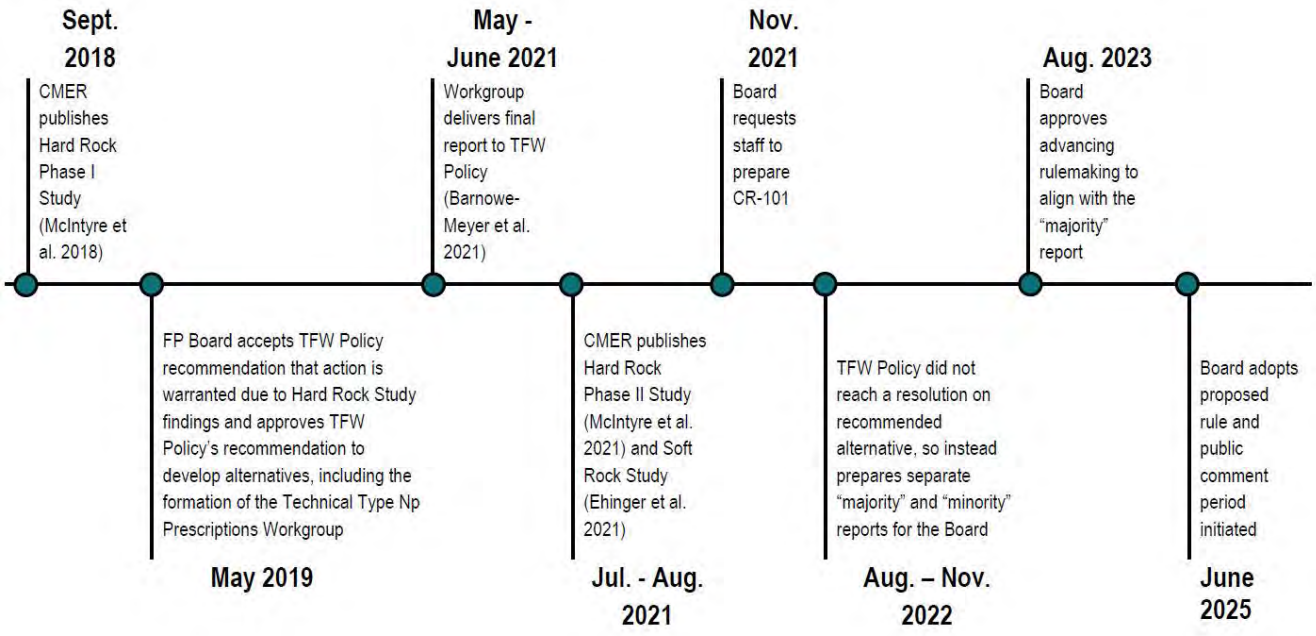
Rule			Distance upstream of F/N break (feet)			
			<300’	300’-600’	600’-1000’	>1000’
Current Rule (Baseline)		For all Type Np streams (apart from those with sensitive sites)	50’ no-harvest buffer	50’ no-harvest buffer that is the greater of 300’ or 50% of the entire length of the Type Np water		50’ no-harvest buffer on the first 500’ + additional % of total stream length
Final Rule	Rule Scenario 2	If basin>30 acres and >85% harvest planned within a five-year period	75’ no-harvest buffer the entire length of the Type Np Water			
		Incremental change:	*Additional 25’ buffer in lengths where buffer is required in the current rule; additional 75’ buffer in lengths where no buffer is required in the current rule*			
	Rule Scenario 1A	If basin<30 acres and/or <85% harvest planned within a five-year period + partial management strategy and BFW>3’	75’ no-harvest buffer for the first 600’ upstream from the confluence		50’ no-harvest buffer along the entire stream reach in the harvest unit + additional 25’ outer buffer representing 50% harvest zone (partial-harvest zone)	
		Incremental change:	*Additional 25’ no-harvest buffer*	*Additional 25’ no-harvest buffer, for up to an additional 300’*	*Additional 25’ partial harvest buffer, length depends on stream reach length within harvest unit*	
		Scenario 1A, if BFW<3’	75’ no-harvest buffer for the first 600’ upstream from the confluence		50’ no-harvest buffer along the entire stream reach in the harvest unit	
		Incremental change:	*Additional 25’ no-harvest buffer*	*Additional 25’ no-harvest buffer, for up to an additional 300’*	*No change in buffer width where it was required previously, additional 50’ buffer where new buffer required; additional buffer length depends on stream reach length within harvest unit*	
	Rule Scenario 1B	If basin<30 acres and/or <85% harvest planned within a five-year period + no-cut strategy and BFW>3’	75’ no-harvest buffer for the first 600’ upstream from the confluence		65’ no-harvest buffer along the entire stream reach in the harvest unit	
		Incremental change:	*Additional 25’ no-harvest buffer*	*Additional 25’ no-harvest buffer, for up to an additional 300’*	*Additional 15’ no-harvest buffer, length of new buffer depends on stream reach length within harvest unit*	
		Scenario 1B, if BFW<3’	75’ no-harvest buffer for the first 600’ upstream from the confluence		50’ no-harvest buffer along the entire stream reach in the harvest unit	
		Incremental change:	*Additional 25’ no-harvest buffer*	*Additional 25’ no-harvest buffer, for up to an additional 300’*	*No change in buffer width where it was required previously, additional 50’ buffer where new buffer required; additional buffer length depends on stream reach length within harvest unit*	

Note: The buffers and incremental changes described in the above table do not differentiate between the nuances of the current rule, where landowners must consider the total length of each separate Type Np stream system where at least a portion of the system is within their harvest unit, and the final rule, which emphasizes stream length within the landowner-specific harvest unit. Sensitive sites, as outlined in both the current and final rule, are also not accounted for in the buffers and incremental changes outlined above. As such, the changes described above are simplified representations of the final rule.

1.2 Background on the Rulemaking Process

This section summarizes the history of the rulemaking process that led to the rule, drawing on key studies and decisions by the Forest Practices Board and its associated committees. By providing a historical account, this section contextualizes how the rule and CBA are informed by published scientific studies, specifically two studies in western Washington in two distinct lithologies (underlying rock type) commonly referred the as the Hard Rock Study and the Soft Rock Study. The timeline of significant events is presented below to illustrate the progression of this rulemaking effort (Figure 1).

Figure 1. Timeline of the Np Buffer Rulemaking Process



In September 2018, the CMER program published the Hard Rock Study (McIntyre et al. 2018), which demonstrated that existing Forest Practices RMZ buffers did not meet state water temperature criteria for Type Np streams. This study used a Before-After/Control-Impact design with six unharvested reference sites and 11 sites that were harvested following one of three buffering strategies: a 50-feet-wide unharvested buffer along the entire perennial stream, a 50-feet-wide buffer along at least 50 percent of the stream length, and no buffer. Shade decreased and temperature increased in all buffer treatments, with the greatest change in temperature occurring during the July to August period. The 7-day average daily maximum (7DADM) temperature exceeded state water quality standards, which permit no temperature increase of 0.3°C or greater (WAC 173-201A-200, -300-320), in the 100 percent buffer treatment (1.2°C) and the Forest Practices buffer treatment (1.4 – 1.0°C) for the first two years after harvest.

Responding to these findings, the Forest Practices Board accepted the TFW Policy's recommendation that rulemaking was warranted and approved the formation of the Technical Type Np Prescriptions Workgroup to develop alternatives in May 2019. The workgroup delivered its final report in May 2021 (Barnowe-Meyer et al. 2021), summarizing literature on buffer composition and water temperature and proposing three alternatives that balanced resource needs with landowner impacts. Barnowe-Meyer et al. proposed three buffer descriptions which they concluded had the best chance of succeeding at meeting the resource and economic objectives, including a 100 percent, 75-foot buffer incorporating a 50-foot no-harvest management zone, a site-specific buffer, and an aspect-based buffer.

In 2021, CMER released Phase II of the Hard Rock study (McIntyre et al. 2021), which evaluated post-harvest data from two years to nine years post-harvest. In the same summer, CMER also published the Soft Rock Study (Ehinger et al. 2021), which similar to the Hard Rock Study analyzed temperature impacts, but in streams with a fine-grained substrate. In the Soft Rock Study, the 7DADM exceeded state water quality numeric criteria (16ºC at that location) at one site and reported a treatment response (>0.3ºC) for four years after harvest. As with the Hard Rock Study, shade was the main driver of temperature response.

By November 2021, the Forest Practices Board initiated the formal rulemaking process by directing staff to prepare the CR-101. However, from August to November 2022, the TFW Policy was unable to reach consensus on a recommended alternative, leading to the submission of separate "majority" and "minority" reports for Board consideration. In August 2023, the Forest Practices Board approved the advancement of the rulemaking process to align with the majority report in order to address concerns about water temperature in Type Np streams. In June 2025, the Board voted to define a proposed rule and initiate a public comment period. This CBA evaluates the costs and benefits of the final rule, which is consistent with the proposed rule. Accordingly, the Final CBA is not substantially changed from the Preliminary CBA that was made available with the proposed rule.

1.3 Framework for the Economic Analysis

This section summarizes our approach to evaluating the probable, incremental costs and benefits of the rule as well as the geographic scale and timeframe for analysis. For framework and methods topics for which Washington State guidance and requirements are not prescribed, we generally follow best practices in regulatory cost-benefit analysis.

1.3.1 Focus on Identifying Probable Effects of the Rule

This analysis assesses costs and benefits that are "probable" effects of the rule, consistent with RCW 34.05.328. To determine whether an effect is "probable," we conduct analysis and employ logic to identify those costs and benefits that are more likely than not to result from implementation of the rule. Where we determine the effect is probable, we identify the best available information to provide perspective on the magnitude of the effect.

Ideally, sufficient information would be available to quantify the monetary values of all categories of costs and benefits, allowing for a straightforward, quantitative weighing of probable benefits and costs all expressed in like terms (i.e., dollars). However, for this rule, information limitations prevent valuation of costs and benefits. It is not uncommon in cost benefit analysis for certain categories of costs and benefits to remain unquantified due to data limitations or methodological challenges. This issue is particularly prevalent in the assessment of environmental regulations, for example where the influence of the rule on certain ecosystem services and biodiversity preservation is often difficult to quantify and express in monetary terms without primary research. As a result, qualitative assessments and categorical rankings are frequently used to supplement quantitative estimates and provide a more comprehensive basis for decision-making.

According to RCW 34.05.328, the objective of the CBA for a rule is to determine whether the probable benefits of the rule outweigh the probable costs, *taking into account both quantitative and qualitative impacts*. This framing underscores the importance of a comprehensive weighing of all probable cost and benefit categories regardless of whether they are quantified or monetized. In this analysis, the weighing of probable benefits and costs is qualitative. We do not estimate a single benefit-cost ratio, as many categories of impacts, particularly the ecological benefits, are not monetized in this analysis. We discuss our approach to the weighing of costs and benefits in Chapter 6.

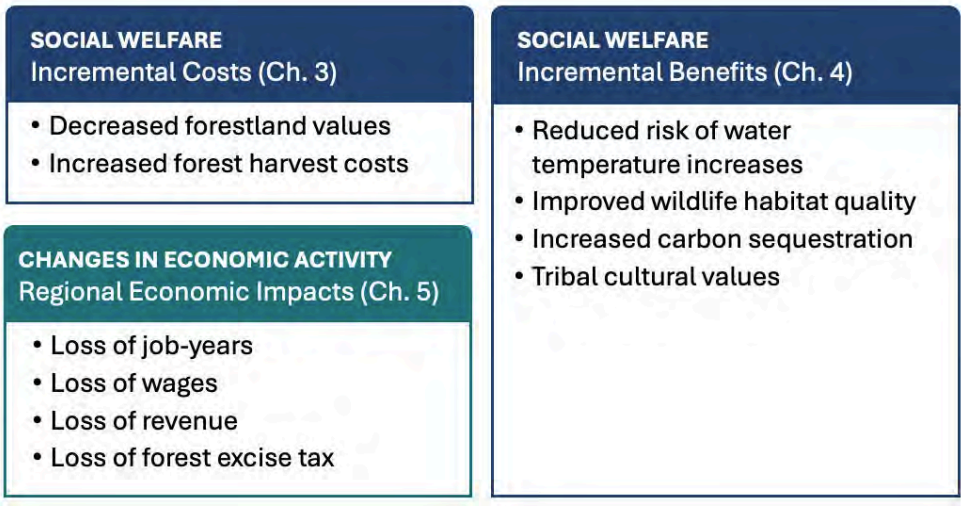
1.3.2 Focus on Incremental Effects

We evaluate the incremental costs and benefits for the rule by comparing Type Np buffer prescriptions in Washington under two scenarios: the world with the rule and the world without the rule. The world without the rule reflects the regulatory baseline for the analysis. An important aspect of the baseline is the required buffer prescriptions for Type Np water under current WAC 222-30-021(2). It also includes an assessment regarding how Np buffers would likely be managed absent the rule, how the harvest industry would likely access timber directly outside of required buffers, etc. Because the baseline captures future conditions absent the rule, we also consider the influence of climate change on future stream temperatures.[3] The role of the CBA is to isolate effects specifically attributable to the rule that would not occur in the baseline, absent the rule.

1.3.3 Key Impact Categories

The changes in Np buffer requirements are expected to result in a net increase in riparian buffer area in western Washington. Figure 2 outlines the probable effects of the Np rule analyzed in this CBA. Overall, increased buffer widths will result in costs to forestland owners associated with additional harvest restrictions, including reductions in forestland values, and potential for increased forest harvest operating costs at some sites. These incremental costs are evaluated in Chapter 3. The probable benefits of the rule are primarily environmental and ecological and are associated with improved water quality and aquatic and terrestrial habitats, as well as improved riparian functions. These incremental benefits are assessed in Chapter 4. In addition to these social welfare effects, the analysis considers the potential for regional economic impacts stemming from decreased timber harvest, including potential losses in jobs, wages, revenue, and timber excise tax revenue. In arriving at our set of probable impacts, we considered several other categories that we ultimately determined were not probable. Appendix B of this report details those categories as well as our rationale for why they are not probable effects of the rule. Chapter 5 describes these changes in economic activity and why these effects of the rule are presented separately from the social welfare effects addressed in Chapters 3 and 4.

Figure 2. Probable Effects of the Rule Described in This Report



[3] It is beyond the scope of the CBA to model stream temperatures under various future climate change scenarios. Instead, this analysis relies on findings from external modeling efforts that demonstrate the relationship between future climatic conditions (e.g., air temperature, snowpack) and future stream temperatures in Washington as evidence that stream temperatures have the potential to increase absent the rule due to other environmental factors (e.g., Snover et al. 2013).

1.3.4 Geographic Scope and Affected Populations

The main objective of the analysis is to determine effects of the rule stemming from changes in land management in western Washington, where the divide line between the eastern and western regions of the state is the summit of the Cascade Mountains. We provide results for western Washington at a landscape scale. In particular, data delineating the complete extent of Type Np stream across western Washington are not available, nor are data identifying all sensitive sites, BFWs, harvest plans, and other site-specific data that would be required to develop a comprehensive, site-specific analysis of the rule. Therefore, our results are developed based on understanding of typical conditions across each ecoregion within western Washington.[4] While the actual effects of the rule may differ from the average at any specific site, the aggregated ecoregion-level effects reflect the probable effects at the ecoregion scale. Where feasible, the analysis quantifies and summarizes effects by ecoregion.

In most cases, the effects of the rule will be experienced in western Washington. For instance, the probable costs of the rule, in terms of land value losses and increased harvest costs, will be experienced by landowners with harvestable timber in the region. For the ecological benefits of the rule, people outside of western Washington may value improvements in water quality and species habitat, even if they do not directly experience those effects firsthand. However, when considering the magnitude of these effects, we specifically focus on benefits that accrue to populations in Washington State. Chapter 6 further discusses the distributional consequences of the rule's effects (i.e., the populations bearing the costs and experiencing the benefits of the rule).

1.3.5 Analysis Timeframe

For the rule, incremental costs and benefits begin to accrue as soon as the RMZ buffer area changes. These costs and benefits persist as long as the rule is in effect. Importantly, the benefits of the rule grow over time, as forested riparian buffers mature and improve ecological functions. Where feasible, the analysis evaluates economic costs and benefits over a 45-year time period between the year the rule would take effect (expected 2025) through 2070. This timeframe is tied to average harvest rotations in western Washington and balances the need to capture the important benefits of the rule that grow over time with the growing uncertainty regarding the socioeconomic and biophysical state of the world over longer timeframes.

1.3.6 Discounting Convention

Because the costs and benefits of the rule occur at different times within the 45-year period described above, discounting allows for an economically consistent method of comparing and weighing the probable effects of the rule (USEPA 2024). Consistent with best practices, all monetized effects are discounted using the same discount rate to enable comparison. In this analysis, very few of our effect categories can be monetized, therefore discounting is only relevant in a few cases. For the monetary values described in this report, we apply standard discounting methods to describe the present value rule effects as well as annualized values, which illustrate the magnitude of the effect that would need to occur in each year of the analysis timeframe to produce the present value.[5] When discounting future effects, we assume the first year of analysis (2025) is the base year. Therefore, effects that occur in the first year of the analysis are not discounted, but all subsequent effects are.

[4] A map of ecoregions in the state is available at the following link: https://dmap-prod-oms-edc.s3.us-east-1.amazonaws.com/ORD/Ecoregions/wa/wa_eco.pdf. The ecoregions in western Washington include Cascades, Coast Range, North Cascades, Puget Lowland, and Willamette Valley (a very small portion of this ecoregion is found in western Washington).

[5] Comparing present values and annualized values produces the same ordinal ranking of effect magnitudes.

The monetized costs and benefits in the CBA are discounted using a social discount rate, which is appropriate in "the broad society-as-a-whole point of view embodied in benefit-cost analysis" (USEPA 2024, p. 6-1).[6] The best approximation for the social discount rate is the real rate of return on long-term and risk-free U.S. government debt. Over the last 30 years (2003 to 2022), this rate has averaged around 2 percent per year in pre-tax real terms, when considering 10-Year Treasury Inflation Protected Securities. We apply this rate as our primary discount rate in the analysis. Recognizing uncertainty exists regarding the social discount rate, we quantify effects by applying an alternative social discount rate assumption of 4.5 percent to test the sensitivity of our monetized results to our discount rate assumption.[7]

1.3.7 Consideration of Uncertainty

Forecasting costs and benefits of a rule is inherently uncertain. This uncertainty stems from limitations in available data, difficulty in accurately predicting future conditions under the baseline, and the complexity and unpredictability regarding how industry will change operations under the rule. The biggest source of uncertainty in this analysis is the ecological response to the added buffer width and length. For this reason, we employ a weight of evidence approach based on the available information as to the likely magnitude of these benefits.

For our quantified endpoints, we convey uncertainty by providing low- and high-end estimates as well as rounding our results to two-significant digits. An important source of uncertainty that enters many of our calculations is the number of Np stream miles that will be affected by the rule. Chapter 2 discusses our rigorous approach to determining the number of Np miles that may be affected, although uncertainty still results in a wide range. For any effect category that can be quantified in the subsequent chapters, we adopt this range and in some cases layer additional ranges as part of key input parameters (e.g., land values, substitute harvest). We also present our results "per Np stream mile" in Chapter 6 to demonstrate the scalability of our results and to facilitate a weighing of costs and benefits at the "average stream mile" level.

In addition to conveying uncertainty through ranges, we also highlight key sources of uncertainty and the influence on the analysis. Each probable effect that can be quantified is accompanied by a tabular discussion of these assumptions, uncertainties, and potential biases. Finally, Appendix D includes additional sensitivity analysis that presents our quantified results under alternative key assumptions for a select set of analyses, and addresses whether these other assumptions affect the main findings of our analysis.

1.4 Organization of the Report

The analysis in the chapters that follow addresses the requirements of RCW 34.05.328. In Chapter 2, we describe our approach to estimating the number of Np miles and adjacent buffers likely to be affected by the rule. We assess the probable costs and benefits of the rule in Chapter 3 and Chapter 4, respectively. Chapter 5 includes our estimates of the regional economic impacts of the rule. Finally, Chapter 6 weighs the incremental costs and benefits of the rule and discusses the distributional implications. The main text is accompanied by

[6] USEPA (2024, p. 6-26) states, "private discount rates should not be used to estimate the net present value of the social net benefits of policies and projects because the intertemporal preferences of society as a whole (measured by the social rate of time preference) are not likely to be equal to the private market lending rates or individual or firm preferences." In some cases, analysts may need to model market behavior to quantify a particular effect and, in these cases, the appropriate private discount rates should be used. This is reflected in our analysis in using the current market rates for land, which incorporate the private discount rate (which reflects not only the social rate of time preference but also a risk premium). Once the market behavior is modeled using the private rates, the effects are then placed in time (in our analysis the land value effects are realized upon rule implementation) and then discounted using a social discount rate. This is why we then apply the social discount rate for annualizing the land value effect, as we do for all other monetized categories of costs and benefits.

[7] While the 4.5 percent rate aligns with typical private discount rates used in forestland transactions in recent years, for the purposes of this analysis we consider the magnitudes of costs and benefits assuming the social discount rate aligns with the private discount rate. Additionally, the rate of 4.5 percent is a reasonable alternative assumption as it falls within the range of social discount rates applied in cost-benefit analyses of regulations.

several appendices. Appendix A provides a visual summary of both the current and final Np buffer rule. Appendix B describes the rule effect categories that we considered and ultimately determined were not probable. Appendix C includes detailed analysis tables that accompany the higher-level summary findings presented in the main report. Finally, Appendix D provides sensitivity analyses, demonstrating how our results differ under different key assumptions.

Although this analysis attempts to mirror the terms and wording of the rule, no attempt is made to precisely replicate the regulatory language, and readers are cautioned that the actual finalized regulatory text, not the text of this analysis, is binding.

CHAPTER 2 | Changes in Type Np Buffers Attributable to the Rule

A key input for most rule effect categories in this analysis is the change in acres of no-cut and partial-cut riparian buffers adjacent to Type Np streams in western Washington relative to the current rule baseline. As summarized in Section 1.1 and presented in Appendix A, the rule ties Np buffer requirements to several characteristics of the stream (including length and BFW) as well as characteristics of the basin (size and planned harvest intensity). The rule also offers options for pursuing a "no-cut" or "partial harvest" management strategy under certain circumstances. While the specific composition of Np buffers varies based on site specific characteristics, the rule generally results in longer and wider buffers adjacent to Np streams relative to the current rule.

Our approach to estimating changes in buffer areas relies on geospatial modeling conducted by Four Peaks (Four Peaks 2024a) as well as extrapolation to the ecoregions of western Washington. This chapter first describes the Four Peaks data that underlies our analysis, followed by our method of using the Four Peaks' inputs to analyze change in buffer area across western Washington. The chapter concludes with a discussion of key assumptions and sources of uncertainty in this analysis.

2.1 Use of Modeled Data to Predict Changes in Np Buffer Extent

This analysis relies on modeled geospatial data from Four Peaks as the basis for understanding of how buffer extents are likely to change on a selection of Np streams in western Washington. Four Peaks developed synthetic stream networks (SSNs) to model riparian buffers for the rule scenarios across approximately 263 miles of Type Np streams across 150 sample sites in four of the five ecoregions in western Washington.[8] Detailed methods are provided in the Four Peaks report (2024a). Four Peaks used this sample of concurred F/N breakpoints to evaluate the differences between 1) applying buffers to Type Np waters using buffer widths and extents defined under the current rule; and 2) buffer widths and extents defined by the Type Np Buffer rule for the same stream segments.

To simplify the many possible permutations of the rule that could exist across sites, the Four Peaks analysis refers to three "scenarios" which correspond with different possible outcomes of implementing the rule, as summarized in the text box. Figure 3 that follows provides an example of what the Four Peaks data provides for specific stream segments across the three scenarios.

Rule "Scenarios"

Four Peaks (2024a) uses the term "options" to refer to three ways in which the rule could be applied at specific sites. To avoid the appearance that the rule includes regulatory options, we refer to these as rule "scenarios" throughout this report. To match the numbering convention used by Four Peaks, our analysis considers the following three scenarios:

- Scenario 1A: Partial harvest management requirements if basin<30 acres and/or <85% harvest planned within a five-year period and BFW>3'; all other requirements for BFW<3'
- Scenario 1B: No-cut management requirements if basin<30 acres and/or <85% harvest planned within a five-year period and BFW>3'; all other requirements for BFW<3'
- Scenario 2: Rule requirements if basin>30 acres and >85% harvest planned within a five-year period

[8] No-harvest zone buffers were created by combining the sensitive site buffers (for the purposes of this analysis, only the junction between two Type Np streams and the upstream extent of Type N streams), waterbody buffers (created using the process described in the Four Peaks 2024a report), and the following buffer distances: Scenario 1a: 75-foot buffers for the first 600 feet, 50-foot buffers for all Type Np streamlines above 600 feet; Scenario 1b: 75-foot buffers for the first 600 feet, 65-foot buffers for all Type Np streamlines above 600 feet with BFW above 3 feet, 50-foot buffers with BFW below 3 feet; Scenario 2: 75-foot buffers for all Type Np streamlines with basins greater than 30 acres.

Figure 3. SSN Streamlines from Four Peaks (2024a) For Three Rule Scenarios

(a) If basin>30 acres and >85% harvest planned within a five-year period

(b) If basin<30 acres and/or <85% harvest planned within a five-year period + partial management strategy

(c) If basin<30 acres and/or <85% harvest planned within a five-year period + no-cut strategy

(a, b, and c)

Note: Blue buffers represent no-harvest zones, while yellow crosshatch represents partial management areas. For more details on both buffer designations, see text. This figure is intendent to be a visual representation of each buffer scenario in one specific location of the synthetic stream network (SSN) and should not be interpreted as representative of incremental changes in buffer area associated with the rule in general or across western WA.

While the data from Four Peaks provides the best available information related to the possible changes in Type Np buffers, the sample of streams selected for the analysis may differ from those found across the broader western Washington region, with implications for the CBA. Specifically, the rule specifies requirements based on site-specific characteristics for which data across the broader region are limited. Table 2 compares characteristics of streams within the Four Peaks network and across the broader western Washington region that affect the size and length of the buffers as described in the rule, specifically BFW, stream length, basin size, and harvest intensity. As described in the rightmost column, in some cases our analysis methods can correct for differences (i.e., Np stream length, basin size, and harvest intensity). In other cases, we acknowledge that use of the Four Peaks data has the potential to underestimate effects at certain sites (i.e., through the influence of BFW) and that data limitations prevent our ability to adjust Four Peaks results accordingly.

Table 2. Comparison of Np Streams in the Four Peaks Sample (N=150) and Broader Western WA

Characteristics	Four Peaks Sample	Broader Western WA	Implications for This Analysis
Np stream BFW	Mean BFW in the Four Peaks sample was 2.5 feet, although individual stream segments exhibit variation around this mean.[1] BFW was calculated at the stream segment scale by applying the Beechie and Imaki (2014) formula based on basin area and mean annual basin precipitation using PRISM data (Daly et al. 2015).	An inventory of BFW does not exist for western WA. Data provided by Washington State Department of Ecology (Ecology) consisting of 149 measurements indicated an average BFW of 5.8 feet across sample sites.[2] However, the Ecology data is also sample-based and may not be representative of the ecoregions.	This analysis relies upon the modeled stream networks from the Four Peaks sample. It is possible that the Four Peaks sample identifies narrower Np streams on average than is representative across the broader ecoregion. This is based on both a comparison with the Ecology data and findings that the Beechie and Imaki formula is biased at smaller BFWs (Beechie and Imaki 2014). As the rule requires wider buffers for streams with BFW>3-ft, the incremental buffer area observed in Four Peaks may underrepresent the total increase in buffer area across western WA because fewer streams in the Four Peaks network may be buffered based on the requirements for BFW>3ft.
Np stream length	Within the Four Peaks sample, 39% of Np stream reaches are greater than 1,000 feet.[1]	WC Hydro identifies that 90% of Np stream reaches are greater than 1,000 feet.[3] A Washington Forest Protection Association (WFPA) analysis of Np stream length indicated mean Np stream length of 1,200 feet.[4]	Two available data sources suggest that the Four Peaks SSNs may be shorter than typical stream networks across the ecoregion. As longer streams experience a greater increase in buffer area under the rule, the incremental buffer area observed in Four Peaks may underrepresent the total increase in buffer area across western WA. This analysis partially accounts for this by adjusting for the total number of Np miles affected using outside data sources, including WC Hydro and Ecology's EDH.
% of basins surrounding Np streams that are greater than 30 acres and harvested with 85% intensity	An analysis by the Washington State Department of Natural Resources (DNR) identified no basins that meet these criteria within the Four Peaks sample network.[5]	The same analysis by DNR identified a small sample of stream miles that abut basins that meet these criteria. For instance, 1.9% of streams in Coast Range, 0.6% of streams in Puget Lowland, and 0.5% of streams in Cascades.[5] A WFPA analysis of the frequency of basins meeting these criteria in six western WA WAUs over 10 years suggests both criteria were met at a rate of 1.4%.[4]	Available data sources suggest that the Four Peaks sample does not include areas likely to meet the requirements for buffering under rule scenario 2. We correct for this by applying the "probability" that any given stream mile within an ecoregion may fall into rule scenario 2 based on analysis by DNR. In other words, we provide results as if the Four Peaks sample looked more like the ecoregions for this specific set of characteristics.

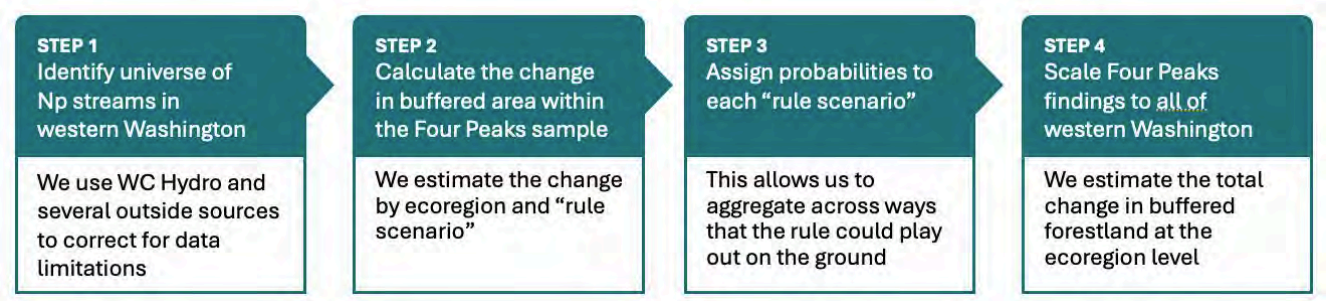
Notes and sources:

1. Spatial data provided by Four Peaks pursuant to Four Peaks (2024a).
2. Data provided by Ecology via email on September 12, 2024. Data came from sample locations at the CMER Hard Rock and CMER Soft Rock Studies, Ecology's Watershed Health Monitoring program, and the CMER Extensive Monitoring study. Only Type Np measurements were considered.
3. WC Hydro, available at https://data-wadnr.opendata.arcgis.com/
4. See October 31, 2022, special Forest Practices Board meeting notes, available at bc_fpb_minutes_20221031_1101.pdf.
5. Data collection and analysis conducted by DNR. Data received September 23, 2024. See Section 3 for details.

2.2 Estimating the Extent of Type Np Buffers With and Without the Rule

We outline our analytic approach to estimate the amount of forestland affected by the rule-requiredType Np buffers in the steps below. In general, we follow the overarching approach described in Figure 4. The remainder of this section provides more details on our methods and findings.

Figure 4. Methods Overview for Analysis of Change in Buffer Acres



Step 1: Identify Np streams likely to be affected by the rule. We identify Np streams overlapping with the extent of affected forestland that are most likely affected by the rule. We rely on Geographic Information System (GIS) data defining Type Np stream miles in forestland from DNR's DNR Hydrography – Watercourses (WC Hydro) GIS Open Data as the starting point for our analysis.[9] Given uncertainty in 1) which forestland would be harvested consistent with current Np buffers absent the rule and 2) which stream miles in WC Hydro are truly Np miles, we provide low-end and high-end estimates of affected Np streams that capture these uncertainties.

Which Np buffers would be harvested absent the rule: The rule generates effects only where it influences future forest management decisions.

- At the high end of our range, we include all Np streams within forestland subject to Forest Practices rules (i.e., "regulated forestland" which is largely private and municipal forestland), which excludes Np stream segments intersecting with Federal, Tribal, and the State Trust Lands HCP.[10] While there are other HCPs that offer select landowners other choices for how to manage riparian buffers, spatial information is not available to remove these other HCPs.[11] Additionally, there is also uncertainty into whether those landowners would follow Forest Practices Np buffers or the buffers outlined in their HCPs.[12]
- At the low end, we include only the regulated forestland that is not subject to other harvest restrictions absent the rule, including both regulatory and non-regulatory restrictions. To identify this area, we start with the areas identified in the high-end scenario, then additionally remove areas where harvest is likely

[9] WC Hydro, available at https://data-wadnr.opendata.arcgis.com/.

[10] Stream segments overlapping Federal and Tribal land are identified using land ownership data from DNR and Atterbury Consultants, as provided by DNR via email on February 26, 2024. Stream segments overlapping with lands part of the Riparian Conservation Strategy HCP (which includes DNR-managed state trust lands and natural areas), identified using the 'HCP Lands' layer, is available at: https://data-wadnr.opendata.arcgis.com/datasets/wadnr::habitat-conservation-plan-lands/about.

[11] In January 2025, DNR sent Industrial Economics, Inc. (IEc) seven other HCPs that cover forestland in Washington. A review of these HCPs revealed that they cover a small fraction of forested acres in Washington. Because we lack spatial data identifying where these HCPs are located, we did not attempt to exclude these additional areas from our analysis.

[12] Personal communication between IEc and DNR on January 14, 2025.

precluded for other reasons, including Type Np stream segments intersecting with unstable slopes, certain areas of northern spotted owl (NSO) habitat, and conservation land.[13] Lands that fall into these areas already have other baseline harvest restrictions and are therefore unlikely to be affected by the rule.

Which streams in WC Hydro are Np: In WC Hydro, Type N streams are further classified as Type Np (perennial non-fish), Type Ns (seasonal non-fish), or Type Nu (non-fish, but unknown whether it is perennial or seasonal). Across western Washington, only one percent of Type N streams in WC Hydro are classified as Type Np, while 98 percent are categorized as unknown (Type Nu). While we are certain that some portion of the Nu miles are Np stream, available data does not provide a precise estimate of the portion that we should consider for this analysis. To address this uncertainty, we applied a high- and low-end approach to estimate the proportion of Type Nu streams that may be classified as Type Np.

- Our high-end Type Nu scalar is informed by a Type N Stream Demarcation Study by Northwest Indian Fisheries Commission staff that sampled 123 points across 365 acres around the state (Pleus and Goodman 2003). The authors report that the average distance between the channel head and uppermost perennial flow (i.e., the Type Ns stream length) in their sample was 24 meters in western Washington (Pleus and Goodman 2003, page 29). To determine the average length of an Nu stream segment in WC Hydro, which should contain both Ns and Np portions, we calculated the total length of each unique stream ID, then averaged these lengths across all identified stream miles.[14] Subtracting the average Ns stream length (24 meters) from the length of an average Nu stream (383 meters), we estimate an average Np stream length of 359 meters (approximately 1,179 feet). Under these assumptions, approximately 94 percent of Type Nu stream miles in WC Hydro may be Type Np.

- For our low-end Type Nu scalar, we apply the same method described above but rely on the maximum Ns stream length from Pleus and Goodman (2003) instead, which is equivalent to 225 meters (see page 29 of the source). We additionally align our estimate of the average length of a Nu stream segment in WC Hydro with the Nu streams identified in the low-end scenario described above.[15] Subtracting the maximum Ns stream length (225 meters) from the length of an average Nu stream (388 meters), we estimate an average Np stream length of 163 meters (approximately 534 feet). Under these alternate assumptions, approximately 42 percent of Type Nu stream miles in WC Hydro may be Type Np.[16]

Table 3 summarizes what is included in our low- and high-end estimates based on our discussion above.

[13] Streams abutting unstable slopes as classified in the DNR LSI spatial layer is available at: https://data-wadnr.opendata.arcgis.com/, and/or WGS Landslide Inventory Database, available at: https://geologyportal.dnr.wa.gov. For forest unlikely to be harvested due to northern spotted owl (i.e., areas within old forest, sub-mature forest, and young forest marginal northern spotted owl habitat), the Northern Spotted Owl habitat layer was provided by DNR. Conservation land as identified in the U.S. Geological Survey (USGS) Gap Analysis Project Protected Areas Database of the United States is available at https://www.usgs.gov/programs/gap-analysis-project/data. Conservation land excluded from miles affected by the rule includes state wilderness, state conservation areas, local conservation areas, private conservation, and conservation easement.

[14] We used the WC Hydro attribute field "WC_LLID_NR" to identify and count unique stream segments for our analysis, as directed by DNR via personal communication on February 10, 2025. We find that the 33,524 Nu stream miles we identify in the high-end scenario are associated with 140,861 unique stream segments, and therefore each Nu stream segment is approximately 383 meters.

[15] See footnote 14 for details on methods. Here, we find that the 30,851 Nu stream miles we identify in the low-end scenario are associated with 127,996 unique stream segments, and therefore each Nu stream segment is approximately 388 meters.

[16] For additional context, among the stream miles tagged as Ns and Np in WC Hydro, approximately 47 percent are Np across western Washington. However, this distribution represents only about two percent of total Type N streams identified in WC Hydro. We therefore do not use this percentage as the basis quantifying the total extent of Np stream, although we note that this falls within the range identified in our approach described.

Table 3. Characterization of Low- and High-End Estimates for Number of Np Stream Miles Affected

Consideration	Low-end	High-end
Which Np buffers would be harvested absent the rule	Forestland regulated by the Forest Practices rules that is not currently subject to other harvest restrictions	All forestland regulated by the Forest Practices rules
Which streams in WC Hydro are Np	42% of Nu miles are Np miles	94% of Nu miles are Np miles

Beyond classification assumptions, we also adjusted WC Hydro to account for missing data in both the low- and high-end scenarios. Through conversations with DNR, it is our understanding that WC Hydro has limitations related to incomplete geographic coverage, particularly of the upper reaches of Type Np streams. Ongoing work by Ecology on its elevation-derived hydrography (EDH) layer provides some insight into the extent of missing stream miles in WC Hydro. However, analysis and comparison of these data sources to date has not focused on identifying undercounting of Np streams in particular. Instead, based on expert judgment, a representative of Ecology familiar with both EDH and WC Hydro expects that Np stream length in western Washington is 40 percent greater than what is identified in WC Hydro but acknowledges considerable uncertainty associated with this estimate.[17,18] Based on this best professional judgment, we accordingly adjust the Np stream miles identified in WC Hydro by multiplying by 1.4.

After applying these adjustments, our final estimates for Type Np stream miles affected by the rule range from approximately 19,000 miles at the low end to 44,000 miles at the high end (see Table 4). The wide range reflects the uncertainty in the forestland acres likely to be affected by the rule given their management conditions absent the rule as well as significant uncertainty about the extent of Np stream miles in western Washington based on available data. For comparison, DNR reports that the Forest Practices HCP covers 60,000 miles of stream habitat.[19]

[17] Personal communication between IEc, DNR, and Joshua Greenberg (Interim GIS Manager and Hydrography Steward, WA Department of Ecology) on March 10, 2025.

[18] In making this assessment, the representative from Ecology considered several other reported findings. First, based on a data from 3 USGS Hydrologic Units (HUCs) in Skagit County, a comparison of the two data sources found that, within the sample area, WC Hydro included 3,182 stream miles while EDH included 7,025 miles (Wischer 2024), suggesting that the total stream miles in western Washington is likely to be 120 percent greater than what is reported in WC Hydro. However, representatives from Ecology note that many of the stream miles identified in EDH that are not in WC Hydro are likely to be Ns stream, and therefore adjusting based on this information is likely to significantly overestimate the number of Np miles. Second, the effort also identified that streams already named in WC Hydro (including both Type F and Np streams), were found to be up to 20 percent longer in the EDH data (Ecology 2024a, page 33). This figure, however, only accounts for streams already identified in WC Hydro (i.e., just sinuosity), and an additional element of undercounting is the discovery of new streams not currently tagged in WC Hydro.

[19] For example, DNR describes the geographic extent of its Forest Practices HCP on this website: https://www.dnr.wa.gov/HCPs. Accessed April 7, 2025. It is unknown whether this estimate reflects only those stream miles that are mapped in WC Hydro or is from some other source.

Table 4. Affected Np Stream Miles Under Low- and High-End Estimates

Scenario	Ecoregion	Stream Miles in WC Hydro				Adjusted Np Miles
		Total N	Np	Ns	Nu	
Low-end: - Likely harvestable regulated forestland - 42% of Nu miles	Cascades	8,655	58	61	8,536	5,100
	Coast Range	14,749	175	175	14,399	8,710
	North Cascades	2,344	18	19	2,307	1,382
	Puget Lowland	5,323	27	48	5,248	3,123
	Willamette Valley	365	2	3	360	214
	Total					18,529
High-end: - All regulated forestland - 94% of Nu miles	Cascades	9,757	67	65	9,626	12,725
	Coast Range	15,429	201	196	15,032	20,008
	North Cascades	2,984	21	22	2,940	3,888
	Puget Lowland	5,632	28	49	5,554	7,328
	Willamette Valley	377	2	3	372	491
	Total					44,440

Source and notes: IEc analysis of WC Hydro. See main text of the description of assumptions used to establish the low- and high-end estimates. Through conversations with DNR, it is our understanding that the WC Hydro dataset has limitations related to incomplete geographic coverage, particularly of the upper reaches of Type Np streams. We apply scalars described in the text above to address both missing and misclassified stream miles. The rightmost column presents the number of Np stream miles affected by the rule by ecoregion across western Washington.

Step 2: Calculate the change in buffer acres in the Four Peaks sample area by ecoregion. Using the Four Peaks riparian buffers, we used ArcGIS to calculate the total buffer area around Np streams under the current rule and each rule scenario.[20] We apply the same high- and low-end exclusions described in Step 1 to the Four Peaks buffer areas to ensure consistency in the analysis and incorporate the range of forestland acres subject to the rule into the modeled inputs. In other words, for the high-end scenario, we ensure that the Four Peaks sample only includes regulated forestland, while the low-end scenario only includes likely harvestable regulated forestland.

Table 5 shows the effects of the exclusions on the Four Peaks buffer areas under the current rule and by rule scenario. This table also provides perspective on how the total buffer area may increase relative to current buffer requirements across Np streams. When looking at the buffer acres in the low-end scenario specifically (rightmost column), we calculate an 87 to 88 percent increase in buffer acres for stream reaches that fall under rule scenarios 1A and 1B relative to the current rule, and a 139 percent increase for stream reaches that fall

[20] Four Peaks GIS data were provided by DNR. Data downloaded on June 27, 2024.

under rule scenario 2. This provides some indication of the increase in buffer acres across Np stream miles across western Washington relative to current restrictions on Np buffers in the region.

Table 5. Total Buffer Acres in Four Peaks SSN After Applying High- and Low-end Exclusions

Rule (and Rule Scenario)	Original Four Peaks SSN	Federal + Tribal	HCP	High-End Buffer Area	Unstable Slopes	NSO	Conservation	Low-End Buffer Area
Current rule	1,900	34	654	1,213	158	79	0	1,034
Final rule: Scenario 1A (50' inner no harvest area)	3,306	50	970	2,127	331	117	0	1,829
Final rule: Scenario 1A (25' outer partial harvest area)	419	3	154	259	59	25	0	203
Final rule: Scenario 1B (65’ no harvest BFW ≥ 3 ft, 50’ no harvest BFW<3ft)	3,566	65	1,222	2,282	325	133	0	1,950
Final rule: Scenario 2 (75’ no harvest area)	4,519	80	1,561	2,880	464	158	0	2,471

Source: IEc analysis of spatial data that accompanies Four Peaks (2024a). Four Peaks GIS data were provided by DNR. Data downloaded on June 27, 2024. Four Peaks data consider the modeled buffers around the Type Np SSN. See text box on page 21 for a description of the Four Peaks scenarios used in this analysis.

In Table 6, we present changes in total buffer area relative to the baseline by ecoregion and rule scenario. This was done by subtracting the baseline buffer areas from the buffer areas under each rule scenario. The Four Peaks incremental buffer areas shown in Table 6 serve as key inputs into our extrapolation across western Washington.

Table 6. Incremental Buffer Area in Four Peaks SSN Attributable to the Rule Scenarios (Acres)

Ecoregion	Rule Scenario 1A (50' inner no harvest)	Rule Scenario 1A (25' outer partial harvest)	Rule Scenario 1B (65' no harvest BFW≥ 3 ft, 50' no harvest BFW< 3ft)	Rule Scenario 2 (75' no harvest)
Low-end				
Cascades	164	12	171	209
Coast Range	159	13	167	106
North Cascades	405	171	496	413
Puget Lowland	40	1	41	55
High-end				
Cascades	170	13	177	219
Coast Range	172	16	182	111
North Cascades	505	223	627	506
Puget Lowland	40	1	41	55

Source: See notes in Table 5. See text box on page 21 for a description of the Four Peaks scenarios used in this analysis.

Step 3: Scale up from the Four Peaks sample to all Np stream miles in western Washington. To extrapolate from the Four Peaks sample to all of western Washington, we calculate the fraction of stream miles within our estimated Np stream miles from Step 1 that are in the Four Peaks sample. As shown from Table 7, the streams within the Four Peaks sample represent a small fraction of all Np stream miles throughout western Washington.

Table 7. Portion of Western Washington Type Np Stream Miles Represented in in Four Peaks SSN

Ecoregion	Low-end	High-end
Cascades	0.69%	0.28%
Coast Range	0.50%	0.22%
North Cascades	11.86%	4.21%
Puget Lowland	0.65%	0.28%

Source: IEc calculations using Four Peaks spatial data and total Np stream mile calculations summarized in Table 4.

To estimate the additional buffer acres by ecoregion to Type Np stream miles in western Washington, we divide the ecoregion-specific Four Peaks incremental buffer areas (Table 6) by the proportions of total western Washington Np stream miles represented in the Four Peaks network (Table 7). Table 8 presents the result of this step.

Table 8. Incremental Buffer Area in Western Washington Attributable to the Rule Scenarios (Acres)

Ecoregion	Rule Scenario 1A (50' inner no harvest)	Rule Scenario 1A (25' outer partial harvest)	Rule Scenario 1B (65' no harvest BFW≥ 3 ft, 50' no harvest BFW< 3ft)	Rule Scenario 2 (75' no harvest)
Low-end				
Cascades	23,568	1,790	24,625	30,068
Coast Range	31,928	2,597	33,516	21,131
North Cascades	3,418	1,440	4,181	3,485
Puget Lowland	6,186	123	6,248	8,444
High-end				
Cascades	61,039	4,524	63,721	78,761
Coast Range	79,146	7,213	83,552	51,181
North Cascades	11,982	5,295	14,888	11,995
Puget Lowland	14,515	288	14,660	19,813

Source: IEc analysis combining data from Table 6 and Table 7. See text box on page 21 for a description of the Four Peaks scenarios used in this analysis.

Step 4: Assign and apply probabilities to rule scenarios 1A, 1B, and 2. To derive the total change in buffer area attributable to the rule, we next identified the probability that each rule scenario will occur. Available data does not identify which basins greater than 30 acres will experience harvests of greater than 85 percent over a 5-year period. As such, for scenario 2, we relied on an analysis conducted by DNR that spatially compared Forest Practices Applications (FPAs) with approved harvest acres that were received between 2019 and 2024 with Western Washington Ecology Basins (30 acres or more) to assess whether 85 percent or more of each basin was harvested during that timeframe.[21] Outside of the areas where scenario 2 applies, data are not readily available to predict whether landowners are likely to select scenario 1A (partial harvest) or scenario 1B (no cut). Absent this information, we assume these two scenarios occur with equal probability.

Table 9 summarizes the probabilities derived from this process by ecoregion. To assess the sensitivity of our results to our assumptions regarding the likelihood of scenario 1A versus scenario 1B specifically, we present results of our analysis under the alternative assumption that *all* landowners outside of scenario 2 opt for scenario 1B in Appendix D (Section D.1). As described in Appendix D, the results of our various quantitative cost and benefit analyses are nearly identical under these alternate assumptions, therefore this assumption is not a driver of the magnitude of our evaluation of probable costs and benefits.

[21] Data collection and analysis conducted by DNR. Data received September 23, 2024.

Table 9. Probability of Rule Scenarios by Ecoregion

Ecoregion	Scenario 1A	Scenario 1B	Scenario 2
Cascades	49.75%	49.75%	0.50%
Coast Range	49.05%	49.05%	1.90%
North Cascades	50.00%	50.00%	0.0%
Puget Lowland	49.70%	49.70%	0.60%

Source: See text for details and text box on page 21 for a description of the Four Peaks scenarios used in this analysis.

As a final step, we multiply the probabilities for each rule scenario by ecoregion (Table 9) to the estimated changes in buffer areas by rule scenario across all of western Washington (Table 8). While none of the Four Peaks SSNs overlapped with the Willamette Valley ecoregion, we estimated the effects for the limited number of Np streams in this ecoregion by applying Four Peaks' findings from Puget Lowland.[22] Table 10 presents our final results. Using our methods and assumptions, our low-end estimate suggests an increase in approximately 67,000 acres of no-harvest buffers and 2,900 acres of partial harvest buffers. At the high end, our analysis finds an increase in approximately 170,000 acres of no-harvest buffers and 8,600 partial harvest buffers. **This area is equivalent to approximately 0.8 percent to 2.2 percent of all private and municipal forestland in western Washington and 1.1 to 2.9 percent of all forestland in western Washington governed by the Forest Practices HCP.**[23,24]

Table 10. Estimated Increases in Np Buffer Acres Across Western Washington (Acres)

Ecoregion	Low-end: Only "likely harvestable" forestland, 42% Nu are Np		High-end: All "regulated" forestland, 94% Nu are Np	
	No cut	Partial cut	No cut	Partial cut
Cascades	24,127	890	62,462	2,251
Coast Range	32,502	1,274	80,776	3,538
North Cascades	3,799	720	13,435	2,647
Puget Lowland	6,230	61	14,619	143
Willamette Valley	427	4	980	10
Total	67,085	2,949	172,271	8,589

Source and notes: IEc analysis described in main text.

[22] Based on email communication with DNR regarding the ecoregion most representative of conditions in the Willamette Valley on October 23, 2024.

[23] Forestland identified using land ownership data from DNR and Atterbury Consultants, as provided by DNR. Our comparison assumes a partial harvest acre is equivalent to a half-acre. These data identify approximately 8.2 million acres of forestland in western Washington are non-federal, non-tribal, and non-state HCP.

[24] DNR reports that the Forest Practices HCP covers approximately 6.1 million acres of forestland in western Washington. Accessed April 5, 2025 from: https://www.dnr.wa.gov/programs-and-services/forest-practices/forest-practices-habitat-conservation-plan

These area estimates reflect acres of forestland with new harvest restrictions. Absent the rule, we expect these acres are part of active timber rotations, and that the adjacent Np streams are largely buffered by standing trees outside of harvest and the following few years after replanting. In other words, these acres function as buffers absent the rule apart from the time during and directly after harvest. The rule prevents harvest on the acres identified in Table 10 and thereby eliminates these windows of time during which the Np streams are unprotected and vulnerable to temperature increases.

Our results differ from estimates in Four Peaks (2024a) primarily due to differences in the treatment of the rule scenarios and spatial extrapolation. First, this analysis considered a high- and low-end estimation of the number of affected Np stream miles, considering uncertainties such as which forestland would be harvested and which streams in WC Hydro are Type Np. The Four Peaks report extrapolates to all waters in WC Hydro in western Washington. Second, we assign probabilities to the three rule scenarios in order to model the total effect of the rule across the western Washington landscape. This adds nuance to our projections, particularly regarding buffers that meet the criteria of Scenario 2, which are based on DNR's analysis of recent harvest patterns. The Four Peaks report models incremental buffer area under all scenarios across their entire SSN, without considering the likelihood of each scenario occurring across the landscape. Therefore, Scenario 2 cannot be directly compared with Scenario 1 and the current rule with respect to buffer area. These methodological differences make it difficult to directly compare results between this analysis and Four Peaks (2024a).

Another key finding of our analysis of the Four Peaks data is that, across the rule scenarios, approximately 40 percent of the miles in the SSN do not have any riparian buffer requirements under the current rule; these areas would require buffers under the rule. In other words, of the Np stream miles that require buffers under the rule, 40 percent of them could be harvested all of the way to the streams absent the rule. The remaining 60 percent of streams in the Four Peaks SSN do have required buffers under the current rule; for these stream reaches, the rule either maintains the current buffer width or expands it, depending on the specific characteristics of the stream (see Table 1). Our analysis relies upon this distribution as representative of conditions across the Np stream network in western Washington.

2.3 Key Assumptions and Sources of Uncertainty

Our estimate of the number of additional acres of forestland that would become buffered on account of the rule incorporates the best available information. Because our approach relies on an analysis by Four Peaks, all of the uncertainties and data limitations associated with that analysis and the underlying LiDAR data are relevant to this analysis as well (see Four Peaks 2024a for a detailed overview). To extrapolate and refine findings across western Washington and aggregate across rule scenarios, our analysis incorporates additional data sources. Table 11 explores the sources of uncertainty and their implications on the analysis.

Given the uncertainties summarized below, our results are best interpreted as an order-of-magnitude estimate of changes in riparian buffer extent rather than precise, acre-specific accounting. The buffer changes expected under the rule are highly site-specific and influenced by site characteristics and landowner management strategies, for which data remain limited. While we provide perspective on the probable costs, benefits, and economic impacts of the rule at the western Washington scale in the chapters that follow, we also follow with a discussion of the impacts "per average Np stream mile." In doing so, we reduce our reliance on precise estimates of the number of affected acres.

Table 11. Sources of Uncertainty in Assessment of Changes in Extent of Type Np Buffers

Key Assumption or Source of Uncertainty	Direction of Potential Bias	Likely Effect of the Uncertainty on Results
WC Hydro correctly "types" streams.	Unknown	Likely minor. To estimate the number of Np miles that are affected by the rule, we assume that WC Hydro correctly categorizes miles. A report from Ecology (2019) compared field observations with WC Hydro and found that 22 percent of sample points that were categorized as Np in WC Hydro were not Np in the field. This report only describes miscategorization of miles assigned Np in WC Hydro, although it is possible that some Type F and Type Ns miles in WC Hydro should be categorized as Np instead. Absent data describing miscategorization of stream type in WC Hydro more broadly, we are unable to evaluate a direction of potential bias. We do, however, account for which portion of Nu miles in WC Hydro are likely to be Np.
All forestland outside of Federal, Tribal, and HCP land is subject to the rule.	Overestimate number of affected acres	Likely minor. As noted in footnote 11, DNR identified seven other HCPs that cover private forestland and may include conditions that exempt the landowners from Forest Practices rules. We did not undertake an in-depth review of these HCPs but did identify that they constitute a small fraction of the forestland in western Washington. Therefore, by including these areas in our analysis, we are likely to overestimate the number of affected acres, but only by a small amount.
The rule is unlikely to result in management changes on unstable slopes, areas within select areas of northern spotted owl (NSO) habitat, and on conservation land, and available geospatial areas accurately identify these locations.	Overestimate number of affected acres	Likely minor. Our low-end estimate removes areas where the rule is unlikely to result in management changes because harvest is unlikely absent the rule. Given uncertainty in whether the rule results in management changes on these acres, we also include a high-end estimate where they remain in the analysis. Therefore, our range should capture this uncertainty. Available spatial data on unstable slopes is incomplete, therefore we may exclude too few miles and overestimate the number of affected acres as a result.
All other areas are harvestable absent the rule.	Overestimate number of affected acres	Potentially major. Absent data identifying forestland with future harvest potential, this analysis assumes that all regulated forestland outside of the "excluded" areas is harvestable and is therefore affected by the change in buffer requirements around Np streams. However, some areas may not be harvestable absent the rule due to operational constraints, other regulatory and non-regulatory restrictions on harvest (e.g., easements), the presence of unharvestable features within forestland, etc. Using gradient nearest neighbor (GNN) data from the Landscape Ecology, Modeling, Mapping, and Analysis (LEMMA) project, we find that 45 percent of trees in buffer areas in western Washington are older than 45 years, implying that not all forested areas are managed for harvest and likely to experience effects of the rule.

Key Assumption or Source of Uncertainty	Direction of Potential Bias	Likely Effect of the Uncertainty on Results
Pleus and Goodman (2003) provide an approach for determining which portion of Nu streams in WC Hydro are Np streams.	Unknown	Likely minor. This study is based on a non-random and small sample of streams, and it is unknown how these streams differ from other streams throughout the region. Based on the description of their methods, Pleus and Goodman (2003) appear to use all stream orders in their calculation, whereas WC Hydro only captures first order streams. However, this study represents the best available information to parse out the Np streams from the Nu streams in WC Hydro. It is unknown to what extent using the study over- or underestimates Np stream miles. The large range we derive from this study (42 percent at low end, 94 percent at the high end) likely captures the true portion.
The Four Peaks sample provides a reasonable basis for extrapolating across all western WA.	Underestimate number of affected acres	Likely minor. While the Four Peaks sample provides a useful basis for extrapolation, site-specific factors such as topography, stream distribution, and landowner management strategies could introduce variability in estimated riparian buffer changes. As described in Section 2.1, there are several ways in which characteristics of the Four Peaks sample differ from characteristics across western Washington. While we are able to correct for the difference in length of Np miles and the portion of stream that may fall within rule scenario 2, we do not have adequate data to correct for differences in BFW. This may lead to a minor underestimation of the number of affected acres, as streams with BFW>3-ft would have greater buffers on average. On the other hand, Four Peaks (2024a) acknowledges that their methods are likely to overestimate stream density at the HUC12 watershed scale within their SSN. However, our approach scales the Four Peaks data to all of western Washington using WC Hydro and other scalars. Therefore, the fact that Four Peaks may have overestimated streams within their sample networks specifically should have little effect on the results of this analysis.
Outside of basin>30 acres and >85% harvest planned within a five-year period (rule scenario 2 in the Four Peaks data), the partial harvest and no-cut management strategies are likely to be employed with equal probability.	None	Insignificant. Lacking information to forecast what portion of Np stream miles will be buffered under the "partial-cut" versus "no-cut" management approaches, we assume they will occur with equal probability across the landscape. We test the sensitivity of our results to the alternate assumption that all landowners (outside of scenario 2) opt for the "no-cut" option (i.e., no landowners choose the "partial cut" option), as presented in Appendix D. There, we find that our results are virtually identical under this alternate set of assumptions. Accordingly, this sensitivity analysis finds that our results would not change if we had more precise information to forecast landowner choices.

CHAPTER 3 | Probable Costs of the Rule

This chapter describes our evaluation of probable costs of the rule. We identify two categories of costs as probable outcomes of the rule, specifically reductions in value of the affected forestland and increased forest harvest operating costs. Each of these categories of costs are evaluated relative to a baseline where the current Np buffer rule remains in effect. In making our determinations, we also considered the potential for costs associated with land use change outside of the buffers. As described in Appendix B, the weight of evidence suggests this is not a probable cost of the rule.

3.1 Decreased Forestland Values

The rule renders the acres presented in Table 10 unharvestable (or only partially harvestable), which reduces the market value of the land and constitutes a social welfare loss incurred by forestland owners. Generally, the market value of a parcel of land reflects the discounted present value of expected future rents (i.e., income streams). For example, for forested land, market values include the discounted present value of income from future tree harvests and may include the discounted present values of income from alternative future uses of the parcel (e.g., for development).

Accordingly, if a given use of a parcel of land is restricted, it will be worth less than its market value in the previously unrestricted state. This reduction in market value is a cost to the landowner, with the magnitude of reduction depending on the nature of the restrictions. In this section, we describe our methods to estimate the reduction in value of forestland that will fall within the expanded Np buffer width and length under the rule, summarized in Figure 5 and provided in more detail below. We also discuss key sources of uncertainty influencing our assessment.

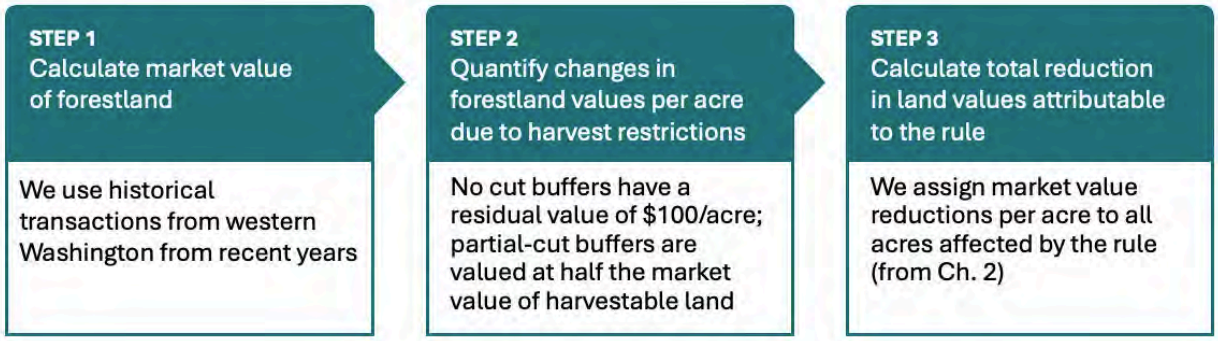
Summary findings: Decreased forestland values

Major cost

$320 million to $1.0 billion in land value losses in the first year the rule is in effect

On an annualized basis, these losses are equivalent to $11 to $35 million assuming a 2% discount rate (alternatively, annualized costs are $17 to $54 million assuming a 4.5% discount rate)

Figure 5. Methods Overview for Decreased Forestland Values Analysis



Step 1: Calculate market value of forestland in western Washington using historical transaction data. We worked with Atterbury Consultants, timberland appraisers experienced in western Washington, to access data from 15 timberland transactions that occurred in western Washington from 2019 to 2023, accounting for 120,000 total acres.[25] The data include a total sale price and total acres represented by the transaction, from

[25] Data provided by email from Atterbury Consultants on various dates between September and October 2024.

which we derive a *market value per acre sold*. The data additionally identify the portion of the area that constitutes harvestable timber, from which we calculate a *market value per harvestable acre*.[26] Based on practices employed by timberland appraisers, this analysis assigns a residual market value of $100 per acre for unharvestable land. That is, if timber harvest is precluded on an acre of forest land, the market value of that acre is reduced to $100.

After converting all nominal values to real 2023 dollars using the GDP deflator, we observe an increase in average market prices over the five-year period between 2019 and 2023.[27] Given an increase in the real value of forestland over this timeframe, we rely on the five most recent transactions (in 2022 and 2023) as the best estimate for forestland values when the rule goes into effect. Over this two-year period, we find that the average market value per acre sold was approximately $4,700 while the average market value per harvestable acre sold was approximately $6,000 (2023 dollars).[28]

We compared these market values to several other data sources to assess their reasonableness at representing the value of forestland in western Washington potentially affected by the rule.

- First, we compared our findings with the output of a model maintained by the forestland industry that evaluates the value of timberland using age class and site class information as inputs into a discounted cash flow analysis.[29] When inputting region-specific data on the distribution of age and site class across private commercial forest acres, these models identify a 4.5 percent private discount rate for timberland and produce a price per acre of $3,933 in western Washington. That per acre value is less than what we estimate using transaction data from 2022 and 2023, and more aligned with averages across the longer 2019 to 2023 timeframe.

- Next, we analyzed data from three sales of investment grade industrial timberland in the Northwest (i.e., across Washington and Oregon) provided by a regional timberland appraiser.[30] These data identify a market value per acre sold of $5,200 across three transactions that occurred in 2022 and 2023, which is similar to the average market value estimated using Atterbury's data for the same years. This value is consistent with the range of timberland values identified above and confirms the reasonableness of our estimated land values.

[26] The transaction area also includes some unharvestable land (e.g., due to regulations or economic viability) as well as non-forest (e.g., rocks, roads, other infrastructure). Atterbury's data identify that on average 23 percent of the transacted area is unharvestable and therefore valued at $100 per acre per their appraisal methods. For example, consider a forestland transaction that included 100 acres valued at $100,000 where 80 acres was harvestable. The market value per acre sold would be $1,000 ($100,000/100 total acres) whereas the market value per harvestable acre would be $1,225 (($100,000-($100*20 unharvestable acres))/80 harvestable acres).

[27] We adjust all land values to 2023 dollars using the GDP deflator (Source: Bureau of Economic Analysis, National Income and Product Accounts. Available here: https://apps.bea.gov/iTable/iTable.cfm?ReqID=19&step=4&isuri=1&1921=flatfiles. See Section 1 "Domestic Product and Income," Table 1.1.9 "Implicit Price Deflators for Gross Domestic Product," Line 1 "Gross Domestic Product." Accessed February 3, 2025.)

[28] While the five forestland transactions constitute a relatively small sample size, data based on the more recent 2-year time period better reflects current market conditions, pricing trends, and economic factors, whereas a larger sample size reflecting a longer time period would likely include outdated data that are no longer representative. Given the small sample size of recent forestland transaction data available, we additionally compare our value range with other, alternative sources of information on timberland values.

[29] John Ehrenreich of the WFPA provided the Forest Valuation Model to DNR via email on April 25, 2024. The Forest Valuation Model was prepared by Roger Lorder of Mason, Bruce & Girard.

[30] Vic Musselman, a timberland appraiser and member of the Forest Practices Board's Economics Work Group, provided these data via email on October 22, 2024.

Step 2: Quantify changes in forestland values per acre due to changes in harvest restrictions. In this step, we quantify the change in land values per acre attributable to the rule restrictions on harvest in Np buffer areas, as follows:

- **Value of harvestable acres:** We rely on the average land values per acre described in Step 1 to value forestland not subject to harvest restrictions absent the rule. We apply the average *value per acre sold* at the low end under the assumption that land within the buffers represents a mix of harvestable and unharvestable land absent the rule. At the high end, we apply the average *value per harvestable acre* under the alternate assumption that all acres affected by the rule would be harvestable but for the rule.
- **Value of unharvestable acres:** As described above, we apply conventions used in the timberland appraisal industry that assign a market value of $100 per acre to unharvestable land included in timberland purchases. This value reflects the fact that the land has a non-zero value, which is $100 on average, although the specific magnitude will vary by site and context. We assume that all acres that fall within "no harvest" buffers are valued at this level once the rule goes into effect.
- **Value of partially harvestable acres:** Partial-harvest buffers limit cut to a maximum of 50 percent of trees, with additional restrictions on tree spacing and representative tree diameter and species distribution. Based on guidance from timberland appraisers at Atterbury Consultants, we identify that the value of these acres is half the value of a fully harvestable acre on average. Using the market values described in Step 1 as a starting point, the value of a partially harvestable acre is approximately $2,300 at the low end and $3,000 at the high end.

Table 12 summarizes these inputs as well as the resulting change in market value when harvest is restricted on a previously unrestricted acre of forestland (i.e., a land value reduction of $4,600 to $5,900), as well as when a previously unrestricted acre is limited to partial harvest (i.e., a land value reduction of $2,300 to $3,000).

Table 12. Change in Forestland Values per Acre Attributable to the Rule (2023 dollars)

Year of Sale	Low-end	High-end
Market value of harvestable	$4,690	$6,007
Market value of unharvestable	$100	$100
Market value of partially harvestable	$2,345	$3,003
Difference harvestable – unharvestable	$4,590	$5,907
Difference harvestable – partially harvestable	$2,345	$3,003

Source: IEc analysis of data from Atterbury Consultants described in the main text.

Step 3: Calculate total reduction in land values attributable to the rule. We apply the change in land values per acre (Table 12) to the number of acres affected by the rule (Table 10). We match the low-end change in value per acre with the low-end estimate of affected acres in no-harvest and partial harvest buffers, and do the same with the high-end of each range. Our analysis assumes a one-time loss in land value occurs the year the rule (and the associated harvest restrictions) goes into effect. Because these impacts occur upon implementation of the rule (2025), the land values occur immediately and are represented as a present value cost of the rule. That is, because these costs do not occur over time, there is no discounting required to calculate the present value effect. Table 13 presents the findings of our analysis. **We estimate a major reduction in land values attributable to the rule on the order of $320 million at the low end and $1.0 billion at the high end.**

We also calculate annualized effects assuming both 2 percent and 4.5 percent discount rates (reflecting uncertainty in the social discount rate) over the 45-year analysis timeframe.[31] When applying these assumptions, we estimate annualized land value losses on the order of $11 to $35 million assuming a 2 percent discount rate (alternatively, annualized costs are $17 to $54 million assuming a 4.5 percent discount rate).

Table 13. Decrease in Forestland Values in Western Washington (2023 dollars)

Ecoregion	Low-end: Only "likely harvestable" forestland, 42% Nu are Np, market value per acre sold	High-end: All "regulated" forestland, 94% Nu are Np, market value per harvest acre
Cascades	$110,000,000	$380,000,000
Coast Range	$150,000,000	$490,000,000
North Cascades	$20,000,000	$87,000,000
Puget Lowland	$29,000,000	$87,000,000
Willamette Valley	$2,000,000	$5,800,000
Total present value	$320,000,000	$1,000,000,000
Annualized value (2% discount rate)	$11,000,000	$35,000,000
Annualized value (4.5% discount rate)	$17,000,000	$54,000,000

Source: IEc analysis of various data sources described in the main text. Land value reductions occur in the first year of the rule and are therefore not discounted, so the discount rate does not influence the present value costs presented above. As shown, discount rate assumptions do factor into the calculation of annualized effects. Annualized values are considered over the 45-year analysis timeframe.

Table 14 describes key assumptions underpinning our analysis and the influence on our land value cost results.

[31] Because land value losses reflect a loss in potential future uses of the land in perpetuity, annualizing over a 45-year timeframe likely *overstates* the annualized effect of land value losses.

Table 14. Sources of Uncertainty for Analysis of the Reduction in Land Values

Key Assumption or Source of Uncertainty	Direction of Potential Bias	Likely Effect of the Uncertainty on Results
The average market value per acre of forestland derived from large transactions reflects the average market value per acre across all riparian forestland.	Underestimate costs	Likely minor. The historical market transaction data underpinning this analysis derives from large transactions representative of forestland owned by industrial entities. Conversations with timberland appraisers highlight that the value of Small Forest Landowner (SFL) land is typically greater because SFL parcels have stands that tend to be older or may be more likely to be targeted for future land use conversion, such as for development. These parcels are less frequently sold (i.e., more likely to stay within a family) and therefore occur less frequently in land transaction data; most of what is known about their value comes from private appraisals. For these SFL acres, the land value losses may be better represented by the high end of our range, although we expect the values to fall within our range. Section 6.3 of this report further explores the number of SFLs and SFL-owned parcels affected.
Only the acres within the Np buffers experience land value losses.	Unknown	Likely minor. This analysis focuses specifically on the riparian acres that become unharvestable or only partially harvestable within the required buffers. The rule also has the potential to make harvestable acres outside of the buffers impossible or economically inviable to access, stranding additional acres and rendering their value diminished as well. Data are not available to provide context on how often this scenario may occur. Conversations with engineers within DNR Forest Practices suggest that harvesters are almost always able to access timber (personal communication on December 23, 2024), therefore we do not find this uncertainty is likely to have a major effect on the analysis of land value losses. Further, restrictions in supply have the potential to drive up land values elsewhere. Therefore, it is possible that restrictions on timber harvest in the buffers will make timberland outside of the buffers more valuable, resulting in marginal forestland value increases in the region. Lacking data and the potential for these countervailing effects, it is unknown whether focusing only on lost land values within the buffers themselves under- or overestimates the total change in forestland values in the region.

Note: See also Table 11 for a discussion of the uncertainty associated with our estimated extent of Np miles, which is a key input in this analysis.

3.2 Increased Forest Harvest Operating Costs

Summary findings: Increased forest harvest operating costs
Minor cost
At most 16 percent of Np stream miles may be associated with increased cable harvest costs Increased costs per thousand board feet (Mbf) are uncertain but likely minor where the rule widens existing buffers, and moderate for areas where buffers do not exist with the current rule and would be required under the rule

In areas that would rely on cable harvest methods absent the rule, increased no-harvest and partial-harvest buffers under the rule are likely to result in increased harvest costs under some circumstances.[32] There are two mechanisms through which the rule may increase cable harvest costs:

1. For areas that experience an increase in *buffer width* (i.e., the current rule requires some buffer along the Np stream segment), there will be a longer yarding distance over which cables need to be strung, resulting in slightly higher costs and time associated with stringing cables.
2. For areas that experience an increase in *buffer length* (i.e., new areas with buffers along Np stream segments that would not be buffered in the baseline), harvesters may need to create additional yarding corridors in order to reach harvestable timber, resulting in increased labor and materials costs. Tree falling to create yarding corridors often requires skilled fallers to ensure directional falling.

Landowners pursuing ground-based harvest or other non-cable harvest methods in the baseline are unlikely to change their harvest method under the rule or experience increases in harvest-related costs.[33] In this section, we describe our analysis of the probable magnitude of this incremental cost to landowners. Figure 6 summarizes our approach while the text that follows provides a more in-depth explanation of data sources, methods, and findings.

Figure 6. Methods Overview for Increased Forest Harvest Operating Costs Analysis

Step 1: Determine the portion of Np stream miles where cable harvest may become more costly. Available information suggests that cable harvest is most appropriate when slopes are steeper (greater than 35 percent) (DNR 2021a; Schiess and Krogstad 2004). Therefore, to determine how frequently increases in harvest costs may occur, we analyzed geospatial data to identify slopes on buffers adjacent to the Four Peaks sample streams. Specifically, we used high-quality, one-meter LiDAR terrain elevation data to determine slope within the affected buffers from Four Peaks SSN.[34] Because we expect the greatest change in buffer area under rule

[32] Our understanding of how the rule results in increased cable harvest costs is derived from 1) email communication with Dean Warner (DNR, NW region) on December 3, 2024; 2) personal communication with Mark Stevens, Kelly Childers, and Kelcie Hopkins (DNR) on December 23, 2024; and 3) personal communication with Court Stanley (Heartwood Consulting, LLC) on January 7, 2025.

[33] Personal communication between IEc and DNR on August 20, 2024.

[34] 1-m LiDAR data was provided by DNR on October 25, 2024.

scenario 2, we focus on those buffer areas in this screening analysis. In doing so, we capture more stream miles with the potential for buffers relative to rule scenarios 1A and 1B.

Of the Type Np stream miles in Four Peaks SSN, Table 15 shows that roughly 16 percent are associated with slopes greater than 35 percent on average across all ecoregions. Conversations with engineers familiar with harvest methods used in western Washington confirmed that only a portion of areas where cable harvest may be employed are likely to experience more complex operations and therefore increases in costs as a result of the rule. However, these experts similarly identified that the conditions that would lead to increased costs are likely very site-specific and difficult to predict. Accordingly, this analysis does not quantify the subset of Np miles that may experience increased costs and finds that *no more than 16 percent* of the Np stream miles within the Four Peaks SSN are likely to experience these increased costs. It remains unknown how the slopes abutting Four Peaks SSN streams may differ from the full extent of Np streams throughout the affected ecoregions.[35]

Table 15. Np Stream Miles in Four Peaks SSN Adjacent to Areas That May Require Cable Harvest

Ecoregion	Percent of All Np Stream with Slopes >35%
Cascades	10.8%
Coast Range	22.7%
North Cascades	14.0%
Puget Lowland	5.5%
Willamette Valley	N/A
Total	15.6%

Source and notes: IEc analysis of 1-m LiDAR data was provided by DNR on October 25, 2024. This analysis relies on the "option 2" buffers from Four Peaks as the basis of the potentially affected areas, which are the most expansive (wider and longer) in most instances.

Step 2: Quantify changes in cable harvest costs per Mbf attributable to changes in Np buffer composition. As described in Step 2, the conditions that lead to increases in cable harvest costs are likely highly site-specific, and the increases in unit costs for cable harvest operations are similarly variable. Empirical data are not available to compare cable harvest costs with variable buffer ranges in order to inform an estimated increase in costs associated with new or widening buffers. Through discussions with experts familiar with cable harvest costs and a review of available literature we conclude the following:

- ***Minor increase in cable harvest costs among buffers that widen.*** Discussions with DNR staff and others familiar with cable harvest operations suggested that the increase in cable harvest costs per unit is unlikely to be significant in buffers that widen. One engineer described that the main difference for Np buffers that experience an increase in width is in the time required to move the haulback line using the strawline. Historically, harvesters completed this process manually, which was time-consuming and therefore expensive. Under modern cable harvest operations, harvesters use drone aircraft to move the strawline, reducing the time and costs associated with the process. We expect an increase in cost on the order of dollars to tens of dollars per Mbf.

[35] The high spatial resolution of the 1-m LiDAR data provides confidence that we are accurately calculating slopes around the Four Peaks sample streams. However, the size of that data source makes it less feasible to use when evaluating slopes across all Np streams in western Washington identified with WC Hydro.

- ***Moderate increase in cable harvest costs among stream miles with new buffers.*** The range of cable harvest costs per Mbf is highly variable across sites. We identified three sources of data that provide ranges of cable harvest costs per Mbf, as summarized in Table 16. However, the ranges reflect the many variables that contribute to differences in cable harvest costs at a given site and are not reflective of changes in required RMZ buffers specifically. We expect an increase in cost on the order hundreds of dollars per Mbf.

Table 16. Range of Harvest Costs per Mbf from Various Sources

Source	Ground based harvest	Cable based harvest	Helicopter based harvest or other more complex harvest methods
Atterbury Consultants (2024)	$75 to $100 per Mbf	$175 to $225 per Mbf	$400 per Mbf
WA DOR survey (2024)	$128 to $136 per Mbf	$224 to $260 per Mbf	$619 per Mbf
Schiess and Krogstad (2004)	$65 to $124 per Mbf	$85 to $325 per Mbf	$331 to $441 per Mbf

Sources and notes:

1. Atterbury provided data via email to IEc on September 27, 2024. These costs are built into typical appraisals for forestland in the Pacific Northwest.
2. Washington Department of Revenue (DOR) survey results provided via email to IEc on January 8, 2025. The estimates represent the average across 16 western Washington landowners from a survey conducted in early 2024. The presented ranges capture different types of harvest within the overall categories instead of true ranges. For ground-based harvest, the range is derived from average costs associated with "ground mechanized falling and logging" at the low end and "hand falling mechanized ground logging" at the high end. For cable-based harvest, the range includes "tethered falling cable/tower yarding" at the low end and "hand falling cable/tower yarding" at the high end.
3. Schiess and Krogstad (2004) values adjusted to 2023 dollars using the GDP deflator. The range includes estimates from Table 10.3 of the source specific to "live skyline – large tower" and "standing skyline – small tower."

The available information summarized above suggests that while individual landowners may experience significant harvest cost increases, the aggregate social welfare cost is expected to be minor.

CHAPTER 4 | Probable Benefits of the Rule

This chapter describes our analysis of the probable benefits of the rule stemming from reduced risk of stream temperature increases, improved wildlife habitat quality, increased carbon sequestration, and tribal cultural values. Because our assessment of these benefit categories is largely qualitative, we conclude this chapter by providing additional perspective on the monetized magnitude of these benefits by describing existing research on economic values of improvements in terrestrial riparian buffers in other contexts. In making our determination, we additionally considered two other potential benefits of the rule (i.e., avoided costs associated with lost assurances and uplisting of salamanders) and ultimately determined that they were not probable effects, as discussed in Appendix B.

4.1 Reduced Risk of Stream Temperature Increases

The primary objective of the rule is to prevent an increase in mean 7-day maximum water temperature of 0.3°C or greater from human activities above natural conditions, or an increase above specified temperature thresholds on waters designated for aquatic life or else specified in WAC 173-201A-200 and -602. Ecology is responsible for determining whether Forest Practices rules meet water quality standards and is engaged in Tier II antidegradation analysis to determine whether the rule will cause a measurable change to water quality, defined for temperature increases of 0.3°C or greater, and, if so, whether such a measurable change in water quality is in the necessary and overriding public interest.

Ecology's analysis is not yet available for consideration and incorporation into this CBA.[36] To assess whether the reduced risk of stream temperature increases is a probable benefit of the rule for the purpose of this analysis, Section 4.1.1 references the key research and information sources that evaluate the efficacy of the rule in minimizing or preventing future stream temperature increases. In Section 4.1.2, we describe available economics literature that provides perspective on the values Washington residents place on the water quality enhancements described in Section 4.1.1.

Summary findings: Reduced risk of stream temperature increases

Moderate to major benefit

Existing evidence and expert review demonstrate that longer and wider buffers are necessary to minimize the risk of stream temperature increases associated with harvest near Np streams

Economics literature consistently demonstrates that people value improvements in water quality, regardless of whether they directly use the resource (e.g., for drinking or recreation)

4.1.1 Effectiveness of the Buffers at Reducing Risk of Stream Temperature Increases

The rule is based on a recommendation from the Adaptive Management Program (AMP), which encompasses extensive scientific work, literature review, and policy response and recommendations. The assessment of the effectiveness of the buffers in reducing the risk of stream temperature increases is drawn from several key sources:

- The Hard Rock Study (McIntyre et al. 2021) compared 1) current Forest Practices Np buffers with 2) 50-ft buffers for 100 percent of the length and 3) clearcut throughout the RMZ (no buffers). The authors found that the current Forest Practices buffers did not always protect against stream temperature increases after harvest. The studies also found that streams that were 100 percent buffered (i.e., received

[36] Because research and analysis of the effectiveness of the specific buffer configurations prescribed by the rule is ongoing and future, on-the-ground research may result in different or more nuanced conclusions regarding this benefit category.

buffers along the full length of the stream) were the most effective in limiting stream temperature increases relative to pre-harvest temperature conditions. Based on these findings, the Forest Practices board warranted that longer buffers are necessary to protect water temperature.

- The Soft Rock study (Ehinger et al. 2021) compared an unharvested site with harvest dictated by current Forest Practices buffers and also found that the current buffers did not prevent increases in stream temperatures. This study does not specifically evaluate effectiveness of the buffers.
- The Type N Prescription Work Group conducted a detailed literature review to glean the effectiveness of several alternative buffer descriptions that could be used as the basis for the rule (Barnowe-Meyer et al. 2021). The committee used the available literature to describe that 50-foot continuous buffers are expected to exhibit warming for one to two years post-harvest, whereas 75-foot continuous buffers are not expected to warm beyond the measurable change standards amount. This expert review of the literature provides confidence that a continuous 75-foot buffer will maintain stream temperatures.
- In late 2022, the Forest Practices Board accepted the majority recommendations (2022) to form the basis of the rule. In doing so, the Board accepted the rationale that wider and longer buffers are required to reduce the risk of stream temperature increases. Specifically, the majority report stated the following:

  > *"It is the conclusion of the majority caucuses that the completed CMER science and report from the Technical Workgroup demonstrates a continuous buffer, from the end of fish-bearing waters (F/N break) to the uppermost point of perennial flow of Type Np waters is required to meet Washington's Water Quality Standards."*

- At the August 2023 board meeting, Ecology's Water Quality Program Manager provided testimony providing further support to the Type Np Prescription Work Group recommendations and TFW Policy Committee majority recommendations, noting that Ecology supports the TFW Policy Committee majority recommendations because "they have the highest likelihood of protecting water quality while still considering the impact to landowners and providing a practical path forward."[37]

Based on the available scientific evidence and expert judgment, the wider and longer Np stream buffers associated with the rule relative to the current rule are necessary to meet water quality standards. Therefore, the reduced risk of stream temperature increases is a probable benefit of the rule. Because this body of evidence suggests water quality standards cannot be consistently achieved absent this rulemaking, we categorize the reduced risk of stream temperature increases as a moderate to major benefit of the rule. Given the extensive scientific evidence on this topic, this CBA does not include additional analysis on the likelihood that the rule will minimize increases in stream temperatures or meet water quality standards.[38]

4.1.2 Values Associated with Maintaining Stream Temperatures

Reducing the risk of stream temperature increases is one way to improve the overall quality of streams in western Washington. People value improvements in water quality through multiple mechanisms, including the values they place on the *use* of streams (i.e., for recreation, as an input into drinking water systems, aesthetic enjoyment) as well as other *non-use* values they perceive (i.e., benefits to species and overall ecosystem health, preserving a resource for future generations, sense of stewardship for the environment). A key challenge in

[37] Written testimony from Vincent McGowan delivered during the August 9, 2023 Forest Practices Board Meeting was provided to IEc on April 3, 2025. Video from the August 2023 Forest Practices Board Meeting can be found here: http://deptofnaturalresources.app.box.com/s/f5wiaq9mkm7njxuq1zlklsdy6aonrot5. The Ecology testimony begins at 58:38.

[38] DNR memo sent to IEc on March 31, 2025.

valuing changes in water quality stemming from specific regulatory actions is isolating the pathway through which water quality improvements are experienced and the impacts associated with those changes.

> *"The aim of a benefits analysis of an environmental policy is to describe the changes resulting from the policy and to estimate the social benefits that ensue. Willingness to pay (WTP) is the preferred measure for benefits."*
>
> *U.S. EPA (2024, page 7-1)*

The U.S. Environmental Protection Agency (USEPA) has a long history of developing regulatory analyses to accompany rulemakings that target water quality improvements on impaired streams under the Clean Water Act (Moore et al. 2023). In many of these analyses, the benefits of water quality improvements are aggregated in a water quality index (WQI) that considers contributions across a range of specific pollutants. For instance, the freshwater WQI used by USEPA to evaluate water quality in rivers and streams includes six parameters that represent major stream impairment categories: dissolved oxygen, biochemical oxygen demand, fecal coliform, total nitrogen, total phosphorus, and total suspended solids.[39] Of note, the USEPA's freshwater WQI does not include stream temperature because temperature is not a common cause of impairment nationally and is not included in the original WQI method developed by Cude (2001).[40] Once changes in WQI attributable to a specific regulatory action are evaluated, these analyses apply standard measures of people's willingness to pay (WTP) for specific changes in WQI (see, for instance Johnston and Bauer 2020). The WQI represents a frequently used tool in assessing benefits associated with regulations that seek to improve impaired waterways, although is not a good match for the context of this rule.

Understanding the value the public holds for water quality improvements (where public WTP is the measure of economic value) remains an active area of academic research (Moore et al. 2023). Most of the available literature to date focuses on the values people derive from "use" of the water, through recreation (e.g., boating, swimming, fishing), drinking water, etc. The following bullet points describe recent work—much of which revolves around converting traditional water quality parameters to economic value-relevant endpoints—with an emphasis on relevance to valuing the expected water quality effects of the Np rule. This discussion considers both "non-use" components as well as "indirect use" through effects on wildlife that people value. We note that, as these papers are intended primarily to advance water quality valuation methods, direct relevance in terms of quantitative WTP estimates is limited.

- Vossler et al. (2023) focused on translating a continuous WQI (the Biological Condition Gradient) into six discrete levels defined by a set of relevant attributes (i.e., supported human uses, degree of biodiversity, and visual conditions) to facilitate more reliable value estimates. Reported WTP estimates focus on non-incremental moves between the six steps (e.g., $169 per respondent for a localized one-step improvement; $207 for a similar improvement applied on a larger and non-local geographic scale, all in 2023 dollars). While the authors do not report estimates disaggregated between use and non-use values, their study design facilitates this, and they note that non-use sources (e.g., bequest value, intrinsic aesthetic value) are an "important" component of the value the public holds for water quality improvements. Transferring results to this study, however, would require understanding not only the individual components of value but also the marginal contribution of water temperature changes.

- Lupi et al. (2023) take a similar approach to disaggregating sources of value, presenting respondents with individual indices ("scores") for wildlife, water contact, and recreational fishing, derivatives of a standard WQI. The wildlife score serves as a potential metric for overall ecological health associated

[39] See for example: https://www.epa.gov/sites/default/files/2015-06/documents/cd_envir-benefits-assessment_2009.pdf

[40] Dissolved oxygen, however, is highly temperature dependent, so temperature is indirectly incorporated through measurement of dissolved oxygen.

with changes in the WQI, but the paper does not provide welfare estimates associated with changes in that index. The other scores, which are focused only on use values, are less relevant for the changes expected from the Np rule.

- Von Haefen et al. (2023) similarly use ecological production functions and expert elicitation to describe changes in water quality in terms of ecosystem condition, health risk, and water clarity, each on a qualitative scale (i.e., low, medium, and high). Results suggest that respondents valued even small improvements in ecosystem condition similarly (in order of magnitude) to values placed on the other, more use-focused dimensions.

As described above, a robust economics literature exists that consistently demonstrates positive value for even small changes in water quality. Further, this literature demonstrates the public values improvements in water quality even beyond any direct use of water resources (e.g., for recreation or drinking water). While we did not identify any studies that provide a direct estimate for the value of reduced risk of stream temperature increases in particular, the known linkage between temperature and overall water quality (explicit in some indices, e.g., Walsh and Wheeler, 2013) identifies that the public most likely holds a positive value for the expected water quality benefits of the Np rule, even in the absence of direct use of the affected streams and riparian areas.

Other approaches to valuing changes in water quality include modeling how changes in specific water quality parameters influence populations of fish, then quantifying values associated with the increase in fish abundance. For example, Ecology used this approach in assessing the benefits of its water quality standards for surface waters in Washington (Ecology 2024b). The next section discusses our related assessment of how the expanded Np buffers contribute to improvements in habitat quality for species.

4.2 Improved Wildlife Habitat Quality

Riparian buffers provide important ecosystem services across Washington State (Quinn et al. 2020). Despite covering a small fraction of the landscape, approximately 85 percent of terrestrial vertebrate species in the state depend on riparian habitats, which provide vital resources such as nesting sites, productive food webs, natural corridors for species dispersal, mild microclimates, fertile soils, and shelter (King County 2024, Knutson and Naef 1997, Quinn et al. 2020). Forested riparian zones are particularly biodiverse, including diverse vegetation with snags, downed logs, and multiple canopy layers that provide habitat for cavity-nesting and insectivorous birds, amphibians, reptiles, and small mammals (Knutson and Naef 1997, Quinn et al. 2020).

Summary findings: Improved wildlife habitat quality
Moderate to major benefit
Terrestrial species
Minor to moderate benefit
Stream-associated amphibians
Negligible to minor benefit
Fish downstream of Np streams

The Washington Department of Fish and Wildlife (WDFW) maintains a Priority Habitats and Species List (WDFW 2008), a catalog of those species and habitat types identified as priorities for management and preservation. WDFW recognizes riparian ecosystems and instream habitats as Priority Habitats for fish and wildlife and recommends that jurisdictions designate those ecosystems as Fish and Wildlife Habitat Conservation Areas, a type of critical area under the Washington State Growth Management Act.[41] In reviewing the current scientific literature for riparian ecosystems, WDFW found that there was no evidence that full riparian ecosystem functions along non-fish-bearing streams are less important to aquatic ecosystems than

[41] The Growth Management Act requires all cities and counties in Washington to adopt regulations protecting "critical areas" in order to preserve the natural environment, wildlife habitats, and sources of fresh drinking water: https://mrsc.org/Explore-Topics/Planning/gma/Growth-Management-Act

full riparian ecosystem functions along fish-bearing streams (Rentz et al. 2020). This is because non-fish-bearing streams perform the following ecological services:

- Support a unique community of aquatic and riparian-obligate wildlife;
- Provide movement corridors for wildlife, particularly in the face of changing climate conditions;
- Provide downstream fish-bearing streams with matter and energy; and
- Provide cool water to downstream reaches. Washington State has already experienced increased stream temperatures due to climate change and expects further increases, which have direct implications for the persistence of fish. For instance, a report by the Climate Impacts Group of the University of Washington projects an increase in western Washington sites that will experience weekly stream temperatures stressful to adult salmon by the 2080s (Snover et al. 2013).

In evaluating the wildlife habitat quality benefits of the rule, a key challenge is differentiating between the ecological importance of riparian buffers in general and the *incremental changes afforded by the increases in buffer width and length in the Np rule relative to the current rule*. To accomplish this, we reviewed the literature related to riparian functions to qualitatively assess the magnitude of ecological benefits of the world with the rule versus without. We focused on the five riparian functions that contribute to instream habitat and groups of species that have been studied and that are known to be influenced by forest management practices. In making these determinations, we also considered that approximately 40 percent of the streams in the Four Peaks SSN did not have buffer requirements under the current rule and do under the rule, while 60 percent of the Np streams receive wider buffers. We also considered that Type Np streams comprise more than 65 percent of the total length of streams on industrial forestland in western Washington (Rogers and Cooke 2010).

4.2.1 Effectiveness of Buffers at Improving Instream Habitat Via the Five Riparian Functions

In this section, we use existing literature to evaluate how the rule is likely to affect the five riparian functions as defined in Forest Practices rules: bank stability, the recruitment of woody debris, leaf litter fall, nutrients, sediment filtering, and shade (WAC 222-16-010). These functions are key inputs into how the rule protects and enhances species' habitat, partially habitat for species that reside in or depend on the streams themselves. Table 17 summarizes our findings related to changes in function. The table is followed by a more detailed synthesis of relevant literature.

Table 17. Summary of Rule Attributable Effects on Five Riparian Functions

Five Riparian Functions	Probable Changes in Function
Shade and temperature	Probable reduction in risk (benefit) of stream temperature increases
Nutrient/leaf litter	Probable increase (benefit) in leaf litter in areas with new buffers
Erosion control and sedimentation	Probable short-term minor decrease in sedimentation (benefit), but current forest practices minimize sedimentation
Discharge	Probable short-term minor benefit to discharge with possible negative (costs) summer baseflow impacts
Woody debris	Probable increase (benefit) in wood recruitment and instream wood load

Shade and Temperature

Water temperature impacts aquatic life, influencing species metabolism, behavior, habitat choices, and overall survival, with higher temperatures potentially leading to reduced dissolved oxygen and increased metabolic demands. Canopy cover provides shade for streams that decreases the amount of incoming solar radiation and thus influences stream temperatures, although that influence can be highly variable depending on shade structure and density surrounding stream courses. From the studies reviewed in Spei et al. (2024), the results show evidence that changes in canopy cover and effective shade are, not surprisingly, directly related to the intensity of harvest operation. Initial reduction in canopy cover and shade from pre- to post-harvest are influenced by the basal area removed and the width of the retention buffer. Stream temperatures in several studies had greater increases in treatment over reference sites (McIntyre et al. 2021; Ehinger et al. 2021). However, the relative effectiveness of most prescriptive treatments implemented is highly variable (Martin et al. 2021). This is because there is evidence that multiple site factors can affect stream temperatures (e.g., aspect, groundwater, geology, hydrology, topography, latitude, and stream azimuth). Consistent with the available evidence presented in Section 4.1, the rule is expected to reduce the risk of stream temperature increases, in large part through the increase in shade over streams.

Despite increased water temperatures, several studies have shown that water temperatures never reach amphibians' upper thresholds (McIntyre et al. 2021; Olson and Davis 2009; McCullough 1999), and many studies observed cooling of water temperatures downstream after flowing through a buffered or unharvested stream reach (McIntyre et al. 2021; Roon et al. 2021). However, streamside shade in Np streams will likely become even more critical with the predicted increases in air temperature over the next century (Manuta et al. 2010). Section 4.2.2 provides additional support for how stream-associated amphibians are affected by the rule.

Nutrient and Leaf Litter

There is evidence from the studies reviewed by Spei et al. (2024) that nutrient dynamics and leaf litter inputs are affected by the intensity of riparian timber harvest (e.g., presence of buffer widths, percent of basin harvested), changes in streamflow (either seasonally or from harvest), climatic events (e.g., drought, heavy precipitation), physiography (e.g., hillslope gradient), and soil disturbance. In general, leaf litter inputs decrease, and nutrient levels increase post-harvest. Studies reviewed by Spei et al. (2024) provide evidence that the effects of timber harvest on nutrient export are proportional to the intensity of the treatment (e.g., percent of basin harvested, presence of protective buffer).

Salo and Cundy (1987) noted that removal of the forest canopy from timber harvesting resulted in decreases in annual litter fall from 300-400 g/m^2 in the mature forests to less than 100 g/m^2. Further, the authors state that decreased litter inputs after logging can persist for 10 to 20 years before recovering. Results from Hartman and Scrivener (1990) showed that litter inputs post-logging were 25 to 50 percent of pre-logging levels with about 50 percent of the loss recovering within a decade. However, in the Hard Rock Study there was no consistent response in nitrogen concentration and export to buffer treatment (McIntyre et al. 2021). Ecological responses to modifications to nutrient and leaf litter are difficult to predict but may include changes to invertebrate species and biomass exported downstream. This could benefit amphibians and macroinvertebrate species considering the additional nutrient and leaf litter benefits on the 40 percent of Np streams that require buffers under the final rule and do not under the current rule.

Discharge, Erosion Control, and Sedimentation

While discharge generally increases following harvest, the magnitude of the response varies with a range of factors including the season or storm period being examined (Buttle and Metcalfe 2000; Brown et al. 2005; Grant et al. 2008; Kuras et al. 2012; Winkler et al. 2017), the spatial pattern and amount of forest harvest (Abdelnour et al. 2011; Zhang et al. 2017), the climate and hydrologic zone (Robinson et al. 2003; Grant et al.

2008; Zhang et al. 2017), and soils and vegetation (Robinson et al. 2003; Neary 2016). Discharge changes are expected to be greatest immediately following harvest and slowly decline over subsequent decades as vigorous young vegetation with higher evapotranspiration rates becomes established (Du et al. 2016; Coble et al. 2020); however, discharge increases and decreases may still be measurable up to 40 years after harvest (Perry and Jones 2017; Safeeq et al. 2020). Long-term decreases in base flow are especially concerning because of the potential impact to aquatic species (Gronsdahl et al. 2019; Coble et al. 2020).

Forest practices have the potential to not only affect discharge but may also affect headwater sediment supply by affecting a range of processes including road surface erosion, windthrow, and bank erosion (Roberts and Church 1986; Grizzel and Wolff 1998; Araujo et al. 2013). The combination of changes in flow and/or sediment supply can affect the frequency and magnitude of sediment transporting events (Gomi et al. 2005; Alila et al. 2009; Kaufmann et al. 2009). Sediment routing through a basin is complex and subject to changes in bedforms, large wood, and other channel features that alter hydraulic resistance, shear stress, and in-channel sediment storage (Buffington and Montgomery 1999; Jackson et al. 2001; Kaufmann et al. 2009). A source for concern is that forest practices can increase suspended sediment loads and sediment export (MacDonald et al. 2003; Reiter et al. 2009; Klein et al. 2012), which can have deleterious effects on fish (Kemp et al. 2011) and stream-associated amphibians (Grialou et al. 2000; Stoddard and Hayes 2005).

All treatments in the Hard Rock Study exhibited statistically significant changes in magnitude and frequency of discharge over the period of study and in every post-treatment year. In the 100 percent treatment basins, the biggest change was a reduction in baseflow (McIntyre et al. 2021). One possible reason for the reduction in baseflow is that increased light availability associated with adjacent harvest increased evapotranspiration enough to decrease streamflow during relatively dry periods when soil water is depleted and stream discharge is low. Although stormflow increased in all Forest Practices and zero percent treatment basins, it did not translate to a commensurate increase in suspended sediment export. The basins appeared to be supply-limited both before and after harvest based on the lack of sediment transport across a range of large storm events.

Woody Debris

Wood plays an important functional role in Pacific Northwest streams (Bilby and Bisson 1998), influencing channel morphology and hydraulics, storage and routing of sediment and organic matter, aquatic habitat, aquatic communities, and food resources (Harmon et al. 1986; Bisson 1987; Curran and Wohl 2003; Montgomery et al. 2003; Wilcox et al. 2011). One effect of timber harvest is increased in-channel wood loading, primarily a result of logging slash and windthrow (McIntyre et al. 2021). In general, the studies reviewed by Spei et al. (2024) show evidence that upland timber harvest with riparian retention buffers initially increases stand mortality within the buffers and increases large wood recruitment relative to unharvested reference stands in the short term. In three studies that collected post-harvest data for eight or more years (Bahuguna et al. 2010; McIntyre et al. 2021; Schuett-Hames and Stewart 2019), there is indication that mortality in the riparian buffers and annual large wood recruitment into adjacent streams stabilize within 5 to 10 years. These studies also show that that large wood recruitment dynamics are complex and highly variable even within treatment groups, and local site and landscape factors may interact with treatments making it difficult to generalize the effectiveness of different protective buffer treatments on preserving large wood recruitment and in-stream wood loads (Spei et al. 2024). The weight of the available evidence suggests that the Np rule is likely to have some benefit to wood recruitment and instream wood load, specifically for the 40 percent of streams with required buffers under the rule that would not necessitate buffers under the current rule.

4.2.2 Effectiveness of Buffers at Protecting and Conserving Species

The rule has the potential to benefit three categories of species: stream-associated amphibians and macroinvertebrates (within and alongside Np streams), terrestrial riparian wildlife (that rely upon the forested

buffers), and fish located downstream of buffered Np streams. This section summarizes the available literature linking changes in riparian buffer length and width with effects on these three groups of species.

We used the U.S. Fish and Wildlife Service's (USFWS's) Information for Planning and Consultation database (IPaC), WDFW's Species in Washington database, Washington's State Wildlife Action Plan (WDFW 2015), the Forest Practices HCP (i.e., covered and not covered species listed in Table 1.3 and 1.4 of the document), WDFW's Priority Habitats and Species list, and professional judgment to establish a list of species that may experience benefits of the rule through preservation of riparian forest habitat, including Endangered Species Act (ESA) -listed species, state priority species, migratory bird species, and species that are of ecological, cultural, and recreational interest.[42,43,44] The resulting list, found in Table C-2 of Appendix C, does not provide a comprehensive accounting of all species types that may be affected by the rule but reveals that many important species likely utilize habitat that would be conserved under the rule. The table also aims to distinguish species with ranges that likely overlap the areas affected by the rule (based on the data sources listed above) from species most likely to occur within the Np areas based on professional judgment.

Stream-Associated Amphibians

Amphibians are often considered one of the most susceptible organisms to environmental change (Welsh and Ollivier 1998; Lawler et al. 2010). Many headwater streams in the Pacific Northwest support abundant amphibian populations compared to larger streams (Richardson and Danehy 2007). Some studies have concluded that stream-associated amphibians are sensitive to forestry practices (Corn and Bury 1989). Conversely, others have not detected a correlation between amphibian abundance and forestry activities (Murphy and Hall 1981; O'Connell et al. 2000).

Several studies reveal a positive relationship between stream-associated amphibian populations and stand age (Welsh and Lind 2002; Stoddard and Hayes 2005; Welsh et al. 2005; Ashton et al. 2006; Pollett et al. 2010). However, it is likely that forest age alone does not determine amphibian species' occupancy and abundance, but rather the microclimate and microhabitat conditions that tend to vary in relation to forest age (Welsh 1990; Diller and Wallace 1994). Amphibian abundance has been associated with stream temperature, overstory canopy, primary productivity, wood loading, sediment retention, flow dynamics, stream and bank morphology, and nutrients, all metrics that likely impact occupancy and abundance at the microhabitat level. In a systematic review, Martin et al. (2021) found mixed evidence regarding the relationship between amphibian population responses and buffers that were maintained along streams during forest harvest in the Pacific Northwest of North America. They also found considerable uncertainty exists about which environmental covariates are associated strongly with amphibian population responses.

McIntyre et al. (2021) did not observe an immediate negative effect of treatment on amphibians in the post-harvest period (except for giant salamanders in the Forest Practices treatment) when the post-harvest increase in stream temperatures was the greatest. However, it is possible that the increased temperatures observed in all buffer treatment streams had negative longer-term consequences that were not immediately apparent, but which may have impacted movement or reproductive success over time, especially for coastal tailed frogs, which had experienced the greatest declines across all buffer treatments seven and eight years post-harvest. However, the authors did observe a substantial negative response to timber harvest in the eight years post-harvest for some focal species in some buffer treatments, and for coastal tailed frog in all buffer treatments. The authors

[42] USFWS's Information for Planning and Consultation database (IPaC): https://ipac.ecosphere.fws.gov/location/index. To create the list, we queried three representative areas in western Washington: North Cascades, Olympic Peninsula, and Willapa Hills.

[43] WDFW's Species in Washington: https://wdfw.wa.gov/species-habitats/species

[44] Forest Practices HCP: https://www.dnr.wa.gov/programs-and-services/forest-practices/forest-practices-habitat-conservation-plan

recommended continued study and concluded that without further investigation, it is unclear if populations will rebound in buffer treatment sites, or whether densities will continue to decline, stabilize, or return to pre-harvest levels.[45] This consideration is especially important given the temporally and spatially stochastic nature of disturbances, both natural and human-made, across western Washington.

Magnitude of Ecological Benefits: The Np rule will likely have minor to moderate benefits to stream-associated amphibians through the increase in newly buffered Np streams. Sensitive amphibian species are certain to be present in headwater streams as part of their primary habitat, and they are generally sensitive to temperature and other water quality changes. Thus, the benefit of protecting a significant amount of riparian habitat may have a moderate benefit on the species by both reducing habitat fragmentation and improving habitat quality. Additionally, the added buffers may be particularly important for the species depending on whether there are increased climactic events due to climate change (e.g., drought, heavy precipitation, forest fires). However, existing research shows different levels of effects associated with timber harvest in riparian areas generating uncertainty about the magnitude of these benefits. We therefore conclude that it's possible the benefits could be minor and present our findings as a range of minor to moderate.[46] Continued monitoring of the amphibian response to treatment is strongly suggested to expand on our understanding of the long-term impacts of timber harvest and variable length buffers on stream-associated amphibians (McIntyre et al. 2021).

Terrestrial Riparian Wildlife

Riparian zones are particularly biodiverse, including diverse vegetation with snags, downed logs, and multiple canopy layers that provide habitat for cavity-nesting and insectivorous birds, amphibians, reptiles, and small mammals (Knutson and Naef 1997; Quinn et al. 2020). Intact riparian habitat has well-developed vegetation, usually with multiple canopy layers. Each layer consists of unique habitat niches that together support a diversity of bird and mammal species. The relatively mild microclimate of riparian areas provides relief from hot, dry summers and cold, snowy winters which is especially important to deer, elk, and moose. Riparian habitat forms natural corridors that are important travel routes between foraging areas, breeding areas, and seasonal ranges, and provides protected dispersal routes for young. Protected access to water is also an essential attribute of intact riparian habitat.

Magnitude of Ecological Benefits: The Np rule will likely have a moderate to major benefit to riparian wildlife by the addition of buffer extent and width provided by the rule.[47] As previously noted, 85 percent of terrestrial vertebrate species in the state depend on riparian habitats for sustaining life functions, including nesting, foraging, and shelter. The forested riparian zones specifically benefiting from the rule are particularly biodiverse. We find a significant increase in harvest restrictions on unfragmented forested riparian habitat would result from the rule, on the order of 67,000 to 170,000 acres across western Washington. This would provide significant benefit to the species listed in Table C-1 in Appendix C and many others, including sensitive and endangered wildlife. We include the range of moderate to major recognizing that, at the moderate level, the riparian forests within the headwater streams at higher elevations are likely not the most biodiverse riparian forests. However, the species that do rely on these habitats would experience significant benefits.

[45] Phase III of the Hard Rock study is currently ongoing and addresses these questions related to longer-term response of amphibian populations.

[46] Given data limitations, findings regarding the magnitude of the ecological benefits are based on the weight of evidence from the existing literature and the professional judgment of James Shannon, Fish Biologist with Haley and Aldrich.

[47] Given data limitations, findings regarding the magnitude of the ecological benefits are based on the weight of evidence from the existing literature and the professional judgment of James Shannon, Fish Biologist with Haley and Aldrich.

Fish Downstream of Np Streams

Non-fish-bearing "headwater" (Type N) streams comprise more than 65 percent of the total stream length on industrial forestlands in western Washington (Rogers and Cooke 2010). These streams provide important subsidies of organic matter and macroinvertebrates (Wipfli et al. 2007), nutrients (Alexander et al. 2007), and cool water to downstream reaches. Although we know that invertebrates transported from headwaters enter fish-bearing streams, empirical data on actual effects on fish is limited (Wipfli and Gregovich 2002). Also, water temperatures under various buffer treatments never reach salmonid upper thresholds and decrease after entering Type F buffered waters (McIntyre et al. 2021; McCullough 1999). The streams that would not have any buffer requirement under the current rule but would be buffered under the rule stand to benefit the most from riparian habitat function and water quality improvements. However, these streams are generally farther from the fish-bearing waters than the Np streams for which the rule increases the buffer widths.

Magnitude of Ecological Benefits: The Np rule will likely have a negligible to minor benefit to fish downstream of the Np point relative to the current rule.[48]

4.2.3 Values Associated with Protecting Species Habitat

The relevant economic benefits of improving conditions of the species described above are the public's willingness to pay to preserve and protect these species through conservation of their habitats. Given the many types of species that may benefit from the rule, for tractability, we collapsed the full species list into nine groups based on common characteristics.[49] We then searched the economic valuation literature to provide context for the values Washington residents may hold for supporting these groups of species. Starting from a recently published comprehensive review of species valuation studies (Lewis et al. 2024), we attempted to identify at least one valuation study for each species group that is closely related to a species identified in the Np buffer analysis. For certain species, multiple valuation studies exist. In these cases, we selected the study that was published most recently. We filtered further to include only studies set in the United States or Canada. Finally, we focused on studies estimating non-use values only, recognizing that the areas expected to be affected by the rule are private and remote (e.g., many studies of elk and white-tailed deer exist that are focused on the value of hunting).

It is important to note that the species types that benefit most directly from the Np rule (e.g., invertebrates, amphibians, small mammals) are systematically underrepresented in the valuation literature relative to more charismatic species (e.g., Richardson and Loomis 2009, Subroy et al. 2019). When values for lesser-known species are estimated, WTP for protection of these species tends to be lower than it is for more well-known species, potentially due to an inherent lack of familiarity among the public (e.g., Martín-López 2007, Colléony et al. 2016, Ferrato et al. 2016).

Table 18 summarizes our findings. As shown, Lewis et al. (2024) does not identify any valuation studies for amphibians. An independent search revealed a small sample of valuation studies focused on amphibians, but typically outside of North America, and focused on market values associated with the species (as pets or food). Our search also yielded one study from the United States describing results from a survey of visitors at two national parks that elicited WTP for a program to prevent loss of amphibian species at those sites (Cavasos et al. 2023). In this case, the WTP is expressed in "per trip" terms and is best interpreted as a "use value" because the

[48] Given data limitations, findings regarding the magnitude of the ecological benefits are based on the weight of evidence from the existing literature and the professional judgment of James Shannon, Fish Biologist with Haley and Aldrich.

[49] This exercise omitted valuation studies for fish species given findings that the rule is expected to generate negligible to minor benefits for fish.

respondent visitors may have some expectation that they will encounter the species; for these reasons, the study is not suitable for monetizing benefits for stream-associated amphibians that may benefit from the Np rule.

The review includes valuation studies for NSOs, monarch butterflies, and the gray wolf, all occurring in Washington State. While none of these studies describe a context equivalent to the changes or conditions associated with the rule, the studies demonstrate that people possess a positive WTP for protecting the habitat of terrestrial species reliant on habitats similar to those affected by the rule. *These values are included to provide perspective on the range of magnitudes of values people hold for species conservation in the absence of research focused specifically on the species of greatest relevance to the rule.*

For example, Hagen et al. (1992) find that U.S. households may be willing to pay on the order of $180 per household per year to preserve old growth forests to benefit northern spotted owls. We note that most riparian buffers affected by the rule are unlikely to qualify as "old growth." While northern spotted owls make their homes in forested riparian buffers that are not old growth as well, the study suggests a positive value for forest protection in order to protect sensitive species. Additionally, Diffendorfer et al. (2014) find that U.S. households may be willing to pay $42 per household for monarch butterfly conservation. Again, the habitat protection mechanism in this study is not identical to the habitat change that would follow from the rule, though this study provides additional evidence of a positive preference for habitat protection for sensitive species. We refer to these studies to provide perspective on the existing research focused on the values that the public, including Washington households, hold for the protection of species habitat, including species that reside in or depend upon terrestrial riparian areas.

Table 18. Willingness to Pay for Conservation of Species in and Near Riparian Buffers Based on Lewis et al. (2024)

Species Group Identified in Np Stream Buffer Analysis	Representative Study[1]	Species	Valuation Context	Sampled Population	Average annual WTP per Household (2023 USD)[2]
Amphibians	No appropriate valuation studies identified				
Birds	Hagen et al. (1992)	Northern spotted owl	Preserve old growth forest specifically to benefit Northern spotted owl in the Pacific Northwest	US households	$180.70
Invertebrates, insects	Diffendorfer et al. (2014)	Monarch butterfly	Unspecified program to conserve habitat nationally	US households	$41.61 (one-time payment)
Large game	No appropriate valuation studies identified				
Molluscs	No appropriate valuation studies identified				
Predators	van Eeden et al. (2021)	Gray wolf	Implement a non-lethal control strategy in order to maintain current population in Washington	Washington households	$93.48
Rodents	No appropriate valuation studies identified				

Notes:
[1] Appropriate valuation studies are defined as those: (1) estimating non-use or total economic value for a species closely related to one identified in the Np stream buffer analysis, and (2) located in the US or Canada.
[2] Dollar values reported in studies are adjusted to 2023 USD in this table.

4.2.4 Summary

Table 19 combines our findings related to how the rule will generate benefits to species at specific affected forest and stream sites, the total magnitude of those changes given the scale of land management changes afforded by the rule, and what is known about how people value these improvements in species habitat protection from the existing economic valuation literature.

Table 19. Summary of Rule Attributable Effects on Wildlife

Species Category	Probable Benefits to Species
Stream-associated amphibians	Minor to moderate benefits as climate continues to warm and Np buffers help to reduce the risk of stream temperature increases on individual streams, as amphibians are particularly sensitive to temperature increases and benefit from habitat conservation. These species also benefit from general improvement to their habitat (e.g., breeding sites, shelter, food resources). 19,000 to 44,000 Np stream miles with requirements for wider or longer buffers that will protect species from stream temperature increases No available valuation studies for this species group
Terrestrial riparian wildlife	Moderate to major benefits through the addition of buffer extent and width and preserving connectivity of habitat, as 85 percent of terrestrial vertebrate species in the state depend on riparian habitats 67,000 to 170,000 additional acres with harvest restrictions, representing 0.4 to 0.9 percent of all forest habitat in western Washington (regardless of owner) Economic valuation literature identifies that the public, including Washington State households, hold substantial value for species conservation and restoration, including through habitat protection
Fish downstream of Np streams	Negligible to minor benefits through delivery of organic matter, macroinvertebrates, nutrients, and cooler water, although improved conditions do not persist far downstream Unknown number of stream miles or fish that may experience these benefits Abundant valuation literature demonstrates Washington households value conservation and recovery of primarily anadromous species (not reported)

4.3 Increased Carbon Sequestration

Carbon fluxes in forested landscapes are a function of multiple factors including stand type, age, health, and management approach. The Np buffer rule would reduce the amount of timber harvested from riparian areas, thereby leaving trees in the ground to continue sequestering carbon from the atmosphere. Restricting timber harvest also generates avoided emissions from decomposing logging residues and wood products as well as from the machinery used to harvest, transport, and process timber. The rule not only prevents forest harvest and replanting in the affected Np buffers, but it also avoids the risk of potential future conversion of forested buffers to non-forest land (e.g., for development), which is associated with considerably greater emissions trajectories.

A comprehensive analysis of how the rule results in net changes in forest carbon flux would require significant information about how the stands would be managed with and without the rule. A complete accounting of changes in carbon would also incorporate information about demand for wood versus non-wood products with and without the rule, including to what extent restrictions on forest harvest leads to increased demand for more carbon intensive non-wood products. However, given data limitations, *this analysis focuses narrowly on the improvements in sequestration associated with changes in stand age.*[50] In doing

Summary findings: Increased carbon sequestration

Negligible to minor benefit

220,000 to 3.3 million MT CO_2 increase in total carbon sequestered relative to active timber rotation over the first 45 years of rule implementation

Reduction in annual atmospheric carbon represents between 0.005 percent and 0.07 percent of all emissions in the state

[50] For a full accounting of the key limitations in our assessment of carbon benefits, see Table 30.

so, this analysis identifies a negligible to minor benefit in forest carbon flux associated with the rule. We acknowledge that some existing literature and modeling exercises find that managed forests can result in greater carbon flux than conserved (unmanaged) forests in the United States due to planting and tree improvement, thinning and competition control, and increased demand for wood (e.g., Mendelsohn and Sohngen 2019).

While specific land management practices can result in net carbon benefits, the extent to which those specific practices and conditions occur across the forests of western Washington is uncertain. Furthermore, the risk of land use conversion of these areas absent the rule requirements is uncertain. While we find a probable positive benefit of increased carbon sequestration over the timeframe of our analysis at a landscape scale, the magnitude of this benefit is negligible to minor given both the uncertainties described and the extent of this change as a fraction of total emissions.

The benefits of carbon sequestration and storage reflect the avoided marginal climate change-related damages associated with the reduction in atmospheric carbon. That is, in economic terms, the benefits of reductions in atmospheric carbon dioxide (and other greenhouse gases) reflect the value that people derive from avoiding additional climate change-related impacts (e.g., to crops, human health, infrastructure).

To quantify these improvements, this analysis estimates the difference in carbon sequestration under 1) a baseline scenario that assumes a generalized timber rotation and 2) harvest restrictions under the rule. Carbon sequestration rates in forests, particularly commercially managed forests, are complicated and highly site-specific. Quantifying the degree to which the rule will affect the carbon sequestration potential of the landscape requires significant assumptions about the buffers and how they are managed for timber harvest absent the rule. This analysis relies on data, methods, and a tool from the U.S. Department of Agriculture's (USDA's) "Quantifying Greenhouse Gas Fluxes in Agriculture and Forestry" (Hanson et al. 2024) (henceforth, the "USDA tool") as the basis for assumptions about typical forestland and forestland management in western Washington.[51,52]

Though some Washington state agencies rely on other methods for carbon accounting, these alternatives require site-specific data and field measurements of existing carbon stocks. For example, to estimate carbon offsets for their Cap-and-Invest program, Ecology uses carbon accounting methods based on the California Air Resources Board's Compliance Offset Protocol (CARB 2015).[53] The protocol relies on comparing actual (i.e., measured) carbon stocks after project implementation with modeled baseline carbon stocks. Modeling baseline carbon stocks over time requires a field measurement of carbon stocks as a starting point to input into one of several approved growth and yield models (CARB 2025). The only approved model that is actively maintained and freely accessible to the public is the Forest Vegetation Simulator (FVS). As outlined in Hanson et al. (2024), models like FVS should only be used over the USDA tool in cases where the user is looking to conduct a tree-level analysis and has detailed, site-specific information to input into the model. Since our analysis is at a regional scale, encompasses stands of varying condition, and is not based on actual field measurements of initial carbon stocks, we determined the USDA tool is the best available tool to quantify changes in sequestered carbon with and without the rule.

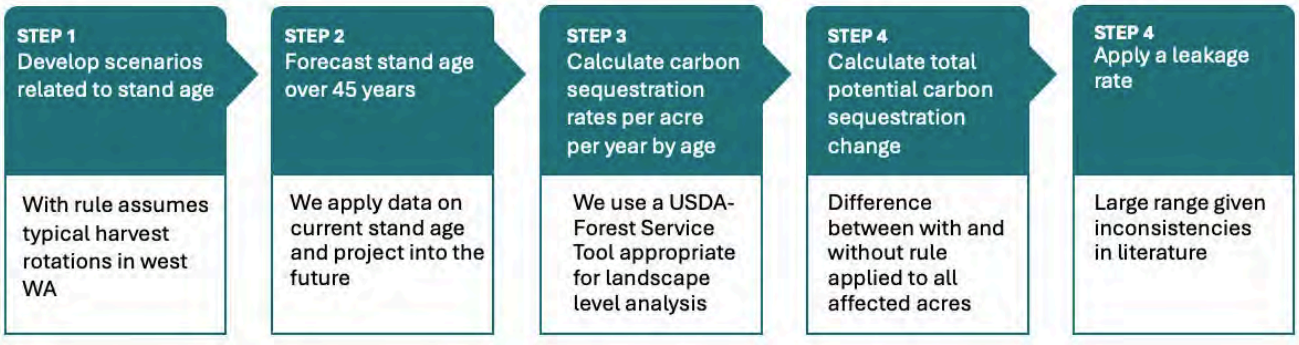
[51] Through personal communication between IEc and the Forest Service on October 17, 2024, the authors of the report and tool confirmed that quantifying carbon flux with and without the rule was an appropriate use case for the tool and agreed with our use of the outputs to quantify carbon sequestration under the "no harvest" scenario. While the tool includes estimates of emissions associated with manufacturing non-wood alternatives to wood products (e.g., product substitution), authors of the USDA tool cautioned us against incorporating those outputs because they cannot be summed or directly compared with sequestration outputs.

[52] The USDA Tool uses Forest Inventory Analysis (FIA) data to estimate a given stand's rate of carbon sequestration.

[53] Our understanding of Ecology's methods is derived from a phone call with staff of the Cap-and-Invest program on January 3, 2025.

This analysis relies on the steps summarized in Figure 7, described in more detail in the remainder of this section.

Figure 7. Methods Overview for Carbon Sequestration Analysis



Step 1: Develop "without rule" and "with rule" scenarios related to stand age. Our "without rule" scenario assumes a generalized timber rotation (i.e., that Np buffers are part of a timber rotation absent the rule) while our "with rule" scenario assumes harvest restrictions in Np buffers consistent with the new rule.

Table 20 provides more details about the assumptions inherent in each scenario.

Table 20. Assumptions in Scenarios for Carbon Sequestration Analysis

Without rule	With rule
○ All trees in age group 0-20 would be cut in 35 years (i.e., when average age is 45). ○ All trees in age group 21-40 would be cut in 15 years (i.e., when average age is 45). ○ 50 percent of all trees in older age groups would be left unharvested and continue to sequester carbon. ○ 10 percent of the trees in the older age groups would be cut in the first year of analysis. ○ Another 10 percent of the trees in the older age groups would be cut every 10 years (i.e., years 11, 21, 31, and 41). ○ After trees are harvested, trees are replanted and begin sequestering carbon a year later.	○ For the additional acres that would fall within no-cut buffers, all trees would be left unharvested and continue to sequester carbon throughout the timeframe of the analysis. ○ For the acres that would fall within the partial harvest buffer, one half of the trees would be harvested (as in the baseline scenario) while the other half would be left unharvested.

Step 2: Determine distribution of stand age at Year 1 of rule implementation, then forecast stand age across the first 45 years of rule implementation using the scenarios in Step 1. We use gradient nearest neighbor (GNN) data from the Landscape Ecology, Modeling, Mapping, and Analysis (LEMMA) project to approximate the percentage of trees in each of the following age groups at Year 1: 0 to 20, 21 to 40, 41 to 60, 61 to 80, 81 to 100, and 100 and over.[54] To simulate a timber rotation, we assume the average age of the trees in each age group is equivalent to the midpoint of each age group at Year 1. We then use the assumptions outlined

[54] More about these data is available here: https://lemma.forestry.oregonstate.edu/data/plot-database. The GNN database was downloaded for use in the analysis on March 18, 2019.

in Step 1 to forecast stand age across the 45-year period of analysis for the "without rule" and "with rule" scenarios (see Table C-2 and C-3 in Appendix C).

Step 3: Calculate annual carbon sequestration rates per acre by stand age under typical conditions in western Washington. We use the U.S. Department of Agriculture's "Quantifying Greenhouse Gas Fluxes in Agriculture and Forestry" to estimate the total amount of carbon sequestered per acre under the "without rule" and "with rule" scenarios. The tool requires that users input parameters specific to the forest and forest management plan, which we summarize in Table 21.

As shown in this table, our analysis relied on specific assumptions about dominant tree species in the affected buffers as well as the origin of the stands as planted or natural. To assess the sensitivity of our analysis to these assumptions, which are likely to vary across space, we conduct our analyses under alternate input assumptions as described in Appendix D, Section D.2. That analysis demonstrates that our results are not significantly influenced by these assumptions; indeed, the total quantified benefits increase under the alternate assumptions.

Though we do not consider emissions associated with harvest itself, we rely on the "Basic projection under forest maintenance, with harvest" management treatment to estimate carbon sequestration rates because it allows input of years until harvest.[55] Since each age group (except for the 101+ age group) spans 20 years, we estimate sequestration levels over 20 years and divide by 20 to approximate the total amount of carbon sequestered per acre per year. For the 101+ age group, we estimate sequestration levels over 50 years and divide by 50 because trees remain in this group indefinitely. The rightmost column of Table 21 presents the estimated annual carbon sequestration rates that we derive from the USDA tool output.

[55] The "with harvest" management treatment allows users to input the number of years over which the trees sequester carbon. We do not use the "Basic projection under forest maintenance" management treatment because it forces users to estimate sequestration levels over 50 years. Because the tool assesses the impacts of harvest at the end of the specified period, the level of carbon sequestered from the atmosphere is unaffected by the management treatment parameter. We verified this by confirming sequestration levels over 50 years were equivalent for both treatments.

Table 21. USDA Tool Inputs and Outputs

Required Data Field	IEc Input Selection into USDA Tool[1]	USDA Tool Output: Carbon flux in living and dead carbon pools (t CO_2-eq/acre)[2]	Estimated Annual Carbon Sequestration Rates (t CO_2-eq/acre/year)[3]
Type of forest management treatment to be applied	Basic projection under fm, with harvest		
Area subject to management activity	1 acre		
U.S. region	Pacific Northwest Westside		
Forest type group	Fir / spruce / mountain hemlock group		
Planted or natural forest origin	Unknown		
How many years from now will you harvest?	20[4]		
Do you know what your harvest volume is?[5]	No		
What percent of the "area subject to management activity" entered above will be harvested?[5]	"Blank"		
Age class	0-20	-47.95	-2.40
	21-40	-111.32	-5.57
	41-60	-110.77	-5.54
	61-80	-101.71	-5.09
	81-100	-86.99	-4.35
	101+	-163.24	-3.26

Source: VERSION 1.0 Excel Workbook to Support "Level I" Quantification Approaches for the Managed Forest Systems Chapter within the 2024 update to the USDA Publication *Quantifying Greenhouse Gas Fluxes in Agriculture and Forestry: Methods for Entity-Scale Inventory.* Downloaded June 28, 2024 from: https://www.usda.gov/oce/entity-scale-ghg-methods/download. Documentation for the tool is available for download at the same website.

Notes:

1. We input these selections into the "User Data Entry" tab of the USDA tool.
2. These results are output on the "Forest Mgmt & HWP Results" tab of the USDA tool. We specifically pull the output under the "Ecosystem Carbon Impacts from Forest Growth" section of the output.
3. IEc analysis of the USDA tool output by dividing the tool output 1) by 20 years for all age class categories less than 101+ and 2) by 50 for the age class category of 101+.
4. This value was set to 50 for the 101+ age class only.
5. These input parameters do not affect the output of interest and can be left blank.

To ground-truth the sequestration rates we derived from the USDA tool, we compare our estimates with a report on Washington's carbon inventory coauthored by DNR and the Forest Service (Christensen et al. 2020). The report finds that sequestration rates in forestland the state range from 2.8 to 4.9 metric tons of CO_2-eq per acre per year, depending on land ownership, which is very similar to our range derived from the USDA tool of 2.4 to 5.6 metric tons of CO_2-eq per acre per year. Christensen et al. (2020) does not provide estimates by stand age for comparison. The ordering of sequestration rates by stand age from the USDA tool aligns with a common understanding of the relationship between stand age and carbon sequestration rates. The annual carbon sequestered is highest among middle aged (i.e., ages 21-100) forests as opposed to young forests (i.e., ages 0-20) and mature forests (i.e., ages 101+).

Step 4: Calculate potential increase in carbon sequestration attributable to the rule. First, we apply annual sequestration rates per year to the "without rule" and "with rule" scenarios based on stand age and the range of total acres affected by the rule. We assume stands sequester carbon at the annual rate associated with their age class, as shown in the rightmost column of Table 26. In the year of harvest and the first year after harvest, we assume stands do not sequester carbon. To accomplish this, we apply the annual sequestration rates from Table 26 to the stand ages in Table C-2 and Table C-3 of Appendix C. Then, we sum the total amount of CO_2 removed under the "without rule" and "with rule" scenarios over the 45-year period of analysis. We then subtract the total removed under the "without rule" scenario from the total removed under the "with rule scenario" to estimate increased carbon sequestration attributable to the rule.

Step 5: Apply a leakage rate, under the assumption that some portion of the harvest restricted in riparian areas will be displaced to other areas. When harvest is restricted in one area, it does not necessarily result in an overall reduction in atmospheric carbon if those harvest activities are displaced elsewhere. To meet global demand for timber, harvest may occur more rigorously elsewhere instead. Several research papers aim to quantify this "leakage" at a global scale and provide a wide range of estimates. For example, a recent literature review identifies estimates of leakage ranging from −10.3 percent to 100 percent (Pan et al. 2020). The authors undertook a meta-analysis to determine what drives variation in leakage estimates across studies. They found that factors such as GDP per capita and whether studies considered emissions changes in agricultural sectors (i.e., land use change) had significant effects on results. Given inconsistencies in estimated leakage rates in the literature, we apply a range.

- Several U.S.-based studies suggest that leakage rates could be as high as 90 percent (Murray et al. 2004; Nepal et al. 2013). This means that only 10 percent of the change in sequestered CO_2 described above would be attributed to the rule due to offsetting increases in harvest elsewhere. We apply this assumption to our low-end scenario.
- The literature review found that the average estimated leakage rate in the forest sector is 40 percent (Pan et al. 2020). This means that 60 percent of the change in sequestered CO_2 described above is attributable to the rule. We apply this assumption to our high-end carbon benefit scenario.

Table 22 summarizes the benefits of increased carbon sequestration stemming from changes in forest management in western Washington over the 45-year analysis timeframe. This analysis finds that an additional 220,000 to 3.3 million metric tons of CO_2 would be sequestered over the first 45 years of the rule, or, equivalently, 0.07 to 0.41 metric tons of CO_2 per affected acre per year. This represents a 2 to 10 percent increase in total sequestered carbon over the baseline that is attributable to the rule. To put these benefits in perspective, we compared the total increase in sequestered carbon with the total emissions in Washington in a recent year. Data from Ecology show that total emissions in Washington across all sectors in 2019 were 102.1 million metric tons of CO_2 equivalents (Waterman-Hoey 2022). Therefore, this change in annual atmospheric carbon represents between 0.005 percent and 0.07 percent of all emissions in the state.

Because carbon accumulates in the atmosphere and contributes to climate change at a global level, increases in carbon sequestration reflect benefits to the global population and are not representative of the benefits specifically to Washington residents. Appropriate monetization of these global benefits is described in the text box that follows. Because these benefits accrue to a global population, these monetized values do not factor into our weighing of costs and benefits in Chapter 6. Finally, Table 23 describes key sources of uncertainty in our quantification of carbon sequestration benefits, as well as how the bias introduced by uncertainty affects our results.

Table 22. Incremental Increase in Carbon Sequestration (Mt CO_2) Over 45 Years

Ecoregion	Low-end: Only "likely harvestable" forestland, 42% of Nu are Np, 90% leakage	High-end: All "regulated" forestland, 94% Nu are Np, 40% leakage
Cascades	77,000	1,200,000
Coast Range	100,000	1,600,000
North Cascades	13,000	280,000
Puget Lowland	20,000	280,000
Willamette Valley	1,400	19,000
Total (45 years)	220,000	3,300,000
Average annual per acre	0.069	0.410

Source: IEc analysis of various data sources described in the main text.

Valuing Increases in Carbon Sequestration

Changes in atmospheric carbon can be valued using social cost of carbon dioxide (SC-CO_2), which measures the avoided economic damages (e.g., to crops, human health, infrastructure) associated with one additional metric ton of CO_2 in the atmosphere. Metrics of the SC-CO_2 reflect global benefits, not benefits experienced in western Washington specifically.

In 2023, the USEPA developed "EPA Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances" (USEPA 2023). The USEPA provides SC-CO_2 estimates across three near-term target discount rates (1.5, 2, and 2.5 percent) "based on multiple lines of evidence on observed real market interest rates" (USEPA 2023, p. 2). These values are supported in the academic literature (for instance, Rennert et al. 2022).

To provide perspective on how removing 220,000 to 3.3 million metric tons of CO_2 from the atmosphere over a 45-year period contributes to a decline in climate-related damages, we apply the 2 percent SC-CO_2 from USEPA (2023). The SC-CO2 varies by emissions year and ranges from $190 per metric ton of CO_2 in 2020 to $380 per metric ton of CO_2 in 2070. Assigning the appropriate value to each year of our analysis alongside the annual changes in carbon sequestration described in the main text we estimate a global present value benefit on the order of $44 million to $690 million over the analysis timeframe, equivalent to $1.5 million to $23 million in annualized terms (2 percent discount rate).

Another approach to valuing carbon is use of carbon market prices. Relying on carbon market prices in regulatory analysis is inconsistent with best practices because carbon market prices are unlikely to accurately reflect the true social cost of carbon. Carbon markets are also highly volatile given their relative infancy and voluntary nature in many places, including Washington. For comparison, as part of their Cap-and-Invest program, Ecology granted carbon allowances at the price of $40.26 per ton in December 2024 (Ecology 2024c).

Source: IEc analysis.

Table 23. Sources of Uncertainty in Assessment of Carbon Benefits

Key Assumption or Source of Uncertainty	Direction of Potential Bias	Effect of the Uncertainty on Results
Changes in atmospheric carbon only through changes in carbon sequestration associated with stand age.	Unknown	Potentially major. This analysis only quantifies changes in atmospheric CO_2 attributable to changing rates of sequestration associated with stand age. Other sources of emissions associated with harvest include decomposing logging residues and wood products and the machinery used to harvest, transport, and process timber. The USDA tool is not calibrated to convert these emissions into annual equivalents necessary for this analysis. However, other analysis also identifies that, under certain circumstances, managed timberland has the potential to result in more carbon sequestration than unmanaged (conserved) land. Finally, the "world without the rule" modeled in this exercise assumes an active timber rotation, whereas in reality some of the affected land could convert to non-forestland, resulting in significantly increased carbon emissions relative to conserved forestland.
Rule does not change wildfire risk.	Overestimate benefits	Likely minor. Unmanaged forests, like no-harvest buffers, may be more vulnerable to wildfires, which increase emissions by burning fuel. In its assessment of the environmental impacts of the rule, Four Peaks (2024b) determined that there is an increased wildfire risk under the rule but did not categorize the increase in risk as major.
Absent the rule, all acres would be managed according to average standard timber management practices in western Washington.	Unknown	Likely minor. This analysis requires modeling a timber harvest rotation absent the rule that may differ from on the ground management practices. Further, the GNN data may not capture the exact age of specific trees within buffers. However, this is an order of magnitude analysis and should not be considered a precise accounting of carbon-related effects on any given parcel.
Affected tree species and whether standards or planted or of natural origin.	Underestimate benefits	Likely minor. We provide our results under alternate assumptions about the primary tree species type and whether the origin of the trees is natural or planted in sensitive analysis presented in Appendix D. Accordingly we find that the total quantified carbon sequestration benefits marginally increase under these alternate input assumptions relative to those used in this main analysis.
Leakage.	Unknown	Likely minor. We account for this uncertainty directly by using a wide range of leakage rates in our analysis: 40 percent to 90 percent.
Rule does not result in a shift from wood products to other products that generate greater emissions.	Overestimate benefits	Likely minor. In addition to leakage, reducing timber harvests may inadvertently increase emissions by increasing consumption of other materials and products through a process called "product substitution." For example, if the supply of timber decreases, consumers may rely more heavily on plastic, which requires more emissions to produce. We are unable to quantify the extent to which product substitution would occur following implementation of the rule but expect these effects to be minor.

Note: See also Table 11 for a discussion of the uncertainty associated with our estimated extent of Np miles, which is a key input in this analysis.

4.4 Tribal Cultural Values

Washington State tribes and indigenous communities more broadly value the natural environment as an interconnected and inseparable system where all components play a critical role.

> *It's all interconnected. Almost all cultures seem to have a word or phrase for this. For Nuu-chah-nulth, the words are hishuk'ish tsawalk, meaning everything is connected, everything is one. It is definitely a principal that is first and foremost in dialogue, discussion, and documents. Not giving lip service to it, but real meaning, that this is so fundamental to our existence. That protecting and caring for all—air, water, animals—that are in First Nations' territories, all interconnected.*
>
> *Dr. Don Hall, Pacific Salmon Commission Canadian First Nations Caucus*

This holistic understanding emphasizes the vital role of riparian buffers in maintaining ecological health. As outlined in Section 4.2.1, increases in buffer length and width have the potential to improve bank stability, sediment filtering, water quality, large wood, and leaf litter/nutrients that may provide a minimal benefit to fish lower in the watershed. While Np streams by definition do not contain fish, these streams and the riparian habitats support amphibians and other wildlife. Therefore, any improvements in Type Np stream conditions may directly affect these species. In the words of Wilbur Slockish, Klickitat Chief:

> *All of the animals have a role in this world, in our belief. Rocks and water was the first one, the last one, but [salmon] is the first one that said he would take care of the people, providing them with drink to quench the thirst.*
>
> *Wilbur Slockish, Klickitat Chief, as quoted in Earth Economics (2021)*

Importantly, tribes do not support the concept of monetizing the value of natural resources:

> *We don't want to put a dollar value on fish. It means more to us than that. One of the sayings that First Nations have—both in Canada and in the United States—is that when the last tree is gone, when the last fish is gone, only then will people find out that you can't eat money. That's something that we have in common with the folks that we work with in the United States is that we have the same kind of belief system because we are family. Because before Canada and the United States existed, we existed, and we had those feelings about fish.*
>
> *Grand Chief Ken Malloway, Stó:lō Nation*

For this reason, this analysis focuses on a qualitative description of the potential benefits of the rule to tribes. We acknowledge tribal cultural values of probable benefits of the rule but do not rank them as major, moderate, or minor. Throughout the rule development process, western Washington Tribes provided support for a rule that would enlarge riparian buffers along Np streams, in part due to the value the Tribes derive from these ecological changes. In reviewing the material provided to date, DNR was unable to identify testimony that specifically addressed tribal cultural values of riparian Np buffers outside of treaty fishing rights.[56]

[56] Email from DNR to IEc on February 7, 2025.

4.5 Other Perspectives on Benefits of Riparian Buffers

The assessment provided in this chapter is largely qualitative given limitations in the available literature to link the rule requirements with specific changes in ecological conditions and/or to apply a value to changes in environmental conditions or ecosystem services. In addition to benefits highlighted in this chapter, riparian buffers more generally also provide flood and erosion mitigation through their diverse vegetation, moderating water volumes year-round by attenuating peak flows during floods and releasing water gradually during dry periods (King County 2024, Knutson and Naef 1997). They also provide supporting services such as nutrient cycling, sediment and pollutant filtering, air quality improvement, climate regulation, and noise abatement. Moreover, riparian buffers provide cultural value to local communities, including recreational, spiritual, educational, and other benefits (Knutson and Naef 1997, Quinn et al. 2020), although some of these benefits are only available when the buffers are publicly accessible, which is typically not the case for Np buffers that are the subject of the rule. In this section, we provide additional perspective on the values people derive from establishing or enhancing riparian buffers. We reviewed existing valuation studies related to restoration or enhancement of riparian buffers in the U.S. and Canada, as summarized in Table 24.

Table 24. Willingness to Pay for Restoration or Enhancement of Riparian Buffers

Study	Valuation Context	Site	Named Ecological Improvements	Sampled Population	Average annual WTP per Household (2023 USD)[1]
Trenholm et al. (2013)	Doubling the riparian buffer from 30 to 60m on private woodlots and associated reforestation (approx. 29,000 acres)	Canaan-Washademoak watershed (southern New Brunswick, Canada)	Water filtration, fish and wildlife habitat, aesthetics	Probability samples across three strata: Households (HHs) in riparian areas in the watershed (oversampled); HHs elsewhere in the watershed; HHs elsewhere in southern New Brunswick	$31.14 (high estimate); $7.85 (low estimate)
Holland and Johnston (2017)	Restore natural vegetation on up to 500 acres of degraded riparian land by enhancing development setbacks 100 ft	Merriland, Branch Brook, and Little River watershed (southern Maine)	River health, game fish abundance, water quality	Probability sample of HHs in Kennebunk, Sanford, and Wells, Maine	$8.51 (Kennebunk); $15.10 (Sanford); $27.96 (Wells)
Lewis et al. (2017)	Establish a 100-ft riparian zone along over 50 miles of stream banks in the watershed	Clear Creek watershed (northwest Arkansas)	Water purification, erosion control, wildlife habitat, climate regulation, recreation	Probability sample of HHs in the watershed	$97.93

Study	Valuation Context	Site	Named Ecological Improvements	Sampled Population	Average annual WTP per Household (2023 USD)[1]
Holmes et al. (2004)	Implement best management practices at construction sites and along private roads; establish riparian buffers along up to six miles of the river	Little Tennessee River watershed (western North Carolina)	Game fish abundance, water clarity, wildlife habitat, allowable water uses, naturalness (aesthetics)	Non-probability sample recruited from local civic organizations in Macon County, NC	$53.85 (weighted to match county population demographics)
Weber and Stewart (2009)	Re-establish native tree dominance along up to 17 miles of riparian area	Middle Rio Grande (Albuquerque, New Mexico)	Aesthetics, river processes	Probability sample of Greater Albuquerque area	$83.03
Blaine and Smith (2006)	Preserve riparian lands throughout the upper watershed through conservation easements	Upper Grand River watershed (northeast Ohio)	Not specified	Probability sample of HHs in the upper watershed (portions of Geauga, Ashtabula, Portage, and Trumbull Counties)	$43.67

Notes:
[1] Dollar values reported in studies are adjusted to 2023 USD. The value reported in the Canadian study has also been adjusted for currency and income effects using World Bank exchange rates and income adjusted for purchasing power parity.

All six studies show that people possess a positive WTP to improve the functioning of riparian areas through buffers. Five of the six studies describe contexts that are unrelated the context of this rulemaking, due to differences in settings (e.g., suburban or developed areas), magnitude of changes (e.g., riparian buffers along less than 100 miles of waterways), or because the anticipated ecological improvements are dissimilar (e.g., game fish abundance).

The one remaining study, Trenholm et al. (2013), quantifies values specific to increasing riparian buffers on private forestland in New Brunswick, Canada. Although this study focused on a different geography and population, the findings of this study provide insight regarding values held for riparian habitat protections most similar – although not identical – to those prescribed by the rule. Specifically, the text box that follows considers the findings from this study in the context of the Np buffer rule to provide perspective regarding the potential order of magnitude of riparian protection benefits to the public, finding that the annualized values may be on the order of tens of millions of dollars based on the low end WTP estimates from the source study.

Given that considerable uncertainty exists regarding the applicability of the source study to the Np rule context (e.g., differences in the baseline levels and specific changes in water quality, habitat, and aesthetics expected from the Np rule relative to those perceived by respondents in the Trenholm study), **we do not include this value as a measure specifically of the benefit of the rule**. The values expressed through this research on riparian buffers provide insight regarding the preferences the public holds for water quality and species protection and thus these values attempt to measure the kinds of benefits described throughout this chapter. Given this, these values should not be considered additive with the other categories of benefits described.

Empirical Research on Public Values for Riparian Conservation Related to the Np Rule Context

Trenholm et al. (2013) is a contingent valuation study estimating the mean household WTP for riparian buffer programs of varying scopes in the Canaan-Washademoak Watershed in New Brunswick, Canada. Most relevant is a proposed policy to deliver "slight improvements" in water quality, fish and wildlife habitat, and forest scenery by increasing the riparian buffer on private woodlots from 30 to 60 meters (approximately 29,000 acres total across the watershed). The researchers' preferred model suggests a mean WTP for the program among households in southern New Brunswick (i.e., not exclusively within the watershed) of $31.14 annually (2023 dollars).[a] A more conservative estimate of mean WTP for the program, utilizing data obtained from the follow-up contingent valuation questions only, is $7.85 per household annually.

Having determined appropriate estimates for mean household WTP, estimating aggregate WTP requires defining the "extent of the market" (i.e., the number of households expected to benefit from the Np rule) in a way that is consistent with Trenholm et al. (2013) based on available data. Applying the findings of this analysis to the Np buffer rule context implicitly assumes that the spatial distribution of the sampled southern New Brunswick population relative to the Canaan-Washademoak Watershed (though not necessarily the size of the population) is representative of the relationship between Washington residents and the areas where the Np buffers would apply. The geographic extent of the surveyed households relative to the area of preserved riparian habitat in New Brunswick indicates households distant from the buffer areas still demonstrate a positive WTP. We therefore consider the magnitude of the value held by the public for the Np rule riparian habitat buffers based on households across Washington state (3.02 million households based on U.S. Census 2023) and referring to the low-end WTP value identified by Trenholm et al. This is consistent with the spatial relationship in the source study between preserved riparian habitat and the households benefitting.

Finally, we rely on the estimates for WTP and numbers of households benefiting to determine the order of magnitude of this value to the public in Washington. Utilizing the low estimate for mean WTP ($7.85), annual benefits are approximately $23.7 million. Expressed as a present value by aggregating over 10 years, consistent with the framing of the valuation scenario in Trenholm et al. (2013), the rule may generate on the order of $210 million assuming a 2 percent discount rate (or $190 million assuming a 4.5 percent discount rate). *As noted in the main text, this estimate is not a measure of the rule benefits given the differences between the study context and the rule context. However, this research provides empirical support for public values for riparian conservation, and perspective on the potential order of magnitude of rule benefits.*

Sources: IEc analysis using Trenholm et al. (2013), U.S. Census (2023), the World Bank's GNI per capita, the World Bank's official exchange rates, and the Federal Reserve Bank of St. Louis' CPI.

Notes: [a] To obtain this value, we utilize the midpoint between WTP estimated from the initial and follow-up contingent valuation questions for Program 2 (Trenholm et al. 2013, Table 5). We account for income effects using income per capita in Canada and the United States adjusted for purchasing power parity (using various World Bank sources) and assuming constant income elasticity (e.g., Czajkowski et al. 2017), further adjusted to reflect 2023 USD (using the CPI). Effectively, we assume that WTP represents a constant proportion of disposable income.

CHAPTER 5 | Regional Economic Impacts

The previous two chapters (Chapters 3 and 4) evaluate the probable costs and benefits of the rule in terms of changes in social welfare values. Social welfare values are measures of "economic efficiency," which reflect changes in *overall* societal well-being. While economic efficiency is concerned with the net benefits of a rule, it is also prudent to consider the distribution of effects across specific populations because those who bear the costs of a regulation and those who enjoy the benefits are typically not the same. *Circular A-4*, the official guidance from the U.S. Office of Management and Budget (OMB) to Federal agencies engaged in economic analysis of regulatory actions, directs analysts to provide a separate description of these distributional effects "so that decision makers can properly consider them along with the effects on economic efficiency (OMB 2003, page 14).

Regional economic impact analyses—including consideration of economic output (sales, revenues), jobs, and tax revenue—demonstrate how specific economic sectors in a given geographic region experience impacts to their business activity due to the rule by measuring changes in the flow of dollars through regional economies (USEPA 2024). However, economic impacts are not measures of economic efficiency because they are not evaluated with respect to overall social well-being, do not incorporate the values people derive from participation in specific activities, and do not consider the potential to offset negative economic impacts through the value created for rule beneficiaries. Importantly, economic impacts cannot be summed with the social welfare costs and benefits because they typically measure related rule effects but using different frameworks. For example, changes in revenue associated with timber harvest (an economic impact) are also reflected in the land value losses described in Section 3.1 (a social welfare cost).

In this chapter, we estimate the impacts of the rule on regional economic activity stemming from changes in annual timber harvest from the additional acres conserved in the Np buffers. To place these economic impacts in context, we first provide an overview of historical trends in timber harvest and adjacent industries in Washington (see Section 5.1), the importance of the timber industry to local communities (see Section 5.2), and how county governments rely on the forest excise tax to fund public services (see Section 5.3).

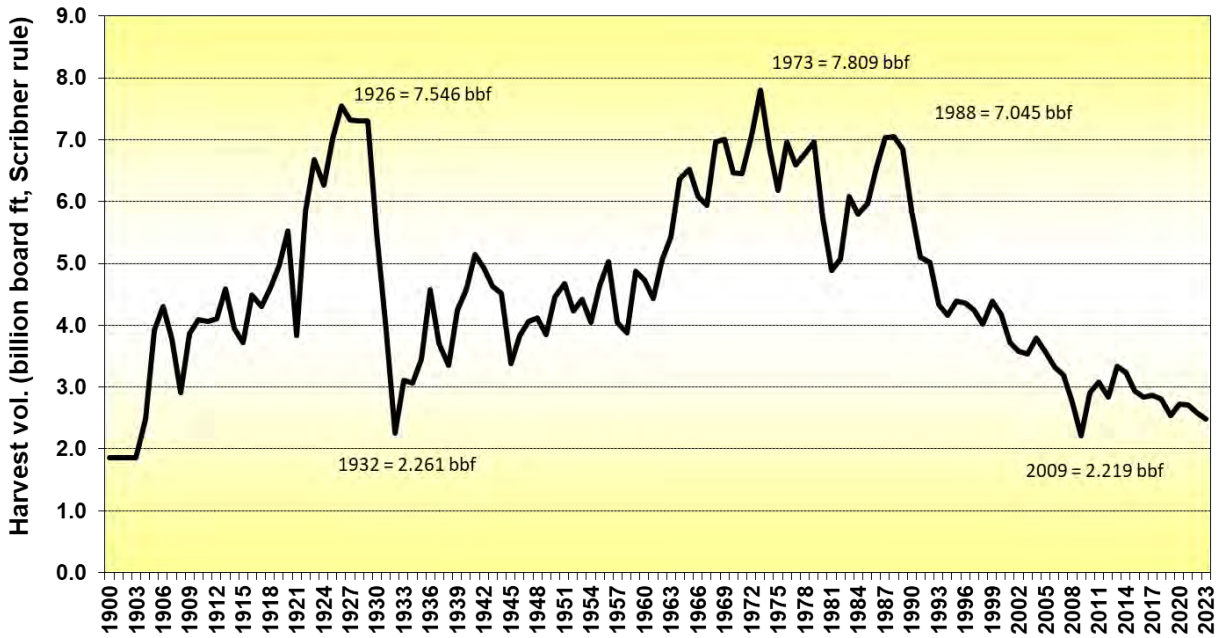
In developing this chapter, we also considered whether the ecological changes and other probable benefits described in Chapter 4 are likely to result in changes in regional economic activity through increases in recreation (e.g., hunting, wildlife viewing, fishing), tourism, etc. Because much of the affected forestland is privately owned and inaccessible to the general public, benefits to recreation are unlikely to be associated with measurable increases in recreational opportunities (e.g., recreational trips and associated trip-related spending). It is more likely that improvements in species habitat conditions benefit recreationally valuable species populations broadly, which can improve the quality of recreational experiences in other accessible areas, although the likelihood and magnitude of this benefit are uncertain.

5.1 Trends in Washington Timber Harvest and Adjacent Industries

Timber harvest volumes in Washington have varied significantly over time. Figure 8 presents official statistics on total harvest volume in the state from 1900 through 2023. Low points were experienced in 1932 (the Great Depression) and 2009 (the Great Recession). From about 1990 to the present, a steady decline in timber harvest has occurred. This downward trend is a function of several factors, including changes in federal land management policies (e.g., 1994 Northwest Forest Plan), state Forest Practice rules restrictions (e.g., 2001 Forest and Fish rules), changes in private forest management practices, demand for timber in global markets, and wildfire-related reductions in available timberland (DNR n.d., personal communication with WFPA on March 14, 2025). The downward trend in forest harvest is also mirrored in the number of mill operators in the state. DNR's last publicly available Washington Mill Survey notes a decline in number of businesses operating

in primary forest products industries since the 1980s, including sawmills as well as lumber and shake and shingle sectors (DNR 2017).

Figure 8. Washington State Timber Harvest, 1900 through 2023



Source: Graphic provided to IEc by WFPA via email on March 14, 2025 based on DNR Timber Harvest Statistics collected from the DOR. Harvest volumes for 1900 through 1903 are estimates and equal harvest volumes from 1899.

5.2 Importance of the Timber Industry to Local Communities

Timber harvest has played a crucial role in shaping Washington's economy since the mid-1800s. By the early 1900s, Washington was the nation's leading timber producer, with the lumber industry driving the state's economy. A study by the U.S. Bureau of Corporations found that 63 percent of Washington's workers relied directly or indirectly on the timber industry for employment in the early 1900s (Chiang and Reese n.d.). Even after World War II, the industry played a key role in supporting the housing boom by providing materials for the construction of homes (Chiang and Reese n.d.).

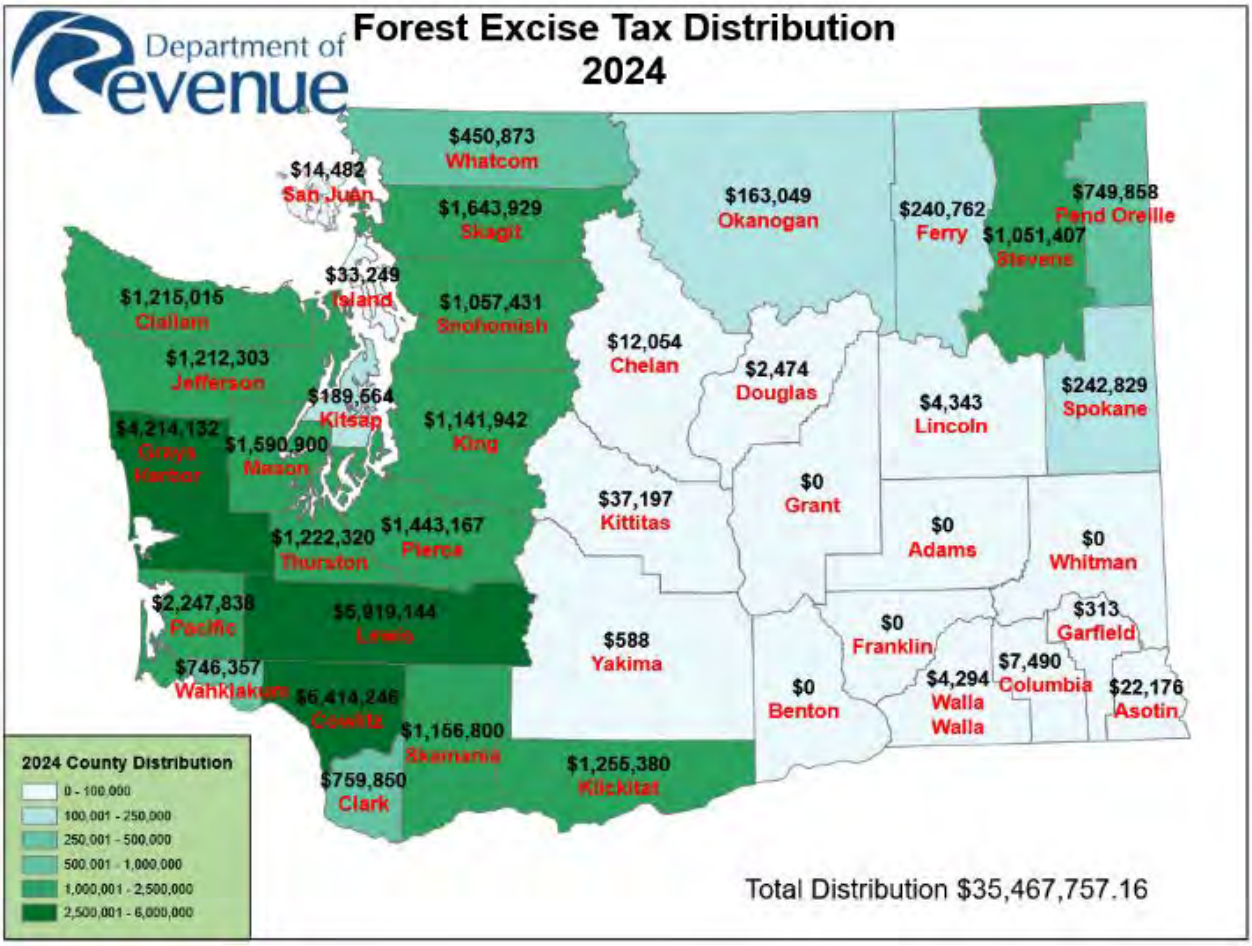
Forestry continues to be a major employer in rural communities across the state. In 2021, the forest products industry supported over 42,000 jobs and $2.6 billion in wages across the state. When additionally accounting for the jobs and wages the timber industry supported indirectly in interrelated economic sections, these numbers are over 100,000 jobs and $5.6 billion in wages (Mason, Bruce & Girard 2022). In addition to the economic significance of the industry, many small, rural timber harvesters in Washington have a strong sense of place associated with their forestland, referring to their work as a core part of their identities and a source of pride (Cantrill 1998; Beda 2014). These rural timber harvesters view the continuation of their trade as preserving a valuable way of life and passing it down to future generations (Creighton 2005). Forestland ownership also represents a significant source of generational wealth for and connectivity within many families in western Washington. A common reason for owning forestland in this region is the transfer of resources and responsibilities among family members (Creighton et al. 2002). This connection to land continues to shape the lives of rural timber harvesters, highlighting the significance of these lands to their identities, families, and communities.

5.3 Importance of Forest Excise Tax to County Services

Forestland owners pay timber excise tax on the timber they harvest in lieu of a property tax on their forestland (RCW 84.33 and WAC 458-40). Accordingly, restrictions on harvest along Np streams under the rule would reduce total harvest and the associated tax revenues. The Washington Department of Revenue collects a 5 percent timber excise tax on all timber harvested, of which 4 percent goes back to the counties where the timber was harvested (DOR 2020). The county portion funds schools, county roads, libraries, fire districts, capital projects, and voter-approved bonds. A reduction in timber excise tax collected may affect social services provided by counties if counties are unable to make up the revenue shortfalls elsewhere.

In 2024, Washington counties received $35.5 million through the timber excise tax fund (see Figure 9). Of that total, roughly $32.9 million went to counties in western Washington. Timber harvesting is also considered a business activity and is subject to the business and occupancy tax (DOR 2020). For the purpose of this analysis, we focus specifically on the forest excise tax component given its importance to county governments.

Figure 9. Forest Excise Tax Distribution by County in 2024



Source: DOR (2024)

5.4 Decreased Timber Harvest

In this section, we quantify the probable loss in annual timber harvest attributable to the rule. This estimate is a key input into our assessment of the regional economic impacts of the rule. Figure 10 provides an overview of our approach.

Figure 10. Methods Overview for Decreased Timber Harvest Analysis

Step 1: Calculate an average annual timber harvest rate for western Washington. We use 2017 data from two sources to estimate the average timber harvest per acre of available timberland across private, state, and other local land: data from the Pacific Northwest Forest Inventory and Analysis (FIA) to identify the total timberland available and data from the Washington Timber Harvest Reports (DNR 2018). Across counties in western Washington, these data identify approximately 7.1 million total timberland acres and a harvest of 2.31 Mbf across those acres in the same year.[57,58] This results in an average harvest rate per available acre of approximately 325 bf/acre/year across the counties in western Washington.

Step 2: Apply the harvest rate to all buffer acres affected by the rule. We multiply the harvest rate from Step 1 by the total affected forestland in Table 10 of Chapter 2. For the no harvest buffers, we assume all timber harvest is lost. In the partial harvest buffers, we assume 50 percent of the timber harvest is lost.

Step 3: Adjust for the potential for leakage within the region. Restricting timber harvest in one area may result in more aggressive harvests in other areas, offsetting the overall reduction in timber harvest. Most of the publications that explore leakage describe effects across a global market for timber, not regional markets.[59] Given uncertainty regarding this parameter, we apply two assumptions about leakage as a range:[60]

- A publication by Murry et al. (2004) uses data from Wear and Murray (2003) from the western U.S. to estimate a "regional" leakage rate of 43 percent. In other words, 43 percent of restrictions on

[57] DNR (2018, page v) identifies harvest volume in western Washington from 2017 as follows: 1,798,044 Mbf from private land, 471,027 Mbf from state lands, and 38,432 from other public lands.

[58] We acknowledge that the 7.1 million acres of private (5.3 million acres), state (1.4 million acres), municipal (330,000 acres), and other non-federal public land (12,000 acres) from the 2017 FIA data fall within the range of other estimates of regulated forestland described elsewhere in this report, including 8.2 million acres of non-federal, non-tribal, and non-state HCP land identified in spatial landownership data from Atterbury Consultants and the 6.1 million acres of land in western Washington DNR describes as subject to the Forest Practices HCP. One of the major differences across these estimates is the treatment of land subject to the state lands and other HCPs. For this calculation, we rely on the FIA 2017 data to align the acres with the harvest volume by the same landowner types from DNR (2018).

[59] The leakage rates that we apply in this analysis differ from the leakage rates in the carbon sequestration analysis (see Section 4.3) because the geographic scope of the two analyses differ.

[60] These leakage rate assumptions do not seek to reflect how individual landowners may or may not be able to offset harvest restrictions on their own land. We recognize that some landowners, in particular large industrial landowners, may have increased opportunities to harvest more intensively on other forested acres while landowners with more limited forestland may be unable to deflect harvest elsewhere.

harvests were replaced by other harvest within the same region. Using this rate, we assume that 57 percent (100 minus 43 percent) of the restricted harvest in western Washington is truly lost from the broader region. We apply this assumption to our low-end scenario.

- The data used to derive the above rate is relatively old (from the period 1990 to 1995), and harvestable forestland in Washington is scarcer today on account of regulatory and other restrictions (e.g., forest management preferences, conservation easements, etc.).[61] To provide perspective on the total regional economic impacts if displaced harvest from Np buffers cannot be absorbed by harvest in other parts of the region (i.e., meaning leakage is more likely to occur outside of Washington), we include a high-end estimate that assumes no leakage within the region. In other words, harvest lost in riparian Np buffers is lost entirely.

Table 25 reports the results of these several steps. At the low end, we estimate an annual loss in timber harvest on the order of 13,000 Mbf. At the high end, the loss is estimated to be 57,000 Mbf on an annual basis. To put this annual reduction in timber harvest in perspective, we compared the total projected losses with the average production capacity of a sawmill in the state. The DNR's 2016 Washington Mill Survey finds that the log production was about 33,700 Mbf per average sawmill (DNR 2017, Table 18). Therefore, this analysis finds that, under our high-end assumptions, the reduction in annual timber harvest is greater than the productive capacity of one sawmill in the state.

Table 25. Estimated Reduction in Annual Timber Harvest Across Western Washington (Mbf)

Ecoregion	Low-end: Only "likely harvestable" forestland, 42% Nu are Np, 43% leakage			High-end: All "regulated" forestland, 94% Nu are Np, no leakage		
	No cut	Partial cut	Total	No cut	Partial cut	Total
Cascades	4,451	82	4,533	20,216	364	20,581
Coast Range	5,996	117	6,114	26,144	573	26,716
North Cascades	701	66	767	4,348	428	4,777
Puget Lowland	1,149	6	1,155	4,731	23	4,755
Willamette Valley	79	0	79	317	2	319
Total	12,376	272	12,648	55,757	1,390	57,147

Source: IEc analysis using data sources described in the main text.

5.5 Decreased Economic Activity

This section considers how a reduction in harvested timber would affect regional economies in terms of jobs, wages, revenues, and tax revenue. This analysis is not focused exclusively on landowners but rather the broader "timber industry," defined in Mason, Bruce, & Girard (2022) as including forestry and logging, wood product manufacturing, paper and furniture manufacturing, wholesale (of lumber, plywood, etc.), and port-related activities. Additionally, changes in the timber industry activity from reduced timber production have broader regional economic impacts (i.e., multiplier effects) by changing demand for goods and services within the

[61] For instance, Rabotyagov et al. (2021) found that Washington state forestland declined by two percent between 2007 and 2019.

supply chain of the timber industry (i.e., "indirect impacts") and due to changes in timber industry employees spending income in the region (i.e., "induced impacts").

The direct (i.e., timber industry only) and total (i.e., direct, indirect, and induced effects across the timber industry and interrelated sectors) losses in job-years, wages, revenues, and taxes are quantified using data from the Mason, Bruce & Girard, Inc. (2022) report titled, *Contribution of Working Forests to the Washington State Economy: 2021*. The study relies on employment census data for calculating direct effects, primarily from the Quarterly Census of Employment and Wages (QCEW) from Washington and the Bureau of Labor Statistics. Revenue and tax information comes from the Washington Department of Revenue data. Indirect and induced effects rely on the Bureau of Economic Analysis (BEA) RIMS II Imput-Output model multipliers. The study focuses on timber industry impacts in Washington for a single year of data (2021); thus, this is not a time trend analysis or "average year" estimate. However, the study reflects a recent snapshot of the economy associated with the timber industry.

Our analysis focuses on the following indicators of economic activity:

- **Job-years and wages** measure economic activity in terms of employment. Job-years are a measure of the number of jobs (the QCEW jobs number reflects filled jobs, including full-time or part-time, and temporary or permanent) in a year. Wages include total compensation to employess (including bonuses, tips, employer retirement contributions, etc.).
- **Revenues** correspond to Gross Business Income reported to the Washington Department of Revenue.
- **Taxes** consider timber excise taxes (i.e., stumpage taxes) only. Forest excise tax calculations are based on stumpage values and other variables, therefore an assessment of the actual magnitude of changes in forest excise taxes would require significant details about the locations of affected harvest, the types of stands affected, logging conditions, and thinning conditions.[62] Absent this information, we approximate the decrease in forest excise tax contributions to county level services at a screening level. As described in Section 5.3, timber excise tax is collected at the state level and distributed to counties where the harvest occured.

The remainder of this section describes our methodological approach and findings of our evaluation, which follow the approach summarized in Figure 11.

Figure 11. Methods Overview for Regional Economic Impact Analysis

[62] The most recent instructions for calculating forest excise taxes are available at: https://dor.wa.gov/sites/default/files/2024-07/InstrSVtables2024_2ndHalf.pdf

Step 1: Calculate rates of impact at the county level. Mason, Bruce & Girard, Inc. (2022) report impacts by Washington county. We calculate rates of impact per timber harvest volume (i.e., per million board feet) at the county level by dividing the direct and total impacts by the total timber harvest by county.

Step 2. Assign county-level information to ecoregions. For consistency with other effects presented in this report, we convert the county-level rates derived from Mason, Bruce & Girard, Inc. (2022) to ecoregion-level rates based on the percentage of working forests subject to the rule in each county and ecoregion. The share of county in each ecoregion is calculated based on the amount of working forest land from Atterbury Consultants that is subject to the rule (i.e., largely private and municipal forestland), excluding areas with Federal, Tribal, and State HCP, and is therefore consistent with our high-end estimate described in Chapter 2. Table C-6 in Appendix C presents the weighting factors used in this analysis.

Applying these weighting factors to the county-level rates of impact described in Step 1 yields the impact rates presented in Table 26. We find that across western Washington, one million board feet (MMbf) of timber harvest is associated with 14 direct (i.e., timber industry) and 36 total (i.e., timber industry plus broader regional economy) job-years as well as $900,000 in direct and $1.9 million in total wages annually. This same quantity of timber harvest is also associated with $11.9 million in revenue in the directly affected forest product industry sectors and $20,000 in primary taxes from stumpage sales.

Table 26. Regional Economic Impact "Rates" per MMbf of Timber Harvest

Ecoregion	Job-Years (count)		Wages (mill $)		Revenues (mill $)	Taxes (mill $)
	Direct	Total	Direct	Total		
Cascades	17	46	$1.0	$2.4	$14.0	$0.02
Coast Range	5	12	$0.3	$0.8	$4.7	$0.02
North Cascades	25	59	$1.4	$3.1	$19.6	$0.02
Puget Lowland	21	51	$1.3	$2.7	$17.3	$0.02
Willamette Valley	33	98	$1.8	$4.7	$25.3	$0.02
Average	14	36	$0.9	$1.9	$11.9	$0.02

Source: IEc analysis of county-level data presented in Mason, Bruce & Girard (2022) combined with county-to-ecoregion mapping presented in Table C-6 of Appendix C.

Step 3: Apply economic impact "rates" at the ecoregion level to the estimated annual reduction in timber harvest. Finally, we apply the rates presented in Table 26 to the total annual decrease in timber harvest presented in Table 25.

Table 27 tabulates our estimated regional economic impacts by ecoregion and across the low- and high-end scenarios. Estimated losses in total job-years range between roughly 390 and 1,800 under the low-end and high-end scenarios respectively, while losses in annual wages are estimated to range between $24 million and $110 million. These losses in job-years and annual wages represent 0.5 percent to 2.5 percent of the total forest product industry in western Washington in 2021. The high end of this range corresponds directly to the total portion of regulated forestland removed from harvest (see Section 2.2). However, the low end

extends beyond the range reported in that same section because we assume only a portion of the harvest is displaced in our low-end estimate.

Table 27. Estimated Annual Regional Economic Impacts by Ecoregion

Ecoregion	Direct Job-Years		Total Job-Years		Total Wages (million$/Year)		Revenue (million $/Year)		Stumpage Taxes (million $/Year)	
	Low	High	Low	High	Low	High	Low	High	Low	High
Cascades	77	351	208	946	$11.9	$54.0	$70.2	$318.9	$0.1	$0.5
Coast Range	29	127	72	314	$5.2	$22.5	$31.7	$138.6	$0.1	$0.5
North Cascades	19	118	45	282	$2.6	$16.4	$16.7	$104.0	$0.0	$0.1
Puget Lowland	25	102	59	242	$3.4	$14.0	$22.1	$91.1	$0.0	$0.1
Willamette Valley	3	10	8	31	$0.4	$1.7	$2.2	$9.0	$0.0	$0.0
Total	153	709	392	1,816	$23.5	$108.6	$143.0	$661.6	$0.3	$1.2
% W WA	*0.5%*	*2.1%*	*0.5%*	*2.2%*	*0.5%*	*2.2%*	*0.5%*	*2.2%*	*0.5%*	*2.5%*

Source: IEc analysis using inputs presented in Table 25 and Table 26. The low-end estimates reflect only "likely harvestable" forestland, the assumption that 42 percent of Nu streams in WC Hydro are Np, and 43 percent leakage. The high-end estimates reflect all "regulated" forestland, the assumption that 94 percent of Nu streams in WC Hydro are Np, and no leakage.

5.6 Key Assumptions and Sources of Uncertainty

Table 28 summarizes the sources and implications of uncertainty in our regional economic impact analysis.

Table 28. Sources of Uncertainty in Assessment of Regional Economic Impacts

Key Assumption or Source of Uncertainty	Direction of Potential Bias	Likely Effect of the Uncertainty on Results
Average annual harvest rate per acre across western Washington is a good indicator for harvest intensity in Np buffer areas specifically.	Unknown	Likely minor. This analysis applies an average annual harvest rate derived from recent harvest statistics across all private, state, and municipal forestland across western Washington. We assume this harvest rate is also applicable to forested riparian buffers absent any information to suggest harvest intensity differs in these areas.
Regional economic impacts are linear with changes in harvest.	Overestimate regional economic impacts	Likely minor. The regional economic impacts estimated in this chapter rely on Mason, Bruce & Girard (2022) to estimate impacts per MMbf, then scale those rates using estimated changes in annual MMbf attributable to the rule. Implicit in this approach is that regional economic impacts scale linearly, although it may be the case that relatively small restrictions in annual harvest do not translate directly to changes in, for example, employment opportunities.
Potential for compensating harvest outside of Np buffer within the region.	Unknown	Likely minor. Harvest restrictions in one area may be made up through more intensive harvest elsewhere. We assume 43 percent of harvest volume is truly displaced from the region at the low end and that none of the harvest volume is displaced at the high end. Given this wide range, we are likely to capture the true extent of displacement.
Only harvest within Np buffers is affected by the rule.	Underestimate regional economic impacts	Likely minor. As described in Chapter 3, the rule has the potential to result in "stranded timber" because it becomes operationally or financially infeasible to access due to the changing composition of Np buffers. The conditions under which harvestable timber becomes unreachable are highly site-specific, and therefore this analysis does not seek to model these instances across western Washington. However, we acknowledge that this section only considers the lost timber harvest within the expanded Np buffers and may underestimate the total regional economic impacts if the rule results in foregone harvest outside of the buffers.

Note: See also Table 11 for a discussion of the uncertainty associated with our estimated extent of Np miles, which is a key input in this analysis.

CHAPTER 6 | Summary and Conclusions

This chapter summarizes our key findings from this CBA. In Section 6.1, we aggregate and compare our results across impact categories in multiple ways. We use that information in Section 6.2 to provide our perspective on whether the probable benefits of the rule outweigh the probable costs. Finally, in Section 6.3, we describe the distributional consequences of the rule, considering which affected populations ultimately incur the probable costs and benefits of the Np rule.

6.1 Summary of Analysis Findings

We synthesize the findings of our analysis in several ways. First, in Table 29, we describe the probable effect of the rule in terms of its magnitude. As shown, there are both major probable costs and major probable benefits of the rule. We also identify several other categories of probable benefits that are considered moderate, minor, and negligible. For the probable costs, an additional category is likely minor.

The probable costs of the rule stem from restrictions on harvesting timber in the added riparian buffer. The rule would change the viable economic uses of a significant extent of added riparian buffer acres—67,000 to 170,000 acres with full harvest restrictions and an additional 2,900 to 8,600 acres with partial harvest restrictions (Table 10), amounting to approximately 0.8 percent to 2.2 percent of all private and municipal forestland in western Washington and 1.1 to 2.9 percent of all forestland in western Washington governed by the Forest Practices HCP. The significant amount and fraction of forestland with new harvest restrictions results in $320 million to $1.0 billion land value losses (Table 13), characterized as a major cost of the rule. We additionally find that it is likely that the rule will increase the costs of cable-based timber harvest in certain areas adjacent to the added buffer area. However, we categorize these costs as minor given that they are relevant to a limited extent of Np stream with relatively steep slopes and the added costs, while potentially significant to an individual landowner, are limited.

The probable benefits of the rule are likewise driven by the magnitude of the riparian forest that will be removed from harvest rotation. Regarding the targeted benefit of the rule, available scientific evidence and expert judgment find that the rule is required to meet water quality standards by minimizing the risk of future stream temperature increases. The added riparian buffer is additionally likely to improve other riparian functions; this is particularly true along stream reaches where the rule adds riparian buffer where none is required under the current rule, which we estimate to be 40 percent of the Np stream network in western Washington. The analysis additionally finds potentially major benefits to riparian wildlife given the significant increase in riparian forest habitat protected from future harvest. The rule increases the security of undisturbed habitat and reduces habitat fragmentation in areas of high biodiversity of importance to 85 percent of the terrestrial vertebrate species in Washington. The benefits to stream-associated invertebrates and fish occurring downstream of the Type Np streams affected are less certain and thus are characterized as minor to moderate and negligible to minor level benefits, respectively. The economics literature, while insufficient to monetize the benefits of improved habitat quality and species, demonstrates that the public highly values species conservation, including through habitat protection initiatives. Our analysis also identifies increased carbon sequestration, another ecosystem service provided by riparian buffers, as a negligible to minor benefit of the rule.

While the economics literature focuses on surveys of the general population, we recognize the unique relationship and knowledge held by western Washington tribes regarding the riparian habitats benefiting from this rule. Tribes and indigenous communities more broadly value the natural environment as an interconnected and inseparable system. We do not impose a monetized value construct on tribal cultural values in this CBA but emphasize the importance of considering information provided by tribes in decision-making regarding the rule.

Table 30 expresses the effects of the rule per Np stream mile. As described in Chapter 2, there is considerable uncertainty about the number of Np miles that may be affected by the rule given significant data limitations. While the ranges we present throughout this report aim to convey the wide range of uncertainty associated with the total costs and benefits of the rule, expressing the impacts "per stream mile" facilitates a scaling of our findings to alternative assumptions or findings of affected stream miles.

When translating our estimates into "per stream mile" equivalents over the 45-year analysis timeframe, we calculate 3.7 to 4.0 acres of added riparian buffers associated with a $17,000 to $23,000 in land value losses per average Np stream mile, and a 16 percent probability of increased cable harvest costs.[63] On the benefits side, fewer of our results can be expressed in per stream mile terms. However, while not every stream mile is equal in terms of the contribution of riparian forest to water quality and habitat services provided, on average greater and more continuous riparian habitat protection is better for riparian functions and for aquatic and terrestrial habitats and species. For the one quantified benefit, we estimate an increase in carbon sequestration on the order of 12 to 74 t CO_2-eq per Np stream mile. In addition to the quantified benefits, the table also provides information about the annual regional economic impacts per stream mile.

Ultimately, we find that while the relative costs and benefits of the rule are highly site-specific, the weighing of probable costs and benefits at a landscape scale does not require a precise accounting of stream miles affected. The key categories of costs and benefits of the rule generally scale (i.e., costs and benefits both increase with increased Np stream miles affected by the rule).

[63] Table 1 describes that the change in buffer width between the current rule and final rule can be 0 feet, 15 feet, 25 feet, 50 feet, or 75 feet, depending on conditions along a particular stream segment. These changes in buffer width result in increased buffer area per stream mile on the order of 0 acres, 1.8 acres, 3.0 acres, 6.1 acres, and 9.1 acres respectively. An average increased buffer area per stream mile of 3.7 to 4.0 acres (see Table 37) is associated with an increased buffer width of 31 to 33 feet.

Table 29. Summary of Probable Costs and Benefits of the Np Buffer Rule

Incremental costs	Incremental benefits

Major costs
• Decreased forestland values
  ○ Total present value losses of $320 million to $1.0 billion, reflecting added harvest restrictions on 1.1 to 2.9 percent of Forest Practices HCP land in western Washington
  ○ On an annualized basis, these losses are equivalent to $11 to $35 million assuming a 2% discount rate (alternatively, annualized costs are $17 to $54 million assuming a 4.5% discount rate)
  ○ These costs are concentrated among forestland owners in western Washington
Minor costs
• Increased forest harvest operating costs
  ○ At most 16 percent of Np streams abut slopes where cable harvest may become more costly
  ○ Increased costs per Mbf are uncertain but likely minor where the rule widens existing buffers, and moderate for areas where buffers do not exist with the current rule and would be required under the rule
  ○ These costs are incurred by a subset of forestland owners
	Moderate to major benefits
	• Reduced risk of stream temperature increases
	  ○ Existing evidence and expert review demonstrate that longer and wider buffers are necessary to minimize the risk of stream temperature increases associated with harvest near Np streams
	  ○ Economics literature consistently demonstrates that people value improvements in water quality, regardless of whether they directly use the resource (e.g., for drinking or recreation)
	• Improved habitat conditions for terrestrial riparian wildlife
	  ○ 67,000 to 170,000 additional acres with harvest restrictions, representing 0.4 to 0.9 percent of all forest habitat in western Washington (regardless of owner)
	  ○ Economic valuation literature identifies that the public, including Washington State households, hold substantial value for species conservation and restoration, including through habitat protection
	Minor to moderate benefits
	• Improved habitat conditions for stream-associated amphibians
	  ○ 19,000 to 44,000 Np stream miles with requirements for wider or longer buffers that will protect species from stream temperature increases and improved general habitat quality
	Additional benefits
	• Tribal cultural values: As described in Section 4.4, the cultural importance of these ecosystems to tribes is best communicated by the tribes.
	Negligible to minor benefits
	• Increased habitat conditions for fish downstream of Np streams
	  ○ Increased delivery of organic matter, macroinvertebrates, nutrients, and cooler water, although improved conditions do not persist far downstream
	• Increased carbon sequestration
	  ○ Likely positive effect in reducing atmospheric carbon although significant uncertainty exists regarding magnitude of this benefit due to influence of timber management practices and uses of the harvested timber on carbon budget
	  ○ On the order of 220,000 to 3.3 million MT CO_2 increase in total carbon sequestered relative to active timber rotation over the first 45 years of rule implementation
	  ○ Reduction in annual atmospheric carbon represents between 0.005 percent and 0.07 percent of all emissions in the state
	  ○ Avoided climate damages associated with increased carbon sequestration experienced at a global level

Notes: This table only includes the probable costs and benefits of the rule, as opposed to the regional economic impacts, to facilitate a comparison in the next section.

Table 30. Summary of Probable Rule Effects Per Average Np Stream Mile in Western Washington

Impact Category	Method and Source	Estimate
Land use change per Np stream mile (45 years)		
Number of acres with harvest exclusions	(Total no-cut acres (Table 10) + Half of partial-cut acres (Table 10)) / Total Np miles affected (Table 4)	3.7 – 4.0 acres per Np stream mile
Probable costs per Np stream mile (45 years)		
Decreased forestland values	Total present value of land losses (Table 13) / Total Np miles affected (Table 4)	$17,000 – $23,000 lost land value per Np stream mile
Increased forest harvest operating costs	Portion of Np stream miles adjacent to Np streams with slopes > 35 percent (Table 15)	16 percent of Np stream mile will experience increased costs
Probable benefits per Np stream mile (45 years)		
Reduced risk of stream temperature increases	Qualitative	Qualitative
Improved wildlife habitat quality	Qualitative	Qualitative
Increased carbon sequestration	Total CO_2 reduction (Table 22) / Total Np miles affected (Table 4)	12 – 74 t CO_2-eq per Np stream mile
Tribal cultural values	Qualitative	Qualitative
Regional economic impacts per stream mile (annual)		
Reduction in timber production	Decrease in annual timber harvest (Table 25) / Total Np miles affected (Table 4)	0.68 – 1.3 Mbf per Np stream mile
Job-years	Total job-years lost per year (Table 27) / Total Np miles affected (Table 4)	0.02 – 0.04 total lost jobs per Np stream mile
Wages	Total wages lost per year (Table 27) / Total Np miles affected (Table 4)	$1,300 – $2,400 total lost wages per Np stream mile
Revenue	Total revenue lost per year (Table 27) / Total Np miles affected (Table 4)	$7,700 – $15,000 lost wages per Np stream mile
Timber excise tax revenue	Total revenue lost per year (Table 27) / Total Np miles affected (Table 4)	$16 – $27 lost taxes per Np stream mile

6.2 Weighing of Probable Benefits and Costs

According to RCW 34.05.328, the objective of the CBA for a rule is to determine whether the probable benefits of the rule outweigh the probable costs, *taking into account both quantitative and qualitative benefits and costs and the specific directives of the statute being implemented*. Based on the information and analysis presented in this CBA, we find that the probable benefits of the rule likely outweigh the probable costs. This determination is based on the following comparison of rule outcomes that we determined are both probable and more than minor:

- The total forestland value losses are likely on the order of $320 million to $1.0 billion. This is a significant cost, all incurred in the first year the rule goes into effect. While these total present value losses are most salient, we also present these losses in annualized terms for comparison with other rule effects that can be expressed in annualized terms. We calculate annualized effects assuming both 2 percent and 4.5 percent discount rates (reflecting uncertainty in the social discount rate) over the 45-year analysis timeframe.[64] When applying these assumptions, we estimate annualized land value losses on the order of $11 million to $35 million (assuming a 2 percent discount rate) and $17 million to $54 million (assuming a 4.5 percent discount rate). We focus our weighing of probable costs and benefits on whether the combined benefits are likely to exceed these major costs.

- Based on the available scientific evidence and expert judgment relied upon for developing the rule, the wider and longer Np stream buffers associated with the rule relative to the current rule are required to meet water quality standards. Therefore, the reduced risk of stream temperature increases is a probable benefit of the rule. Because this body of evidence suggests water quality standards cannot be consistently achieved absent this rulemaking, we categorize the reduced risk of stream temperature increases as a moderate to major benefit of the rule. The economic valuation literature demonstrates that people broadly value improvements in water quality but is scant on research specific to water temperature. Recent valuation studies identify that these preferences also extend to "non-use" attributes of the water resources, meaning people value water quality improvements even in waterways they do not access for direct use, for example for recreation or drinking water purposes.

- The analysis additionally finds moderate to major benefits to riparian wildlife given the significant increase in riparian forest habitat that will remain undisturbed on account of the buffer requirements. The rule increases habitat availability and reduces habitat fragmentation in areas of high biodiversity and of importance to 85 percent of the terrestrial vertebrate species in Washington. The benefits to stream-associated invertebrates and fish occurring downstream of the Type Np streams affected are less certain and thus are characterized as minor to moderate and negligible to minor level benefits, respectively. Limitations in both the ecological research and economic valuation literature impede our ability to directly compare the combined magnitude of the ecological benefits to species habitat with the land value losses. However, this literature does provide perspective on how people value the protection and conservation of wildlife, including species that depend upon the riparian habitats of Washington State. The species valuation literature demonstrates that the public holds significant value for actions that conserve and protect vulnerable species and their habitats.

- The added riparian buffer improves riparian functions more broadly. The economics literature, while insufficient to monetize the benefits, demonstrates that people value the suite of ecosystem services provided by riparian buffers. To provide context regarding the benefits people derive from riparian

[64] Because land value losses reflect a loss in potential future uses of the land in perpetuity, annualizing over a 45-year timeframe likely *overstates* the annualized effect of land value losses.

ecosystem functions, we consider findings from a study that quantifies the value people hold for widening buffers on private timberland in another setting, specifically in New Brunswick, Canada. As described in Section 4.5, based on the low-end per household value ($7.85) from that study, annualized benefits to Washington residents of the additional riparian habitat protection may be on the order of tens of millions of dollars. Given uncertainty regarding the applicability of the source study to the Np rule context, **we do not include this value as a measure specifically of the benefit of the rule**. However, the values identified through this research on riparian buffers provide empirical support for the positive preferences the public holds for water quality and species protection resulting from riparian habitat protection, even for households distant from the protected riparian area.

- While the economics literature quantifying values people hold for ecosystems and species focuses on surveys of the general population, we recognize the unique relationship and knowledge held by western Washington tribes regarding the riparian habitats benefiting from this rule. Tribes and indigenous communities more broadly value the natural environment as an interconnected and inseparable system. We do not impose a monetized value construct on tribal cultural values in this CBA but emphasize the importance of considering information provided by tribes in decision-making regarding the rule.
- While costs and benefits are likely to vary depending on site-specific factors, this analysis focuses on quantifying the effects of additional Np stream mile buffers at a landscape scale. Accordingly, the costs and benefits are generally scalable. That is, while the total extent of affected Np miles influences the magnitudes of the benefits and costs, the weighing of probable benefits and costs is not materially affected by the total number of Np stream miles affected. We therefore provide information on costs and benefits "per average stream mile" for additional context and perspective, recognizing the uncertainty regarding the total number of Np stream miles affected by the rule.

Given our analysis demonstrating that the effects of the rule on carbon sequestration and on fish habitat downstream of the Np streams are negligible to minor, these effects do not materially factor into the overall finding that the probable benefits of the rule likely outweigh the probable costs.

6.3 Distributional Effects

Despite our assessment that the rule most likely generates net benefits, this analysis finds there are significant distributional effects. The rule generates substantial costs, primarily borne by forest landowners whose land use will be restricted. The ecological benefits are experienced more broadly by the public. This creates a disparity in which the social and environmental benefits of the rule are broadly distributed among the public, while the burdens are concentrated on a specific subset of landowners within a particular economic sector. Table 31 summarizes which rule effects (costs, benefits, and economic impacts) are experienced by each affected population and provides perspective on the size of the population experiencing the effects. The remainder of this section provides additional details about the burden of the rule experienced by SFLs in particular (Section 6.3.1) as well as methods strategies for mitigating the costs of the rule on these and other landowners (Section 6.3.2).

Table 31. Summary of Rule Effects by Population

Affected Population	Population size	Effect of the Rule
Forestland owners	23,000 SFLs (see Section 6.3.1), as well as approximately 11,000 other private and 440 government landowners[1]	Decreased forestland values Increased forest harvest costs Lost timber harvest revenue
Employees in industries connected with the harvest industry	100,000 (see Section 5.2)	Lost job opportunities
Western Washington county governments	20 counties	Lost tax revenue
Washington households and tribes	3.02 million households (Census 2023) 29 federally recognized tribes (WDFW 2025)	Values associated water quality improvements, riparian protections, species and habitat conservation Values associated with habitat and species conservation
Global population	8 billion people	Reduced climate damages

Sources and notes: [1]Population size by landowner type was estimated based on the number of unique landowners with properties containing Np streams that are subject to the rule (see Chapter 2, "high end" estimate) from the 2019 Washington State Forestland Database. To estimate the number of non-SFL private and municipal/state landowners affected by the rule, we used the "MaxNameAcres" field from the 2019 Washington State Forestland Database. This field is the total acreage owned by the listed owner within each county and serves as a best estimate of county-level ownership. We identified the number of unique "MaxNameAcres" values for parcels that overlap with Np or Nu stream miles, as mapped in WC Hydro. This approach assumes ownership is confined within individual counties and may overstate the number of distinct landowners affected by the rule.

6.3.1 Consideration of Costs Experienced by Small Forest Landowners

SFLs have the potential to be significantly adversely affected by the modifications in riparian regulations under the rule. To provide perspective on these impacts, we analyzed the presence of Np and Nu streams affected by the rule in WC Hydro (see Chapter 2 for details) on parcels owned by SFLs in western Washington based on the 2019 Washington State Forestland Database. Overlaying these two data sources reveals that between 15 and 17 percent of parcels owned by SFLs contain streams potentially affected by the rule, affecting between 21,000 and 23,000 SFLs (Table 32). DNR (2021b) reports approximately 160,000 SFLs in western Washington, therefore this analysis identifies that 13 to 14 percent of SFLs in the region may experience the effects of the rule.

This same spatial analysis finds that, of the total Np and Nu stream network in western Washington identified in WC Hydro as potentially affected by the rule, 11 percent of stream miles occur on SFL land.[65,66] To approximate the total land value losses that SFLs may incur on account of the rule, we apply 11 percent to the total land value losses presented in Table 13. In doing so, we estimate that SFLs may experience land value

[65] As described in Chapter 2, in reality only a fraction of Type Nu stream miles identified in WC Hydro are Type Np streams affected by this rule. Because we are unable to assign a probability that a given stream segment is non-fish perennial in the spatial data, we conduct this portion of our analysis on all Type Nu and Type Np streams identified in our high-end scenario. We are also unable to incorporate other forestland that includes Type Np streams not identified in WC Hydro. It is uncertain whether these limitations over- or underestimate the portion of Np stream miles associated with SFL land.

[66] The remaining 89 percent of stream miles are on non-SFL private (73 percent), municipal (2 percent), state (1 percent), and other forestland.

losses on the order of $35.2 million to $110 million the first year the rule goes into effect. SFLs may additionally experience increases in cable harvest costs at specific sites, as outlined in Section 3.2. A recent survey of SFLs documented that existing riparian harvest restrictions contained in other Forest Practices rules had a negative impact on some of the respondents (Rabotyagov et al. 2021). The restrictions associated with the Np rule are likely to result in additional negative impacts to this group.

Rogers and Cooke (2010) use a previous version of the Washington State Forestland Database (2007) to assess the distribution of streams by type separately on SFL and private "industrial" land. That report finds that a smaller portion of total streams on SFL land are Type N (between 9 and 11 percent, see Table 15 of Rogers and Cooke 2010) relative to private industrial land (between 59 and 60 percent, see Table 16 of the same source) for Lewis County in particular. If this county is representative of other western Washington counties, then this implies that non-SFL land may have a higher concentration of Type N streams.

Table 32. Small Forest Landowner Impacts of the Rule

Scenario	Stream miles potentially affected by the rule[1] in SFL-owned parcels[2]	Percent of SFL-owned parcels containing streams affected by the rule	Approximate number of SFLs affected[3]
Low-end: Only "likely harvestable"	3,547	15.5%	20,946
High-end: All "regulated" forestland	4,073	17.5%	23,349

Sources and notes:

1. WC Hydro, available at https://data-wadnr.opendata.arcgis.com. IEc analysis using inputs described in Chapter 2. The low-end estimates reflect only "likely harvestable" forestland. The high-end estimates reflect all "regulated" forestland.
2. 2019 Washington State Forestland Database, provided by DNR on March 25, 2025.
3. To approximate the number of SFLs affected by the rule, we relied on the "MaxNameAcres" field in the 2019 Washington State Forestland Database. This field is a "best attempt to determine ownership acres, the total acreage owned by the owner of each parcel within that parcel's county," per the data dictionary. We determined the number of unique "MaxNameAcres" for parcels that intersect Np or Nu stream miles documented in WC Hydro. This method assumes that SFLs' ownership is limited by county and therefore is likely an overestimate of the number of affected owners.

6.3.2 Cost Mitigation Options

Given this distribution of costs and benefits, decision-makers may consider potential mitigation strategies to alleviate the financial costs, particularly to small businesses and SFLs. Several strategies exist, as described in the Small Business Economic Impact Statement (SBEIS) accompanying the rule. DNR provides significant technical and financial assistance to reduce the burden of compliance with existing Forest Practices rules. In 1999, the Washington State Legislature determined that the regulatory requirements for forestland were "diminish[ing] the economic viability of small forest landowners" and established the Small Forest Landowner Office to serve as a resource and focal point for SFL concerns and policies (RCW 76.13.100). This office provides assistance to eligible SFLs to help them meet the requirements of legislation with significant cost implications. To date, the Small Forest Landowner Office has implemented several programs that reduce the compliance costs for businesses.

The Forestry Riparian Easement Program (FREP), in particular, compensates SFLs for the loss of revenue associated with lost timber harvest in riparian buffer areas by offsetting 90 percent of the timber value in return

for granting a 40-year conservation easement. Data provided by a manager of FREP indicates that the program has purchased 500 easements between 2001 and 2023.[67] In the 10 most recent years in the data (2014 through 2023), the program compensated SFLs for lost timber harvest on nearly 2,300 acres. Funding for FREP varies from year to year. This program was originally intended to compensate SFLs for the increased costs associated with the 2001 Forest Practices rules, and it is uncertain whether available funding will increase in order to offset the costs of expanded Np buffer requirements.[68] To the extent that SFLs are able to make use of this program to offset any of the land value losses they experience through this rule, the burden of the rule is transferred back to the state and the taxpayers that financially support and benefit from these programs.

Additionally, given the finding that the rule generates disproportionate impacts on small businesses, the Forest Practices Board and DNR may consider the following types of cost mitigation strategies described in the SBEIS for the rule and as described in RCW 19.85.030. These cost mitigation strategies may be considered, as relevant and where legal and feasible, in meeting the stated objectives of the statutes upon which the rule is based.

a) Reducing, modifying, or eliminating substantive regulatory requirements;
b) Simplifying, reducing, or eliminating recordkeeping and reporting requirements;
c) Reducing the frequency of inspections;
d) Delaying compliance timetables;
e) Reducing or modifying fine schedules for noncompliance; or
f) Any other mitigation techniques including those suggested by small businesses or small business advocates.

[67] Data provided to IEc by DNR's Conservation Easement Program via email on May 7, 2024 and described via personal communication with IEc on April 22, 2024.

[68] Personal communication between DNR and IEc on April 1, 2025.

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Note: This reference list includes sources cited in the main text and appendix that follows.

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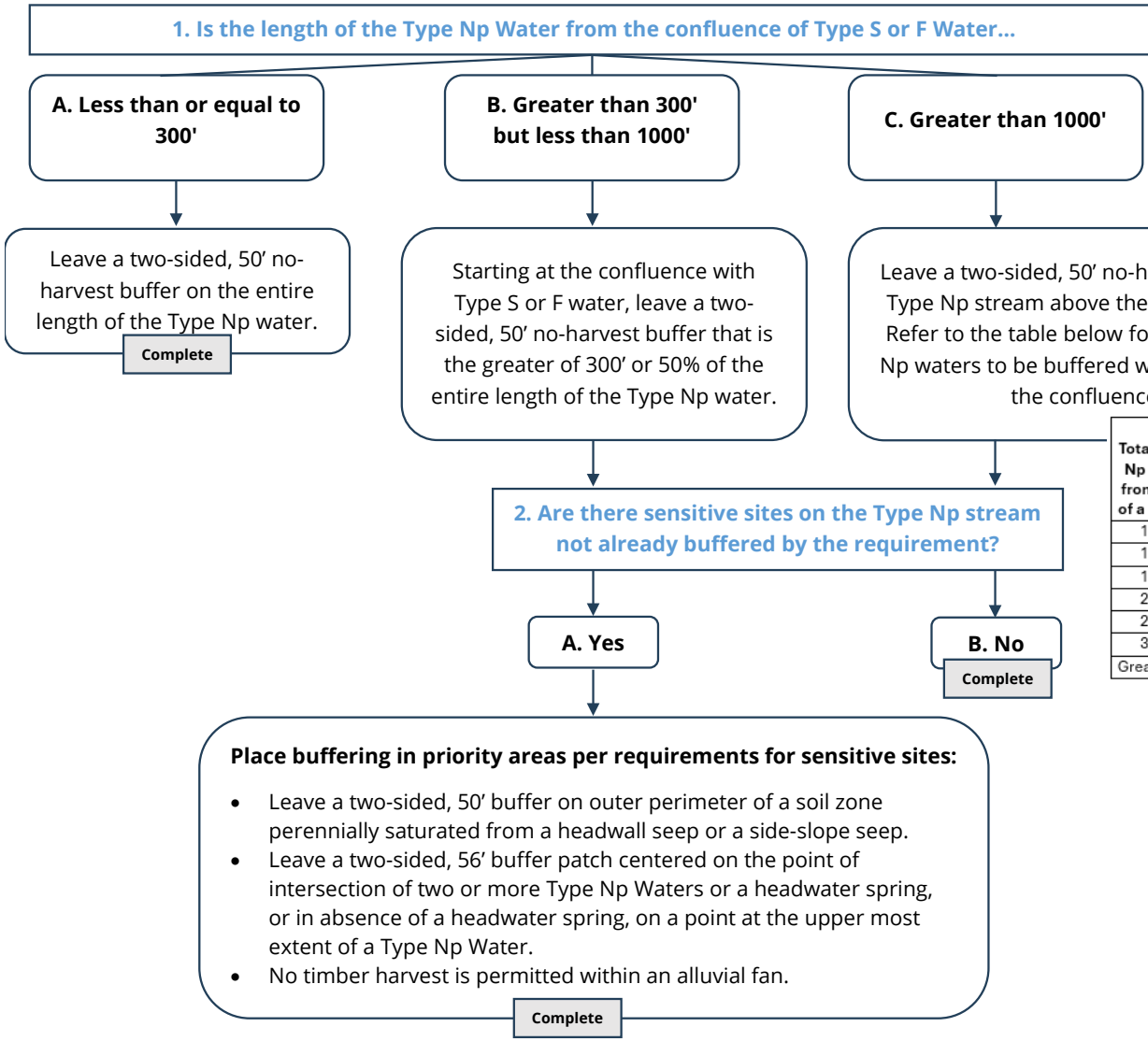
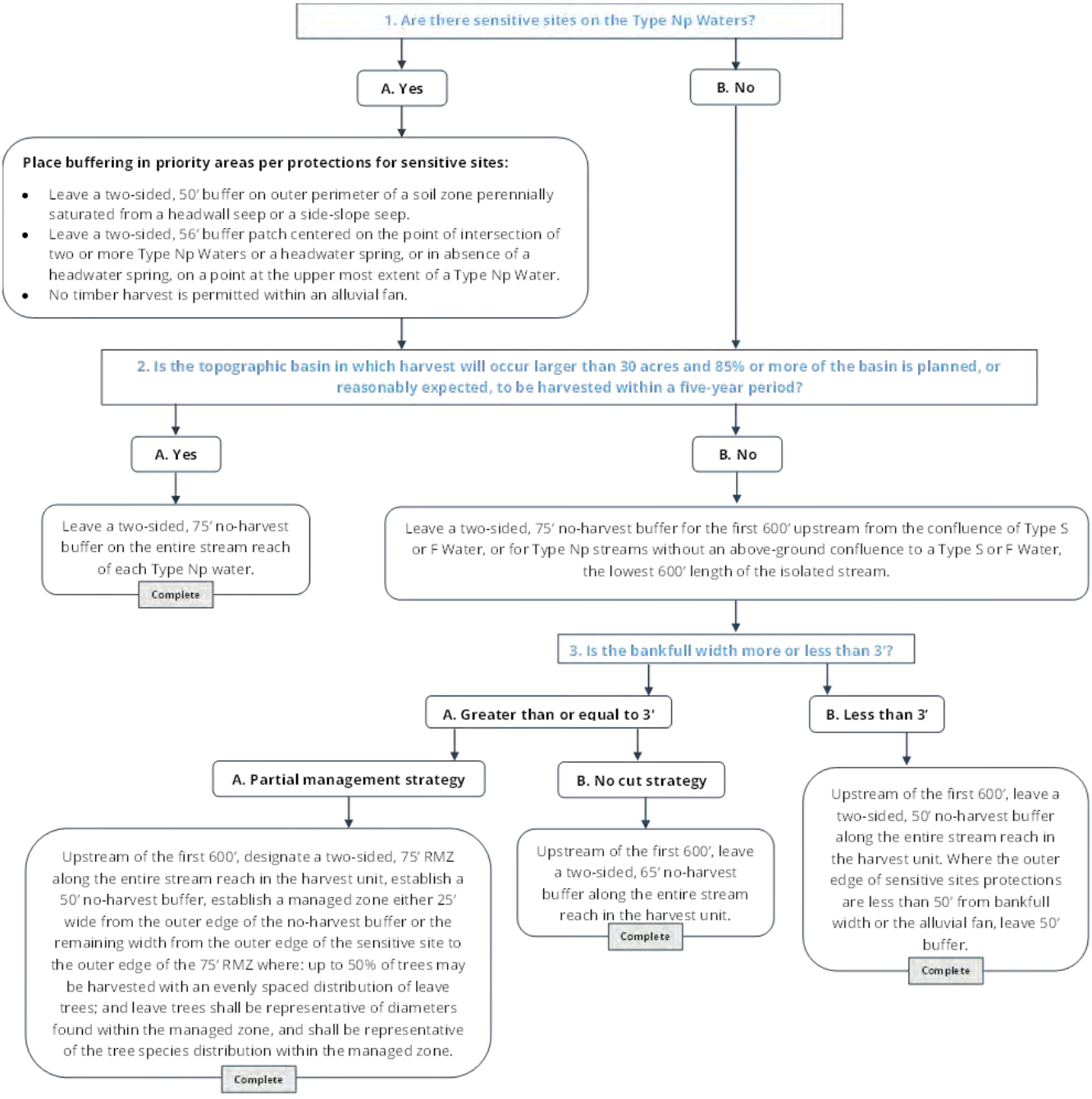
Appendix A | Diagrams on Current and Final Rule Pathways

Figure A-1. Current Rule (WAC 222-30-021)



Total length of a Type Np Water upstream from the confluence of a Type S or F Water	Percent of length of Type Np Water that must be protected with a 50 foot no harvest buffer more than 500 feet upstream from the confluence of a Type S or F Water
1001 - 1300 feet	19%
1301 - 1600 feet	27%
1601 - 2000 feet	33%
2001 - 2500 feet	38%
2501 - 3500 feet	42%
3501 - 5000 feet	44%
Greater than 5000 feet	45%

Figure A-2. Final Rule (WAC 222-30-021)



Appendix B | Effects of Rule Considered and Determined Not Probable

This appendix describes other effects of the rules evaluated and determined to be "not probable" costs or benefits of the Np rule. We describe our justification for our determination in the sections that follow.

B.1 Other Categories of Incremental Costs Considered

B.1.1 Increased Land Use Change Outside of the Buffers

One pathway through which the rule could generate costs is if harvest restrictions within expanded Np buffers result in land use change outside of the buffers. Namely, restrictions on harvest across a larger portion of forestland could drive some landowners, in particular SFLs, to sell their land for development. Four Peaks (2024b) evaluated the potential environmental impacts of the Type Np rule and determined that there is a low risk. As a basis for this determination, they cited 1) no evidence that current Forest Practices rules have been a significant contributor to development conversion and 2) existing programs that help to ease the financial burden of Forest Practices regulations on SFLs specifically (see Section 6.3).

B.1.2 Increased Administrative and Rule Implementation Costs to Landowners

The rule includes consideration of basin size, BFW, stream length, etc. to determine the extent of required buffers, therefore effort is required to assess relevant variables on the landscape and interpret the rule requirements for particular parcels and planned harvests. However, the current rule also requires similar effort to interpret and operationalize for a given harvest unit. DNR staff contend that the rule is unlikely to require more effort or costs for landowners to assess their parcels.[69] Therefore, the CBA does not evaluate the costs associated with increased landowner effort to apply the rule on the ground.

B.2 Other Categories of Incremental Benefits Considered

B.2.1 Avoided Costs Associated with Lost Assurances

Forest Practices rules are developed, in part, in service of achieving environmental goals and the State of Washington's water quality standards, including requirements through the Clean Water Act (CWA). Ecology is responsible for determining whether Forest Practices rules meet the needs and goals of the CWA. Currently, Ecology considers the Forest Practices Program, which includes landowners covered by the Forest Practices HCP, to meet the objectives of the CWA and water quality standards. This recognition is codified into Schedule M-2 of the Forest and Fish Report which describes the CWA "assurances" provided to the Forest Practices Program.[70] These "assurances" mean that any landowner that is following Forest Practices Rule will not be the target of 303(d) listing. The schedule also notes that Ecology provides these assurances so long as regulations are upgraded as called for through the adaptive management process.

Given that the "world without the rule" now includes evidence that the current Forest Practices rules do not always maintain required water temperature levels, Ecology may no longer offer "assurances" to the Forest Practices Program if upgraded protections for Type Np waters are not adopted into rule. This has the potential to result in additional 303(d) listing for Np streams and other waters of the state (as defined by RCW 90.48.020) if

[69] Personal communication with DNR on March 25, 2025.

[70] Document shared with IEc via email on September 12, 2024.

water temperatures increase above water quality criteria.[71] Further, impaired waters of the state on Forest Practices HCP lands are assigned a low priority for Total Maximum Daily Load (TMDL) development because of the assurances. Ecology notes the risk if Type Np rule upgrades are not adopted of the potential withdrawal of CWA assurances. If withdrawn, there would likely be costs associated with TMDL development and implementation. However, the extent and scale of these potential costs are significantly uncertain. Determining the likelihood and outcomes of the Forest Practices Program no longer receiving CWA assurances is beyond the scope of this CBA.[72]

B.2.2 Avoided Costs Associated with Listing Salamanders

There are two salamander species under consideration for listing under the Endangered Species Act (ESA): the Cascade and Columbia torrent salamanders.[73] Listing status under the ESA triggers the need to review Forest Practices rules to ensure they are adequately protecting the species. Therefore, by updating the Np buffer requirements through this rule, the rule has the potential to result in avoided costs associated with uplisting. In this case, these species are already covered species under the Forest Practices HCP.[74] Because they are covered species, their listing under the ESA would not trigger a review of Forest Practices rules, therefore this rule does not result in probable cost savings associated with ESA listing of the two salamander species.[75] Evaluating whether this rule will influence the likelihood that the salamanders will be listed and what the associated avoided costs would be is beyond the scope of this CBA. [76]

[71] Personal communication with Ecology on September 4, 2024.

[72] DNR memo sent to IEc on March 31, 2025.

[73] The FWS National Domestic Listing Workplan for Fiscal Years 2024-2028 is available here: https://www.fws.gov/sites/default/files/documents/2024-05/national-domestic-listing-workplan-2024.pdf (May 2024 version)

[74] See Table 1.3 "Species covered by the Forest Practices Habitat Conservation Plan" in Chapter 1 of the Forest Practices HCP: https://www.dnr.wa.gov/publications/fp_hcp_07ch1.pdf

[75] See Section 10.4 "Listing of Species That Are Covered Species" in Appendix A of the Forest Practices HCP: https://www.dnr.wa.gov/publications/fp_hcp_17appa.pdf

[76] DNR memo sent to IEc on March 31, 2025.

Appendix C | Detailed Analysis Tables

Table C-1. Wildlife Potentially Affected by Rule Due to Reliance on or Proximity to Buffers

Common Name	Scientific Name	Status	Forest Practices HCP Species	Likelihood of Occurrence in Np Areas
Stream-associated amphibians				
Coastal tailed frog	*Ascaphus truei*	State sensitive	Yes	High
Cascade torrent salamander	*Rhyacotriton cascadae*	State candidate	Yes	High
Olympic torrent salamander	*Rhyacotriton olympicus*	Species of greatest conservation need	Yes	High
Pacific giant salamander	*Dicamptodon tenebrosus*	Secure	No	High
Cope's giant salamander	*Dicamptodon copei*	Species of greatest conservation need	No	High
Larch mountain salamander	*Plethodon larselli*	State sensitive, species of greatest conservation need	No	Low
Long toed salamander	*Ambystoma macrodactylum*	Secure	No	Low
Northwestern salamander	*Ambystoma gracile*	Secure	No	Low
Van Dyke's salamander	*Plethodon vandykei*	State candidate, species of greatest conservation need	Yes	High
Dunn's salamander	*Plethodon dunni*	State candidate	Yes	High
Rough-skinned newt	*Taricha granulosa*	Secure	No	Low
Terrestrial riparian wildlife				
Mammals				
Gray wolf	Canis lupus	Federal endangered, state endangered	No	Low
Grizzly bear	*Ursus horibillis*	Federal threatened, state endangered	No	Low
Canada lynx	*Lynx canadensis*	Federal threatened, state endangered	No	Low
Fisher	*Pekania pennanti*	State endangered	No	Moderate
Wolverine	*Gulo gulo luscus*	Federal threatened, state candidate	No	Low
Bobcat	*Lynx rufus*	Secure	No	Moderate
Black bear	*Ursus amaericanus*	Secure	No	Moderate
Roosevelt elk	*Cervus elaphus roosevelti*	Secure	No	Low
Birds				
Northern spotted owl	*Strix occidentalis*	Federal threatened	No	Moderate
Marbled murrelet	*Brachyramphus marmoratus*	Federal threatened	No	Moderate
Yellow billed cuckoo	*Coccyzus americanus*	Federal threatened	No	Low
Bald eagle	*Haliaeetus leucocephalus*	Secure	No	Moderate
Golden eagle		State candidate	No	Low
Western screech owl	*M. kennicotti cardonensis*	Species of greatest conservation need	No	Moderate

Common Name	Scientific Name	Status	Forest Practices HCP Species	Likelihood of Occurrence in Np Areas
Rufous hummingbird	*Selasphorus rufus*		No	Moderate
Invertebrates, insects				
Suckley's cuckoo bumble bee	*Bombus suckleyi*	Federal proposed endangered	No	Low
Monarch butterfly	*Danaus plexippus*	Federal proposed threatened	No	Low
Caddisfly	*Trichoptera sp.*		No	High
Mayfly	*Ephemopter sp.*		No	High
Stonefly	*Plecoptera sp.*		No	High
Dragonfly	*Anisoptera sp.*		No	High
Fish downstream of Np streams				
Coho salmon	*Oncorhynchus kisutch*	Federal candidate; State endangered	Yes	Low
Cutthroat trout	*Oncorhynchus clarki*	Federal candidate	Yes	High
Bull trout	*Salvelinus confluentus*	Federal threatened	Yes	Low
Western brook lamprey	*Lampetra richardsoni*	State sensitive	Yes	Low
Sculpin (reticulate, riffle, prickly, Paiute, simy)	*Family Cottidae*	Secure	Yes	Moderate
Source and notes: See Section 4.2.2 of the main text for a discussion of the various sources used to create this table.				

Table C-2. Stand Age Projection for Carbon Sequestration Analysis (Without Rule)

Age Group	0-20	21-40	41-60						61-80						81-100						101+					
Age Group %[1]	22%	27%	18%						13%						7%						12%					
% Within Age Group	100%	100%	50%	10%	10%	10%	10%	10%	50%	10%	10%	10%	10%	10%	50%	10%	10%	10%	10%	10%	50%	10%	10%	10%	10%	10%
H/N[2]	H	H	N	H	H	H	H	H	N	H	H	H	H	H	N	H	H	H	H	H	N	H	H	H	H	H
Analysis Year	Stand Age by Analysis Year																									
1	10	30	50	50	50	50	50	50	70	70	70	70	70	70	90	90	90	90	90	90	110	110	110	110	110	110
2	11	31	51	0	51	51	51	51	71	0	71	71	71	71	91	0	91	91	91	91	111	0	111	111	111	111
3	12	32	52	1	52	52	52	52	72	1	72	72	72	72	92	1	92	92	92	92	112	1	112	112	112	112
4	13	33	53	2	53	53	53	53	73	2	73	73	73	73	93	2	93	93	93	93	113	2	113	113	113	113
5	14	34	54	3	54	54	54	54	74	3	74	74	74	74	94	3	94	94	94	94	114	3	114	114	114	114
6	15	35	55	4	55	55	55	55	75	4	75	75	75	75	95	4	95	95	95	95	115	4	115	115	115	115
7	16	36	56	5	56	56	56	56	76	5	76	76	76	76	96	5	96	96	96	96	116	5	116	116	116	116
8	17	37	57	6	57	57	57	57	77	6	77	77	77	77	97	6	97	97	97	97	117	6	117	117	117	117
9	18	38	58	7	58	58	58	58	78	7	78	78	78	78	98	7	98	98	98	98	118	7	118	118	118	118
10	19	39	59	8	59	59	59	59	79	8	79	79	79	79	99	8	99	99	99	99	119	8	119	119	119	119
11	20	40	60	9	60	60	60	60	80	9	80	80	80	80	100	9	100	100	100	100	120	9	120	120	120	120
12	21	41	61	10	0	61	61	61	81	10	0	81	81	81	101	10	0	101	101	101	121	10	0	121	121	121
13	22	42	62	11	1	62	62	62	82	11	1	82	82	82	102	11	1	102	102	102	122	11	1	122	122	122
14	23	43	63	12	2	63	63	63	83	12	2	83	83	83	103	12	2	103	103	103	123	12	2	123	123	123
15	24	44	64	13	3	64	64	64	84	13	3	84	84	84	104	13	3	104	104	104	124	13	3	124	124	124
16	25	45	65	14	4	65	65	65	85	14	4	85	85	85	105	14	4	105	105	105	125	14	4	125	125	125
17	26	0	66	15	5	66	66	66	86	15	5	86	86	86	106	15	5	106	106	106	126	15	5	126	126	126
18	27	1	67	16	6	67	67	67	87	16	6	87	87	87	107	16	6	107	107	107	127	16	6	127	127	127
19	28	2	68	17	7	68	68	68	88	17	7	88	88	88	108	17	7	108	108	108	128	17	7	128	128	128
20	29	3	69	18	8	69	69	69	89	18	8	89	89	89	109	18	8	109	109	109	129	18	8	129	129	129
21	30	4	70	19	9	70	70	70	90	19	9	90	90	90	110	19	9	110	110	110	130	19	9	130	130	130
22	31	5	71	20	10	0	71	71	91	20	10	0	91	91	111	20	10	0	111	111	131	20	10	0	131	131
23	32	6	72	21	11	1	72	72	92	21	11	1	92	92	112	21	11	1	112	112	132	21	11	1	132	132
24	33	7	73	22	12	2	73	73	93	22	12	2	93	93	113	22	12	2	113	113	133	22	12	2	133	133
25	34	8	74	23	13	3	74	74	94	23	13	3	94	94	114	23	13	3	114	114	134	23	13	3	134	134
26	35	9	75	24	14	4	75	75	95	24	14	4	95	95	115	24	14	4	115	115	135	24	14	4	135	135
27	36	10	76	25	15	5	76	76	96	25	15	5	96	96	116	25	15	5	116	116	136	25	15	5	136	136
28	37	11	77	26	16	6	77	77	97	26	16	6	97	97	117	26	16	6	117	117	137	26	16	6	137	137
29	38	12	78	27	17	7	78	78	98	27	17	7	98	98	118	27	17	7	118	118	138	27	17	7	138	138
30	39	13	79	28	18	8	79	79	99	28	18	8	99	99	119	28	18	8	119	119	139	28	18	8	139	139
31	40	14	80	29	19	9	80	80	100	29	19	9	100	100	120	29	19	9	120	120	140	29	19	9	140	140
32	41	15	81	30	20	10	0	81	101	30	20	10	0	101	121	30	20	10	0	121	141	30	20	10	0	141
33	42	16	82	31	21	11	1	82	102	31	21	11	1	102	122	31	21	11	1	122	142	31	21	11	1	142
34	43	17	83	32	22	12	2	83	103	32	22	12	2	103	123	32	22	12	2	123	143	32	22	12	2	143
35	44	18	84	33	23	13	3	84	104	33	23	13	3	104	124	33	23	13	3	124	144	33	23	13	3	144

Age Group	0-20	21-40	41-60						61-80						81-100						101+					
Age Group %[1]	22%	27%	18%						13%						7%						12%					
% Within Age Group	100%	100%	50%	10%	10%	10%	10%	10%	50%	10%	10%	10%	10%	10%	50%	10%	10%	10%	10%	10%	50%	10%	10%	10%	10%	10%
H/N[2]	H	H	N	H	H	H	H	H	N	H	H	H	H	H	N	H	H	H	H	H	N	H	H	H	H	H
Analysis Year	Stand Age by Analysis Year																									
36	45	19	85	34	24	14	4	85	105	34	24	14	4	105	125	34	24	14	4	125	145	34	24	14	4	145
37	0	20	86	35	25	15	5	86	106	35	25	15	5	106	126	35	25	15	5	126	146	35	25	15	5	146
38	1	21	87	36	26	16	6	87	107	36	26	16	6	107	127	36	26	16	6	127	147	36	26	16	6	147
39	2	22	88	37	27	17	7	88	108	37	27	17	7	108	128	37	27	17	7	128	148	37	27	17	7	148
40	3	23	89	38	28	18	8	89	109	38	28	18	8	109	129	38	28	18	8	129	149	38	28	18	8	149
41	4	24	90	39	29	19	9	90	110	39	29	19	9	110	130	39	29	19	9	130	150	39	29	19	9	150
42	5	25	91	40	30	20	10	0	111	40	30	20	10	0	131	40	30	20	10	0	151	40	30	20	10	0
43	6	26	92	41	31	21	11	1	112	41	31	21	11	1	132	41	31	21	11	1	152	41	31	21	11	1
44	7	27	93	42	32	22	12	2	113	42	32	22	12	2	133	42	32	22	12	2	153	42	32	22	12	2
45	8	28	94	43	33	23	13	3	114	43	33	23	13	3	134	43	33	23	13	3	154	43	33	23	13	3

Notes: Blue shading indicates the applicable stand was harvested that year. For additional information on the harvest rotation, see Table 20.

1. We use gradient nearest neighbor (GNN) data from the Landscape Ecology, Modeling, Mapping, and Analysis (LEMMA) project to approximate the percentage of trees in each of the age groups. More about these data is available here: https://lemma.forestry.oregonstate.edu/data/plot-database.
2. "H" indicates the applicable stand is subject to harvest during the analysis period. "N" indicates the applicable stand is not subject to harvest.

Table C-3. Stand Age Projection for Carbon Sequestration Analysis (With Rule)

Age Group	0-20	21-40	41-60	61-80	81-100	101+
Age Group %[1]	22%	27%	18%	13%	7%	12%
% Within Age Group	100%	100%	100%	100%	100%	100%
H/N[2]	N	N	N	N	N	N
Analysis Year	Stand Age by Analysis Year					
1	10	30	50	70	90	110
2	11	31	51	71	91	111
3	12	32	52	72	92	112
4	13	33	53	73	93	113
5	14	34	54	74	94	114
6	15	35	55	75	95	115
7	16	36	56	76	96	116
8	17	37	57	77	97	117
9	18	38	58	78	98	118
10	19	39	59	79	99	119
11	20	40	60	80	100	120
12	21	41	61	81	101	121
13	22	42	62	82	102	122
14	23	43	63	83	103	123
15	24	44	64	84	104	124
16	25	45	65	85	105	125
17	26	46	66	86	106	126
18	27	47	67	87	107	127
19	28	48	68	88	108	128
20	29	49	69	89	109	129
21	30	50	70	90	110	130
22	31	51	71	91	111	131
23	32	52	72	92	112	132
24	33	53	73	93	113	133
25	34	54	74	94	114	134
26	35	55	75	95	115	135
27	36	56	76	96	116	136
28	37	57	77	97	117	137
29	38	58	78	98	118	138
30	39	59	79	99	119	139
31	40	60	80	100	120	140
32	41	61	81	101	121	141
33	42	62	82	102	122	142
34	43	63	83	103	123	143
35	44	64	84	104	124	144
36	45	65	85	105	125	145
37	46	66	86	106	126	146
38	47	67	87	107	127	147
39	48	68	88	108	128	148
40	49	69	89	109	129	149

Age Group	0-20	21-40	41-60	61-80	81-100	101+
Age Group %[1]	22%	27%	18%	13%	7%	12%
% Within Age Group	100%	100%	100%	100%	100%	100%
H/N[2]	N	N	N	N	N	N
Analysis Year	Stand Age by Analysis Year					
41	50	70	90	110	130	150
42	51	71	91	111	131	151
43	52	72	92	112	132	152
44	53	73	93	113	133	153
45	54	74	94	114	134	154

Notes: Blue shading indicates the applicable stand was harvested that year. For additional information on the harvest rotation, see Table 20.

1. We use gradient nearest neighbor (GNN) data from the Landscape Ecology, Modeling, Mapping, and Analysis (LEMMA) project to approximate the percentage of trees in each of the age groups. More about these data is available here: https://lemma.forestry.oregonstate.edu/data/plot-database.
2. "H" indicates the applicable stand is subject to harvest during the analysis period. "N" indicates the applicable stand is not subject to harvest.

Table C-4. County-to-Ecoregion Weighting Factors for Regional Economic Impact Analyses

County	Timber Harvest (Mbf)	Ecoregion	Share of County in Ecoregion
Clallam	215,500	Coast Range	77%
		Puget Lowland	23%
Clark	65,600	Cascades	34%
		Willamette Valley	66%
Cowlitz	246,700	Cascades	54%
		Coast Range	19%
		Puget Lowland	24%
		Willamette Valley	3%
Grays Harbor	279,500	Coast Range	98%
		Puget Lowland	2%
Island	4,800	Puget Lowland	100%
Jefferson	118,200	Coast Range	46%
		Puget Lowland	54%
King	99,700	Cascades	18%
		North Cascades	12%
		Puget Lowland	70%
Kitsap	22,400	Puget Lowland	100%
Lewis	401,100	Cascades	42%
		Coast Range	25%
		Puget Lowland	33%
Mason	97,600	Coast Range	20%
		Puget Lowland	80%
Pacific	201,300	Coast Range	100%
Pierce	80,600	Cascades	33%
		Puget Lowland	67%
San Juan	1,400	Puget Lowland	100%
Skagit	115,500	North Cascades	54%
		Puget Lowland	46%
Skamania	60,300	Cascades	94%
		Willamette Valley	6%
Snohomish	102,100	North Cascades	20%
		Puget Lowland	80%
Thurston	92,900	Cascades	16%
		Coast Range	6%
		Puget Lowland	78%
Wahkiakum	51,000	Coast Range	100%
Whatcom	47,600	North Cascades	35%
		Puget Lowland	65%

Sources and notes: Timber harvest by county obtained from Mason, Bruce & Girard (2022). The share of county in each ecoregion is calculated based on the amount of working forest land from Atterbury Consultants that is subject to the rule (i.e., largely private and municipal forestland), excluding areas with Federal, Tribal, and State Trust Lands Habitat Conservation Plan (HCP).

Appendix D | Sensitivity Analyses

In this appendix, we present results of our analyses under different key assumptions used in our main text.

D.1 Alternate Assumption Around Portion of Landowners that Select No Cut Versus Partial Management Buffers

In the main text, we assume that landowners will opt to use the partial management strategy (scenario 1A) for half of the affected Np stream miles outside of scenario 2, whereas the remaining half of stream miles will be buffered using the no-cut strategy (scenario 1B). To assess the sensitivity of our results to our assumptions regarding the likelihood of scenario 1A versus scenario 1B specifically, we present results of our analysis under the alternative assumption that all landowners outside of scenario 2 opt for scenario 1B. As described in the tables that follow, our estimated land value losses (see Table D-3) and quantified effects related to increased carbon sequestration (see Table D-4) are nearly identical to the findings in the main text. In other words, our analysis findings are not sensitive to our assumption regarding the distribution of stream miles that will be buffered using scenario 1A versus 1B.

Table D-1. Probability of Rule Scenarios by Ecoregion

Ecoregion	Scenario 1A	Scenario 1B	Scenario 2
Cascades	0.0%	99.50%	0.50%
Coast Range	0.0%	98.10%	1.90%
North Cascades	0.0%	100.00%	0.0%
Puget Lowland	0.0%	99.40%	0.60%

Source: For Scenario 2, DNR spatially compared FPAs with approved harvest acres that were received between 2019 and 2024 to Western Washington Ecology Basins (30 acres or more) to assess whether 85 percent or more of each basin was harvested during that timeframe. For this sensitivity analysis, we assume that all remaining landowners select Section 1B.

Table D-2. Estimated Increases in Np Buffer Acres Across Western Washington (Acres)

Ecoregion	Low-end: Only "likely harvestable" forestland, 42% Nu are Np		High-end: All "regulated" forestland, 94% Nu are Np	
	No cut	Partial cut	No cut	Partial cut
Cascades	24,653	0	63,797	0
Coast Range	33,281	0	82,937	0
North Cascades	4,181	0	14,888	0
Puget Lowland	6,261	0	14,691	0
Willamette Valley	430	0	985	0
Total	68,805	0	177,297	0

Source and notes: IEc analysis described in main text.

Table D-3. Decrease in Forestland Values in Western Washington (2023 dollars)

Ecoregion	Low-end: Only "likely harvestable" forestland, 42% Nu are Np, market value per acre sold	High-end: All "regulated" forestland, 94% Nu are Np, market value per harvest acre
Cascades	$110,000,000	$380,000,000
Coast Range	$150,000,000	$490,000,000
North Cascades	$19,000,000	$88,000,000
Puget Lowland	$29,000,000	$87,000,000
Willamette Valley	$2,000,000	$5,800,000
Total present value	$320,000,000	$1,000,000,000
Annualized value (2% discount rate)	$11,000,000	$36,000,000
Annualized value (4.5% discount rate)	$16,000,000	$55,000,000

Source: IEc analysis of various data sources described in the main text. Land value reductions occur in the first year of the rule and are therefore not discounted so the discount rate does not influence the present value costs presented above. As shown, discount rate assumptions do factor into the calculation of annualized effects. Annualized values are considered over the 45-year analysis timeframe.

Table D-4. Incremental Increase in Carbon Sequestration (Mt CO_2) Over 45 Years

Ecoregion	Low-end: Only "likely harvestable" forestland, 42% of Nu are Np, 90% leakage	High-end: All "regulated" forestland, 94% Nu are Np, 40% leakage
Cascades	78,000	1,200,000
Coast Range	100,000	1,600,000
North Cascades	13,000	280,000
Puget Lowland	20,000	280,000
Willamette Valley	1,400	19,000
Total (45 years)	220,000	3,400,000
Average annual per acre	0.070	0.420

Source: IEc analysis of various data sources described in the main text.

D.2 Alternate Assumptions in Carbon Sequestration Analysis

This section presents our carbon sequestration results under different assumptions regarding tree species type (Section D.2.1) and whether the trees were planted or of natural origin (Section D.2.2).

D.2.1 Tree Species Type

To test the sensitivity of the carbon sequestration analysis results to the forest type input, we replicate the analysis using "Douglas-fir" as the forest type instead of "fir/spruce/mountain hemlock." As shown in Table D-

5, altering the input increases the sequestration rate associated with each age class. Using these new sequestration rates and the same approach described in Section 4.3, we estimate the results shown in Table D-6. The total low- and high-end carbon benefits are 5 and 9 percent greater, respectively, than the low- and high-end benefits shown in the main analysis.

Table D-5. USDA Tool Inputs and Outputs (Douglas-fir Forest Type Group)

Required Data Field	IEc Input Selection into USDA Tool[1]	USDA Tool Output: Carbon flux in living and dead carbon pools (t CO_2-eq/acre)[2]	Estimated Annual Carbon Sequestration Rates (t CO_2-eq/acre/year)[3]
Type of forest management treatment to be applied	Basic projection under fm, with harvest		
Area subject to management activity	1 acre		
U.S. region	Pacific Northwest Westside		
Forest type group	Douglas-fir group		
Planted or natural forest origin	Unknown		
How many years from now will you harvest?	20[4]		
Do you know what your harvest volume is?[5]	No		
What percent of the "area subject to management activity" entered above will be harvested?[5]	"Blank"		
Age class	0-20	-101.83	-5.09
	21-40	-193.66	-9.68
	41-60	-175.70	-8.78
	61-80	-153.54	-7.68
	81-100	-138.25	-6.91
	101+	-320.05	-6.40

Source: VERSION 1.0 Excel Workbook to Support "Level I" Quantification Approaches for the Managed Forest Systems Chapter within the 2024 update to the USDA Publication *Quantifying Greenhouse Gas Fluxes in Agriculture and Forestry: Methods for Entity-Scale Inventory*. Downloaded June 28, 2024 from: https://www.usda.gov/oce/entity-scale-ghg-methods/download. Documentation for the tool is available for download at the same website.

Notes: Green shading indicates the input or output is different from the one shown in the main analysis.

1. We input these selections into the "User Data Entry" tab of the USDA tool.
2. These results are output on the "Forest Mgmt & HWP Results" tab of the USDA tool. We specifically pull the output under the "Ecosystem Carbon Impacts from Forest Growth" section of the output.
3. IEc analysis of the USDA tool output by dividing the tool output 1) by 20 years for all age class categories less than 101+ and 2) by 50 for the age class category of 101+.
4. This value was set to 50 for the 101+ age class only.
5. These input parameters do not affect the output of interest and can be left blank.

Table D-6. Incremental Increase in Carbon Sequestration (Mt CO_2) Over 45 Years (Douglas-fir Forest Type Group)

Ecoregion	Low-end: Only "likely harvestable" forestland, 42% of Nu are Np, 90% leakage	High-end: All "regulated" forestland, 94% Nu are Np, 40% leakage
Cascades	84,000	1,300,000
Coast Range	110,000	1,700,000
North Cascades	14,000	300,000
Puget Lowland	21,000	300,000
Willamette Valley	1,500	20,000
Total (45 years)	230,000	3,600,000
Average annual per acre	0.074	0.445

Source: IEc analysis of various data sources described in the main text.

D.2.2 Planted or Natural Trees

To test the sensitivity of the carbon sequestration analysis results to the forest origin input, we replicate the analysis using "planted" as the forest origin instead of "unknown." As shown in Table D-7, altering the input increases the sequestration rate associated with four of the six age classes (i.e., the carbon flux outputs from the tool do not differ for these two age categories relative to the analysis in the main text). Using these new sequestration rates and the same approach described in Section 4.3, we estimate the results shown in Table D-8. The total low- and high-end carbon benefits are 9 and 12 percent greater, respectively, than the low- and high-end benefits shown in the main analysis.

Table D-7. USDA Tool Inputs and Outputs (Planted Origin)

Required Data Field	IEc Input Selection into USDA Tool[1]	USDA Tool Output: Carbon flux in living and dead carbon pools (t CO_2-eq/acre)[2]	Estimated Annual Carbon Sequestration Rates (t CO_2-eq/acre/year)[3]
Type of forest management treatment to be applied	Basic projection under fm, with harvest		
Area subject to management activity	1 acre		
U.S. region	Pacific Northwest Westside		
Forest type group	Fir / spruce / mountain hemlock group		
Planted or natural forest origin	Planted		
How many years from now will you harvest?	20[4]		
Do you know what your harvest volume is?[5]	No		
What percent of the 'area subject to management activity' entered above will be harvested?[5]	"Blank"		
Age class	0-20	-57.48	-2.87
	21-40	-130.24	-6.51
	41-60	-135.76	-6.79
	61-80	-119.14	-5.96
	81-100	-86.99	-4.35
	101+	-163.24	-3.26

Source: VERSION 1.0 Excel Workbook to Support "Level I" Quantification Approaches for the Managed Forest Systems Chapter within the 2024 update to the USDA Publication *Quantifying Greenhouse Gas Fluxes in Agriculture and Forestry: Methods for Entity-Scale Inventory.* Downloaded June 28, 2024 from: https://www.usda.gov/oce/entity-scale-ghg-methods/download. Documentation for the tool is available for download at the same website.

Notes: Green shading indicates the input or output is different from the one shown in the main analysis.

1. We input these selections into the "User Data Entry" tab of the USDA tool.
2. These results are output on the "Forest Mgmt & HWP Results" tab of the USDA tool. We specifically pull the output under the "Ecosystem Carbon Impacts from Forest Growth" section of the output.
3. IEc analysis of the USDA tool output by dividing the tool output 1) by 20 years for all age class categories less than 101+ and 2) by 50 for the age class category of 101+.
4. This value was set to 50 for the 101+ age class only.
5. These input parameters do not affect the output of interest and can be left blank.

Table D-8. Incremental Increase in Carbon Sequestration (Mt CO_2) Over 45 Years (Planted Origin)

Ecoregion	Low-end: Only "likely harvestable" forestland, 42% of Nu are Np, 90% leakage	High-end: All "regulated" forestland, 94% Nu are Np, 40% leakage
Cascades	86,000	1,300,000
Coast Range	120,000	1,700,000
North Cascades	15,000	310,000
Puget Lowland	22,000	310,000
Willamette Valley	1,500	21,000
Total (45 years)	240,000	3,700,000
Average annual per acre	0.076	0.457

Source: IEc analysis of various data sources described in the main text.

IEc

Washington State Type Np Water Buffer Rule

Small Business Economic Impact Statement

October 24, 2025

Prepared for:

Washington Forest Practices Board
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Summary

The analysis in this report addresses the requirements of Revised Code of Washington (RCW) 19.85 that relevant agencies prepare an SBEIS (Small Business Economic Impact Statement) if the rule "will impose more than minor costs on businesses in an industry" (RCW 19.85.030). The rule directly regulates forest landowners, a subset of which are businesses. This analysis identifies that the rule is likely to result in more than minor costs to businesses, stemming from limitations on timber harvest in riparian forest. This analysis also finds that all affected businesses are most likely to be small businesses; therefore, the rule disproportionately affects small businesses. The analysis also identifies that the rule is likely to result in lost jobs due to restrictions in timber harvest across industries reliant on timber harvest for employment. In accordance with RCW 19.85.040, this SBEIS identifies steps taken to reduce the costs of the rule and opportunities to mitigate costs to small businesses, along with the other required elements of an SBEIS per the RFA (Washington Regulatory Fairness Act).

Section 1. Introduction

Washington Administrative Code (WAC) 222-30-021 regulates timber harvest within Riparian Management Zones (RMZs) in Western Washington. These regulations include requirements for "riparian buffers," which are areas within a specified distance of the outer edge of a stream in which timber harvest is precluded or restricted. Riparian buffer size varies depending on site characteristics, including whether a stream is known fish habitat (Type F) or not fish bearing (Type N). Riparian buffers on Type N waters are designed to protect water quality, stabilize stream banks, provide habitat for riparian and aquatic species, and maintain stream temperatures. Buffering requirements differ between Type N streams that are perennial (Type Np) and that flow only seasonally (Type Ns). Type Np streams are typically found in the upper watersheds and headwaters in western Washington because they begin at the uppermost point of perennial flow.

In 2018, the Cooperative Monitoring, Evaluation, and Research (CMER) Committee's *Type N Experimental Buffer Treatment Project on Hard Rock Lithologies (Phase 1)* ("Hard Rock Study", McIntyre et al. 2018) determined that the current buffer prescriptions for forest adjacent to Type Np waters were insufficient to ensure that streams consistently meet state water quality standards with regard to stream temperature. Specifically, the water quality standards mandate no temperature increase of 0.3°C or greater (measured by the 7-day maximum temperatures) above natural condition (WAC 173-201A-200, -300-320).[1] As a result, in May 2019, the Forest Practices Board accepted the Timber, Fish, and Wildlife Policy Committee's (TFW Policy) recommendation that action was warranted as a result of these findings and directed TFW Policy to develop a Type Np buffer recommendation for the Board to minimize or prevent temperature increases in streams protected by rule-required riparian buffers (Forest Practices Board 2022).

The 2019 action plan recognized that five additional CMER Type Np studies needed to be completed to complement the Hard Rock Study and better inform a Type Np buffer rulemaking proposal. TFW Policy established a working group to develop buffer options that would 1) minimize the likelihood of exceeding temperature standards in Np streams after harvest; 2) reduce post-harvest withdrawals to maintain a future supply of large wood; and 3) mitigate economic impacts on landowners (Barnowe-Meyer et al. 2021). The working group developed and evaluated seven alternate prescriptions and concluded that three alternatives could best balance the trade-off between stream temperature protections and economic impact, as follows: 1) a 75-

[1] Water bodies can have a more stringent temperature criterion based on absolute 7-day maximum temperatures if they are designated for aquatic life or require special protection for salmonid spawning and egg incubation, or 1-day maximum temperatures if specified under WAC 173-201A-602. The rules also allow for exceptions where Ecology determines that lowering of water quality is necessary and is in the overriding public interest, per WAC 173-201A-320(4).

foot, two-sided, no-harvest buffer; 2) a site-specific buffer based on effective shade; and 3) an aspect-based buffer based on Np stream orientation.

Based on the findings of the CMER Hard Rock Study (McIntyre et al. 2021), a 2021 CMER Soft Rock Study (Ehinger et al. 2021), and the Technical Type Np Prescription Workgroup report (Barnowe-Meyer et al. 2021), the Forest Practices Board seeks to update the Type Np Water Buffer Rule. In June 2025, the Forest Practices Board defined a proposed rule to update the Np buffer requirements. The proposed rule was made available for public comment in summer 2025; the final rule is consistent with the proposed rule. The Washington Regulatory Fairness Act (RFA), RCW 19.85, requires that the Washington State Department of Natural Resources (DNR) prepare an SBEIS if the rule "will impose more than minor costs on businesses in an industry." This report provides the required components of an SBEIS. Additionally, the Final Cost-Benefit Analysis (CBA) of the rule includes a more detailed description of the analysis of the costs of the rule and informs this analysis of the costs incurred by small businesses.

1.1. Objective and Summary of the Rule

The Forest Practices Board is updating the Type Np Water Buffer Rule with a primary objective of improving temperature protections for Type Np streams in western Washington to achieve compliance with water pollution control laws (RCW 90.48.420, WAC 222-12-010) and meet the overall performance goals of the Forest Practices Habitat Conservation Plan (HCP) and WAC 222-12-045(2)(a)(ii)(C). The strategy to achieve the objective is a rule that expands riparian buffers along Type Np streams relative to baseline conditions in order to prevent an increase in mean 7-day maximum water temperature of 0.3°C or greater from human activities above natural conditions per WAC 173-201A-320, or an increase above specified temperature thresholds on waters designated for aquatic life or else specified in WAC 173-201A-200 and -602.

The rule would amend the existing Type Np buffer requirements at WAC 222-30-021(2). Under the current rule, a 50-foot, no-harvest buffer must be established based on the length of the Type Np water from the confluence of Type S or F water (i.e., F/N or F/S breakpoint), with additional buffering around sensitive sites. In the amended rule, sensitive sites must be identified and protected before establishing the Type Np RMZ and buffers. For topographic basins larger than 30 acres in which 85 percent or more of the basin is planned to be harvested within a five-year period, landowners must leave a two-sided, 75-foot, no-harvest buffer along the entire stream reach of each Type Np water.

In all other scenarios, landowners must first leave a two-sided, 75-foot, no-harvest buffer for the first 600 feet upstream from the confluence of Type S or F Water, and then evaluate further buffer prescriptions based on bankfull width (BFW) and landowner management strategies. For each Type Np stream of three-foot BFW or greater, the landowner must identify either a partial management strategy or a no-cut strategy. The partial management strategy requires a 75-foot riparian zone, including a 50-foot no-harvest buffer and a 25-foot managed zone where up to 50 percent of trees may be harvested. The no-cut strategy requires a 65-foot no-harvest buffer along the stream reach. For all streams with BFW of less than three feet, landowners are required to leave a 50-foot, continuous no-harvest buffer along the remainder of the stream reach.

The changes in buffer requirements at any specific site are conditional on a range of factors including: Type Np stream length within the landowner-specific harvest unit, basin size, planned forest harvest extent, stream BFW, and other forest management strategies. In most cases, the rule increases buffer width and length relative to the current rule. Table 1 summarizes requirements of the current rule, rule, and changes under specific circumstances. The Final CBA of the rule provides more information on the final rule requirements relative to the current rule.

Table 1. Changes to Buffer Requirements on Type Np Streams in Western Washington

Rule			Distance upstream of F/N break (feet)			
			<300'	300'-600'	600'-1000'	>1000'
Current Rule (Baseline)		For all Type Np streams (apart from those with sensitive sites)	50' no-harvest buffer	50' no-harvest buffer that is the greater of 300' or 50% of the entire length of the Type Np water		50' no-harvest buffer on the first 500' + additional % of total stream length
Final Rule	Rule Scenario 2	If basin>30 acres and >85% harvest planned within a five-year period	75' no-harvest buffer the entire length of the Type Np Water			
		Incremental change:	*Additional 25' buffer in lengths where buffer is required in the current rule; additional 75' buffer in lengths where no buffer is required in the current rule*			
	Rule Scenario 1A	If basin<30 acres and/or <85% harvest planned within a five-year period + partial management strategy and BFW>3'	75' no-harvest buffer for the first 600' upstream from the confluence		50' no-harvest buffer along the entire stream reach in the harvest unit + additional 25' outer buffer representing 50% harvest zone (partial-harvest zone)	
		Incremental change:	*Additional 25' no-harvest buffer*	*Additional 25' no-harvest buffer, for up to an additional 300'*	*Additional 25' partial harvest buffer, length depends on stream reach length within harvest unit*	
		Scenario 1A, if BFW<3'	75' no-harvest buffer for the first 600' upstream from the confluence		50' no-harvest buffer along the entire stream reach in the harvest unit	
		Incremental change:	*Additional 25' no-harvest buffer*	*Additional 25' no-harvest buffer, for up to an additional 300'*	*No change in buffer width where it was required previously, additional 50' buffer where new buffer required; additional buffer length depends on stream reach length within harvest unit*	
	Rule Scenario 1B	If basin<30 acres and/or <85% harvest planned within a five-year period + no-cut strategy and BFW>3'	75' no-harvest buffer for the first 600' upstream from the confluence		65' no-harvest buffer along the entire stream reach in the harvest unit	
		Incremental change:	*Additional 25' no-harvest buffer*	*Additional 25' no-harvest buffer, for up to an additional 300'*	*Additional 15' no-harvest buffer, length of new buffer depends on stream reach length within harvest unit*	
		Scenario 1B, if BFW<3'	75' no-harvest buffer for the first 600' upstream from the confluence		50' no-harvest buffer along the entire stream reach in the harvest unit	
		Incremental change:	*Additional 25' no-harvest buffer*	*Additional 25' no-harvest buffer, for up to an additional 300'*	*No change in buffer width where it was required previously, additional 50' buffer where new buffer required; additional buffer length depends on stream reach length within harvest unit*	

Note: The buffers and incremental changes described in the above table do not differentiate between the nuances of the current rule, where landowners must consider the total length of each separate Type Np stream system where at least a portion of the system is within their harvest unit, and the final rule, which emphasizes stream length within the landowner-specific harvest unit. Sensitive sites, as outlined in both the current and final rule, are also not accounted for in the buffers and incremental changes outlined above. As such, the changes described above are simplified representations of the final rule.

1.2. Requirements for an SBEIS

19.85 RCW requires that the relevant agency prepare an SBEIS if the rule "will impose more than minor costs on businesses in an industry" (RCW 19.85.030). "Minor cost" is defined in RCW 19.85.020 as a cost per business that is less than 0.3 percent of annual revenue or income, or $100, whichever is greater, or one percent of annual payroll (RCW 19.85.020). Per the SBEIS *Frequently Asked Questions* guidance, agencies are required to consider "costs imposed on businesses and costs associated with compliance with the proposed rules" (Washington Attorney General Office 2021). Agencies are not required under 19.85 RCW to consider indirect costs not associated with compliance with the rule. The SBEIS also requires consideration of whether small businesses are disproportionately affected by the costs of the rule. This report addresses the requirements of RCW 19.85.

Small Businesses vs. Small Forestland Owners

In Washington, a small business is defined as a business with 50 or fewer employees. Separately, the state defines small forest landowners (SFLs) as those who harvest less than an average timber volume of two million board feet per year (RCW 76.13. 010 and RCW 76.09. 450). The term also generally applies to non-industrial, privately owned forestland of less than 5,000 acres. While there is likely considerable overlap between affected small businesses and affected SFLs, the focus of this analysis is on small businesses.

Although this analysis attempts to mirror the terms and wording of the final rule, no attempt is made to precisely replicate the regulatory language and readers are cautioned that the actual finalized regulatory text, not the text of this analysis, is binding.

Section 2. Small Business Impacts

This section evaluates the potential economic impacts of the rule on small businesses in Washington State. As outlined in the RFA and in accordance with other guidance and best practices, this SBEIS addresses the following questions (RCW 19.85.040):

1. What are the industries and universe of businesses that may incur costs as a result of this rule?
2. What are the likely costs of the rule to those businesses, including both compliance costs (e.g., for equipment, supplies, labor, professional services, or increased administrative costs) as well as potential lost sales or revenues?
3. Are those costs resulting from the rule anticipated to be more than minor?
4. Will the rule disproportionately affect small businesses?
5. What steps has the agency taken to reduce the costs of the rule on small businesses?
6. How has the agency involved small businesses in the development of the rule?
7. How many jobs may be created or lost as a result of compliance with the rule?

The subsections that follow address each of these questions.

2.1. Small Businesses in Relevant Industries

The rule directly regulates owners of forestland immediately adjacent to Np streams in western Washington. In some cases, these forestland owners are businesses; in other cases, these landowners are private individuals and public entities, including state and local government. The Final CBA of the rule finds that on the order of 23,000 small forest landowners (SFLs), 11,000 other private landowners, and 440 government landowners may be affected by the rule based on a comparison of the 2019 Washington State Forestland Database and DNR's map of streams in the state (WC Hydro). Analysis by the U.S. Endowment for Forestry and Communities reports that about 43 percent of all forestland in Washington is privately owned, and approximately half of that is owned by private corporations (Alvarez, n.d.). Among the landowners that we identify as likely affected by the rule, we

are unable to determine which portion are businesses. Even among the forestland owners that are incorporated as private businesses, they likely span a wide variety of industry classifications given the diversity of ways that forestland is used for business purposes. For example, due to recent interest in holding forestland as a financial asset, financial institutions (including Timberland Investment Management Organizations (TIMOs) and Real Estate Investment Trusts (REITs)) are among the industry types that could be subject to the rule (Alvarez, n.d.).

As the rule is relevant to all forest landowners (except federal and tribal entities) across western Washington, the scale of the analysis constrains our ability to accurately characterize the nature of all businesses that own forestland in affected riparian areas. To our knowledge, no publicly available data source exists that identifies the locations and Uniform Business Identification (UBI) information of small businesses that are landowners. Instead, we identify three North American Industry Classification System (NAICS) codes with businesses most likely to want to harvest timberland in riparian areas that are subject to the rule:

- 113110 – Timber tract operations
- 113210 – Forest nurseries
- 113310 – Logging

While these three NAICS codes do not encompass all business types potentially affected by the rule, they are the sectors most closely tied to the timberland management and harvest industries. We present information on these sectors to determine whether small businesses are disproportionately affected by the rule and whether the costs of the rule are more than minor.

Data provided by the Washington Department of Revenue reveal that there was a total of 811 businesses identified using these NAICS codes in 2022 (and virtually the same number in 2021).[2,3] Of these, approximately 99 percent meet Washington's definition of small business. RCW 19.85.020 defines a small business as, "...any business entity, including a sole proprietorship, corporation, partnership, or other legal entity, that is owned and operated independently from all other businesses, and that has fifty or fewer employees."

Based on data from the Washington Department of Revenue, all businesses in the "113110 – Timber tract operations" and "113210 – Forest nurseries" industries qualify as small businesses. Table 2 presents these findings. Because the vast majority of businesses in the sample of affected industries are small businesses, *this analysis concludes that small businesses are disproportionately affected by the effects of the rule.*

Table 1. Number of Small Businesses and Minor Cost Threshold in a Sample of Relevant Industries

NAICS code – Industry name	Total Number of Businesses in WA	Percent that are Small Businesses	Minor Cost Threshold for SBEIS Consideration (Based on Annual Revenue)
113110 – Timber tract operations	19	100%	$5,537
113210 – Forest nurseries	25	100%	$5,740
113310 – Logging	767	99%	$6,970
Total	811	99%	-

Source: IEc analysis of data provided by the Washington Department of Revenue on May 2, 2024. The data characterize fiscal year 2022; very similar numbers were reported in 2021.

[2] Data provided by the Washington Department of Revenue on May 2, 2024. Analysis was prepared by the Research and Fiscal Analysis department by combining Department of Revenue and Employment Security Department data. While a longer time series of data was requested, the Department of Revenue cautioned against using data from 2020 given the influence of the COVID-19 pandemic.

[3] The available data include all businesses in Washington registered with these NAICS codes, not specifically those with operations in western Washington. Therefore, it is possible that fewer businesses are found in the counties overlapping western Washington specifically.

2.2. Costs of the Rule Relative to Minor Cost Thresholds

For these sampled industries, we calculate the "minor cost" threshold associated with each (see Table 2). For all three, we determine that the minor cost measure derived from revenue data is the greatest of the three options (i.e., based on revenue, payroll, or $100).

Complying with the rule requires that a landowner follow the new requirements for the buffer configurations around Np streams. In most cases, the rule results in both wider and longer Np buffers, increasing the total buffer area and reducing available forestland for timber harvest. Costs to landowners accrue through two mechanisms:

1. ***Increased harvest restrictions on forestland reduce revenue potential of the affected land:*** The rule renders additional forested acres near Np streams unharvestable (or only partially harvestable), which reduces the potential future revenues associated with timber harvest for the landowners. Generally, the market value of a parcel of land reflects the discounted present value of expected future rents (i.e., income streams). For example, for forested land, market values include the discounted present value of income from future tree harvests and may include the discounted present values of income from alternative future uses of the parcel (e.g., for development). Accordingly, if a given use of a parcel of land is restricted, it will be worth less than its market value in the previously unrestricted state. Thus, the rule restricting harvest (and associated revenues) results in a reduction in market value of the land, which is a cost to the landowner.

2. ***Increased cable harvest costs in some instances:*** In areas that would rely on cable harvest methods absent the rule, increased no-harvest and partial-harvest buffers under the rule are likely to result in increased harvest costs under some circumstances. There are two mechanisms through which the rule increases cable harvest costs:

    - For areas that experience an increase in *buffer width* (i.e., the current rule requires some buffer along the Np stream segment), there will be a longer yarding distance over which cables need to be strung, resulting in slightly higher costs and time associated with stringing cables.

    - For areas that experience an increase in *buffer length* (i.e., new areas with buffers along Np stream segments that would not be buffered in the baseline), harvesters may need to create additional yarding corridors in order to reach harvestable timber, resulting in increased labor and materials costs. Tree falling to create yarding corridors often requires skilled fallers to ensure directional falling.

Calculating the costs of the rule for specific businesses would require data on the amount of forestland that abuts Np streams, as well as whether and to what extent harvesting timber could be more costly through the cable harvest option, which is very likely to be a site-specific determination. Data are not available to estimate the incremental costs of the rule to specific affected businesses in western Washington. Absent this data, we compare the estimated cost of the rule per Np stream mile with the minor cost thresholds to assess whether the rule is likely to result in more than minor costs for a typical business.

As described above, the costs associated with more complex cable harvest operations are highly site-specific. As such, we focus this analysis on the impacts associated with harvest restrictions specifically. We demonstrate these costs to landowners through two approaches: 1) reduced land values associated with restrictions on harvest and 2) lost stumpages sales associated with reduced harvest potential of the land. Importantly, these are alternative metrics for evaluating effects of the rule on landowners and both reflect the lost opportunity from timber harvest; therefore, the reduced land values and foregone stumpage sales are not additive effects.

2.2.1. Reduced Land Values

2.2.1.1. Acres of Affected Forestland Per Np Stream Mile

This analysis relies on modeled geospatial data from Four Peaks as the basis for understanding how buffer extents are likely to change on a selection of Np streams in western Washington. Four Peaks developed synthetic stream networks (SSNs) to model riparian buffers for the rule scenarios across approximately 263 miles of Type Np streams across 150 sample sites in four of the five ecoregions in western Washington. Detailed methods are provided in the Four Peaks report (2024). Four Peaks used this sample of concurred F/N breakpoints to evaluate the differences between 1) applying buffers to Type Np waters using buffer widths and extents defined under the current rule; and 2) buffer widths and extents defined by the Type Np Buffer rule for the same stream segments.

To simplify the many possible permutations of the rule that could exist across sites, the Four Peaks analysis offers three "scenarios" that correspond with different possible outcomes of implementing the rule. We aggregate across these scenarios by applying information on the probability of each rule scenario, then also average across sites within the synthetic stream network.[4] In doing so, we identify that the average Np mile is likely to require an additional 3.6 to 3.9 acres with no-harvest restrictions and an additional 0.16 to 0.19 acres with partial harvest restrictions. When treating each partial harvest acre as only "half" affected, we identify 3.7 to 4.0 acres affected per stream mile.[5]

2.2.1.2. Lost Land Values Per Stream Mile

We worked with Atterbury Consultants, timberland appraisers experienced in western Washington, to access data from 15 timberland transactions that occurred in western Washington from 2019 to 2023, accounting for 120,000 total acres.[6] The data include a total sale price and total acres represented by the transaction, from which we derive a *market value per acre sold*. The data additionally identify the portion of the area that constitutes harvestable timber, from which we calculate a *market value per harvestable acre*.[7] Based on practices employed by timberland appraisers, this analysis assigns a residual market value of $100 per acre for unharvestable land. That is, if timber harvest is precluded on an acre of forest land, the market value of that acre is reduced to $100.

After converting all nominal values to real 2023 dollars using the GDP deflator, we observe an increase in average market prices over the five-year period between 2019 and 2023.[8] Given an increase in the real value of forestland over this timeframe, we rely on the five most recent transactions (in 2022 and 2023) as the best estimate for forestland values when the rule goes into effect. Over this two-year period, we find that the average market value per acre sold was approximately $4,700 while the average market value per harvestable acre sold was approximately $6,000 (2023 dollars).

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[4] Chapter 2 of the Final CBA for the rule provides more details on our methods for using the data from Four Peaks.

[5] See Chapter 6 of the Final CBA for the rule for the derivation of these numbers.

[6] Data provided by email from Atterbury Consultants on various dates between September and October 2024.

[7] The transaction area also includes some unharvestable land (e.g., due to regulations or economic viability) as well as non-forest (e.g., rocks, roads, other infrastructure). Atterbury's data identifies that on average 23 percent of the transacted area is unharvestable and therefore valued at $100 per acre per their appraisal methods. For example, consider a forestland transaction that included 100 acres valued at $100,000 where 80 acres was harvestable. The market value per acre sold would be $1,000 ($100,000/100 total acres), whereas the market value per harvestable acre would be $1,225 (($100,000-($100*20 unharvestable acres))/80 harvestable acres).

[8] We adjust all land values to 2023 dollars using the GDP deflator (Source: Bureau of Economic Analysis, National Income and Product Accounts. Available here: https://apps.bea.gov/iTable/iTable.cfm?ReqID=19&step=4&isuri=1&1921=flatfiles. See Section 1 "Domestic Product and Income," Table 1.1.9 "Implicit Price Deflators for Gross Domestic Product," Line 1 "Gross Domestic Product." Accessed February 3, 2025.)

To estimate the *change* in land values per acre attributable to the rule restrictions on harvest in Np buffer areas, we make the following assumptions:

- **Value of harvestable acres:** We rely on the average land values per acre to value forestland not subject to harvest restrictions absent the rule. We apply the average *value per acre sold* at the low end under the assumption that land within the buffers represents a mix of harvestable and unharvestable land absent the rule. At the high end, we apply the average *value per harvestable acre* under the alternate assumption that all acres affected by the rule would be harvestable but for the rule.
- **Value of unharvestable acres:** As described above, we apply conventions used in the timberland appraisal industry that assign a market value of $100 per acre to unharvestable land included in timberland purchases. This value reflects the fact that the land has a non-zero value, which is $100 on average although the specific magnitude will vary by site and context. We assume that all acres that fall within "no harvest" buffers are valued at this level once the rule goes into effect.

Table 3 summarizes these inputs as well as the resulting change in market value when an acre of land goes from harvestable to unharvestable (i.e., $4,600 at the low end, $5,900 at the high end).

Table 2. Change in Forestland Values per Acre Attributable to the Rule (2023 dollars)

Year of Sale	Low-end	High-end
Market value of harvestable	$4,690	$6,007
Market value of unharvestable	$100	$100
Difference harvestable – unharvestable	$4,590	$5,907

Source: IEc analysis of data from Atterbury Consultants described in the main text.

We multiply the changes in forestland values presented in Table 3 by the total number of acres with harvest restrictions per Np stream mile identified above. In doing so, we estimate that the lost land value per typical Np stream mile is on the order of $17,000 at the low end and $23,000 at the high end.

2.2.1.3. Number of Np Stream Miles Affected to Reach Minor Cost Threshold

Finally, we compare these estimated average land value losses per Np stream mile to the minor cost thresholds for the relevant industries presented in Table 2. Across the three affected industries, a typical small business would need to own forestland that intersects 0.3 to 0.4 Np stream miles for the rule to impose a minor cost. The Final CBA of the rule identifies between 19,000 and 44,000 Np stream miles in western Washington likely to be subject to the rule. **Therefore, under this approach, it is highly likely that small businesses will experience more than minor costs stemming from the rule.**

2.2.2. Lost Stumpage Sales

Another approach to estimating the costs of the rule on affected landowners is through lost stumpage sales, a direct measure of lost revenue.

2.2.2.1. Reduction in Annual Timber Harvest

To estimate the impact of the rule on stumpage sales, we require information on how the rule is likely to affect timber harvest. The Final CBA of the rule provides an in-depth analysis of data from Four Peaks as well as an understanding of the extent of Np streams in western Washington that results in the following estimates:

- **Low end:** 67,000 acres of no-cut buffers and 2,900 acres of partial-cut buffers
- **High end:** 170,000 acres of no-cut buffers and 8,600 acres of partial-cut buffers

To translate these numbers of restricted harvest acres to reductions in timber harvest, we use 2017 data from two sources to estimate the average timber harvest per acre of available timberland across private, state, and other local land: data from the Pacific Northwest Forest Inventory and Analysis (FIA) to identify the total timberland available and data from the Washington Timber Harvest Reports (DNR 2018). Across counties in western Washington, these data identify approximately 7.1 million total timberland acres and a harvest of 2.31 thousand board feet (Mbf) across those acres in the same year.[9,10] This results in an average harvest rate per available acre of approximately 325 bf/acre/year across the counties in western Washington.

Restricting timber harvest in one area may result in more aggressive harvests in other areas, offsetting the overall reduction in timber harvest. Most of the publications that explore leakage describe effects across a global market for timber, not regional markets. Given uncertainty regarding this parameter, we apply two assumptions about leakage as a range:

- A publication by Murray et al. (2004) uses data from Wear and Murray (2003) from the western U.S. to estimate a "regional" leakage rate of 43 percent. In other words, 43 percent of restrictions on harvests were replaced by other harvest within the same region. Using this rate, we assume that 57 percent (1 minus 43 percent) of the restricted harvest in western Washington is truly lost from the broader region. We apply this assumption to our low-end scenario.
- The data used to derive the above rate is relatively old (from the period 1990 to 1995), and harvestable forestland in Washington is scarcer today on account of regulatory and other restrictions (e.g., forest management preferences, conservation easements, etc.). To provide perspective on the total regional economic impacts if displaced harvest from Np buffers cannot be absorbed by harvest in other parts of the region (i.e., meaning leakage is more likely to occur outside of Washington), we include a high-end estimate that assumes no leakage within the region. That is, harvest lost in riparian Np buffers is lost entirely.

This results in a reduction in an annual loss in timber harvest on the order of 13,000 Mbf at the low end and 57,000 Mbf at the high end.

2.2.2.2. Reduction in Stumpage Sales

The losses in stumpage sales to landowners are quantified using available information from the Mason, Bruce & Girard, Inc. (2022) report titled, *Contribution of Working Forests to the Washington State Economy: 2021*. The study relies on employment census data for calculating direct effects, primarily from the Quarterly Census of Employment and Wages from Washington and the Bureau of Labor Statistics. Revenue information comes from the Washington Department of Revenue data. Indirect and induced effects rely on the Bureau of Economic Analysis (BEA) RIMS II Imput-Output model multipliers.

[9] DNR (2018, page v) identifies harvest volume in western Washington from 2017 as follows: 1,798,044 Mbf from private land, 471,027 Mbf from state lands, and 38,432 from other public lands.

[10] We acknowledge that the 7.1 million acres of private (5.3 million acres), state (1.4 million acres), municipal (330,000 acres), and other non-federal public land (12,000 acres) from the 2017 FIA data fall within the range of other estimates of regulated forestland described elsewhere in the Final CBA for the rule, including 8.2 million acres of non-federal, non-tribal, and non-state HCP land identified in spatial landownership data from Atterbury Consultants and the 6.1 million acres of land in western Washington DNR describes as subject to the Forest Practices HCP. One of the major differences across these estimates is the treatment of land subject to the state lands and other HCPs. For this calculation, we rely on the FIA 2017 data to align the acres with the harvest volume by the same landowner types from DNR (2018).

Mason, Bruce & Girard, Inc. (2022) report stumpage sales and harvest by Washington county for the year 2021.[11] We first calculate stumpage sales per timber harvest volume (i.e., per million board feet) at the county level by dividing the sales by the total timber harvest by county. Then, we aggregate across counties in western Washington. This process yields an estimate of approximately $360,000 in stumpage sales per million board feet (MMbf) of timber harvest (2023 dollars). Applying this rate to the estimated annual decrease in timber harvest due to the rule yields a range of $5.1 million to $23 million in lost stumpage sales to landowners in western Washington in a given year (based on 2021 stumpage sales and harvest levels).

Distributed across the approximately 34,000 landowners identified in Section 2.1 as potentially affected by the rule, this equates to roughly $150 to $680 in lost revenue per year per landowner on average. In reality, revenue losses will only be experienced in the years when harvest would occur absent the rule and will be distributed disproportionately across affected landowners.

Data in Mason, Bruce & Girard, Inc. (2022) identifies approximately $840 million in stumpage sales across western Washington in 2021. The lost annual stumpage sales attributable to the rule are likely on the order of 0.6 percent to 2.7 percent of total stumpage sales across these counties in a given year, which is greater than the "0.3 percent of annual revenue or income" that defines the minor cost threshold described above (per RCW 19.85.020). While not a measure assigned to specific businesses, **this alternate approach also demonstrates it is highly likely that small businesses will experience more than minor costs stemming from the rule.**

2.3. Disproportionate Economic Impact Analysis

When rule changes impose more than minor costs to businesses, the RFA (RCW 19.85.040) requires an analysis that compares the cost of compliance for small business with the cost of compliance for the ten percent of businesses that are the largest businesses required to comply with the rules to determine whether the costs are considered disproportionate. The RFA (RCW 19.85.040[1]) describes the following formula for determining disproportionate impacts:

$$\frac{C_S}{A_S} > \frac{C_L}{A_L}$$

where:

- *C* indicates the cost of compliance,
- *A* indicates an adjustment factor (total number of employees, total sales, or total labor hours),
- *S* subscripts denote small businesses (those with 50 or fewer employees) required to comply with the rule, and
- *L* subscripts denote large businesses (the top ten percent) required to comply with the rule.

If the analysis finds that the inequality condition is met, the rule is considered to have a disproportionate impact on small businesses. As described above, data limitations prevent precise identification of sectors, industries, or particular businesses that may be affected. Therefore, there is no way to empirically perform the analysis. **However, given that the firms within the industries affected are effectively all small businesses, we find that the costs are likely disproportionately borne by small businesses.** Accordingly, this SBEIS identifies and documents cost mitigation strategies.[12]

[11] Table 7 of the source study provides stumpage sales by county while Table 12 of the source study provides harvest, both in 2021 specifically.

[12] In the absence of sufficient data to calculate disproportionate impacts, an agency whose rule imposes more than minor costs must mitigate the costs to small businesses, where legal and feasible (RCW 19.85.030[4]).

2.4. Steps Taken to Reduce Costs of the Rule

Before selecting a rule, the Forest Practices Board undertook extensive research into different possible options for the composition of Np buffers. In early 2019, TFW Policy established a working group to develop buffer options that would 1) minimize the likelihood of exceeding temperature standards in Np streams after harvest; 2) reduce post-harvest withdrawals to maintain a future supply of large wood; and 3) mitigate economic impacts on landowners. The working group developed and evaluated seven alternate prescriptions and concluded that three alternatives could best balance the trade-off between stream temperature protections and economic impact. Therefore, consideration of economic impacts has been part of the rule development process from the onset.

DNR also provides significant technical and financial assistance to reduce the burden of compliance with existing Forest Practices rules. In 1999, the Washington State Legislature determined that the regulatory requirements for forestland were "diminish[ing] the economic viability of small forest landowners" and established the Small Forest Landowner Office to serve as a resource and focal point for SFL concerns and policies (RCW 76.13.100). This office provides assistance to eligible SFLs to help them meet the requirements of legislation with significant cost implications. To date, the Small Forest Landowner Office has implemented several programs that reduce the compliance costs for businesses. The Forestry Riparian Easement Program, in particular, compensates SFLs for the loss of revenue associated with lost timber harvest in riparian buffer areas. Given the expected overlap between SFLs and small businesses in Washington State, these programs are expected to continue to mitigate the cost of compliance with Forest Practices rules for small businesses by transferring some portion of the compliance costs back to the state government.

Given the finding that the rule generates disproportionate impacts on small businesses, the Forest Practices Board and DNR should consider the following types of cost mitigation strategies according to RCW 19.85.030, as relevant and where legal and feasible, in meeting the stated objectives of the statutes upon which the rule is based:

a) Reducing, modifying, or eliminating substantive regulatory requirements;
b) Simplifying, reducing, or eliminating recordkeeping and reporting requirements;
c) Reducing the frequency of inspections;
d) Delaying compliance timetables;
e) Reducing or modifying fine schedules for noncompliance; or
f) Any other mitigation techniques including those suggested by small businesses or small business advocates.

2.5. Involvement of Small Businesses in the Rulemaking Process

Throughout the rule development process, the Forests Practices Board and DNR engaged with SFLs (which are likely small businesses). Small businesses were involved in the rule development through the inclusion of the industrial forest landowner (some industrial landowners are small business) and SFL caucuses in:

- The development of TFW Policy Committee recommendations to the Forest Practices Board of elements for inclusion in the revised Np buffer rule;
- Stakeholder meetings for the draft rule; and as
- A board member representing SFLs.

2.6. Impact on Jobs

The rule may impact jobs in western Washington through the reduction in harvestable timber. Mason, Bruce & Girard, Inc. (2022), described in more detail in Section 2.2.2.2, also calculates the number of jobs across several

industries that are directly reliant on timber harest: forestry and logging, wood products manufacturing, and transport. Importantly, this larger list of industries goes beyond the regulated landowner businesses that are the subject of this SBEIS.

Following the same approach described in more detail in Section 2.2.2.2, we estimate 14 job-years per million board feet (MMbf) of timber harvest across the industries listed above.[13,14] Applying this rate to the estimated annual decrease in timber harvest yields a range of 150 to 710 lost job-years. This is equivalent to approximately 0.5 percent to 2.2 percent of all jobs that fall into these categories.

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[13] Table 12 of the source study provides number of "direct jobs" per MMbf by county, which includes employment in the various industries described in the main text.

[14] Job-years are a measure of the number of jobs (filled jobs, including full-time or part-time, and temporary or permanent) in a year.

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