Draft Tier II Antidegradation Analysis

For The Washington Forest Practices Board's Proposed Western Washington Type Np Waters Buffer Rule

Water Quality Program

Washington State Department of Ecology

Olympia, Washington

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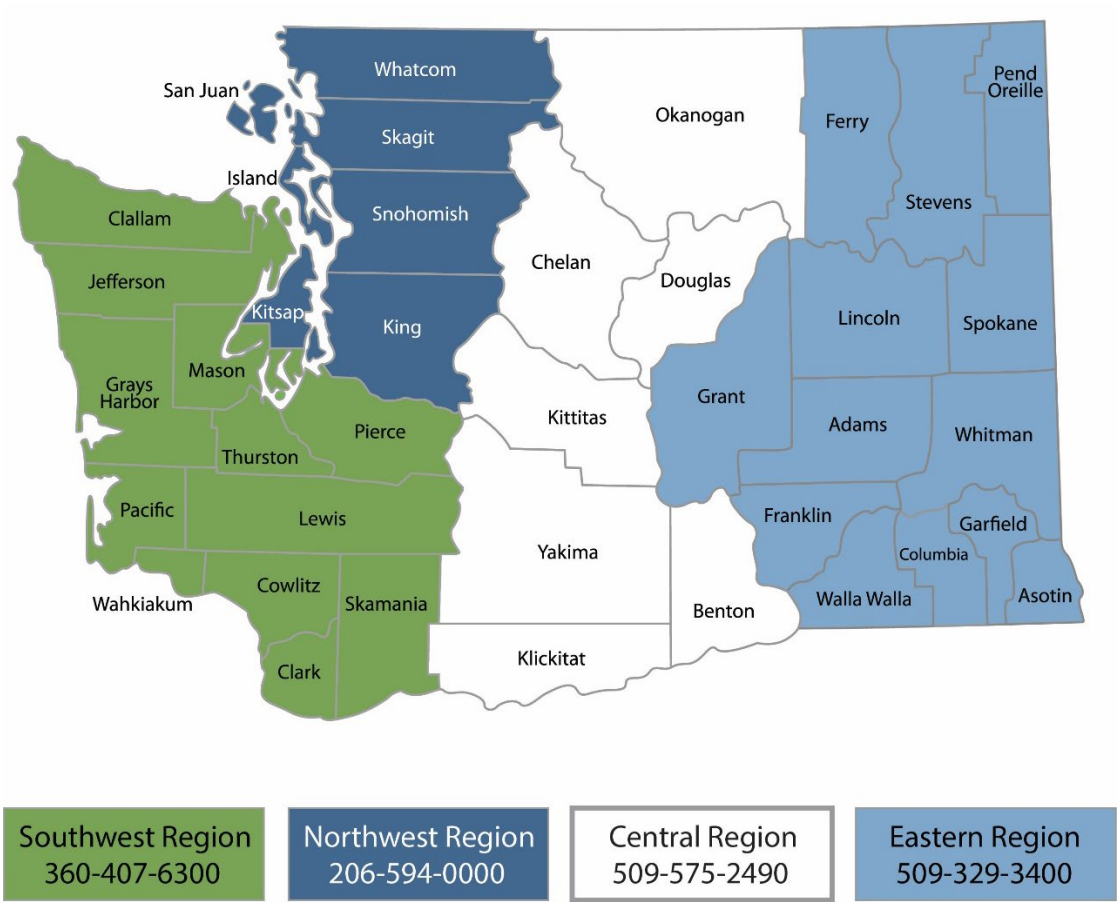

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Executive Summary

Ecology conducted a Tier II antidegradation analysis for the Forest Practices Board's proposed western Washington Type Np buffer rule. The proposed rule establishes continuous two-sided riparian buffers for non-fish, perennial (Type Np) streams ranging from 50-75 feet and represents a new or expanded action per Washington Administrative Code (WAC) 173-201A-320, therefore requiring a Tier II antidegradation review. We find the proposed rule is likely to result in substantial improvement to Type Np water quality in western Washington when compared to baseline conditions. The proposed rule is likely to protect many Type Np waters across the landscape from warming beyond 0.3°C, satisfying Tier II antidegradation temperature protections under regional and site-specific conditions.

Following our review of the best available science, we determined the proposed rule is likely to protect streams from warming in many instances. However, the proposed rule is still likely to result in water temperature increases of 0.3°C or greater under certain regional and site-specific conditions. In general, we anticipate streams with less topographic and riparian shade and a higher proportion of surface water are more likely to warm under the proposed rule. Conversely, we anticipate streams with more topographic and riparian shade that have more groundwater influence are less likely to warm.

After analyzing the costs and benefits of the proposed rule, including additional consideration of a less degrading 100-foot buffer alternative for illustrative purposes, we determine it is necessary and in the overriding public interest to allow the Forest Practices Board to adopt the rule as proposed. If the Board adopts the proposed rule, uncertainty related to rule effectiveness needs to be addressed through additional research by the Board's Adaptive Management Program (AMP). Additional AMP projects have the potential to increase our understanding of stream temperature, changes in canopy cover, and amphibian use in headwater streams.

Background

Forestry is a major land use in Washington State that consists of growing and harvesting timber, forest road construction and maintenance, forest biomass removal, reforestation, brush control, and other activities. The Washington Forest Practices Board, established in the 1974 Forest Practices Act, is the agency that adopts the rules that regulate forest practices activities. Forest practices are mandated under law to meet state Water Quality Standards (Washington Administrative Code (WAC) 173-201A) and are implemented using forestry prescriptions (WAC 222) developed and refined through a science-based adaptive management program (WAC 222-12-045).

In areas applicable to the Washington State Forest Practices Habitat Conservation Plan, an established water typing system groups waters into the following classifications: Type Ns (non-fish, seasonal), Type Np (non-fish, perennial), Type F (fish bearing), and Type S (shorelines) (WAC 222-16-031). Water quality and aquatic habitat associated with these water types are protected by the implementation of forest practices rule prescriptions and best management practices, which include, but are not limited to, no-harvest and partial harvest riparian management zone stream buffers.

Laws and regulations for forestland water quality protection

State laws establish that forest practices rules must be designed to achieve compliance with state water quality standards.

- The State Forest Practices Act requires forest practices rules to achieve compliance with federal and state water pollution control laws (Revised Code of Washington (RCW) 76.09.010(2)(g)). The Act also requires rules covering aquatic resources only be adopted or changed by the Forest Practices Board where those changes are consistent with recommendations resulting from a scientifically-based adaptive management process (RCW 76.09.370).
- The State Water Pollution Control Act requires forest practices rules to achieve compliance with water pollution control laws and requires Ecology's agreement to any proposed rules pertaining to water quality before those rules are adopted by the Forest Practices Board (RCW 90.48.420(1)).
- The forest practices regulations also require rules to achieve compliance with water quality laws (WAC 222-12-010), and calls attention to the legislative requirement for Ecology to agree to any proposed rule pertaining to water quality protection prior to Forest Practices Board adoption.

Federal Clean Water Act

The Federal Clean Water Act (CWA) requires states to adopt water quality standards that consist of designated uses, water quality criteria, and an antidegradation policy. Section 303(c)(2)(A) of the CWA gives the responsibility for adopting water quality standards to states and authorized Tribes, and requires these standards to protect the public health or welfare, enhance the quality of water, and serve the purposes of the Act.

The CWA and implementing regulations require all states to adopt an antidegradation policy into their Water Quality Standards (40 Code of Federal Regulations (CFR) 131.12).[2] At a minimum, that policy must be consistent with the following:

1. Existing instream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected.
2. Where the quality of the waters exceed levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water, that quality shall be maintained and protected unless the State finds, after full satisfaction of the intergovernmental coordination and public participation provisions of the State's continuing planning process, that allowing lower water quality is necessary to accommodate important economic or social development in the area in which the waters are located. In allowing such degradation or lower water quality, the State shall assure water quality adequate to protect existing uses fully. Further, the State shall assure that there shall be achieved the highest statutory and regulatory requirements for all new and existing point sources and all cost-effective and reasonable best management practices for nonpoint source control.
3. Where high quality waters constitute an outstanding National resource, such as waters of National and State parks and wildlife refuges and waters of exceptional recreational or ecological significance, that water quality shall be maintained and protected.
4. In those cases where potential water quality impairment associated with a thermal discharge is involved, the antidegradation policy and implementing method shall be consistent with section 316 of the Act.

Washington State Water Pollution Control Act

Water pollution control in the State of Washington is regulated under Revised Code of Washington (RCW) Chapter 90.48. This law declares that it is the public policy of the state to maintain the highest possible standard to ensure purity of waters consistent with public health, public enjoyment, and propagation and protection of wildlife, birds, game, fish, and other aquatic life (RCW 90.48.010).

[2] https://www.ecfr.gov/current/title-40/chapter-I/subchapter-D/part-131/subpart-B/section-131.12

The State Water Pollution Control Act establishes the rulemaking authority for the Department of Ecology to promulgate rules and regulations necessary to carry out the provisions of the Act, including water quality standards for the state (RCW 90.48.035). Chapter 173-201A WAC is the Water Quality Standards for Surface Waters of the State of Washington. This chapter establishes standards for public health and public enjoyment of waters in the state and for propagation and protection of fish, shellfish, and wildlife.

Washington's antidegradation policy for surface waters is guided by Chapter 90.48 RCW, the Water Pollution Control Act, Chapter 90.54 RCW, the Water Resources Act of 1971, and 40 CFR 131.12 which are the federal regulations that implement the CWA requirements. The antidegradation policy applies three tiers of protection for surface waters of the state (WAC 173-201A-310 through -332):

- Tier I protects and maintains existing and designated uses and applies to all waters and all sources of pollution by applying numeric and narrative criteria for surface waters.
- Tier II ensures waters that are of higher quality than the assigned criteria are not degraded unless such lowering of water quality is necessary and in the overriding public interest.
- Tier III protections function to set the very best waters of the state aside from future sources of degradation entirely (Tier III(A)), or above measurable amounts (Tier III(B)). These are known as Outstanding Resource Waters.

Tier II antidegradation protections

When a water quality parameter is of higher quality than the applicable numeric criteria designated for that water, then Tier II Antidegradation protections apply. For these waters and water quality constituents, new or expanded actions that are expected to cause a measurable change in the quality of the water may not be allowed unless Ecology determines that the lowering of water quality beyond the measurable change is necessary and in the overriding public interest.

A Tier II review, including applicable public involvement, occurs for new or expanded actions associated with:

- National Pollutant Discharge Elimination System (NPDES) waste discharge permits
- State waste discharge permits to surface waters
- Federal Clean Water Act Section 401 water quality certifications
- Other water pollution control programs authorized, implemented, or administered by Ecology

A Tier II evaluation occurs at the time that a new or expanded pollution source control program is developed. The measurable change analysis determines whether these new or expanded actions have the potential to cause a measurable change in the physical, chemical, or biological quality of the water. Washington's water quality standards define measurable change as:

- Temperature increase of 0.3° or greater
- Dissolved oxygen decrease of 0.2 mg/L or greater
- Bacteria level increase of 2 CFU or MPN per 100 mL or greater
- pH change of 0.1 units or greater
- Turbidity increase of 0.5 NTU or greater
- Any detectable increase in the concentration of a toxic or radioactive substance

If an action has been determined to cause a measurable change in water quality, then an analysis is conducted to determine if the lowering of water quality is both necessary and in the overriding public interest (WAC 173-201A-320(4)). New or reissued general permits or other water pollution control programs (such as the Forest Practices rules) authorized, implemented, or administered by Ecology will undergo an analysis under Tier II at the time Ecology develops and approves the general permit or program, and individual activities (such as site-level Forest Practices Applications) will not require a Tier II analysis (WAC 173-201A-320(6)(a)). Ecology has developed supplemental guidance for implementing the Tier II Antidegradation Policy (Ecology, 2011).[3]

Recent history of current forest practices rules

Leading up to the current Forest Practices Rules for stream protection was the Forests and Fish Report.[4] This 1999 document was the result of the collaboration of stakeholders including Tribes, forest landowners, local governments, and state and federal resource agencies. These diverse parties outlined ways to protect water quality and aquatic and riparian-dependent species on non-Federal, non-Tribal forestlands in Washington.

The Forests and Fish Report identified four goals:

1. Provide compliance with the federal Endangered Species Act for aquatic and riparian-dependent species on non-federal forestlands;
2. Restore and maintain riparian habitat on non-federal forest lands to support a harvestable supply of fish;
3. Meet the requirements of the Clean Water Act for water quality on non-federal forest lands; and
4. Keep the timber industry economically viable in the state of Washington.

[3] https://apps.ecology.wa.gov/publications/documents/1110073.pdf
[4] https://www.dnr.wa.gov/publications/fp_rules_forestsandfish.pdf

Clean Water Act assurances

In response to the strength and focus of the agreements contained in the Forests and Fish Report, the Department of Ecology in cooperation with the United States Environmental Protection Agency established the Clean Water Act (CWA) Assurances.[5] The CWA Assurances established that the State Forest Practices Rules and programs, as updated through a formal adaptive management program, would be used as the primary mechanism for bringing and maintaining forested watersheds into compliance with water quality standards. Likewise, the rules and programs are the primary mechanism for maintaining compliance with water quality standards.

The foundation for granting the CWA Assurances was the belief that the Forest Practices Rules were a substantial step forward in environmental protection, and, when implemented, would provide the quickest and most efficient means for achieving environmental goals and compliance with the state's water quality standards. Therefore, Ecology placed a lower priority for developing CWA-mandated Total Maximum Daily Loads to serve as regulatory water cleanup tools for forested watersheds. The value of offering formal assurances is that they provide landowners and agencies with a predictable and consistent regulatory system, and in doing so, provide an additional motivation for partners to participate in the Adaptive Management Program. The Forest Practices Program has benefited from the regulatory stability provided by the CWA Assurances for over twenty-five years.

Salmon Recovery Act of 1999

Following the release of the Forests and Fish Report was passage and enactment of the Salmon Recovery Act. This Act directed the adoption of the goals of the Forests and Fish Report into the State Forest Practices Rules. Those rules are guided by the Forest Practices Board, and set standards for timber harvests, pre-commercial thinning, road construction, and other forest practices on over 10 million acres of state and private forestland.

The State Legislature found that the Salmon Recovery Act and the resulting Forests and Fish Rules, taken as a whole, constitute a comprehensive and coordinated program to provide substantial and sufficient contributions to salmon recovery and water quality enhancement in areas impacted by forest practices (RCW 77.85.180(2)). It also authorized the development of new Forest Practices Rules based on the analyses and conclusions of the Forests and Fish Report. The rules included the development of an adaptive management program to adjust forest practices rules that are not achieving resource objectives (RCW 76.09.370(7)).

These provisions for the Forest Practices Adaptive Management Program are designed to meet the goals and objectives for water quality and habitat for fish and other covered species within the jurisdiction of the program.

[5] Schedule M-2, Forests and Fish Report p.167

Forest practices habitat conservation plan

The Forest Practices Habitat Conservation Plan[6] (FPHCP) is a direct result of the Forests and Fish Report and Salmon Recovery Act. The FPHCP was approved in 2006 by the U.S. Fish and Wildlife Service and the National Oceanic and Atmospheric Administration's National Marine Fisheries Service. Covering approximately 60,000 miles of stream habitat across 9.3 million acres of private and state forestlands, this 50-year agreement protects the habitat of aquatic species, supports economically viable and healthy forests, and creates regulatory stability for landowners. The FPHCP relies on the Adaptive Management Program to assist in determining if and when it is necessary or advisable to adjust the Forest Practices Rules and guidance to achieve the FPHCP's resource objectives, or to respond to monitoring results, evaluation, or research.[7]

Schedule L-1

Schedule L-1 is an appendix to the FPHCP and serves as the foundation for the Adaptive Management Program (AMP).[8] L-1 describes the program's overall performance goals, resource objectives, functional objectives and performance targets. This schedule guides the development of research and monitoring projects described in the Cooperative Monitoring Evaluation and Research Committee's (CMER) workplan.

Overall performance goals for the AMP declare resource objectives intended to ensure forest practices, either singularly or cumulatively, will not significantly impair the capacity of aquatic habitat to:

a) Support harvestable levels of salmonids;
b) Support the long-term viability of other covered species; or
c) meet or exceed water quality standards (protection of beneficial uses, narrative and numeric criteria, and antidegradation).[9]

Heat/Water Temperature is identified as a primary Resource Objective in Schedule L-1, with an associated Functional Objective to provide cool water by maintaining shade, groundwater temperature, flow, and other watershed processes controlling stream temperature. The performance target for stream temperature is the state's water quality standards.

[6] https://www.dnr.wa.gov/programs-and-services/forest-practices/forest-practices-habitat-conservation-plan#HCP%20Sections
[7] FPHCP Implementation Agreement, page 9
[8] https://www.dnr.wa.gov/publications/bc_tfw_attachment_1_schedule_l1_021401.pdf
[9] Schedule L-1 and WAC 222-12-045(1)(2)(a)(ii)

Forest practices adaptive management program

The Forest Practices Adaptive Management Program (AMP) is a multi-caucus program that includes representatives from state departments (Fish and Wildlife, Ecology, Agriculture, Commerce, and Natural Resources), landowners, the forest industry, county governments, the environmental community, and Tribal governments. Representatives of these caucuses participate in two key AMP committees established by the Forest Practices Board: The Timber, Fish and Wildlife Policy Committee (TFW Policy); and the Cooperative Monitoring, Evaluation, and Research Committee (CMER).

The TFW Policy Committee considers the findings of CMER research and monitoring and makes recommendations related to Forest Practices Rules, Board Manual sections, and other guidance to the Forest Practices Board for decision. CMER reviews existing science and contributes original research to the program. This science function is designed to produce unbiased technical information for consideration by the TFW Policy Committee and the Board. Both AMP committees are consensus-based; however, if consensus cannot be reached through the adaptive management process, participants will have their issues addressed through an established dispute resolution process. If necessary, the Forest Practices Board will make the final determination regarding dispute resolution (WAC 222-12-045(2)(h)).

The Department of Natural Resources (DNR) is the lead agency for ensuring compliance with Forest Practices Rules on state and private forestlands in Washington. Ecology partners with Washington Department of Fish and Wildlife and Tribal biologists to support the implementation of Forest Practices Rules.

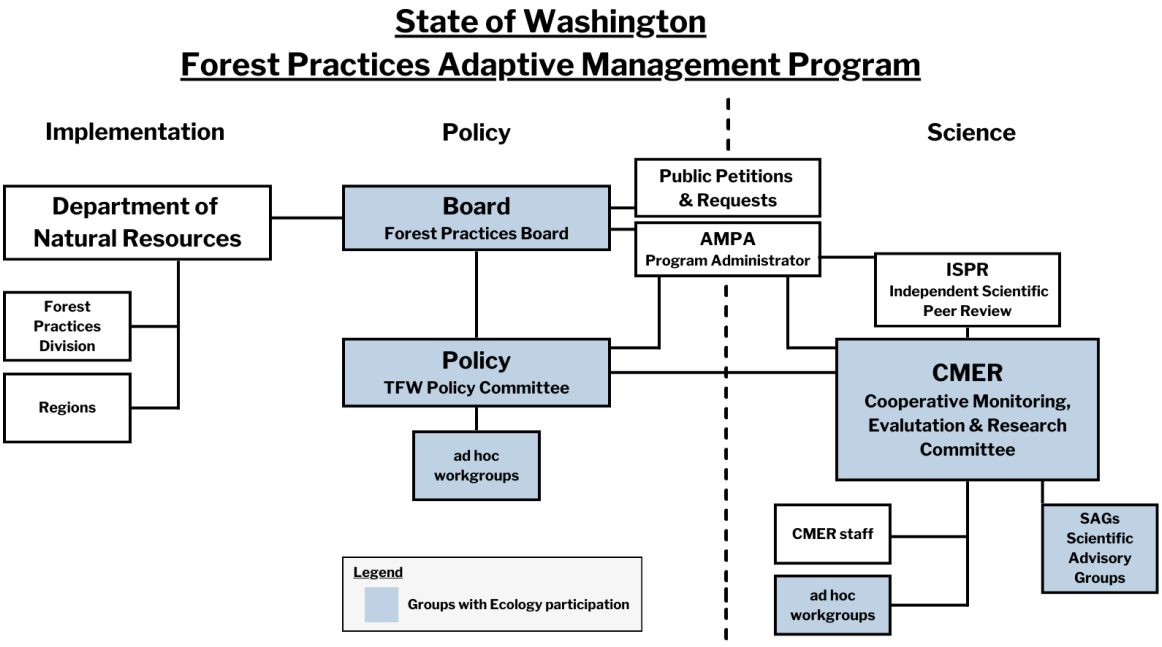

Figure 1. Forest Practices Adaptive Management Program diagram.

Forests and fish western Washington Type Np buffer rule

Type Np waters are defined in WAC 222-16-031*(4)[10] as *"…*all segments of natural waters within the bankfull width of defined channels that are perennial nonfish habitat streams. Perennial streams are flowing waters that do not go dry any time of a year of normal rainfall and include the intermittent dry portions of the perennial channel below the uppermost point of perennial flow."

The existing Forests and Fish buffer rule for western Washington Type Np waters (WAC 222-30-021*(2)) was adopted in 2001 as part of the Forests and Fish Report and Salmon Recovery Act rule package. The rule consists of:

- 50-foot no-harvest buffers on both sides of perennial non-fish waters for 50% of the water's length, except for Type Np water segments 300 feet or less in length which require 100% of the water's length to be buffered with 50-foot no-harvest buffers on both sides of the stream.
- 50-foot no-harvest buffers for sensitive sites associated with Np streams, including headwall and side slope seeps.
- 56-foot no-harvest buffers are for the intersection of two or more Type Np waters, for headwater springs, and uppermost points of perennial flow.
- In addition to the existing Np buffer rule, additional no-harvest buffers are often applied adjacent to Np waters where the presence of adjacent rule-identified potentially unstable landforms warrants the need for additional resource protection. These buffers are applied to protect the stability of inner gorges, bedrock hollows, convergent headwalls, and other landforms.

[10] Forest Practices Rules marked with an asterisk (*) pertain to water quality protection and have been adopted or amended by the Forest Practices Board with agreement from the Department of Ecology per WAC 222-12-010.

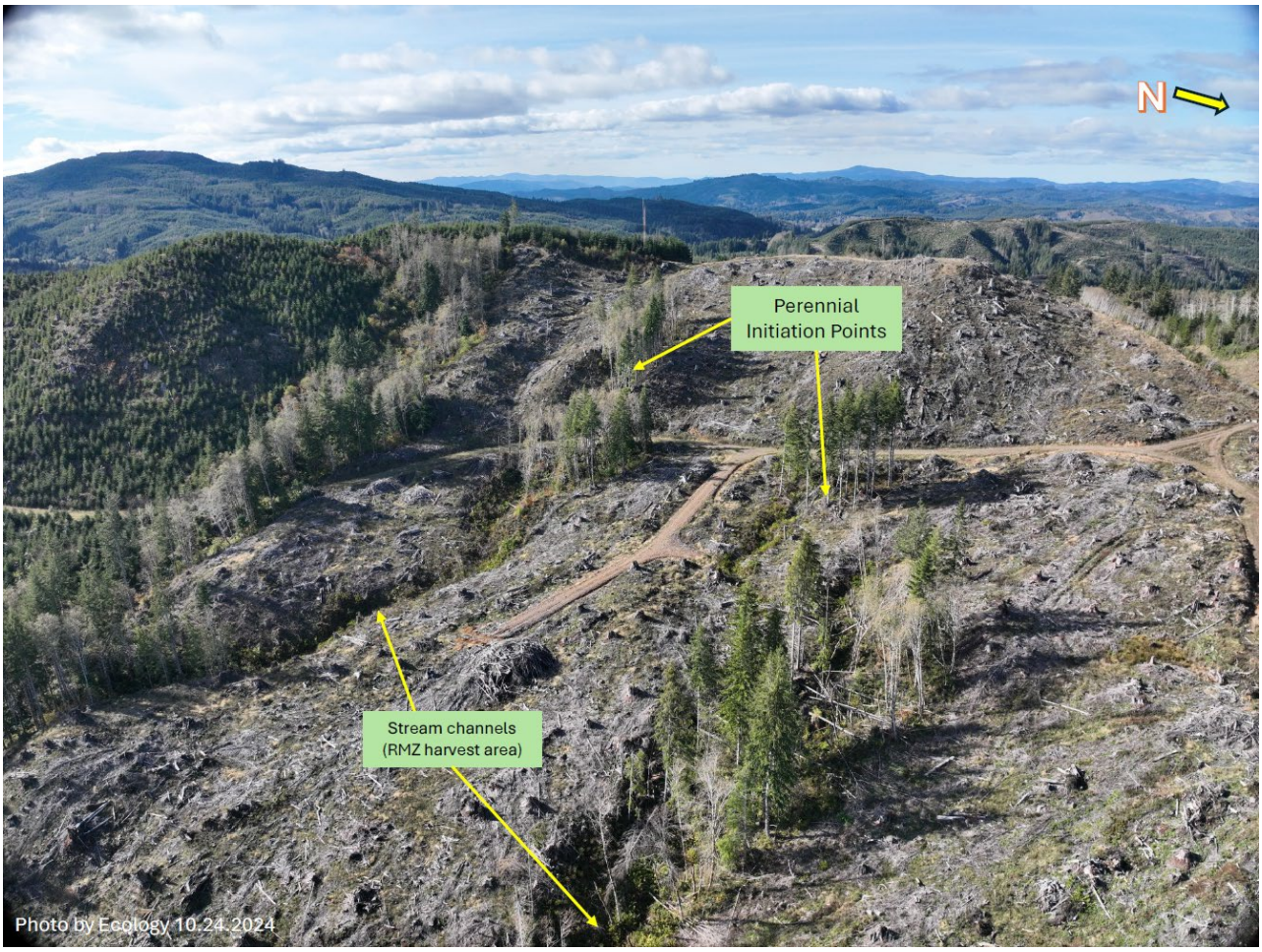

Figure 2. Example application of Forests and Fish western Washington Type Np buffer rule prescription.

Despite concerns with respect to the uncertainty and effectiveness of the Forests and Fish western Washington Type Np rule when it was under review, Ecology agreed to the overall Forests and Fish rule package as it represented a substantial step forward in environmental protection, and when implemented would provide the quickest and most efficient means for achieving environmental goals and compliance with the state's water quality standards. Key to Ecology's support of the Forests and Fish rule package was the Adaptive Management Program function to test the effectiveness of the rules and drive rule revisions when necessary to meet water quality standards.

The FPHCP Environmental Impact Statement Responses to Public Comments recognized uncertainty with the Forests and Fish protection measures for Type Np waters and acknowledged that results of CMER studies will allow the Forest Practices Board to assess Type Np protection measures and adapt where necessary to meet FPHCP objectives.[11]

In 2002, the CMER Committee ranked the AMP's effectiveness monitoring and extensive status and trend monitoring programs by asking two questions:

1. How certain are we of the science and/or assumptions underlying the rule?
2. How much risk is there to aquatic resources if the science or assumptions underlying the rule are incorrect?

Out of sixteen effectiveness/validation programs, two of the three highest ranked programs were centered around uncertainty and aquatic resource risk in Type N streams. At the top of the list was the Type N Buffer Characteristics, Integrity Function program, and third from the top was the Type N Amphibian Response program. The Type N Buffer Characteristics, Integrity, Function Project was ranked as urgent.[12] Following this priority ranking, studies to evaluate Type N streams and the effectiveness of the existing western Washington Type Np rule were chartered, scoped, designed and implemented. These included:

- Buffer Integrity – Shade Effectiveness (Amphibians) Project
- Westside Type N Buffer Characteristics, Integrity and Function Project (BCIF)
- Experimental Riparian Buffers on Perennial Non-fish-bearing Streams on Competent Lithologies in Western Washington (Hard Rock), Study Phases I and II;
- Extensive Riparian Status and Trends Monitoring – Temperature, Type F/N (Westside and Eastside) Project
- Effectiveness of Forest Practices Buffer Prescriptions on Perennial Non-fish-bearing Streams on Marine Sedimentary Lithologies in Western Washington Study (Soft Rock)

Hard Rock and Soft Rock studies

Two studies were designed and implemented by CMER to test the effectiveness of riparian buffers on non-fish-bearing perennial streams in western Washington. The design for the Effectiveness of Experimental Riparian Buffers on Perennial Non-fish-bearing Streams on Competent Lithologies in Western Washington (Hard Rock) was approved by CMER consensus in 2005. Part of that study design included limiting the site selection to streams with attributes that are known to influence stream associated amphibian distribution, to ensure presence at the sites (McIntyre et al., 2018). One of the site selection criteria was competent stream

[11] FPHCP EIS Responses to Public Comments pages 3-75, 3-76

[12] FPHCP Appendix H. CMER Work Plan, pages 5-9. Urgent projects are effectiveness and extensive monitoring projects that received the highest priority ranking because they are critical elements of a credible Forests and Fish Report Adaptive Management Program, and immediate implementation is desirable. The urgent projects address the key scientific uncertainties in the underlying assumptions of the Forests and Fish Report agreement.

lithology, which McIntyre et al. (2018) defined as potentially producing long-lasting coarse grain sizes. This left large swaths of western Washington with incompetent lithology, defined by Ehinger et al. (2021) as likely to produce fine-grained stream substrate, out of the scope of inference. In response, CMER added a companion study, Effectiveness of Forest Practices Buffer Prescriptions on Perennial Non-fish-bearing Streams on Marine Sedimentary Lithologies in Western Washington (Soft Rock), to assess the effectiveness of buffer prescriptions in more highly erodible Type N watersheds. The study design for Soft Rock was approved by consensus in 2011. Once study designs were approved, data collection began in 2006 for Hard Rock and in 2012 for Soft Rock.

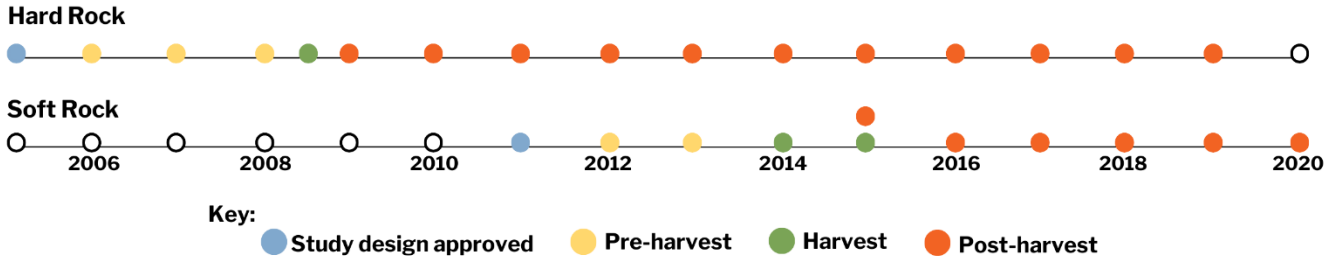

Figure 3. Timeline of the Hard Rock and Soft Rock studies.

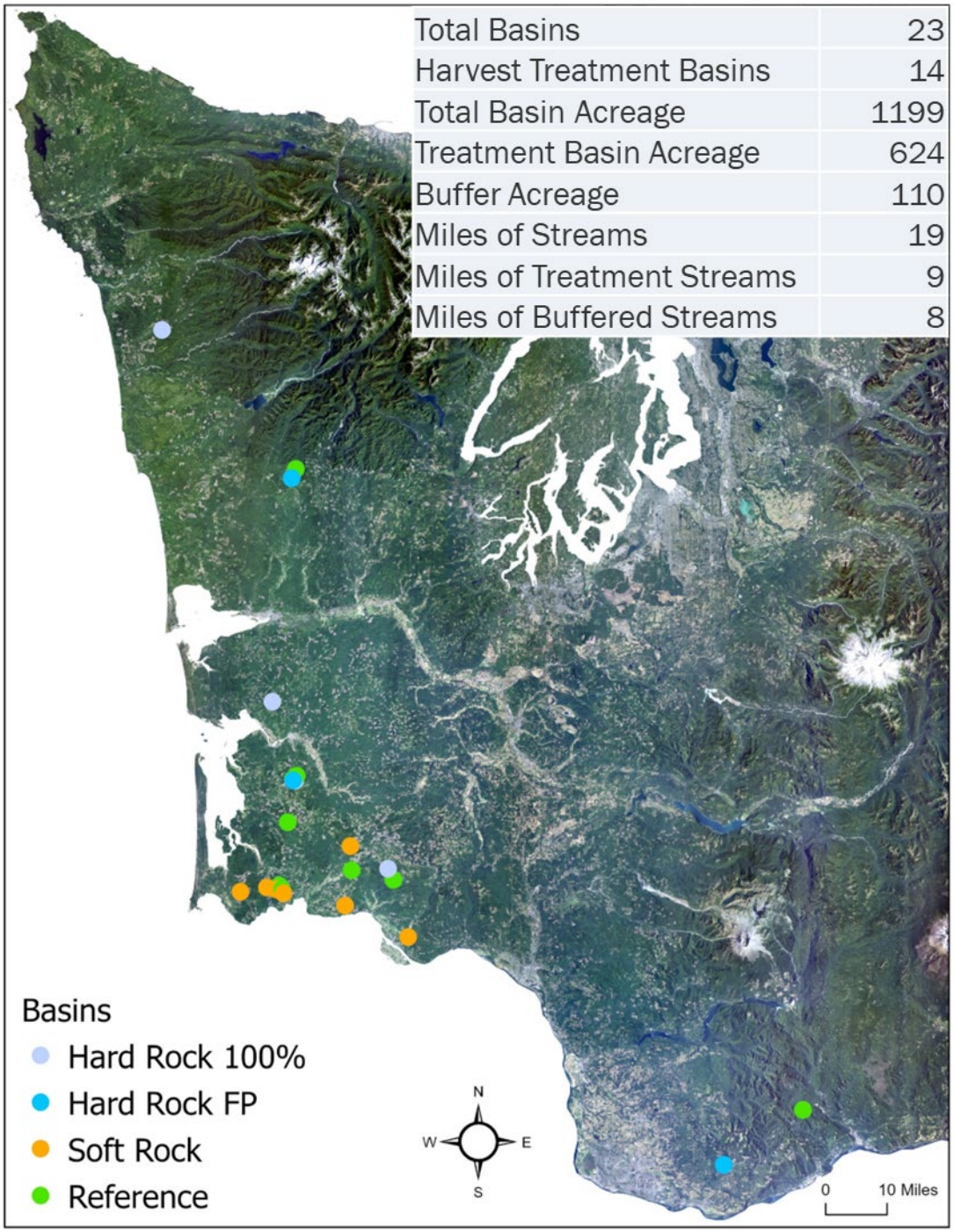

Figure 4. Sites for Hard and Soft Rock studies.

Three reports were published from these studies: Hard Rock Phase I (McIntyre et al. 2018); Hard Rock Phase II (McIntyre et al. 2021); and Soft Rock (Ehinger et al. 2021). Phase I of the Hard Rock report covered the first two years post-harvest in accordance with the original study design. Due to a significant stream temperature response in the first two years post-harvest, the Forest Practices Board decided to continue post-harvest monitoring (McIntyre et al. 2021).

The authors of Phase II note that by continuing to monitor through post-harvest year nine, they would be able to evaluate the trajectories of variables, like stream temperature, that changed after harvest. They would also be able to detect potential lag effects for stream associated amphibians, which didn't initially show a response to the harvest. The Soft Rock report covers the first two years post-harvest with an additional Chapter 4 addendum that reports on stream temperature and canopy cover through post-harvest year six. Unlike Hard Rock, there was no amphibian component to Soft Rock, so that delayed response was not necessary to estimate.

All three reports were approved by CMER and sent to an Independent Scientific Peer Review (ISPR) panel, administered through the University of Washington. Edits and suggestions from ISPR were incorporated (or a justification for leaving the text unchanged was provided) by the authors, approved by CMER consensus, and published by the AMP in 2018 (Hard Rock Phase I) and 2021 (Hard Rock Phase II and Soft Rock). The final Findings Report, including the final reports and answers to the CMER/Policy Interaction Framework Six Questions document, for Hard Rock (Phase I and II) and Soft Rock was sent to TFW Policy for consideration.

Timber, fish and wildlife policy committee response to study findings

Identified below are actions and activities by the TFW Policy Committee following receipt of the Hard Rock Phase I findings report. [13] Upon receipt of completed CMER projects, the TFW Policy Committee has up to 180 days to develop a decision and make a recommendation to the Forest Practices Board. Policy recommendations can include a formal petition for rulemaking, a non-rulemaking alternative action, or a recommendation to take no action.[14]

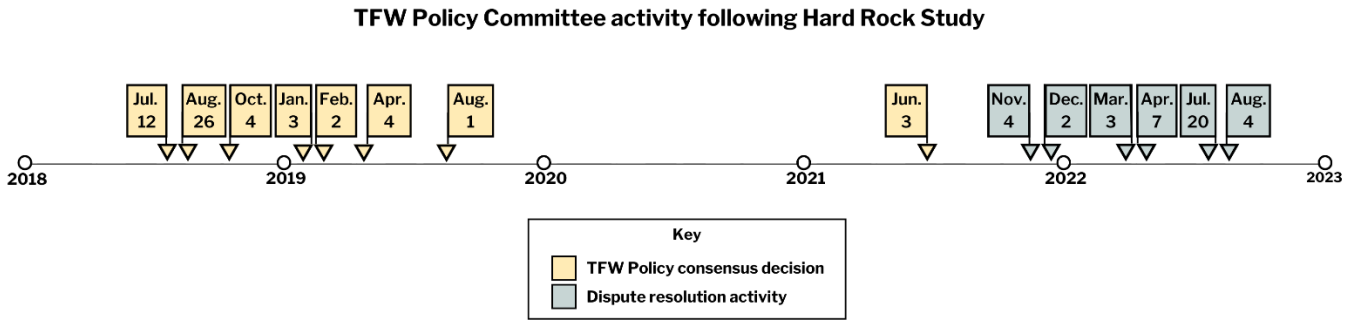

Figure 5. TFW Policy Committee activity following Hard Rock Phase I Study.

- July 12th, 2018. TFW Policy by consensus accepted the Hard Rock Phase I findings report.
- August 26th, 2018. TFW Policy by consensus agreed that the Hard Rock Phase I findings report merited action, and that action alternatives would begin to be developed.
- October 4th, 2018. TFW Policy by consensus approved the Type N Alternative Workgroup Charter.

[13] TFW Policy Committee activity is documented in meeting minutes and posted on DNR's website at https://www.dnr.wa.gov/about/boards-and-commissions/forest-practices-board/tfw-policy-committee/tfw-policy-committee-past

[14] Forest Practices Board Manual Section 22, part 3.4

- January 3rd, 2019. TFW Policy by consensus accepted the Type Np Alternative Workgroup Charter.
- February 2nd, 2019. TFW Policy by consensus accepted the proposed plan to determine membership of the Type Np Alternatives Workgroup.
- April 4th, 2019. TFW Policy by consensus approved inclusion of $200,000 for the Type Np Alternatives Workgroup for the 2019-2020 fiscal year.
- August 1st, 2019. TFW Policy by consensus approved a ranking system for participation in the Technical Type Np Prescriptions Workgroup.
- June 3rd, 2021. TFW Policy by consensus accepted the Type Np Technical Workgroup's final report and agreed to define a vetting process and timeline to include consideration of the Hard Rock Phase II and Soft Rock studies.
- November 4th, 2021. The Conservation Caucus representative invoked the dispute resolution process on Hard Rock Phase I. This dispute became known as the Hard Rock Type N Action Development Timeline Dispute.
- December 2nd, 2021. The Conservation Caucus representative presented a description of the dispute, declaring that more than 150 days had passed since TFW Policy had received the Type Np Technical Workgroup's final report, and that the Forest Practices Board Manual guidelines allow for 150 days for TFW Policy to decide on an action alternative for recommendation to the Board following receipt of a report. A lack of meaningful progress towards a consensus decision was emphasized. The Conservation Caucus also shared a vision for successful resolution: A consensus alternative recommendation for a formal rulemaking petition to the Forest Practices Board for western Washington Type Np streams.
- March 3rd, 2022. The Conservation Caucus representative invoked stage 2 of the dispute resolution process for the Hard Rock Type N Action Development Timeline Dispute.
- April 7th, 2022. The three-month timeline for Stage 2 of the Hard Rock Type N Action Development Timeline Dispute was started.
- July 20th, 2022. Stage 2 of the Hard Rock Type N Action Development Timeline Dispute ended without consensus.
- August 4th, 2022. The DNR representative announced that following the end of Stage 2, majority/minority reports now need to be completed, and these reports will be presented to the Forest Practices Board at their November 2022 quarterly meeting.
    - Majority TFW Policy caucuses were identified as the Westside Tribes, Eastside Tribes, Conservation, and State Departments of Fish and Wildlife and Ecology.
    - Minority TFW Policy caucuses were identified as Large Industrial Forest Landowners, Small Forest Landowners, and Washington State Association of Counties.

Forest Practices Board actions and resolution of TFW policy dispute

Identified below are actions and activities taken by the Forest Practices Board regarding Type Np rulemaking and resolution of the Type Np TFW Policy Committee dispute. Adaptive Management Program disputes that are not resolved at the conclusion of the TFW Policy dispute resolution process are presented to the Forest Practices Board as majority/minority reports. The Board makes the final determination in resolving all disputes.

- November 10th, 2021. Forest Practices Board directs staff to file a CR-101 Pre-Proposal Statement of Inquiry with the Washington State Code Reviser's Office. The CR-101 is filed on November 30th, 2021, notifying the public that possible rulemaking may occur for Type Np riparian management zone buffers in Chapter 222-30 WAC.
- November 9th, 2022. The Forest Practices Board resolved the Hard Rock Type N Action Development Timeline Dispute by voting to approve the majority TFW Policy recommendations[15] and to advance the proposal forward for rulemaking consideration.[16] The majority recommendation included a new western Washington Type Np waters buffer rule derived from the recommendations included in the Type Np Technical Workgroup's Final Report.
- August 9th, 2023. The Forest Practices Board rescinded their November 9th, 2022, vote due to alleged Open Public Meetings Act process concerns. The Board then held a new vote on the majority/minority TFW Policy Type Np recommendations, again approving the majority TFW Policy recommendation for advancement in the rulemaking process.[17] This decision provided a final determination on the Hard Rock Type N Action Development Timeline Dispute.

[15] Type Np Action Development Dispute, Majority Recommendations. https://www.dnr.wa.gov/publications/bc_fpb_meeting_packet_20221109.pdf
[16] November 9th, 2022, Forest Practices Board Meeting Minutes. https://www.dnr.wa.gov/publications/bc_fpb_mtgminutes_20221109_10.pdf
[17] August 9th, 2023, Forest Practices Board Meeting Minutes. https://www.dnr.wa.gov/publications/bc_fpb_mtg_minutes_20230809.pdf

Forest Practices Board's Proposed Rule

The Forest Practices Board's CR-101 Pre-Proposal Statement of Inquiry states that, "The Board's adaptive management program is in the process of completing a series of six studies on the adequacy of current riparian buffers on Type Np streams. The adaptive management program is developing alternative recommendations, based upon the results of all of the Type Np studies, to present to the Board. These recommendations may result in changes to the riparian management zone buffers associated with Np stream segments to ensure the buffers protect water quality and other aquatic resources from potential temperature increases."[18]

The Board's approved TFW Policy Majority caucus recommendations contain new prescriptions for Type Np waters in western Washington covered by the Forest Practices Habitat Conservation Plan in a proposed new rule section, WAC 222-30-0211 *Western Washington Type Np water riparian management zones and Type Ns water riparian protections. These draft rule prescriptions include riparian management zone buffer protections that vary by basin size, bankfull width, and harvest strategy selected by the proponent. Proposed rule language[19] and illustrations[20] can be found below and would be under WAC 222-30-0211(3):

a) When the topographic basin in which harvest will occur is larger than 30 acres and 85% 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.

[18] https://www.dnr.wa.gov/publications/bc_fpb_typnp_cr101_20211110.pdf
[19] https://www.dnr.wa.gov/publications/bc_fpb_typenp_proposal_20240509.pdf
[20] Majority Proposal Illustrations, pages 44-45.
https://www.dnr.wa.gov/publications/bc_fpb_mtg_packet_20221031.pdf

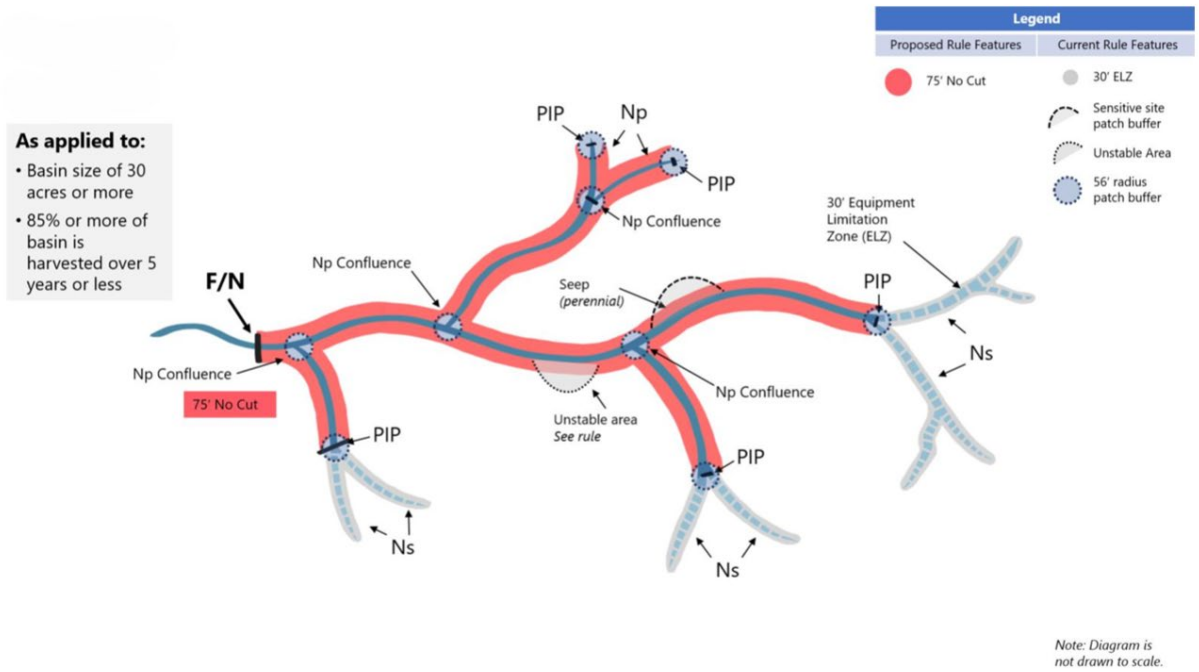

Figure 6. Option 2 from Majority TFW Policy Recommendations.

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 seventy-five-foot RMZ along the stream reach in the harvest unit, and establish:

(I) A no-harvest buffer fifty feet wide measured from outer edge of bankfull width, and;

(II) A managed zone, twenty-five feet wide measured from outer edge of the no harvest buffer, 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 outer zone.

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

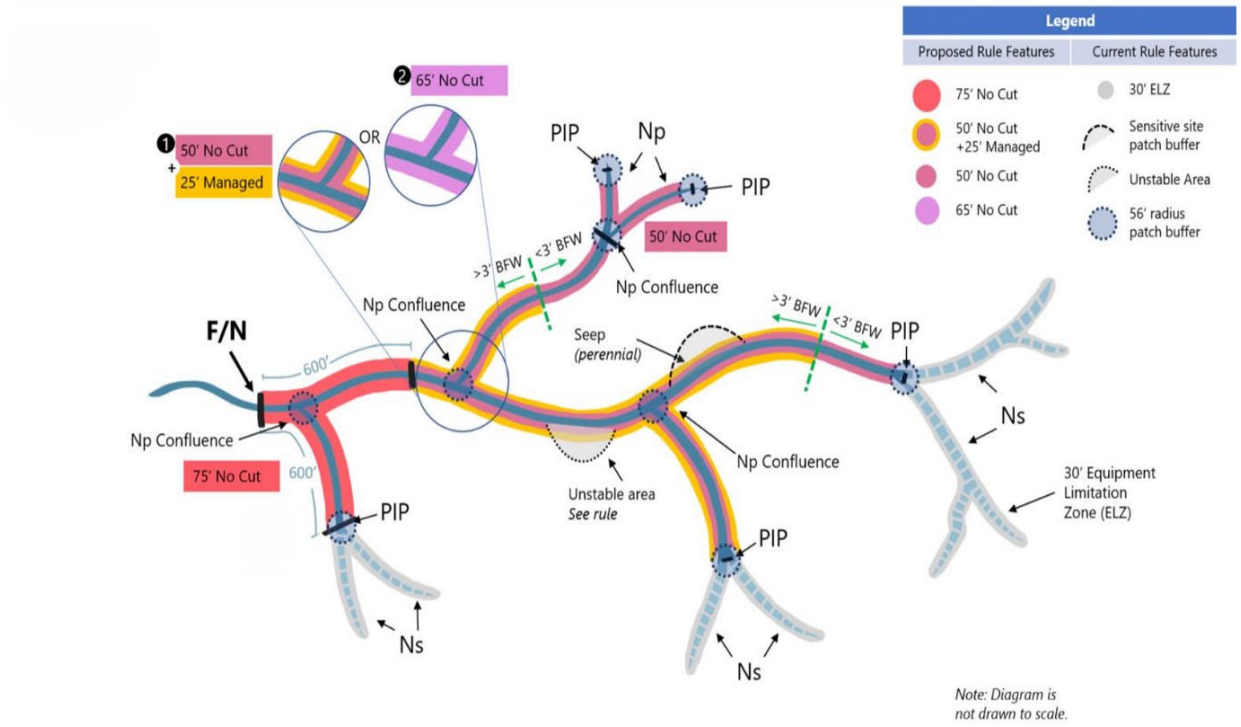

Figure 7. Option 1 from Majority TFW Policy Recommendations.

Tier II Antidegradation Analysis For Proposed Western Washington Type Np Waters Buffer Rule

This document presents Ecology's Tier II Antidegradation Analysis findings for the Forest Practices Board's proposed western Washington Type Np waters buffer rule. We evaluated:

1) Whether the proposed rule will cause exceedances of applicable water quality criteria,
2) Whether the proposed rule will cause a measurable change in waters that are currently of higher quality than the applicable criteria, and
3) If the proposed rule will cause a measurable change, whether there is a necessary and overriding public interest for the proposed rule.

New or expanded action discussion

As stated in WAC 173-201A-320(2), a Tier II review occurs for new or expanded actions associated with:

- National Pollutant Discharge Elimination System (NPDES) waste discharge permits
- State waste discharge permits to surface waters
- Federal Clean Water Act Section 401 water quality certifications
- Other water pollution control programs authorized, implemented, or administered by Ecology

The Washington State Forest Practices Rules fall under the "Other water pollution control programs" category and are therefore subject to Tier II review when a new or expanded pollution source control program is developed. The Tier II rule specifies:

> "WAC 173-201A-320(6) General permit and water pollution control programs are developed for a category of dischargers that have similar processes and pollutants. New or reissued general permits or other water pollution control programs authorized, implemented, or administered by the department will undergo an analysis under Tier II at the time the department develops and approves the general permit or program."

In the context of nonpoint pollution and forest practices, the Forest Practices Board's proposed western Washington Type Np buffer rule is equivalent to a "reissued" general permit for the following reasons: 1) The proposed rule functions to protect Type Np water quality across all FPHCP lands in western Washington, and 2) the proposed rule revises the existing Forests and Fish Type Np rule.

The Forest Practices Rules (WAC 222) fall under the "other water pollution control programs" category in the state antidegradation policy (WAC 173-201A-320(2)(d)).

Ecology's Supplemental Guidance on Implementing Tier II Antidegradation addresses Washington's Forest Practices Rules, stating:

> "The forest practices system in Washington is specifically designed to meet the requirements of the Clean Water Act and the state water quality standards. Forest practices must be conducted so as to meet the state's narrative and numeric water quality standards and the Tier II antidegradation requirements. These requirements are monitored through the comprehensive Forest and Fish Adaptive Management Program, which includes compliance, validation, and effectiveness monitoring.
>
> This adaptive management program uses the findings of scientific investigations to periodically update forestry requirements. These updates are designed to ensure that compliance with the forest practice rules also results in compliance with the state surface water quality standards, including the Tier II antidegradation requirements. This expectation should remain true so long as: 1) the adaptive management program continues to be adequately funded, functional, and scientifically robust; and, 2) an antidegradation evaluation is conducted as part of any rule making affecting water quality related requirements in the forest practices system."[21]

Tier I protections

Type Np streams are generally considered waters of higher quality; however, they remain subject to Tier II protections in streams with lower temperature regimes than the numeric standards protected under Tier I. The ability of the proposed buffer rule to help prevent streams from warming will be vital in streams that maintain narrow margins before numeric temperature thresholds are exceeded. For example, if a Type Np stream naturally flows near 15.8°C in a stream with an assigned numeric criterion of 16°C, the application of the proposed buffer rule under site-level conditions will play an important role in helping to prevent the stream from warming beyond 16°C. Based on our analysis, we find that on average across the landscape the proposed rule is not likely to cause exceedances of applicable water quality numeric criteria, although we acknowledge that the effectiveness of each buffer scenario will vary due to regional differences and site-specific factors contributing to water temperature. Additional Adaptive Management Program effectiveness monitoring studies are likely to provide increased certainty on the ability of the proposed buffer rule to prevent waters from warming beyond applicable numeric criterion.

[21] Ecology publication no. 11-10-073, pages 5-6

Measurable change analysis

The Hard and Soft Rock studies reported on both temperature and turbidity response following timber harvest treatments. The focus of the follow up action by the TFW Policy Committee and the Forest Practices Board is in response to the temperature response observed following the study treatments. For this reason, the focus of this Tier II antidegradation analysis is limited to temperature.

We found that there are likely to be minor temperature increases in some Type Np streams after adjacent timber harvest under the proposed rule's buffer prescriptions. On average, the majority of streams should be protected from a 0.3°C increase in temperature after adjacent timber harvest. However, there are some specific situations, identified below, that will likely lead to an increase in temperature even under the proposed buffer prescriptions.

In general, streams with less topographic and riparian shade (i.e. north-south oriented, gently sloped valley walls, 50ft buffers) and a higher proportion of surface water (i.e. competent lithologies) are more likely to warm under the proposed rule. Conversely, streams with more topographic and riparian shade (i.e. east-west oriented, steep valley walls, 65-75ft buffers) and have more groundwater influence (i.e. incompetent lithologies) are less likely to warm.

This measurable change determination was achieved through an analysis that included:

- An aggregation of Hard and Soft Rock temperature and shade data
- An analysis of site-specific conditions that may make streams more susceptible to warming
- An estimation of how those conditions are distributed across the landscape

Aggregated Hard Rock and Soft Rock findings

Stream temperature increased in both the Hard and Soft Rock studies after harvest across all treatment types (100% continuous buffers and partial cut FP buffers)[22]. This temperature response was highly variable among and within the treatment sites. On average, temperatures remained elevated (0.3°C – 1.2°C), relative to reference conditions, for 7 years in the Hard Rock FP treatment, 4 years in the Soft Rock FP treatment, and 2 years in the Hard rock 100% treatment (Figure 8). Even though the authors of the Hard Rock report note that none of the buffer treatments prevented significant increases in stream temperature, they do report that the 100% treatment was more effective than the FP treatment in preventing long-term temperature increases. The authors also report that the primary driver of this increase was due to the loss of riparian cover.

[22] Hard Rock also included a 0% buffer treatment that was not included in this analysis. For all other studies discussed in this section that included a full clearcut of the riparian area, that treatment was left out as well.

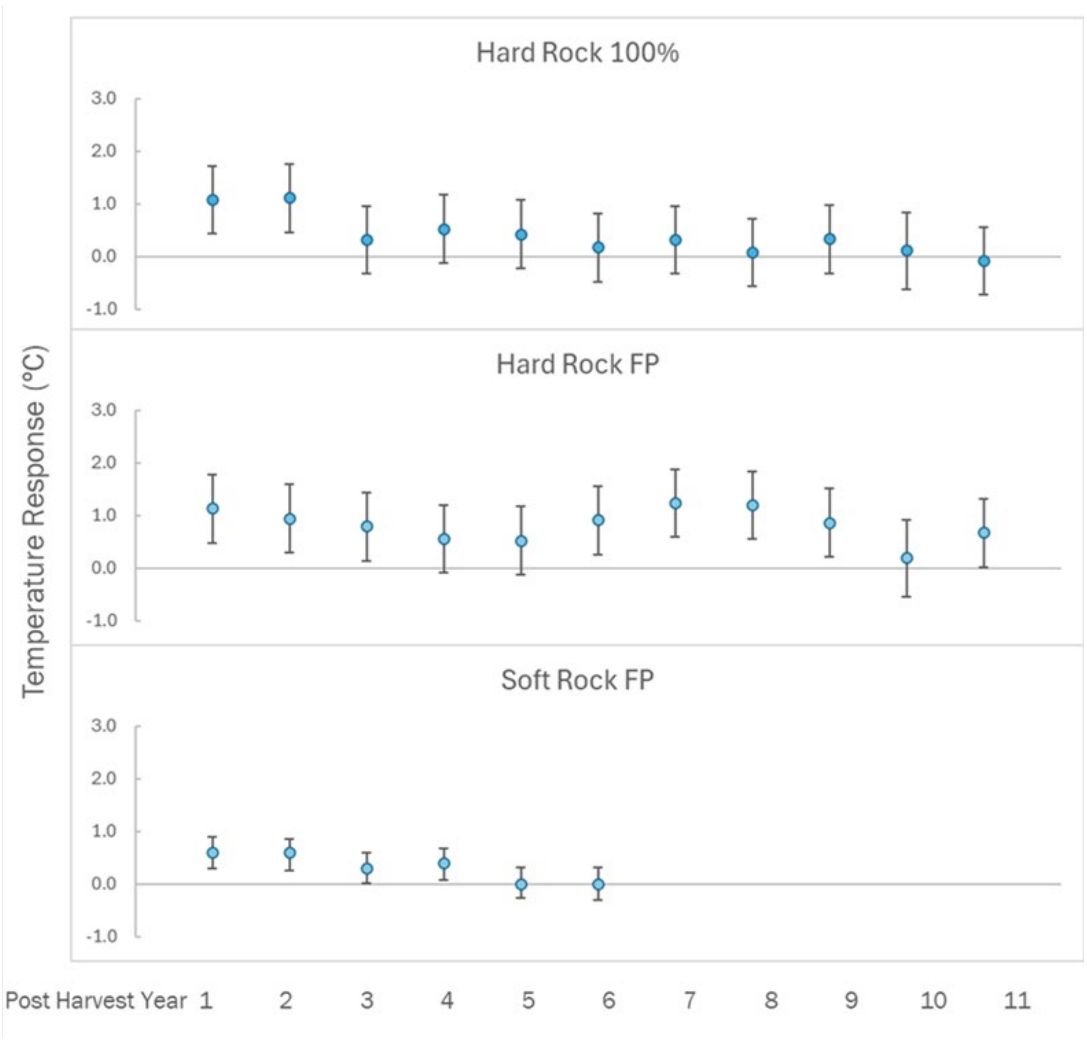

Figure 8. Average temperature response of the Hard and Soft Rock treatments, relative to the reference conditions. Confidence intervals that do not cross the zero line (reference conditions) are considered statistically significant. 7DTR is the seven-day average temperature response.

The Soft Rock FP treatment also saw temperature increases from shade loss. The initial temperature increases (0.6°C) seen in Soft Rock was less than both Hard Rock treatments. However, the Soft Rock FP treatment recovered quicker than the Hard Rock FP treatment. The authors note that this was likely due to the additional unstable slope buffers (4 sites >90% buffered) and groundwater influence in the more permeable soft rock (marine sediment) lithology. Looking at the combined 14 treatment sites (9 miles of stream) of these studies, it's clear that buffer area and the shade that it provides influences stream temperature. Other studies have found similar results and relationships to buffer area (Table 1), but only Groom et al. (2011) tested a similar amount of treatment sites and stream miles (33 sites, 6.2 miles of stream).

Table 1. Studies that tested buffer effectiveness on stream temperature. Only studies that tested a clear-cut harvest with an unharvested buffer were included. The Partial Cut buffer types are variable length buffers (not all studies reported the actual lengths of the buffer).

Study	Number of Treatments	Buffer Type	Average Buffer Width (ft)	Max Temperature Response (°C)	Duration of Response (years)
Gomi 2006	2	Continuous	98	0.0	0
Groom 2011	15	Continuous	98	0.0	0
Wilkerson 2005	3	Continuous	75	0.0	0
Groom 2011	18	Continuous	59	0.7	2
Hard Rock	4	Continuous	50	1.1	2
Bladon 2018	4	Continuous	45	1.2	4
Janisch 2012	6	Continuous	41	1.1	2
Wilkerson 2005	3	Continuous	36	0.0	0
Gomi 2006	1	Continuous	32	0.0	0
Soft Rock	7	Partial Cut	54	0.6	4
Hard Rock	3	Partial Cut	50	1.2	7
Bladon 2018	2	Partial Cut	26	3.3	4

The authors of the Hard Rock report state that, “The loss of riparian cover was the dominant factor in the increased summer stream temperatures observed in the first four years after harvest.” A similar response was seen in the Soft Rock study. Figure 9 shows the loss of riparian cover in both studies, with similar responses and trajectories based on treatment type. In this graph, Soft Rock was averaged by sites that were <60% buffered and sites that were >90% buffered to compare with the FP and 100% buffered Hard Rock treatments. The authors in both studies note that the continued decline in riparian cover after the first-year post-harvest was due to tree mortality from windthrow. This additional loss of shade likely contributed to the extended temperature response, especially in the Hard Rock FP treatment (as noted in the Hard Rock report).

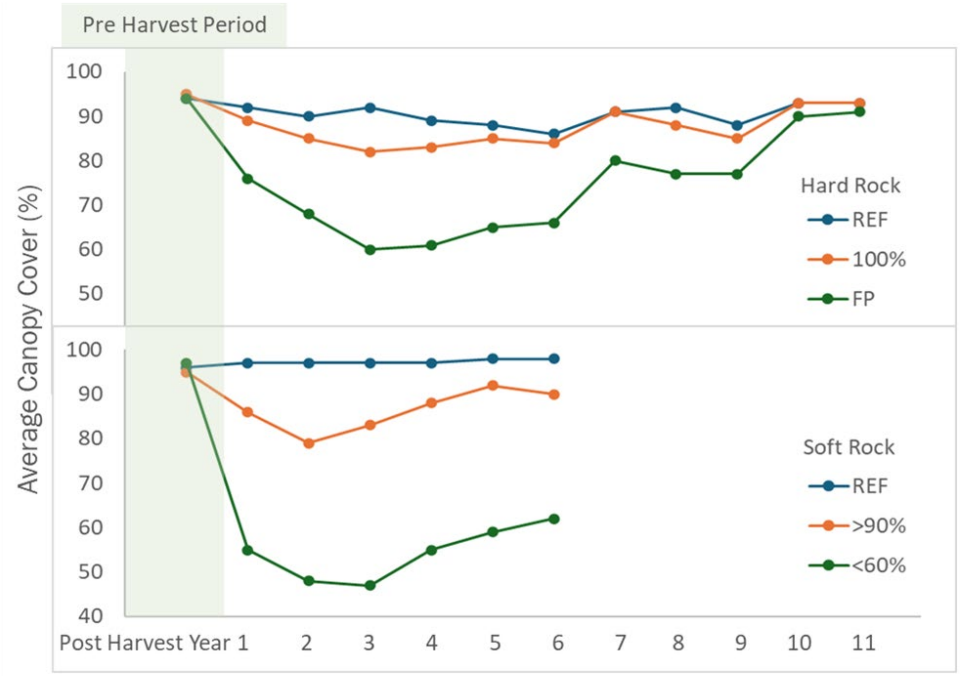

Figure 9. The average percent canopy cover broken out by treatment type. The average of the 100% continuous and 50% (FP) buffer treatments compared to the average of the reference sites. Soft Rock sites were averaged by sites with buffers greater than 90% and less than 60% compared to the average of the reference sites. Data pulled from Table 4A-1 (Hard and Soft Rock) of the reports.

In addition to reporting on the overall treatment response of stream temperature, the authors of both Hard and Soft Rock studies also provided additional measurements taken within the individual treatment sites. These were reported as the Mean Monthly Temperature Response (MMTR), which also used the 7-day average daily maximum (7DADM) at the temperature stations. Every one of the 75 temperature stations recorded at least 1 increase in the MMTR, relative to reference conditions, over the course of the studies. There were 3,713 instances of temperatures increasing greater than 0.5°C at the treatment sites (Figure 10). This represents temperature increases for over half of the post-harvest temperature readings. This same level of temperature increase was not seen at the reference sites (Figure 10). However, the temperature increases seen in the treatment sites were not distributed evenly across the seasons or the locations within or between the sites.

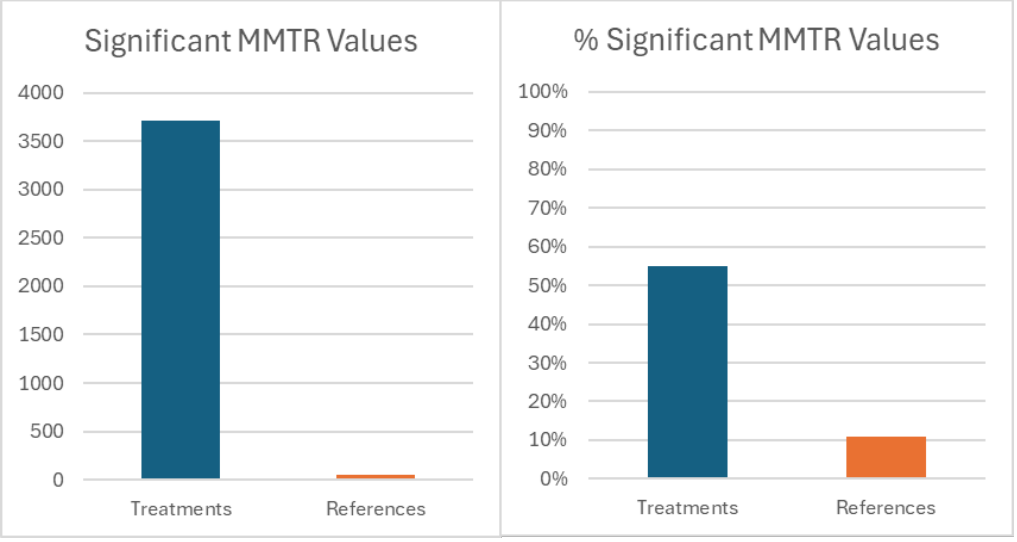

Figure 10. Left: The number of times that the mean monthly temperature increased at the treatment temperature stations (>0.5°C, relative to reference conditions) as reported in the MMTR tables of Hard Rock Phase II and Soft Rock (Appendix Table 4A-5 and 4A-2, respectively), compared to the increase as seen at the Hard Rock reference stations. Right: The percentage of times there was an increase in mean monthly temperature compared to the reference stations.

While most of the average monthly temperature increases were in the spring, approximately 600 of the seasonal MMTR values (35%) were in the summer months when temperatures are already elevated (Figure 11). The temperature increases in the spring are an interesting response but do not have the same potential to impact in-stream biota as the increases in summer temperatures.

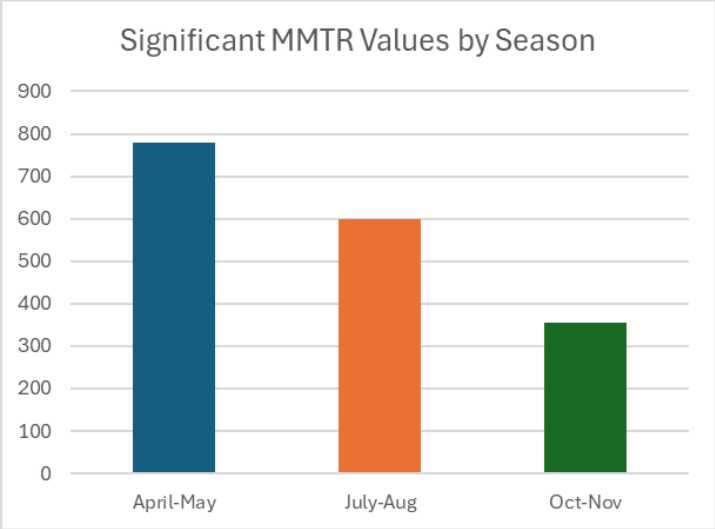

Figure 11. The number of times a mean monthly temperature increase of >0.5°C was reported from a Hard or Soft Rock treatment temperature station, by season. Spring, summer, and fall bins are consistent with how seasons were reported in Hard Rock and Soft Rock.

The MMTR values were used to investigate site specific factors, in addition to shade, that may have influenced the temperature response at the Hard and Soft Rock sites. The Hard Rock authors reported a tendency for higher July MMTR in the south-facing sites, however this was not the case for Soft Rock (only one south-facing site). The authors did note that the lower amounts of flowing water in the Soft Rock streams may have been one reason why there was less of a temperature response compared to the Hard Rock treatments. The reduced flow at the Soft Rock sites may have been a biproduct of the underlying marine sediment lithology which is more permeable than the volcanic substrate of Hard Rock. This more permeable substrate can allow for more groundwater influence which could reduce the influence of air temperature on the surface water of the stream[23]. Blanden et al. (2018) also reported smaller temperature responses in sites with more permeable lithology. In addition to the lower flows, Soft Rock also reported steep incised valley walls with an average slope of 60% compared to a 45% average across the Hard Rock sites. The authors note that, in addition to the shading provided by the unstable slope buffers, these steep valley walls also provide topographic shading.

Below, Figures 12 and 13 display the average monthly temperature response measured at the temperature stations in the 14 treatment sites included in this analysis. These are grouped by sites that more closely align with the current forest practice rule (~50% buffered) and by sites that are fully buffered or almost fully buffered (>90%). Even though Soft Rock only tested the current forest practices buffers, the additional unstable slope buffers that were left at some of the sites increased the buffer area (63-163%) to the point that some streams (TRT4 – 7) were almost continuously buffered.

While individual sites cannot be used to find specific causal mechanisms that may influence the magnitude and longevity of a temperature response, they can be useful in assessing areas that may be more susceptible to temperature increases after harvest.

Site Specific Conditions

- Figure 14, SR TRT2 and HR Casc-FP sites show no summer temperature response at the outlet of the watershed (T1 sensor).

  Between the T1 sensor and the next sensor upstream (T2) at both sites was a persistent dry section of stream that likely reduced the warming trends seen upstream of this dry section. These discontinuous portions of Type Np streams are common and can cause irregular patterns of warming and cooling throughout Np stream networks by changing ratio of groundwater to surface water.

- Of the sites that saw the most canopy reduction in Figure 14, the sites that saw the highest and most persistent temperature response (TRT1, OLYM-FP, WIL1-FP) also experienced the greatest amount of windthrow (e.g. Figure 12).

[23] Process known as hyporheic exchange and that area of influence is called the hyporheic zone.

Figure 12. An example of windthrow in the riparian buffer at the Soft Rock TRT1 site.

There was already shade loss at these sites due to the 50% harvest of the stream length; however, as mentioned above, the additional shade loss due to windthrow could have exacerbated, and likely prolonged, the temperature response. Hard Rock reported that the continued shade loss in the riparian areas throughout the post-harvest period was due to tree mortality associated with windthrow. This was also the case for Soft Rock; however, the windthrow was less widespread and instead concentrated in a few highly susceptible areas. One example is TRT1 which, despite having a north-facing aspect, lost a lot of the buffer due to windthrow, likely because of the winds coming up from the Columbia River valley (Figure 13). The Perennial initiation Point (PiP, also known as the uppermost point of perennial flow) buffers near the top of the watershed were the most susceptible (71% mortality, due to wind).

Figure 13. PiP buffer at Soft Rock TRT1 with Columbia River valley in the background.

- Most concerning are the high and persistent average temperature responses throughout the continuously buffered watersheds of WIL3-100% and OLYM-100% shown in Figure 14.

WIL3-100% has a south-facing aspect that saw a 0.5-2.5°C temperature increase that persisted through post-harvest year 11 at some locations. This result was consistent with the overall findings of Hard Rock. The sensor at the PiP and the next sensor downstream were still elevated 1.3 and 1.1°C in post-harvest year 10, respectively.

The other main difference at this site was the gentle topography. The average valley slope of this site was only 20% compared to 49-83% at the other sites in Figure 15. This resulted in a lack of topographic shading compared to other steeper sites.

OLYM-100% on the other hand is a north-facing basin with greater topographic shading (average valley slope of 60%) and additional wider buffers. However, the majority of the wider buffers were on the north side of the basin, with narrower buffers to the south, which also coincided with some gently sloped valley walls. It's also possible that because the southern tributaries flow south to north, they are not providing as much topographic shade in the summer months when the sun is at its highest point in the sky.

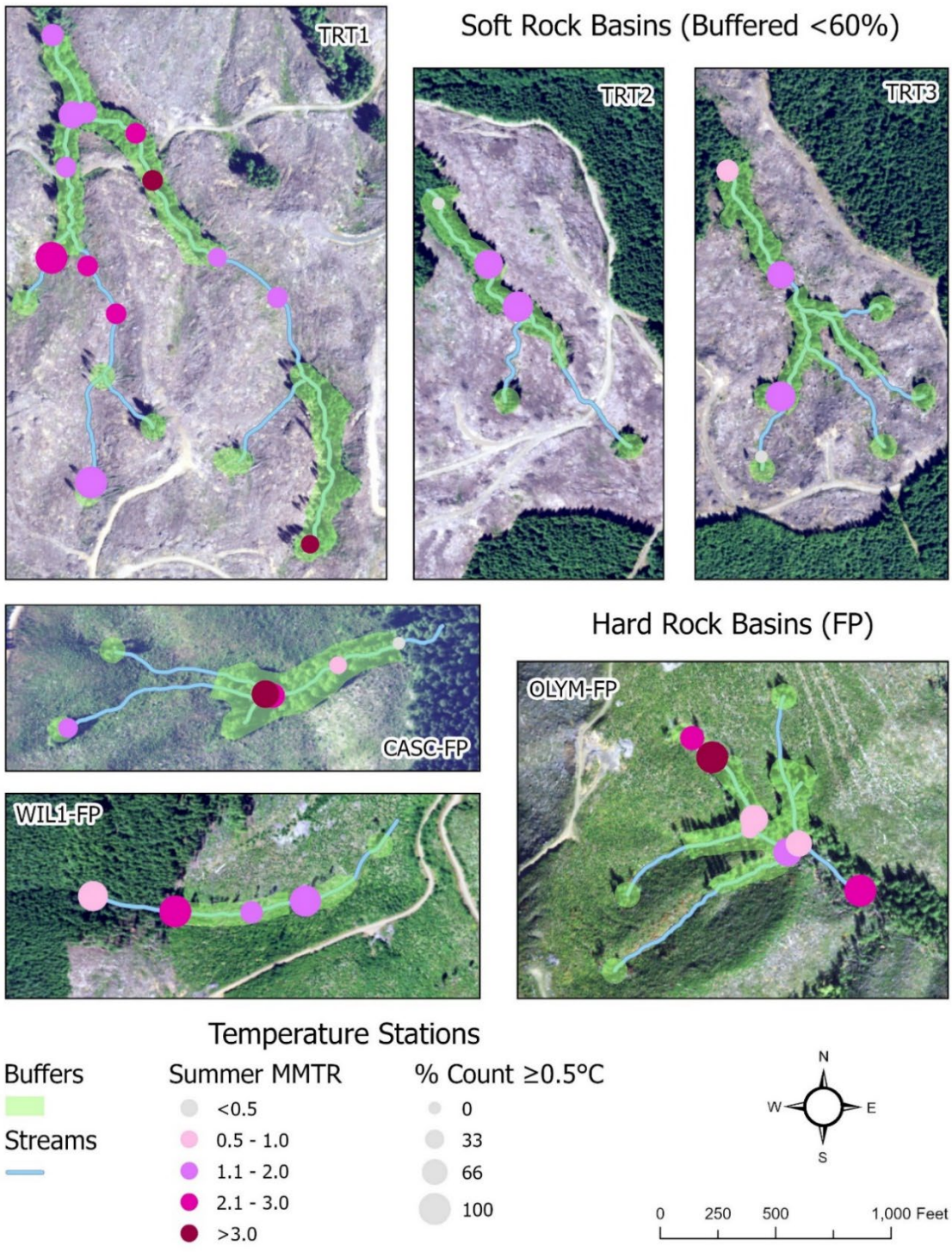

Figure 14. Maps of the summer maximum Mean Monthly Temperature Response (MMTR) at the Forest Practice (FP) buffered Hard Rock sites and the Soft Rock sites with 50 – 60% stream length buffered. The size difference in the points (% Count) represents how many years that station recorded a temperature response greater than 0.5°C (The larger the point, the more years that station had an elevated stream temperature).

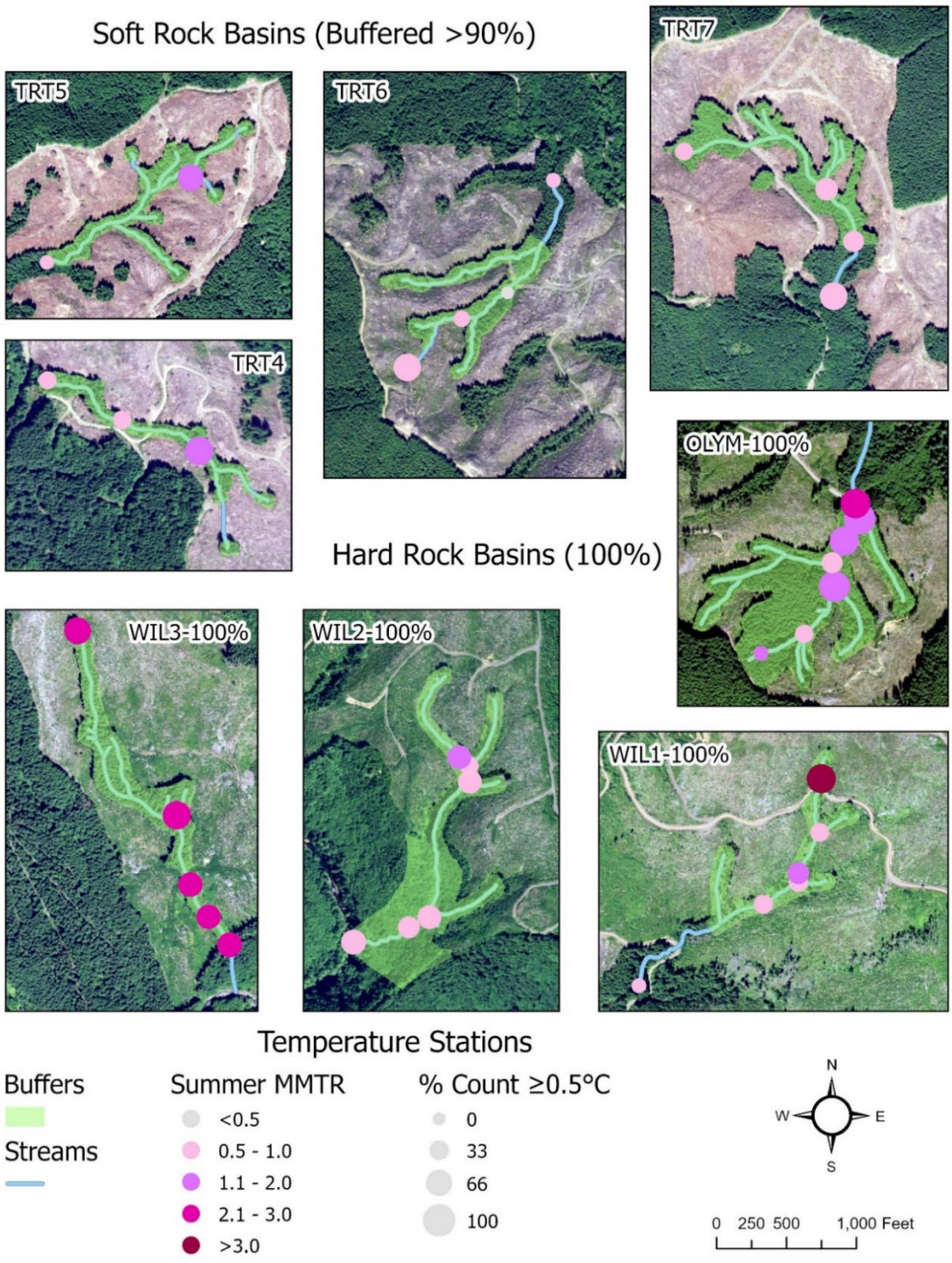

Figure 15. Maps of the summer maximum Mean Monthly Temperature Response (MMTR) at the 100% buffered Hard Rock sites and the Soft Rock sites with 90 – 100% stream length buffered. The size difference in the points (% Count) represents how many years that station recorded a temperature response greater than 0.5°C (The larger the point, the more years that station had an elevated stream temperature).

These site-specific differences, which may have influenced how certain treatment sites responded to harvest and buffer configurations, illustrate the complexity of thermal sensitivity in small headwater catchments.

As noted above, there is considerable variability in how temperature in Type Np streams may respond to upland harvest under different buffer configurations. However, because the Hard Rock study included a 100% buffer treatment and one of the Soft Rock sites was fully buffered, we can use these sites as test cases for what the proposed rule may look like and how these specific sites may, or may not, respond differently. Figure 16 shows the 100% buffered sites with an additional 25ft added to represent a full length 75ft buffered which would have been applied under the proposed rule (had it been in effect during the time of harvest). Table 2 indicates that the increase in area that the additional buffer width would provide is relatively small (1.1 – 1.6 acres). While this may reduce the risk of windthrow closer to the stream, it seems unlikely that this would have drastically reduced the temperature response at the sites that saw the greatest temperature response (e.g. WIL3-100%, OLYM-100%).

Table 2. Buffer Acreage left after harvest at the 4 Hard Rock 100% treatment sites and the 1 fully buffered Soft Rock site (TRT7), the total acreage of a 75ft buffer at each of the sites, and the percent increase from the current rule to the proposed rule's 75ft option. The "65ft Increase" is the increase in buffer area had a 65ft buffer been applied.

Basin	Buffer Acreage	75ft Buffer Acreage	Percent Increase	65ft Increase
OLYM-100%	21.2	22.5	5.9%	4%
WIL1-100%	8.0	9.2	14.3%	8%
WIL2-100%	18.6	20.2	8.7%	5%
WIL3-100%	10.9	12.4	13.4%	6%
TRT7	10.3	11.7	12.9%	13%

The sites in Figure 16 can also be used as case studies for the 65ft buffers proposed under the new rule. This buffer prescription would have added less than an acre in all but one site (TRT7 – 1.4 acres). Had only the upper half of these watersheds been harvested, then a 65ft buffer would have been applied under the proposed rule due to these streams all being, on average, greater than 3ft in bankfull width (BFW). The other option would be to harvest in the outer 25ft of a 75ft buffer. However, both of these options would provide less shade than the full 75ft no-cut buffer described above. This would likely have less of a chance of preventing the temperature increase seen at the sensors in the upper half of the watersheds.

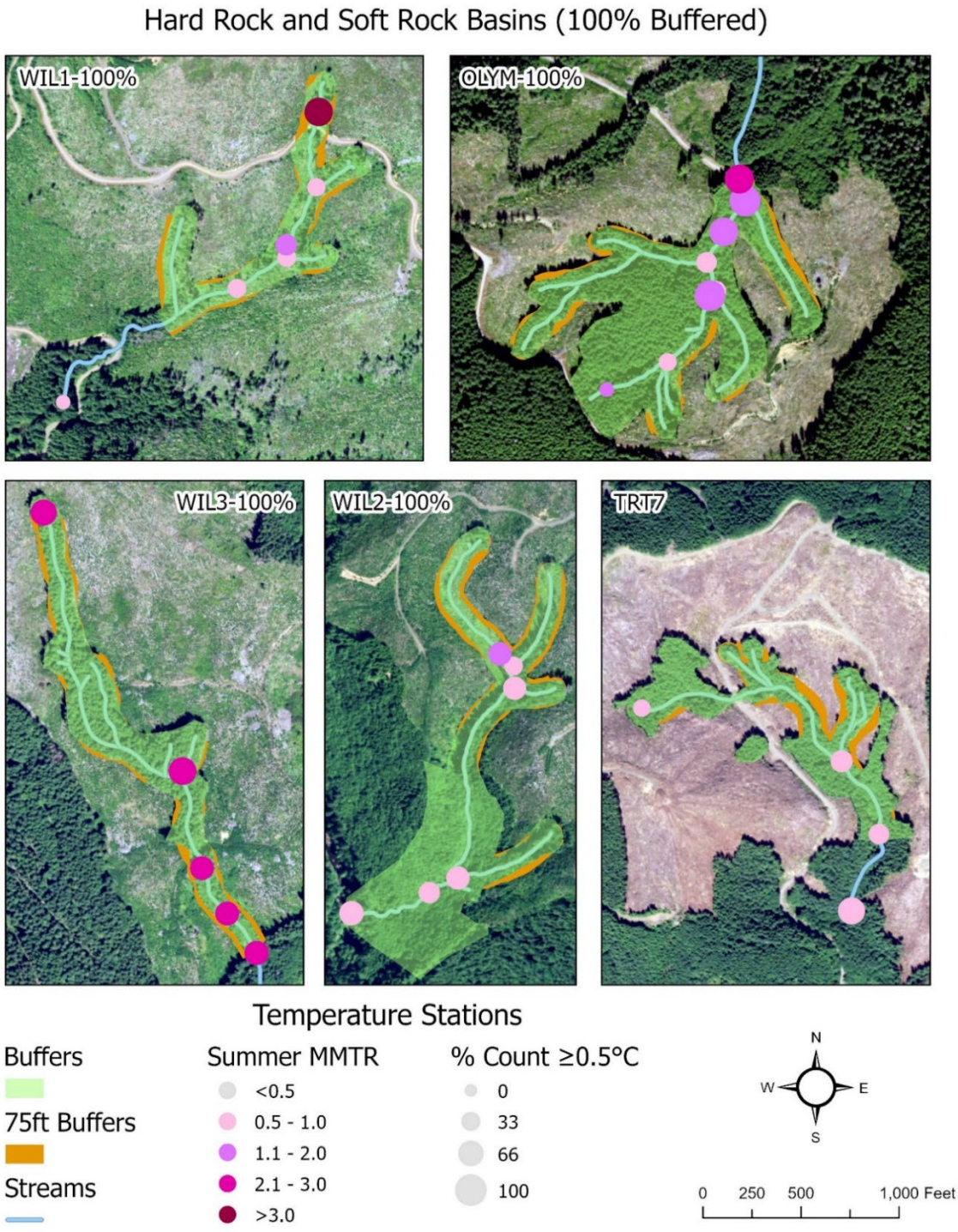

Figure 16. Maps of the summer maximum MMTR at the 100% buffered treatment sites (including Soft Rock TRT7). The size difference in the points (% Count) represents how many years that station recorded a temperature response greater than 0.5°C (The larger the point, the more years that station had an elevated stream temperature). The additional orange (75ft) buffers show how much the proposed rule would have increased the buffers at these sites.

Unfortunately, none of the fully buffered treatment sites from Hard and Soft Rock had average BFWs under 3ft in the upper areas of the watersheds, where a 50ft buffer would have likely been applied under the proposed rule. Some of the 100% treatments in Figure 16 may have tributaries that could have met the requirements for the 50ft prescription, but BFWs were not measured in the Hard Rock tributaries. Only 1 of the 14 treatment sites had an average BFW of less than 3ft (Soft Rock TRT5); this site was buffered along 95% of the stream length with some sections narrower than 50ft (3 acres less than a continuous 50ft buffer). Also, many of the Soft Rock tributaries, or at least portions of them, were less than 3ft in BFW, but not fully buffered, so none would be good case studies for the proposed rule. Since this is the option likely to provide the least amount of shade, it would then also be least likely to prevent temperature increases. However, this is also the area in the watershed most likely to have discontinuous surface flow. As noted above, dry sections of the channel can have a cooling effect on the downstream flowing portions of the channel due to the higher proportion of groundwater to surface water.

Instead, we can look at the predicted relationship between temperature and buffer widths presented in Groom et al. (2018) and adapted for horizontal buffer widths in Barnowe-Meyer et al. (2021). Figure 17 shows that an approximately 0.8°C increase in temperature is still likely with a 50ft continuous buffer. This model represents the best available science for the Type Np Technical workgroup (Barnowe-Meyer et al. 2021) at the time. However, this model was developed using data from studies testing the effectiveness of buffers on state and private lands in Oregon, so there is some uncertainty around how well this model translates to FPHCP lands in western Washington.

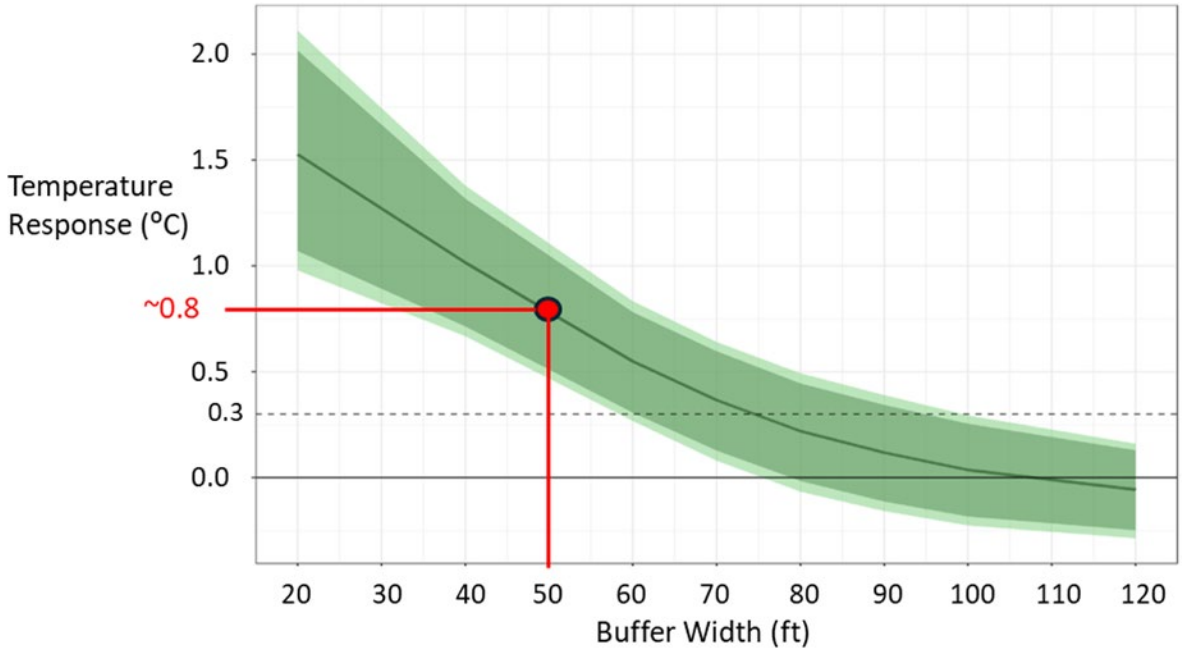

Figure 17. “Predicted relationship between two-sided buffer width and stream temperature increase post-harvest. This prediction was based on the data and analysis approach of Groom et al. (2018)” (Barnowe-Meyer et al. 2021).

The final area of concern are streams that are naturally warmer due to site-specific conditions. As mentioned above, in the Tier I section of the antidegradation portion of the water quality standards, if warming occurs in a stream that is already near the criteria, it's more likely to have exceedances. This situation occurred at two sites, one each from Hard and Soft Rock (Figure 18). As shown below, these sites were naturally warmer pre-harvest (2007 for Hard Rock, 2012 and 2013 for Soft Rock), then increased above 16°C (numeric criteria for these sites) for multiple years post-harvest. This contrasts with the remaining treatment sites (grayed-out in Figure 18), which were cooler in the pre-harvest period and did not exceed the numeric criteria at the outlet of the watersheds.

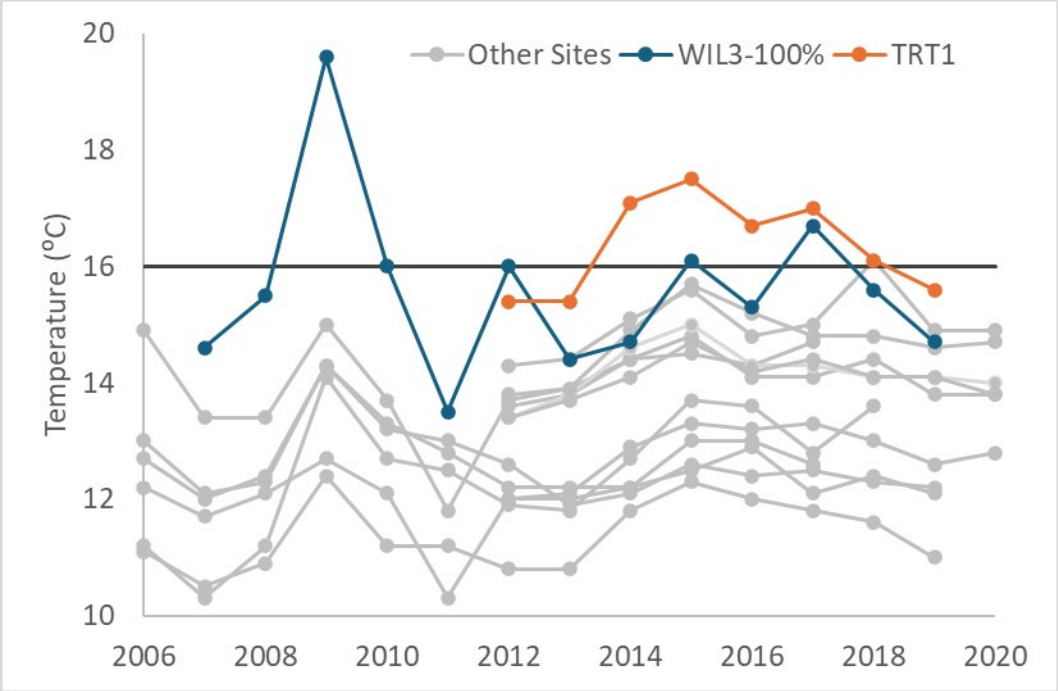

Figure 18. The two sites (Hard Rock WIL3-100%, Soft Rock TRT1) that exceeded the numeric criteria (16°C) at the outlet of the watersheds (Summer 7DADM). The other twelve Hard and Soft Rock sites are represented in gray. Data is from Tables 4A-4 (Hard Rock) and 4A-7 (Soft Rock) of the reports.

Scope of Inference

The authors of Hard Rock state that the spatial scope of the study is comprised of Type Np stream networks of similar lithology, basin size, stand age, and presence of amphibians. The Soft Rock authors similarly conclude that inference is limited to similar site conditions but can be informative to other situations depending on variable of interest and the characteristics of the site in question. It is important to note that the authors of the Hard Rock report mention that there is an upcoming report from the Soft Rock study and that, "In combination, the two studies will allow for broader inferences about FP rule effectiveness." The purpose of the above section was to assess the results of both studies in combination. This increases the number of treatments, lithology type, geographic coverage, and variation in site-specific conditions which broadens the scope of inference. However, it is important to note that this only applies to the

broader treatment effects. The investigation into site-specific conditions that may have influenced temperature response is more limited.

Landscape Scale Distribution

The section below explores how the site-specific conditions (lithology, aspect, valley slope, stream size) that may influence a temperature response are distributed across the landscape. Data was aggregated from two separate studies that used a Generalized Random Tessellation Stratified survey design to select stream reaches across Washington for sampling.

The Extensive Riparian Status and Trends (ERST) project was a CMER study that monitored stream temperature and riparian conditions in 2008 and 2009, the results from western Washington were published by Ehinger et al. (2019). Seven-day average daily maximum temperature, BFW, and aspect data were pulled from the report. The valley slope and lithology data were extracted from LiDAR and a shapefile (used in the Soft Rock site selection process) using Esri (2024).

The Watershed Health Monitoring (WHM) program is a status and trends monitoring program at the Department of Ecology that collects data on both instream and riparian conditions. The program and sampling design are detailed in the Quality Assurance Project Plan by Cusimano et al. (2006) with additional information located on the Habitat Monitoring Methods[24] website. The aspect and BFW data from a subset of these sites were extracted from the Department of Ecology's Environmental Information Management (EIM[25]) database. Valley slope and lithology data were also extracted using the same process described above. Continuous temperature data is not collected as part of the WHM program. An alternate method for estimating Maximum Weekly Maximum Temperature (also known as 7DADM) was used with a temperature index based on benthic macroinvertebrate assemblages found in streams in the Pacific Northwest.

The Macroinvertebrate Thermal Tolerance Index (MTTI) was developed by Hubler et al. (2024) using data from the WHM program along with other regional sampling efforts. The authors describe their work as adding to previous efforts to identify and classify macroinvertebrate taxa that could be used as thermal indicators. Once they identified the temperature preferences of certain taxa (324 individual taxa, mostly at the genus level, with some species and family groupings), they could then evaluate the relationship between those taxa and stream temperatures across Oregon and Washington. Using the NorWeST[26] temperature model, the authors found a strong relationship between the 7DADM and the MTTI model ($R^2 = 0.68$). MTTI uses the same metric used in Washington and Oregon water quality standards and should be comparable to the 7DADM values reported in the ERST, Hard Rock, and Soft Rock studies.

[24] https://ecology.wa.gov/Research-Data/Monitoring-assessment/River-stream-monitoring/Habitat-monitoring/Habitat-monitoring-methods
[25] https://ecology.wa.gov/research-data/data-resources/environmental-information-management-database
[26] https://www.fs.usda.gov/rm/boise/AWAE/projects/NorWeST.html

To verify the comparability of MTTI values to the temperatures seen in Hard Rock, Soft Rock, and the ERST project, WHM staff generated MTTI values from the Soft Rock macroinvertebrate data. Since the Soft Rock project had both macroinvertebrate and continuous temperature data collected at the same location, we were able to plot both MTTI and 7DADM values by year in Figure 19. While the MTTI values appear to be close in range to the continuous temperature data from year to year, these modeled values seem to predict slightly warmer temperatures than were measured. Around 50% of the MTTI values were within 1°C of the sites summer 7DADM measured at the outlet of the watershed. While these MTTI values are estimates, they do provide additional randomly selected streams with similar temperature profiles to help understand regional implications of the proposed rule.

Figure 19. MTTI and 7DADM values for Soft Rock sites during the years macroinvertebrates were collected near the outlet of the watersheds.

Temperature data from the two randomly selected monitoring programs (ERST and WHM) were plotted along with the 7DADM temperature data collected at the outlets of the Hard and Soft Rock sites in Figure 20. Only data from small streams (<4m in BFW) without fish presence from ERST and WHM were included in this analysis. Figure 20 shows that most Type Np streams on FPCHP lands in western Washington are likely between 10.5°C and 18°C (90% of temperatures fall within this range). Hard Rock sites tended to be slightly cooler than Soft Rock sites (also noted by the Soft Rock authors), but both studies fall well within this range, indicating that the Hard and Soft Rock streams are likely typical streams of this region. As noted above, one area of concern are streams near the numeric criteria (mostly 16 or 17.5°C on FPHCP lands) (WAC 173-201A-200(1)(c)). The data from Figure 20 suggests that around 8% of streams are within 0.5°C of the numeric criteria.

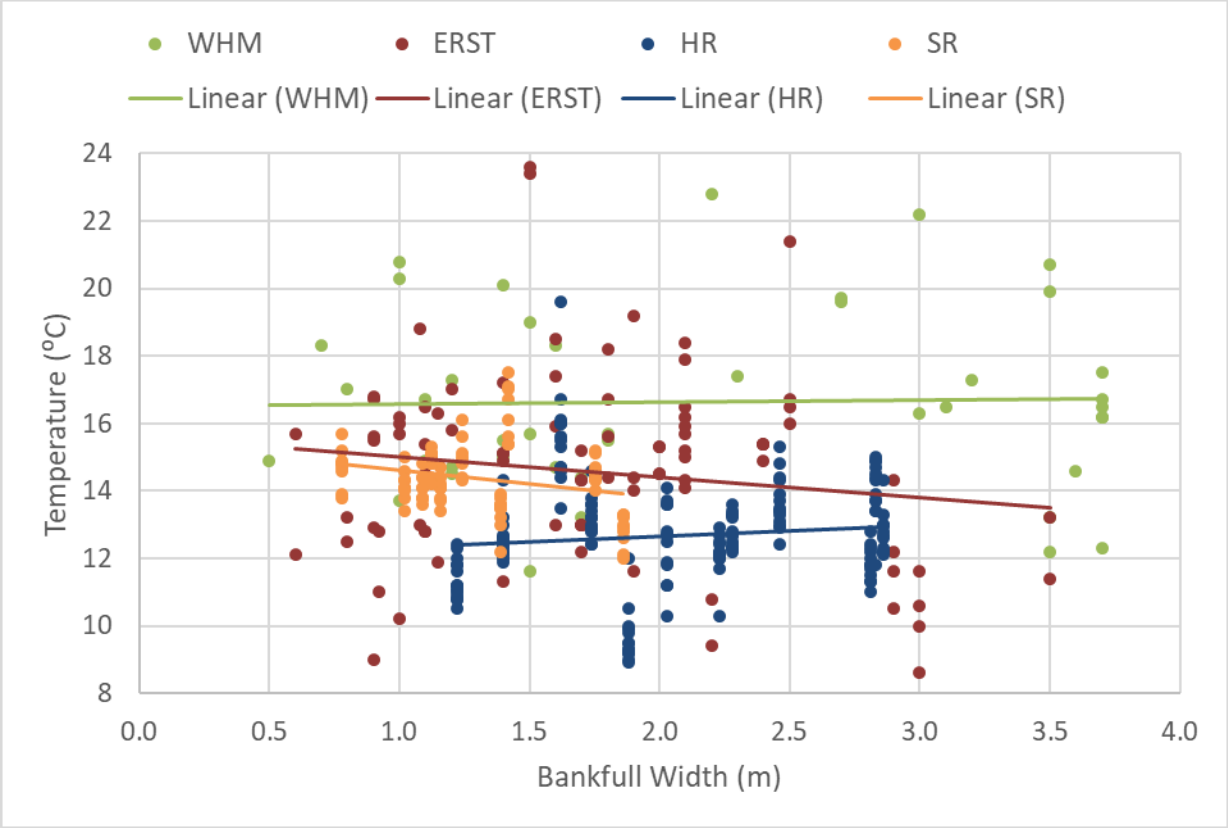

Figure 20. Average maximum summer temperatures for the Watershed Health Monitoring (WHM), Extensive Riparian Status and Trends (ERST), Hard Rock (HR), and Soft Rock (SR) sites plotted against average BFWs. ERST, HR, and SR are the 7-day average daily maximums from Tables E-3 (Ehinger et al. 2019) for ERST, 4A-4 (Hard Rock), and 4A-7 (Soft Rock) of the reports. WHM are Macroinvertebrate Thermal Tolerance Index (MTTI) values calculated by the Watershed Health Monitoring Unit at the Department of Ecology. Hard and Soft Rock reference sites are included. Linear trendlines show no correlation between average BFW and stream temperature and how the different studies compare to each other.

Together the Hard and Soft Rock sites appear to be somewhat well distributed across the landscape and categories of lithology of western Washington. Figure 21 shows the WHM, ERST, Hard Rock and Soft Rock sites along with temperature ranges represented in different shades of pink (darker colors are higher) and bigger points being streams with larger BFWs. The majority of sites from all studies are clustered in the southwest corner of the state, which coincides with high concentration of FPHCP lands in this region. A smaller group of Hard Rock and random sites are clustered on the Olympic Peninsula and only a handful of random sites are distributed along the north and central Cascades. The lack of sites from the Hard and Soft Rock studies in these areas of the Cascades, and on a smaller scale the Kitsap Peninsula, is the biggest gap in our understanding of the regional impacts of the proposed rule. There is also a slight over representation of the competent lithology in the random sites and slightly in the Hard and Soft Rock studies (Hard Rock had more total sites). Competent lithologies represent 29% of the FPHCP landscape compared to the 67% that are likely incompetent.

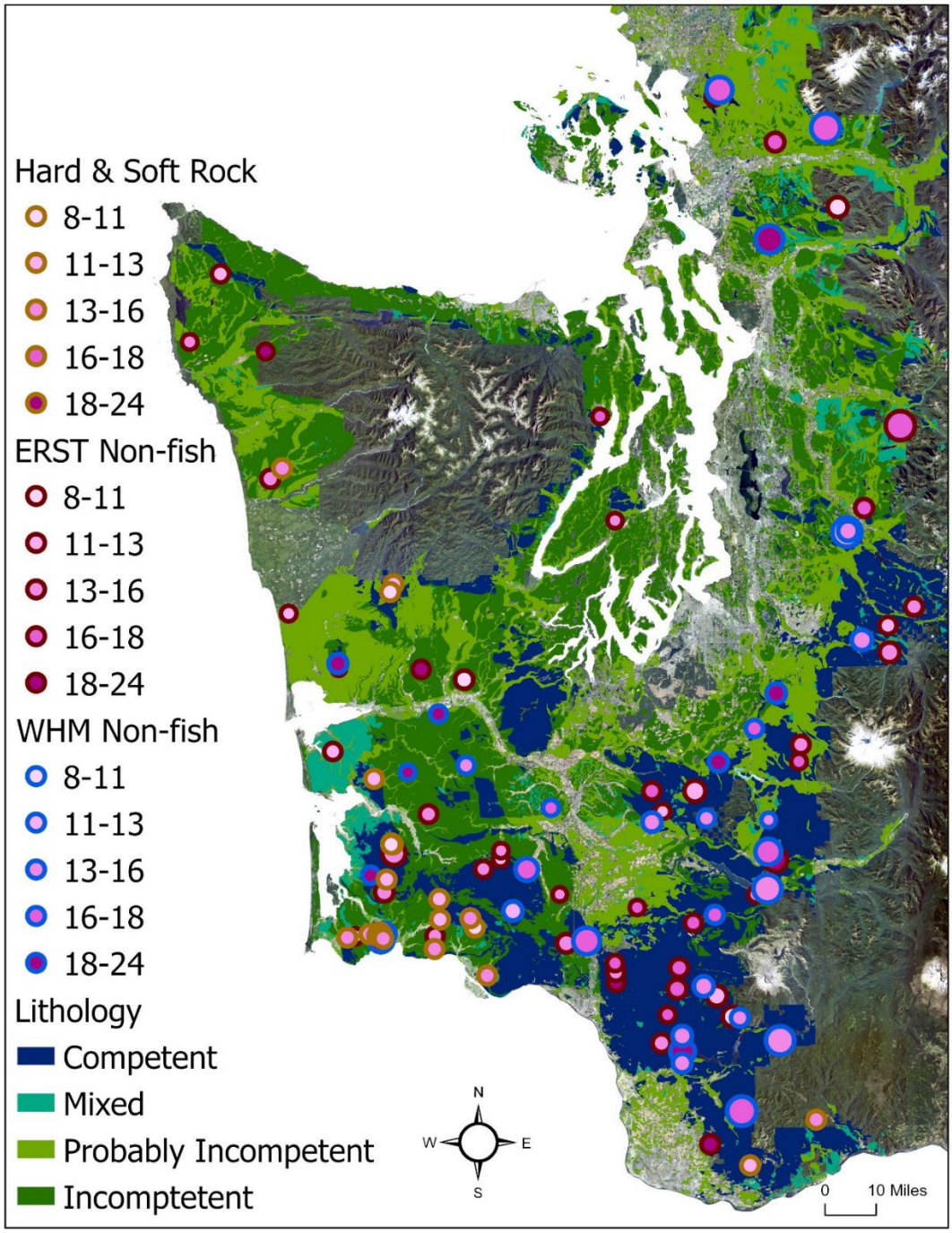

Figure 21. Overview of Hard and Soft Rock sites alongside randomly selected sites from the Extensive Riparian Status and Trends (ERST) and Watershed Health Monitoring (WHM) studies. Temperature is the summer 7DADM (°C) separated into bins ranging from 8-24°C (same bins for each study). Points increase in size relative to the average BFW of the stream. Lithology identified using geologic layers in Esri (2024), with the categories (competent and incompetent) used in the Hard and Soft Rock studies. Mixed lithology likely contains both competent and incompetent in a single feature class.

The categories of lithology are based on how the underlying geology of an area was grouped for the purposes of selecting sites for Hard Rock (competent lithology) and Soft Rock (incompetent lithology). The competent geologic group is comprised mostly of volcanic with some metamorphic rock. Incompetent lithology is sedimentary rock. The probably incompetent group is mostly glacial outwash, which has been included in the incompetent category for the rest of this analysis.

Site-specific characteristics

As mentioned above lithology, aspect, valley wall slope, and BFW were identified, from the Hard and Soft Rock 100% buffered sites, as site-specific characteristics that may influence stream temperature. Tables 3 and 4 are aggregated data from randomly selected sites (WHM and ERST) compared to the effectiveness study sites from the Hard and Soft Rock studies. This data can be used to identify what percent of Type Np streams on FPHCP lands that may be more susceptible to temperature increases.

Lithology

Hard Rock sites tended to be cooler than both the Soft Rock sites and the randomly selected streams. However, it appears that they also may be more susceptible to temperature increases based on the average treatment effect being around 0.5°C warmer and lasting longer than the Soft Rock treatments (Figure 8). Bladen et al. (2018) also found that stream reaches with less permeable (competent) lithology had higher post-harvest stream temperatures compared to streams with higher permeability (incompetent). This is likely because the proportion of groundwater in a stream increases in areas with more permeable geology (Blanden et al. 2018, Hale & McDonnell, 2016; Tague & Grant, 2004). The data from Table 4 suggests that streams with higher permeability are roughly 50% of the Type Np streams on FPHCP lands.

While the Hard Rock sites tended to be more susceptible to temperature increases, the Soft Rock sites tended to be slightly warmer (Figure 20). This leaves less of a margin for temperature to increase after harvest and not exceed the numeric criteria. As mentioned above, around 8% of streams are within 0.5°C of the numeric criteria (16 or 17.5°C).

Aspect

Steams with a south-facing aspect receive more sun exposure and warming due to an increase in short and long-wave radiation (Hard Rock, Moore et al. 2005). This is consistent with the reported July MMTR being higher in Hard Rock sites with a southerly aspect. The fully buffered stream with the highest and most persistent temperature response (WIL3-100%) was also south-facing. Because stream networks will likely have a mixture of south, southeast, and southwest reaches, the S Aspect column in Tables 3 and 4 includes all three categories. Based on the randomly selected set of Type Np sites, and consistent with the percentage of Hard and Soft Rock sites with a south aspect (41%), approximately 37% of streams are likely to be south facing.

A separate category of north facing streams was included due to the increase in stream temperature at a fully buffered Hard Rock stream (OLYM-100%) with north facing tributaries (Figure 15). Moore et al. (2005) also reported that streams oriented north-south tend to have less shading. Even though this is describing large streams with canopy gaps, the same concept could apply to a reduction in topographic shade in streams that flow north. For this reason, the N Aspect category was added, but only includes streams with an exclusively north aspect as this would be the most susceptible to the topographic shade reduction. It is likely that around 10% of Type Np streams flow north (Table 4).

Valley Wall Slope

Headwater streams that are deeply incised with steep valley walls have more topographic shading than streams within a more gently sloped valley. The Soft Rock sites tended to have steeper valley walls (60% slope) than the average of the Hard Rock sites (45% slope) (Soft Rock report). The authors of the Soft Rock report speculated that the incised valleys present at the Soft Rock sites might have been a contributing factor to the smaller temperature response, compared to Hard Rock. Also, the fully buffered site with the greatest and most persistent temperature response and the Soft Rock site with the greatest temperature response had the lowest valley gradient, 20% and 44% respectively. There were likely other factors, in addition to canopy cover, (e.g. aspect, windthrow) that contributed to the significant and persistent warming throughout the stream network.

Bankfull width (BFW)

This category was included because of the proposed rule allowing for 50ft buffers on streams less than 3ft in BFW (above the first 600ft). As noted above, this is the part of the Type Np stream network that we know the least about. This is also the most difficult part of the stream to measure water temperature due to the shifting patterns of dry reaches and extremely shallow depths. This provides a unique challenge for keeping temperature sensors fully submerged for the long periods of time that are needed to track temperature response after harvest. Only 2 Soft Rock sites and 9 random sites had average BFWs under 3ft. This represents a 10% distribution of streams with BFWs under 3ft.

Table 3. Total number of randomly selected sites from western Washington (ERST, WHM), between 0 and 4m in width, and the total number of Hard and Soft Rock sites, including references. From those totals, the number of sites with certain characteristics that may influence stream temperature (Lithology, aspect, Valley Slope, and BFW) and with readily available data.

Studies	Total Sites	Competent	Incompetent	North Aspect	South Aspect	Valley Slope ≤20%	BFW <1m
ERST	45	20	24	9	18	8	6
WHM	42	22	17	0	14	11	3
HR	12	12	0	2	5	1	0
SR	10	0	10	1	4	0	2

Table 4. The percentage of the randomly selected sites (the average of WHM and ERST) with site characteristics that may influence stream temperature compared with the percentages from Hard Rock (HR) and Soft Rock (SR). HR and SR averaged together, including reference sites.

Studies	Competent	Incompetent	North Aspect	South Aspect	Valley Slope ≤20%	BFW <1m
Random Sites	48%	47%	10%	37%	22%	10%
HR and SR	55%	45%	14%	41%	5%	9%

Measurable change determination

There are likely to be minor temperature increases in some Type Np streams after adjacent timber harvest under the proposed rule's buffer prescriptions. On average, the majority of streams should be protected from a 0.3°C increase in temperature after adjacent timber harvest. However, there are some specific situations, identified above, that will likely lead to an increase in temperature even under the proposed buffer prescriptions. These situations are summarized below, along with the estimated distribution of Type Np streams across FPHCP lands in western Washington.

Lithology

- Competent – 48% of Np streams
  - Areas could be more susceptible to warming, especially if some of the below conditions are also present. Tend to be cooler streams, so likely to have more of a margin of safety before exceeding numeric criteria.
- Incompetent – 47% of Np streams
  - Less susceptible to warming. Tend to be warmer streams, which reduces the margin of safety before temperature increases exceed the numeric criteria.

Temperature margins

- Within 0.5°C of numeric criteria (16 or 17.5°C) – 8% of Np streams.
  - More susceptible to exceeding the numeric criteria, especially if other site-specific characteristics are present within the watershed.

Aspect

- Southern facing – 37% of Np streams
  - Potentially more susceptible to warming, likely in combination with other topographic features such as gently sloped valley walls. Probably a wide range of variability.
- North facing – 10% of Np streams
  - Potentially more susceptible to warming, almost certainly in combination with gently sloped valley walls and stream gradient.

Valley Wall Slope

- Less than or equal to an average of 20% slope – 22% of Np streams
    - Potentially more susceptible to warming, either in combination with other topographic features or possibly as the only warming feature present.

Bankfull width

- Less than 3ft – 10% of Np streams
    - Likely more susceptible to warming due to the narrower 50ft buffers that have been widely documented to not be protective of temperature increases of over 0.3°C. Higher degree of uncertainty from the minimal amount of research on these smaller sized streams.

In general, streams with less topographic and riparian shade (i.e. north-south oriented, gently sloped valley walls, 50ft buffers) and a higher proportion of surface water (i.e. competent lithologies) are more likely to warm under the proposed rule. Conversely, streams with more topographic and riparian shade (i.e. east-west oriented, steep valley walls, 65-75ft buffers) and have more groundwater influence (i.e. incompetent lithologies) are less likely to warm.

Overall, the proposed buffer prescriptions should result in minimal temperature increases after harvest and likely only under certain conditions. Based on the results of the Hard Rock 100% buffer treatment, the shade-temperature model (Figure 17), and other best available science, these minimal increases (~0.0-1.0°C) should be temporary, likely no longer than 2 years post-harvest.

Necessary and overriding public interest analysis

Before a lowering of water quality can be authorized under the Tier II antidegradation rules, that lowering of water quality must be demonstrated to be necessary and in the overriding public interest. The necessary and overriding public interest determination follows the regulations at WAC 173-201A-320(4), and Ecology has written supplemental guidance for implementing the Tier II Antidegradation Policy (Ecology, 2011).[27] Information of necessity must include information that identifies and selects the best combination of site, structural, and managerial approaches that can be feasibly implemented to prevent or minimize the lowering of water quality. Of note, the Tier II rule language identifies the establishment of buffer areas with effective limits on activities as an example of a managerial approach to prevent or minimize the lowering of water quality (WAC 173-201A-320(4)(b)(vii)). Information for the overriding public interest determination must include an assessment and statement of the costs and benefits of the social, economic, and environmental effects associated with the lowering of water quality (WAC 173-201A-320(4)(a)).

[27] Ecology Tier II Supplemental Guidance. https://apps.ecology.wa.gov/publications/documents/1110073.pdf

As discussed in the "Measurable Change Determination" section of this report, Ecology has determined that while the proposed Type Np buffer rule is significantly more protective than the existing rule, and is anticipated in many cases to meet Tier II temperature protections under site-level conditions in particular regions of western Washington, there remains a possibility of measurable change in water quality parameters – specifically a temperature increase of greater than or equal to 0.3°C to some Type Np waters. In this section, we discuss our consideration of additional protections that would be likely to provide a higher degree of certainty in meeting Tier II temperature protection requirements, and their relative impact on the environment and public.

The figure below depicts an overview of our considerations in determining whether the remaining risk of exceeding Tier II antidegradation requirements is in the necessary and overriding public interest. Considerations include understanding what set of rule requirements would meet Tier II temperature protections with greater certainty than the proposed rule, and what additional impacts such requirements would create. In other words, what costs would be avoided under the proposed rule by allowing some degree of risk of failing to meet Tier II protection requirements, compared to a more protective alternative. Those potential impacts are considered relative to one another, in the context of baseline regulations and economic variables, and with an understanding of existing scientific uncertainty, variability, and data gaps. These factors are used to determine whether the remaining risk of exceedances would be necessary and in the overriding public interest.

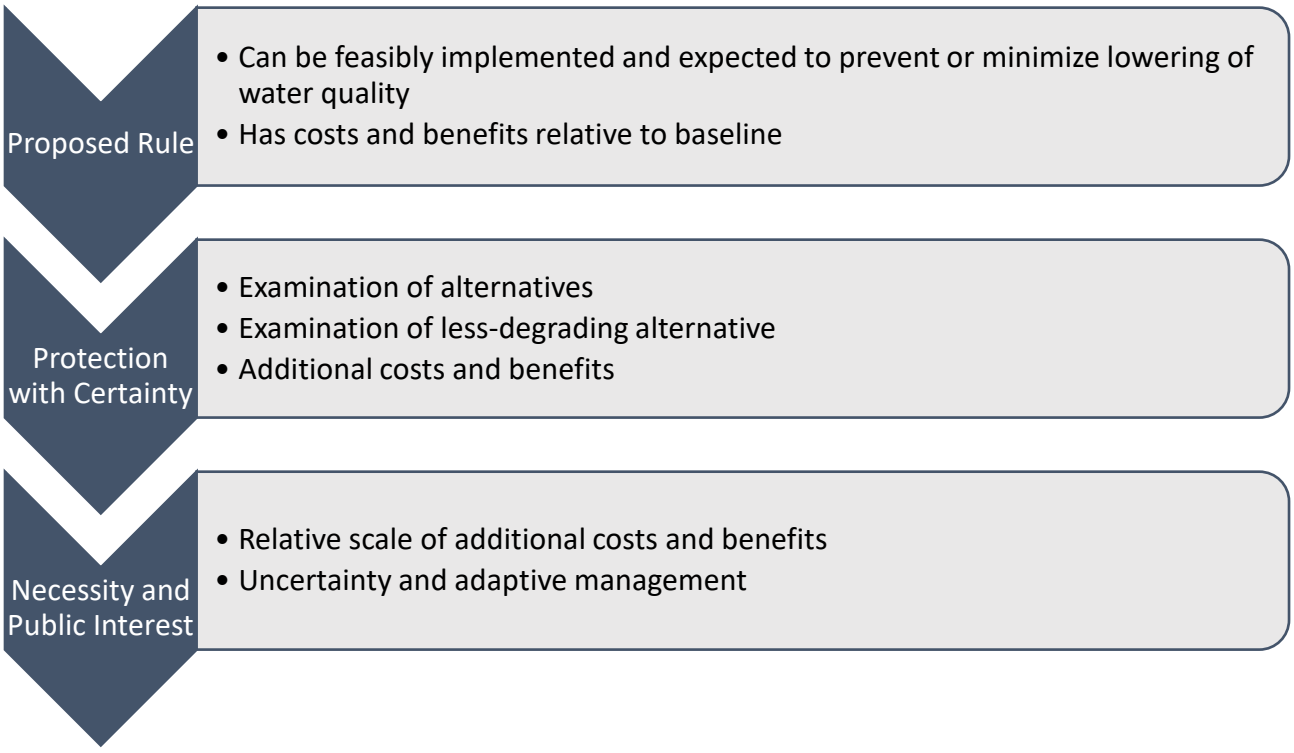

Figure 22. Necessary and Overriding Public Interest flow chart.

Costs and benefits of proposed rule

As part of the Forest Practices Board's rule proposal, DNR's consultant IEc has assessed likely costs and benefits of the proposed rule as required under the Administrative Procedure Act (APA; RCW 34.05.328(1)(d)) and Regulatory Fairness Act (RFA; Chapter 19.85 RCW).[28] The APA requires the agency proposing a rule to determine that the likely benefits of the rule are greater than the likely costs, accounting for quantitative and qualitative impacts. The RFA requires comparison of relative compliance cost burden on small businesses as compared to the largest affected businesses, as well as assessment of impacts to revenues and employment, and mitigation of disproportionate impacts so far as is legal and feasible. The table below summarizes costs and benefits of the proposed rule as compared to the baseline (existing laws and rules), as identified in IEc's analysis.[29]

[28] IEc, 2025. Washington State Type Np Water Buffer Proposed Rule, Final Preliminary Cost-Benefit Analysis. April 23, 2025.

[29] Information taken from IEc, 2025, Table ES-3.

Table 5. IEc summary of Probable Costs and Benefits of the Proposed 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 million to $35 million assuming a 2% discount rate (alternatively, annualized costs are $17 million 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 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 proposed 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 [of the Preliminary Cost-Benefit Analysis], 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 harvester timber on carbon budget
	  ○ On the order of 220,000 to 3.3 million MT CO_2e 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

To further understand the benefits of the proposed rule for stream-associated amphibians, we examined evidence from the Hard Rock study. The figure below identifies locations of torrent salamanders and giant salamanders in areas of the study that used baseline buffer and 100 percent buffer treatments.

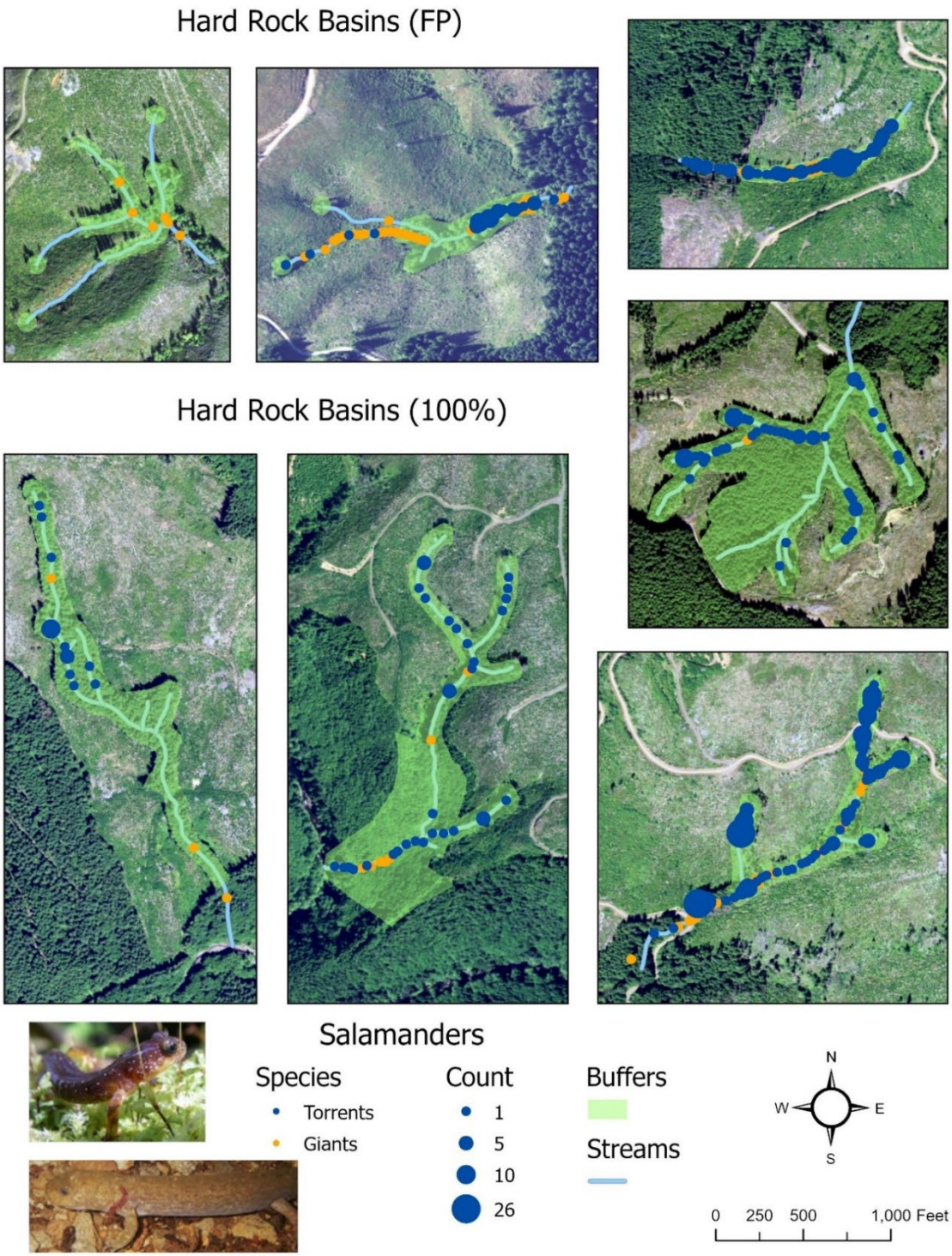

Figure 23. Distribution of torrent (Ryacotriton) and giant (Dicamptodon) salamanders in the Hard Rock streams, from the initial survey in 2006. Larger points had greater numbers of individuals found at that specific location.

Regarding impacts to employment, industry, and taxes, IEc identified the impacts summarized in the following tables.

Table 6. IEc Estimated Annual Regional Economic Impacts by Ecoregion (number of job-years).

Ecoregion	Direct Job-years Low	Direct Job-years High	Total Job-Years Low	Total Job-Years High
Cascades	77	351	208	946
Coast Range	29	127	72	314
North Cascades	19	118	45	282
Puget Lowland	25	102	59	242
Willamette Valley	3	10	8	31
Total	153	709	392	1,816
% western WA	0.5%	2.1%	0.5%	2.2%

Table 7. IEc Estimated Annual Regional Economic Impacts by Ecoregion (millions of $ per year).

Ecoregion	Total Wages Low	Total Wages High	Revenue Low	Revenue High	Stumpage Taxes Low	Stumpage Taxes High
Cascades	$11.9	$54.0	$70.2	$318.9	$0.1	$0.5
Coast Range	$5.2	$22.5	$31.7	$138.6	$0.1	$0.5
North Cascades	$2.6	$16.4	$16.7	$104.0	$0.0	$0.1
Puget Lowland	$3.4	$14.0	$22.1	$91.1	$0.0	$0.1
Willamette Valley	$0.4	$1.7	$2.2	$9.0	$0.0	$0.0
Total	$23.5	$108.6	$143.0	$661.6	$0.3	$1.2
% western WA	0.5%	2.2%	0.5%	2.2%	0.5%	2.5%

The above impacts are based on a comparison of the proposed rule to the baseline of the existing rule and other regulations affecting stream buffers and forest management. We note that the high end of each range above does not exclude some aspects of the baseline, such as the assumption that all regulated forestland is likely to be harvested, and underrepresentation of baseline requirements related to unstable slope protections. Additionally, overestimation of affected acres results from the inclusion of lands unaffected by the proposed rulemaking, including private lands associated with individual Habitat Conservation Plans with different water typing systems and associated protection measures for waters of the state compared to those found in the Forest Practices Habitat Conservation Plan.

We acknowledge that data and modeling limitations prompted the approaches taken in the Preliminary Cost-Benefit Analysis to mitigate various uncertainties. Ecology believes the likely impacts of the proposed rule would be toward the lower end of the ranges above, based on potential to overestimate acreage affected specifically by the proposed rule over and above baseline.

Clean Water Act assurances discussion

As mentioned earlier in this report, the CWA Assurances issued by Ecology and EPA established that the State Forest Practices Rules and programs, as updated through a formal adaptive management program, would be used as the primary mechanism for bringing and maintaining forested watersheds into compliance with water quality standards. The agreement to rely on the forest practices rules in lieu of developing separate Total Maximum Daily Load (TMDL) allocations or implementation requirements remains conditioned on maintaining an effective adaptive management program.

The CWA Assurances were originally granted for a 10-year period in 1999. In 2009, Ecology published a review of Washington's Forest Practices Program and conditionally extended the Assurances for another 10 years to allow for program improvements and research development.[30] In 2019, Ecology extended the Assurances for another two years based on the completion or near completion of several key Type N research projects that provided enough information for the Forest Practices Board to consider new rulemaking regarding riparian buffers on Type Np waters. In 2021 Ecology extended the Assurances for an additional year, on condition that the Board direct staff to develop a Type Np rule package and prepare a CR-102. In 2022 Ecology extended the Assurances pursuant to progress related to the Type Np CR-102 development and indicated that if progress on a new Type Np buffer rule stalls, or parties abandon a continued commitment to the Adaptive Management Program, Ecology will consider withdrawing the Assurances and pursuing alternatives to achieve water quality protection under the Clean Water Act.[31]

IEc notes in the final preliminary CBA Appendix B that "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."[32]

[30] https://apps.ecology.wa.gov/publications/documents/0910101.pdf
[31] November 30, 2022, Ecology letter to Forest Practices Board.
[32] Appendix B. IEc, 2025. Washington State Type Np Water Buffer Proposed Rule, Final Preliminary Cost-Benefit Analysis. April 23, 2025.

We agree that the extent and scale of costs to landowners and the state related to the potential withdrawal of Assurances are uncertain. However, it is critical to draw attention to the regulatory stability the Assurances have afforded the Forest Practices Program over the last 25 years. When compared to the baseline rule, the Board's proposed Type Np buffer rule and the associated improvements to water quality it provides align with the intent of the Assurances. If advanced in the rulemaking process, the proposed rule would likely position the Forest Practices Program to continue receiving the regulatory stability afforded by the Assurances (subject to approval by Ecology's Director), and because of this, we recommend the likely potential of retaining CWA Assurances be considered an additional probable benefit of the proposed rule. Due to the uncertain scope, timing, and ultimate requirements of any agency actions taken in the absence of the Assurances, we acknowledge it is not possible to confidently quantify or monetize this benefit. For additional discussion on Clean Water Act Assurances and the Board's proposed Type Np rulemaking, see Appendix C.

Examination of alternatives

Considering alternatives is a key component of Tier II antidegradation analysis. Ecology retains discretion to require examination of specific alternatives or provide additional information (WAC 173-201A-320(4)(b) and (5)). The Administrative Procedure Act also requires the Forest Practices Board to consider alternative versions of the rule, and that the rule being adopted is the least burdensome alternative for those required to comply with it that will achieve general goals and specific objectives (RCW 34.05.328(1)(e)).

Alternatives the Forest Practices Board is considering for this rulemaking include:

1. The current Forests and Fish Type Np rule found in WAC 222-30-021*(2). This represents the "no-action" alternative, and;
2. Proposed buffer prescriptions as identified in the draft Type Np buffer rule language.[33] This alternative represents the "action alternative," and consists of continuous 50-75 foot no-harvest buffers for Type Np waters. Specific buffer width is dependent on basin size, harvest planning, and bankfull width of the Np water.

While these are the primary alternatives the Board is considering, we find it important to provide broader context in the Tier II analysis to reflect the Forest Practices Adaptive Management Program's considerable time and resources spent on developing and refining a suite of alternatives before providing final recommendations to the Board for consideration. Following receipt of the Type Np Technical Workgroup's recommendations, the TFW Policy Committee evaluated numerous iterations of buffer prescriptions for a new Type Np buffer rule over the course of approximately eighteen months, with the Forest Practices Board approving the majority TFW Caucus buffer recommendations for rulemaking advancement on August 9th, 2023.

[33] Proposed Type Np rule language. https://www.dnr.wa.gov/publications/bc_fpb_typenp_proposal_20240509.pdf

Adaptive Management Program alternatives

Type Np Technical Workgroup

The Type Np Technical Workgroup was assembled by the Timber, Fish and Wildlife (TFW) Policy Committee and approved by the Forest Practices Board in response to the results of the CMER Type Np Hard Rock Study, Phase I. TFW Policy agreed that the Hard Rock Phase I study found there was a water temperature increase associated with the treatments tested, including the existing Forests and Fish Type Np buffer rule. The workgroup was instructed to consider other relevant studies associated with Type Np waters and to develop western Washington Type Np water buffer alternatives for TFW Policy consideration. The Workgroup Charter states:

"The purpose of the Workgroup is to develop proposed RMZ buffer prescriptions for perennial, non-fish bearing (Type Np) streams in western Washington that meet the following objectives:

- Protect water temperatures to meet the rule (WAC 173-201A-200, -300, -320);
- Are repeatable and enforceable;
- Are operationally feasible;
- Provide wood to the stream over time;
- Account for windthrow;
- Consider options that allow for management (e.g. selective harvest) in the RMZ; and
- Minimize additional economic impact."[34]

In the Workgroup's final report, seven alternatives were evaluated using a Structured Decision Making process (Gregory et al. 2012).[35] The Workgroup's final recommendation was for TFW Policy to consider three of the alternatives evaluated (C, E, and F), and further recommended TFW Policy, "…consider the adoption of a combination of the three alternatives." All three recommended alternatives employed a continuous buffer from the Type F/N water break, where the regulatory stream classification changes from fish to non-fish, to the upper-most point of perennial flow.

[34] https://www.dnr.wa.gov/publications/bc_tfw_typencharter_20190710.pdf?0z3ica

[35] https://www.dnr.wa.gov/sites/default/files/publications/bc_tfw_policy_type_n_workgroup_review_final_052021.pdf

Table 8. Summary of Type Np Technical Workgroup Alternatives.

Alternative	Description	Estimated Ability to Prevent Temperature Increase of 0.3°C, on Average	Economic Impact Score (1-5, with 1 best avoiding landowner economic impact)
A	WAC 222-30-021*(2). Baseline Forests and Fish Western Washington Type Np buffer rule.	Across the landscape, and immediately post-harvest, very unlikely to meet measurable change standards.	1
B	100% buffer, 50’ wide, both banks.	Sites are expected to exhibit warming above measurable change standards for approximately one to two years post-harvest but return to pre-harvest temperature ranges after two years. We are fairly certain this prescription will not meet the measurable change standards, but we are not 100% certain.	3
C	100% buffer, 75’, both banks. First 50’ of buffer is an unmanaged zone. The outer 25’ beyond the unmanaged zone can include harvest of economically valuable trees. Removal of 50% of the basal area within the managed zone, removing the largest trees first, will result in the retention of at least 50% of the trees in this zone. Tree retention will be evenly distributed.	With a 75’ no-cut buffer we would expect, across the landscape, that immediately following harvest sites will not warm beyond the measurable change standards amount. The inclusion of a 25’ managed zone may reduce the efficacy of the buffer, but we do not know to what extent.	3.5-4
D	100% buffer, 100’, both banks.	We expect, with high certainty, that sites with buffers of this size will not warm beyond the measurable change standards amount for any given year post-harvest.	5
E	Site-specific buffer. Based on the Headwater Stream Smart Buffer Design Project (Martin and Romey 2020). The portion of the riparian buffer that will provide effective shade to the stream is retained. At a minimum, for both stream banks,	We expect this prescription to have a reasonable chance of meeting the measurable change standards for the first two years following harvest and for the measurable change standards to	2.5

Alternative	Description	Estimated Ability to Prevent Temperature Increase of 0.3°C, on Average	Economic Impact Score (1-5, with 1 best avoiding landowner economic impact)
	all streamside, merchantable trees (those within 10' of the bankfull width) will be retained. Operators are encouraged to leave non-merchantable trees within 30'.	be met beyond two years post-harvest.	
F	Aspect-based buffer. East-west oriented portions of the Np stream system have a 75' south-sided buffer and a 25' north-sided buffer. North-south oriented portions of the Np system have 65' buffers on both banks.	We expect this prescription to have a reasonable chance of meeting the measurable change standards for the first two years following harvest and a high probability of meeting the standard in subsequent years.	3
G	Variable-width two-sided buffer. The buffer width is determined by the stream bankfull width, evaluated in 200' sections. Np streams < 1'wide receive a 25' two-sided buffer while 1'to 5' wide streams receive 50' two-sided buffers. Np streams >5' width have 50' no-management ("core") buffers, with an added 25' outer managed zone. Removal of 50% of the basal area within the managed zone of 25', removing the largest trees first, will result in equal to, or greater than, 50% of the trees in this zone retained. Tree retention will be evenly distributed.	Since most Np streams fall within the first two width categories (i.e., less than 5' wide), we expect this prescription on average to fail to meet the measurable change standards, with probabilities of success falling between Alternatives A and B.	2

TFW Policy Response to Type Np Technical Workgroup recommendations

The TFW Policy Committee evaluated the recommendations provided by the Type Np Technical Workgroup, and after completing a two-stage dispute resolution process, the committee was unable to agree on a final package of Type Np rule recommendations.[36] Majority and minority recommendations were finalized and presented to the Board for a final determination, in accordance with Forest Practices Rule WAC 222-12-045(2)(h) and Board Manual guidance[37].

Minority TFW Policy caucuses, including Large Forest Landowners, Small Forest Landowners, and the Washington State Association of Counties recommended a package of new Type Np riparian buffer prescriptions[38]. The Board considered these prescriptions; however, in the end voted not to advance the proposal in the rulemaking process.

[36] Final Report for Type Np buffer Alternative Dispute. https://www.dnr.wa.gov/publications/bc_fpb_mtg_packet_20221031.pdf
[37] Forest Practices Board Manual Section 22, part 5. Dispute Resolution.
[38] Minority TFW Policy Caucus Proposal. https://www.dnr.wa.gov/publications/bc_fpb_mtg_packet_20221031.pdf

Table 9. Minority TFW Policy Caucuses Type Np Buffer Recommendations.

Np Prescription	Description
A - Area Control	Type Np stream basins greater than 30 acres and 85% or more harvested over a five-year or less period require a 75-foot wide, two-sided, unmanaged continuous buffer from the confluence of a Type S of F water to the upper point of perennial flow.
B - 1,000-foot Buffer	In all other circumstances, harvest adjacent to Type Np streams require a 75’ wide, two-sided, unmanaged buffer for 500’ upstream from the confluence of a Type S or F water and a 50’ wide, two-sided, unmanaged buffer for the next 500’ for a total of 1,000’. Landowners are encouraged to leave non-merchantable trees, understory, and shrubs within the 30’ equipment limitation zone (ELZ) upstream of the no-cut buffered areas to the upper point of perennial flow. Like the current rule, the objective is to provide a minimum of 50% buffering of the total Np stream length (inclusive of the 1000’ of continuous buffer from F/N break). If an operating area is located more than 2,000’ upstream from the confluence of a Type S or F stream and the Type Np stream is more than 2,000’ in length, and if the 50% stream length buffered objective is not met by protecting sensitive sites, potentially unstable landforms, and/or other buffered leave areas, then additional 50’ buffers are required to meet the objective of 50% of the Np stream length buffered.
Small Forest Landowner Option	The small forest landowner option is the same as prescription A and B above, except the buffer configuration is a 50’ wide, two-sided buffer with the outer 25’ manageable at the landowner’s option. Small landowners who choose to manage within the outer 25’ buffer may remove half the available volume in a “thin from above” approach.

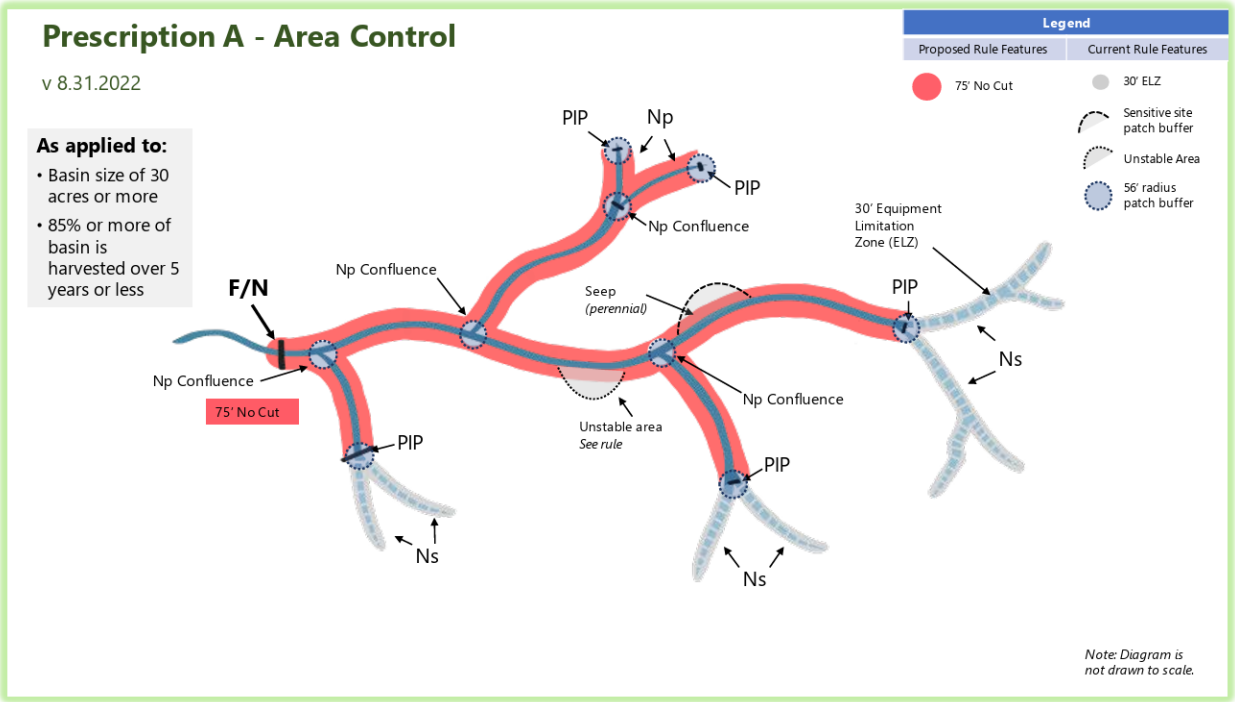

Figure 24. Prescription A – Area Control, from Minority TFW Policy recommendations.

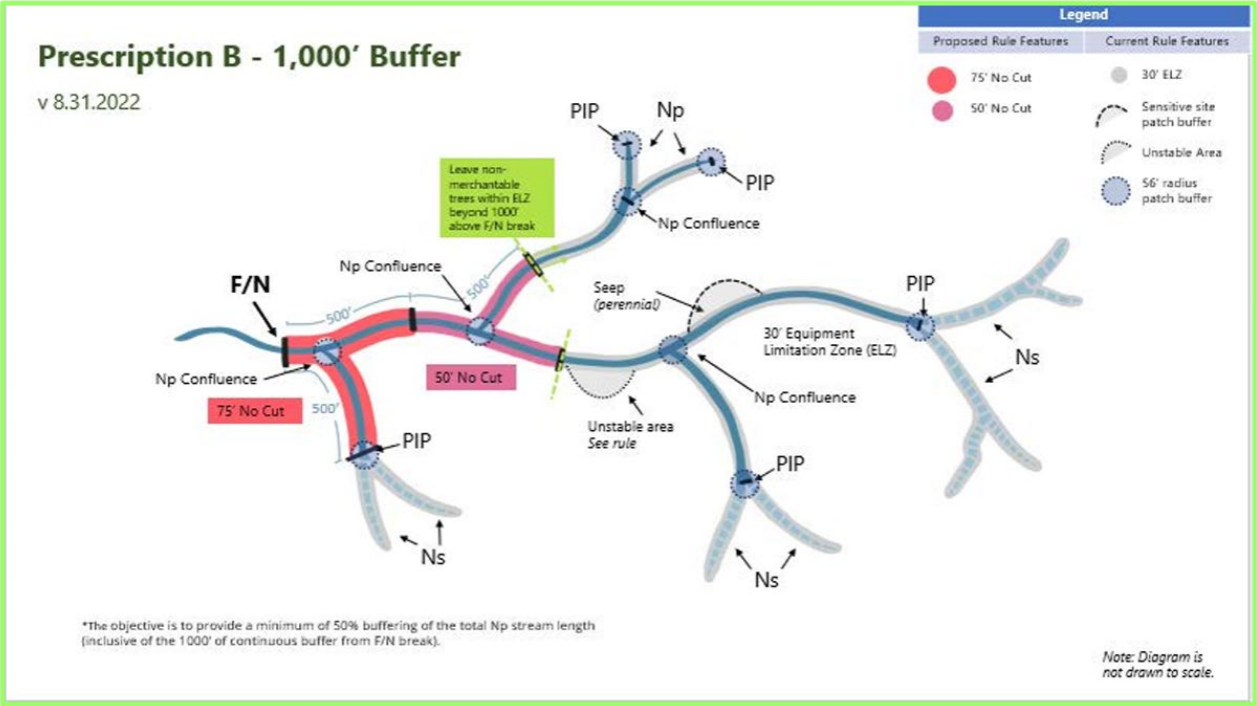

Figure 25. Prescription B – 1,000' Buffer from Minority TFW Policy recommendations.

Majority TFW Policy caucuses, including Western Washington Tribes, Eastern Washington Tribes, the Conservation Caucus, and the State Departments of Fish and Wildlife and Ecology also produced a package of Type Np buffer recommendations. The recommended prescriptions were based on two of the Type Np Technical Workgroup recommended alternatives, C **"**100% buffer, 75 feet, both banks**"** and F "Aspect-based buffer." Option 2 of the majority proposal is identical to the Prescription A – Area Control recommendation in the minority proposal and represented a consensus recommendation. The Board held a final vote to advance the majority proposal for rulemaking on August 9th, 2023.

Table 10. Majority TFW Policy Caucuses Type Np Buffer Recommendations.

Np Prescription	Description
Option 1	All Type Np streams are buffered by a two-sided 75' no harvest buffer for the first 600' upstream from the F/N break, or for the lowest 600' for isolated Type Np streams which have no downstream confluence. Upstream from the first 600' of a Type Np stream, the two-sided buffer width is determined by the bankfull width of the stream (BFW). Where Type Np streams have a 3' BFW or greater, one of the following prescriptions is required: 1) Two-sided 75' buffer where the inner 50' management zone is no harvest, and the outer 25' zone can be managed using an evenly spaced thinning strategy, such as by diameter class or relative density, 50% of the trees must be retained; or a 2) Two-sided 65' fixed-width no harvest buffer. Where Type Np streams average less than 3' BFW, a two-sided 50' fixed-width no harvest buffer is required. All existing equipment limitation zones, sensitive sites, forest practices hydraulic project, roads, yarding corridors, and unstable slope rules will continue to be applied to the full length of all Type Np waters.
Option 2	This prescription is applied when 85% or more of a Type Np stream basin greater than 30 acres is to be harvested within a five-year period. The prescription requires the Type Np streams to be buffered with a two-sided 75' wide no harvest buffer for the entire length of the Type Np stream.

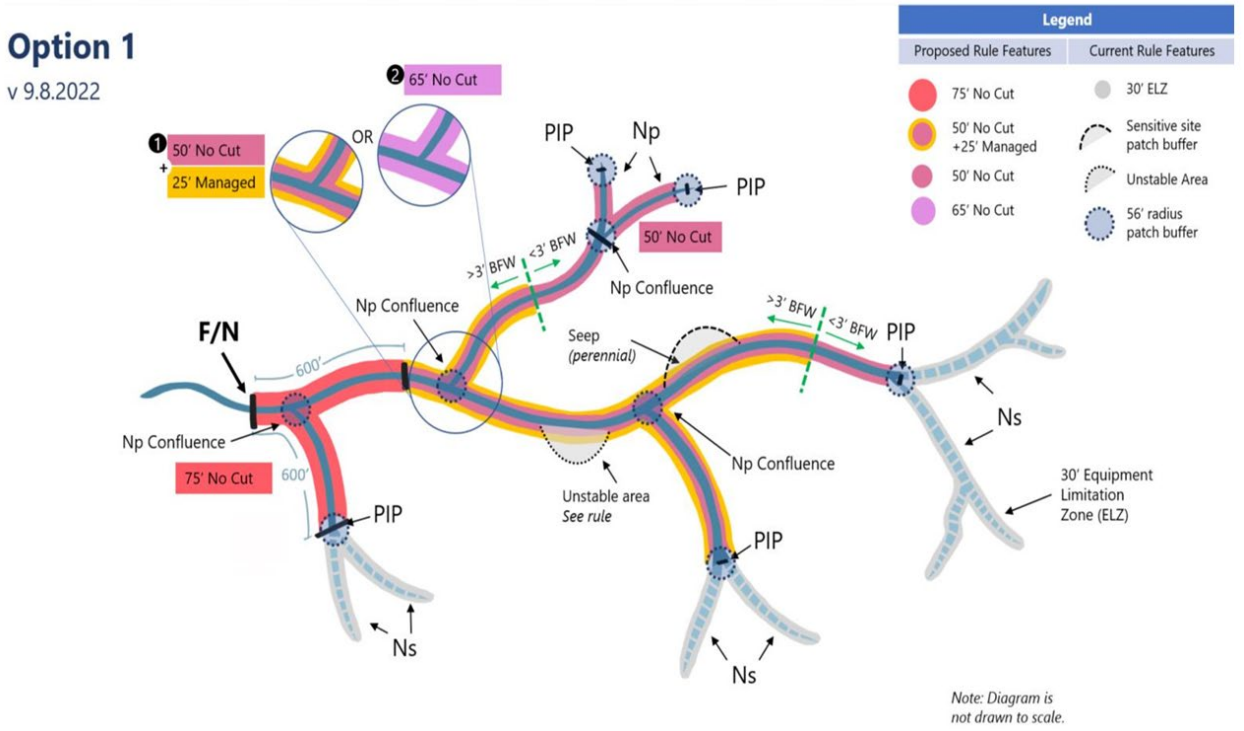

Figure 26. Option 1 from Majority TFW Policy recommendations.

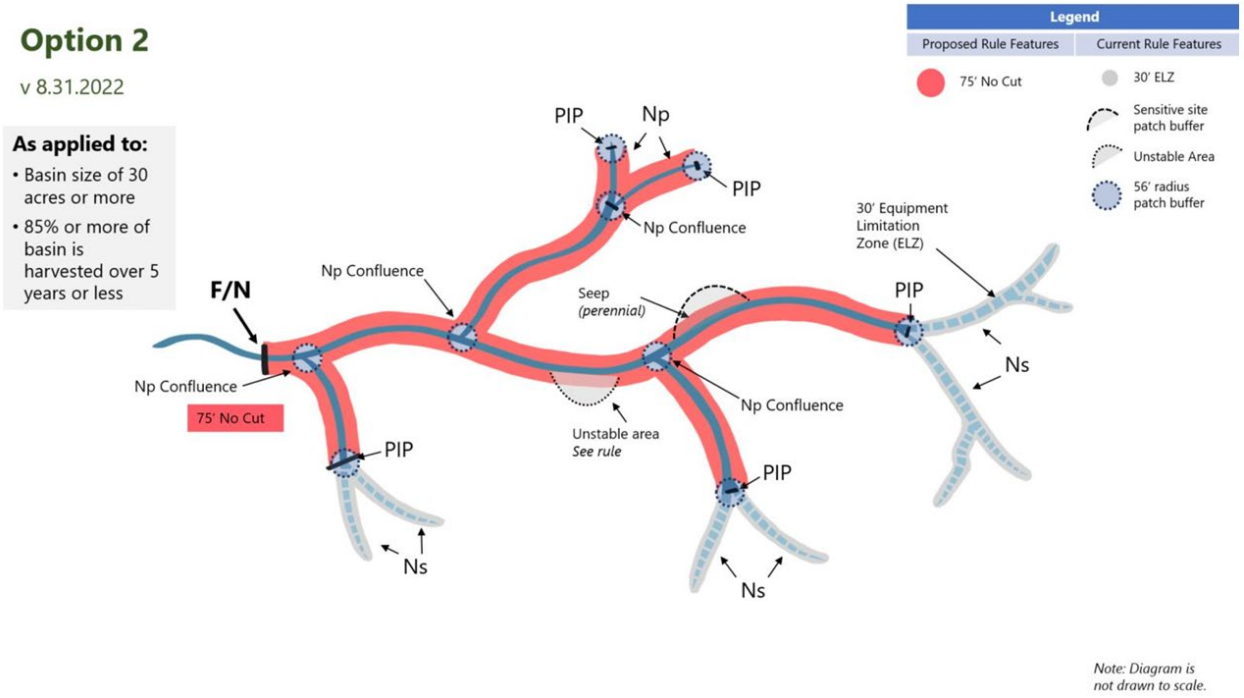

Figure 27. Option 2 from Majority TFW Policy recommendations.

Costs and benefits of a less degrading alternative

Given the proposed rule is likely to cause measurable change in certain Type Np streams, it is important to examine an alternative where there is a higher degree of certainty that no warming beyond 0.3°C will occur. The Type Np Technical Workgroup identified a continuous 2-sided 100-foot buffer (Table 8, Alternative D) as being most likely to meet measurable change standards. The authors state that:

> We expect, with high certainty, that sites with buffers of this size will not on average warm beyond the measurable change standards amount for any given year post-harvest. Uncertainty is moderate since some individual sites will likely exhibit temperature warming above the measurable change standards because of factors related or unrelated to harvest. However, these sites are expected to fall strongly in the minority.

The Type Np Technical Workgroup also qualitatively identified this alternative as having the highest impact to industry, based on best professional judgement.

We decided to select this option as our less degrading alternative for assessing incremental costs and benefits compared to the proposed rule. (By allowing the proposed rule's risk of exceeding Tier II protections on some streams, these costs would be avoided, and benefits would be foregone.) This represents the most protective option considered by the Type Np Technical Workgroup and also represents the upper limit of the shade to temperature response model reported in Quinn et al. (2020)[39]. Below is an analysis of the costs and benefits of this more protective alternative, compared to the proposed rule and to the baseline.

Additional stream miles and acreage impacted by 100-foot buffers

In their Preliminary Cost-Benefit Analysis, IEc identified multiple sources of uncertainty in identifying Type Np streams likely to be impacted by the proposed rule and how riparian buffers on those streams affect temperature. These are summarized in the table below, taken from the Preliminary Cost-Benefit Analysis.

[39] We did not select the full 200-year site potential tree height buffer, as recommended by WDFW in volumes 1 and 2 of the Riparian Ecosystems report, as that encompasses all riparian functions on streams of all sizes. The focus of this Tier II analysis is on impacts to temperature in small headwater streams.

Table 11. IEc's 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
All other areas are harvestable absent the rule.	Overestimate number of affected acres	Potentially major
WC Hydro correctly "types" streams.	Unknown	Likely minor
All forestland outside of Federal, Tribal, and HCP land is subject to the proposed rule.	Overestimate number of affected acres	Likely minor
The proposed 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
The Four Peaks sample provides a reasonable basis for extrapolating across all western WA.	Underestimate number of affected acres	Likely minor
Pleus and Goodman (2003) provide an approach for determining which portion of Nu streams in WC Hydro are Np streams.	Unknown	Likely minor
Outside of basin>30 acres and >85% harvest planned within a five-year period (proposed 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

To estimate the scale of additional streams that would be impacted by an alternative 100-foot buffer requirement, we initially considered performing additional impacted acreage modeling to extend the methodologies used in the Preliminary Cost-Benefit Analysis. This approach would inherently bear the uncertainties listed in the above table, as well as carrying through assumptions about the baseline, and add additional considerations such as potential for wider buffers to intersect one another. Uncertainties would also be compounded by any subsequent extension to estimating additional impacts on stream temperature, habitat, or carbon sequestration.

Recall, also, that Ecology believes the impacts of the proposed rule are likely to be toward the lower end of the acreages and stream miles (and resulting aggregate cost and benefit estimates) estimated in the Preliminary Cost-Benefit Analysis, due to factors discussed in the previous section.

Additional costs of 100-foot buffers

In their Preliminary Cost-Benefit Analysis, DNR identified unit costs associated with property value reductions associated with reduced ability to harvest timber in newly buffered areas. These included (in 2023-dollars):

- $4,590 to $5,907 per acre reduction between harvestable and unharvestable areas
- $2,345 to $3,003 per acre reduction between harvestable and partially harvestable areas.

They also identified various ranges of ground-based, cable-based, and helicopter-based harvest costs, per million board feet of timber. While the analysis was not able to fully quantify and monetize the additional operating costs associated with the proposed rule, it did identify a:

- Minor increase in cable harvest costs among buffers that widen.
- Moderate increase in cable harvest costs among stream miles with new buffers.

The Preliminary Cost-Benefits analysis concluded that, "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." (IEc, 2025. Page 32)

As we were not able to confidently quantify the additional acres likely impacted by extending the proposed rule requirements to 100-foot buffer requirements, we chose to scale the findings of IEC's Preliminary Cost-Benefit Analysis. We made a range of simplifying assumptions to examine the scale of impacts under 100-foot buffer requirements:

1. Low cost: Assuming 50-foot baseline buffer width, increasing to 75 feet under the proposed rule, and to 100 feet under our alternative. Assuming an incremental increase in the minimum 50-foot buffers to buffers twice as wide under the alternative 100-foot buffer requirement would double incremental costs estimated by IEc. This approach resulted in the addition of $320 million to $1.0 billion to the cost of the proposed rule, a doubling of costs estimated in the Preliminary Cost-Benefit Analysis, or an overall range of $640 million to $2.0 billion in present value over 45 years as compared to the baseline.
2. High cost: Assuming 50-foot baseline buffer width, increasing to an average of 62.5 feet under the proposed rule, and to 100 feet under our alternative. Assuming an additional incremental increase of 37.5 feet over the proposed rule would quadruple incremental costs over the baseline. This approach resulted in the addition of $960 million to $3 billion to the cost of the proposed rule, or an overall incremental cost range (compared to the baseline) of $1.3 billion to $4 billion in present value over 45 years.

From a distributional standpoint, IEc's Preliminary Cost-Benefit Analysis (Section 6.3.1) estimates that 11 percent of land value losses due to the proposed rule would be experienced by small forest landowners (SFL). Applying this distinction to our scaled estimates from above for 100-foot buffers, we estimate that SFL's alone may experience an additional $35 million to $330 million to the cost of the proposed rule due to expanding buffer widths from the proposed rule's requirements, or an overall cost range compared to the baseline of $70 million to $440 million in present value over the 45 years compared to the baseline.

We acknowledge that these scaling approaches are likely to:

- Underestimate costs, where:
    - Existing buffers mitigate the impacts of the proposed rule.
    - Larger buffers result in a greater proportion of land shifting to unharvestable than assumed in the Preliminary Cost-Benefit Analysis.
    - Larger harvest restrictions result in broader changes to forestland purchase and management behavior (e.g., in geographies where economies of scale are significantly reduced across multiple parcels).
- Overestimate costs where:
    - The lowest 600 feet of Np streams has a 75-foot buffer under the proposed rule.
    - Larger buffers result in a smaller proportion of land shifting to partially harvestable than assumed in the Preliminary Cost-Benefit Analysis.
    - Larger buffers may be more likely to intersect with one another and result in double-counting.
    - Larger buffers originating on SFL land may intersect with non-SFL boundaries, inflating SFL proportions.

Recall that Ecology believes likely impacts are toward the lower end of ranges of impacts estimated in the Preliminary Cost-Benefit Analysis (see discussion under above "Proposed Rule: Costs and Benefits" section). From this starting point, a scaled increase in costs under either approach would move likely total costs from nearer IEc's low-end estimate of $320 million toward approximately $640 million to $1.3 billion under 100-foot buffer requirements. This would be an upward movement through the overall range of quantified costs estimated in the Preliminary Cost-Benefit Analysis for the proposed rule. While Ecology supports IEc's determination that the likely benefits of the rule exceed the likely costs, accounting for both qualitative and quantitative impacts, and having identified the additional likely benefit of avoided withdrawal of CWA Assurances subject to Ecology director's decision, we acknowledge the resulting impacts of high-end costs would have more impact on local employment, revenues, and taxes. We also acknowledge that the public and decision-makers may benefit from examination of both low-end and high-end impacts under our scaling scenarios. We therefore considered the impacts and context of scaling up the overall range of cost estimates from the Preliminary CBA.

Context of Additional Costs

In their Preliminary Cost-Benefit Analysis, IEc identified proportional impacts of the proposed rule as shown in the following table (for incremental totals and breakdown by ecoregion, see Table 6 and Table 7 above).

Table 12. IEc's Estimated Annual Regional Economic Impacts by Ecoregion (percent of western WA levels; proposed rule compared to baseline).

Direct Job-years Low	Direct Job-years High	Total Job-Years Low	Total Job-Years High	Total Wages Low	Total Wages High	Revenue Low	Revenue High	Stumpage Taxes Low	Stumpage Taxes High
0.5%	2.1%	0.5%	2.2%	0.5%	2.2%	0.5%	2.2%	0.5%	2.5%

Scaling the above impact ranges under 100-foot buffer requirements could result in additional reductions between 0.5% and 7.5% depending on relevant category (employment, wages, revenue, and stumpage taxes), and scenario, or between 1% and 10% overall compared to the baseline. As costs increase, however, impacts to these economic outcomes may become increasingly nonlinear – in other words, market responses to higher costs could become disproportionately larger as costs increase. This could occur if at some cost threshold within either estimated range, the forestry and forest products markets begin to reduce infrastructure or become less competitive than forest products markets unaffected by new buffer requirements, impacting demand as well as supply. Under these conditions, market pressure to further consolidate businesses and forestland ownership are more likely to exceed implicit incentive thresholds for participation in forestry or associated markets for some businesses or owners, or in certain regions. This means eventual impacts could be larger than the range above for the 100-foot buffer alternative.

We also considered an alternative scenario in which we assume likely costs of the proposed rule are at the lower end of the range presented in the Preliminary Cost-Benefit Analysis (based on our observations of likely overestimation of impacted acreage under high-end assumptions, which include assuming all forestland is harvestable, and so capturing baseline requirements as well as proposed rule requirements; see discussion above under "Additional Streams and Acreage Impacted by 100-Foot Buffers"). This would mean a 100-foot continuous buffer requirement would move costs toward the higher end of the range estimated in the Preliminary Cost-Benefit Analysis, which is associated with overall 2.1% to 2.5% impacts to employment, wages, revenue, and stumpage taxes.

It is difficult to confidently identify the degree to which the above impacts pose a risk to the continued function and profitability of industry or programs supported by taxes, and there is no universal measure or threshold for the larger relevance of these impacts for industry function. To better understand the context in which these cumulative impacts would occur, we looked to the current state of economic and social variables related to the forest products industry in Washington.

In the following sections we categorically apply scalers from within the range given above (i.e. jobs, revenue, tax specific) to publicly available economic data. This allows us to estimate the additional impacts of expanding the proposed rule to a 100-foot continuous buffer requirement. Where relevant, we also present total impacts, which include impacts of the proposed rule plus expansion to a 100-foot continuous buffer.

We note that the economic data discussed below differs from the numeric results (e.g., the specific number of job-years) and data underlying models used in the Preliminary Cost-Benefit Analysis. These differences potentially occur because of factors such as different occupations being included (e.g. administrative, managerial, or other business activities) or different scope of revenue classifications at firms owning and operating on affected lands. Nonetheless, these allow us to consider the relative size of potential impacts under a 100-foot continuous buffer requirement.

Employment

In terms of direct employment in the industry, the US Bureau of Labor Statistics identifies five primary occupation types active specifically in the forestry and logging subsector, with corresponding nationwide employment summarized in the table below[40]. (US Bureau of Labor Statistics, 2023)

Table 13. Surveyed employee counts by occupation; Forestry and logging sector, United States.

Data series	Employment, 2023
Fallers	2,960
First-line supervisors/managers of farming, fishing, and forestry workers	2,460
Logging equipment operators	18,120
Sawing machine setters, operators, and tenders, wood	550
Truck drivers, heavy and tractor-trailer	7,740

Focusing in on Washington state, the WA Employment Security Department reports 2023 Occupational Employment and Wage Estimates for the state as a whole, as well as by metropolitan statistical area and nonmetropolitan areas. (WA Employment Security Department, 2023) The occupations above are only captured in statewide and nonmetropolitan areas, but the data also includes additional related occupation classes. The table below summarizes estimated employment and wages in Western Washington.

We note that for the "Heavy and Tractor-Trailer Truck Drivers" class, the data captures employment across all industries in the state, and is likely an overestimate of this type of employment as it relates specifically to the forest products industry. "Fallers" were also not listed in the Western Washington nonmetropolitan data, but were captured in the statewide

[40] https://www.bls.gov/iag/tgs/iag113.htm

data. Understanding that truck drivers and fallers are likely overestimated in the above data, we may still consider the relative scope of potential direct impacts to the industry as a whole.

Table 14. Western WA employment counts and wages, forestry and logging sector.

Western WA Nonmetropolitan Area (NMA) occupational title	Estimated employment	Average hourly wage	25th percentile hourly wage	50th percentile hourly wage	75th percentile hourly wage	Annual wage
First-Line Supervisors of Farming, Fishing, and Forestry Workers	98	$30.34	$22.96	$30.00	$33.92	$63,110
Foresters	120	$35.89	$29.43	$36.31	$41.06	$74,660
Heavy and Tractor-Trailer Truck Drivers (all industries)	1,727	$28.12	$23.43	$26.55	$30.95	$58,480
Logging Equipment Operators	438	$29.66	$28.50	$29.28	$30.26	$61,700
Logging Workers, All Other	241	$29.02	$28.77	$28.78	$28.93	$60,370
Sawing Machine Setters, Operators, and Tenders, Wood	425	$23.59	$18.91	$23.75	$27.61	$49,060
Fallers (statewide)	228	$41.92	$24.57	$40.88	$46.32	$87,190

Compared to the proposed rule, a 100-foot buffer alternative could result in an additional 0.5% to 6.3% reduction in job-years, or the equivalent of 16 to 206 of the above total 3,277 employees' work. In total compared to the baseline, this amounts to an approximate 1.0% to 8.4% reduction in job-years, or the equivalent of 33 to 275 of the above total 3,277 employees' work. It is important when looking at job-year impacts to know they are not necessarily losses of whole positions, but rather consist of multiple smaller reductions (a simplified example would be that 10 job-years could be 10 full-time employees, 20 employees shifting to half-time, or hundreds of employees reducing work hours by a small percentage).

The WA Employment Security Department also publishes establishment size (facility-level or location-level) by industry subsector (WA Employment Security Department, 2024). It lists the Forestry and Logging subsector as having 377 establishments and 3,101 employees (March 2024). The table below summarizes the distribution of establishments in the industry and employment by size. To prevent disclosure of identifiable information for locations with greater than 50 employees, the data for 10 additional facilities with a total of 772 employees is not broken out by size.

Table 15. Distribution of businesses in the forestry and logging sector, by number of employees at location.

	1 - 4 Employees	5 - 9 Employees	10 - 19 Employees	20 - 49 Employees	50 - 99 Employees	100 - 249 Employees
Number of establishments	230	63	45	29	*	*
Total employment	422	410	571	926	*	*

* Withheld to prevent disclosure of individually identifiable data.

If we apply the 1.0% to 8.4% total reduction in direct employment compared to the baseline to the 3,101 employees in this dataset, the corresponding employment losses would be between 31 and 260 job-years in total, between 16 and 195 of which are associated with scaling to a 100-foot buffer alternative from the proposed rule's buffer requirements. If these total impacts were focused on the smallest establishments in the dataset that make up the majority of establishments in this data (1 to 4 employees), the high-end impacts would be the equivalent of about half of employment at those businesses, which employ an average of approximately 2 people. If the smallest businesses were to be most affected by 100-foot buffer requirements and would have difficulty continuing to operate with such reductions in force – particularly at the upper end of the impact range – these more-stringent requirements could result in market pressure to further conglomerate operations into fewer, larger establishments.

Business revenues

We were able to identify US sales volumes for 597 businesses located (headquartered or with an office or similar physical location or address) in Washington that were listed as being in the forestry and logging subsector (D&B, 2025). These businesses had a total US sales volume of over $374 million annually, when considered at the local level. Many of these businesses have parent companies, indicating that some may have a greater ability to adjust to costs over time, depending on internal business structure and planning. The total US sales volume of independent businesses and relevant parent companies was over $281 billion annually.[41]

Total impacts (of a 100-foot buffer requirement compared to the baseline) of approximately 1.0% to 8.8% to revenues associated with local establishments in this dataset would be between $3.7 million and $32.9 million, $1.9 million to $24.7 million of which is attributed to the expansion from the proposed rule to a 100 foot buffer.

[41] We note that establishment counts and sales values are likely underestimated due to missing data for small establishments on account of recently changed addresses, unresponsiveness to surveys, or unpublished investor, regulatory, and other sales information the database relies on.

Stumpage tax revenues

Regarding stumpage tax revenues, the Preliminary Cost-Benefit Analysis notes that, "In 2024, Washington counties received $35.5 million through the timber excise tax fund. Of that total, roughly $32.9 million went to counties in western Washington." It also presents the map below, of the distribution of forest excise tax revenues by county. While it varies by county revenue and budget plans, a total impact of 1.0% to 10.00% to these revenues in total from a 100-foot buffer (compared to the baseline) would be more likely to impact counties that rely more heavily on forest excise tax revenues or target them to specific programs in their budgets, as compared to the impacts of the proposed rule.

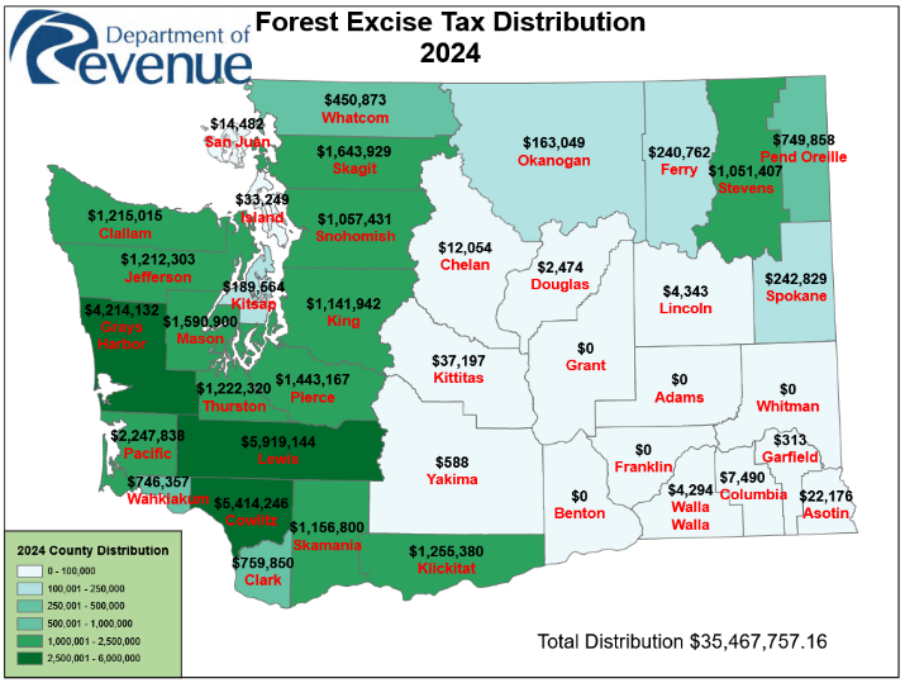

Figure 28. Forest Excise Tax Distribution by County in 2024. Source: DOR (2024).

In discussion of the per-acre costs of the proposed rule, the Preliminary Cost-Benefit Analysis also notes that, "Geospatial analysis presented in IEc (2024) found that 16 percent of the acres abutting streams that may be typed in the future in western Washington are owned by [small forest landowners]. For these acres, the land value losses may be better represented by the high end of our [per-acre cost] range, although we expect the values to fall within our range.". In this way, additional revenue losses from buffer expansion beyond the rule may trend towards the higher end of the aforementioned range.

Infrastructure and supply chain

We were not able to identify data on the specific relationship between forest harvest and its co-reliance with local inputs (e.g., labor) and purchasers of its products further down the supply chain (e.g., sawmills), in terms of what minimum sustainable local levels of activity would be. Ecology uses the REMI E3+ model to examine dynamic impacts of interrelationships between economic factors such as output, labor, prices, and trade over time and across industry sectors,

the public sector, and regions. The model optimizes by allowing all variables to adjust over time. An underlying aspect of the model is an input-output matrix (a static element that does not account for price, wage, or population changes). The matrix presents the amount that is spent on intermediate inputs to an industry to produce one dollar of output from that industry. We examined that data to better understand the relationship between forestry and the associated industries further along the supply chain.

The forestry and logging sector:

- Spends 72 cents on labor and capital inputs combined, to produce a dollar of output.
- Other significant contributors to production include: within-industry spending, support activities and wholesale trade.

The sawmill and wood preservation sector:

- Spends more on forestry and logging products (25 cents per dollar of output) than on either labor or capital.
- Other significant contributors to production include: within-industry spending, wholesale trade, other wood products manufacturing, and truck transportation.

The veneer, plywood, and engineered wood product sector:

- Spends 44 cents on labor and capital inputs combined, to produce a dollar of output.
- Spends 14 cents on the forestry and logging sector to produce a dollar of output.
- Other significant contributors to production include: within-industry spending; wholesale trade; resin, synthetic rubber, and artificial synthetic fibers and filaments; and other wood products manufacturing.

The other wood products sector:

- Spends 45 cents on labor and capital combined, to produce a dollar of output.
- Spends 3 cents on the forestry and logging sector to produce a dollar of output.
- Other significant contributors to production include: sawmills and wood preservation; other wood products; wholesale trade; veneer, plywood, and engineered wood products; and truck transportation.

The pulp, paper, and paperboard mill sector:

- Spends 34 cents on labor and capital combined, to produce a dollar of output.
- Spends 7 cents on forestry and logging to produce a dollar of output.
- Other significant contributors to production include: wholesale trade; sawmills and wood preservation; basic chemical manufacturing; converted paper; fuels; within-industry spending; management; machinery; and truck transportation.

Based on its higher relative spending on forestry and logging, and on the significant contribution of truck transportation (which is also a significant contributor to overall forestry and logging sector employment), we focused further on the sawmill and wood preservation sector. We identified 123 businesses in Washington with sales and employment data in the

sector. Their total US sales were valued at $878 million per year and they have local employment of 4,881. (D&B, 2025) Again, this data may omit businesses that did not respond to surveys or have available publications or reports including sales and employment. Accounting for those with parent companies, this total US sales value across independent and parent businesses rises to over $114 billion.

A 100% to 300% increase in revenue losses in the forestry and logging sector under a 100-foot buffer requirement, compared to the impacts of the proposed rule, would likely more heavily impact the above closely related industries. Based on inter-sectoral financial relationships above, this could particularly be the case in the sawmill and wood preservation sector. The significance of these larger impacts would be determined not only by complex sectoral and individual business relationships, but at higher cost levels could be compounded by geographic factors (e.g., regional availability of timber and locations of sawmill operations) and their interaction with not only timber costs but transportation costs. To the extent these factors combined with at least double the incremental costs would make it more profitable for businesses in the sector to shift business relationships outside current regions, or to seek additional economies of scale, given the economics of alternative options, a 100-foot buffer requirement could put additional pressure on infrastructural shifts within these sectors.

Additional benefits of 100-foot buffers

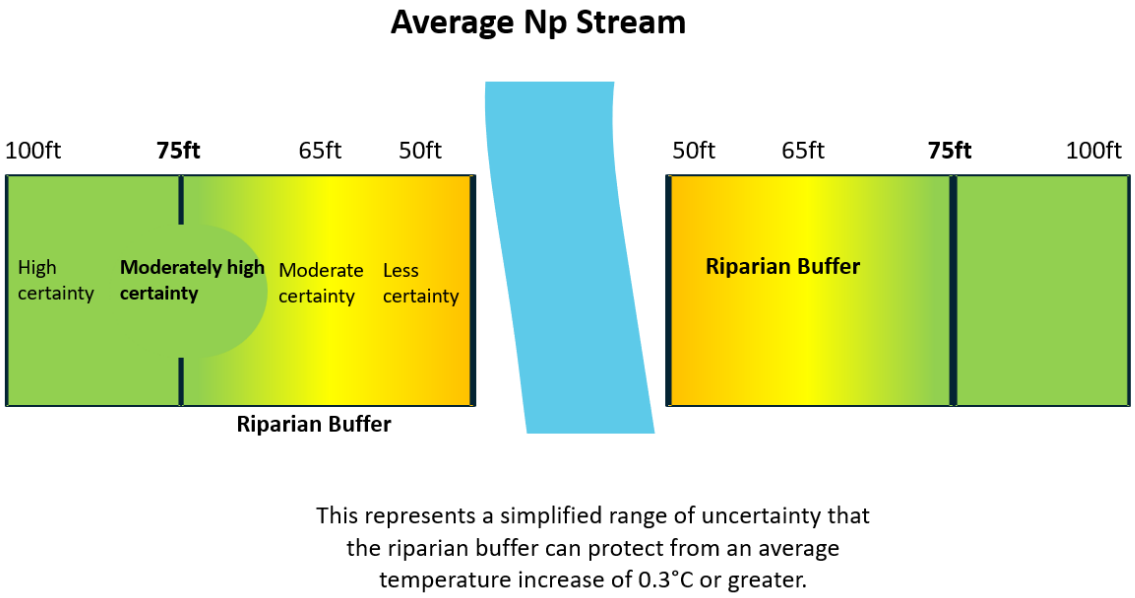

Figure 29. Simplified depiction of relative uncertainties in ability of buffer widths to protect Type Np streams from temperature increases of 0.3°C or greater on average across western Washington. We expect the effectiveness of each buffer scenario to vary due to regional differences and site-specific factors.

While benefits of 100-foot continuous buffer requirements would also increase as compared to the proposed rule, we believe there would be diminishing marginal returns to additional buffer width when it comes to some benefit categories.

Recall that the Preliminary Cost-Benefit Analysis identified the following benefits of the proposed rule:

- Moderate to major reductions in risk of stream temperature increases.
- Moderate to major improvements to 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 improvements to habitat conditions for stream-associated amphibians:
    - 19,000 to 44,000 Np stream miles with wider or longer buffers that will protect species from temperature increases and improve general habitat quality.
- Negligible to minor benefits of improved 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.
- Negligible to minor benefits of 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_2e 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 0.0005 percent and 0.07 percent of all emissions in the state.
    - Avoided climate damages associated with increased carbon sequestration experienced at a global level.
- Tribal cultural values.

Recall Ecology has also identified the likely benefit of avoided withdrawal of CWA Assurances, subject to Ecology Director's decision.

While a requirement for 100-foot continuous buffers would provide more certainty that Tier II temperature protections are met on Type Np waters on average, the most significant incremental benefits would likely be for a minority of streams. In regard to specific benefit

categories identified for the proposed rule to achieve the objectives of this rulemaking, the benefits of expansion to 100-foot continuous buffers would likely differ in the following ways.

- **Risk of stream temperature increases:**
    - We expect that under the proposed rule, streams with less topographic and riparian shade (i.e. north-south oriented, gently sloped valley walls, 50ft buffers) and a higher proportion of surface water (i.e. competent lithologies) are more likely to warm under the proposed rule. Conversely, streams with more topographic and riparian shade (i.e. east-west oriented, steep valley walls, 65-75ft buffers) and have more groundwater influence (i.e. incompetent lithologies) are less likely to warm. It should be emphasized that within this wide spectrum there remains a highly variable landscape where the effectiveness of each buffer scenario will vary due to regional differences and site-specific factors.
    - The greatest benefit would likely be to the stream reaches with only a 50ft buffer under the proposed rule (most likely to see temperature increases). However, shade provided by canopy cover generally begins to diminish beyond approximately 75 feet from the edge of stream (Figure 17). The placement of additional riparian buffer trees beyond 75 feet may have less of an effect on maintaining stream temperatures via direct shade contribution. However, retaining trees beyond 75 feet likely increases the ability of the entire riparian buffer to better resist wind events, potentially increasing overall riparian shade effectiveness. Retaining trees beyond 75 feet may also positively influence the microclimate of the riparian area, however the scientific literature on this is limited.
- **Habitat conditions for terrestrial riparian wildlife:** Habitat conditions would likely improve and expand, maintaining between 100% and 300% additional habitat in our scaling scenarios as compared to the proposed rule. Wider, continuous buffers would also improve a stand's resilience to disturbance events (e.g. high winds), especially higher in the watershed where the smaller 50ft buffers are more likely to be present. There is uncertainty, however, in whether or how these beneficial returns may diminish as buffer width increases.
- **Habitat conditions for stream-associated amphibians:** The greatest benefit would likely be the reduced risk of stream temperature increases and greater terrestrial riparian habitat availability. Even though all of the amphibian species studied in Hard Rock are known to utilize cooler waters, as the authors note, the Costal Tailed Frogs (*A. Truei*) are likely to benefit the most from an expanded buffer prescription. Egg masses and larvae (tadpoles) are found in cold rocky streams (de Vlaming and Bury 1970, Karraker et al. 2006, McIntyre et al. 2021), so a doubling of the buffer width in the upper reaches would likely increase the suitable habitat for reproduction and rearing. The additional buffer width would also increase the terrestrial habitat for the highly mobile long-lived adult Costal Tailed Frogs (Daugherty and Sheldon 1982, McIntyre et al. 2021).

- **Carbon sequestration:** An increase in buffer width would inherently increase the number of trees left standing, and so would increase the carbon sequestered in the larger buffers. Assuming the distribution and composition of trees within the added buffer under a 100-foot buffer requirement is similar to the trees within the buffers required under the proposed rule, this benefit could potentially scale linearly by 100% to 300% (in the aggregate) from the findings of the Preliminary Cost-Benefit Analysis, on the order of 220,000 to 9.9 million additional MT CO_2 (compared to the proposed rule) in total carbon sequestered relative to active timber rotation over the first 45 years of rule implementation, or a total of 440,000 to 13.2 million additional MT CO_2 as compared to the baseline. Larger buffers would also be likely to increase the resilience of riparian stands to wind events, which may aid in further increasing carbon sequestration by preventing loss during these events. We note that such additional protection would be highly site-specific and event-specific.
- **Improved habitat conditions for fish downstream of Np streams:** Similarly to the direct impacts of additional riparian buffer width on stream temperature in buffered areas, the relationship between additional buffer width and downstream habitat conditions is complex and site specific. As we note in the first bullet above, stream temperature improvements generally diminish beyond the initial 75 feet of buffer width, but this additional width may contribute to stand resilience. Subsequent or collective downstream impacts would likely be consistent with findings for the proposed rule in the Preliminary Cost-Benefit Analysis.
- **Tribal cultural values:** As tribal cultural values for instream and riparian areas and the ecosystem services they provide are unquantifiable, we cannot speak to the size of any proportional change in in these unquantifiable values associated with a 100-foot continuous buffer requirement compared to the proposed rule.

Context of Additional Benefits

We expect that under the proposed rule, streams with less topographic and riparian shade (i.e. north-south oriented, 50ft buffers) and a higher proportion of surface water (i.e. competent lithologies) are more likely to warm under the proposed rule. Conversely, streams with more topographic and riparian shade (i.e. east-west oriented, 65-75ft buffers) and have more groundwater influence (i.e. incompetent lithologies) are less likely to warm. As stated previously, it should be emphasized that within this wide spectrum there remains a highly variable landscape where the effectiveness of each buffer scenario will vary due to regional differences and site-specific factors. However, the proposed rule package represents a substantial improvement to water quality protection across the landscape, resulting in substantial increases in protection of temperature responses of 0.3°C or greater.

A 100-foot continuous buffer requirement or similar alternative would reduce the likelihood of degradation occurring on streams more susceptible to warming under the proposed rule. This would also likely generate additional benefits to the streams discussed above (e.g. less warming, riparian stand resilience, associated benefits to stream-associated amphibians, and

potentially to downstream waters). Other benefits related to terrestrial habitat and carbon would occur on all streams with expanded buffer width, though these benefits may not be directly related to stream temperature.

It is important to note, like the authors of the Hard Rock reports did, that the study was not designed to determine the mechanism for increases or decreases in amphibians after harvest. What the authors (McIntyre et al. 2021) could say is that they, "observed a substantial negative response to timber harvest in the eight years post-harvest for some species in some buffer treatments, and for Coastal Tailed Frog in all buffer treatments." McIntyre et al. (2021) goes on to say that: "[I]t is possible that the increased temperatures we 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."

What is also clear is that the same treatment effect that caused the temperature increases at the Hard and Soft Rock sites, can also affect in-stream and riparian habitat for amphibians. McIntyre et al. (2021) reported an increase in in-channel wood loading, from windthrow and logging slash, and a retention of fine sediments in the streams. The authors report that both can have negative consequences for stream-associated amphibians. This decrease in habitat quality can also restrict movement of amphibian populations, that may utilize the stream banks or move between streams (Wahbe and Bunnell 2001, Peterman et al. 2011, McIntyre et al. 2021). The authors point to an increase in wood in the stream and gaps in riparian cover as potential barriers to in-stream and overland travel.

Whether it was an increase in stream temperature, the general degradation of riparian habitat, or a combination of both, the current buffer prescriptions did not provide enough protection for the long-term health of amphibian populations in the Hard Rock study. It is important to note that not all amphibian populations responded in the same way to the different harvest treatments and Hard Rock did not test a 100ft buffer prescription. So, it is difficult to say how much of an increased benefit an additional 25-50ft of buffer would provide stream associated amphibians. However, as with stream temperature, the increase in buffer area from the current rule to the proposed rule represents a substantial improvement to stream associated amphibian habitat. This is especially true for the upper reaches of the watersheds where riparian cover is removed and there is a substantial increase in woody debris in the stream channel.

Necessary and Overriding Public Interest Determination

The Tier II rule states that "Once an activity has been determined to cause a measurable lowering in water quality, then an analysis must be conducted to determine if the lowering of water quality is necessary and in the overriding public interest" (WAC 173-201A-320(4)). The rule also specifies that information to conduct the analysis must include information that "…identifies and selects the best combination of site, structural, and managerial approaches that can be feasibly implemented to prevent or minimize the lowering of water quality" (WAC

173-201A-320(4)(b)), and includes examples that may be considered as alternatives, including "Establishing buffer areas with effective limits on activities" (WAC 173-201A-320(4)(b)(vii)). In this case, Ecology must provide a statement of the benefits and costs of the social, economic, and environmental effects associated with the lowering of water quality (WAC 173-201A-320(4)(a)). To determine whether the potential for lowering water quality beyond Tier II measurable change thresholds under the proposed rule is necessary and in the public interest, we considered not only the relative size of costs and benefits of alternative rule requirements that provided more certainty of protecting Type Np waters from temperature increases of 0.3°C or greater, but also their feasibility within a rulemaking context, and the uncertainties inherent in stream temperature impacts in upper headwaters.

We observe that a central theme to our discussion is the level of certainty with which the proposed rule or a more protective alternative would protect Type Np streams from temperature increases of 0.3°C or greater. This does not mean degradation will occur with certainty on any given stream under the proposed rule (temperature is affected by a number of site-specific factors). Rather, the risk of degradation is necessary because requirements that would more confidently avoid it are potentially not feasible. Feasibility for rulemaking includes the likely ability to meet the Administrative Procedure Act requirement to:

> Determine, after considering alternative versions of the rule and the analysis required under (b), (c), and (d) of this subsection [which includes a determination that the rule is needed to achieve the general goals and specific objectives of the statute that the rule implements; to meet cost-benefit analysis requirements; and a determination 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] that the rule being adopted is the least burdensome alternative for those required to comply with it that will achieve the general goals and specific objectives [of the statute that it implements]. (RCW 34.05.328(1)(e))

The statute implemented by the proposed rule is Chapter 76.09 RCW ("Forest Practices"). The goals and objectives of the statute reflect a need to balance multiple factors, including that "a viable forest products industry is of prime importance to the state's economy" and that, "coincident with maintenance of a viable forest products industry, it is important to afford protection to forest soils, fisheries, wildlife, water quantity and quality, air quality, recreation, and scenic beauty." These goals are further detailed in specific objectives to create and maintain a comprehensive statewide system of laws and forest practices rules that achieve a range of forestland maintenance, industry efficiency, and comprehensive and cooperative system objectives, and to, "achieve compliance with all applicable requirements of federal and state law with respect to nonpoint sources of water pollution from forest practices." (RCW 76.09.010(2)(g)).

As detailed in this report, additional buffer requirements that are less likely to result in degradation would likely result in increased costs. However, despite providing the greatest water quality-related benefits (i.e., related to stream temperature directly or indirectly) to a

subset of streams most at risk of degradation under the proposed rule, we cannot confidently assess the scale and scope of benefits using current knowledge. Therefore, the alternative 100ft continuous buffer, which provides the highest degree of certainty to prevent degradation across Type Np waters, may not currently be able to demonstrate that it would meet the goals and objectives of the authorizing statute with the least necessary burden on those required to comply with it. If this is not possible, such a highly protective alternative would not be feasible. The remaining minor risks of lowering water quality on some waters under the proposed rule would therefore be necessary in order to meet other rule adoption requirements.

Under our simplified scaling assumptions, we observed that a less degrading 100ft alternative buffer requirement would meet Tier II antidegradation protections on average with greater certainty than the proposed rule (i.e., on waters that the proposed rule is less certain to protect from temperature increases of greater than 0.3°C). We observed this could at least double costs in comparison to the proposed rule, including lost land values, jobs impacts, and state revenues. While an expanded buffer would meet Tier II antidegradation protections on average with greater certainty than the proposed rule, we could not determine that it would increase benefits as consistently based on current scientific knowledge. The scale by which temperature-related benefits would increase depends on site-specific and complex relationships between incremental buffer width, stream temperature, habitat, and affected species. The potential for lowering of water quality under the proposed rule is likely in the public interest in avoiding these increased costs and uncertainties in the size of realized benefits.

Table 15 below illustrates Ecology's anticipated performance of buffer scenarios on average across the landscape, based on best available science and professional judgement.[42] The naming convention is reflective of IEc's Preliminary Cost Benefit Analysis and the Type Np Technical Workgroup's final report. If the proposed rule is implemented, we expect the effectiveness of each buffer scenario to vary due to regional differences and site-specific factors.

[42] "Baseline rule" represents the no-action Board alternative. "Proposed rule" represents the Board action alternative. "Less Degrading" represents an alternative evaluated for Ecology's Tier II antidegradation analysis for illustrative purposes only.

Table 16. Summary of Forest Practices Board and Tier II Analysis Alternatives.

Alternative		Description	Certainty of Prescription's Effectiveness for Protecting Western WA Np Waters from Warming Beyond 0.3°C on Average, Across Landscape
Baseline Rule (no action)		WAC 222-30-021*(2)	**High certainty** this buffer rule is ineffective in protecting Type Np waters
Proposed Rule (action)	Scenario 2	If basin >30 acres and >85% harvest planned within five-year period: 75' no-harvest buffer for entire length of Type Np water	**Moderately high certainty** buffer will protect Type Np waters
	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 lowest 600' of stream, then 50' no-harvest buffer along entire stream reach + additional 25' outer buffer representing 50% partial harvest zone	**Moderate certainty** buffer will protect Type Np waters
		Scenario 1A, if BFW<3': 75' no-harvest buffer for lowest 600' of stream, then 50' no-harvest buffer along remaining stream reach	**Less certainty** buffer will protect Type Np waters
	Scenario 1B	If basin <30 acres and/or <85% harvest planned within a five-year period + no cut management strategy and BFW >3': 75' no-harvest buffer for lowest 600' of stream, then 65' no-harvest buffer along remaining stream reach	**Moderate certainty** buffer will protect Type Np waters
Less Degrading	D	100% buffer, 100', both banks.	**High certainty** buffer will protect Type Np waters

Uncertainty associated with the proposed rule's effectiveness may be reduced by relying on additional Adaptive Management Program study. Additional study, in combination with other CMER projects, has valuable potential to increase understanding of small Type Np streams under three-foot bankfull width, which the Hard and Soft Rock CMER studies did not directly evaluate. Further studies may also increase understanding of other contributing factors to Type Np stream temperature in combination with canopy cover, such as windthrow, aspect, topography, lithology, and flow permanence.

Conclusion

Ecology highly values the work conducted by the Forest Practices Board's Adaptive Management Program (AMP) in developing Type Np buffer alternatives. As mentioned earlier in this report, shortly after the baseline Forests and Fish Type Np buffer rule was adopted, sixteen original effectiveness/validation monitoring programs were ranked by CMER, with the study of Type N waters being declared a top priority for addressing key scientific uncertainties and underlying assumptions. Over the 23 years following the original priority ranking, the AMP has spent considerable time and resources studying Type N waters, the effectiveness of the baseline western Washington Type Np buffer rule, and working to adapt to study findings. The program's science clearly illustrates that the baseline rule does not meet the requirements of the Clean Water Act for water quality or the Washington State water quality standards, and has demonstrated to be ineffective in protecting waters of the state from degradation. The action alternative the Board advanced for rulemaking meaningfully attempts to achieve compliance with the requirement to meet Washington State water quality standards while minimizing economic impact to landowners. It is critical to emphasize the significance of this profound adaptive management decision the Forest Practices Board is presented with.

Ecology focused this Tier II antidegradation analysis on the proposed Type Np buffer rule because this represents a new or expanded action per WAC 173-201A-320. We find the proposed rule is likely to result in substantial improvement to Type Np water quality in western Washington when compared to baseline rule conditions. Establishing continuous riparian buffers along Type Np waters represents a considerable step forward in water quality protection. We find that relative to baseline conditions, the proposed rule is likely to significantly improve chances of preventing warming of Type Np waters beyond 0.3°C, which is the threshold where impacts will not cause a measurable change in the physical, biological, and chemical makeup of the water. As a result, the proposed rule is also likely to significantly improve chances in preventing Type Np waters from warming beyond applicable numeric criterion in the water quality standards antidegradation Tier I protections, when compared to baseline conditions. Nevertheless, it remains critical to acknowledge the proposed rule is not anticipated to protect all Type Np waters from warming. Based on our review, following potential implementation of the proposed buffer prescriptions, we anticipate some Type Np streams will exhibit warming beyond 0.3°C following timber harvest activities due to regional and site-specific factors, likely to last no longer than two years.

It may currently be difficult to demonstrate that a less degrading alternative (100ft continuous buffer) would not be an overly burdensome rule on landowners. It would also currently be difficult to demonstrate that the potential incremental benefits of adding 25 to 50ft of buffer to the proposed rule would be commensurate with the additional incremental costs to landowners.

Ecology finds it necessary and in the overriding public interest to allow the Forest Practices Board to adopt the proposed rule, thereby continuing to incur a level of risk, and likely exceeding Tier II measurable change temperature thresholds in some areas.[43] In consideration of the alternatives rigorously developed and refined by the Type Np Technical Workgroup and TFW Policy Committee, Ecology finds the Board's proposed rule is representative of an alternative that selects the best combination of site, structural, and managerial approaches at this time that can be feasibly implemented at the landscape scale (western Washington) to prevent or minimize the lowering of Type Np water quality. The remaining level of risk of exceeding Tier II measurable change temperature thresholds in some areas is necessary and in the public interest to meet administrative requirements for rulemaking (by meeting statutory goals and objectives with least burden) and to avoid potentially significant additional costs to landowners, and resulting impacts to employees, businesses, and local governments. The cost benefit analysis developed for the proposed buffer rule, which we have established would be associated with the lowering of water quality, demonstrates the proposed rule strikes the balance in ensuring the probable benefits likely outweigh the probable costs with respect to social, economic, and environmental effects given current scientific knowledge.

If the Board chooses to adopt the proposed Type Np buffer rule, remaining uncertainty associated with rule effectiveness must be reduced by relying on additional AMP studies. Further studies may increase understanding of other contributing factors to Type Np water temperature in combination with canopy cover, such as bankfull width, windthrow, aspect, topography, lithology, and flow permanence. Following additional scientific study and analysis, additional TFW Policy Committee and Board action may be necessary.

It is important to mention that additional CMER projects are currently underway that are likely to increase our understanding of stream temperature, changes in canopy cover, and amphibian use in headwater streams, including Temperature and Amphibians in Discontinuously Flowing Np Reaches, Extensive Riparian Status and Trends Monitoring Program – Riparian Vegetation and Stream Temperature, and the Riparian Characteristics and Shade Response project. Building from previous Type N studies by further increasing our collective understanding of upper headwater streamflow processes, including temperature response to forest practices treatments, should continue to be a priority for the program.

[43] Ecology's necessary and overriding public interest determination is informed by the following statutes: RCW 76.09.040(1)(b) Forest practices rules pertaining to water quality protection shall be adopted by the board after reaching agreement with the director of the department of ecology or the director's designee on the board with respect to these rules. All other forest practices rules shall be adopted by the board.
RCW 90.48.420 (1) … Adoption of forest practices rules pertaining to water quality by the forest practices board shall be accomplished after reaching agreement with the director of the department or the director's designee on the board. Adoption shall be accomplished so that compliance with such forest practice[s] rules will achieve compliance with water pollution control laws.

The Antidegradation Policy Tier II rule recognizes that many water quality protection programs for general permits and water pollution control programs are in a continual state of improvement or development. The rule states in WAC 173-201A-320(6)(c) that "…antidegradation requirements of this section can be considered met for general permits and programs that have a formal process to select, develop, adopt, and refine control practices for protecting water quality and meeting the intent of this section." Ecology finds that should the proposed rule be adopted, the Forest Practices Board's AMP must be relied upon to address remaining uncertainty with regard to Type Np water quality protection. Ecology will consider antidegradation requirements met for western Washington Type Np streams subject to the Forest Practices Rules under these conditions.

References

Barnowe-Meyer, S., Bilby, R., Groom, J., Lunde, C., Richardson, J., and Stednick, J. 2021. "Review of current and proposed riparian management zone prescriptions in meeting westside Washington State anti-degradation temperature criterion" Timber, Fish, and Wildlife Policy Committee, Washington State Forest Practices Board Adaptive Management Program, Washington Department of Natural Resources, Olympia.

Bladon, K. D., Segura, C., Cook, N. A., Bywater-Reyes, S., & Reiter, M. (2018). A multicatchment analysis of headwater and downstream temperature effects from contemporary forest harvesting. Hydrological Processes, 32(2), 293-304.

Cusimano, R., Merritt, G., Plotnikoff, R., Wiseman, C., Smith, C. 2006. Status and Trends Monitoring for Watershed Health and Salmon Recovery Quality Assurance Monitoring Plan. Washington State Department of Ecology, Lacey, WA. Publication No. 06-03-203.

D&B (Dun & Brandstreet). 2025. Market Insight Database. Accessed April 2, 2025.

Daugherty, C. H., & Sheldon, A. L. (1982). Age-determination, growth, and life history of a Montana population of the tailed frog (Ascaphus truei). *Herpetologica*, 461-468.

de Vlaming, V. L., & Bury, R. B. (1970). Thermal selection in tadpoles of the tailed-frog, Ascaphus truei. *Journal of Herpetology*, 179-189.

Ehinger, W.J., W.D. Bretherton, S.M. Estrella, G. Stewart, D.E. Schuett-Hames, and S.A. Nelson. 2021. Effectiveness of Forest Practices Buffer Prescriptions on Perennial Non-fishbearing Streams on Marine Sedimentary Lithologies in Western Washington. Cooperative Monitoring, Evaluation, and Research Report CMER 2021.08.24, Washington State Forest Practices Adaptive Management Program, Washington Department of Natural Resources, Olympia, WA.

Esri. 2024. ArcGIS Pro (Version 3.3.4). Redlands, CA: Environmental Systems Research Institute

Four Peaks Environmental. 2024. "Spatial Analysis of the Water Typing System Rule Synthetic Stream Development, Comparison of Alternatives, and Buffer Analysis." Prepared for Washington Department of Natural Resources. DNR Contract No. 93-1005525. Dated June 2024.

Gomi, T., R.D. Moore, and A.S. Dhakal. 2006. Headwater stream temperature response to clear-cut harvesting with different riparian treatments, coastal British Columbia, Canada. Water Resources Research 42:1-11.

Gregory, R., Failing, L., Harstone, M., Long, G., McDaniels, T., & Ohlson, D. (2012). Structured decision making: a practical guide to environmental management choices. John Wiley & Sons.

Groom, J.D., L. Dent, L.J. Madsen, and J. Fleuret. 2011. Response of western Oregon (USA) stream temperatures to contemporary forest management. Forest Ecology and Management 262:1618-1629.

Hale, V. C., & McDonnell, J. J. (2016). Effect of bedrock permeability on stream base flow mean transit time scaling relations: 1. A multiscale catchment intercomparison. Water Resources Research, 52(2), 1358-1374.

Hubler, S., Stamp, J., Sullivan, S. P., Fernandez, M., Larson, C., Macneale, K., ... & Bierwagen, B. (2024). Improved thermal preferences and a stressor index derived from modeled stream temperatures and regional taxonomic standards for freshwater macroinvertebrates of the Pacific Northwest, USA. Ecological Indicators, 160, 111869.

Industrial Economics, Incorporated (IEc) 2025. "Washington State Type Np Water Buffer Proposed Rule Final Preliminary Cost Benefit Analysis" Dated April 23, 2025.

Janisch, J.E., S.M. Wondzell, and W.J. Ehinger. 2012. Headwater stream temperature: Interpreting response after logging, with and without riparian buffers, Washington, USA. Forest Ecology and Management 270:302-313.

Karraker, N. E., Pilliod, D. S., Adams, M. J., Bull, E. L., Corn, P. S., Diller, L. V., ... & Peterson, C. R. (2006). Taxonomic variation in oviposition by tailed frogs (Ascaphus spp). *Northwestern Naturalist*, *87*(2), 87-97.

Kennedy, J.T., H. Nicholas, S. Job, J. Butcher, S. Hood, T. Mohamedali, 2020. South Fork Nooksack River Temperature Total Maximum Daily Load Water Quality Improvement Report and Implementation Plan. Washington State Department of Ecology. Publication No. 20-10-007.

McIntyre, A.P., M.P. Hayes, W.J. Ehinger, S.M. Estrella, D. Schuett-Hames, and T. Quinn (technical coordinators). 2018. Effectiveness of Experimental Riparian Buffers on Perennial Non-fish-bearing Streams on Competent Lithologies in Western Washington. Cooperative Monitoring, Evaluation, and Research Report, CMER 18-100. Washington Department of Natural Resources, Olympia, WA. 890 p.

McIntyre, A.P., M.P. Hayes, W.J. Ehinger, S.M. Estrella, D.E. Schuett-Hames, R. Ojala-Barbour, G. Stewart, and T. Quinn (technical coordinators). 2021. Effectiveness of Experimental Riparian Buffers on Perennial Non-fish-bearing Streams on Competent Lithologies in Western Washington—Phase 2 (9 Years after Harvest). Cooperative Monitoring, Evaluation, and Research Report CMER 2021.03.23, Washington State Forest Practices Adaptive Management Program, Washington Department of Natural Resources, Olympia, WA.

Moore, R. D., Sutherland, P., Gomi, T., & Dhakal, A. (2005). Thermal regime of a headwater stream within a clear-cut, coastal British Columbia, Canada. Hydrological Processes: An International Journal, 19(13), 2591-2608.

Peterman, W. E., Crawford, J. A., & Semlitsch, R. D. (2011). Effects of even-aged timber harvest on stream salamanders: support for the evacuation hypothesis. *Forest Ecology and Management*, *262*(12), 2344-2353.

Quinn, T., Wilhere, G. F., & Krueger, K. L. (Eds.). (2020). *Riparian Ecosystems, Volume 1: Science synthesis and management implications*. Washington Department of Fish and Wildlife.

Schuett-Hames, D & Stewart, G. (BCIF), 2019. Changes in stand structure, buffer tree mortality and riparian-associated functions 10 years after timber harvest adjacent to non-fish-bearing perennial streams in western Washington. Cooperative Monitoring Evaluation and Research Report. Washington State Forest Practices Adaptive Management Program. Washington Department of Natural Resources, Olympia, WA.

Tague, C., & Grant, G. E. (2004). A geological framework for interpreting the low-flow regimes of Cascade streams, Willamette River Basin, Oregon. Water Resources Research, 40(4).

US Bureau of Labor Statistics. 2023. Occupational Employment and Wage Statistics (OEWS) Survey. Data for Washington State, Cross-industry. https://www.bls.gov/iag/tgs/iag113.htm

Wahbe, T. R., & Bunnell, F. L. (2001). Preliminary observations on movements of tailed frog tadpoles (Ascaphus truei) in streams through harvested and natural forests. *Northwest science.*, *75*(1), 77-83.

Washington State Department of Ecology (Ecology). 2011. "Supplemental Guidance on Implementing Tier II Antidegradation." Publication no. 11-10-073. https://apps.ecology.wa.gov/publications/documents/1110073.pdf

Washington State Employment Security Department. 2023. 2023 Occupational employment and wage estimates. Published by the Washington State Employment Security Department, Data Architecture, Transformation and Analytics (DATA) division. https://esd.wa.gov/labormarketinfo/occupations

Washington State Employment Security Department. 2024. Establishment Size Report, Washington state, March 2024. Covered employment classified by number of establishments and employment size. Employment Security Department, Labor Market Information and Research.

Wilkerson, E., Hagan, J. M., Siegel, D., & Whitman, A. A. (2006). The effectiveness of different buffer widths for protecting headwater stream temperature in Maine. Forest Science, 52(3), 221-231.

Appendix A. Public Involvement Information

This report, Ecology's Draft Tier II Antidegradation Analysis, is not a component of the Forest Practices Board's formal rulemaking materials. However, public participation is a required element of the state's antidegradation program. The Tier II Antidegradation Policy states "…Public involvement with the Tier II review will be conducted in accordance with the public involvement processes associated with these actions [Other water pollution control programs]" (WAC 173-201A-320(2)). Ecology considers the state Forest Practices Rules to be an "Other water pollution control program." Therefore, Ecology is holding a concurrent public review period generally consistent with the Forest Practices Board's established public review period for the proposed western Washington Type Np buffer rule as identified in the Board's CR-102 Proposed Rule Making form submitted to the Office of the Code Reviser.

Ecology needs to make a Tier II antidegradation determination for the Forest Practices Board's proposed western Washington Type Np buffer rule because this proposed rule represents a new or expanded action per WAC 173-201A-320 and has been determined to cause a measurable lowering in water quality. The waters being affected are non-fish perennial waters as defined in WAC 222-16-031*(4) on lands subject to the State Forest Practices Rules and Habitat Conservation Plan in western Washington. Constituents of concern include landowners, the timber industry, state and federal agencies, Tribes, the environmental community, local governments, and the general public.

Public Comment

Ecology invites public comment on our draft analysis from midnight July 7, 2025, until 11:59 p.m. on Aug. 18, 2025. We welcome all comments that address the draft Tier II analysis. However, comments on the Board's proposed Type Np buffer rule need to be directed to the Forest Practices Board through the Board's public comment process.

How can I comment?

- You can submit comments online[44] (until 11:59 p.m. on August 18, 2025)
- By US Mail (must be postmarked by August 18, 2025):
  Watershed Management Section
  Department of Ecology
  PO Box 47696
  Olympia, WA 98504-7696
- At our public hearing on July 31 at 5:30 p.m. (details below)

[44] https://wq.ecology.commentinput.com/?id=juMmcHx2Ff

Public Hearing

Ecology will hold a virtual public hearing via Zoom webinar format on our draft Tier II analysis. The hearing will begin with a short presentation about the draft analysis. Formal public testimony will start immediately after the presentation. We encourage both questions and comments to be submitted during the public testimony period. The hearing will conclude once everyone who wants to provide testimony has had the opportunity to do so. Written comments will receive the same consideration as oral testimony.

Webinar hearing – July 31, 2025, 5:30 p.m.

- Register for the webinar[45]

  After registering, you will receive information on how to join on your computer or phone.

Next steps

Following the public comment period, we will review and respond to comments received. We will incorporate feedback, finalize our analysis, and provide a final Tier II Antidegradation Analysis report on our webpage and to the Forest Practices Board prior to the Board's Nov. 12, 2025, meeting. We will update this appendix to provide a response to comments in our final Tier II analysis report.

[45] https://waecy-wa-gov.zoom.us/meeting/register/4jfrgkDbS_q4z46lJh_yPQ#/registration

Appendix B. Regulatory Context for Forest Practices in Washington State Needing to Meet State Water Quality Standards

Table B-1. Regulatory Context for Forest Practices in Washington State Needing to Meet State Water Quality Standards.

Document	Purpose	Description/Result
Forests and Fish Report April 1999	Goals. The authors of this Report have been working to develop biologically sound and economically practical solutions that will improve and protect riparian habitat on non-federal forest lands in the State of Washington (page 2).	The goals of the forestry module discussions are four fold: (1) to provide compliance with the Endangered Species Act for aquatic and riparian dependent species on non-federal forest lands; (2) to restore and maintain riparian habitat on non-federal forest lands to support a harvestable supply of fish; (3) to meet the requirements of the Clean Water Act for water quality on non-federal forest lands; and (4) to keep the timber industry economically viable in the State of Washington. Forest and Fish Report Appendix M - Assurances M.3 Assurances related to the Clean Water Act. EPA's and DOE's assurances are contained in Schedule M-2. Each of EPA and DOE agree for the benefit of the other authors of this Report to fully perform their obligations under Schedule M-2. Schedule M-2 - Clean Water Act Section 303 Assurances
Salmon Recovery Act ENGROSSED SUBSTITUTE HOUSE BILL 2091 Chapter 4, Laws of 1999 (partial veto) 56th Legislature 1999 1st Special Session FOREST PRACTICES--SALMON RECOVERY	Took the Forests and Fish Report and turned it into a bill that became state law. This bill was codified into three different state statutes.	Chapter 76.09 RCW – Forest Practices Chapter 77.85 RCW – Salmon Recovery Chapter 90.48 RCW – Water Pollution Control
Chapter 76.09 RCW	Forest Practices Act	76.09.010 - Legislative finding and declaration (2) The legislature further finds and declares it to be in the public interest of this state to create and maintain through the adoption of this chapter a comprehensive statewide system of laws and forest practices rules which will achieve the following purposes and policies: (g) Achieve compliance with all applicable requirements of federal and state law with respect to nonpoint sources of water pollution from forest practices; 76.09.020 definitions

Document	Purpose	Description/Result
		(4) "Aquatic resources" includes water quality, salmon, other species of the vertebrate classes Cephalaspidomorphi and Osteichthyes identified in the forests and fish report, the Columbia torrent salamander (Rhyacotriton kezeri), the Cascade torrent salamander (Rhyacotriton cascadae), the Olympic torrent salamander (Rhyacotriton olympian), the Dunn's salamander (Plethodon dunni), the Van Dyke's salamander (Plethodon vandyke), the tailed frog (Ascaphus truei), and their respective habitats. 76.09.040 Forest practices rules—Adoption—Review of proposed rules—Hearings—Fish protection standards—Program for the acquisition of riparian open space (1)(b) Forest practices rules pertaining to water quality protection shall be adopted by the board after reaching agreement with the director of the department of ecology or the director's designee on the board with respect to these rules. All other forest practices rules shall be adopted by the board. 76.09.040(2)(a) 2)(a) The board shall prepare proposed forest practices rules consistent with this section and chapter 34.05 RCW. In addition to any forest practices rules relating to water quality protection proposed by the board, the department of ecology may submit to the board proposed forest practices rules relating to water quality protection. (b)(i) The board shall hold one or more hearings on the proposed rules pursuant to chapter 34.05 RCW. Any county representative may propose specific forest practices rules relating to problems existing within the county at the hearings. (ii) The board may adopt and the department of ecology may approve such proposals if they find the proposals are consistent with the purposes and policies of this chapter. 76.09.370 Findings-Forest and Fish report-Adoption of rules (7) In adopting permanent rules, the board shall incorporate the scientific-based adaptive management process described in the forests and fish report which will be used to determine the effectiveness of the new forest practices rules in aiding the state's salmon recovery effort. The purpose of an adaptive management process is to make adjustments as quickly as possible to forest practices that are not achieving the resource objectives. The adaptive management process shall incorporate the best available science and information, include protocols and standards, regular monitoring, a scientific and peer review process, and provide recommendations to the board on proposed changes to forest practices rules to meet timber industry viability and salmon recovery.

Document	Purpose	Description/Result
Chapter 77.85 RCW	Salmon Recovery Act	77.85.180 Findings (1) The legislature finds that the forests and fish report as defined in RCW 76.09.020 was developed through extensive negotiations with the federal agencies responsible for administering the endangered species act and the clean water act. The legislature further finds that the forestry industry, small landowners, tribal governments, state and federal agencies, and counties have worked diligently for nearly two years to reach agreement on scientifically based changes to the forest practices rules, set forth in the forests and fish report as defined in RCW 76.09.020. The legislature further finds that if existing forest practices rules are amended as proposed in the forests and fish report as defined in RCW 76.09.020, the resulting changes in forest practices (a) will lead to: (i) Salmon habitat that meets riparian functions vital to the long-term recovery of salmon on more than sixty thousand miles of streams in this state; (ii) identification of forest roads contributing to habitat degradation and corrective action to remedy those problems to protect salmon habitat; (iii) increased protection of steep and unstable slopes; and (iv) the implementation of scientifically based adaptive management and monitoring processes for evaluating the impacts of forest practices on aquatic resources, as defined in RCW 76.09.020, and a process for amending the forest practices rules to incorporate new information as it becomes available; (b) will lead to the protection of aquatic resources to the maximum extent practicable consistent with maintaining commercial forest management as an economically viable use of lands suitable for that purpose; and (c) will provide a regulatory climate and structure more likely to keep landowners from converting forestlands to other uses that would be less desirable for salmon recovery. (2) The legislature further finds that the changes in laws and rules contemplated by chapter 4, Laws of 1999 sp. sess., taken as a whole, constitute a comprehensive and coordinated program to provide substantial and sufficient contributions to salmon recovery and water quality enhancement in areas impacted by forest practices and are intended to fully satisfy the requirements of the endangered species act (16 U.S.C. Sec. 1531 et seq.) with respect to incidental take of salmon and other aquatic resources and the clean water act (33 U.S.C. Sec. 1251 et seq.) with respect to nonpoint source pollution attributable to forest practices. 77.85.190 Federal assurances in forests and fish report—Events constituting failure of assurances—Governor's authority to negotiate. (1) Chapter 4, Laws of 1999 sp. sess. has been enacted on the assumption that the federal assurances described in the forests and fish report as defined in

Document	Purpose	Description/Result
		RCW 76.09.020 will be obtained and that forest practices conducted in accordance with chapter 4, Laws of 1999 sp. sess. and the rules adopted under chapter 4, Laws of 1999 sp. sess. will not be subject to additional regulations or restrictions for aquatic resources except as provided in the forests and fish report. (2) The occurrence of any of the following events shall constitute a failure of assurances: (e) The environmental protection agency or department of ecology fails to provide the clean water act assurances described in appendix M to the forests and fish report;
Chapter 90.48 RCW	Water Pollution Control Act	90.48.010 Policy Enumerated It is declared to be the public policy of the state of Washington to maintain the highest possible standards to insure the purity of all waters of the state consistent with public health and public enjoyment thereof, the propagation and protection of wild life, birds, game, fish and other aquatic life, and the industrial development of the state, and to that end require the use of all known available and reasonable methods by industries and others to prevent and control the pollution of the waters of the state of Washington. Consistent with this policy, the state of Washington will exercise its powers, as fully and as effectively as possible, to retain and secure high quality for all waters of the state. 90.48.420 Water quality standards affected by forest practices—Department of ecology solely responsible for water quality standards—Forest practices rules—Adoption—Examination—Enforcement procedures. 1) The department of ecology, pursuant to powers vested in it previously by chapter 90.48 RCW and consistent with the policies of said chapter and RCW 90.54.020(3), shall be solely responsible for establishing water quality standards for waters of the state. On or before January 1, 1975, the department of ecology shall examine existing rules containing water quality standards and other applicable rules of said department pertaining to waters of the state affected by nonpoint sources of pollution arising from forest practices and, when it appears appropriate to the department of ecology, modify said rules. In any such examination or modification the department of ecology shall consider such factors, among others, as uses of the receiving waters, diffusion, down-stream cooling, and reasonable transient and short-term effects resulting from forest practices. Adoption of forest practices rules pertaining to water quality by the forest practices board shall be accomplished after reaching agreement with the director of the department or the director's designee on the board. Adoption shall be

Document	Purpose	Description/Result
		accomplished so that compliance with such forest practice[s] rules will achieve compliance with water pollution control laws.
Implements Chapter 90.48 RCW	WAC 173-201A Surface Water Quality Standards	These rules are developed under the authorities provided by the State Water Pollution Control Act. State development of Water Quality Standards is a federal requirement under the Federal Clean Water Act. State standards consist of designated uses of a waterbody, criteria to protect designated uses, and antidegradation requirements to protect existing uses and high quality/high value waters.
RCW 76.09	WAC 222 FOREST PRACTICES BOARD	This WAC has 15 chapters that include practices, board function etc. Below are key chapters.
	WAC 222-12-010 Authority	Promulgation of all forest practices rules shall be accomplished so that compliance with such forest practices rules will achieve compliance with the water quality laws. Those rules marked with an asterisk (*) pertain to water quality protection; pursuant to RCW 76.09.040 they can be amended only by agreement between the board and the department of ecology.
	WAC 222-12- 045 Adaptive management program	(2) Program elements: By this rule, the board establishes an active, ongoing program composed of the following initial elements, but not to exclude other program elements as needed: (a) Key questions and resource objectives: Upon receiving recommendations from the Timber/Fish/Wildlife (TFW) policy committee, or similar collaborative forum, the board will establish key questions and resource objectives and prioritize them. (i) Projects designed to address the key questions shall be established in the order and subject to the priorities identified by the board. (ii) Resource objectives are intended to ensure that forest practices, either singularly or cumulatively, will not significantly impair the capacity of aquatic habitat to: (A) Support harvestable levels of salmonids; (B) Support the long-term viability of other covered species; or (C) Meet or exceed water quality standards (protection of beneficial uses, narrative and numeric criteria, and antidegradation).

Appendix C. Discussion of Potential Loss of Clean Water Act Assurances and Related Uncertainty

Ecology considers Forest Practices Rules to meet the objectives of the Clean Water Act (CWA) and state water quality standards, so long as regulations are upgraded as called for in adaptive management (page 172, bullet 4, Forests and Fish Report, Schedule M-2).

The CWA Assurances depend heavily on a rigorous and reliable adaptive management process to address the uncertainty of the Forest Practices Rules' ability to meet required water quality protections. The CWA Assurances apply to the Forest Practices Program, which includes landowners covered by the FPHCP. These "assurances" mean that so long as landowners comply with Forest Practices Rules, the rules are tested for effectiveness, and the rules are upgraded as determined necessary through adaptive management, the development of Total Maximum Daily Loads (TMDLs) remains a low priority for Ecology (page 167, Forests and Fish Report, Schedule M-2).

Further explanation of CWA Assurances can also be found in the Water Quality Program Policy 1-11, Chapter 1,[46] page 50:

> *"Under state law, landowners must conduct forest practices activities in a manner that supports the attainment of water quality standards. In 2000, Washington adopted revised forest practices rules that identify stream buffers and other management prescriptions expected to meet water quality standards. The state Forest Practices Board tests the forestry rules through a formal adaptive management program, which has the goal of identifying and expediently revising any forestry rules that do not support the attainment of water quality standards. Washington established the Clean Water Act Assurances as a formal agreement in the 1999 Forests and Fish Report in recognition of the improvements to the rules and commitments made. Ecology views the forest practices rules, with its adaptive management program, as providing protection equal to what would occur under a TMDL in watersheds where the rules apply. For this reason, TMDL development is a low priority in watersheds where forestry is the primary land use. Ecology may assign a higher TMDL development priority to forested watersheds with a broader mixture of land uses, but Ecology would still rely upon the forest practices rules to address any portion of the pollution contributed by forestry activities.* ***The agreement to rely on the forest practices rules in lieu of developing separate TMDL load allocations or implementation requirements remains conditioned on maintaining an effective adaptive management program" (emphasis added).***

It is important to understand the potential impact of withdrawing CWA Assurances. If Ecology withdraws the Assurances, the impact may not be limited to Type Np streams in western Washington but instead may impact the Forest Practices Program overall. The reason for this is

[46] https://apps.ecology.wa.gov/publications/documents/1810035.pdf

the withdrawal of programmatic Assurances would mean Ecology may no longer be able to rely on the Forest Practices Adaptive Management Program (AMP) to upgrade protections for waters of the state (RCW 90.48.020) when Cooperative Monitoring Evaluation Research (CMER) studies determine existing forest practices rules pertaining to water quality are ineffective at maintaining required water quality protections.

Without a new Np buffer rule, there is potential for additional 303(d) listings for Np streams and other waters of the state (RCW 90.48.020) if water temperatures increase above water quality criteria. Further, impaired waters of the state on FPHCP lands are assigned a low priority for Total Maximum Daily Load (TMDL) development because of the Clean Water Act Assurances, which rely on the Forest Practices AMP to improve water quality protections when determined necessary. If Type Np rule upgrades are not adopted and Ecology withdraws CWA Assurances, Ecology would need to reprioritize category 5 (impaired) waters that were previously covered by the Clean Water Act Assurances for TMDL development. This will result in additional costs associated with TMDL development and implementation, however the extent and scale to the state and landowners remain uncertain. There will also be likely costs associated with updating TMDLs that previously relied on the assurances to address upstream areas.

In addition to TMDL reprioritization and the need to update previously completed TMDLs that relied on the assurances, there will likely be additional costs related to the modeling and analysis required for TMDLs with a forestry component. In the past Ecology largely relied on deferring to the implementation of the forest practices rules and AMP in lieu of modeling those areas and assigning actions to comply with load allocations in the TMDL. Additional compliance costs to those regulated by the TMDL are also likely, however, they remain uncertain.

For greater context in understanding what the “world without Clean Water Act Assurances” may look like, we encourage consideration of the following real-world example:

The South Fork Nooksack River is currently impaired for temperature and has an approved TMDL and Water Quality Improvement Report and Implementation Plan (Kennedy et al. 2020). In the Forestry Practices section (page 154), Kennedy et al. (2020) states that, “The state’s forest practices regulations will be relied on to bring waters into compliance with the load allocations established in this TMDL project on private and state forest lands…The agreement to rely on the forest practices rules in lieu of developing separate TMDL load allocations or implementation requirements for forestry is conditioned on maintaining an effective adaptive management program.” This section is critical for Ecology when developing temperature TMDLs in mixed use watersheds. It allows the authors to assume all FPHCP lands within the watershed meet shade requirements (and temperature limits by extension) when developing effective shade models and load allocations.

In the Shade load allocations section (page 139), the authors note that “For the tributaries to the SFNR [South Fork Nooksack River], which are not modeled individually, the load allocations for effective shade are represented as shade curves in Figure [C-1] …The goal was to capture the characteristics of any tributary over a range of channel widths and aspects that occur in the

SFNR watershed." This approach would no longer be effective if there were known shade deficits in the Type Np stream networks on FPHCP lands. Instead, the authors would have needed to follow the procedure for the SFNR mainstem, as laid out in the Analytical Approach (page 60) and TMDL Analysis (page 61) sections.

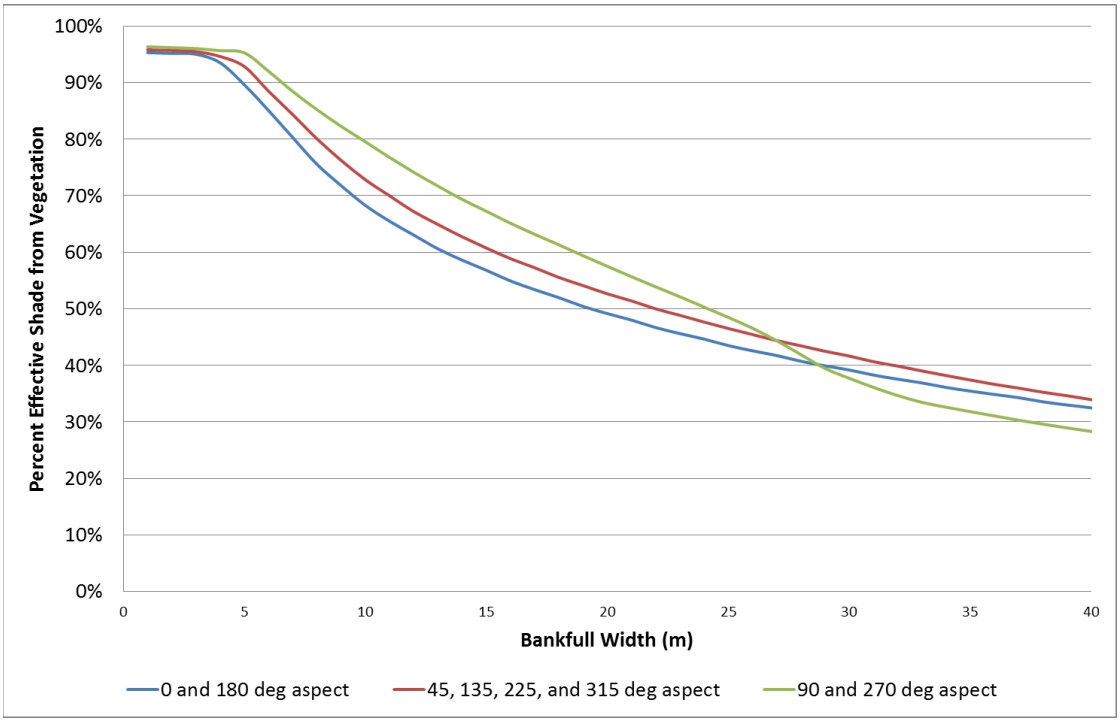

Figure C-1. Shade Curve for determining load allocations of effective shade for tributaries (Kennedy et al. 2020).

The authors are clear in the Shade Load Allocation section that load "allocations for the South Fork Nooksack temperature TMDL establish limits on the allowable heat load from nonpoint sources. The TMDL quantifies heat loads in terms of Watts/m2 and as effective shade. Effective shade allocations control delivery of direct solar radiation to the stream, both to the mainstem and its tributaries. This is considered the largest source of heat."

If the baseline Type Np rule remains in effect and withdrawal of CWA Assurances no longer allows Ecology to assume nonpoint sources of pollution are addressed by the Forest Practices AMP, then Ecology would need to find another way to address nonpoint heat sources in the Type Np networks. There is a high degree of uncertainty around what this would look like, but it is likely to be disruptive to the regulatory environment and potentially very costly in areas, like the South Fork Nooksack watershed, where forestry is a major land use (Figure C-2).

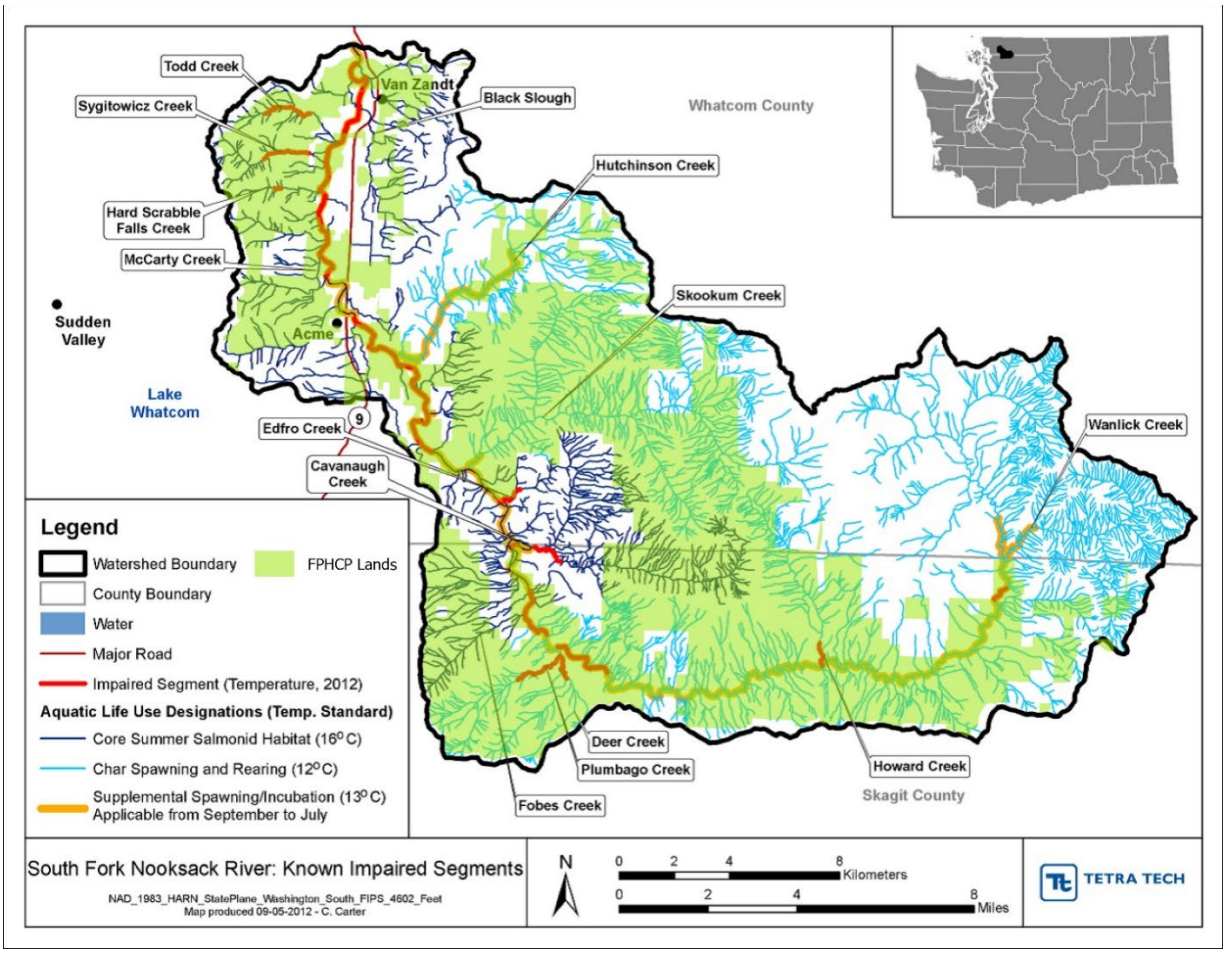

Figure C-2. Map from the South Fork Nooksack temperature TMDL showing designated use categories and impaired waters, overlaid with FPHCP lands (Adapted from Kennedy et al. 2020).

Below are several areas of uncertainty Ecology would need to investigate in a world without CWA Assurances specific to the Nooksack TMDL and including the baseline western Washington Type Np rule:

- Modeling stream networks and riparian buffers in the upper watershed.
- Revising methods to update new load allocations for effective shade.
- Developing implementation strategies for applying load allocations for effective shade to Forest Practices HCP lands.
- Analysis of potential liabilities that may exist.

Additionally, it is important to note that addressing impaired waters across regions of the state, depending on local factors that influence impairments, results in substantial regulatory uncertainty regarding how landowners with impaired waters would be affected. Ecology would need to determine the appropriate scale when assessing shade deficits and temperature impairments. This could be individual watersheds or at the broader landscape level, depending on location and scale of impaired waters.

Appendix D. Acronyms

Table D-1. Acronyms.

Acronym	Meaning
7DTR	Seven Day Average Temperature Response
7DADM	Seven Day Average Dailly Maximum temperature
AKART	All known, available, and reasonable methods of prevention, control, and treatment
AMP	Forest Practices Adaptive Management Program
APA	Administrative Procedure Act, Chapter 34.05 Revised Code of Washington State
BCIF	Westside Type N Buffer Characteristics, Integrity and Function Project
CBA	Cost Benefit Analysis
CFR	Code of Federal Regulations
CMER	Cooperative Monitoring Evaluation Research Committee
CWA	Clean Water Act
DNR	Washington State Department of Natural Resources
Ecology	Washington State Department of Ecology
IEC	Industrial Economics Incorporated
ISPR	Independent Scientific Peer Review
FP	Forest Practices
FPHCP	Forest Practices Habitat Conservation Plan
EPA	Environmental Protection Agency
MMTR	Mean Monthly Temperature Response
Np	Non-fish Perennial
NPDES	National Pollutant Discharge Elimination System
PiP	Perennial Initiation Point
TMDL	Total Maximum Daily Load
TFW	Timber, Fish and Wildlife
RCW	Revised Code of Washington State
RFA	Regulatory Fairness Act, Chapter 19.85 Revised Code of Washington State
RMZ	Riparian Management Zone
UMPPF	Uppermost Point of Perennial Flow
WAC	Washington Administrative Code