Adaptive Management Proposal Initiation
Headwater Stream Smart Buffer Pilot Project
April 21, 2020

Introduction

In May 2019 TFW Policy provided a consensus action recommendation to the Forest Practices Board (FPB) in response to the Type N Hardrock Study, Phase I. That recommendation included formation of a workgroup of scientific and operational experts tasked with reviewing the science relevant to Type Np streams, with the goal of producing alternative Type Np riparian management zone (RMZ) recommendations to TFW Policy for western Washington designed to meet a suite of objectives, including but not limited to, stream temperature standards and minimal economic impact. The workgroup began meeting in November 2019 and has additional meetings scheduled through at least June 2020.

There are more than two dozen projects identified in the Type N Riparian Prescription Rule Group section of the current CMER Workplan, less than half of which have been completed. The TFW Policy Type N workgroup charter specifically calls out six of the western Washington Type N projects in the CMER Workplan, either already completed or anticipated to be complete within the next several months, to be considered. The workgroup may also identify knowledge gaps and utilize outside science/expertise to fill those gaps.

One of the knowledge gaps identified by WFPA is testing of different Type Np stream RMZ configurations (e.g. location, length, width, density) at meeting both resource protection and operational objectives - the Type N Hardrock Study varied RMZ length only. According to the Type N Hardrock Study, Np streams can make up ~60% of the stream length on forestland subject to the Forest Practices Rules in Western Washington, therefore alteration of Type Np RMZs can have a very high cost impact to forest landowners. Accordingly, WFPA members are interested in learning more about alternative RMZ configurations which minimize cost impact while meeting resource protection objectives. To that end, in June 2019 WFPA initiated the Headwater Stream Smart Buffer Pilot Project.

The purpose of the Headwater Stream Smart Buffer Pilot Project is to evaluate alternative RMZ schemes on Type Np streams at maintaining shade and minimizing water temperature changes that may be the result of forest management. At the same time, we are interested in determining if smart buffering is cost effective from both a planning and operational perspective. The working hypothesis is that RMZ locations, lengths, widths, and stand densities can be configured to improve effective shading of Np streams over that provided by existing fixed-width RMZs, and it can be achieved by a cost-effective planning process and strategic allocation of the RMZ area.

WFPA is submitting this project as a proposal initiation in order for the project information to be considered as part of the Adaptive Management Program (AMP) process, and we are committed to working openly and cooperatively with all caucuses on implementation. Below are responses to the proposal initiation questions outlined in Board Manual 22, Guidelines for Adaptive Management Program.

Proposal Questions - Board Manual 22

1. <u>The affected forest practices rule, guidance, or DNR product.</u>

WAC 222-30-021 (2) (a),(b),(c) Western Washington protection for Type Np and Ns Waters

2. <u>The urgency based on scientific uncertainty and resource risk.</u>

The TFW Policy Type N Workgroup referenced above anticipates delivering a final report to TFW Policy at the end of 2020 or early 2021. The timeline in the Department of Ecology's December 2, 2019 letter extending Clean Water Act (CWA) Assurances to December 31, 2021, indicates the Forest Practices Board should initiate rulemaking by the summer of 2021. These timelines do not comport with the AMP having complete information regarding Type Np stream RMZ effectiveness, particularly that of alternative RMZ configurations. Therefore, acquiring as much relevant information as possible for AMP consideration by the summer of 2021 increases the chance for a successful, collaborative outcome, and minimizes the risk of divergence from the AMP program requirements in RCW 76.09.370(6),(7)

3. <u>Any outstanding TFW, FFR, or Policy Committee agreements supporting the proposal.</u>

Schedule L-1 of the Forests & Fish Report (adopted by the FPB in February 2001 and incorporated into the 2005 FP HCP) and the current CMER Workplan contain key questions which include a commitment to *"…test whether less costly alternative prescriptions would be effective in producing conditions and processes that meet resource objectives…"* This pilot project will be the first attempt to embark on such an endeavor. WFPA hosted a field trip for several TFW caucuses to one of the proposed smart buffer pilot project sites on November 21, 2019 and invited any caucus to participate and collaborate on the project.

4. <u>How the results of the proposal could address AMP key questions and resource objectives or other rule, guidance, or DNR product.</u>

In addition to fulfilling the Schedule L-1 and CMER Workplan commitment regarding alternative prescriptions referenced above, this pilot project may provide information helpful for determining if resources objectives in WAC 222-12-045(2)(a)(C) (meet or exceed water quality standards) and Schedule L-1 (provide cool water by maintaining shade within 50' for at least 50% of stream length) can be more efficiently/effectively met.

In addition, this project may help meet Goals 3 and 4 of Forests & Fish Report (meet CWA requirements for water quality on non-federal forest lands, and keep timber industry economically viable), and the desired outcomes of the AMP in WAC 222-12-045(1) (certainty of change as needed to protect targeted resources; predictability and stability of the process, etc.).

5. <u>Available literature, data and other information supporting the proposal.</u>

The primary function of riparian vegetation in controlling water temperature is to block incoming solar radiation (direct and diffuse). Direct-beam solar radiation on the water's surface is the dominant source of heat energy that may be absorbed by the water column and streambed. Absorption of solar energy is greatest when the solar angle is greater than 30° (i.e. 90 to 95% of energy is absorbed as heat; Moore et al. 2005) and solar heating of a stream from direct beam radiation is most significant during mid-day (Beschta et al. 1987) as the sun travels from southeast to southwest (azimuths 135° to 225°). Therefore, riparian vegetation that blocks direct solar radiation along the sun's pathway across the sky is the most effective for reducing radiant energy available for stream heating (Moore et al. 2005). Research shows that the attenuation of direct beam radiation by riparian vegetation is a function of canopy height, vegetation density, and buffer width (Beschta et al., 1987, Sridhar et al. 2004, DeWalle 2010). Light attenuation increases with increasing canopy height and increasing buffer density as a result of the increased solar path and extinction of energy. Buffer width has a variable influence on light attenuation depending on stream azimuth (e.g., effective buffer widths for E-W streams may be narrower than for N-S streams due to shifts in solar beam pathway from the sides to the tops of the buffers; Dewalle 2010).

Effective shade is a term used to distinguish between vegetation that provides shade to the stream versus vegetation that does not provide shade to a stream (Allen and Dent 2001). Effective shade is based on measures of radiant energy and is computed as the fraction of total direct-beam solar radiation that is blocked by riparian vegetation (Teti and Pike 2005). Effective shade is a function of the spatial relationships among sun position, location and orientation of stream reach, hiIlslope topography, and riparian vegetation buffers (Chen et al. 1998). Effective shade differs from canopy closure or canopy cover which are commonly used terms to express the percentage of open sky that is obscured by overhead vegetation.

1. <u>Proposal's testing hypotheses and assumptions.</u>

The working hypothesis for the Headwater Stream Smart Buffer Pilot Project is that RMZ locations, length, widths, and stand densities can be configured to improve effective shading of Np streams over that provided by fixed-width RMZs, and it can be achieved by a cost-effective planning process and strategic allocation of the RMZ area. The project goals are to determine where smart buffers are implementable, to measure their effectiveness, and to provide proof of concept. To achieve these goals, we propose to:

- Implement alternative buffering configurations (e. g., variable width and stand density) that are designed to optimize for the reduction in solar insolation (energy reaching the stream) and allocation of retained riparian stands (i.e., buffered areas) along Np streams.
- Examine smart buffer designs in a range of different harvest unit sizes and locations (e.g., entire Np basin, imbedded within Np basin) that are commonly implemented on Np streams.
- Measure the effectiveness of smart buffer designs to reduce solar insolation and minimize changes in water temperature exported from harvest units.
- Evaluate how watershed characteristics (i.e., aspect, topography) and harvest unit configuration influences effective shade, solar insolation, and air temperature within harvest area.
- Evaluate how watershed and hydrology attributes (e.g., surface flow, substrate composition, slash cover, gradient, geology, elevation) may influence temperature response to treatment.
- Evaluate how riparian stand forestry metrics (e.g., basal area, tree height, density) can be used as guidance for developing smart buffer design.

We expect the initial design process to be a learning exercise for all involved. Also, we expect this process may result in tools and guidelines for different situations where the development of smart buffer prescriptions will be feasible and cost-effective. Similarly, we will likely identify situations where smart buffers are not worth the effort.

2. <u>Description of affected public resources.</u>

Western Washington Type Np streams

3. <u>Potential cause and effect relationships with forest practices management.</u>

If smart buffer prescriptions appear to be promising at improving effective shade, minimizing water temperature response associated with harvest and are cost effective, the Forest Practices Board may want to include them as an option to be evaluated in future Type N RMZ rule making for Western Washington.

4. Description of the proposal's study design.

See attached study plan - The study is focused on monitoring shade and temperature in and adjacent to harvest units that are located on Type Np streams. Measurements of effective shade will be taken along each study stream during the pre-harvest period to provide site-specific data that will be necessary to derive an optimal design for reducing solar insolation and conserving shade. Effective shade is defined as the fraction of total possible solar radiation that is blocked by riparian vegetation. Effective shade is a function of stream orientation (valley aspect) as well as the density and height of riparian stands. Therefore, by knowing and mapping effective shade within a harvest unit we can guide the design of smart buffers to optimize the reduction in insolation.

Valley aspect, topography and stream size are key factors affecting insolation and thermal loading of streams. Therefore, it is desirable to have a range of study basins with different aspects, valley confinement, and size. Also, given variability in topography and stand composition, we want to examine the range of harvest unit configurations in terms of size and location (e.g., harvest of entire Np basin or harvest unit imbedded within Np basin). The intent is to collect sufficient data to explore how well we can design smart buffers given the typical range of conditions and harvest units on WFPA member lands. Therefore, we will measure effective shade both before and after harvest to determine the amount of shade conserved and to evaluate the relative effectiveness of the various RMZ treatments.

Water temperature will be measured before and after harvest at the treatment streams and at several reference streams (e.g., one per geographic region) to facilitate an evaluation of temperature responses that may be associated with the harvest treatments. In addition to shade, water temperature is strongly influenced by the ambient air temperature that varies temporally (weather) and spatially across the landscape. Therefore, reference data are necessary to distinguish changes in temperature that may be associated with treatments from changes due to inter-annual variability (e.g., warm or cool summers) or natural disturbance events. In comparison, changes in shade after harvest can be directly related to treatments baring a major disturbance event.

Multiple physical factors can influence thermal loading and temperature response (e.g., elevation, surface flow, substrate composition, slash cover, geology). Therefore, we plan to collect data on a suite of local attributes to be used as covariates in our analyses of shade and temperature responses to treatment. Because this is a pilot study and funds are limited, we will not try to stratify for any specific factor (e.g., aspect) at the onset. However, given the number of sites and associated physical characteristics, we would perform analyses to determine how post-hoc stratification, if possible, could improve our interpretation of the findings.

We expect the process for initially designing smart buffers to be an iterative and multi-step procedure that will involve interaction among project scientists, forest engineers, and policy representatives. First, project data for each harvest unit will be used to delineate (map) and rank all stream reach/riparian stands (e.g., 300-ft long segments) within the harvest unit according to their potential to provide effective shade and relative sensitivity of stream location to solar insolation. Given these data, various RMZ configurations and their relative effectiveness to retain pre-harvest shade (i.e., expressed in energy units of solar insolation) can be proposed. A key driver will be the retention of shade that is sufficient to meet some specified target. The second step is to provide forest engineers with the effective shade option maps and associated stream sensitivity rankings. This is expected to be followed by a collaborative identification and evaluation of RMZ retention options that incorporate operational concerns (roads, yarding) and consideration for cost-effectiveness. Finally, or maybe jointly, policy input on shade targets and other concerns could be explored. For example, there are no specific shade targets for Np streams other than that provided by a two-sided, 50-ft wide RMZ for at least 50% of stream length. Therefore, we expect to use shade and temperature data from CMER studies (e.g., Type N Hardrock and Softrock) along with this study to inform the smart design process.

There are five WFPA members which offered to participate in the smart buffer study (Table 1). Based on current feedback from participants, there are 29 potential study sites, of which 21 may be treated with smart buffer prescriptions and eight will be unharvested reference sites (Figure 1). Also, we plan to use one Type N Softrock study site (REF2) as an additional reference. We recognize these numbers may change as we progress through the project. Note, the implementation schedule assumes all sites would have one or two years of pre-harvest and two years of post-harvest monitoring. Length of the pre-harvest time period is dependent on when temperature monitoring can be initiated (i.e., 2019 or 2020) and when harvesting occurs. Ideally, harvest should be planned for after September 2020 to facilitate getting at least one full season (June through September) of temperature data. We proposed two years of post-harvest monitoring because this is the minimum duration to evaluate annual variability in temperature and to assess response of the RMZ and shade to potential post-harvest windthrow. Therefore, on the proposed schedule, harvesting should be completed before May 2021. If feasible, it is recommended that post-harvest monitoring extend up-to five years. Based on the Type N Hardrock study findings and other research, we know two years of post-harvest data provides an initial measure of treatment response, and in many studies the largest change in temperature occurs during this period. However, longer monitoring facilitates an evaluation of response trends in temperature and shade, and reduces uncertainty concerning riparian stand structure and functions.

Table 1. Smart buffer study participants, proposed number of study sites and implementation schedule. Schedule assumes harvest would occur after September 2020 and before May 2021. Tre = treatment, Ref = reference.

	Number of sites monitored by year							
	Pre-harvest				Post-harvest			
	2019		2020		2021		2022	
Company	**Tre**	**Ref**	**Tre**	**Ref**	**Tre**	**Ref**	**Tre**	**Ref**
Hancock	5	0	5	0	5	0	5	0
Port Blakely	1	0	1	0	1	0	1	0
Rayonier	5	2	5	2	5	2	5	2
SPI	4	1	4	1	4	1	4	1
Weyerhaeuser	0	0	5	5	5	5	5	5
All	15	3	21	8	21	8	21	8

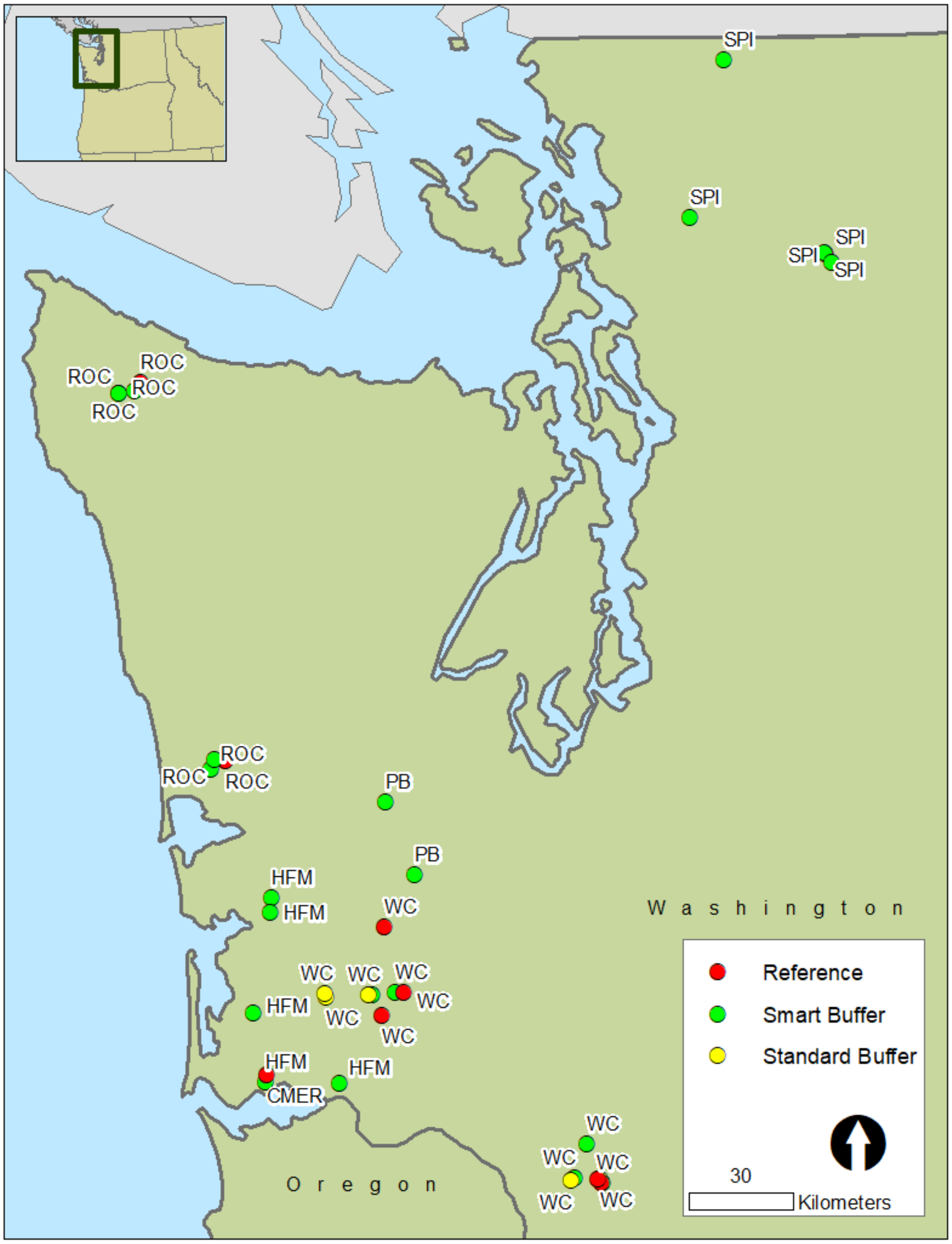

Figure 1. Locations of smart buffer study sites.

5. <u>Estimated timeline with milestones and costs associated with implementation of the proposal.</u> The implementation schedule (Table 2) lists project task and activities during 2019 through 2022 which includes one or two years of pre-harvest and two years of post-harvest monitoring. Data collected during pre-harvest will be used to inform the development of smart buffer designs during late summer 2020. Unit harvesting and treatment implementation is scheduled for the late fall and winter period of 2020 - 2021 pending approval of FPAs. An evaluation of early response trends in temperature and shade

will be developed during winter 2022 and report of the two-year post treatment findings will be prepared in late 2022. Continued monitoring after 2022 may occur pending study findings.

Table 2. Implementation Schedule.

Year	Period	Task
2019	Jun - Sep	Temperature monitoring (N = 16)
	Jun - Sep	Shade and stream channel survey (N = 17)
	Oct - Dec	Process hemi-photos
	Oct - Dec	Process temperature and channel characteristics data
2020	Jan - Feb	FPB proposal and petition
	Mar - Apr	Prepare study design
	Jun - Sep	Temperature monitoring
	Apr - Jul	Riparian plot survey
	Jul - Aug	Shade and stream channel survey
	Aug - Sep	Collaborate and design proposed site-specific treatments
	Sep - Oct	Companies submit FPA with alternative prescriptions
	Nov - Dec	Implement smart buffer treatments
2021	Jan - Apr	Implement smart buffer treatments
	Jun - Sep	Temperature monitoring
	Apr - Jul	Riparian plot survey
	Jul - Aug	Shade and stream channel survey
	Oct - Nov	Process all data
	Oct - Dec	Access effectiveness of smart buffer treatments
2022	Jan - Feb	Access effectiveness of smart buffer treatments
	Feb - Mar	Prepare initial findings progress report
	Apr - Sep	Repeat monitoring and surveys
	Oct - Dec	Analyses and Reporting

Costs

WFPA and its members have been funding the study design, site layout, data collection, analysis, and reporting, in addition to the costs associated with modifying harvest units. Given our resources are limited, we invite any and all TFW caucuses to participate and contribute in any way they can.

References

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1. Relevance: Does the study inform a rule, numeric target, performance target, or resource objective?

Yes, all - see responses above and study plan.
Resource objectives and performance targets are identified in M22-30, fn 2, as “heat/water temperature, LWD/organic inputs, sediment, hydrology, and chemical inputs.”

2. Relevance: Does the study inform the forest practices rules, the Forest Practices Board Manual guidelines, or Schedules L-1 or L-2?

Yes, all - responses above and study plan.

3. Quality: Was the study carried out pursuant to CMER scientific protocols (i.e. study design, peer review)?

This is an opportunistic pilot project based on availability of harvest units meeting the criteria and planned for harvest over the next year or two. While sites were not randomly selected through an experimental design, the harvest units are geographically dispersed across western Washington and represent a range of geologic, hydrologic, and biologic conditions. Implementation of the pilot project is open to review, participation and contribution by any and all TFW caucus participants. Final reports may be subject to independent peer review.

4. Quality: What does the study tell us? What does the study not tell us?

We expect this pilot project may result in tools and guidelines for different situations where smart buffer prescriptions may be feasible and cost-effective. Similarly, we will likely identify situations where smart buffers are not worth the effort. Scope of inference may be limited due to sites not being selected through an experimental design; however, post-hoc comparison of pilot project site physical/biological characteristics with CMER Type N study site characteristics may provide insight into geographic applicability of the results.

5. Completeness: What is the relationship between this study and any others that may be planned, underway, or recently completed? Factors to consider in answering this question include, but are not limited to:
    a. Feasibility of obtaining more information to better inform Policy about resource effects.
    b. Are other relevant studies planned, underway, or recently completed?
    c. What are the costs associated with additional studies?
    d. What will additional studies help us learn?
    e. When will these additional studies be completed (i.e., when will we learn the information)?
    f. Will additional information from these other studies reduce uncertainty?

There are more than two dozen projects identified in the Type N Riparian Prescription Rule Group section of the CMER Workplan, less than half of which have been completed. The TFW Policy Type N workgroup charter specifically calls out six of the western Washington Type N projects in the CMER Workplan, either already completed or anticipated to be complete within the next several months, to be considered. The workgroup may also identify knowledge gaps and utilize outside science/expertise to fill those gaps.

Schedule L-1 and the current CMER Workplan indicates alternative prescriptions should be tested, but that has not occurred to any significant degree in any of CMER's work. The Type N Hardrock study is the only project which contained an alternative treatment (a continuous 50' RMZ). One planned study, the Riparian Characteristic and Shade (RCS) project, intends to vary RMZ width and density and measure effects on shade. However, the RCS project may not start field implementation this biennium. This pilot project may fill an information gap on a schedule which better comports with the desired rule-making timeline associated with the TFW Policy Type N workgroup process and CWA assurances extension.

6. Completeness: What is the scientific basis that underlies the rule, numeric target, performance target, or resource objective that the study informs? How much of an incremental gain in understanding do the study results represent?

In 2001 there was a fair amount of uncertainty regarding the effectiveness of the Type N rules at meeting resource objectives and performance targets. Since that time the uncertainty has been reduced considerably, particularly regarding target amphibian species in Type N streams. However, some uncertainty remains and there is more technical work to do, including evaluation of the long-term viability of target amphibian species, the landscape spatial/temporal context (e.g. frequency, magnitude, duration) of temperature response associated with forest management activities, and the attendant biological implications. Revisiting and refining the resource objectives and performance targets for Type Np streams has also been recommended by several CMER projects. This pilot project may help fill an information gap regarding the feasibility of alternative RMZ configurations at improving effective shade and minimizing water temperature response associated with harvest (compared to existing Type Np RMZs), while also minimizing cost impacts to landowners.