CMER/Policy Interaction Framework Six Questions
Hardwood Conversion Study
October 9, 2019

The results from this study are found in the following Study Report:

Ceder, K., Teply, M., Ross, K., 2019. *Hardwood Conversion Study Summary Report.* Prepared for the Washington State Department of Natural Resources. Cooperative Monitoring Evaluation and Research (CMER) report

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

Yes.

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

Yes. WAC 222-30-21(1)(i) establishes rules for Hardwood conversion in the inner zone, and Forest Practices Board Manual Section 21 which guides the use of alternative plans that commonly include deviations from the rules on hardwood conversion. Concerns were raised at TFW Policy as to whether a narrower no-cut zones than what is permitted in the rules would still protected stream temperature and other riparian functions while conducting conversion of hardwood stands back to conifer stands, and the level of success and cost associated with conducting successful conversions. An exemption from the standard Hardwood Conversion rule was approved to include narrower buffers.

The purpose of this report is to summarize conditions and trends from post-harvest monitoring, four and ten years since harvesting with the later directed at determining whether the "free to grow" criteria in rule (WAC 222-30-021(1)(b)(i)(D)) were being met in response to a TFW Policy request. Specifically, it addresses the following Rule Group Critical Questions outlined in Table 21 of the 2019 CMER workplan:

- How effective are different hardwood conversion treatments in reestablishing conifers in hardwood-dominated riparian stands?
- When is hardwood conversion in riparian stands operationally feasible, and what are the economic costs and benefits of the hardwood conversion treatments?

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

No. This was a Timber Fish and Wildlife Policy Committee directed case study examination of hardwood conversion harvests. The study was started in 2003 before many of the CMER protocols were established. The study design was not reviewed by ISPR. The summary report went through ISPR in 2018.

The results summarized in the report are from case studies that, though they were established professionally and monitored rigorously, were not designed experimentally. Because this is a case study and sites were not randomly selected from the entire population of possible alder conversion sites, valid statistical inferences about the entire population of sites should not be made. Treatments are recorded in the Case Study Report for each site and a summary is provided in the Harvest Practices and Regeneration Practices sections of the summary report.

The Hardwood Conversion Program, as stated in the CMER Work Plan, has five components: the Strategy, the Hardwood Conversion Project, the Hardwood Conversion Project-Temperature Component, the Annotated Bibliography, and The Department of Ecology Water Temperature Modeling Project.

4. What does the study tell us?

Silviculture Results

Since 2003, CMER has conducted the Hardwood Conversion Study to evaluate the effectiveness of hardwood conversions conducted in riparian areas of western Washington. Following the four year post harvest monitoring Report (Duck Creek 2009), Policy questions remained concerning whether sites were on track to meet the "free-to-grow" criteria in rule (WAC 222-30-021(1)(b)(i)(D)) therefore, additional funding was approved to monitor the 10 year post-harvest interval. This was one of the studies that recognized the importance of long -term monitoring.

Hardwood conversion treatments were implemented on a total of 20.5 acres across eight study sites located in lowland forests of western Washington. Treatments are generally described, as follows, in the Case Study Report (Brown 2106): Monitoring was conducted at eight study sites to evaluate the [1]effectiveness and the operational and economic feasibility of hardwood conversion treatments in reestablishing conifers in hardwood-dominated riparian stands. Harvest and regeneration prescriptions were left to the discretion of landowners with the following requirements: no harvest within 25' feet of the edge of bank-full or CMZ; retain residual conifers in the core and inner zones and, where reforestation was required, after harvesting, the goal was to successfully re-establish conifer, and that conifer be on track to dominate the converted Riparian Management Zone.

[1] Within the context of this study, effectiveness refers to the successful establishment of conifer.

Silvicultural results from the Hardwood Conversion Study suggest:

- Survival rates of planted seedlings are higher when shade- and moisture-tolerant species, such as Sitka spruce, western red cedar and western hemlock, were planted in conversion areas.
- Survival and growth rates of planted seedlings are higher when there are lower levels of competing vegetation and larger seedlings (e.g. two-year-old seedlings) were planted.
- Height growth rates are higher once the leaders of trees are above competing vegetation, compared to trees with leaders overtopped by competing vegetation.
- The highest survival 10 years after planting was associated with planting Sitka spruce, high planting densities, and competing vegetation control.
- Competing vegetation, which increased in height and cover after harvest, appears to be the biggest challenge to successful regeneration of planted conifer seedlings.

Factors Explaining Free-to-Grow Status

The final stepwise model (See report, Table 15) reflects differences in hardwood conversion areas managed by Weyerhaeuser (sites 5, 13, 14, and 15) and Pope Resources (23)—where regeneration performance has generally been poorer—and those managed by Green Crow (8) and Merrill and Ring (11 and 12)—where regeneration performance has generally been better.

Factors explaining regeneration performance in the step wise model include topographic position, species selection, and competing vegetation. Weyerhaeuser plots occur predominantly on hillslopes, were planted predominantly with Douglas-fir, and generally have had lower competing vegetation. Most other landowners' plots occur predominantly on fluvial terraces and floodplains, were planted with more diverse species mixes, and generally have had greater competing vegetation.

Of these three factors, the effect of topographic position and competing vegetation may simply be coincidental. The lack of balance within each site (and landowner) limits the ability to discern the ecological influence of floodplain and fluvial terrace sites versus hillslope sites from the coincidental trajectory towards stocking standards on Green Crow and Merrill and Ring. Further, the better regeneration performance on these sites, despite having higher levels of competing vegetation, seems counterintuitive. Sitka spruce is statistically more likely to become free-to-grow at year 10. Likely because of Sitka spruce's shade tolerance, moisture tolerance, and resistance to animal predation, this species has had higher survival.

Though intuition suggests that there is value in animal control, it is difficult to interpret its potential value from the data. Enough anecdotal evidence is provided in the Case Study Report to suggest that, where the potential for animal predation was observed (e.g., beaver presence, animal-browse), animal control measures were employed (e.g., trapping, barriers, deception). However, observations on animal

damage are limited, making it difficult to quantify effectiveness. There are instances where animal control appears consequential (e.g., Sites 11 and 12), there are those where animal control appears inconsequential (e.g., Sites 13, 14, and 15), and there are those where it's simply too difficult to discern (e.g., Sites 5 and 23). Therefore, we can only make the conservative recommendation—that is, that animal control measures should be employed where there is a risk for animal predation.

Economic Results

Generally, harvest values and harvest costs in hardwood conversion areas compared favorably to upland areas—average per-MBF stumpage values were higher in hardwood conversion areas ($333, SD = $49) than in adjacent uplands ($277, SD = $63) and average per-acre conversion costs were lower in hardwood conversion areas ($528, SD = $369) than in adjacent uplands ($575, SD = $625). But, because more volume could be harvested from upland areas (about 26 MBF per acre, on average, SD = 10 MBF) compared to that from the hardwood conversion areas (about 14 MBF per acre, on average, SD = 5 MBF/ac), the overall profitability of operations in the adjacent upland areas ($6,257 per acre, on average, SD = $1,448/ac) was greater than in hardwood conversion areas ($4,148 per acre, on average, SD = $1,627/ac)[2].

Economic Results			
Activity	**Metric**	**Avg. Cost**	**Standard Deviation**
Stumpage Hardwood Conversion	$/MBF	$333	$49
Stumpage Hardwood Upland	$/MBF	$277	$63
Conversion Cost	$/Acre	$528	$369
Regeneration Upland	$/Acre	$575	$625
Volume Conversion	MBF/Acre	14 MBF	5 MBF
Volume Upland	MBF/Acre	26 MBF	10 MBF
Profit Conversion	$	$4,148	$1,627
Profit Upland	$	$6,257	$1,448

- Economic results from the Hardwood Conversion study suggest: Hardwood conversions are economically feasible when there was sufficient harvest volume to make conversion profitable.
- Per-acre harvest volumes tended to be lower in the conversion area, resulting in lower per-acre harvest revenue relative to upland areas.
- Harvest and regeneration costs were generally similar between conversion and upland areas.
- Increased investment in site preparation, planting, and post-planting vegetation and in some cases animal control appear to result in increased seedling survival while still allowing profitable conversion.

[2] For more details regarding costs, see table16, 17 and 18 in the Hardwood Conversion Final report.

What does the study not tell us?

Though partially addressed by the Hardwood Conversion Study Plan, the following Rule Group Critical Questions (CMER Workplan 2019) are not addressed in this report:

- What effects do hardwood conversion treatments in riparian stands have on shade, stream temperature, and LWD recruitment?
- What is the effect of hardwood conversion practices on stream temperature as a function of buffer width and length of stream treated?

The only component of the Strategy that was completed was the Hardwood Conversion Project. The Strategy was not finished because only one aspect of it was completed. Although multiple years of stream temperature data were collected before and after the conversion, the data was rejected by CMER and Policy because it reflected natural conditions at the site and the treatment effects could not be isolated. The attempt at developing an Annotated Bibliography failed and no synthesis of the literature was undertaken. The Department of Ecology Water Temperature Modeling Project was not started because of stream temperature data quality concerns.

The Hardwood Conversion Study does not tell us several things. These are generally related to the time necessary for trees to reach the size needed to make the conversion successful:

- The Hardwood Conversion Study does not tell us when or if conversions will be successful relative to the criteria set out in WAC 222-30-021(1)(b)(i)(D). As of the 10-year measurements, trees have not yet reached the 8-inch diameter at breast height (dbh) at 10 years after planting. Additional measurements will be needed for the Hardwood Conversion Study to tell us when or if conversion can be successful according to the rule.
- The Hardwood Conversation Study does not tell us if the findings from the case study results are representative of all potential hardwood conversion sites. Inferring these findings to other potential conversion areas should be treated with caution given that the results were based on eight sites. While results of the case studies make sense ecologically and economically, the understanding of the relationships between silvicultural and economic performance is limited. With the spatial clustering of the case study site, this study does not cover the extent of the forest area where conversion could happen. For example, results from the coast may or may not apply to the north Cascade foothills since the areas are ecologically different.
- As Alternate Plan case studies, the study did not assess the effectiveness of the standard forest practices rule, Washington Administrative Code (WAC) 222-30-021(1)(b)(i), although the rule is cited throughout the report.

5. What is the relationship between this study and any others that may be planned, underway, or recently completed?

a. ***Feasibility of obtaining more information to better inform Policy about resource effects.*** Though some sites appear more likely than others to achieve stocking standards for hardwood conversion areas under WAC 222-30-021(1)(b)(i)(D), planted conifers have not yet achieved the 8 inches dbh size limit required to make this determination. Tree growth models exist that make reasonably good predictions of tree growth, including effects of competing vegetation. These can be used to estimate when the 8-inch diameter rule may be attained. Additional monitoring of tree growth would provide a more definitive determination of whether this part of WAC 222-30-021(1)(b)(i)(D) is being met.

The data collected and lessons learned from the "Water Temperature Evaluation of Hardwood Conversion Treatment Sites Data Collection Report" (CMER #05-513, June 1, 2010) will be considered because it may be useful in scoping and developing a study plan for a more comprehensive and long-term study addressing the water temperature and shade impacts of hardwood conversion which is a common alternate plan practice. RSAG plans to begin discussing development of a scoping document.

b. ***Are other relevant studies planned, underway, or recently completed?*** No additional studies are planned at this time.

c. ***What are the costs associated with additional studies?*** If this study was extended, a standard regeneration survey is estimated to cost about $2,000-$3,000 per site per year for the eight sites.

d. ***What will additional studies help us learn?*** For these case studies, we would better understand what site preparation, planting and vegetation control will successfully result in regulatory stocking standards.

e. ***When will these additional studies be completed?*** Depending on the length of long-term monitoring determined appropriate.

f. ***Will additional information from these other studies reduce uncertainty?*** Yes. A re-measurement of the plots would provide new stocking data and would indicate if sites are closer to the regulatory stocking level. Policy will need to determine if additional monitoring is a priority for the adaptive management program. If so, this could be achieved through re-measurement of vegetation monitoring plots, or by simpler stand inventory techniques focused solely on tree stocking. In either case, stocking evaluations will require waiting for enough conifer trees to reach 8 inches dbh. Based on professional judgement, this would occur at least at stand age 20 years.

6. **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?**

It does not appear that there was any scientific basis for the Hardwood Conversion rules. Although the case studies provide limited insight into converting hardwood riparian stands to conifer dominated riparian forests under Department of Natural Resources approved Alternate Plans, it demonstrates the need for a more rigorous study design that is replicated and considers all aspects of the strategy.