Class I Streamside Tree Retention Revised Methodology

Rationale and Explanation

Statement of Problem

The existing tree retention rule is very cumbersome. There are myriad opportunities for error, as demonstrated during the recent shade effectiveness study. It requires a spreadsheet, a lot of thought, and sometimes a forestry consultant. Our idea is that we can keep the exact same scientific basis (Teply 2012) but simplify some of the variables. By the end of this proposal, we will have condensed the rule verbiage from 492 words to 100, and made implementation simple enough to be done by an untrained person using only pad, pencil and diameter tool. We have presented our suggested changes in order of increasing departure from the currentRelative Stocking construct:

1. Use only one harvest option
2. Simplify the calculations
3. Simplify forest types
4. Condense the size ranges

1. Use Only One Harvest Option

Presently there are two Relative Stocking (RS) harvest options: the 60/30 option and a 60/10 option. This is hugely confusing for people, because the numbers apply to different areas of the Stream Protection Zone (SPZ) and it requires double calculations. It's like doing your taxes twice. Teply's original work only had one option – 60/30, which was designed to encourage deep SPZ management, one of the original reasons for the rule.

Both options have a 25' wide inner zone with RS of 60. The only difference is the distribution of trees in the outer 50' of the SPZ. A useful way to visualize this is three 25' bands, where the two-harvest options look like 60/30/30 and 60/60/10.

Remember, RS is just a measurement of trees per acre and there is no requirement for a uniform harvest in the SPZ. So a harvest using the 60/60/10 option is mathematically equivalent to 60/35, because the tree densities in the middle and outer bands can be averaged: (60+10)/2 = 35. A final RS of 60/35 would be acceptable under the 60/30 harvest option; in fact, it would be slightly under-harvested. In other words, the 60/10 option is a **special case** of the 60/30 option and can be collapsed into it. So, we only really need one option: the 60/30 option. This also keeps us closer to the scientific research underpinning the rule.

The upshot is that everyone must keep their inner 25' to 60 RS, just like today. Then the outer zone can be managed in whichever manner the landowner chooses. This single option (equivalent to 60/30) would encourage more SPZ management, because it allows harvest deeper into the SPZ. That was one of the original silvicultural goals of the rule.

But…

There is one unusual situation where this single option might restrict a currently legal harvest and based upon the results of the shade effectiveness study, this **might be a good thing**. Sometimes a landowner will use the 60/10 option to harvest the outer zone *even when the inner zone is severely understocked*. In the worst-case scenario, imagine no trees in the inner 50' and a harvest down to RS 10 in the outer 25'. This new rule could gently curb this undesirable harvest scenario.

Teply's paper did not contemplate this scenario, because the rule was developed using only fully stocked inner zones. The two sites with the greatest shade loss in the recent study were both understocked before harvest. This led to shade loss in excess of 15%, which contradicts the original purpose of the rule. A single 60/30 option could have prevented these problems.

'60 Foot No-Cut Buffer' Rule of Thumb

How about the "rule of thumb" whereby the outer 15' of the SPZ is clearcut, leaving the internal 10' to provide enough relative stocking? By only using the 60/30 option, we can see that this rule of thumb could still **always work, provided that** the outer zone exceeded 42.9 RS. 42.9 is the relative stocking required to ensure that the average outer zone is at RS 30 (42.9×35' + 0×15')/50'= 30.

We believe that common practice was to only implement the "rule of thumb" when the inner zone was reasonably well stocked. If this is true, then using only a single 60/30 option should provide no barrier to continuing this method of harvest.

Summary

By eliminating the second harvest option (60/10), we avoid having to run the entire shade calculation twice, and still provide for equivalent shade protection. We return to the original science and landowners are still able to use a simplified rule of thumb, in appropriate circumstances. We also gain a nice simplification benefit that will become evident in the next section.

2. Simplify the Calculations

The current tree retention rule works by a cumulative tree count, aiming for a given RS target. This tree count depends on the tree diameter and forest type, found by the lookup table in the rule, below.

You count the trees of each size times the per-tree contribution and the sum yields the RS. Once that number exceeds the target (e.g. RS 60 or 30), you can harvest the remainder of the trees in that zone:

Current Rule							
	4-7.9”	8-11.9”	12-15.9”	16-19.9”	20-23.9”	24-27.9”	> 28”
NIGF	0.097	0.209	0.347	0.506	0.683	0.878	1.088
CIGF	0.113	0.244	0.405	0.590	0.797	1.024	1.270
SIGF	0.136	0.293	0.486	0.708	0.957	1.229	1.524
WHSF	0.123	0.267	0.442	0.644	0.870	1.117	1.385
DFPP	0.151	0.326	0.540	0.787	1.063	1.366	1.693

2a. Work Backwards and Convert Relative Stocking to Tree Count

However, if you work backwards and *stipulate the target* (in this case RS 60), you can specify the **number of trees per acre** of each size range required to meet it. So, this target is still based on relative stocking, but does not need to mention that concept, because we only care about the number of trees:

Tree count per acre for RS of 60 (rounded)							
	4-7.9”	8-11.9”	12-15.9”	16-19.9”	20-23.9”	24-27.9”	> 28”
NIGF	619	287	173	119	88	68	55
CIGF	531	246	148	102	75	59	47
SIGF	441	205	123	85	63	49	39
WHSF	488	225	136	93	69	54	43
DFPP	397	184	111	76	56	44	35

These numbers are attractive, because they represent a **real entity** – trees! A person can visualize a tree count far more easily than a ‘per tree contribution’. Landowners like rules that they can visualize.

2b. Take Out Tree Diameter Weighting

The tree diameter works like a multiplier, such that a bigger tree counts more than a smaller one. It turns out that the diameter multipliers are the same across forest types, so we can take the green numbers out of this table and include them in their own separate table, below:

Tree count per acre for RS of 60							
	4-7.9"	8-11.9"	12-15.9"	16-19.9"	20-23.9"	24-27.9"	> 28"
NIGF	619	287	173	119	88	68	55
relative weighting	1.00	2.16	3.58	5.22	7.04	9.05	11.22
CIGF	531	246	148	102	75	59	47
relative weighting	1.00	2.16	3.58	5.22	7.05	9.06	11.24
SIGF	441	205	123	85	63	49	39
relative weighting	1.00	2.15	3.57	5.21	7.04	9.04	11.21
WHSF	488	225	136	93	69	54	43
relative weighting	1.00	2.17	3.59	5.24	7.07	9.08	11.26
DFPP	397	184	111	76	56	44	35
relative weighting	1.00	2.16	3.58	5.21	7.04	9.05	11.21
AVERAGE WEIGHTING	1.00	2.16	3.58	5.22	7.05	9.06	11.23

Diameter Range (inches)	4 - 7.9	8 - 11.9	12 - 15.9	16 - 19.9	20 - 23.9	24 - 27.9	> 28
Weight	1.00	2.16	3.58	5.22	7.05	9.06	11.23

So, for example, ten 5" trees, three 15" trees and one 30" tree have a weighted tree count of:

$$10 \times 1.00 \ + \ 3 \times 3.58 \ + \ 1 \times 11.23 \ = \ 31.97$$

(We already use this exact concept for the reforestation rules.)

With the diameters removed, and the 'tree count' replaced with 'weighted tree count', the original table becomes:

Weighted tree count per acre for RS of 60	
NIGF	619
CIGF	531
SIGF	441
WHSF	488
DFPP	397

2c. Convert to Linear Measurement

So far, all these tables have used 'trees per acre', but **there is an easier measurement**. Practically speaking, a linear measurement would be easier than an areal one, because measuring an SPZ involves walking a *length* of stream. 'Trees per 100 feet' is an easy and intuitive measurement. It can also be easily up- or down-scaled for any harvest size. It also has a very nice **bonus feature**, which we'll need later when we consider the outer zone.

The inner zone is 25' wide, so for 100 linear feet, it covers 25 × 100 / 43560 = 0.0574 acres. So, I multiplied the previous tree counts by 0.0574:

Weighted tree count per 100 feet of stream for RS of 60 in a 25' zone.	
NIGF	35.5
CIGF	30.5
SIGF	25.3
WHSF	28.0
DFPP	22.8

Instead of a table, these numbers could just be expressed as a list of weighted tree counts per forest type:

> Within twenty-five feet of the ordinary high water mark leave the following weighted tree count per one hundred feet of class I stream, dependent upon forest type: NIGF 35.5, CIGF 30.5, SIGF 25.3, WHSF 28.0, DFPP 22.8.

2d. Extend to the Outer Zone

We now have the bones of a simpler rule, one that uses a linear tree target for each forest type and expresses the diameters as a weighting factor. But so far, it only works for the inner zone (RS target of 60, 25' wide). This is where the 'bonus' feature of using linear tree counts comes in for the 50' wide outer zone: <u>an RS 30 zone would have exactly half the tree density of an RS 60 zone, but it's exactly twice as wide</u>. So, these two things cancel out. In other words, the tree count target for the 25' inner zone is exactly the same as the target for the 50' outer zone**.** The benefit of using a single harvest option (60/30) and a linear tree count is that it allows us a **single target for both zones.**

With this level of simplicity, a landowner may be able to walk the 25' line, counting trees to the right and the left, in order to get an SPZ inventory.

So with the same target for both zones, the rule simplifies as follows:

> Within twenty-five feet **and between twenty-five and seventy-five feet** of the ordinary high water mark, leave the following weighted tree count per one hundred feet of class I stream, dependent upon forest type: NIGF 35.5, CIGF 30.5, SIGF 25.3, WHSF 28.0, DFPP 22.8.
>
> Calculate weighted tree count by multiplying the number of live trees present in each diameter range by the weighting factor below and then sum the results.

Diameter Range (inches)	4 - 7.9	8 - 11.9	12 - 15.9	16 - 19.9	20 - 23.9	24 - 27.9	> 28
Weight	1.00	2.16	3.58	5.22	7.05	9.06	11.23

3. Simplify Forest Types

So far, the rule modifications have been *mathematically identical* to the original rule. Nothing has changed except the presentation. The next two steps are the same *on average* as the original rule, but it is no longer *identical*.

The current rule uses five forest types. These are used nowhere else in the FPA rules and have proven very difficult to identify reliably in the field. Even the (highly trained) DEQ shade crews misidentified forest types and the IDL Private Forestry Specialists struggle with the blend of habitat type and geographic distinctions in the Forest Type Definitions. The shade effectiveness study suggested that "…a practical solution for agencies involved in enforcing and monitoring the Shade Rule may be to simplify or clarify methods for identifying forest type."

It would be much more reliable to use a geographic indicator to distinguish forest type. To stay true to the scientific research, we should be careful that this does not significantly alter the current tree retention requirements.

Teply's original intent was to define the grand fir series (NIGF, CIGF, SIGF) geographically. NIGF exists only north of the Clearwater River, CIGF exists only between the Salmon and Clearwater Rivers, and SIGF exists only south of the Salmon River. We can retain that system. The DFPP type can occur throughout north, central and southern Idaho, and so must be identified separately. WHSF is an unusual forest type and is harvested so infrequently that we can choose to eliminate the type and include any trees as part of the grand fir series.

Simplifying forest types in this way produces this formulation:

> Within twenty-five feet and between twenty-five and seventy-five feet of the ordinary high water mark, leave the following weighted tree count per one hundred feet of class I stream: 35.5 north of Clearwater/Lochsa Rivers, 30.5 between Clearwater/Lochsa and Salmon Rivers, 25.3 south of Salmon River, and 22.8 in drier forests with stream protection zones dominated by Douglas fir and ponderosa pine.
>
> Calculate weighted tree count by multiplying the number of live trees present in each diameter range by the weighting factor below and then sum the results.

Diameter Range (inches)	4 - 7.9	8 - 11.9	12 - 15.9	16 - 19.9	20 - 23.9	24 - 27.9	> 28
Weight	1.00	2.16	3.58	5.22	7.05	9.06	11.23

There would no longer be any need for the forest type definitions, eliminating subsection 24 and its 180 words.

4. Condense the Size Ranges

In the field, distinguishing between tree sizes takes a lot of time. With seven different size ranges, there is a lot of distinguishing. By reducing the number of size ranges, it will make field practice easier.

Reduce to 4 Ranges

The mid-point weighting would be used.

Diameter Range (inches)	4 - 7.9	8 - 11.9	12 - 15.9	16 - 19.9	20 - 23.9	24 - 27.9	> 28
Weight	1.00	2.16	3.58	5.22	7.05	9.06	11.23
Combined Weight	**1.58**		**4.40**		**8.05**		**11.23**

This becomes

Diameter Range (inches)	4 – 11.9	12 – 19.9	20 – 27.9	>28
Weight	1.58	4.40	8.05	11.23

But…

Condensing the size ranges could allow cutting of larger trees than current size ranges and RS limits permit. In either system, someone could bias their harvest toward the higher end of each size range, but the new system has wider size ranges, which increases the bias.

In fact, Teply recently tested the condensed size ranges on the exact same tree lists used to develop the rule. He found that they allowed 15% more harvest compared to the original size ranges. As such, we need to decrease each diameter range weight by 15% to compensate:

Diameter Range (inches)	4 – 11.9	12 – 19.9	20 – 27.9	>28
Weight	1.37	3.83	7.00	9.76

Normalize the Weights and Tree Count, then Round

To normalize, we divide all the diameter-range weights and the final tree count targets by 1.37. This is mathematically equivalent but will ensure that the smallest tree range counts for 1, which is easier to calculate. The combined weights would then be:

Diameter Range (inches)	4 – 11.9	12 – 19.9	20 – 27.9	>28
Weight	1.00	2.79	5.10	7.12
Rounded	1	3	5	7

And the tree count targets would then be 25.8 north of the Clearwater, 22.2 between the Salmon and Clearwater, 18.4 south of the Salmon, and 16.6 for DFPP. These round to 26, 22, 18 and 17.

Final Result

Incorporating all these changes, FPAC comments, and using the same methodology to develop a very large tree range, 030.07.e.ii could read as follows:

> ii. Within twenty-five feet and between twenty-five and seventy-five feet of the ordinary high water mark, leave the following weighted tree count per one hundred feet of class I stream: 26 north of Clearwater/ Lochsa Rivers, 22 between Clearwater/Lochsa and Salmon Rivers, 18 south of Salmon River and 17 in drier forests with stream protection zones dominated by Douglas fir and ponderosa pine.
>
> Calculate weighted tree count by multiplying the number of live trees present in each diameter range by the weighting factor below and then sum the results.

Diameter Range (inches)	4 – 11.9	12 – 19.9	20 – 27.9	28-35.9	>36
Weight	1	3	5	8	11

Summary

This method would do the following things:

- Replace the unusual and perplexing ‘Relative Stocking’ with ‘trees per 100 feet’.
- Replace the forest types with geographic regions.
- Provide stream protection as good as the current rule.
- Include only integers: no tiny fractions.
- Be easier to implement by a landowner, without needing assistance.
- Be comprehensible and more easily visualized.
- Reduce the number of zones, thereby making fieldwork easier.
- Be easier to field-verify.
- Reduce errors, thereby improving compliance.
- Offer a single harvest option, reducing double-paperwork and what-ifs.
- Leave the rate of harvest unchanged in virtually all cases.
- Restrict harvest on the one situation that causes undesirable loss of shade.
- Offer greater flexibility and encourage management of the outer 50’ of SPZ.
- Leave the internal 25’ of SPZs at their current rate of harvest.
- Simplify: 500 words down to 100 and a 42-element, size-range matrix down to 10.

The Current Rule:

ii. Adjacent to all Class I streams, to maintain and enhance shade and large woody debris recruitment, landowners must comply with one of the two following options defining tree retention. The Relative Stocking per acre (RS) referenced in the options is calculated according to the relative-stocking-contribution table in Subsection 030.07.e.ii. (3-20-14)

(1) Option 1: Within twenty-five (25) feet from the ordinary high water mark on each side of the stream, live conifers and hardwoods will be retained to maintain a minimum relative stocking per acre of sixty (60). A relative stocking per acre of thirty (30) must be retained in the stream protection zone between twenty-five (25) feet and seventy-five (75) feet from the ordinary high water mark on both sides of the stream. (3-20-14)

(2) Option 2: Within fifty (50) feet from the ordinary high water mark on each side of a stream, live conifers and hardwoods will be retained to maintain a minimum relative stocking per acre of sixty (60). A relative stocking per acre of ten (10) must be retained in the stream protection zone between fifty (50) feet and seventy-five (75) feet from the ordinary high water mark on both sides of the stream. (3-20-14)

(3) Only one (1) option may be implemented within the stream protection zones of a harvesting unit covered by a single notification. Landowners are strongly encouraged to retain all trees immediately adjacent to the stream.

Forest Type	**Per Tree Contribution to Relative Stocking by Diameter Class**						
	Diameter Class (DBH in inches)						
	4-7.9"	**8-11.9"**	**12-15.9"**	**16-19.9"**	**20-23.9"**	**24-27.9"**	**28-31.9"**
NIGF (North Idaho Grand Fir)	0.097	0.209	0.347	0.506	0.683	0.878	1.088
CIGF (Central Idaho Grand Fir)	0.113	0.244	0.405	0.59	0.797	1.024	1.27
SIGF (Southern Idaho Grand Fir)	0.136	0.293	0.486	0.708	0.957	1.229	1.524
WHSF (Western Hemlock-Subalpine Fir)	0.123	0.267	0.442	0.644	0.87	1.117	1.385
DFPP (Douglas-fir-Ponderosa Pine)	0.151	0.326	0.54	0.787	1.063	1.366	1.693

24. **Forest Type**. Five forest types in Idaho are defined as follows: (3-20-14)

a. North Idaho grand fir/western red cedar (NIGF): moist to wet interior forests with western red cedar, western hemlock, and grand fir being primary climax species, found in forests north of the Clearwater/ and Lochsa Rivers. (3-20-14)

b. Central Idaho grand fir/western red cedar (CIGF): productive conifer forests found in forests between the Lochsa River Basin and the Salmon River, characterized by stands having western red cedar and grand fir as climax species, with a mixed-conifer overstory increasingly comprised of ponderosa pine, Douglas-fir, and larch in the river breaks canyon-lands. Stocking levels are generally lower than that of the NIGF stands. (3-20-14)

c. South Idaho grand fir (SIGF): mixed-conifer forests, dominated by ponderosa pine and Douglas-fir, found south of the Salmon River with grand fir and occasionally western red cedar being the stand climax species. (3-20-14)

d. Western hemlock-subalpine fir (WH): higher-elevation, moist, cool interior forests dominated by western hemlock, mountain hemlock, and/or subalpine fir. (3-20-14)

e. Douglas-fir-ponderosa pine (PP): drier forests dominated by ponderosa pine and Douglas-fir, generally found in lower-elevation, dry sites. (3-20-14)