Washington Department of Natural Resources
Sustainable Harvest Calculation for Eastern Washington

Staff Report

To: Sustainable Harvest Calculation (SHC) Steering Committee and Board of Natural Resources

From: Economics Team

Prepared by: Dale Yi, Kristoffer Larson

Subject: Defining and Maximizing Economic Value in the Sustainable Harvest Calculation (SHC) Model for Eastern Washington

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Proposed Action

The Sustainable Harvest Calculation Steering Committee is requested to decide on continuing to maximize Net Present Value as the objective function for the Sustainable Harvest Calculation (SHC) models for eastern Washington and to approve methods for how revenues and costs will be specified in the models for the calculation of Net Present Value.

Background

Context

The Sustainable Harvest Calculation (SHC) uses mathematical modeling techniques to determine the sustainable level of timber harvest for the benefit of present and future trust beneficiaries. Specifically, the SHC calculates the maximum sustainable harvest volume for timber during the planning decade. The calculation is provided to inform the Board of Natural Resources (BNR) in making prudent and sustainable harvest decisions. It is important for this calculation to be accurate and realistic.

The SHC is conducted using a Forest Estate Model (FEM). FEM is a linear programming model that searches for the optimal forest management actions that maximize an objective function without violating any constraints set in the model.

The objective function is the mathematical expression of the model's primary goal. In the case of the SHC, it represents economic value, which the model seeks to maximize. Because the model's output depends entirely on how this function is defined, it is critical to specify it carefully to ensure that it accurately and comprehensively reflects forest management goals.

Request to Economics Team

The Economics Team was requested to evaluate options in specifying the model used in the Sustainable Harvest Calculation (SHC). DNR's Policy on the Definition of Sustainability for the Sustainable Harvest

Calculation dictates that the SHC model should be "Optimizing the economic value of forest stands" (*Washington Department of Natural Resources, 2006, p. 5*).

The Economics team was asked for input on how to specify and parameterize "economic value" within the SHC's optimization model.

In response, the Economics team seeks to answer the following questions:

1. How should "economic value" be defined in the SHC?
2. How should key components of economic value be specified?
    a. Revenue (positive economic value)
    b. Cost (negative economic value)

Analysis

How should "economic value" be defined in the SHC?

The Policy for Sustainable Forests (PSF) says the economic performance policies are intended to ensure perpetual revenue for the trusts by "Optimizing the economic value of forest stands" *(Washington Department of Natural Resources, 2006, p. 5)*. The PSF also directs DNR to optimize economic value via the analysis of financial characteristics. The PSF says:

> *"The department **will analyze the financial characteristics of forest stands in order to optimize the economic value** of forest stands and timber production over time, in calculating the sustainable harvest level" (Washington Department of Natural Resources, 2006, p. 29)*

Given this directive, we interpret "economic value" as referring specifically to financial values. Accordingly, "financial characteristics" are taken to mean measurable cash flows over time (e.g. revenues generated, and costs incurred).

In light of this, the SHC should define "economic value" as the stream of revenues and costs incurred over time.

What should the objective function be?

The objective function is the mathematical expression of a goal. It allows the model to consider different management alternatives and rank them based on how well it "scored" on the objective function.

Given that the PSF directs the SHC to optimize economic value which we have interpreted to mean the stream of revenues (positive economic values) and costs (negative economic values) incurred over time, the objective function should ideally exhibit the following characteristics:

- Accurately represent the stream of revenues generated and costs incurred
- Consider differences in the timing of when revenues and costs are incurred

Accurately represent the stream of revenues generated and costs incurred

The objective function should align as closely as possible with the objective to optimize the "financial values" or revenues for the trust. The objective function should represent revenues from timber sales net the operational costs of managing the forest asset. This is the most accurate representation of the objective described in the PSF." (Washington Department of Natural Resources, 2006, p. 29)

Consider differences in the timing of when revenues and costs are incurred

For the SHC, it is important to consider when revenues and costs are incurred because of the long-time horizon and the nature of forest management decisions. Actions taken today can have big consequences for future revenues and costs, and this is an important consideration.

It is important to use a method that considers not only the amount of revenue and costs, but also the timing of when they occur over the long term. "Discount rates"[1] are the standard way to account for timing differences. Discount rates allow the analysis to appropriately balance short-term needs against long-term sustainable income priorities.

Why is NPV the best choice for the SHC objective function?

Deciding between multiple cost and revenue streams over time is challenging, and decision makers almost always turn to using a summary metric to characterize the stream of costs into a single number. The PSF lays out three options for DNR to consider. The PSF says "DNR relies primarily on net present value as the most comprehensive and direct way to measure financial returns to the trusts and evaluate investments. However, measures such as internal rate of return and cost-benefit ratio may be best suited for some specific situations" (Washington Department of Natural Resources, 2006, p. 27)

Below are three of the most common summary metrics used. Each of these summary metrics have their own benefits and drawbacks and none are perfect measures. However, Net Present Value (NPV) is generally preferred as it is the most commonly used and well understood approach in financial analysis.

We summarize three of the commonly used metrics to compare:

1. Net Present Value (NPV)
2. Internal Rate of Return (IRR)
3. Benefit-Cost Ratio (B/C)

Net Present Value (NPV)

$$NPV = \sum_{t} \frac{Revenue_t - Cost_t}{(1+r)^t}$$

t=time; r=discount rate

[1] A discount rate is a factor used to convert future income or costs into present value, reflecting the idea that money available now is more useful than the same amount in the future.

Net present value is considered the gold standard when valuing a stream of revenues and costs over time. It is the most commonly used approach that effectively serves as the default choice unless there is a compelling reason to choose otherwise.

It is primarily used because it converts a stream of costs and revenues over time into a single number that represents the present value of all future costs and revenues. The NPV can be thought of as the lump sum equivalent to receiving all revenues over time. For example, lottery winners sometimes have the option of picking either a lump sum payment or a monthly payment. Given the discount rate, the NPV would be the lump sum equivalent to receiving those monthly payments.

Internal Rate of Return (IRR)

IRR is defined as the discount rate which makes NPV equal to zero. It can be thought of as the "break-even" discount rate. Any IRR that is above a benchmark rate (e.g. bond rate) is profitable, and greater values represent superior performance. Its primary benefit for DNR would be that it allows for determining the most profitable option without having to choose a discount rate. It also has the added benefit of being expressed as a percentage, which is easier to understand by non-experts.

However, implementing IRR may not be technically feasible in the case of the SHC. The IRR is undefined if cash flow is positive for every time-period, in that it requires some initial investment and DNR always operates cash-flow positive for forestry[2]. Furthermore, IRR is numerically solved via algorithm and doesn't have a closed-form solution making it hard to optimize on. In the case of the SHC, it is technically not possible to use.

Benefit Cost Ratio (B/C)

The Benefit Cost Ratio is the ratio of the present value of revenues to the present value of costs. It is also relatively simple to interpret (bigger is better). Its primary benefit is its ease of communication to non-expert audiences as it is simply a fraction.

For the purposes of the SHC, this method is not preferred because it uses the exact same numbers to calculate NPV but expresses it as a ratio, which is not the standard way. It has the added disadvantage of sometimes being misinterpreted as an interest rate equivalent percentage when it is not that. In the case of the SHC, B/C has no discernable benefit over NPV while exhibiting more difficulty in interpretation and communication.

How should Revenue (positive economic value) be specified in NPV?

Definition of revenue is relatively uncontroversial. Money earned from timber sales is gross revenue before costs of production are deducted. No viable alternatives to this definition have been identified.

Revenue: Revenue = Price * Quantity

[2] Currently, the SHC represents standing timber as an endowment in the initial time period. The timber inventory asset is not "purchased" in the model so there isn't a large upfront cost that needs to be covered by future revenue in order to "break even". This results in cash-flows that are positive in every period and precludes the existence of a "break even" discount rate because every discount rate breaks even in this scenario.

Price is a vector representing the dollar value per unit volume ($/mbf) with each element corresponding to a distinct species. Quantity is a vector representing the volume (mbf) of standing logs with each element corresponding to the same species in the Price vector.

In specifying revenue, the quantity vector is treated as a given output of the biophysical model. Discussion here is limited to the specification of the price vector.

Ideal Prices

The ideal prices to use in the SHC should exhibit a number of characteristics:

- **Stumpage Values**
  Stumpage represents the value of standing timber in the forest, accounting for all costs of harvesting and delivering logs to market. As such, it best reflects the net value of the timber. In contrast, delivered log prices represent the gross value of trees at the mill and do not reflect harvesting costs.
- **Species Disaggregated**
  Prices should be disaggregated by species (and by grade if possible) to correspond to the output of the biophysical model.
- **Geographically Specific**
  Price data should also be geographically specific, reflecting any local variation in the cost of harvest, hauling, and road construction that get reflected in the auction value of timber in a given area.
- **Consistent & Reliable**
  Lastly, the consistency and reliability of underlying primary data and the method to calculate SHC prices are key considerations. The data and calculation methods should result in SHC prices that: (a) closely mirror real auction outcomes; (b) have sufficient observations and be collected with sufficiently high frequency, and; (c) use reliable reproducible methods.

Data Sources

Delivered Log Price Survey

Data from the delivered log price survey represents the value of logs at the sawmill gate. This is the price that sawmills purchase logs at. While this is not the value of standing logs, it is a high frequency (monthly) dataset. This data is free of any assumptions and derivations using cost of harvest, hauling, and road construction data. It reflects the purchasing prices during the month of the survey (Washington Department of Natural Resources, 2025b).

- Data:
  - Species Disaggregated: Yes
  - Location: value at sawmill (delivered price)
  - Frequency: monthly
  - Validity: stated purchase prices
- Method:
  - Mail survey with follow-up reminders (Responses are voluntary)
  - Observation unit: sawmill
  - Population: sawmills that purchase logs produced in Washington state

- URL: https://www.dnr.wa.gov/programs-and-services/product-sales-and-leasing/timber-sales/timber-sale-querylog-prices

Timber Sale Appraisals (minimum bids)

Timber sale appraisal prices represent DNR's best estimate of the fair market value of standing timber in the current log market. This method has been rigorously developed and tested to be in compliance with DNR's trust mandate. This price is used to set the minimum bid for a sale and can be interpreted as a lower-bound for the market price. The fair market value appraisal ensures that DNR never sells timber below the prevailing market value at the time of auction.

Due to the fact that this is an appraisal of fair market value (as opposed to auction value) used to set the minimum bid, it consistently underestimates the true auction values.

- Data:
    - Species Disaggregated: Yes
    - Location: at stand(s)
    - Frequency: for each sale
    - Validity: estimated values (consistent under-valuation)
- Method:
    - DNR timber sale appraisal system records
    - Observation unit: timber sale block
- URL: https://www.dnr.wa.gov/programs-and-services/product-sales-and-leasing/timber-sales/timber-auction-packets

Auction Results (bid prices)

Auction results represent the full market value of the stand of timber. This is the most valid data available, as it represents the true value in auction. However, the auction value is a single value representing the entire "bundle" of different kinds of species and grades present in a given sale. It cannot be disaggregated by species and grade and does not give detailed insight into purchaser appraised costs for a given sale (Washington Department of Natural Resources, 2025a).

- Data:
    - Species Disaggregated: No
    - Location: at stand(s)
    - Frequency: for each sale
    - Validity: real winning auction bids
- Method:
    - DNR auction process
    - Observation unit: timber sale block
- URL: https://www.dnr.wa.gov/programs-and-services/product-sales-and-leasing/timber-sales/timber-auction-results

Sort Sale Records

Sort sale records can be used to accurately derive the net stumpage value of timber. These records contain the delivered log value (bid price) less the cost of harvest, haul, and road construction (including

maintenance and abandonment) as directly observed in DNR audit records. This is the real derived market value of timber and can be disaggregated by species and grade (to some extent). Unfortunately, these records sort sales represent a small percentage of all volume sold by DNR and its available data is scattered and geographically isolated.

- Data:
    - Species Disaggregated: Yes
    - Location: at stand(s)
    - Frequency: for each sort sale
    - Validity: real net stumpage price
- Method:
    - DNR sort sale audit records
    - Observation unit: sort sale

How should SHC revenue (prices) be calculated?

Appraisal Price to Bid Price Scaling

This method calculates the SHC price by applying an adjustment to the appraisal prices (See Appendix for a more detailed explanation of this calculation):

$$\text{Adjustment} = \frac{Auction\,Value\ - Appraised\,Value}{Quantity}$$

The key assumption behind this approach is that the bidder uniformly values all timber species at a fixed amount ($/MBF) above the appraisal price. This is a simple and relatively easy way to adjust the carefully estimated appraisal values into auction value consistent prices. This would, on average, reflect the real market value of timber based on real auction bids.

However, there are some drawbacks. The overbid could partially be occurring because the bidder has a higher value for a specific set of species or because purchasers expect to find more volume on the sale than the advertised volume. By applying a flat $/MBF increase over the appraisal value, the resulting prices could be slightly over-valuing unpreferred species while under-valuing the preferred species. This may introduce some bias to the price data. This type of bias would only be concerning if the species composition of future sales were going to change, but species composition is expected remain stable.

Delivered Log Prices as SHC prices

Delivered log prices could be used as the SHC prices. The delivered log price data is high-frequency data on the prevailing buying prices for logs valued at the sawmills. This dataset offers real prices that are free from some of the errors and assumptions inherent to other methods where the costs of hauling, harvest, and construction must be estimated and subtracted. The data is species (and quality) disaggregated by East and West regions of Washington.

However, there are a number of drawbacks of using this data as the SHC price for timber. Since it captures only the most common log grade (camprun) in the eastside, it is unable to consider variations

in log quality that impact market values. Most importantly, because prices are for logs already delivered to mills, it is not a stumpage value. It is over-valuing the price of timber because it does not account for costs of harvest, haul and construction that were incurred to get logs from stands to the mills.

Using these prices would mean that the model would need to assume that harvest, hauling, and road construction costs are the same across all of the SHUs. Internal narrative accounts roughly validate this assumption, but DNR does not have the frequency of data necessary to test this assumption formally.

If the assumption of spatially uniform costs holds, the only actual drawback of using the delivered log price is the resulting inability to directly interpret the resulting NPV values of the model. The NPV values would be artificially inflated by a constant fixed amount, which confounds a direct interpretation of value for trust beneficiaries. This assumption is simply a "fixed" increase to NPV across the board and would not impact the model solution. So if the assumption of spatially non-varying costs is a valid one, using delivered log prices as the SHC prices may be the simplest and most straightforward approach available.

Sort Sale Records Derivation

This method uses detailed data from sort sale audit records, which provides a granular view on all the costs and revenues on a given sale. These audit records contain data on the delivered log price (bid price), as well as all of the costs incurred to bring logs to market from the stand (harvest, haul, road construction, contracting, fees). By subtracting these costs we can calculate the true net stumpage value.

The main benefit of this method is its precision. It provides the most accurate stumpage price data possible from DNR data that is broken down by species and location.

However, it does come with some drawbacks, one of which may be unsurmountable.

First, there is a technical drawback. This method would need to assume that there is no profit margin for the buyer from this part of the supply chain (between standing log and delivered log). This sounds approximately correct, but it cannot be empirically verified without proprietary data that DNR does not have.

Second, the sort sales do not disaggregate species very well. The prices recorded are often a price for a combination of multiple species. This significantly limits the ability of this method to derive species specific stumpage price.

Last, there may not be enough data on sort sales to confidently average across. There are not very many sort sales in any given year on the eastside to begin with. Combine this with the issue of many prices not being species disaggregated, it significantly limits the number of observations that can be used to calculate a species specific price.

Comparing Options

	Delivered Log	Appraisal Adjustment	Sort Sale Net Stumpage
Species Disaggregation	Yes (limited)	Yes	Yes (limited)
Geographic Disaggregation	No	Yes	Yes
Stumpage Value	No	Yes	Yes

	Delivered Log	Appraisal Adjustment	Sort Sale Net Stumpage
Data availability	Good	Good	Limited
Bias/Assumption	Over-value	Slight bias if species composition is not stable	Generalization from few observations

From the available methods to calculate SHC prices from data sources, we can eliminate the sort sale method as the least preferred because of the limited number of sort sale records on hand and the lack of species disaggregated price information within the already limited volume of data.

The delivered log price is a feasible choice. It represents accurately the relative prices for the different species that the SHC needs to consider, but it has the disadvantage of not being a stumpage price. It would overvalue the timber as it doesn't net out the cost of harvest, hauling, and road construction.

The appraisal price adjustment approach will more reliably reflect the auction values. If species compositions are changing, it could introduce slight biases, but species composition is stable so this should not be an issue.

If the composition of species harvested on the eastside will not meaningfully change from the current, then the appraisal price adjustment approach appears to be the most straightforward option and is derived from DNR's robust appraisal system. It would exhibit all of the desired characteristics and be the least biased.

How should Cost be specified in NPV?

How should the SHC define cost? There are two broad choices:

- Actual Management Costs
  - The actual accounting costs incurred by DNR to manage trust assets.
- Trust Costs
  - The percent of revenue deposited into the cost accounts as defined in RCW 79.64[3]

These definitions are not the same, and the SHC is sensitive to how this is specified.

As an example, suppose DNR has the option to either thin a stand or leave it unthinned. If the stand is thinned,

- Revenue = $100 generated from sale of timber
- Actual Management Cost = $110 (the real costs incurred by DNR to make the sale)

[3] RCW 79.64 states that costs are to be allocated on a percent basis. RCW 79.64.110 (for FDA) and RCW 79.64.010 (for RMCA) describe the cost reimbursement structure wherein a percentage of revenue from timber sale is deposited in the cost accounts for the purpose of defraying the necessarily incurred costs of management and administration. The RCW empowers the board to set an appropriate percentage value but caps the percentage by saying the percent "shall not exceed" 32% of revenue for RMCA and 27% for FDA.

- Trust Cost = $31 (31% of revenue paid into management fund)

Should DNR carry out the thinning? The answer depends on how costs are defined:

- Trust Costs – Using this definition, DNR should carry out the thinning. It may be an accounting loss ($110 > $100), but it should be done because the trusts would earn revenue from the activity ($100>$31).
- Actual Management Costs – Using this definition, DNR should not carry out the thinning. The cost of thinning is $110, which is greater than the $100 it would generate. DNR is not required to incur losses to generate revenue.

The Economics Team recommends that DNR use the "actual cost" definition in the SHC because:

- A trust manager is not legally obligated to incur financial losses in order to increase revenue for trust beneficiaries. Doing so is going beyond the trust mandate and is not required.
- It is not prudent to incur financial losses. Carrying out activities where the actual costs of carrying out the action are greater than the revenues generated from the action would not be prudent management.
- RCW 79.64 also states that any balance in the cost accounts should be returned to the trusts. This effectively means that costs are, in theory, incurred on an actual cost basis.
- In the above thinning example, the trust would have earned $69 ($100-$31) if DNR thins the stand. However, the trusts would be better off if DNR returned the cost of the thinning (+$110) rather than the additional revenue resulting from the thinning (+$69).

How should Cost be calculated in NPV?

General Approach

The costs need to be calculated in a way that is specific to:

- The management options being considered
- The decade in which costs are incurred

With that said, there are some options of how costs can be accounted for in NPV:

- All Costs (fixed and variable costs)
- Variable Costs only

All Costs

Approach

This approach is the comprehensive accounting of all costs associated with managing timberland assets. It includes both the fixed agency-level costs and the variable costs that depend on the specific management activities undertaken. These costs would be calculated for each management option as incurred in each decade.

Benefits

Incorporating all costs provides a more complete and accurate representation of total expenditures, enabling a direct interpretation of net present value (NPV) figures that result from the model solution. This approach aligns with traditional financial analysis, where revenue (e.g. stumpage price) is considered against the full cost structure.

Drawbacks:

Fully accounting for all costs can be a very complex and contentious process, especially when it comes to determining which agency line items should be included. This level of detail often becomes a point of stakeholder scrutiny and debate despite having no impact on the model's solution for the optimal management actions. Introducing fixed costs into the analysis may invite enquiry and criticism that, even if valid, ultimately have no harvest decision-relevant impact because fixed cost don't impact the model solution.

Variable Costs Only

Approach

This approach focuses exclusively on variable costs that differ across the management options available. Fixed costs (e.g. administrative overhead that is common to all options) are excluded from the analysis. Only the relative cost differences (e.g. additional silviculture cost for VRH compared to conventional thinning) are included in the cost accounting.

Benefits

This approach significantly simplifies cost accounting by concentrating on the incremental cost differences between management strategies. It reduces administrative burden and avoids entanglement in broader agency-level accounting disaggregation that ultimately does not impact the model solutions.

Drawbacks

By excluding fixed costs, this approach sacrifices the ability to directly interpret NPV in absolute terms. The resulting figures reflect only relative economic performance, which may limit ability to interpret the NPV numbers that the model provides with solutions. Given that a direct interpretation of NPV numbers was never a desired use of result, this is not an important drawback.

Recommendation

DNR's Economics Team was asked to evaluate options for defining "economic value" within the Sustainable Harvest Calculation (SHC) model for eastern Washington. Under current policy, the SHC model must maximize economic value when determining the sustainable harvest level. To support this, the team reviewed various definitions of economic value and assessed how to define its core components—specifically, revenue (as positive economic value) and cost (as negative economic value). Responding this this request, the economics team has considered:

(1) How the SHC should define and specify "Economic Value"

(2) How key components of economic value are to be defined and specified:
   a. Revenue (Positive Economic Value)
   b. Cost (Negative Economic Value)

Based on this evaluation, the Economics Team reached the following conclusions regarding how economic value should be defined and applied within the SHC model:

Recommendation #1: The Economics Team recommends that the SHC continue to use Net Present Value (NPV) to represent economic value for use in the objective function. Given the primacy of the trust mandate, to seek full market value for assets with undivided loyalty to the trusts, the model should only consider "economic value" that impacts the accrual of funds into trust beneficiary accounts over time. This simplifies the problem to a single objective financial analysis in which case NPV is the best choice to represent "economic value". NPV is the gold standard in financial analysis when measuring the value of a stream of revenue over time and is the most appropriate option for the SHC.

Recommendation #2a: The Economics Team recommends that the SHC calculate SHC timber prices by analyzing data from two sources: (1) timber auction results, and; (2) timber sale appraisal data. Analysis of these data sources enables the estimation of species-specific prices that are consistent with the values achieved at auction. There are other viable alternatives (e.g. delivered log prices), but using both auction and appraisal data provides the most consistent representation of the full market value of timber managed by DNR.

Recommendation #2b: The Economics Team recommends that the SHC define costs as actual management costs incurred as opposed to the percentage distribution structures. This is most in line with DNR's fiduciary obligations. Furthermore, the SHC should, as a minimum, ensure that costs are specified in a way that accurately represents the relative costs of each of the management options represented in the SHC (e.g. VRH vs conventional thinning). Lastly, while including fixed costs would be beneficial in some ways, it is not critical to include them. Fixed costs do not impact the solution to the model's optimization problem.

Literature Cited

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Staff Review

Document was reviewed by the following staff:

- Susan Beall – Asset Management Division Manager
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- Denise Roush-Livingston – Environmental Planner
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- Michael Sly – ADM Product Sales
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Appendix: Calculating SHC Prices with Appraisal Worksheets

Overview

Appraised prices are consistently below the true prices achieved at auction. To adjust appraised prices upward to auction prices, this method increases all prices by a fixed $/MBF number. The definition and specific data definitions are described in the sections below.

Definition

$$SHC\ Prices^{*} = \ Appraisal\ Prices + Adjustment$$

The SHC prices are constructed by taking the appraisal prices and adding a fixed adjustment factor ($/MBF) to all of the prices.

$$\text{Adjustment} = \frac{Auction\ Value\ - Appraised\ Value}{Volume}$$

This adjustment factor is the total auction value minus the appraised value, divided by the total timber volume (MBF) of the auction. It can be interpreted as the average "overbid" on a $/MBF basis.

Primary Data

Timber Sale Selection

DNR's Product Sales and Leasing Division PreSales database was queried on 5/20/2025 to identify timber sales in DNR's NE and SE regions to include for estimating adjusted stumpage prices. The database also provided the winning auction prices that were used to adjust stumpage values. All timber sales with auction dates occurring in fiscal years 2015 through 2024 were included[4]. However, any sales that were individual sorts were excluded due to the inherent limitations of this data described previously. Sales associated with salvage harvests (i.e., wildfire or wind blowdown) were also excluded as the frequency of these types of harvests is uncertain and they are not represented in the SHC harvest model.

After compiling the list of sales from the PreSales database, DNR staff located the corresponding excel appraisals worksheets for each sale by searching the Product Sales and Leasing Division's timber sale appraisal folders. Timber sales that fail to sell at auction are typically reoffered and can have multiple appraisals. In these instances, the appraisal worksheet associated with the auction month the sale sold was used so that each timber sale only had one corresponding appraisal worksheet. The resulting number of timber sale appraisals for NE and SE region were 92 and 16, respectively. These worksheets were used to conduct the calculations that follow.

Volume (MBF)

Species disaggregated volume data is sourced from appraisal worksheets. Specifically, the "Camprun MBF" volumes (typically found in Column D) are used as timber volumes. See below for an example.

[4] The SHC solves on a decadal basis, and these 10 years of data from 2015 to 2024 represent a decadal average corresponding to the time-resolution of the SHC solve

Timber Sale	Application Number	Auction Date	Expiration Date
Q Vulcan	105823	April-24	11/30/26
6 miles northwest of Curlew, WA			
TBS Grade Distribution / Species	Ave. DBH	Net Plus MBF	Camprun MBF
Douglas fir	14.2	2,358	2,358
Larch	12.7	645	645
White fir		-	
Alpine fir	12.1	97	97
Spruce	12.3	674	674
Redcedar	19.2	46	46
Lodgepole	13.4	32	32
White pine			
Ponderosa pine			
Hemlock			

Appraisal Prices ($/MBF)

Species disaggregated appraisal price data is sourced from appraisal worksheets as well. Specifically, the "Stumpage" prices (typically found in Column C) are used as the appraisal prices. See below for an example.

Total Delivered Values	WT.$/MBF	Stumpage
Douglas fir	$492	$143
Larch	$476	$127
White fir		
Alpine fir	$425	$76
Spruce	$440	$91
Redcedar	$991	$642
Lodgepole	$411	$62
White pine		
Ponderosa pine		
Hemlock		

Auction Revenue ($)

Auction revenue data is sourced from auction results data. In the auction results workbook, the "BidPrce" column is used as the auction revenue data. See below for an example:

Agreement Number	Bid Price
88241	$1,444,648.38
98559	$817,162.00
99491	$31,000.00
99489	$3,020,095.53
100091	$1,788,427.50
101946	$10,750.00
101512	$198,088.10
103422	$47,326.30
102509	$308,439.50

Calculated Data

Appraised Revenue ($)
Definition:

$$Appraised\ Revenue = \ Appraisal\ Prices * Volume$$

Variables used:

- Appraisal Prices ($/MBF)
- Quantity (MBF)

Appraised Revenue is the timber volume on offer valued at appraisal prices. Note that "Appraised Revenue" is slightly different from the "minimum bid" and "appraised value" that is set in the appraisal worksheet. This is due to a small rounding adjustment that is done at the end. In this method, that final adjustment is disregarded in the calculations here.

Adjustment ($/MBF)
Definition:

$$\text{Adjustment} = \frac{Auction\ Revenue\ - Appraised\ Revenue}{Volume}$$

Variables Used:

- Auction Revenue ($)
- Appraised Revenue ($)
- Volume (MBF)

Adjustment is the average "overbid" per MBF ($/MBF). This overbid will be used as the flat adjustment rate that will be applied across all species prices on the eastside.

Special Exception

SHC prices are calculated in the above way with two exceptions. Douglas fir and Grand fir prices in Skamania and Klickitat counties. These prices are calculated separately from the rest of the eastside. For example, we calculate two SHC prices for Douglas fir:

- Douglas fir price for Skamania and Klickitat
- Douglas fir price for the rest of the eastside (not Skamania or Klickitat)

This same exception is made for grand fir price as well. This exception is made to more accurately represent the market prices specific to those areas. The Douglas-fir and grand fir in Skamania and Klickitat are being purchased by westside mills and fetch westside prices. This disaggregation allows the SHC to better represent that fact by calculating a separate average for Douglas fir and grand fir in Skamania and Klickitat counties.