Executive Summary - 2015 Sustainable Yield Calculation

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This document highlights the purpose and need, design, methods, results and discussion of the Montana Department of Natural Resources & Conservation (DNRC) 2015 Sustainable Yield Calculation (SYC). It also reflects key factors affecting the results of the SYC.

State law requires the DNRC to calculate the annual sustainable yield at least once every 10 years in order to incorporate changes in forest conditions, the manageable land base, management intensity, management objectives, or new laws and regulations.

Purpose and need for the Sustainable Yield Calculation

The Trust Land Management Division of the Montana DNRC manages ~730,000 commercial forest acres (FIGURE 1) for the benefit of the Common Schools and other endowed institutions. Management activities on those lands focus on providing a consistent and long-term revenue source for the trust beneficiaries, which is generated by selling a consistent annual timber volume. The amount of timber sold annually is determined through a sustainable yield calculation.

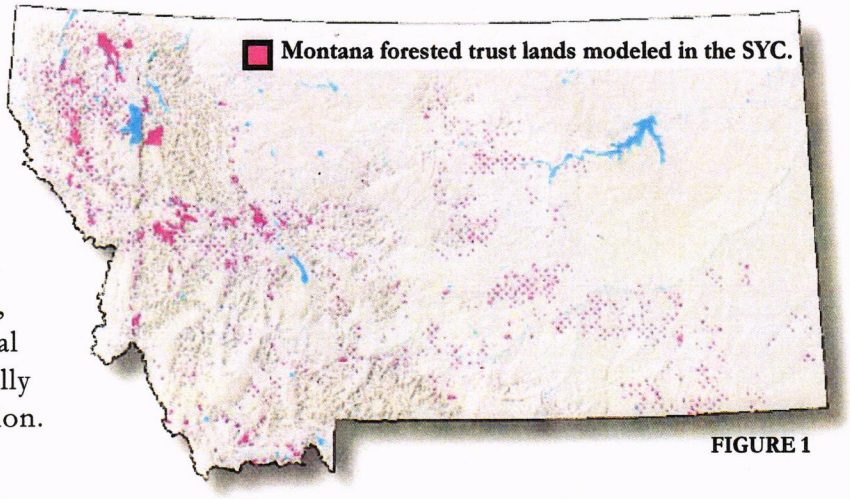


FIGURE 1

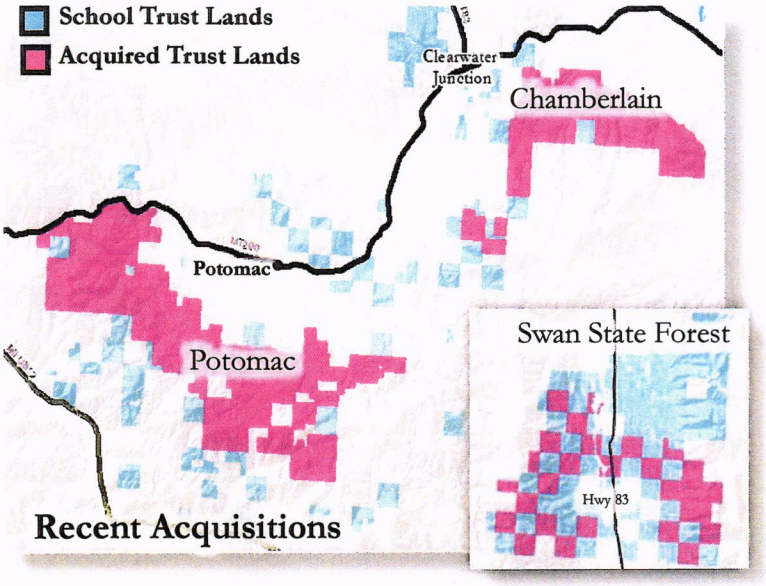
MCA 77-5-221 defines **sustainable yield** as "the quantity of timber that can be harvested from forested state lands each year in accordance with all applicable state and federal laws, including but not limited to the laws pertaining to wildlife, recreation, and maintenance of watersheds, and in compliance with water quality standards that protect fisheries and aquatic life and that are adopted under the provisions of Title 75, chapter 5, taking into account the ability of state forests to generate replacement tree growth."

DNRC has performed four sustainable yield calculations prior to 2015. The last calculation was done in 2011 in conjunction with the DNRC's development of a Habitat Conservation Plan (HCP), and set a sustainable harvest level of 57.6 million board feet (MMBF) annually.

Since the last calculation in 2011, DNRC has acquired ±67,000 acres of former industry-owned timber land (FIGURE 2). That acquisition was the catalyst for a bill (SB 154) in the 2013 Montana legislative session requiring the DNRC to conduct a new calculation beginning on July 1, 2013. State law requires an

DNRC SUSTAINABLE YIELD CALCULATIONS

YEARS	CALCULATION (MMBF)	MANAGED ACRES
1983	50.0	399,700
1996	42.2	363,769
2004	53.2	430,784
2011	57.6	469,159
2015	57.8	582,945



independent third party conduct the calculation, and the DNRC contracted with Mason, Bruce & Girard in 2014 to perform the calculation.

How is the calculation done?

The process of determining the annual SYC involves three steps:

1. Gathering, preparing, and summarizing data to provide a detailed description of the land base
2. Developing estimates of expected forest growth
3. Applying management constraints using an optimization model in order to determine the annual sustainable yield.

Methods

The data used for the calculation includes descriptions of the different types of forests growing on trust lands, wildlife habitat and water resource data, operability data, and spatial data.

The forest data used for the calculation came from two sources. The first source includes plot data collected by the DNRC in 2014 from over 5,300 plots on trust lands in the Northwestern, Southwestern, and Central Land Offices and was used to develop descriptions of forests in those areas. The second source is derived from U.S. Forest Service Forest Inventory and Analysis data and was used to develop descriptions of forests in DNRC's east-side Land Offices. All of the forest data was summarized by timber type, size, and stocking for each Land Office.

Wildlife habitat data used in the calculation included information regarding habitat for the following animals: grizzly bear (visual screening buffers and security core areas), Canada lynx (lynx management areas, potential suitable habitat), and bald eagle (nest sites). Water resource data included the locations of sensitive watersheds and streamside management zones (SMZ) and riparian management zones (RMZ).

Operability data included stands identified as deferred from management, areas suitable only for harvesting using helicopters, areas managed under conservation agreements or easements, and Federal wild and scenic river corridors.

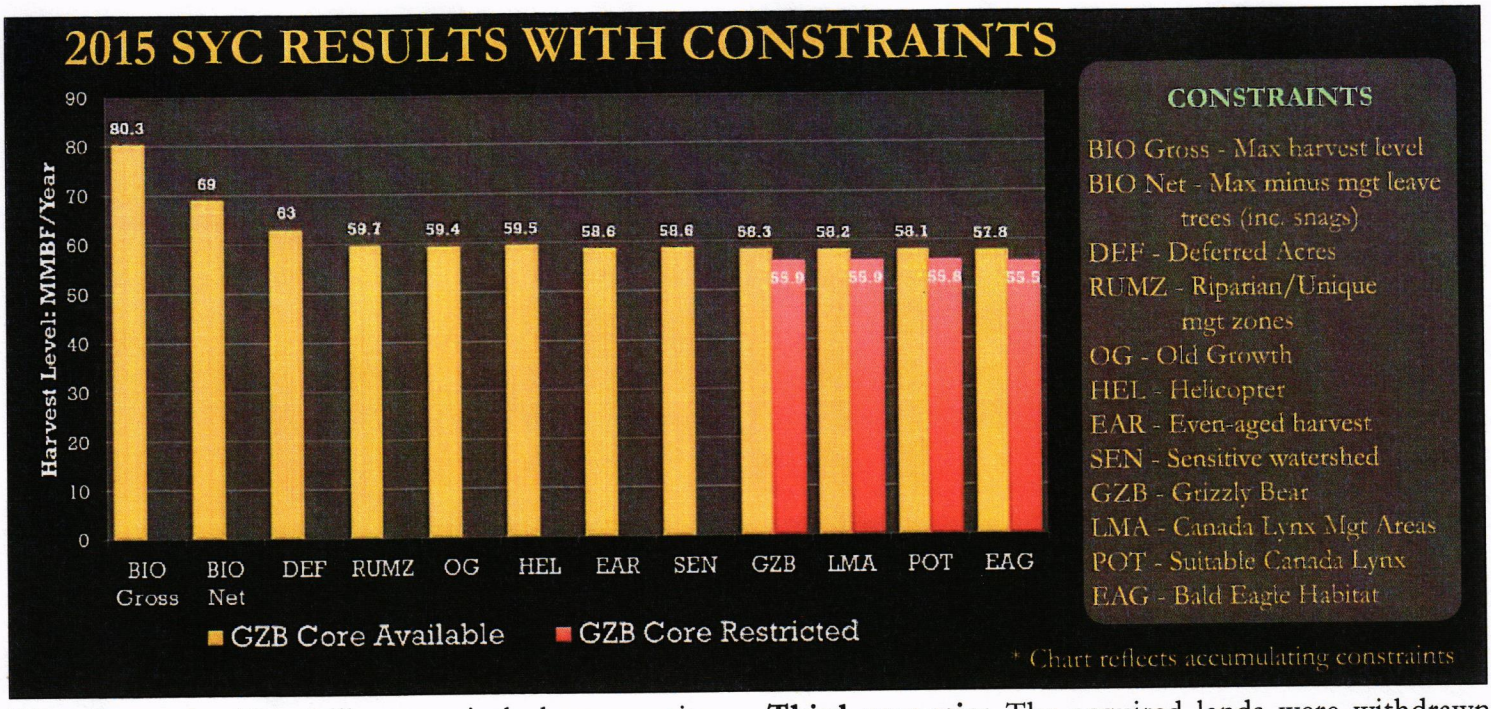
The Forest Vegetation Simulator (FVS) growth and yield model was used to determine estimates of expected forest growth. This model has two variants that apply to forests in Montana; the Inland Empire variant was used for the Northwestern and Southwestern Land Offices, and the Eastern Montana variant was used for the Central and east-side Land Offices. To differentiate among the various ranges of site potential for a given timber type, DNRC supplied information regarding potential growth, habitat types, and site index for use by FVS. To ensure the estimated forest growth and yield projected by FVS was reasonable, simulations that did not include any management activities were modeled. DNRC reviewed those results and adjustments were made to calibrate the model as needed.

Following calibration of the FVS model, simulations were made of DNRC's types of management actions implemented on forested trust lands. These simulations determined the expected growth associated with management activities over time and the harvest volumes associated with those activities for use in the optimization model.

An optimization model was used to apply the management constraints and determine the annual sustainable yield. Constraints are limitations placed on the model that restrict when, where, which, and how often harvesting treatments may be applied. The constraints were determined by laws, administrative rules, and management plans applicable to DNRC's forest management. These included constraints related to operability, harvest and silviculture, wildlife habitat and water resources.

Results of the 2015 SYC

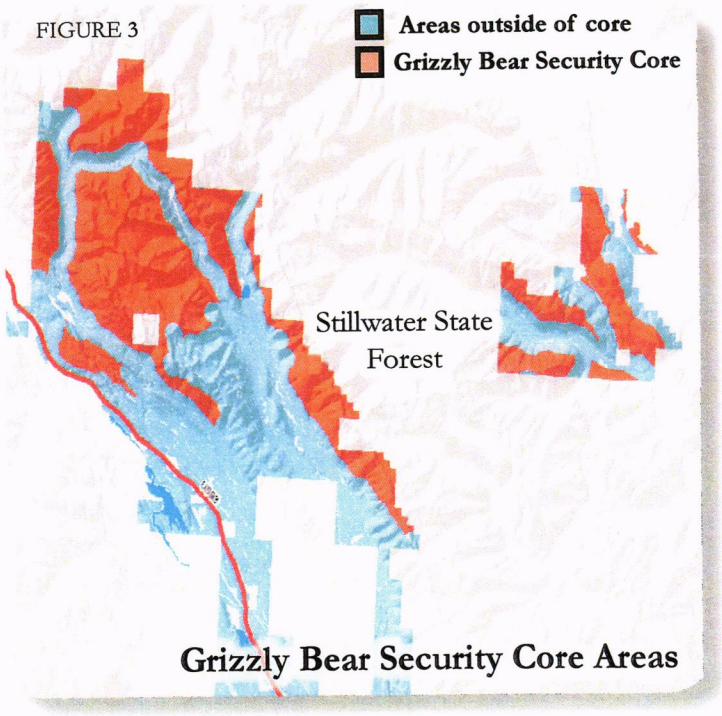
For this calculation, three scenarios were evaluated at the statewide level. Two scenarios were evaluated to address current uncertainty regarding management of grizzly bear security core in the Stillwater Unit, and the third scenario aimed to identify the impact of the acquired lands on the annual sustainable yield. Each scenario evaluated a planning horizon of 200 years.



First Scenario: The Stillwater grizzly bear security core (FIGURE 3) was made available for management, resulting in an annual sustainable harvest level of 57.8 MMBF, with 582,945 acres contributing to the solution. 146,434 acres were not considered in the solution and received no management—these areas are primarily stands deferred from management and riparian areas.

Second scenario: Management in Stillwater grizzly bear security core was restricted, resulting in an annual sustainable harvest level of 55.5 MMBF, with 561,611 acres contributing to the solution. 167,768 acres were not included in the solution due to constraints similar to first scenario.

FIGURE 3



Grizzly Bear Security Core Areas

Third scenario: The acquired lands were withdrawn from the model in order to determine the impact of those acres on the sustainable yield. This resulted in an annual sustainable harvest level of 53.2 MMBF, with 527,456 acres contributing to the solution and inferring that the acquired lands contribute 4.6 MMBF to the annual sustainable yield when compared against the first scenario.

Acquisition lands account for 4.6 MMBF of the SYC.

For all scenarios, acres identified as suitable only for helicopter logging did not contribute to the annual sustainable yield. These acres were considered to provide an opportunistic amount of volume above and beyond the calculated yields when specific markets are available. When market conditions are feasible for helicopter logging, those lands could contribute an additional 1.1 MMBF to the annual sustainable yield.

What factors most affected the results?

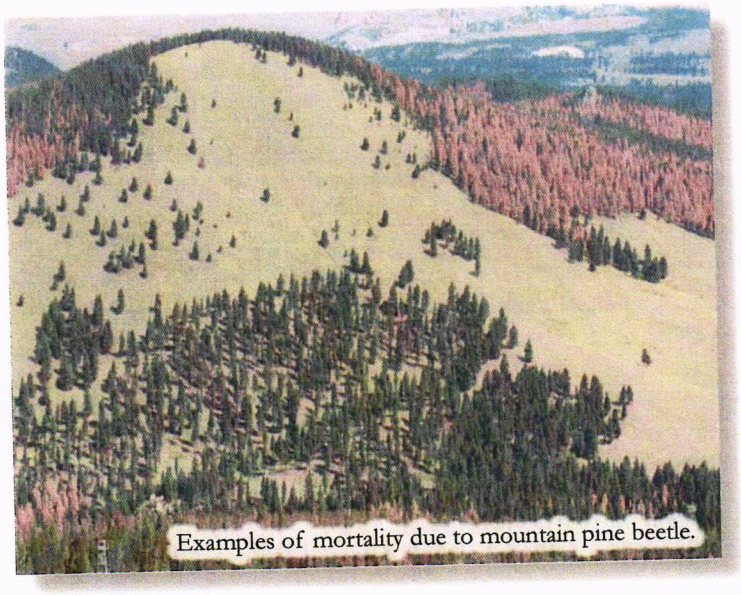
Although the results of this calculation are similar to previous calculations, there are important factors that distinguish this effort from past efforts and that provide a significant contribution to these results - namely improved data, improved growth and yield estimates, and a reflection of changes in forest conditions on DNRC lands.

The data used for this calculation represents a significant step forward for DNRC in terms of quality, and that

The SYC provides a predictable supply of timber to Montana's wood products industry. DNRC manages <5% of the state's timberland, but annualy contributes 15-20% of the statewide harvest volume.

is reflected in the results of the calculation. DNRC collected and relied heavily on data from its own lands for a large part of this calculation, rather than data from other sources as was done in past calculations. This new data reflects influences of past management (or lack thereof) on DNRC lands thus providing a more accurate estimation of existing inventory and potential growth on forested state trust lands.

DNRC used the FVS growth and yield model for this calculation, which is a nationwide model widely-used by several federal, state, and private forest managers. This model includes variants that were developed specifically for Montana forests. DNRC's data was also used to further calibrate the model to the conditions and expected growth rates observed on forested state trust lands. This resulted in more accurate predictions of forest growth compared to previous calculations.



Examples of mortality due to mountain pine beetle.

Over 105,000 acres of state trust lands were substantially affected by damaging events including wildfires and insect outbreaks since 2004 that were not accounted for in the 2011 calculation. These influences were particularly prevalent on lands administered by the Southwestern Land Office, Central Land Office, and on land offices in eastern Montana. This caused significant mortality that reduced the amount of standing volume in some forest types (ponderosa pine, lodgepole pine, Douglas-fir) that represent large acreages in those areas. The reduction in inventory due to those factors largely offset the additional 4.6 MMBF of volume contributed by the acquired lands to the annual sustainable yield.

Qualifications and Recommendations

The primary objective of this project was to determine at a strategic level the amount of timber that the DNRC can sustainably harvest from forested trust lands; however, it was not intended to determine management direction for individual stands. A range of harvest treatment types used by DNRC were simulated and available for use by the model, and although the model is not deterministic with regards to management of individual stands, the types of management used by the model should be reflected in on-the-ground management.

For further information on the 2015 Sustainable Yield Calculation and FAQs, please visit:

http://dnrc.mt.gov/divisions/trust/forest-management/sustainable-yield-calculation/public-participation

or

http://1.usa.gov/1PBfPJO

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Frequently Asked Questions

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1) **Q: What is the Sustainable Yield Calculation (SYC)?**

A: It is a calculation required by state law that DNRC must commission, which sets an annual sustainable yield level for the Trust Lands Management, Forest Management Program. State law requires that an independent, third party conduct the calculation. By state statute (MCA 77-5-221) the ***annual sustainable yield*** is defined as... "the quantity of timber *that can be harvested from forested state lands each year in accordance with all applicable state and federal laws, including but not limited to the laws pertaining to wildlife, recreation, and maintenance of watersheds, and in compliance with water quality standards that protect fisheries and aquatic life and that are adopted under the provisions of Title 75, chapter 5, taking into account the ability of state forests to generate replacement tree growth."*

2) **Q: Why is DNRC completing a SYC?**

A: Periodic recalculation of the annual sustainable yield for state trust lands is necessary to incorporate changes in forest conditions, the manageable land base, management intensity, management objectives, or new laws and regulations. In 2013, MCA 77-5-222 was amended as a result of the passage of Senate Bill 154, directing the Department to conduct a new study to determine the annual sustainable yield on forested state lands effective July 1, 2013, as a result of acquiring approximately 67,000 acres of former industry-owned timber land.

3) **Q: Is the Annual Sustainable Yield a minimum or maximum? Is it a volume harvested target? Is it a volume sold target? Or is it a volume offered for sale target?**

A: By State statute (MCA 77-5-223), the annual sustainable yield constitutes the annual timber sale requirement for the timber sale program administered by DNRC on state trust lands. In that sense, it is a target amount of timber that the DNRC must offer for sale annually. Actual amounts of timber sold may be slightly higher or lower than this number, as are amounts of timber harvested annually from state trust lands.

4) **Q: How is it that DNRC acquired 67,000 acres of new forest land and the SYC only went up 200 MBF/Year?**

A: DNRC completed the acquisition of 67,000 acres of former Plum Creek Timber Company lands in December 2012. A separate SYC model run was conducted solely for the purpose of evaluating the contribution of the newly acquired lands to the annual sustainable yield. The acquired lands contributed an additional 4.6 MMBF of volume per year, however, several other factors—namely a) improved data, b) improved growth and yield projections,

and c) changes in forest conditions on other DNRC lands—largely offset the volume contributed to the SYC by those lands.

a. The data used for this calculation represents a significant step forward for DNRC in terms of quality, and that is reflected in the results of the calculation. DNRC used data from its own lands for a large part of this calculation rather than data from other sources that were used for past calculations, which reflected the influences of past management (or lack thereof) on DNRC lands, resulting in a more accurate estimation of potential growth rates on forested state trust lands.
b. DNRC used the Forest Vegetation Simulator (FVS) growth and yield model for this calculation, which is a nationwide model that is widely-used by several federal, state, and private forest managers and includes variants that were developed specifically for Montana forests. DNRC's data was also used to further calibrate the model to the conditions and expected growth rates observed on forested state trust lands.
c. Over 105,000 acres of state trust lands were substantially affected by damaging events including wildfires and insect outbreaks since 2004 that were not accounted for in the 2011 calculation. These influences were particularly prevalent on lands administered by the Southwestern Land Office, Central Land Office, and on land offices in eastern Montana, and caused significant mortality that reduced the amount of standing volume in some forest types (ponderosa pine, lodgepole pine, Douglas-fir) that represent large acreages in those areas.

5) **Q: How much did the newly acquired lands contribute to the Annual Sustainable Yield?**

A: A separate SYC model run was conducted solely for the purpose of evaluating the contribution of the newly acquired lands to the annual sustainable yield. With the acquired lands in solution, the sustainable yield is 57.8 MMBF/year, and without the acquired lands in solution the sustainable yield would be 53.2 MMBF/year, indicating that the acquired lands contributed an additional 4.6 MMBF of volume per year.

6) **Q: Why is helicopter volume optional?**

A: Volume that would only be accessible with the use of helicopters was not considered as a regularly available component of DNRC's Annual Sustainable Yield because recent timber markets have not made it economically feasible to harvest timber where more expensive helicopter yarding is required. During the last 18 years, less than 2% of DNRC's harvest volume has come from projects requiring helicopter yarding. DNRC opted to consider this volume optional rather than include it as fully available for harvest, because by doing this a

more realistic pool of manageable acres in the timber base could be realized. Considering helicopter volume in this manner helps limit the effect of overharvesting of more accessible acres during the time period that the DNRC operates under this sustainable yield calculation.

7) **Q: Why was a statewide solution used and was that approach used in previous efforts?**

A: Yes, final runs of the model were conducted at the statewide level, which was also done for the 2004 calculation. By running the model in this manner, all acres are optimized in a single model run, as opposed to a land office by land office approach, where the model provides outputs in four separate parts (one for each land office). The land office by land office approach restricts the number of lands and options that are selectable by the model, which results in lower yield outputs for the same given land-base. DNRC managers chose to select the outputs from the state-level, because realizing the greater volume and revenue generation is consistent with trust land management responsibilities, and annual flexibility in harvest level among units and land offices can, and does, occur.

8) **Q: What are deferred acres and why did the amount of deferred acres increase?**

A: Deferred acres included DNRC parcels or portions of parcels that were deemed to be inaccessible for various reasons during the next management decade. Examples of deferred lands include extremely wet lands where mechanical operations are not feasible, deferred zones along riparian areas, lands where legal access was deemed unobtainable, lands not commercially viable with poor growth potential, lands that are physically inaccessible, and lands with easements or legal agreements that make commercial logging a non-viable option.

9) **Q: What are constraints and how are they applied, how do they affect the SYC?**

A: Constraints are limitations placed on the model that may restrict when treatments may be applied, where treatments may occur, the types of treatments that may be applied, the frequency that treatments are applied, and the intensity of the treatments that are applied. Constraints are applied in a number of ways and frequently involve restrictions on acreages or areas that can be intensively harvested, in order to maintain some minimum habitat acreage threshold. Constraints are typically applied to ensure that compliance with environmental laws (such as the Endangered Species Act), state administrative rules, and management plans. When applied, constraints typically reduce the volume output of the annual sustainable yield calculation.

10) **Q: How much does the DNRC SYC contribute to the statewide harvest on all ownership in Montana?**

A: While timberlands administered by DNRC only account for less than 5% of the total timberland within the state, the DNRC SYC contributes approximately 15-20% of the volume harvested across all ownership in the state on any given year.

11) **Q: How was Old Growth addressed (constrained) in the SYC?**

A: Old growth was constrained in a manner that prohibited selection of existing old growth stands for removal harvest types until at least 8% of the commercial timber base in each administrative Unit of the Northwestern and Southwestern Land Offices met structural requirements necessary to meet old growth status. An amount of 4% was required for administrative Units the Central Land Office. The model was constrained in a manner that required units that were below required percentages to be managed in such a way as to meet necessary levels as soon as possible. The model was required to maintain existing old growth in accordance with the management regimes applicable to old growth stands, but also assign management pathways to non-old growth stands that facilitated their development into old growth in an amount sufficient to meet a unit's percentage requirement by the period required (the soonest available period as determined by the "Grow Only" model runs). This ensured that the intended old growth amount was met as quickly as possible and was then maintained over time.

12) **Q: What is a sensitive watershed? How were they selected? And how were they constrained?**

A: Sensitive watersheds include landscapes that contain water resources and beneficial uses that are sensitive to potential increases water yield. Sensitive watersheds were delineated at a landscape scale utilizing existing grizzly bear subunits. Harvests in these subunits were constrained in such a manner as to limit the amount of DNRC forest area in non-stocked or younger-aged forest stands below those levels that are associated with detrimental increases in water yield. This constraint was designed to meet DNRC Forest Management ARMs and HCP commitments governing cumulative watershed effects.

13) **Q: Why is the biological potential lower than the previous SYC in 2004?**

A: Biological potential refers to the highest biologically achievable harvest level attainable when no constraints are applied during the modeling process. In the 2004 and 2011 calculations, the biological potential was calculated to be 94.6 MMBF/year versus 80.3 MMBF in 2015. There are several likely causes that contributed to this. First, improved data from actual DNRC lands was used to support this calculation, which served to more

accurately reflect the biological potential on DNRC lands, whereas prior calculations relied on data that was not collected from DNRC lands and used a growth and yield model that was calibrated using estimates from Idaho forests that have higher productivity and potential growth than Montana forests, resulting in overly optimistic estimates of growth and yield. Additionally, the influence of large wildfires across the state, insect mortality, and associated salvage harvest since 2004 has appreciably influenced standing volume on many trust lands across the state. In some portions of eastern Montana, over 20% of the standing volume in the predominant forest cover types suffered from insect-related mortality.

14) **Q: What is grizzly bear security core?**

A: This term refers to identified habitat areas of large size that provide quiet, secure areas for grizzly bears to live undisturbed by human traffic and motorized activity. This concept was adopted by the Interagency Grizzly Bear Committee (IGBC), which oversees the management and recovery of grizzly bears. More specifically, security core areas are comprised of parcels of land that occur at least 0.31 miles from usable motorized access routes, and they must not receive motorized use during the period they are considered core. Core areas should provide habitat conditions that meet the seasonal needs of bears and should remain in place for long periods, preferably 10 years or more.

15) **Q: Why were there separate calculations modeled with and without Stillwater grizzly bear security core?**

A: In 2003, DNRC adopted administrative rules for forest management that included a requirement to maintain approximately 36,000 acres of grizzly bear security core habitat. Because of inherent topographic and winter operability constraints on these lands, they had to be managed as deferrals, where very little forest management could occur. In 2012, DNRC adopted a Habitat Conservation Plan in partnership with the U.S. Fish and Wildlife Service to address incidental take of federally listed species. Under this plan, DNRC revised their approach for maintaining grizzly bear security on the Stillwater Unit and developed management subzones instead, where limited forest management activities could occur. This plan and approach was challenged in federal court in 2013 with a ruling outcome that required DNRC to abandon the new plan and revert back to maintaining core habitat. Thus, at the time of calculation and development of this report, there remained uncertainty as to the grizzly bear management policy that would be in place on Stillwater Unit during the next decade. Running the SYC both with and without security core was DNRC's best attempt at addressing the most likely range of yield outputs that could be expected pending resolution of the litigation.

16) **Q: Why was FVS selected as the growth model used in the SYC?**

A: The Forest Vegetation Simulator (FVS) model was selected because it is a well-known and broadly accepted growth model used across the United States for similar work. FVS was developed by the United States Forest Service (USFS) and it is widely used in both government agencies and private companies. About 20 variants of FVS are published by the USFS to account for variations in growth between geographic locations. To this end, the MT DNRC elected to use the Inland Empire (IE) variant for the Northwest and Southwest land offices, and the Eastern Montana (EM) variant for the CE and EA land offices, which accurately reflect the conditions and factors affecting growth in Montana forests.

17) **Q: What data was used and where did it come from?**

A: The sustainable yield calculation required data describing several attributes of forested state trust lands, including forest conditions, water resources, wildlife habitat, operability, and spatial data related to each of those attributes. Forest data used for the calculation included over 5,300 plots installed on forested trust lands to obtain stand-level information for the Northwestern, Southwestern, and Central Land Offices, and U.S. Forest Service data collected through the Forest Inventory and Analysis program for the eastern areas of Montana. DNRC maintains a stand level inventory (SLI) that was used to further describe forest stand conditions as well as their relationship to water resource, wildlife habitat, and operability attributes. The SLI contains linkage to spatial data for each forested stand on state trust lands that is stored in a geographic information system (GIS) based format, which was used as the source of spatial data for this calculation.

18) **Q: What improvements were made in this SYC over the previous efforts?**

A: To strengthen the result of this calculation, DNRC collected plot data in 2014 directly from forested lands in the Northwestern, Southwestern and Central land offices. Tree data were collected from over 5,300 plots in over 300 stands across those areas, including data on species, diameter, height, crown ratio, defect, growth rates, and mortality. DNRC also has used contracted services to provide updated stand walk-through data for several administrative units, and updated several other data sources, including road and hydrology GIS layers, which resulted in a more accurate representation of the amount and location of those features and their impacts on management. Ongoing updates to the DNRC SLI database since 2004 have captured and accounted for events that caused substantial amounts of tree mortality on state trust lands, such as wildfires, insect and disease outbreaks, and the acquisition of former industry-owned timberlands. To help refine estimates of manageable acres, DNRC field staff also reviewed and revised the inventory of deferred lands, resulting in a more accurate representation of stands that are not currently available for management. Examples of deferred or partially deferred areas include: places

with rugged terrain, excessively wet sites, stands with very low productivity, sites with low timber value combined with high development costs, lands with timber conservation license or easements in place, and sites only accessible by helicopter, etc. Lastly, many of the data inputs for the model were simplified and streamlined which reduced the potential for generating outputs difficult to explain, made model more nimble, and substantially reduced processing time.

19) **Q: How will the SYC be allocated across the DNRC Land and Unit Offices?**

A: The SYC determined the sustainable levels of harvest from a strategic level of planning which optimized harvest levels using a statewide approach to the model solution. DNRC will use model outputs from the SYC to assist in allocation of harvest targets across both administrative Land and Unit Offices. However, these efforts will require additional tactical and operational planning that will carry out as a cooperative effort between the Forest Management Bureau and field staff. Allocations will likely fluctuate to a modest degree on an annual basis given operational needs. Allocations will generally reflect, and be proportional to, the size of the commercial forested land base, operational constraints, and harvestable inventory of each Unit Office and Land Office.

20) **Q: What is a Riparian Management Zone and how were they considered in the SYC?**

A: Riparian Management Zones (RMZ) are buffers established on Class 1 streams and lakes to protect water quality and aquatic habitat. The widths of these buffers are site and based on site potential tree heights. The methods for determining those widths are established in DNRC Forest Management ARMs and the DNRC Forested Lands Habitat Conservation Plan (HCP). RMZs are also extended to include adjacent wetlands and channel migration zones.

21) **Q: The SYC included constraints for grizzly bear, Canada lynx and bald eagle, what about other sensitive wildlife species?**

A: Habitat and potential constraint needs were considered for all of the federally listed threatened, endangered and sensitive species that have specific measures stipulated in DNRC's administrative rules for forest management. Following a thorough evaluation, it was apparent that habitat mitigations required by forest management policy for grizzly bears, Canada lynx and bald eagles were those most likely to have a measurable influence on harvestable timber volume that would noticeably affect annual yield projections. Constraints applied for these three species, as well as other constraints such as those on riparian harvesting, snag maintenance, old growth maintenance, and constraints applied to proportions of allowable harvest prescriptions by cover type, were considered to more than adequately address potential habitat requirements of the remaining species. A summary of all of the species considered, constraints applied and rationale for exclusion or exclusion is contained in a spreadsheet appended to the full report.

22) **Q: What was the standing volume in the last calculation and what is the standing volume in this calculation?**

A: The standing inventory volume for the 2004 and 2011 calculations was 3.86 billion board feet (BBF) net, and for the 2015 calculation the standing volume was 3.93 BBF net (4.62 BBF gross). As stated in Q&A # 4, the 2015 calculation included 67,000 acres of recently acquired timber land, but mortality associated with wildfires and insect outbreaks on over 105,000 acres of state trust land largely offset the additional volume provide by the acquired lands, resulting in comparable starting inventory estimates.