Mason, Bruce & Girard, Inc.
707 S.W. Washington Street, Suite 1300
Portland, OR 97205-3530

Comments to the BOF Forest Planning Subcommittee

Mark Rasmussen
Mason, Bruce & Girard, Inc.
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I appreciate the opportunity to provide input to the Oregon Board of Forestry Subcommittee on Forest Planning.

I am Mark Rasmussen, a Principal of Mason, Bruce & Girard, a natural resource consulting firm headquartered in Portland Oregon. I have been providing technical expertise and support to the Council of Forest Trust Counties since 2001. I am now on the Technical Expert Review Group (TERG) and it is in that capacity that I offer comments today.

As a member of the TERG, I've been meeting with the ODF planning team since late July. The planning team has been generously shared their time to help us understand the planning process. My impression is that the planning team has been completely transparent and forthcoming with the TERG. A couple of weeks ago, for example, the planning team was gracious enough to set up a field trip for the TERG to give us an opportunity to investigate some of the issues I raise here. I've enjoyed working with the planning team and the TERG and I look forward to continuing to work with them.

To date, the TERG has spent most of its time understanding the timber inventory and the timber growth and yield projections used in the model runs you have today. We have spent a little bit of time on the other components of the planning analysis – land base, economics, model formulation, and analysis of the model results. I expect that we will dive into those areas more deeply in the future. So far, however, we've still back on questions about the current inventory, and the rate of growth of the inventory.

I understand that Dave Walters will offer observations and opinions about the beginning inventory, and I imagine that I'll agree with nearly everything he says. I'm not sure what David Diaz will talk about, but I've found his comments during our TERG meetings thoughtful and useful. I hope you study their comments carefully.

I'll focus my attention on the growth and yield projections.

Qualifications on growth and yield calibrations

First, I'll tell you that we do a lot of growth and yield work at MB&G in support of our forest planning work, our appraisal work, and our due diligence work. Specifically:

- Over the past 15 years, we've developed long term forest plans on nearly 150 forests covering nearly 55 million acres of federal, state, Tribal and private land. On public land planning projects, calibration of a growth model is often an early task, and our objective is to get a

calibration that reflects the opinion of the agency foresters.

During the past year, for example, we calibrated: (1) the FPS (Forest Projection System) growth model for the 1.2 million manageable acres of the Tongass National Forest; (2) the FVS (Forest Vegetation Simulator) growth model for the 726,000 acres of the state forest trust land managed by the Montana Department of Natural Resources and Conservation; (3) the FVS growth model for the 2 million acres of the Helena and Lewis & Clark National Forests in Montana.

We recently completed the harvest scheduling analysis for the BLM on its 2.5 million acres in Western Oregon; we calibrated the Organon growth model for the BLM in 2015.

- By December, we will have appraised this year 49 properties covering 2.6 million acres. Nearly all of our timberland appraisals make use of a discounted cash flow model that relies on future growth projections incorporated into a harvest scheduling model. The appraiser's job is to assess value as seen by the successful bidders, and we have calibrated several growth models to that end.

- In 2015, we have performed some kind of due diligence work on 8 properties covering about 500,000 acres. MB&G's due diligence work assists buyers and sellers of timberland in establishing value. For example, we are often asked to provide an independent assessment of the reliability of the seller's inventory – we do this kind of work for both buyers and sellers. We often assist potential buyers project future cash flows from a property, which means we are developing growth and yield projections as part of a harvest scheduling model. Some buyers rely on MB&G's opinion for this, while others are more prescriptive.

Background on growth and yield calibrations

Perhaps most germane to the current modeling effort is MB&G's work on the 2004-06 H&H modeling effort. We helped ODF select and calibrate a growth model, and build the growth and yield projections used to evaluate the agency's Structure-Based Management (SBM) forest management plan.

The H&H modeling effort was a response to the finding that the District foresters did not have confidence in the modeling effort that supported the 2001 Forest Plan. When the Districts began to create implementation plans, they found that, in total, they could only find about 145 MMbf of the 289 MMbf projected by the plan. It turned out that there was a big difference between the perceptions of the foresters on the District and the foresters on the planning team. The H&H effort was designed to bring everyone together to develop a model that everyone could support.

To that end, considerable time and effort was spent to select a growth model and to develop a calibration of that model that enjoyed the support of the entire organization. MB&G provided technical support – making runs, reporting results, tweaking the models, repeat, repeat, repeat, until everyone was satisfied that the growth projections were reliable enough to support credible projections of growth and yield under a variety of different management scenarios. For other clients, we would call this the "corporate view" of growth and yield.

Before moving on to the current effort, it might be helpful to understand something about this idea of calibration. Growth models are simply a set of equations that predict height growth, diameter growth

and mortality of trees, typically as a function of site index, species, stand characteristics, and management treatments. Most growth and yield models are based on multiple measurements of permanent plot data – the same trees are measured at different time periods, and growth and mortality equations are develop to explain those changes as a function of the parameters listed above.

The problem is that usable permanent plot data are relatively rare – it is expensive to collect and must be collected over a long period of time – at least 10 years, but longer is better. The other problem, of course, is that nature is wild, and all predictions result in averages around a population with a great deal of variation. As a result, foresters must always be skeptical of the first results from an uncalibrated model – it might show more or less growth than local experience suggests.

The objective of a growth model calibration, therefore, is an effort to get the model to predict growth expected by local forest managers. A calibrated model then can be used with more confidence to evaluate the impacts and effectiveness of different silvicultural treatments (brush control, fertilization, thinning) or different management approaches (intensive short rotation forestry, structure based management, forest preserves, etc.)

Why calibrate to foresters expectations? Isn't there another way to test the validity of the growth projections?

Some landowners establish permanent plots – the same set of trees measured periodically over an established interval, say 10 years. These are the best data to test and calibrate a growth model. The first measurement is the starting point for the growth projection, the model growth the plots forward and the results are compared to the re-measured data. If they don't line up, the model parameters are adjusted until they do.

ODF established permanent plots (the PPI) in the late 1990s, I believe. The plots had not aged enough to be used in the H&H modeling. Unfortunately, the PPI was scheduled for re-measurement during the Great Recession, but were not re-measured due to funding problems. ODF says that at this point, the plots may not be recoverable.

ODF could look into using the USFS FIA permanent plots on ODF land, or the BLM CVS permanent plots on nearby BLM land, but both of those would be poor substitutes at best. Bottom line: there are not property-specific permanent plot data available.

Some landowners without permanent plot data compare actual harvest cutout data to inventory data to get a feeling for the reliability of the growth model. If annual growth on the inventory results in cutout volumes close to the book inventory, the theory goes, then the growth model must be doing okay, at least in the short term. We do this kind of analysis on an annual basis for a number of clients. It is tedious and time consuming work, but it is certainly less expensive and more immediate than establishing permanent plots.

My understanding is that ODF has done this on some Tillamook sales, at different points in time. The problem here is that this analysis would be testing the FPS growth model used for inventory, not the FVS growth model used for planning. I believe Dave Walters will talk more about that issue.

In summary, while there are more preferable ways to calibrate a growth model, none available to ODF in the time available. As a result, the best standard available is the opinion of the ODF foresters working the land and in charge of the program.

Tentative observations and findings about the current growth and yield projections

At the request of the TERG, the ODF planners have been kind enough to provide data summaries and comparisons that have helped me to understand the current growth and yield projections, and to compare them to the H&H projections.

Here I summarize what I think are the key points about the growth and yield projections. My intent is to demonstrate to the BOF Subcommittee why I think the current projections understate the productive capacity of the state forest trust lands. I won't go all the technical details – I have plenty of chances to work directly with the planning team. And I've already talked with the planning team about these comments.

1. The current projections depict a less productive forest than the H&H projections

   As I mentioned earlier, a good bit of time, energy and effort was invested during the H&H modeling process to develop a "corporate view" of growth and yield. To compare the current projections against the H&H projections, the ODF planning team prepared a set of graphs and I have extracted from those just the volume graphs and attached them as Exhibit A.

   These graphs compare the projections of per acre volume for future stands (the "regenerated stands" or "regen stands"). These regen stands are a good basis for comparison because they have a similar starting point and purpose in both efforts.

   The yields for Astoria are shown on Exhibit A-1. I've circled the yields for two regen stands at age 60. Notice that for the 1DR4 stand, the H&H yields – the dashed line – is close to the current yields – the solid line, at least at age 60. But for DXR3, the new yields are substantially lower than the H&H yields – perhaps 18% lower.

   Flipping through Exhibit A, you can see this general pattern – sometimes the two sets of yields are close, but sometimes the new yields are substantially below the H&H yields. The biggest differences are in West Oregon and North Cascade, although there are differences in all Districts.

   If the H&H growth projections truly represent the "corporate view" of the forest, then the current projections should be closer, absent any new information about growth and yield. So far, we haven't heard of any new information that would result in lower yields.

2. The current projections show growth culminating too early

   Exhibit B are yield table summaries prepared by the ODF planners. They show height, diameter, stocking and growth rates for the regen stands in the current model. The heavy solid lines shows the projections, the dots are values representing values for current stands in the inventory. In other words, the growth projections for future stands are compared here to the

current inventory as a way to gauge whether they look right. This is a standard practice in a calibration exercise.

Notice the graph in the center titled Scribner MAI. This is the mean annual increment – at each age, the projected yield is divided by the stand age. The MAI graph is useful in that it gives a quick estimate of sustainable yield. If the MAI is 600 bf/ac/yr, then a forest of 1,000 acres could sustain an annual harvest of 600 Mbf/year (600 bf/ac/yr X 1,000 acres).

Notice that on most of these graphs, the Scribner MAI appears to culminate (reach its peak) somewhere around age 40 or 50. This is much sooner than most growth models which would put culmination out around age 80-100.

This suggests to me that there is some technical problem with the projection model. In a volume maximizing model, these yields would drive the model to short rotations – quite the opposite of most models.

3. <u>The current projections do not account for genetic gain on future stands</u>

So far, I've been using the regen stands to talk about the calibration of the model in general. The idea is that if a calibrated model will grow the regen stands correctly, it should grow the existing stands correctly.

But now I want to talk about genetic gain – a topic which is primarily about future stand growth.

Foresters and geneticists in the PNW began programs to improve seed stock in the 1950s. We are now beginning the third cycle of testing to evaluate the improvements from selective breeding of Douglas fir and to a lesser extent, Western Hemlock.

The second cycle of testing shows reliable volume improvement of 20% or more over unimproved seed stock, and there are expectations for even more in the future.

On Exhibit B, the upper right hand graph shows the predicted tree height for the regen stands (the line) against the current inventory. The next graph to the right shows the predicted DBH against the existing inventory.

Notice here that the future stands are predicted to grow at the average of the current stands, or perhaps a little less. This is contrary to expectations that nearly all private timberland owners in the PNW. I made an informal survey last week at the OFIC survey and most landowners are expecting a 15% to 25% gain on the next rotation.

Genetic gain was specifically not included in the H&H model. My memory was that ODF foresters wanted to be conservative about the future – they didn't want to over promise, understandably enough. Second, the SBM approach meant that nearly all the harvest for many decades to come would come from existing stands, and that genetic gains under SBM were nearly irrelevant.

In my view, this assumption and approach should be re-evaluate now with plan based on land allocation. If ODF hopes to produce a harvest level sufficient to cover its budget from only 70%

of the land base, then ODF should evaluate all of the intensive management approaches that their private land peers are using – genetic gain, fertilization, early stand treatments, pre-commercial thinning, etc.

4. The current projections are more conservative than most private landowners are using.

   This is conclusion is based on my work on other properties, and conversations with neighboring landowners.

   As a consultant, I often sign non-disclosure agreements, and it is our company policy to treat every client's data as completely confidential. So I unfortunately cannot provide any direct evidence to support this observation. But that is what I think.

Implications of more optimistic growth and yield projections

The two model runs presented to this subcommittee in August and October suggest to me that the sustainable yield from 65% of the state forest trust lands is not enough to keep ODF in business over the long term.

If that is truly the case, then there are only a few policy choices -- make more land available for the timber emphasis areas, and/or find a way to further trim ODF's budget needs so that they are more commensurate with the land allocations.

(I'll note here for the record that it would be wrong-headed to conclude that this forest cannot be profitably managed. This is some of the most productive timberland in the world, and there are plenty of examples of comparable private timberlands being managed profitably on a sustained yield basis.)

Before making those hard decisions, however, I think it is worth some time to re-evaluate the growth and yield projections. If they truly are too conservative, which I believe, then making them more realistic will improve the projected harvest and revenue flowing from the state forest trust lands.

I am ready to help in this effort.

Exhibit A

Description:

The preceding graphics compare the yield curves used during previous harvest schedule modeling (Alt. 6 through Alt. 9.) with those developed for the Alternative Forest Plan project (Alt. FMP). The lines represent the average of curves for all site classes and SNC zones for each district and planting regime. The curves DO NOT reflect area weighted yields. The shaded ranges indicate the approximate minimum and maximum yield for each regime.

The Alt. 6-9 regen curves were prepared using the Yield Table Generator (YTG Tools). A customized MS Access application that handles interaction with the growth model as well as all silviculture and reporting sub-processes.

The Alt. FMP curves were prepared using Python scripts developed by ODF that generate treelists and keyword files, handle data management, and reporting. Silviculture is handled by the growth model and parameterized through the keyword files.

The key differences in the processes are:

Alt. 6-9 regen curves were initialized with an assumed treelist, species, DBH, height, etc. expected at a stand age of 15 years. This expected treelist was largely derived from expert opinion.

Alt. FMP regen curves are initialized from a planting prescription that is simply an expected planting density by species. The growth model then projects the stand forward through planning horizon.

The planting regimes have been adjusted to concur with planting records for each district and site.

Site Classes for the Alt. FMP regen curves have been set to reflect the average site index within site classes (standard USDA) present on each district. The Alt. 6-9 site indicies where set to the mid-points of three quantiles by area.

Some districts have small acreages of lower site ground, site 4 & 5. However, only site classes 1-3 are displayed here. This captures >90% of all acres, and coincides best with the Alt 8. site breaks.

Regeneration Regimes Yield Comparison
Astoria - Scribner Volume

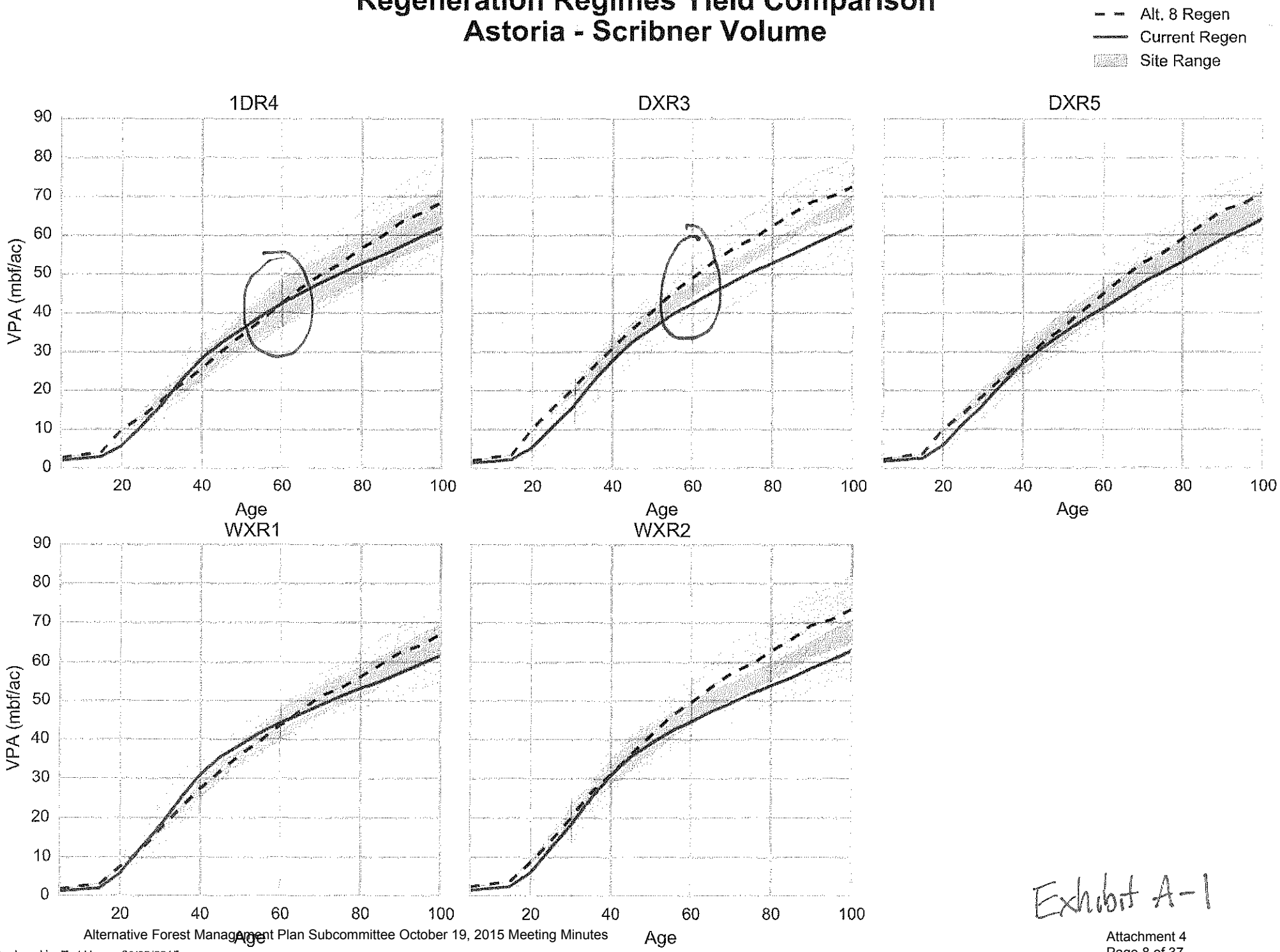


Exhibit A-1

Produced by Tod Haren, 09/23/2015

Regeneration Regimes Yield Comparison
Forest Grove - Scribner Volume

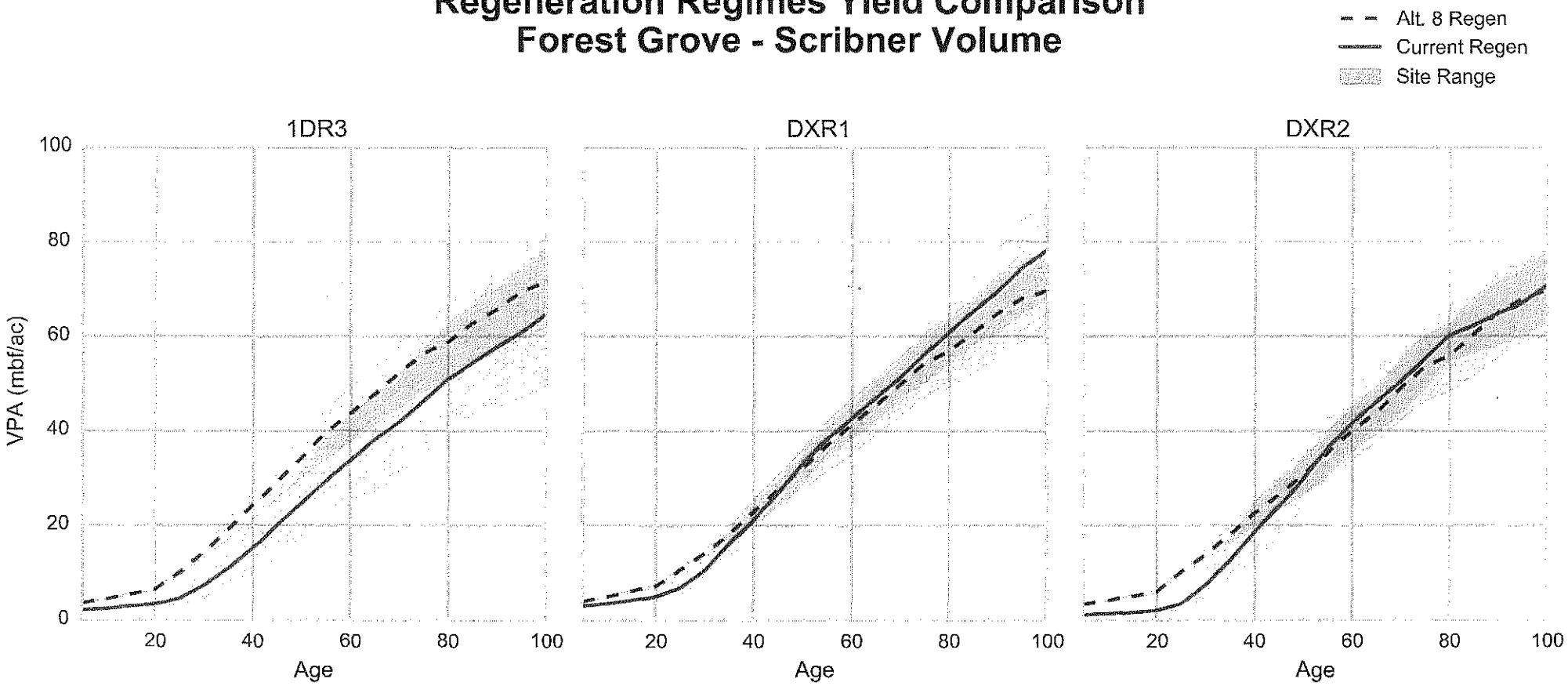


Exhibit A-2

Regeneration Regimes Yield Comparison
Tillamook - Scribner Volume

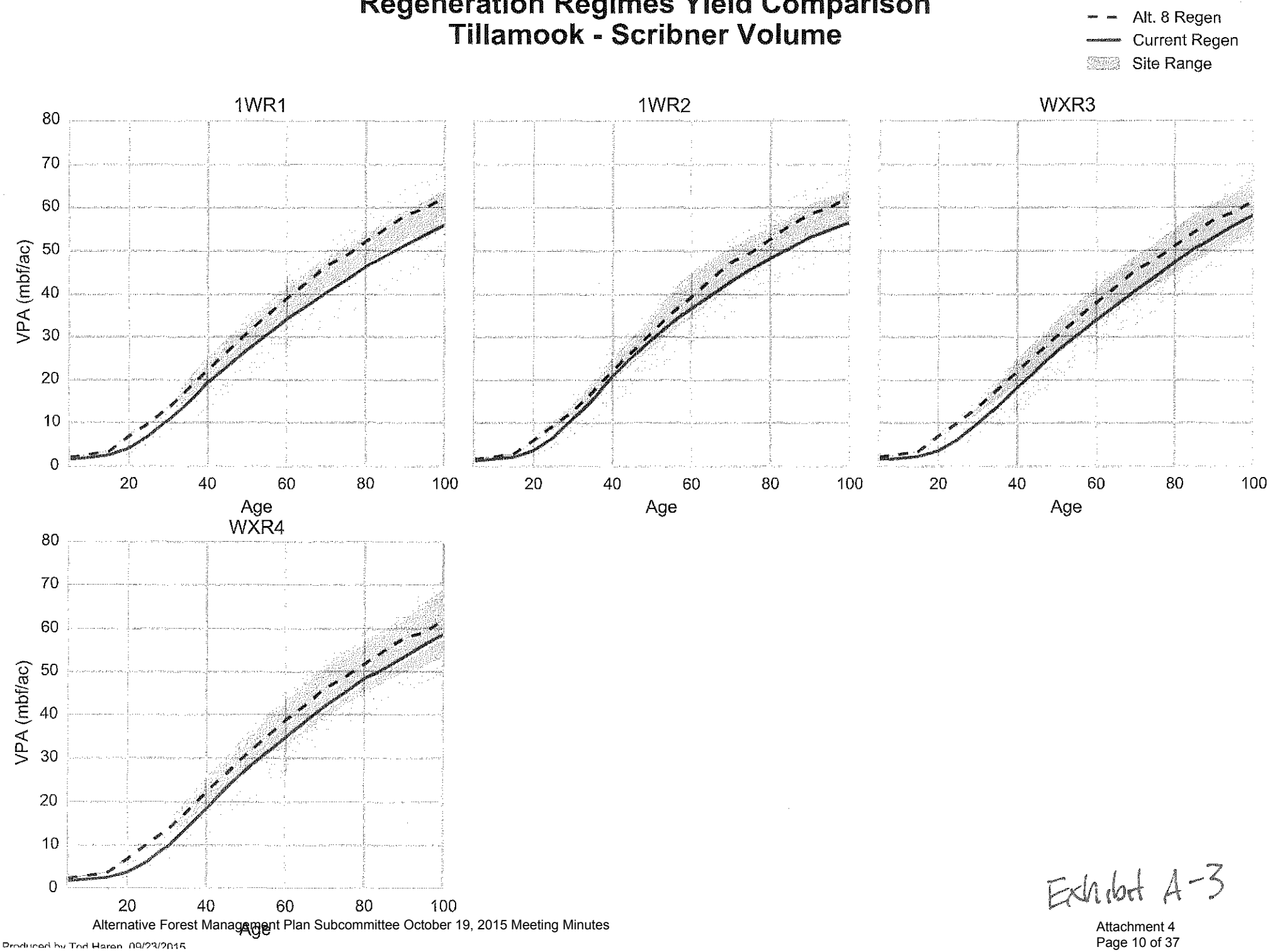


Exhibit A-3

Regeneration Regimes Yield Comparison
West Oregon - Scribner Volume

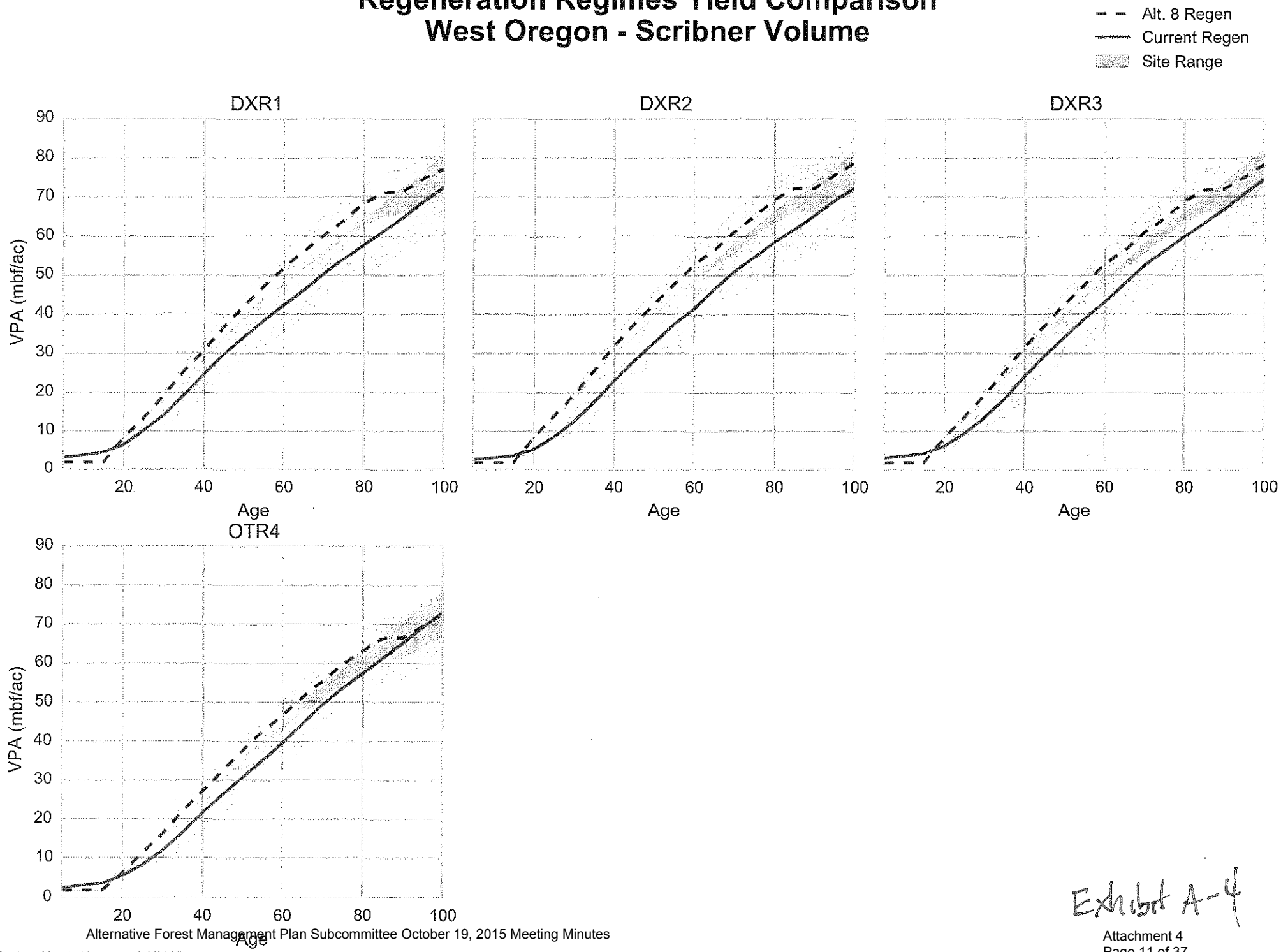


Exhibit A-4

Produced by Tod Haren. 09/23/2015

Regeneration Regimes Yield Comparison
North Cascade - Scribner Volume

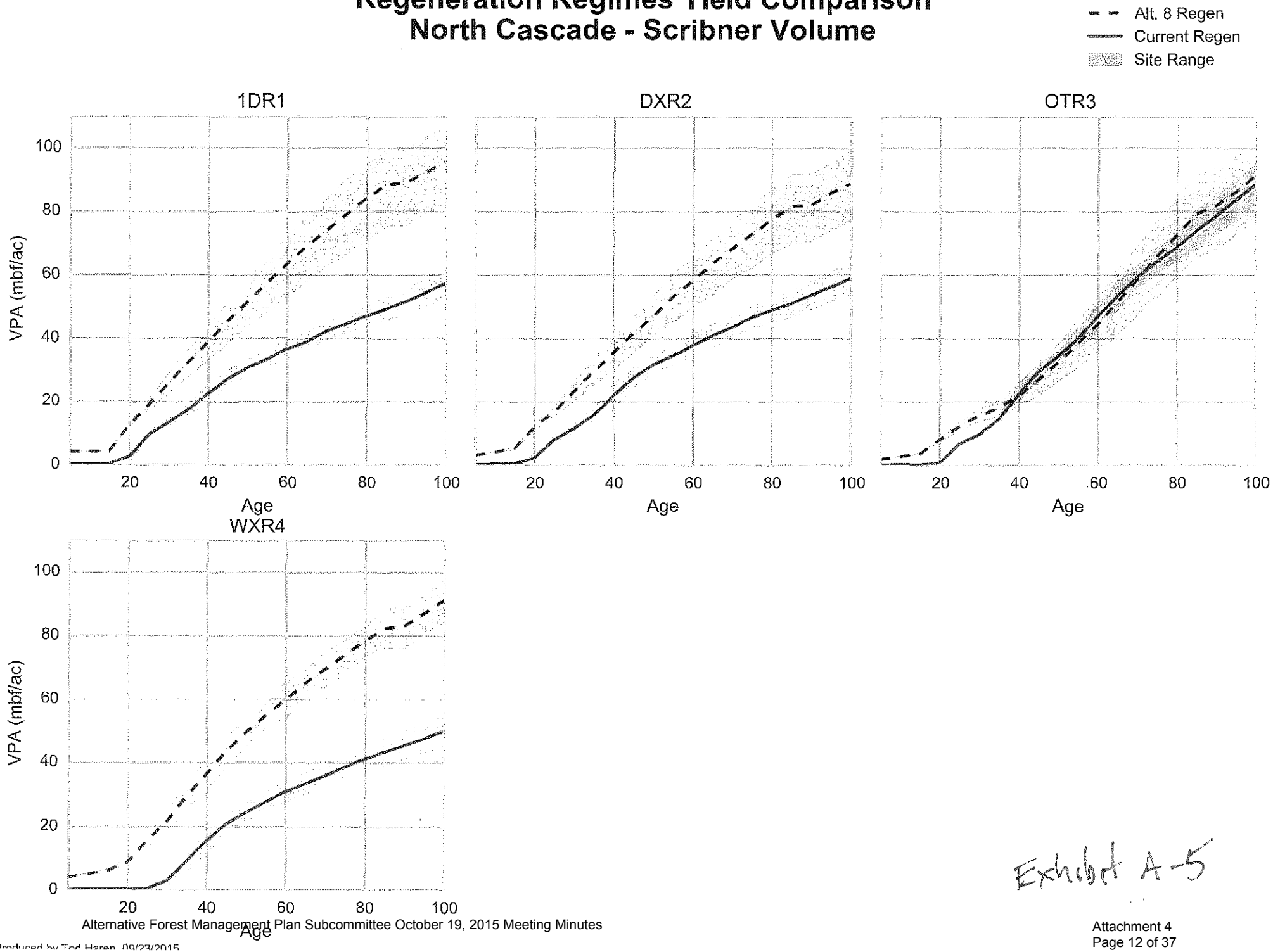


Exhibit A-5

Produced by Tod Haren, 09/23/2015

Regeneration Regimes Yield Comparison
Western Lane - Scribner Volume

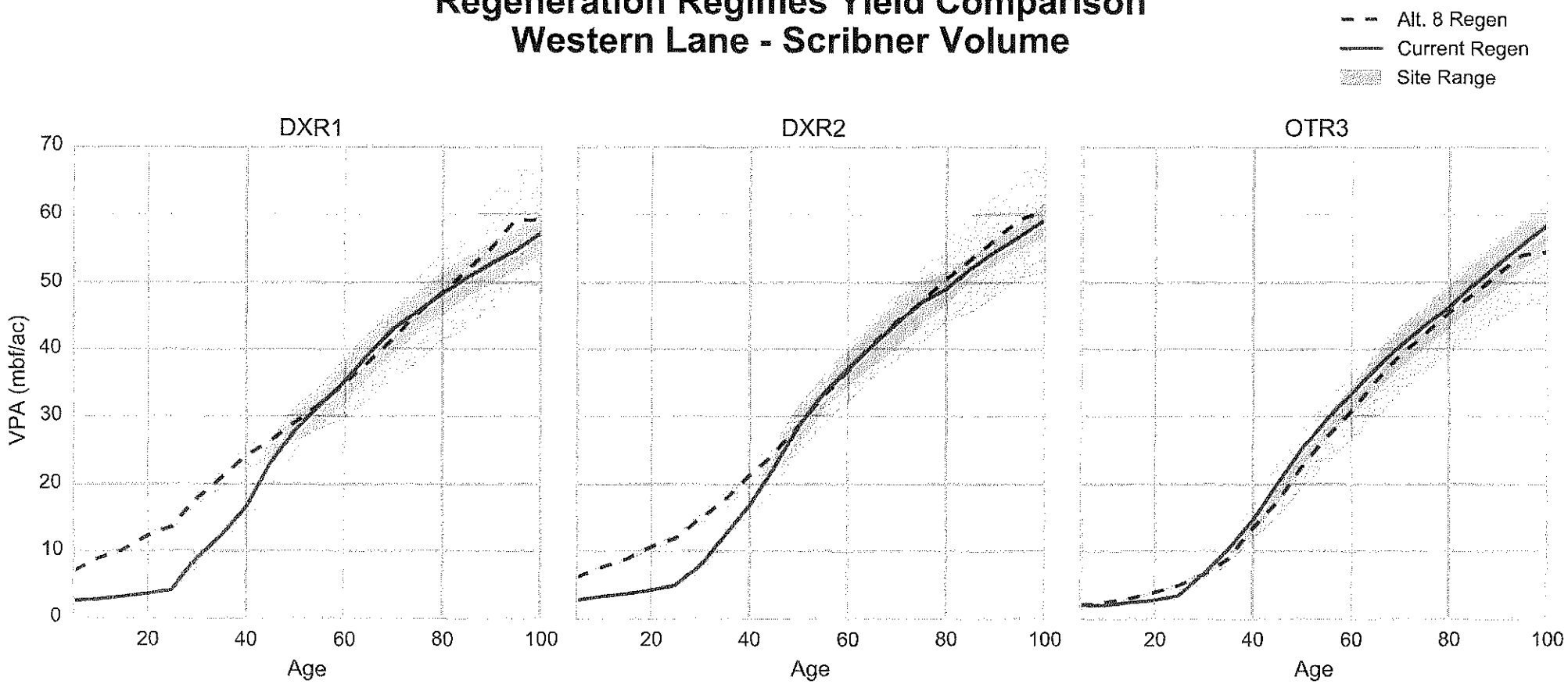
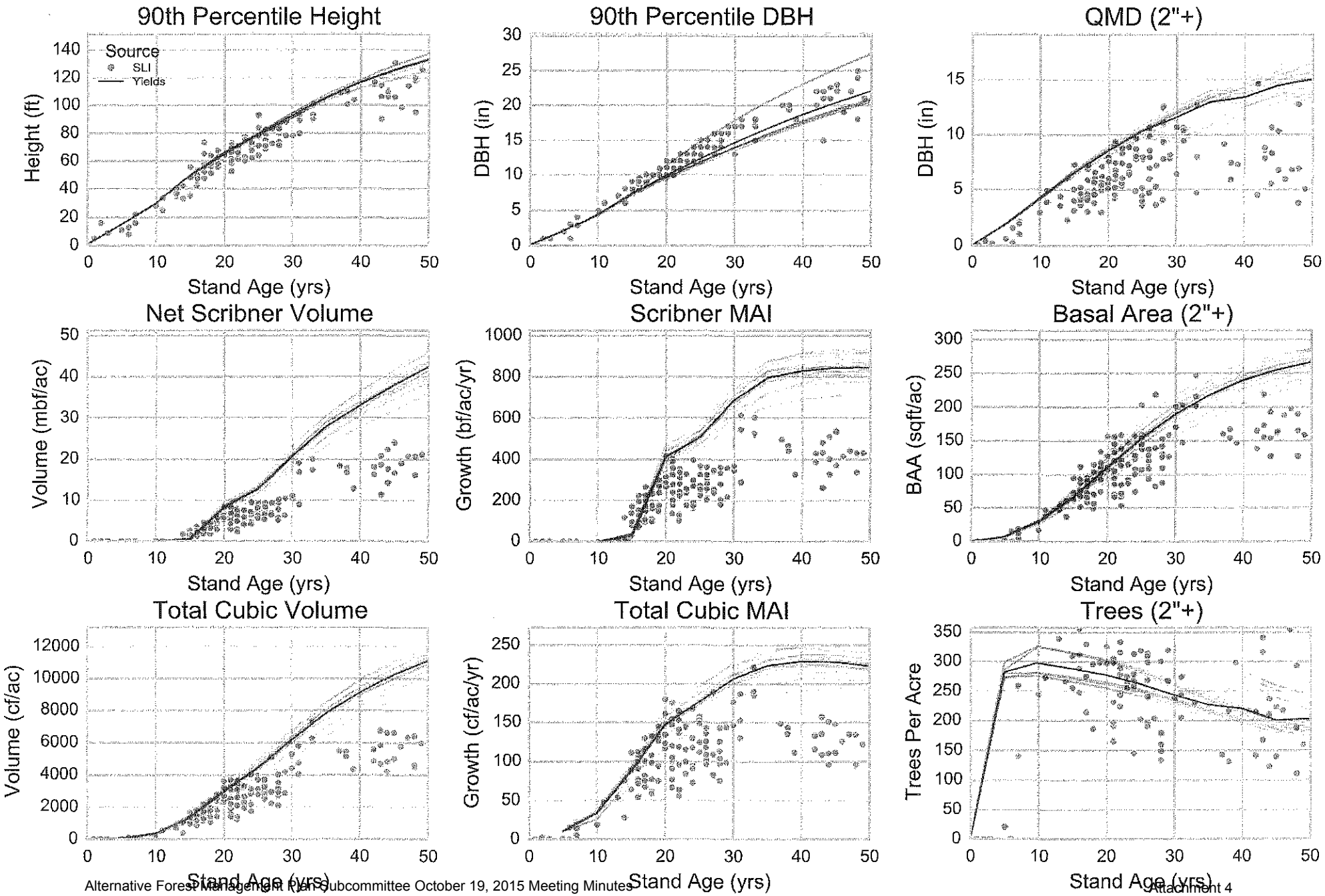
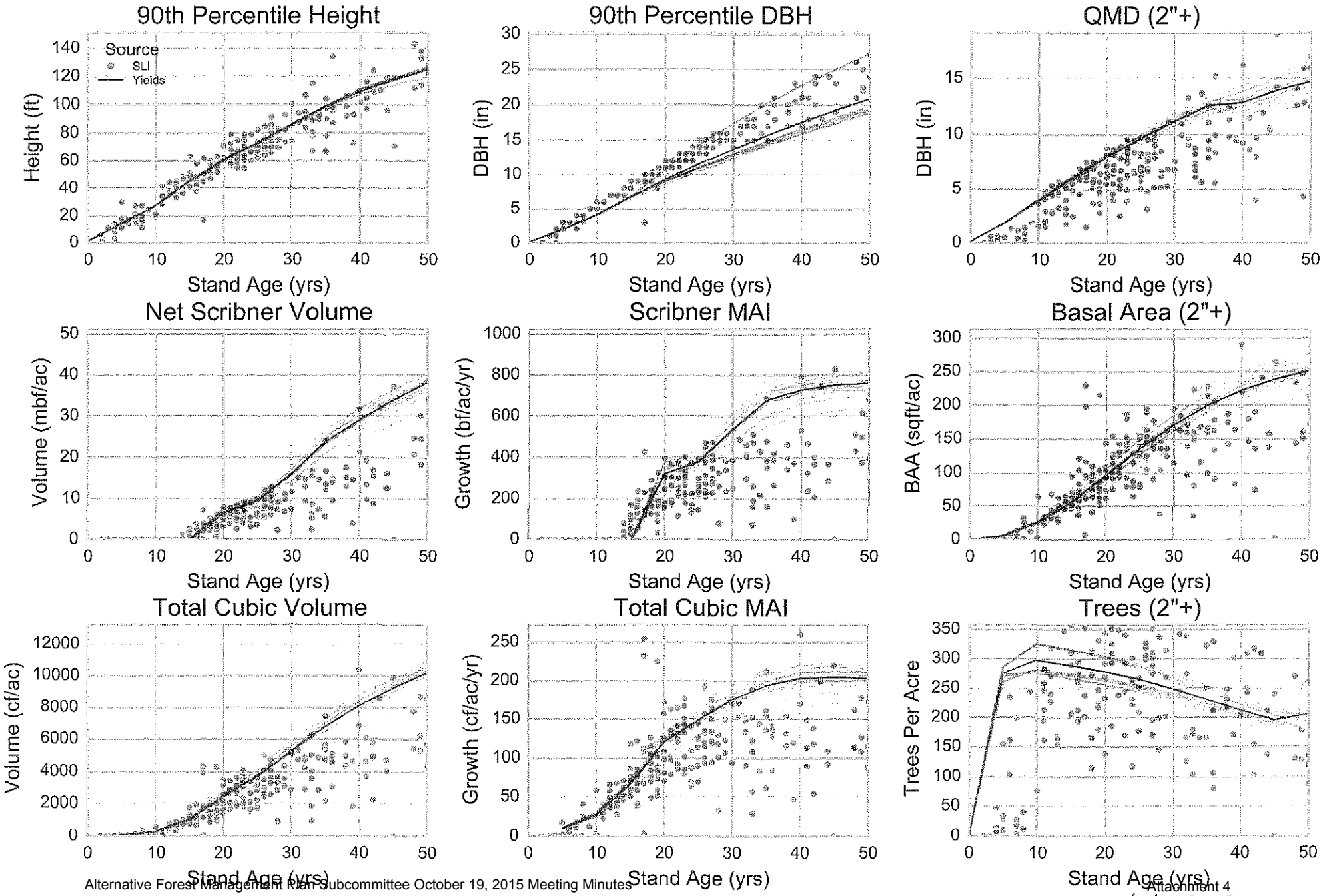


Exhibit A-6

HSM Regen. Yield Projections Compared with SLI Cruised Stands
Astoria - Site Class 1 (SLI 139'; Yld 139')



HSM Regen. Yield Projections Compared with SLI Cruised Stands
Astoria - Site Class 2 (SLI 127'; Yld 127')



HSM Regen. Yield Projections Compared with SLI Cruised Stands
Astoria - Site Class 3 (SLI 111'; Yld 111')

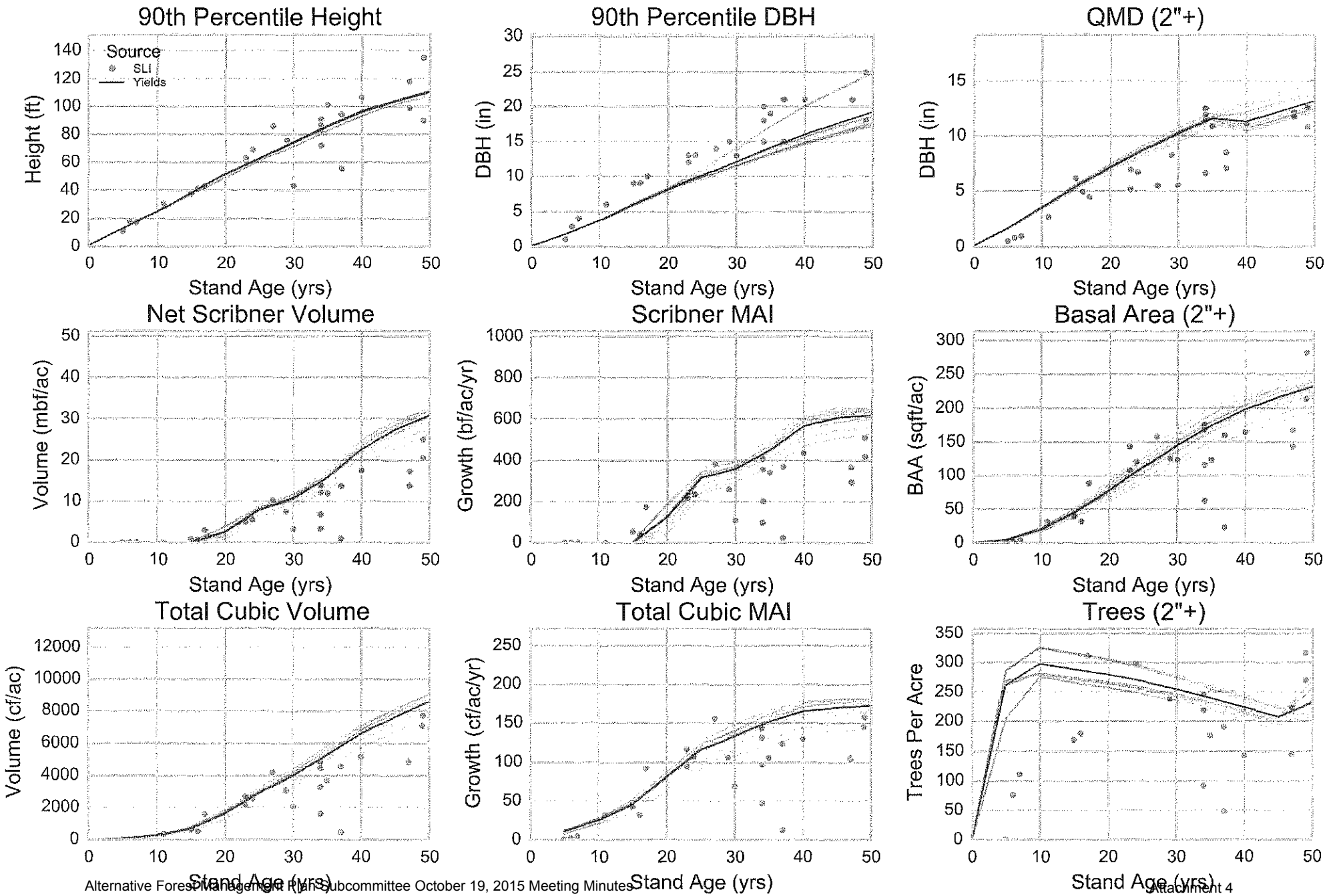
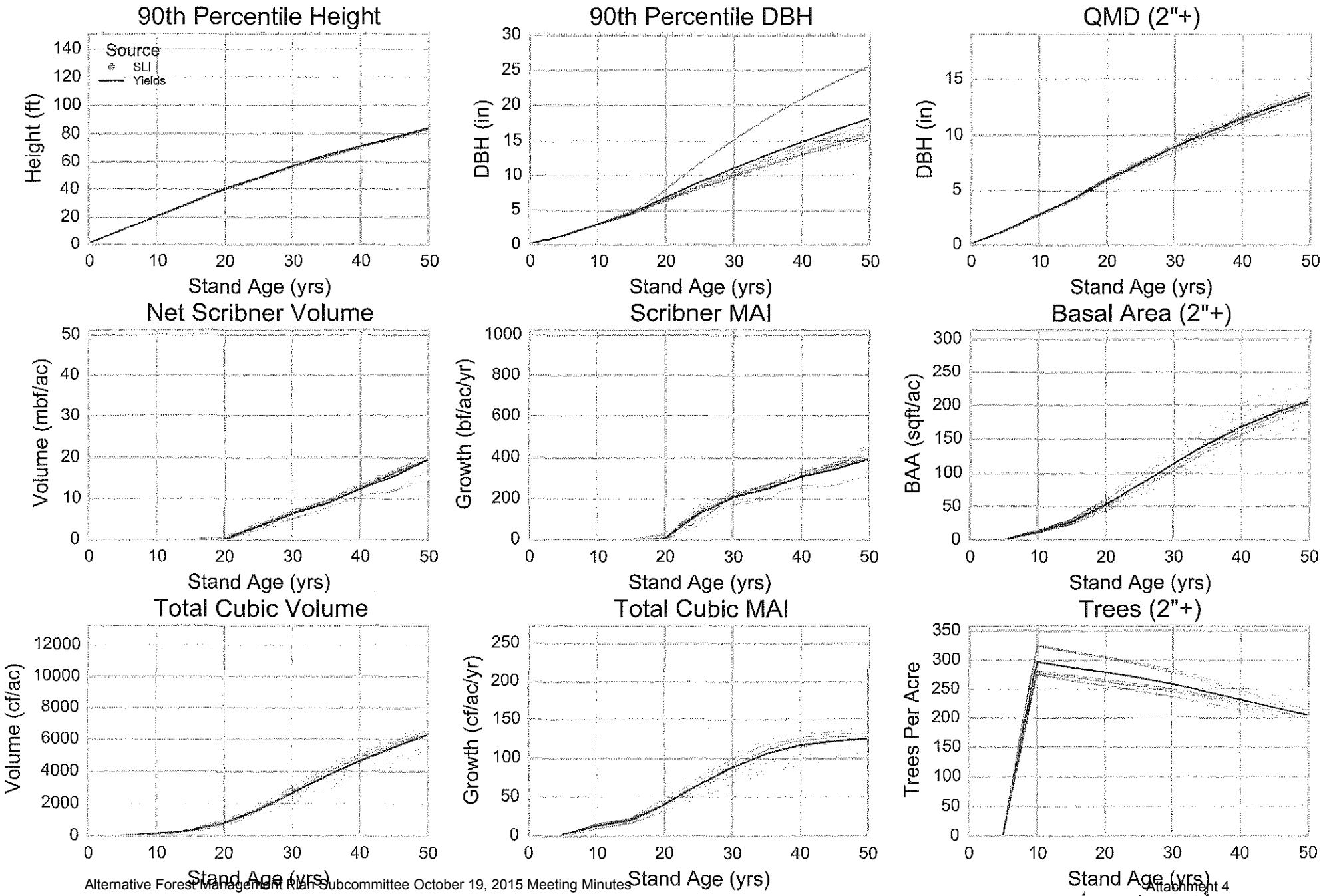
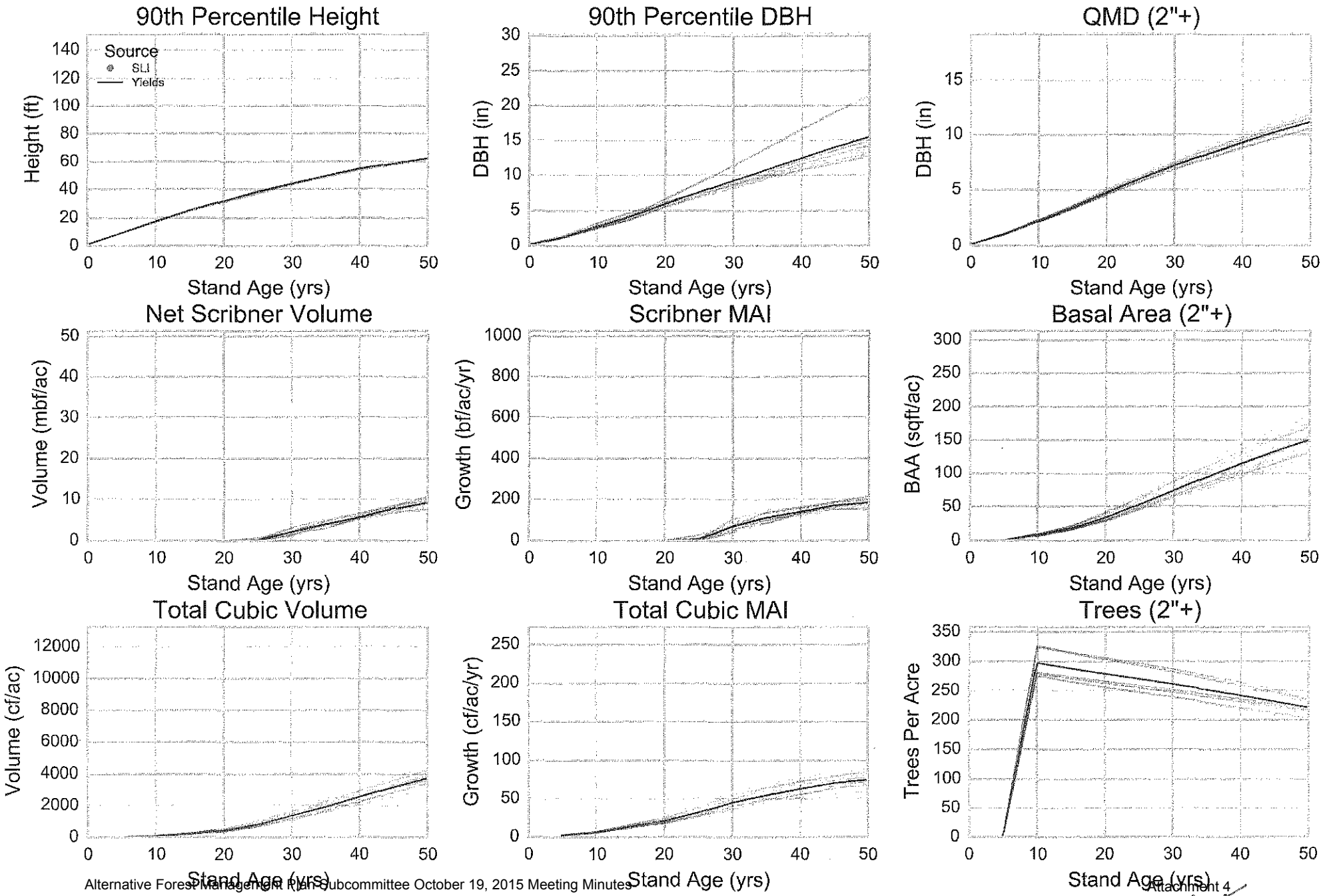


Exhibit B-2

HSM Regen. Yield Projections Compared with SLI Cruised Stands
Astoria - Site Class 4 (SLI nan'; Yld 84')



HSM Regen. Yield Projections Compared with SLI Cruised Stands
Astoria - Site Class 5 (SLI nan'; Yld 62')



HSM Regen. Yield Projections Compared with SLI Cruised Stands
Tillamook - Site Class 1 (SLI 140'; Yld 139')

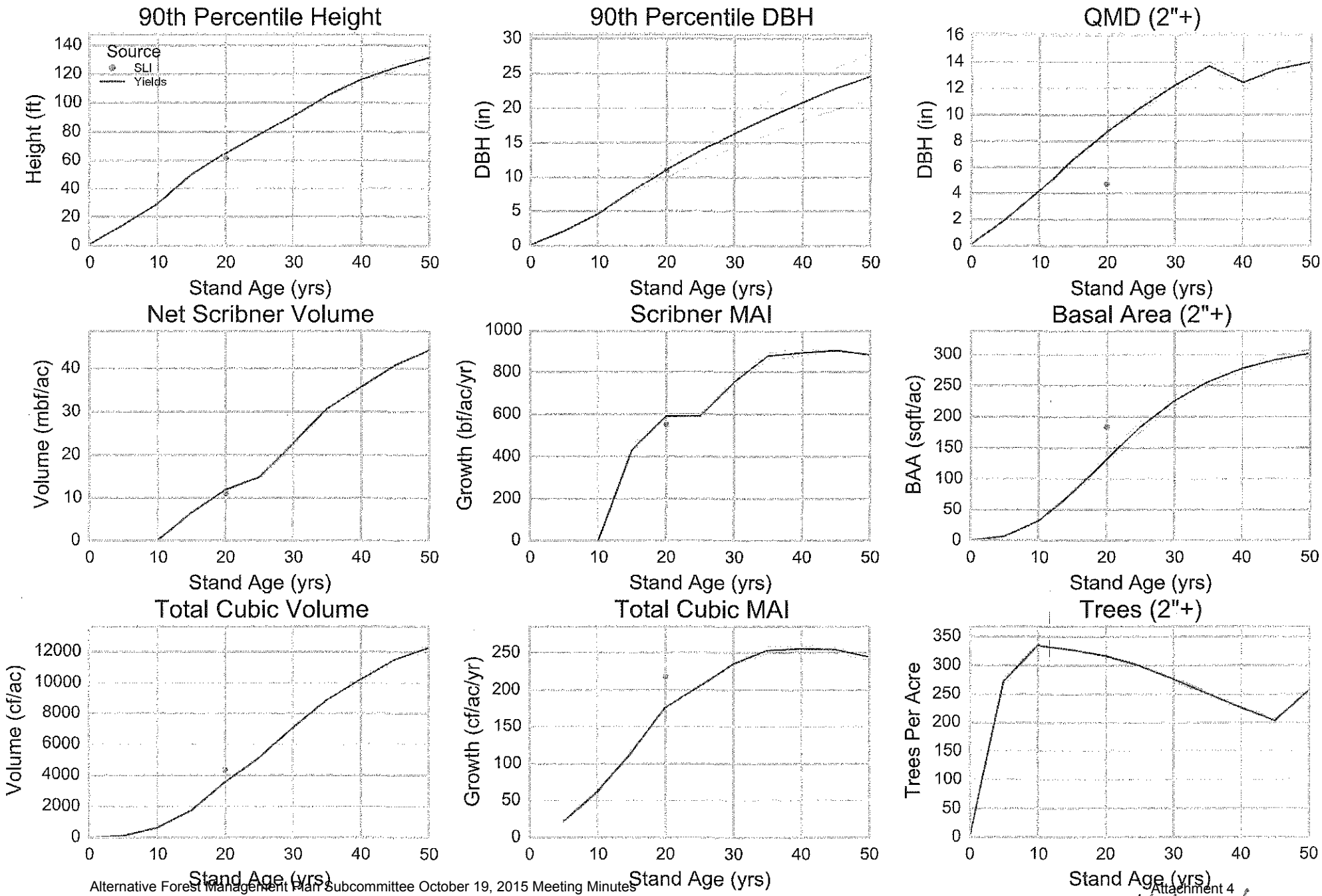
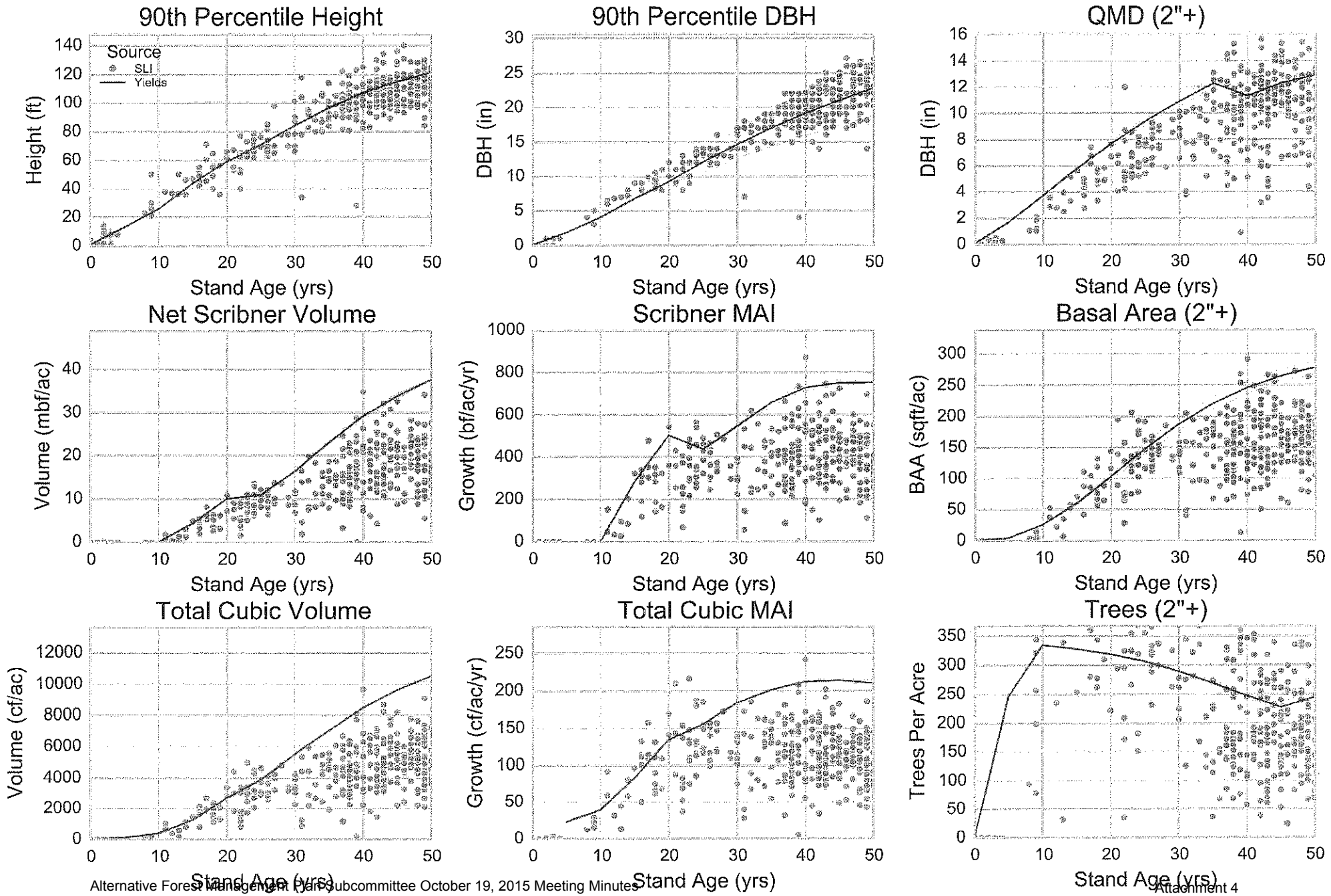
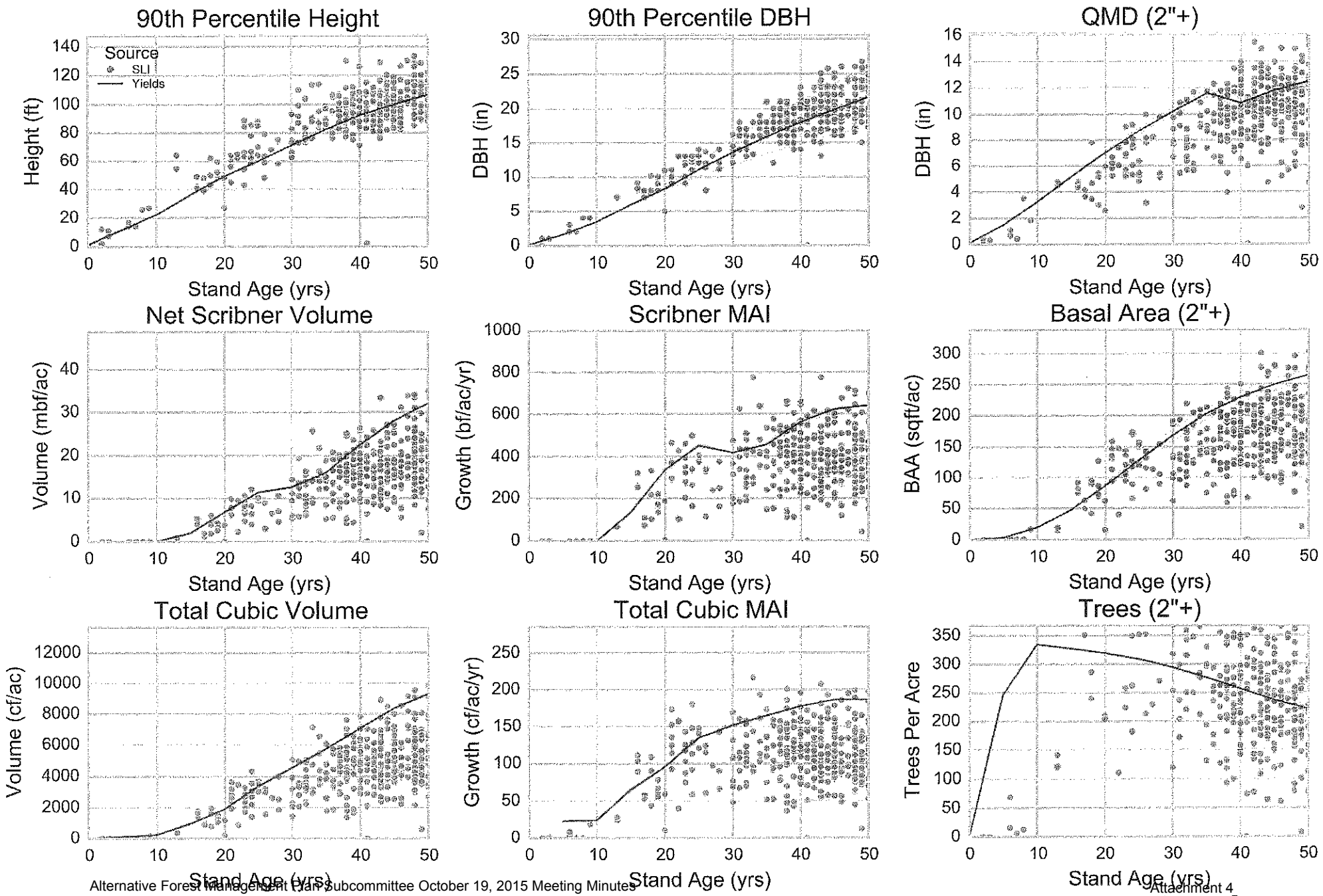


Exhibit 6

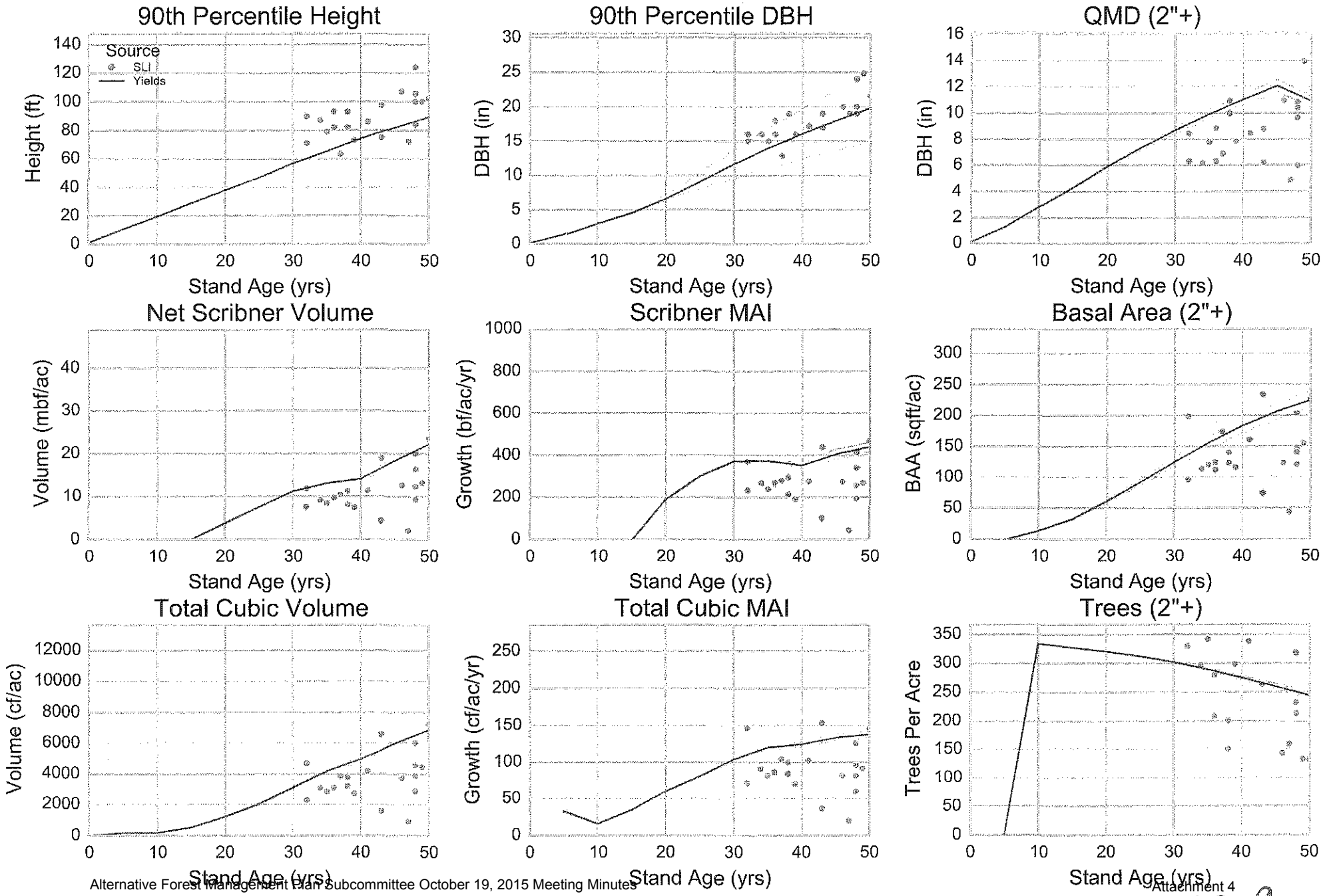
HSM Regen. Yield Projections Compared with SLI Cruised Stands
Tillamook - Site Class 2 (SLI 123'; Yld 123')



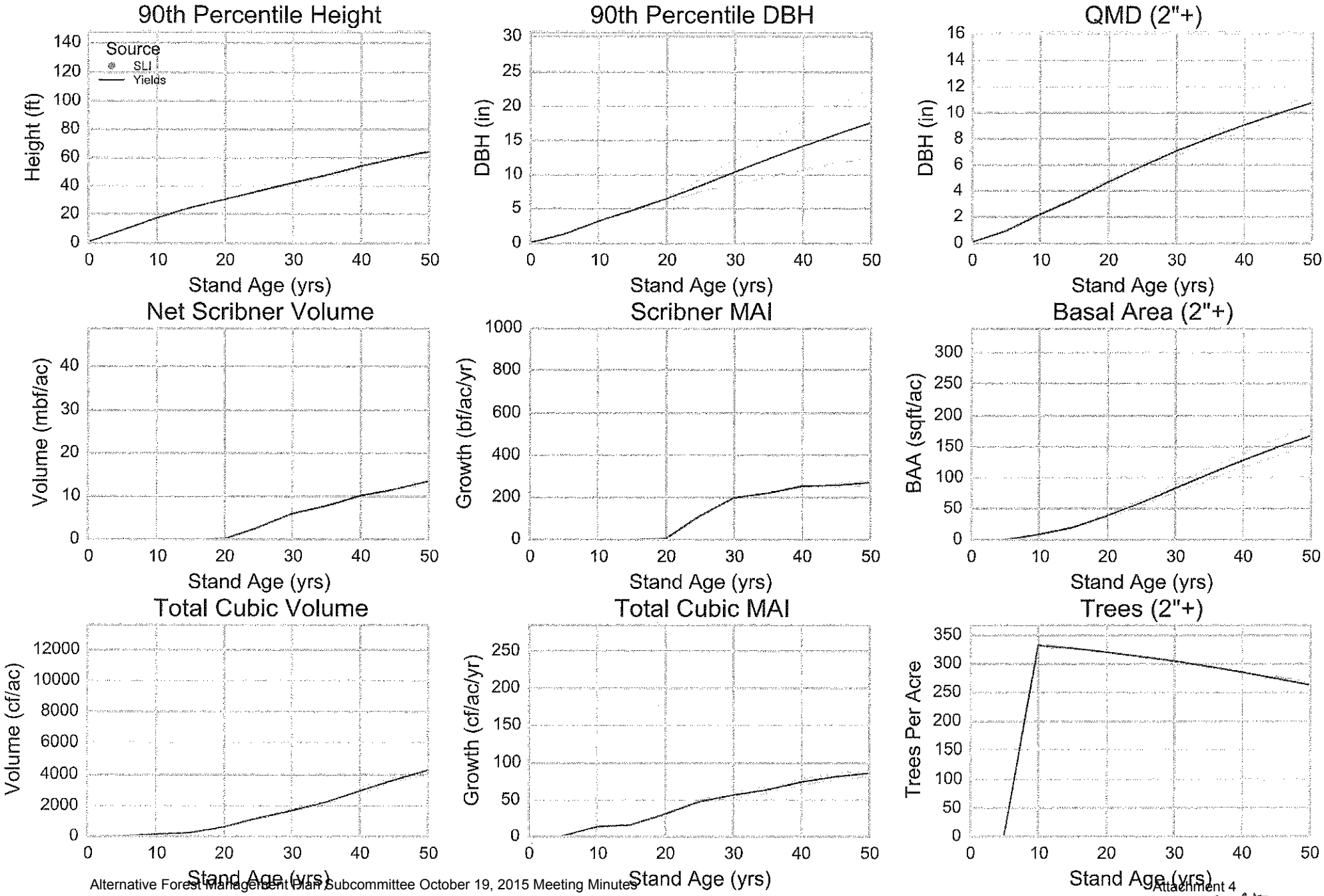
HSM Regen. Yield Projections Compared with SLI Cruised Stands
Tillamook - Site Class 3 (SLI 106'; Yld 106')



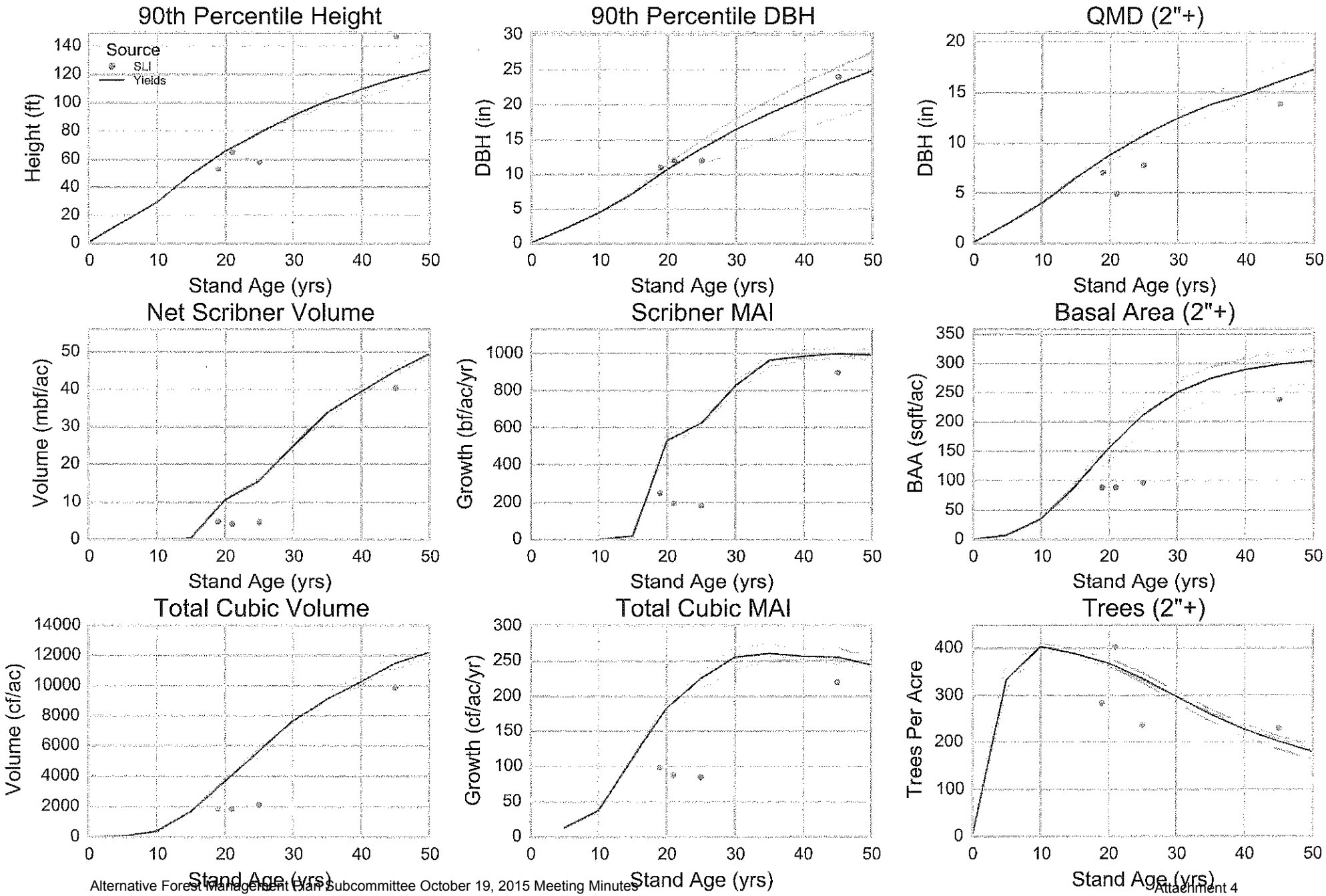
HSM Regen. Yield Projections Compared with SLI Cruised Stands
Tillamook - Site Class 4 (SLI 90'; Yld 89')



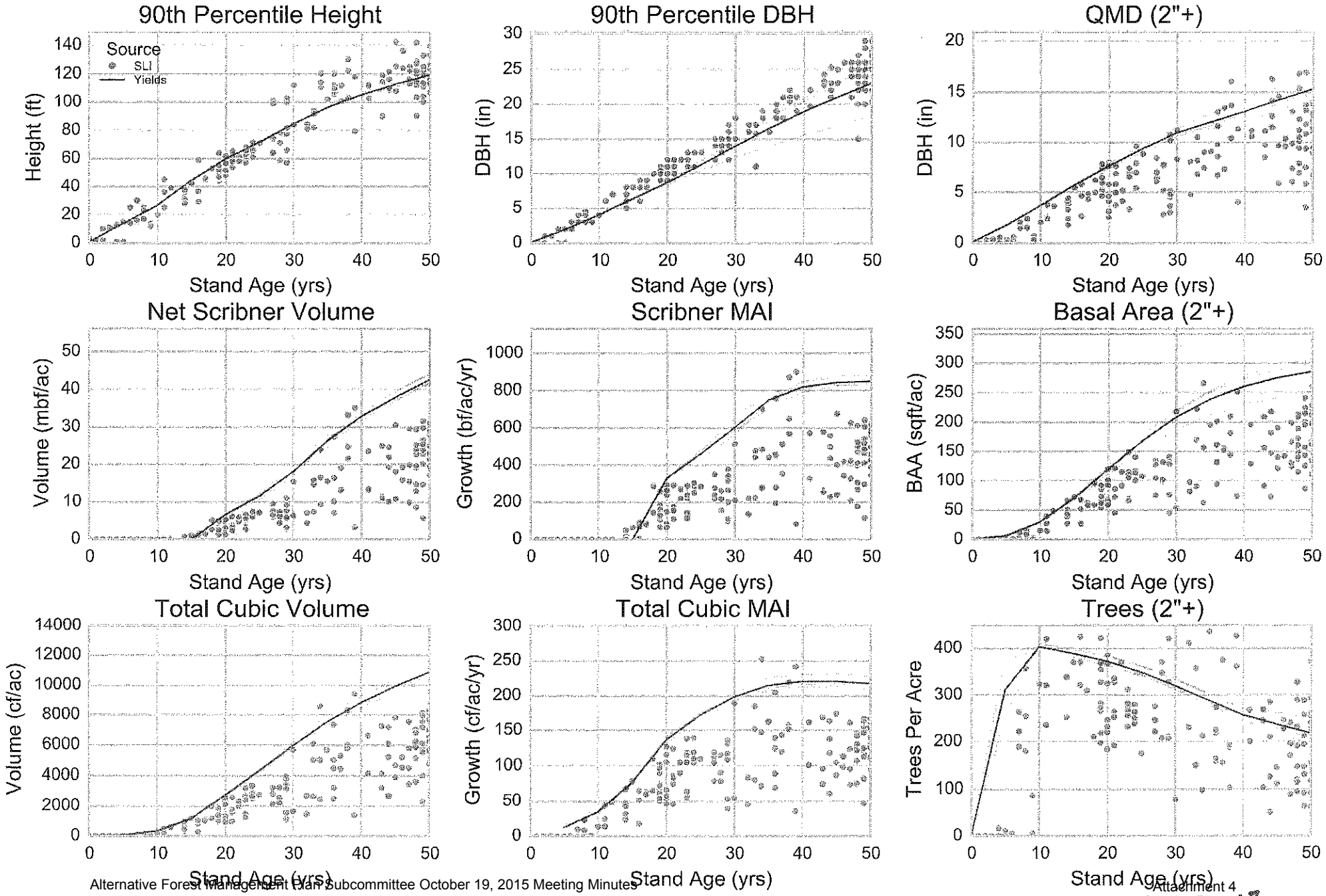
HSM Regen. Yield Projections Compared with SLI Cruised Stands
Tillamook - Site Class 5 (SLI nan'; Yld 65')



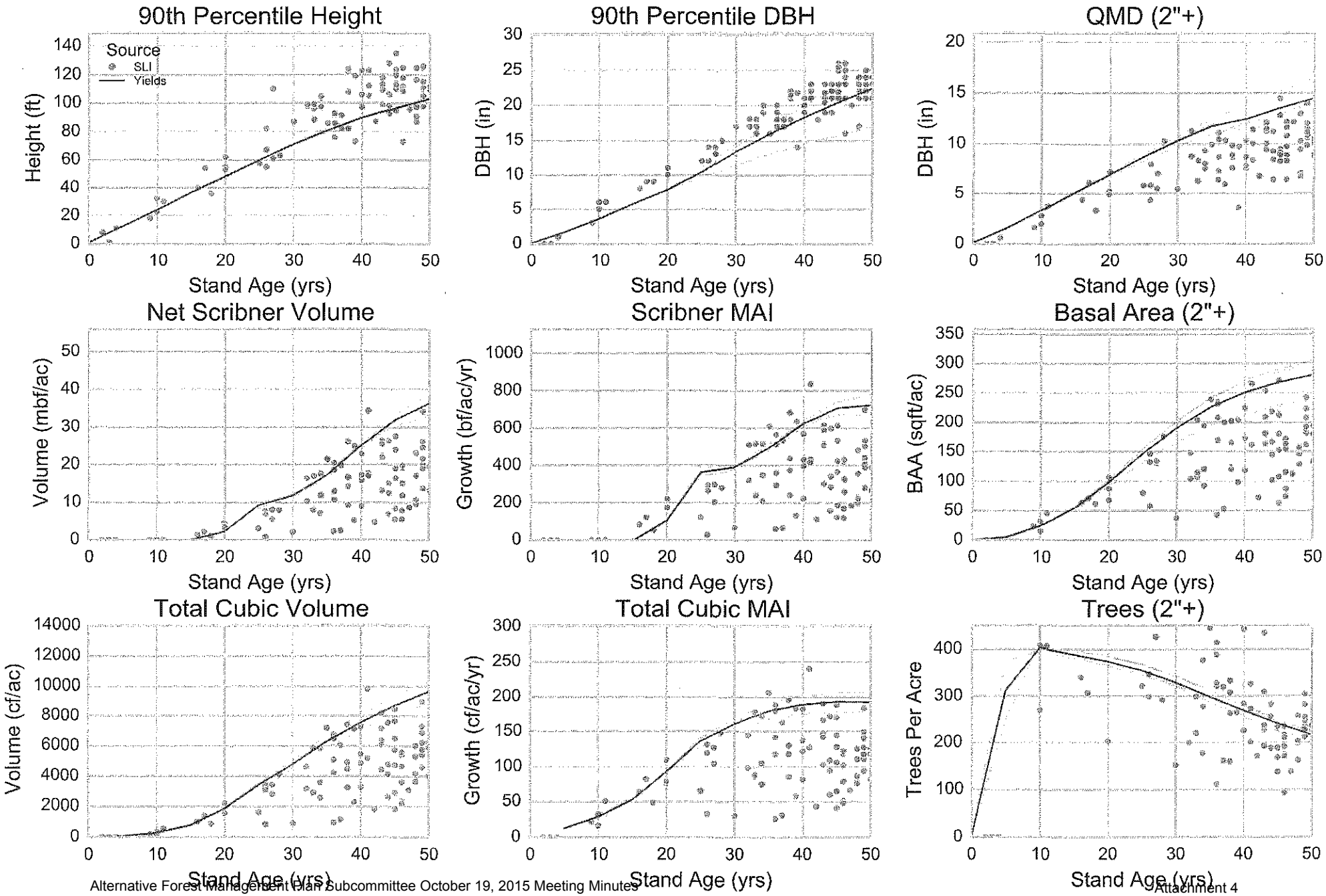
HSM Regen. Yield Projections Compared with SLI Cruised Stands
Forest Grove - Site Class 1 (SLI 140'; Yld 138')



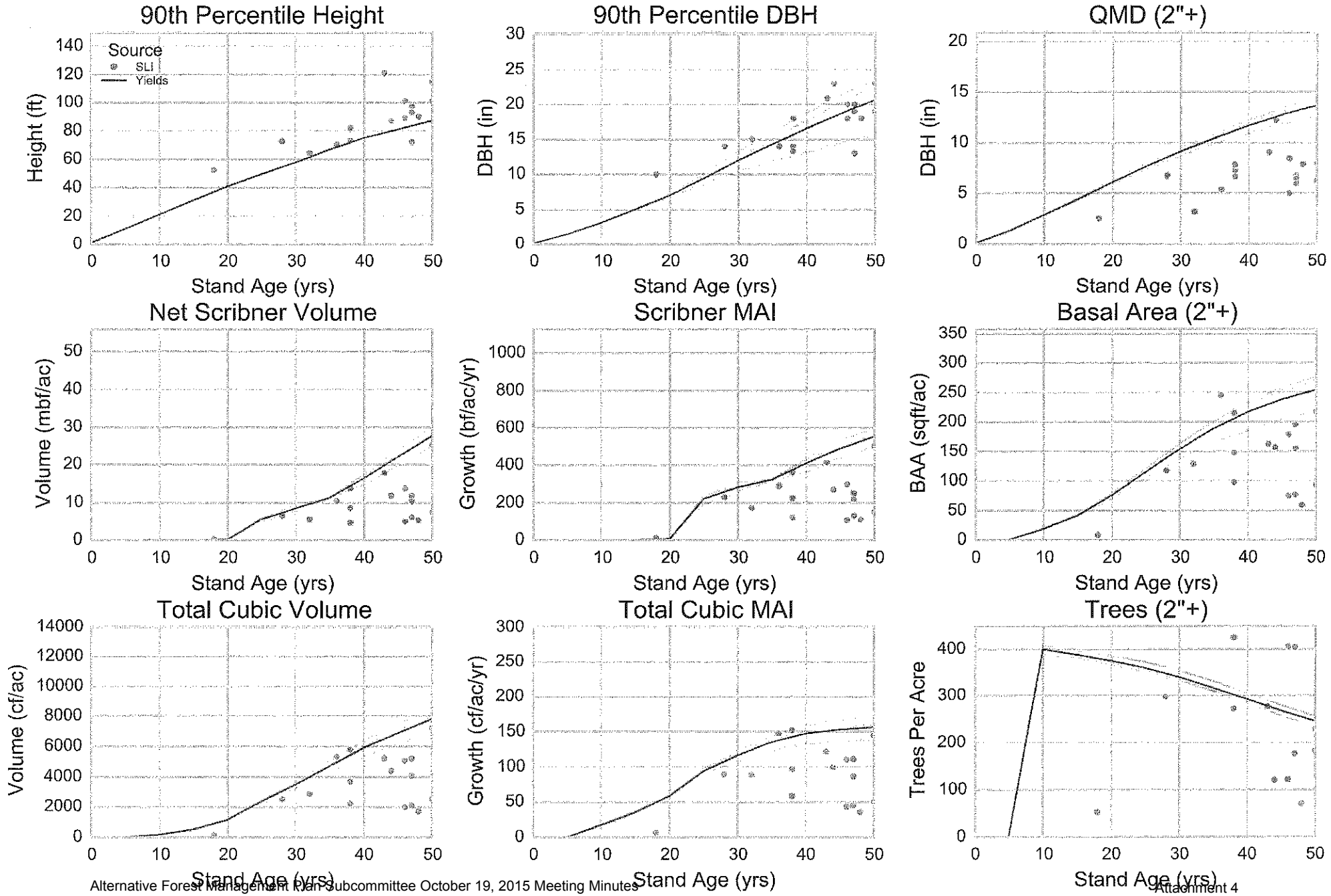
HSM Regen. Yield Projections Compared with SLI Cruised Stands
Forest Grove - Site Class 2 (SLI 124'; Yld 124')



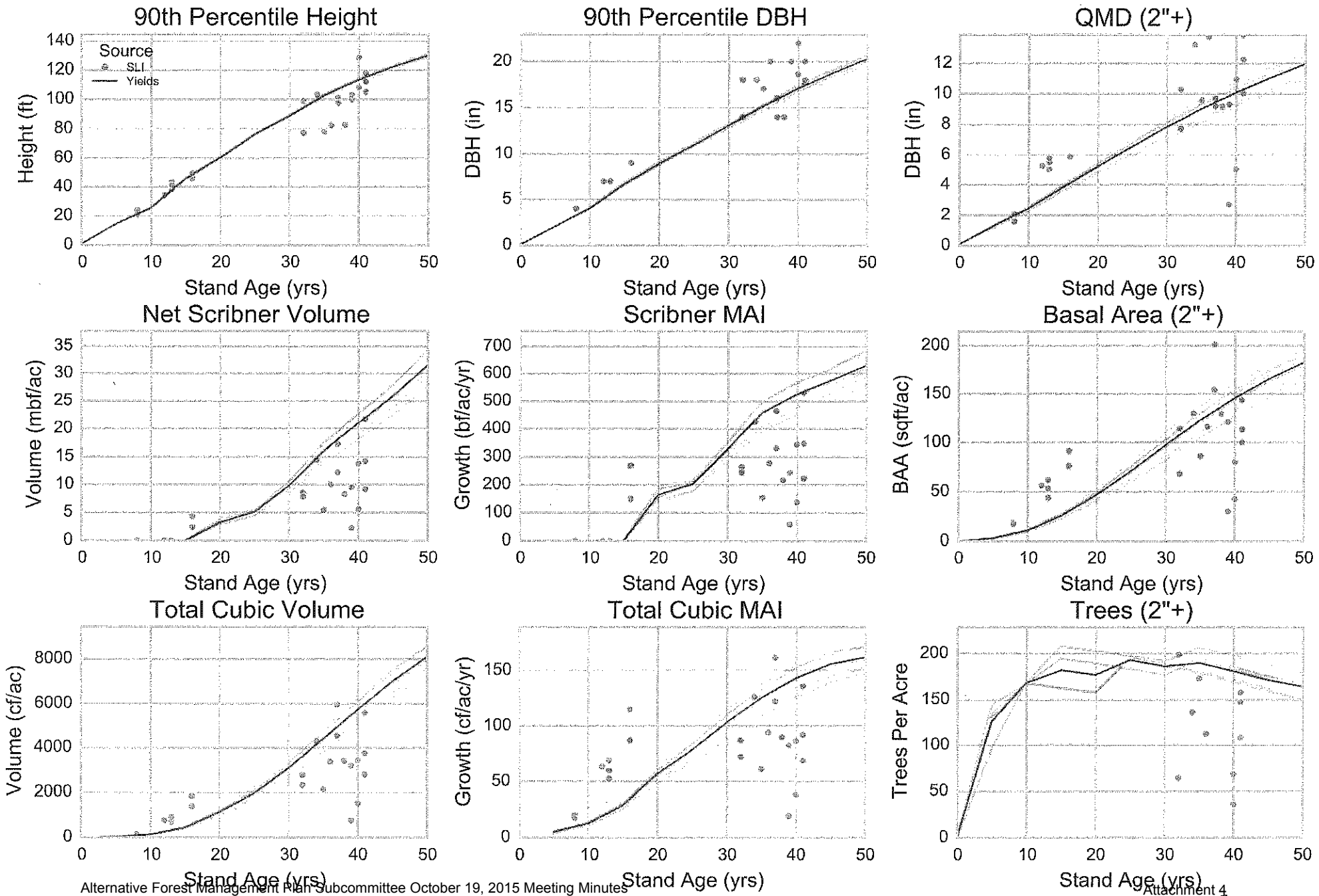
HSM Regen. Yield Projections Compared with SLI Cruised Stands
Forest Grove - Site Class 3 (SLI 107'; Yld 107')



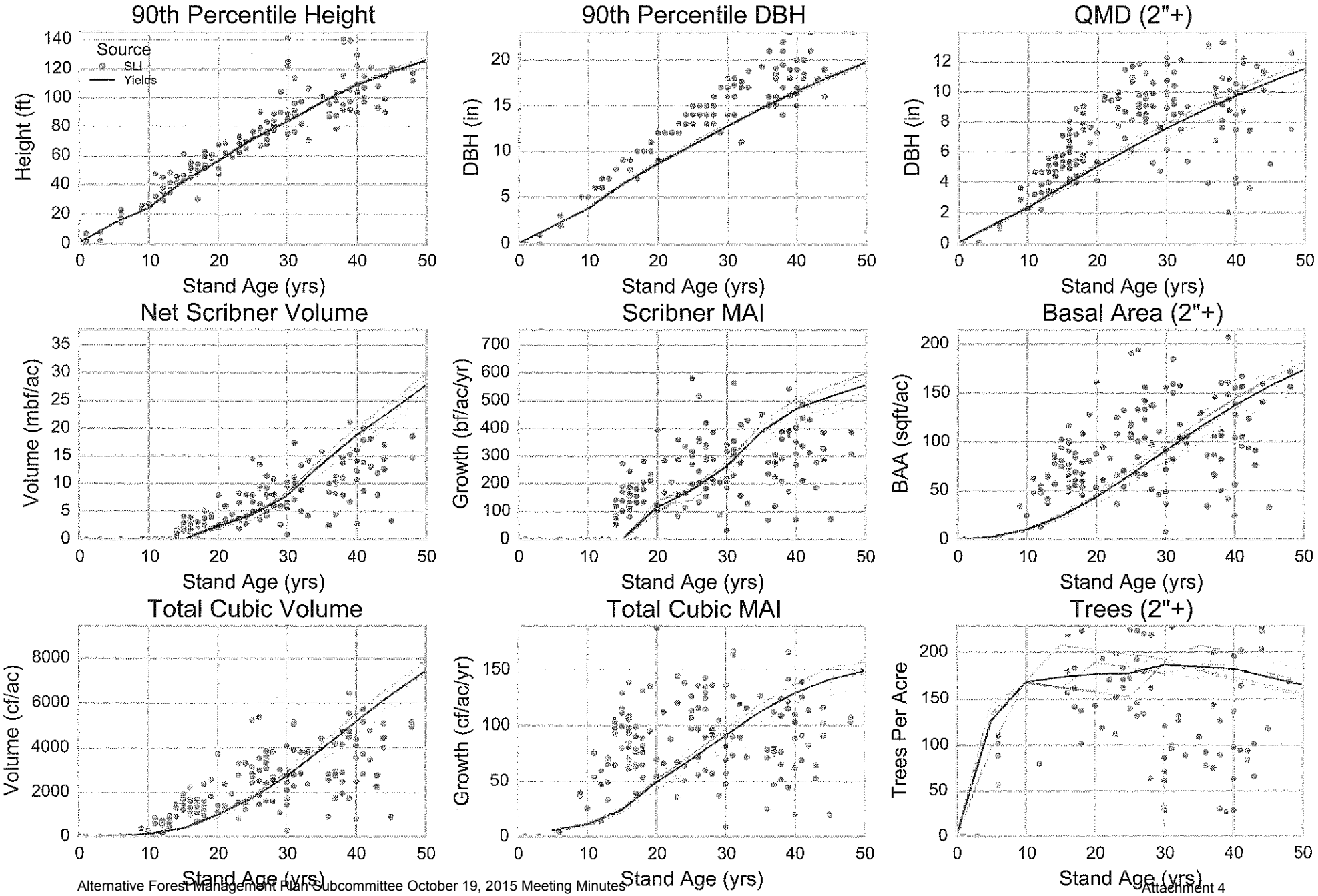
HSM Regen. Yield Projections Compared with SLI Cruised Stands
Forest Grove - Site Class 4 (SLI 90'; Yld 90')



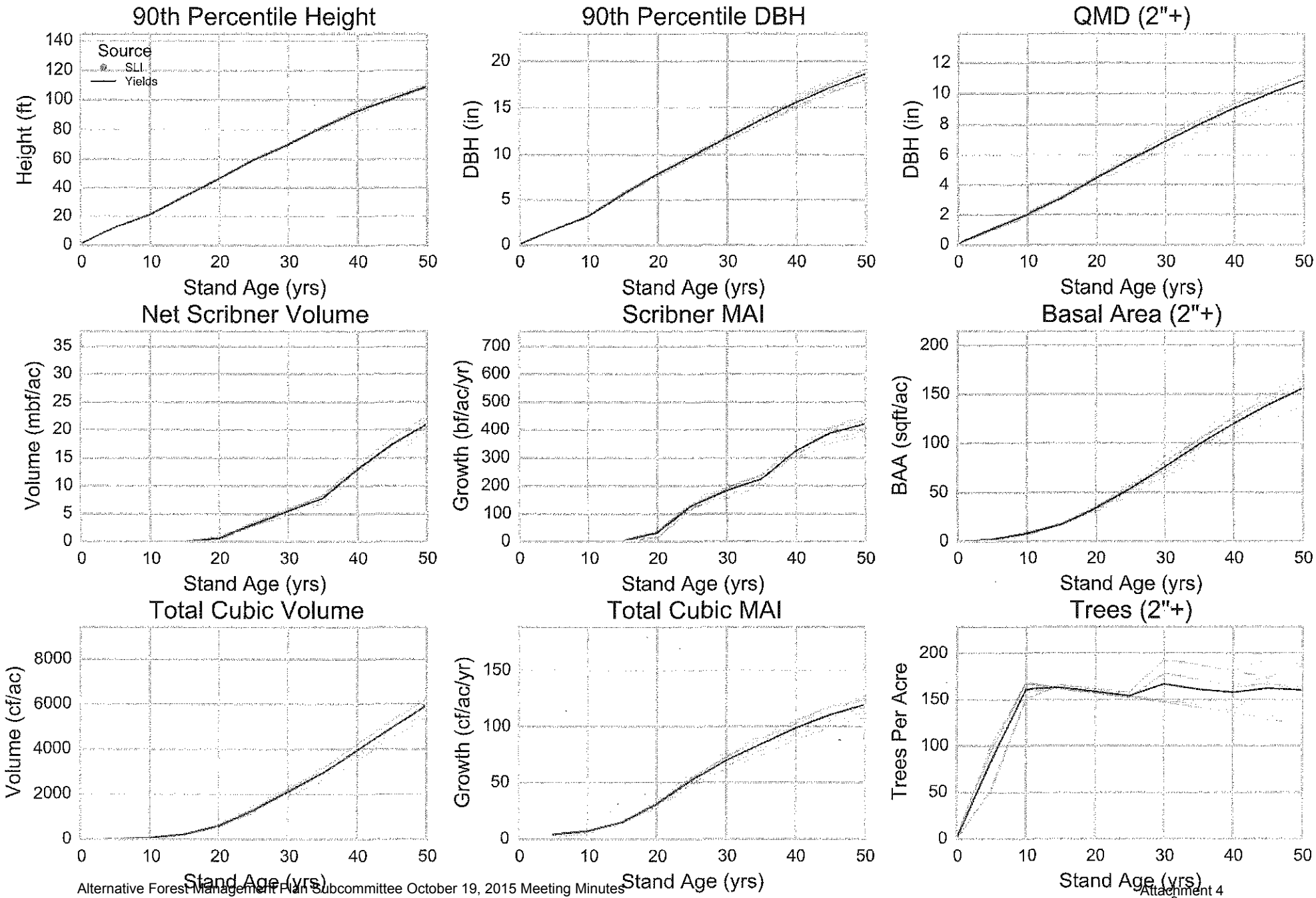
HSM Regen. Yield Projections Compared with SLI Cruised Stands
West Oregon - Site Class 1 (SLI 137'; Yld 137')



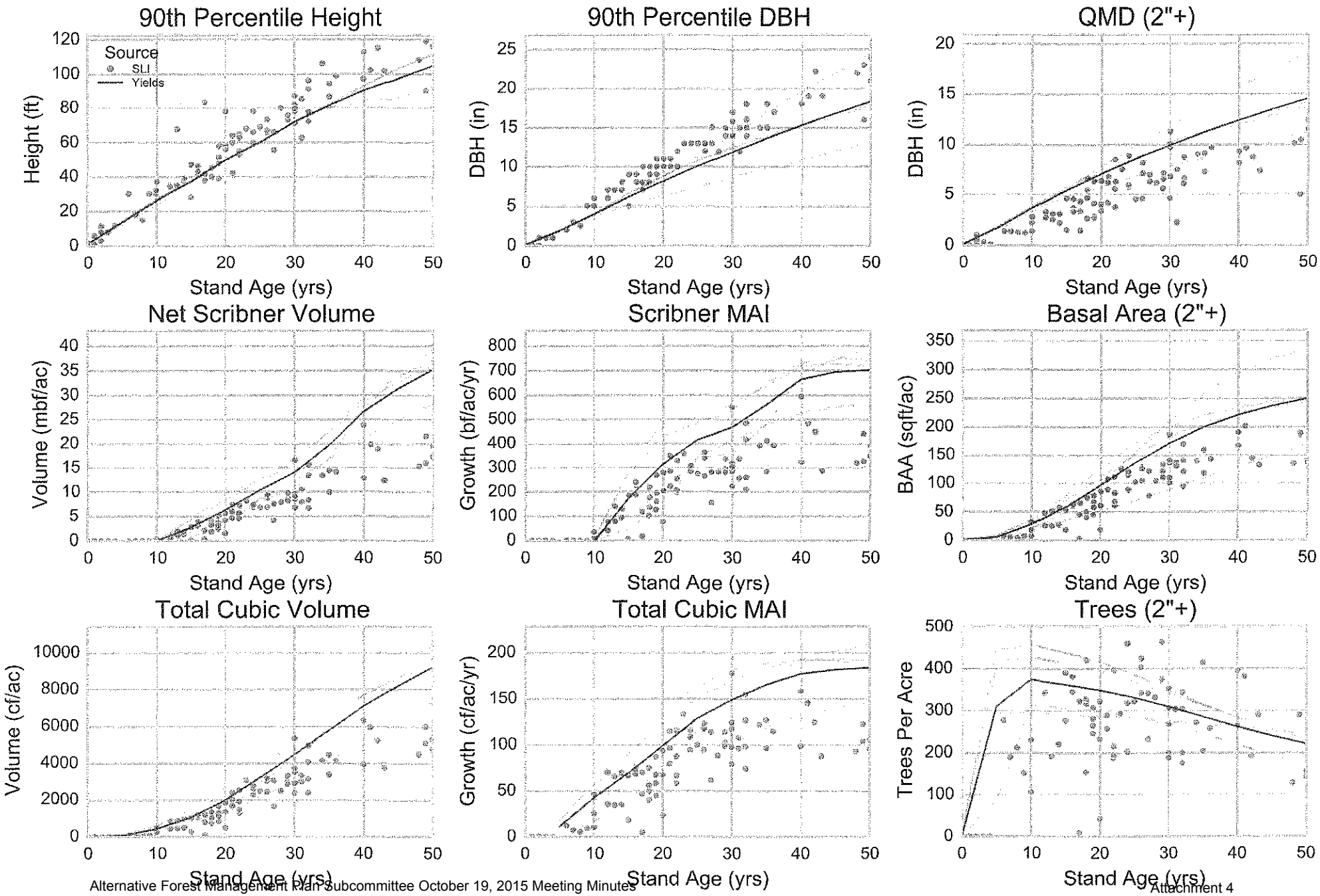
HSM Regen. Yield Projections Compared with SLI Cruised Stands
West Oregon - Site Class 2 (SLI 130'; Yld 130')



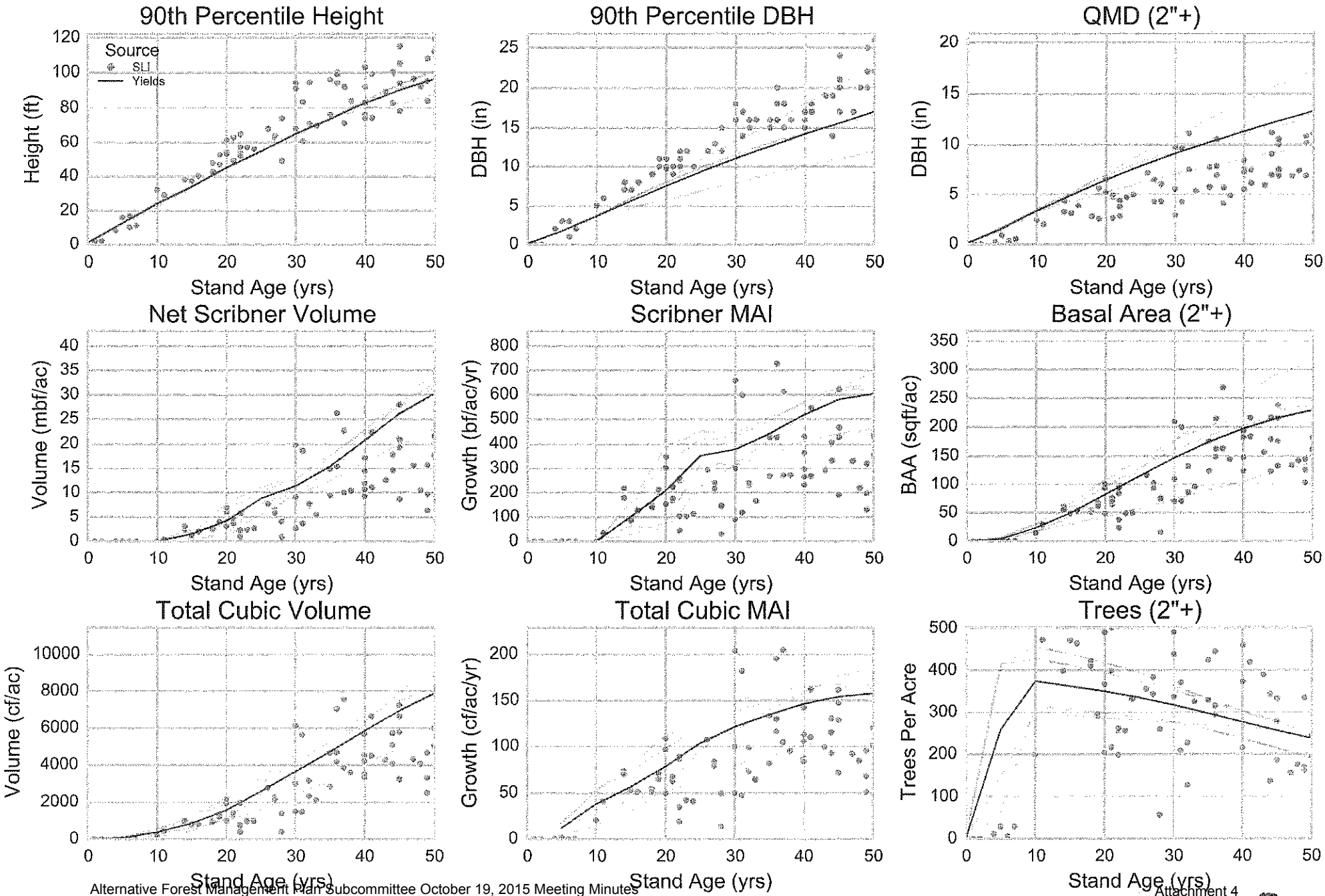
HSM Regen. Yield Projections Compared with SLI Cruised Stands
West Oregon - Site Class 3 (SLI nan'; Yld 112')



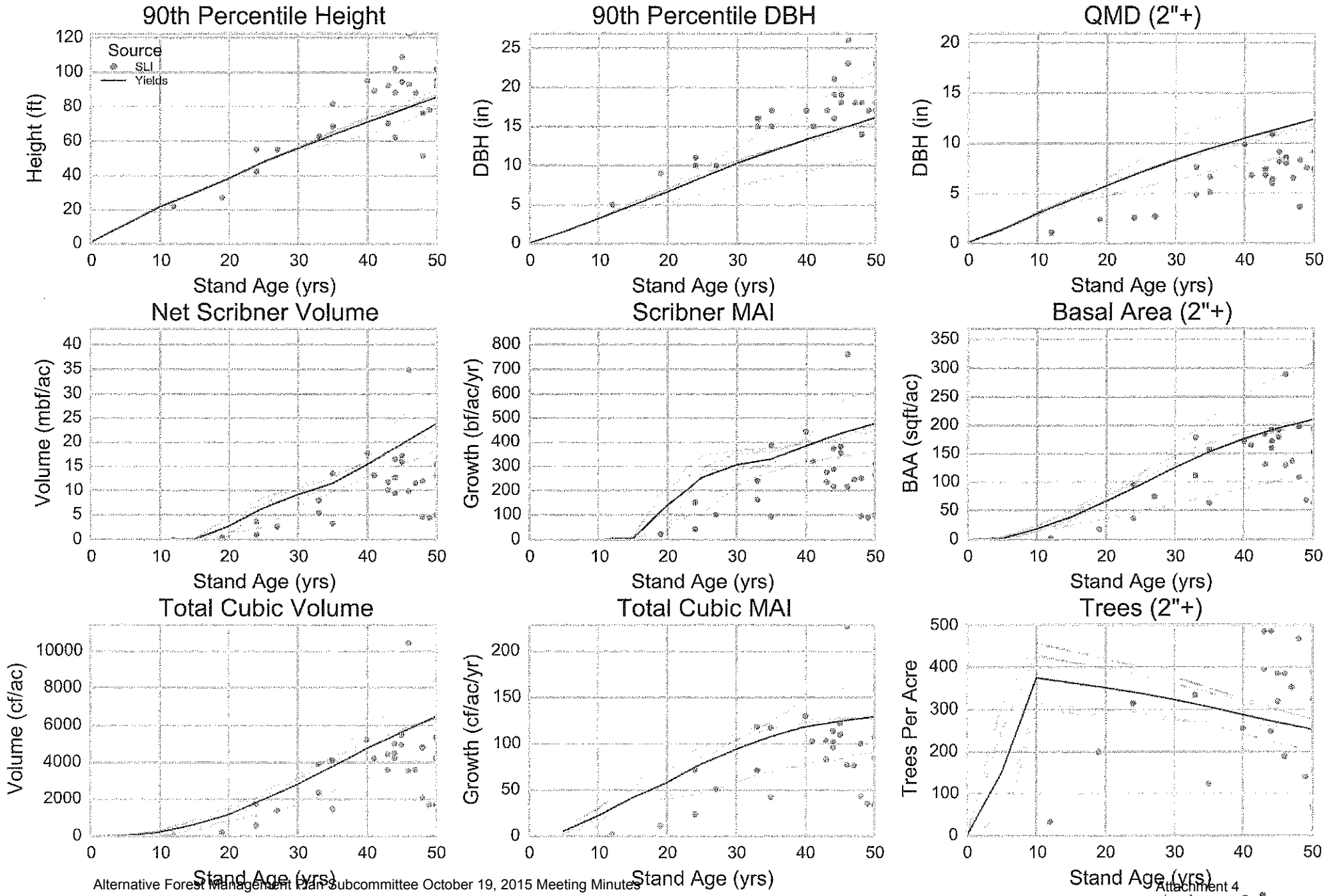
HSM Regen. Yield Projections Compared with SLI Cruised Stands
North Cascade - Site Class 2 (SLI 121'; Yld 178')



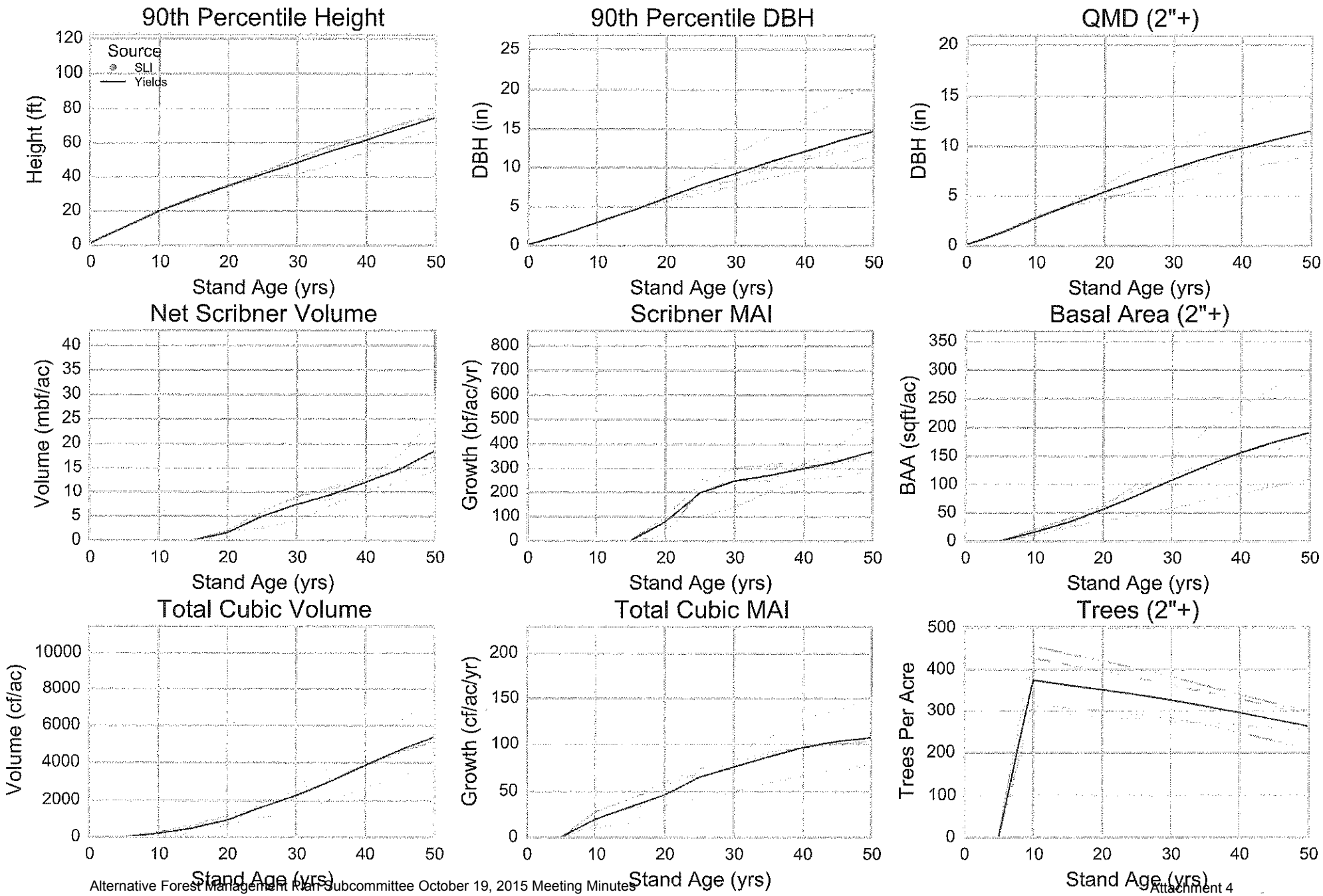
HSM Regen. Yield Projections Compared with SLI Cruised Stands
North Cascade - Site Class 3 (SLI 106'; Yld 160')



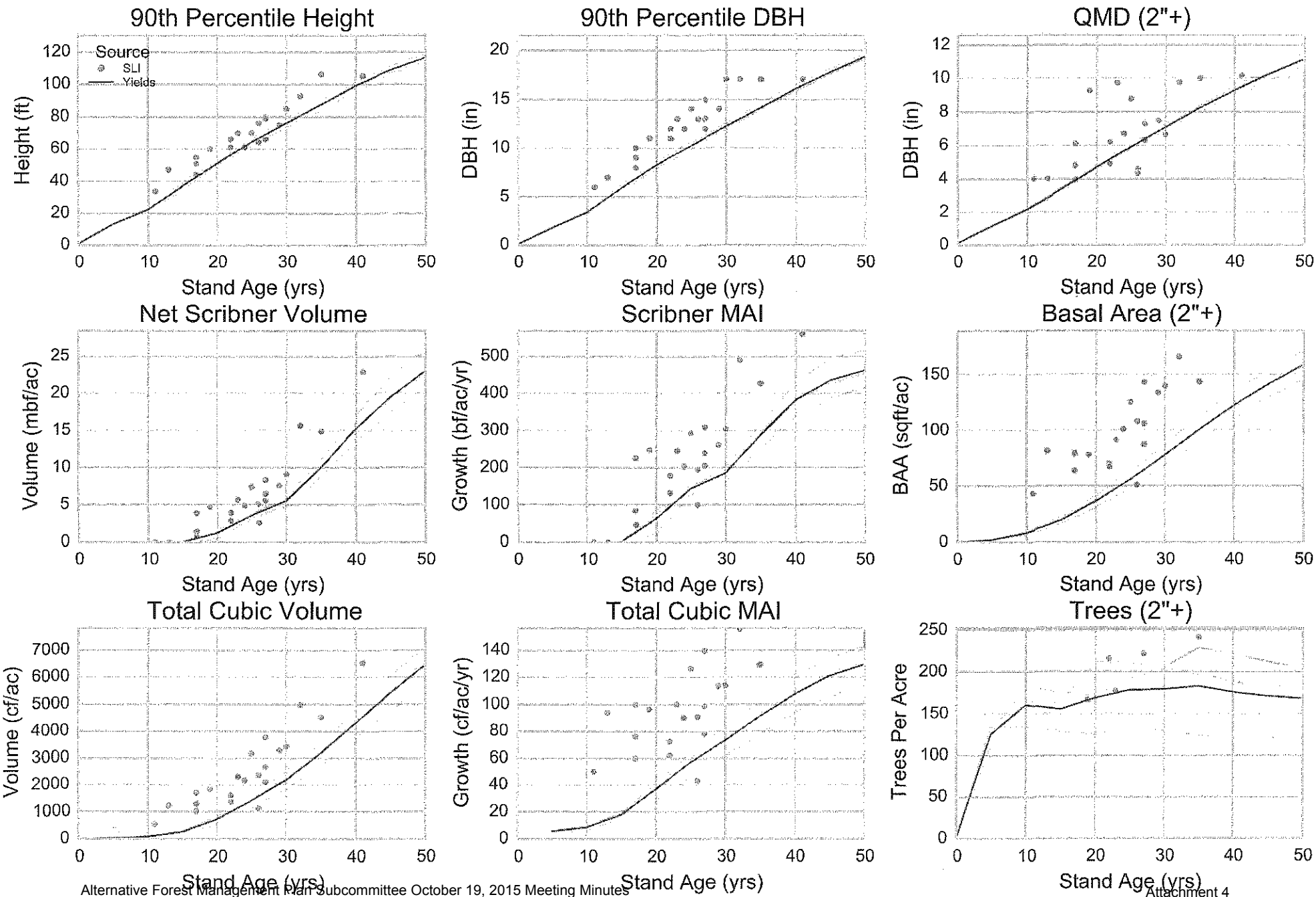
HSM Regen. Yield Projections Compared with SLI Cruised Stands
North Cascade - Site Class 4 (SLI 89'; Yld 135')



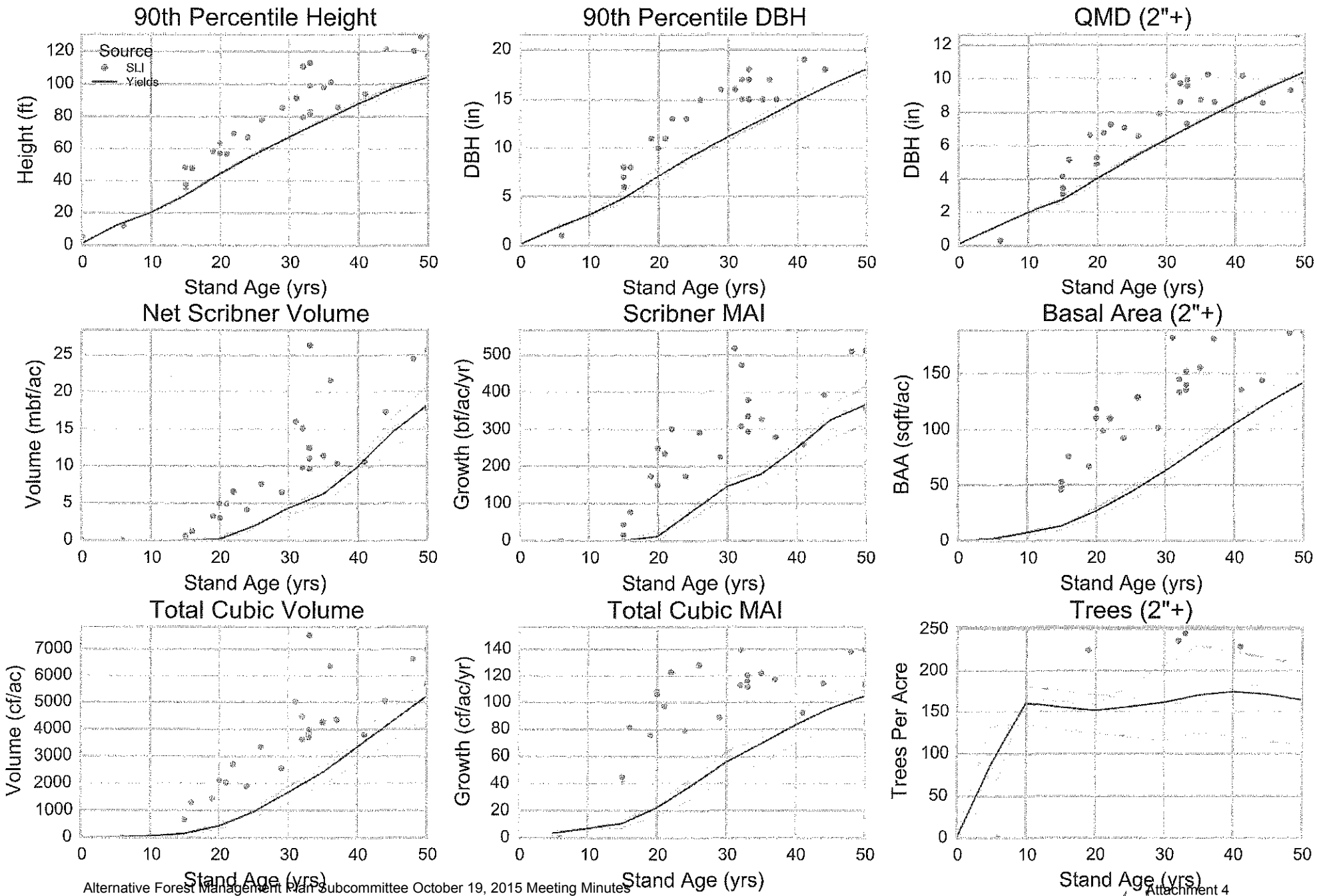
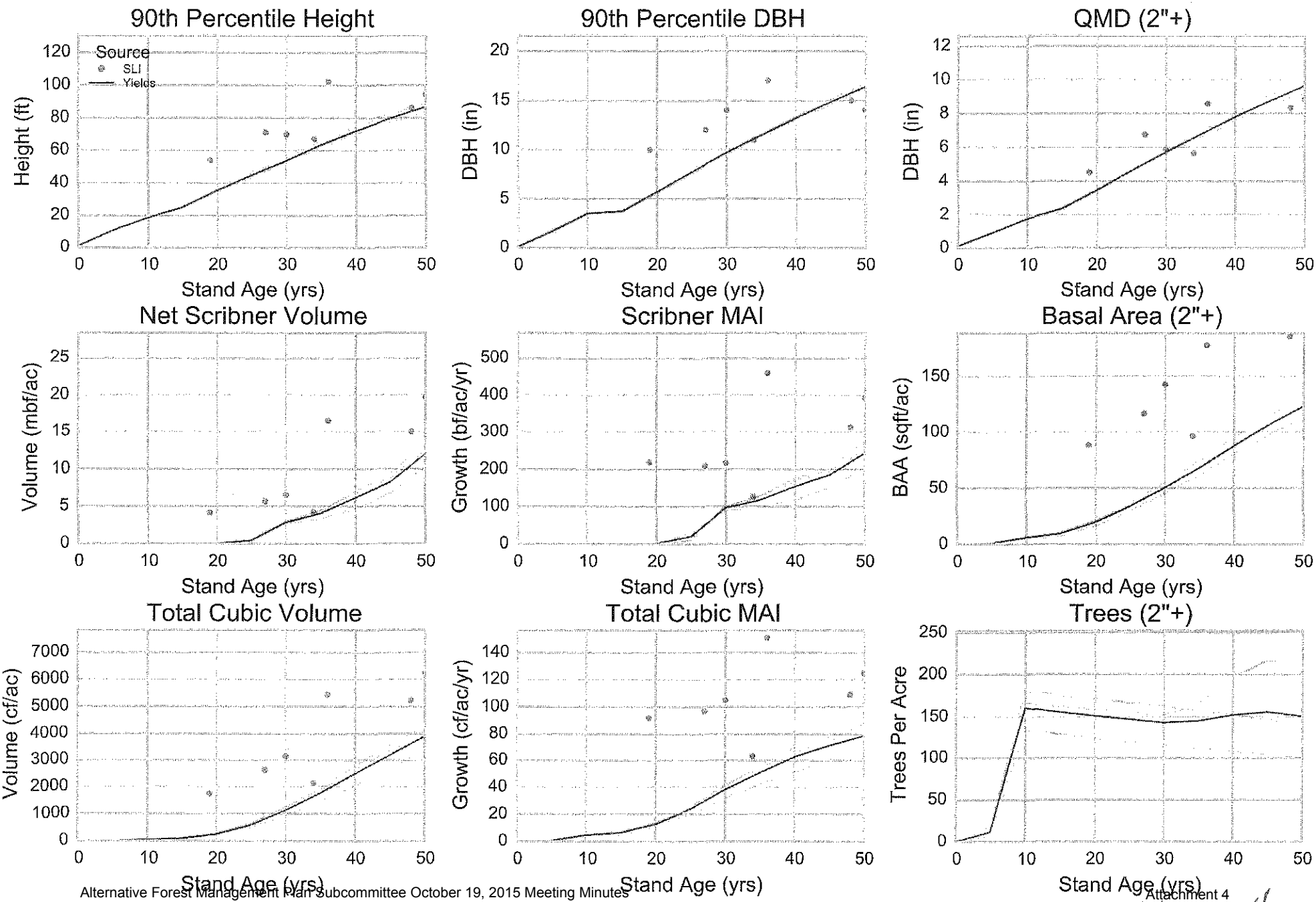
HSM Regen. Yield Projections Compared with SLI Cruised Stands
North Cascade - Site Class 5 (SLI nan'; Yld 116')



HSM Regen. Yield Projections Compared with SLI Cruised Stands
Western Lane - Site Class 2 (SLI 122'; Yld 120')



HSM Regen. Yield Projections Compared with SLI Cruised Stands
Western Lane - Site Class 3 (SLI 106'; Yld 107')



HSM Regen. Yield Projections Compared with SLI Cruised Stands
Western Lane - Site Class 4 (SLI 89'; Yld 90')