Department of Natural Resources

Economic & Revenue Forecast

Fiscal Year 2020, First Quarter
September 2019

Forecast Summary

Lumber and Log Prices. Lumber prices in 2017 increased through the year from $350/mbf to $490/mbf, averaging $425/mbf for the year—significantly higher than previous years and the highest prices in real terms since the height of the previous housing boom in 2005. Prices continued to increase through the first half of 2018, averaging $569/mbf through July, peaking at $635 before dropping markedly to an apparent nadir of $324/mbf in November. Since then prices increased to $395/mbf in February 2019, before falling back to $360/mbf in August.

Prices for the 'typical' DNR log were also markedly higher in 2017 than previous years, climbing from $578/mbf in January to $719/mbf in December, averaging $611/mbf for the year. Prices for DNR logs increased in the first quarter of 2018, averaging $722/mbf, but declined through the rest of the year to a low of $519/mbf in December. Prices have recovered from that low to $560/mbf in February 2019, but fell back again to $537/mbf in August. Prices have averaged $550/mbf year-to-date through August.

Log and lumber prices were expected to weaken in the final two quarters of 2018, but they were still expected to stay above recent years' averages, before climbing back to near early-2018 levels in early 2019. That, obviously, did not happen. The steepness of the price decline was surprising and appears to be due to a confluence of a number of factors. As discussed in the main forecast, throughout the latter half of 2018 housing starts stalled, house price growth flattened (and declined in some areas, like Seattle) and lumber mills built significant inventories of both logs and lumber. Log prices are expected to continue recovering through the rest of 2019, and will average something close to 2016 prices for the calendar year. Prices are expected to continue increasing through early 2020, though they are not expected to approach the highs seen in 2018.

Timber Sales Volume. Sales plans in the current and outlying years have not changed, so absent a new sustainable harvest calculation, sales volume forecasts remain at 500 mmbf. The volume sold in FY 19 was 488 mmbf, 12 mmbf lower than the June forecast. Unfortunately, with the continued low price and weak demand, we continue to see a number of contracts being passed in at auction with no bidders. To date, DNR has sold 65 mmbf in stumpage, with 18 mmbf of contracts left with no bids. That leaves 435 mmbf to auction in the remainder of the year to reach our forecast sales volume. It is DNR's intention to bring more than this auction, however, given the number of contracts with no bidders and the potential issues with the planned volume, 500 mmbf was determined to be a reasonable total estimate of what will actually sell.

Timber Sales Prices. Auction prices for FY 18 totaled $458/mbf, well above the FY 17 average of $346/mbf. The sales price forecast for FY 19 was increased from $350/mbf to $370/mbf in the September 2018 forecast, due to the strong prices in the first half of 2018, which were forecast to wane but not collapse. This was pulled back to $360 in November 2018, which was still achievable given the sales through October. Price continued to be lower in sales through January 2019, so the stumpage price was reduced to $350/mbf in the February forecast. This was an entirely plausible forecast, until April.

FY 19 sales through March 2019 averaged $362/mbf, however, prices plummeted in April. Prices for April and May averaged $257/mbf and the average price for the fiscal year was $325/mbf.

As of the June 2019 Forecast, sales prices for the outlying years were left unchanged because log and lumber prices are expected to recover from the weakness that dominated prices in FY 19. However, the average prices for sales to date have been extremely low at $164/mbf. While the composition of the timber in the first two auctions was not necessarily representative of what will be brought forward in the remainder of the year and we expect prices to recover, we are reducing the forecast average sales price for FY 20 to $330. Prices in outlying years are remain unchanged.

Timber Removal Volume and Prices. The har-

vest volume forecast for FY 19 was reduced by 20 mmbf in June to 500 mmbf, and ended the year slightly above the forecast at 502 mmbf.

In this forecast (and likely the next) we are revising the methods used to forecast harvest volume. Essentially, the previous method used likely harvest volumes estimated from a purchaser survey, as well as historical averages of volume harvested from sales remaining in the year. Downward revisions in volume harvested in a given year are pushed into future years, because that volume is still in inventory and has a contractual time limit to when it must be harvested by. While this is conceptually sound, it has, in practice, led to apparently systematic overestimation of harvest volumes in future years. This problem propagates at the start of new fiscal years when we begin revising the volumes down based on recent harvest history, and pushing that volume out to future years. This issue is illustrated in the appendix review of historical forecasts.

The effect of this method revision is a decrease in the forecast harvest volume for the current and all outlying fiscal years.

The timber removal price forecast for FY 19 was increased in June, but ended the year even higher than expected at $385/mbf. This revision and the end result were due entirely to an increased proportion of the harvest being higher priced timber. This was not the case through the February forecast, where the average price of removals was $375. Between February and May, the average removal price was $442/mbf. Although this increased the removal price in FY 19, it pushed down the forecast prices in outlying year, FY 20 in particular.

However, it appears that the June downward revision to the forecast removal price for FY 20 was too much and it has been increased in this forecast. This is due to the high average price of timber removed to-date this fiscal year—which has had an average price of $384/mbf—and the value of remaining inventory and expiring contracts. There are 152 mmbf worth of contracts expiring in FY 20, with an average value of $372/mbf, and 304 mmbf worth of contracts expiring in FY 21, with an average value of $388/mbf.

Timber Revenue. The downward revisions to harvest volume outweigh the upward revisions to price so that the forecast timber revenue are decreased in FY 20 and all outlying years. Revenue in FY 20 and FY 21 are reduced by $1 million and $2 million respectively.

Revenues for the 2019-2021 biennium are forecast to total $368 million, a decrease of 0.9 percent ($3 million) from the June Forecast, while revenues for the 2021-2023 biennium are decreased by 2.2 percent ($8 million) to $357 million.

Non-Timber Revenues. In addition to revenue from timber removals on state-managed lands, DNR also generates sizable revenues from managing leases on uplands and aquatic lands.

The non-timber uplands revenue forecast for FYs 20 and 21 are decreased slightly due to poor prices for irrigated agricultural products, which have been affected by both broader economic issues and the trade war. Although, orchard/vineyard products are similarly affected, the revenue forecast for this source was already more conservative, so it was left unchanged this forecast.

The aquatic lease revenue forecast is unchanged for all forecast years. However, the forecast geoduck revenue has been revised downward for all forecast years due to very low prices in the first geoduck auction in August and updated auction volume expectations. Price weakness in geoduck auctions are expected to continue as long as the 25 percent tariff to China continues, though prices are expected to be higher than the average of the August auction.

Total Revenues. Total revenues for the 2017-2019 Biennium (FYs 18-19) were $3 million higher than expected in the June Forecast. Forecast revenues for the 2019-2021 Biennium (FYs 20 and 21) are decreased by 1.4 percent ($7 million) to $509 million.

Notes to the Forecast. While we strive to produce an accurate forecast, there are a number of sources of uncertainty that may affect DNR revenue specifically, and the overall economic activity more broadly. These include: the as-yet undetermined sustainable harvest volume; the trade-war

and slow-down in the Chinese economy directly affecting timber and agricultural exports and prices, as well as affecting overall economic growth; uncertainty about future housing starts; and a potentially weaker economic climate, if not an out-right recession.

While the sales volume estimates are based on the best available internal planning data, they are subject to adjustments due to ongoing operational and policy issues. In particular, these issues are likely to affect sales volumes in outlying years, where the assumed sustainable harvest volume of 500 mmbf might be too high.

The most concerning factor in this forecast, and likely for forecasts in the near future, is the combined problem of the slowdown in housing construction and the decreasing exports to China.

Chinese imports of U.S. logs and lumber started meaningfully in 2010 and provided support to prices in the worst years following the Recession in 2008-09, when housing construction was very low. However, Chinese imports have dropped dramatically since 2014, year-to-date exports of untreated Douglas-fir and Hemlock logs from Washington and Oregon to China decreased by 46 percent between 2014 and 2018. While Chinese demand has been dropping, domestic housing demand has been picking up and more than offset the decrease in China-bound exports—it appears that the strong log and lumber price growth from 2017 and the beginning of 2018 was due largely to housing construction. But that housing construction growth has stalled.

Since the beginning of 2018 the U.S. and China have been engaged in an escalating trade dispute. Directly relevant to DNR revenues are a 25 percent tariff on geoduck and wheat, and a five percent tariff on softwood logs. The tariff on geoduck is likely the main driver of the drop in geoduck prices, from an average of $11.31/lb in FY 18 to an average of $9.43/lb in FY 19 (a 17 percent drop). The log tariffs, in addition to the slowdown in housing starts, likely contributed to the lower domestic price of logs.

Although decreasing exports are built into the forecast, China is still a major market for Washington timber and lumber. A faster than expected drop in demand represents a continuing downside risk for the forecast. Aside from the trade tensions discussed above, there are other things that could undermine Chinese demand, such as the current apparent slowdown in Chinese economic growth or continued loss of PNW market share to international and Southeastern US competitors.

Continued growth in domestic housing demand was expected to offset the continued decline in China-bound exports. If housing construction does not recover from its recent weakness, as optimistic analysts have forecast, and Chinese exports continue to decline, then log and lumber prices will continue to fall, in which case even our conservative current stumpage forecast may be optimistic.

The strong housing starts for August 2019 offer a potential upside to the forecast, if it turns into a meaningful recovery in construction. Unfortunately, there are still a number of significant impediments, on both the supply and demand sides, to a strong recovery in prices and starts. Constraints on demand include persistently stringent lending standards, a continued tough labor market for younger workers, enormous student loan debt, poor wage growth, and now increasing interest rates. It has been surprising how high prices have risen given these constraints. Additional, supply side impediments constraining construction growth include a lack of skilled labor or readily buildable land.

Another concern for the overall U.S. economy, which would affect DNR revenue, is the continued political uncertainty surrounding the U.S. Federal Government. The government was shutdown from December 22, 2018 to January 25, 2019 and was the second federal government shutdown of the current U.S. administration. If a budget agreement isn't reached by the end of November, then the government will shut down again. In the end, the effects of the Federal Government shutdown in 2018-19 were likely minimal and insignificant compared to the size of the economy. However, shutdowns cause instability in an economy and could have significant

unforeseen impacts if they happen too often.

Any direct impact of the shutdown on DNR was from the effect on the housing market, potentially delaying what was expected to be a recovery in the first quarter of 2019. Single-family home loans through the FHA and all types of VA loans were still funded through the shutdown, though with delays, while some other types of FHA loans were not processed . Most conventional mortgages are not backed by the federal government and were processed as usual, though tax transcript processing at the IRS was disturbed and caused delays in application processing.

Since the expiration of the Softwood Lumber Agreement (SLA) in late 2015, the U.S. and Canada have been without a trade agreement that covers lumber. As of late 2017 a U.S. ITC finding cleared the Department of Commerce to impose duties, which have been set at 20.23 percent. Although Canada has appealed the finding to a NAFTA panel and has filed a complaint with the WTO, much of the short-term uncertainty about trade costs is gone. Without a breakthrough on the new SLA negotiations or a finding from the WTO or NAFTA panel, the markets are unlikely to see the price volatility that the previous duty uncertainty caused. Additionally, at current lumber prices, the duties shouldn't be significant enough to reduce Canadian production.

Aside from the tariffs pushing down geoduck prices, which they appear to have done, China has twice instituted bans on Pacific Northwest shellfish on food safety grounds—paralytic shellfish poison (PSP) and arsenic contamination. It's not clear that either of these bans significantly affected prices or harvest activity. However, it is entirely possible that China could re-enact a more forceful ban on geoduck that would have a dramatic effect on geoduck prices, and therefore revenue.

As always in the geoduck fisheries, PSP closures create uncertainty around harvest volumes as well.

Table 1: September 2019 Forecast by Source (millions of dollars)

Timber Sales		FY 16	FY 17	FY 18	FY 19	FY 20	FY 21	FY 22	FY 23
Volume (mmbf)		545	520	496	488	500	500	500	500
	Change				(12)	-	-	-	-
	% Change				-2%	0%	0%	0%	0%
Price ($/mbf)		285	346	458	325	330	340	340	340
	Change				$ 0	$ (10)	$ (0)	$ (0)	$ (0)
	% Change				0%	-3%	0%	0%	0%
Value of Timber Sales		**155.3**	**179.8**	**227.1**	**158.8**	**165.0**	**170.0**	**170.0**	**170.0**
	Change				$ (3.7)	$ (5.0)	$ (0.1)	$ (0.1)	$ (0.1)
	% Change				-2%	-3%	0%	0%	0%
Timber Removals									
Volume (mmbf)		490	493	528	502	534	552	523	530
	Change				2	(25)	(18)	(22)	(2)
	% Change				0%	-4%	-3%	-4%	0%
Price ($/mbf)		338	313	338	385	341	337	339	340
	Change				4.9	13.6	6.6	2.1	(1.9)
	% Change				1%	4%	2%	1%	-1%
Timber Revenue		**165.7**	**154.2**	**178.6**	**193.3**	**182.1**	**186.1**	**177.6**	**179.9**
	Change				3.3	(0.9)	(2.3)	(6.3)	(1.6)
	% Change				2%	-1%	-1%	-3%	-1%
Upland Leases									
Irrigated Agriculture		8.7	9.1	10.4	8.9	8.7	8.7	9.0	9.0
	Change				(0.1)	(0.3)	(0.3)	-	-
	% Change				-2%	-3%	-3%	0%	0%
Orchard/Vineyard		8.2	8.1	8.5	9.0	8.2	8.2	8.2	8.2
	Change				0.1	-	-	-	-
	% Change				1%	0%	0%	0%	0%
Dryland Ag/Grazing		5.2	5.6	6.6	6.6	6.0	6.0	6.0	6.0
	Change				0.1	-	-	-	-
	% Change				2%	0%	0%	0%	0%
Commercial		9.0	9.7	10.9	10.2	10.4	10.4	10.4	10.4
	Change				0.0	-	-	-	-
	% Change				0%	0%	0%	0%	0%
Other Leases		10.5	10.7	9.8	10.0	10.2	10.3	10.3	10.3
	Change				(0.0)	-	-	-	-
	% Change				0%	0%	0%	0%	0%
Total Upland Leases		**41.6**	**43.1**	**46.1**	**44.6**	**43.5**	**43.6**	**43.9**	**43.9**
	Change				-	(0.3)	(0.3)	-	-
	% Change				0%	-1%	-1%	0%	0%
Aquatic Lands									
Aquatic Leases		11.1	10.8	12.0	13.5	11.3	11.2	11.2	11.2
	Change				(0.0)	-	-	-	-
	% Change				0%	0%	0%	0%	0%
Geoduck		14.5	27.9	26.4	23.6	14.1	17.5	17.7	18.7
	Change				0.0	(3.0)	(0.1)	(0.3)	(0.2)
	% Change				0%	-18%	0%	-2%	-1%
Aquatic Lands Revenue		**25.6**	**38.7**	**38.4**	**37.1**	**25.4**	**28.7**	**28.9**	**29.9**
	Change				0.0	(3.0)	(0.1)	(0.3)	(0.2)
	% Change				0%	-11%	0%	-1%	-1%
Total All Sources		**232.9**	**236.1**	**263.1**	**275.0**	**250.9**	**258.4**	**250.3**	**253.6**
	Change				3.4	(4.3)	(2.7)	(6.6)	(1.7)
	% Change				1%	-2%	-1%	-3%	-1%

Table 2: September 2019 Forecast by Fund (millions of dollars)

Key DNR Operating Funds		FY 16	FY 17	FY 18	FY 19	FY 20	FY 21	FY 22	FY 23
041	RMCA - Uplands	36.0	33.7	40.6	39.9	35.9	39.3	39.1	39.6
	Change				1.3	(0.6)	(0.4)	(0.9)	(0.1)
	% Change				3%	-2%	-1%	-2%	0%
041	RMCA - Aquatic Lands	11.3	17.9	17.6	16.7	11.0	12.7	12.8	13.3
	Change				0.2	(1.5)	(0.0)	(0.2)	(0.1)
	% Change				1%	-12%	0%	-1%	-1%
014	FDA	22.8	22.0	22.1	25.6	25.2	23.9	22.2	22.4
	Change				0.2	(0.2)	(0.6)	(0.8)	(0.3)
	% Change				1%	-1%	-2%	-3%	-1%
21Q	Forest Health Revolving			4.4	6.5	8.2	9.9	9.8	9.9
					(0.8)	1.0	0.5	(0.4)	(0.1)
					-11%	14%	6%	-4%	-1%
Total DNR Key Operating Funds		**70.2**	**73.6**	**84.7**	**88.7**	**80.4**	**85.8**	**83.8**	**85.2**
	Change				1.0	(1.3)	(0.5)	(2.3)	(0.6)
	% Change				1%	-2%	-1%	-3%	-1%
Current Funds									
113	Common School Construction	59.7	51.8	62.6	64.2	61.8	65.6	64.6	65.3
	Change				1.3	(1.1)	(0.7)	(1.4)	(0.3)
	% Change				2%	-2%	-1%	-2%	0%
999	Forest Board Counties	55.3	58.5	59.6	69.5	62.2	58.8	54.5	54.9
	Change				0.5	(0.4)	(1.0)	(1.8)	(0.6)
	% Change				1%	-1%	-2%	-3%	-1%
001	General Fund	4.1	2.6	2.1	1.9	4.5	4.0	3.6	3.6
	Change				(0.2)	(0.2)	(0.2)	(0.1)	(0.1)
	% Change				-11%	-4%	-4%	-4%	-2%
348	University Bond Retirement	1.8	1.8	3.2	1.3	1.5	1.9	1.8	1.9
	Change				0.1	(0.2)	0.1	(0.0)	0.0
	% Change				5%	-10%	8%	-1%	2%
347	WSU Bond Retirement	1.4	1.7	1.6	1.4	1.7	1.7	1.7	1.7
	Change				(0.3)	(0.0)	(0.0)	-	-
	% Change				-20%	-1%	-1%	0%	0%
042	CEP&RI	3.1	4.1	5.3	2.7	2.7	3.9	4.0	4.1
	Change				0.2	0.0	(0.0)	(0.1)	0.0
	% Change				8%	1%	-1%	-3%	0%
036	Capitol Building Construction	6.7	8.2	6.2	9.8	5.8	7.2	7.5	7.7
	Change				1.1	0.0	(0.2)	(0.3)	(0.0)
	% Change				13%	0%	-3%	-4%	0%
061/3/5/6	Normal (CWU, EWU, WWU, TESC) School	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2
	Change				(0.1)	(0.0)	(0.0)	-	-
	% Change				-44%	-1%	-1%	0%	0%
Other Funds		0.1	0.0	1.1	1.2	1.0	0.3	0.2	0.2
	Change				0.3	(0.1)	(0.3)	(0.1)	(0.1)
	% Change				40%	-10%	-50%	-28%	-31%
Total Current Funds		**132.2**	**129.0**	**141.7**	**152.1**	**141.4**	**143.5**	**138.1**	**139.5**
	Change				2.8	(1.9)	(2.4)	(3.9)	(1.0)
	% Change				2%	-1%	-2%	-3%	-1%

(Continued)

Table 3: September 2019 Forecast by Fund (millions of dollars), cont'd

Aquatic Lands Enhancement Account			FY 16	FY 17	FY 18	FY 19	FY 20	FY 21	FY 22	FY 23
02R			14.2	20.8	20.8	20.4	14.4	16.0	16.1	16.6
		Change				(0.2)	(1.5)	(0.0)	(0.2)	(0.1)
		% Change				-1%	-9%	0%	-1%	0%
Permanent Funds										
	601	Agricultural College Permanent	7.6	4.6	4.2	4.1	7.1	4.8	4.0	4.0
		Change				(0.6)	0.8	0.1	(0.1)	(0.0)
		% Change				-12%	12%	3%	-2%	-1%
	604	Normal School Permanent	2.4	3.1	4.1	2.9	2.7	2.8	2.7	2.7
		Change				(0.1)	(0.2)	(0.1)	(0.1)	(0.0)
		% Change				-2%	-8%	-3%	-4%	-1%
	605	Common School Permanent	1.0	0.6	0.8	0.2	0.3	0.3	0.3	0.3
		Change				(0.1)	-	-	-	-
		% Change				-33%	0%	0%	0%	0%
	606	Scientific Permanent	5.0	4.1	7.0	5.4	4.4	4.8	4.7	4.8
		Change				0.2	0.1	0.1	(0.1)	0.0
		% Change				4%	1%	2%	-3%	0%
	607	University Permanent	0.2	0.3	0.3	0.7	0.2	0.4	0.5	0.5
		Change				(0.2)	(0.1)	(0.0)	(0.0)	0.0
		% Change				-19%	-26%	-3%	-5%	1%
Total Permanent Funds			**16.2**	**12.6**	**16.5**	**13.3**	**14.8**	**13.1**	**12.2**	**12.3**
		Change				(0.7)	0.5	0.1	(0.3)	(0.1)
		% Change				-5%	4%	1%	-3%	-1%
Total All Funds			**232.9**	**236.1**	**263.7**	**274.4**	**250.9**	**258.4**	**250.3**	**253.6**
		Change				2.8	(4.3)	(2.7)	(6.6)	(1.7)
		% Change				1%	-2%	-1%	-3%	-1%

Figure 1: Timber Forecast Charts

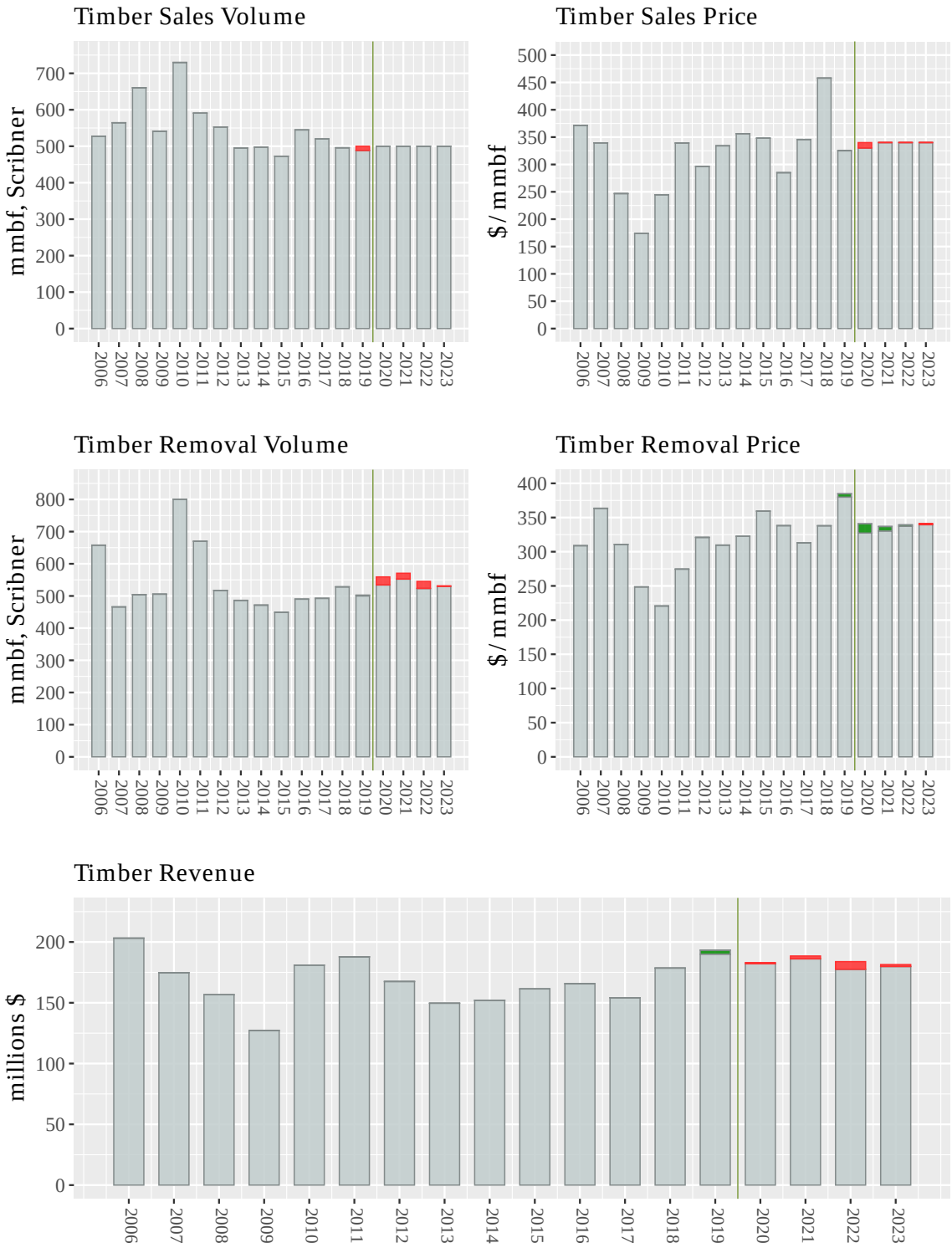


Figure 2: Other Uplands Forecast Charts

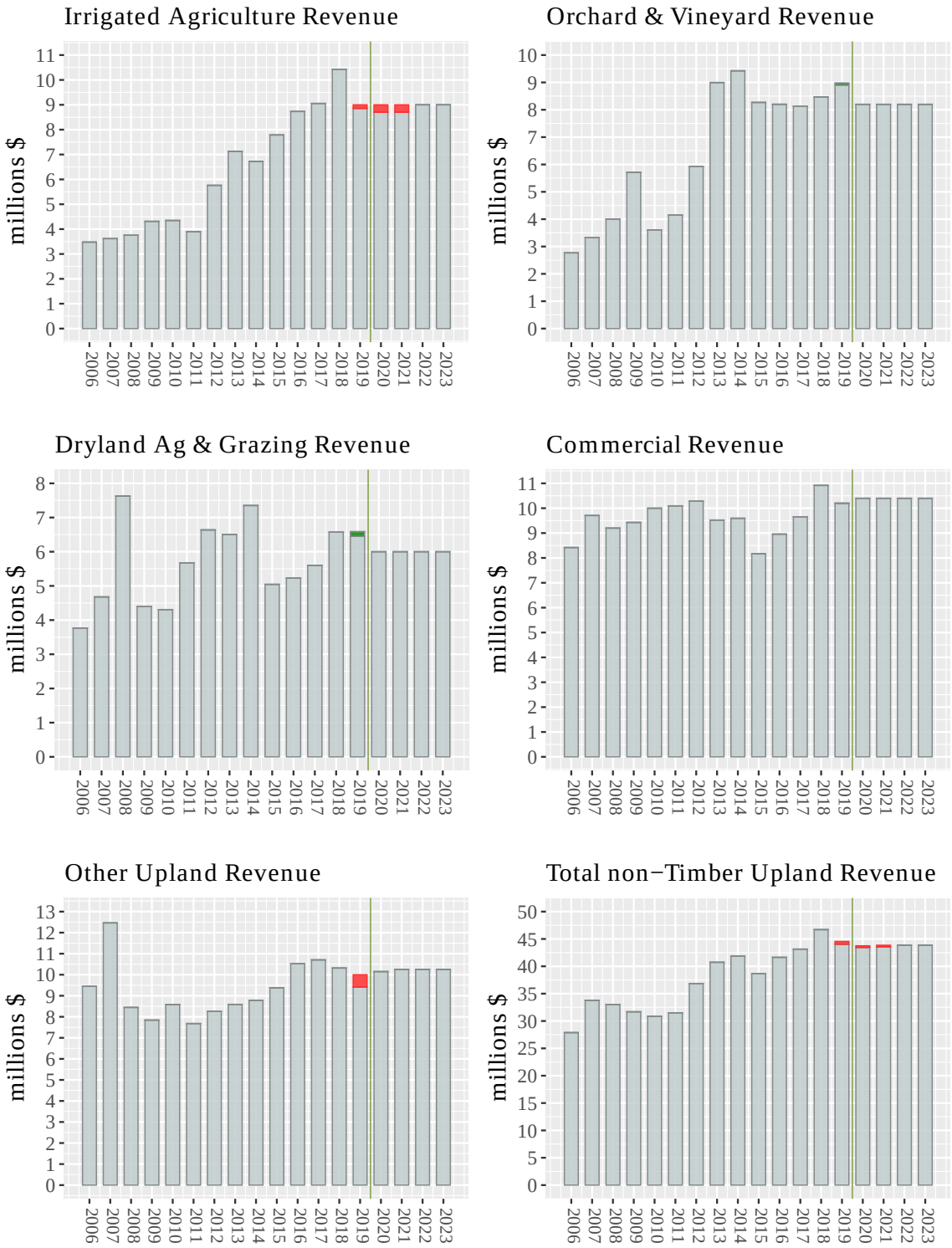
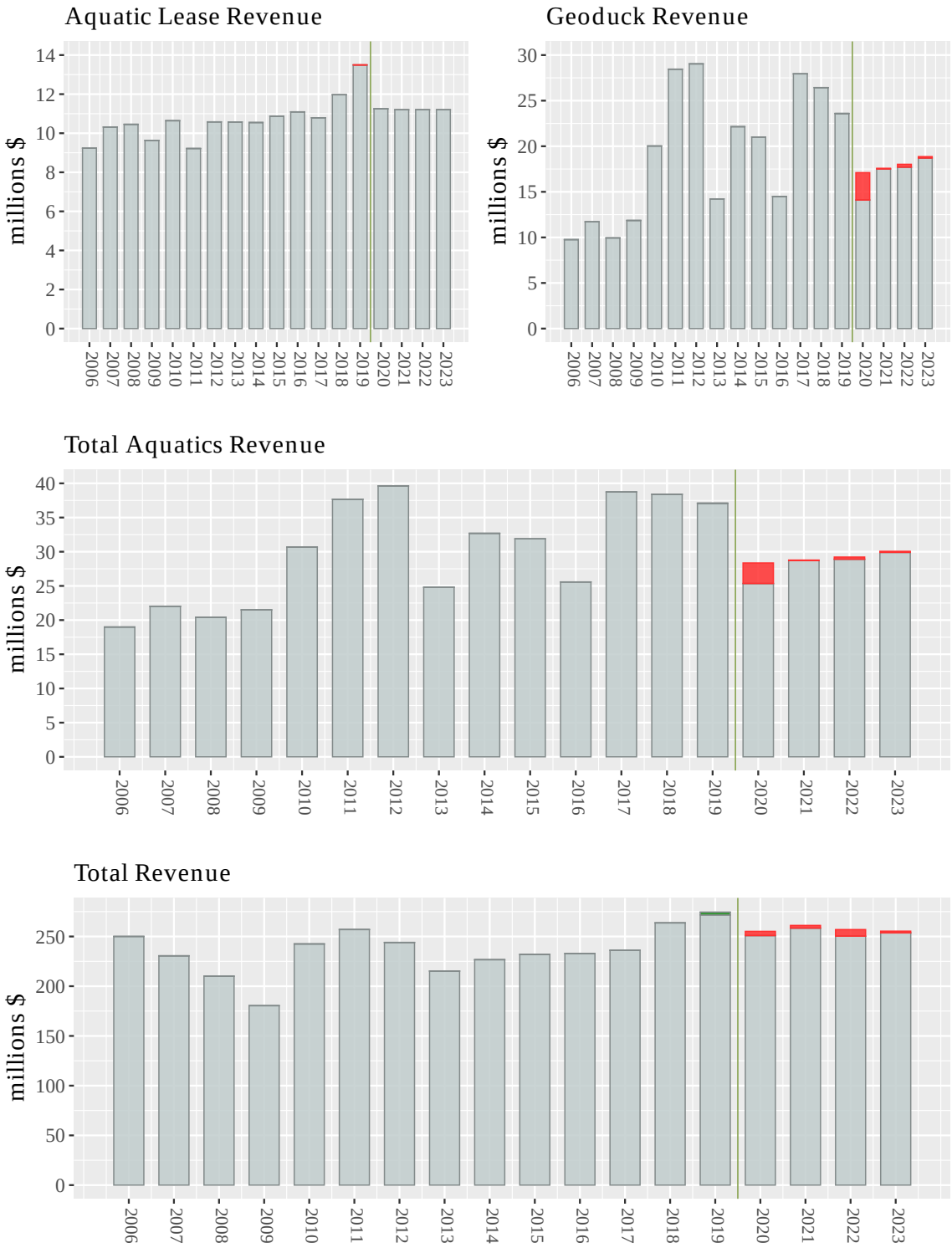


Figure 3: Aquatics and Total Forecast Charts



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Acronyms and Abbreviations

bbf	Billion board feet
BLS	U.S. Bureau of Labor Statistics
CAD	Canadian dollar
CNY	Chinese yuan (renminbi)
CPI	Consumer Price Index
CY	Calendar Year
DNR	Washington Department of Natural Resources
ECB	European Central Bank
ERFC	Washington State Economic and Revenue Forecast Council
FDA	Forest Development Account
FEA	Forest Economic Advisors
Fed	U.S. Federal Reserve Board
FOMC	Federal Open Market Committee
FY	Fiscal Year
GDP	Gross Domestic Product
HMI	National Association of Home Builders/Wells Fargo Housing Market Index
IMF	International Monetary Fund
ITC	U.S. International Trade Commission
mbf	Thousand board feet
mmbf	Million board feet
PSP	Paralytic Shellfish Poisoning
PPI	Producer Price Index
Q1	First quarter of year (similarly, Q2, Q3, and Q4)
QE	Quantitative Easing
RCW	Revised Code of Washington
RMCA	Resource Management Cost Account
SA	Seasonally Adjusted
SAAR	Seasonally Adjusted Annual Rate
SLA	Softwood Lumber Agreement
TAC	Total Allowable Catch
USD	U.S. Dollar
WDFW	Washington Department of Fish and Wildlife
WWPA	Western Wood Products Association
WTO	World Trade Organization

Preface

This *Economic and Revenue Forecast* projects revenues from Washington state lands managed by the Washington State Department of Natural Resources (DNR). These revenues are distributed to management funds and beneficiary accounts as directed by statute.

DNR revises its Forecast quarterly to provide updated information for trust beneficiaries and state and department budgeting purposes. Each DNR Forecast builds on the previous one, emphasizing ongoing changes. Forecasts re-evaluate world and national macroeconomic conditions, and the demand and supply for forest products and other goods. Finally, each Forecast assesses the impact of these economic conditions on projected revenues from DNR-managed lands.

DNR Forecasts provide information used in the *Washington Economic and Revenue Forecast* issued by the Washington State Economic and Revenue Forecast Council. The release dates for DNR Forecasts are influenced by the state's forecast schedule as prescribed by RCW 82.33.020. The table below shows the anticipated schedule for future *Economic and Revenue Forecasts.*

This Forecast covers fiscal years 2020 through 2023. Fiscal years for Washington State government begin July 1 and end June 30. For example, the current fiscal year, Fiscal Year 2020, runs from July 1, 2019 through June 30, 2020.

The baseline date (the point that designates the transition from "actuals" to predictions) for DNR revenues in this Forecast is August 1st, 2019. The forecast numbers beyond that date are predicted from the most up-to-date DNR sales and revenue data available, including DNR's timber sales results through August 2019. Macroeconomic and market outlook data and trends are the most up-to-date available as the Forecast document is being written.

Unless otherwise indicated, values are expressed in nominal terms without adjustment for inflation or seasonality. Therefore, interpreting trends in the Forecast requires attention to inflationary changes in the value of money over time, separate from changes attributable to other economic influences.

Economic Forecast Calendar

Forecast	Baseline Date	Final Data and Publication Date (approximate)
November 2019	October 1, 2019	November 15, 2019
February 2020	January 1, 2020	February 15, 2020
June 2020	May 1, 2020	June 15, 2020
September 2020	August 1, 2020	September 15, 2020

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Thanks also go to DNR staff who contributed to the Forecast: Koshare Eagle, Pat Ryan, Katy Mink, Tom Heller, Keith Jones, Janet Ballew, Linda Farr, and Michelle McLain. They provided data and counsel, including information on markets and revenue flows in their areas of responsibility.

In the final analysis, the views expressed are our own and may not necessarily represent the views of the contributors, reviewers, or DNR.

Office of Finance, Budget, and Economics

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Macroeconomic Conditions

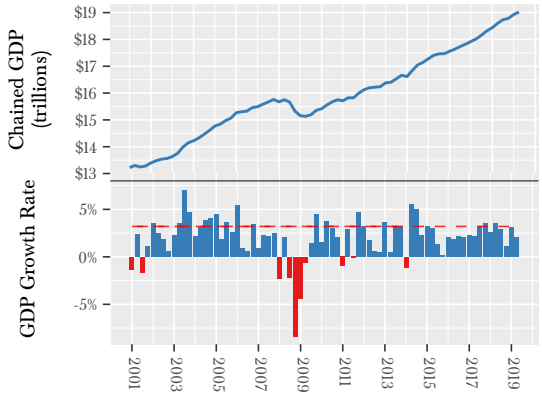
This section briefly reviews macroeconomic conditions in the United States and world economies because they influence DNR revenue—most notably through the bid prices for DNR timber and geoduck auctions and lease revenues from managed lands.

U.S. Economy

Gross Domestic Product

GDP is a useful indicator of how the U.S. economy is growing overall. When GDP is growing well, then generally there will be an increase in jobs, spending and overall economic welfare. This can translate into growth in housing spending and construction, which influence timber prices and DNR's income from timber. It is a useful indicator of how other, more directly relevant indicators, may move in the future.

Figure 4: U.S. Gross Domestic Product



Typically, GDP growth experiences a rebound after a recession, spiking to well above the historical average. For instance, after the recession in 1991, GDP grew 3.5 percent in 1992 and continued growing strongly with a peak growth rate of 4.8 percent in 1999. However, this has not been the case since the end of the Great Recession in 2009. From the end of the Great Recession, during which GDP declined in five out of six quarters, to 2017, GDP growth averaged a weak 2.2 percent on a real annualized basis (Figure 4). This is markedly less than the annualized average of 3.2 percent over the previous 50 years (1960-2009). The Great Recession set back economic growth and seriously harmed many sectors of the economy, with especially lasting effects on employment and wages.

The pattern of slow GDP growth was widely predicted to break in 2014, then again in 2015, 2016, 2017 and yet again in 2018, with economists expecting or hoping for a rebound. However, as each year progressed expectations were repeatedly reduced. However, with very strong second and third quarter annualized growth of 4.2 and 3.2 percent, respectively, 2018 had the strongest GDP growth since the end of the recession—2.9 percent.

Predictions for real GDP in 2019 seem to have coalesced around 2.0 percent—the FOMC median prediction having dropped to this from 2.3 percent in September 2018.The FOMC has signaled significant concerns about GDP growth this year and have decreased the funds rate twice since the previous forecast—to 2.25 percent in July and now 2.0 percent in September.

Predictions for GDP growth in the coming years are perhaps more uncertain than in previous years because there is so much uncertainty around the behavior of the U.S. administration with respect to trade and some leading indications suggesting a recession is likely in 6-18 months. The FOMC has a median prediction of 1.9 and 1.8 percent GDP growth in 2021 and 2022, but other forecasts are much lower, in particular, FEA has forecast in a short recession into 2021-2022.

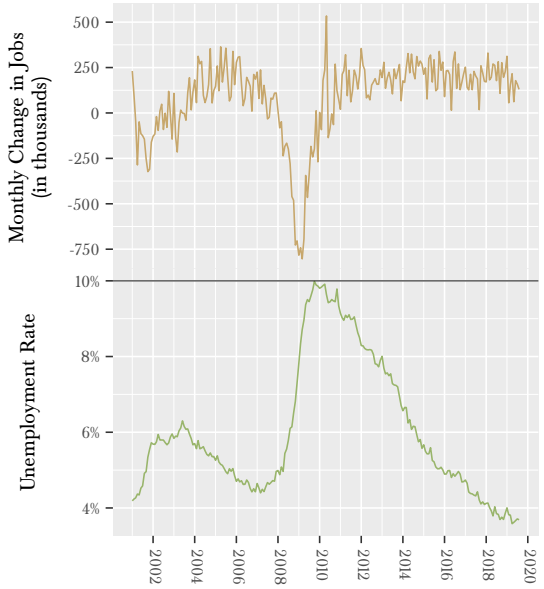
Employment and Wages

The U.S. headline unemployment rate has been trending downward since peaking at 10 percent in 2010 and is 3.7 percent as of August—up slightly from 3.6 percent in April, which was the lowest its been since 1969 (Figure 5).

There were an average of 158,000 new jobs per

month through August 2018. This is lower than the 2018 average of 223,000 jobs per month, but a slowdown in job growth is expected as the economy gets close to operating at full capacity.[1]

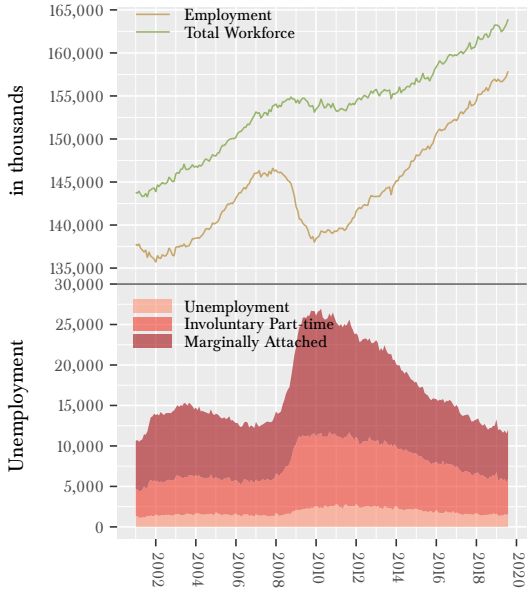
Figure 5: Unemployment Rate and Monthly Change in Jobs



The unemployment rate is a useful indicator because it gives insight into slack in the labor market; that is, how many people are available to work before job growth drives wage growth that starts driving problematic inflation. The labor market is the driving force behind consumption, which constitutes about 70 percent of GDP and naturally extends to the demand for housing, which is the major driver of U.S. timber demand. Data and anecdotes abound that suggest that one of the major effects of high unemployment rates, particularly among young adults, is lower demand for housing as more people live with their parents or housemates.

One continual source of consternation for economists over the past several years has been the low unemployment rate combined with low inflation. Although the unemployment rate has declined and has been below the long run normal unemployment level expected by the FOMC, it has not yet translated into strong wage growth, which is likely a prerequisite for broader economic improvement and an increase in the demand for housing, or higher Inflation. One possible reason for this is that the headline unemployment rate may be underestimating the number of people willing to work. During the 2008-09 recession the number of people who were underemployed or marginally attached to the workforce increased dramatically. Additionally, from the beginning of the recession to mid-2015 the labor force participation rate declined significantly, falling by three percentage points from 66 percent to around 63 percent, where it has remained, possibly because workers left the labor force after they were unable to find jobs.

Figure 6: Employment and Unemployment

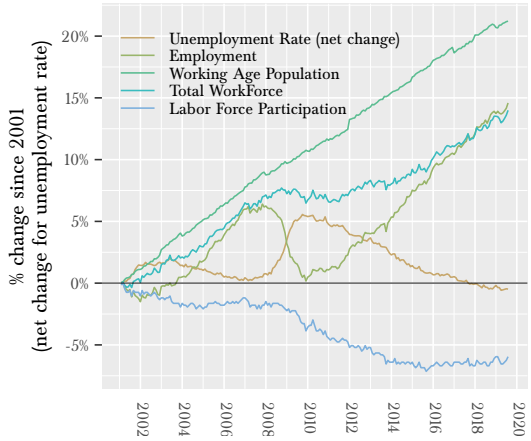


The U-6 is an alternative measure of unemployment that includes involuntarily part-time employment (underemployment) and marginally attached workers, who are not included in the headline un-

[1]These job growth numbers are from the BLS Payroll survey. More information can be found here: `https://www.bls.gov/web/empsit/ces_cps_trends.htm`

employment rate but who, nevertheless, are likely to be looking for work and would benefit from better job prospects. The U-6 has declined from a high of 17.1 percent in 2010 to a low of 7.3 percent in April. This is lower than the average of 9.1 percent from 2001-2006 (Figure 6). The decline in the year-on-year U-6 is the result of a drop in all three of its components.

Figure 7: Labor Market Indicators



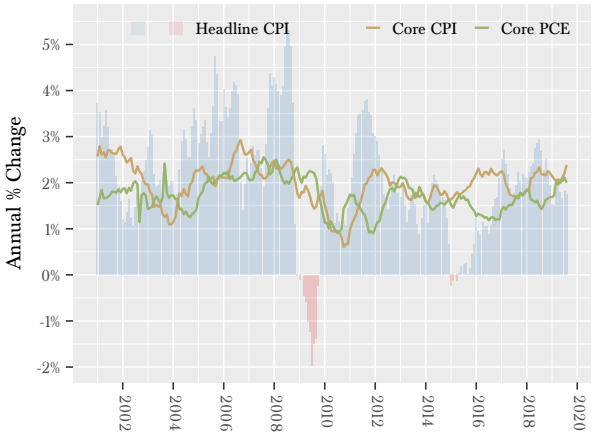
Reductions in the labor force participation rate helped move the unemployment rate and the U-6 lower roughly through January 2014 (Figure 7). Since then the rate has remained relatively stable between 62.4 and 63.0 percent and has averaged 62.8 percent. The decline in the labor force participation rate is an important confounding factor when examining the unemployment rate and is a key consideration when forecasting whether an increase in employment will trigger an increase in wages and inflation. If there are many people waiting to search for employment until jobs are easier to find—such as when people stay out of the labor force and the participation rate declines—then as employment grows, more people will enter the labor force and there will be little or no pressure on wages despite a low unemployment rate. However, if people are not in the labor market for other reasons, then the unemployment rate is a more accurate reflection of the labor pool. In that case, a decrease in the unemployment rate means that there are fewer people looking for work, so in order to fill jobs companies will have to compete for labor, pushing up wages.

The drop in the participation rate since 2008 suggests that the recession itself caused people to leave the labor market, and implies that they may return when things look a bit better. However, Federal Reserve analysts have suggested that the decline in participation may be part of a longer-term trend starting in the late 1970s and pausing during the 1990s, not as a result of the recession. Indeed, according to statistics released by the Federal Reserve Bank of Atlanta, many of those dropping out of the labor force can't or don't want to work.

Inflation

Aside from a short period in 2012, core inflation has been below the FOMC's target since the recession in 2008. Similarly to GDP forecasts, inflation forecasts have been consistently too high, with each year predicted to break the cycle of weak inflation, only to disappoint as the year progresses. (Figure 8).

Figure 8: U.S. Inflation Indices



For policy purposes, the FOMC uses the core Personal Consumption Expenditures (PCE) index as the measure of inflation, which removes the more volatile fuel and food prices. This measure shows

long-term inflation at or below the 2.0 percent target since September 2008. Core PCE growth averaged between 1.4 and 1.7 percent from 2015-2017, but rose to average 1.9 percent in 2018. However, the year-to-date annualized average through August 2019 has been 1.6 percent. The FOMC expects core PCE to be in around 1.5 and 1.9 percent in 2020 and 2021, respectively.

Interest Rates

Interest rates are a powerful tool used by the Federal Reserve bank to influence the U.S. economy. An increase in interest rates will generally slow down economic growth—business investment slows down because borrowing money becomes more expensive, so job and wage growth slow down (constraining consumption). Similarly, it becomes more expensive for consumers to borrow, impeding demand in the housing and auto markets. In normal times, a decrease in interest rates will expand investment, employment, wages, and consumer credit. The opposite of all of this is also true, decreasing or low interest rates can help drive economic expansion.

From December 2008 to December 2015, the Federal Reserve held the federal funds rate in the 0.0-0.25 percent range. To keep rates that low, for that long was unprecedented and reflected the immense damage done by the Great Recession. During that time the Fed pledged to keep the rates near zero until it judged that there had been sufficient progress toward its dual-mandate of maximum employment and around 2.0 percent inflation.

Beginning in December 2015 the FOMC gradually raised interest rates from 0.0-0.25 percent range to 2.25-2.5 percent range by the end of 2018. Its notable that these increases were made based on progress in the recovery of employment and inflation, and a strong the economic growth outlook, rather than employment or inflation that had reached any threshold. These increases were widely expected because the FOMC carefully prepared markets for it with each successive meeting statement.

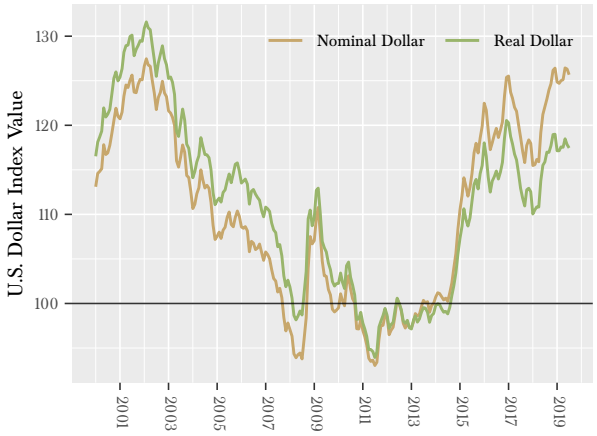
The June and September FOMC meeting materials show that the Committee has become much more uncertain about the strength of the economy and now expects to hold rates steady or decrease them in 2019 and 2020, down to 1.6-2.1 percent. This is a significant change from the December 2018 meeting, where the FOMC expected to raise interest rates one to two times in 2019, leading to a federal funds rate between 2.6-3.1 percent, with further increases leading to 2.9-3.4 percent rates in 2020.

The U.S. Dollar and Foreign Trade

The trade-weighted U.S. dollar index climbed dramatically from 2014 through late 2016. Through 2015 and 2016 this was largely due to the relative strength of the U.S. economy, which, although fairly weak, was growing faster than most other advanced countries. Although the value of the U.S. dollar was below its 2015 peak for most of 2016, the results of the U.S. presidential election pushed the exchange rate well above its previous high. From mid-2017 to May 2018, the dollar dropped back to around its 2015 start; however, since May 2018 it increased above its earlier 2016 high (Figure 9).

A rising dollar means that timber and lumber from the Pacific Northwest become more expensive for international buyers and imported timber and lumber become less expensive. This will tend to suppress local prices and DNR's timber and agricultural revenues. Wildstock geoduck revenue will also be negatively affected because geoduck is primarily marketed abroad. A falling dollar leads to the opposite effects.

Figure 9: Trade-Weighted U.S. Dollar Index



Foreign trade and access to export markets is important for DNR revenues. Chinese demand for timber and lumber have been a major factor supporting lumber prices since 2010, even though DNR timber cannot be exported directly and Chinese demand has been declining. Additionally, much of the soft white wheat produced in Washington is exported to Asia and a large portion of the PNW geoduck harvest is exported to China.

Given the proposed policies of the U.S. administration, and the escalating imposition of tariffs, the upcoming months and years are likely to be more volatile for foreign trade and present a large potential downside risk for DNR revenue. Currently, China is the main target of U.S. tariffs and it has imposed a number of tariffs on U.S. goods in response. Of the products relevant to DNR revenue, softwood logs are subject to a five percent tariff, while geoduck, wheat, and many orchard/vineyard agricultural products (such as apples) are subject to a 25 percent tariff.

The effects of the tariffs DNR revenue will be negative—higher prices to purchasers will reduce export demand. However, that doesn't necessarily mean that revenue from some affect sources will go down. It is possible that increased demand from elsewhere or external supply constraints will support higher prices or revenue.

Chinese timber exports have already fallen from a peak of 4.1 million m^3 in 2011 to 1.7 million m^3 in 2017 (unrelated to tariffs). Analysts had been predicting that increases in domestic demand will offset the drop in Chinese demand, however, there would still be a large drop in overall demand if China were to turn away from Washington log and lumber exports entirely.

Previously, some analysts argued that access to wheat and other agricultural export markets are not in any serious danger because the U.S.'s largest trading partners are dependent upon imports to satisfy their demand and food prices in developing countries are highly political. However, that doesn't mean that they aren't able to preferentially purchase from U.S. competitors, particularly Australia, which is the world's largest exporter of soft white wheat.

Finally, China is apparently the primary market for geoducks so an increase in geoduck prices in the Chinese market could have a large impact[2]. The average prices of the geoduck auctions since the imposition of tariffs have been around 17 percent lower than those of the recent past, suggesting that the tariffs are having a meaningful impact.

Petroleum

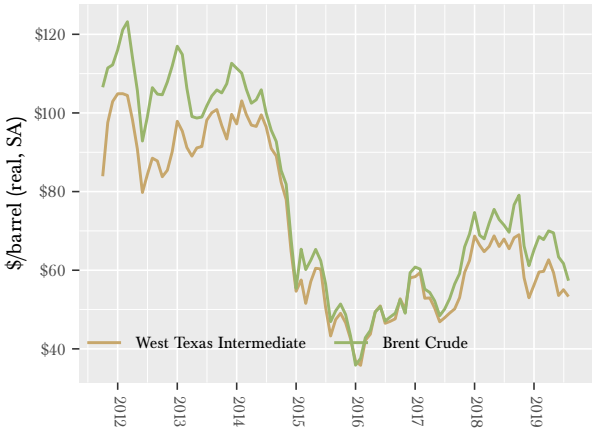
Broadly, a drop in oil prices acts like a tax cut for consumers and can encourage consumption. Additionally, all other things being equal, lower petroleum prices will decrease diesel fuel prices and will make transportation-sensitive industries—such as PNW logging and agriculture—more competitive in international markets. However, all other things are not equal: as discussed above, the U.S. dollar has started to increase again, which will make PNW timber more expensive internationally, while tariffs are being introduced, making it less competitive still.

Crude oil and its derivatives strongly affect production, transportation, and consumption in the world and U.S. domestic economies. Prices for Brent crude oil plummeted from $108/barrel in

[2]There is very little information about the geoduck market, so much of our understanding is anecdotal.

January 2014 to $30/barrel in January 2016, a 70 percent drop. Since then prices have ranged between $40/barrel and $75/barrel. Recently, Saudi Arabian oil refineries were attacked, increasing the price of oil by around 30% - however, prices have fallen back again and are currently between $50-$60/barrel.

Figure 10: Crude Oil Prices



China

China is a major export market for logs, lumber, geoduck, and wheat and other agricultural products from the Pacific Northwest. Since 2011, between 50 and 60 percent of the softwood log exports leaving the Seattle and Columbia River Customs District have gone to China. Additionally, China is (anecdotally) the primary export market for Washington's geoduck. Changes to the Chinese economy can have a dramatic impact on the prices for logs, lumber, and geoduck in the Pacific Northwest.

China's GDP and employment weathered the global economic and financial crises better than most other economies. There have been concerns for several years that that resilience may based on poor policy, as the costs of propping up investment and maintaining significant political control over the economy mount. However, although Chinese GDP growth has slowed from 10.4 percent in 2010 to 6.6 percent in 2018, it has not crashed as—though there are current indications that it is slowing markedly due to both business cycle factors and the trade war.

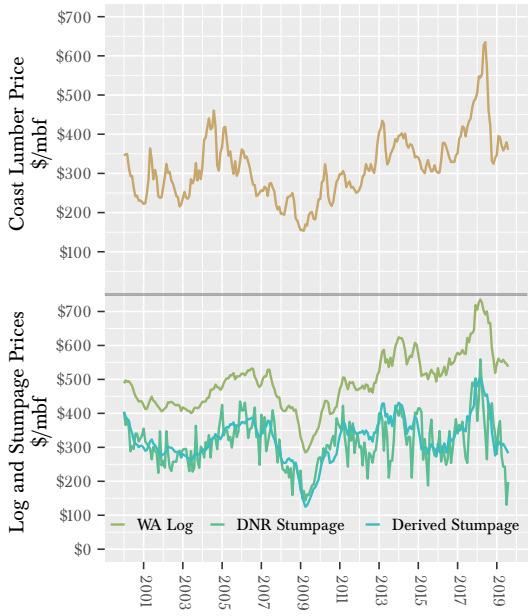
There is still some concern that Chinese GDP growth will fall much lower, possibly even into recession, with some analysts looking out for a 'Minsky moment'—a sudden sharp drop in economic activity triggered by excess debt. This risk is mostly due to the prominence of investment as a component of GDP, the huge amount of debt in the country, and the way that debt is held. Household and corporate debt (to non-financial corporations) ballooned from about 110 percent of GDP in 2008 to over 190 percent in 2014, and much of it is linked to real estate. Investment comprises almost 50 percent of China's GDP. At those levels of debt a slowdown in an economy can lead to a drop in income and an inability to service debt en masse, potentially leading to a debt crisis that would undermine that investment and have a tremendous impact on China's GDP.

The concern about the overall economy is amplified by the U.S. administration, which has been very critical of trade with China and has imposed tariffs on Chinese goods. China is particularly vulnerable to changes in access to international markets, with exports making up 25 percent of its GDP and a large proportion of employment dependent upon labor-intensive export industries.

Wood Markets

Over the past decade, timber stumpage revenue has constituted about 70 percent of total DNR revenues. DNR is, therefore, vitally concerned with understanding stumpage prices, log prices, lumber prices, and the related supply and demand dynamics underlying all three. This section focuses on specific market factors that affect timber stumpage prices and overall timber sales revenue generated by DNR.

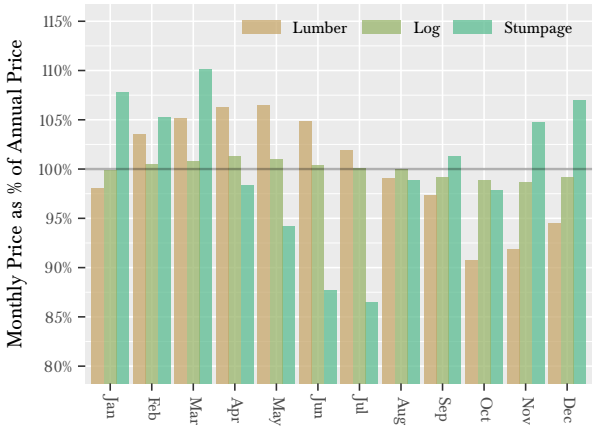
Figure 11: Lumber, Log, and Stumpage Prices in Washington



In general, timber stumpage prices reflect demand for lumber and other wood products, timber supply, and regional lumber mill capacity. There is a consistent, positive relationship between log prices and DNR's stumpage prices, despite notable volatility in stumpage prices (Figure 11). High log prices make access to logs more valuable, increasing purchasers' willingness to pay for stumpage (the right to harvest). Volatility in stumpage prices arise not only from log prices, but also from the volume of lumber and logs held in mills' inventories and from DNR-specific issues, such as the quality and type of the stumpage mix offered at auction, the region, and the road-building requirements of a particular sale.

The relationship between lumber and log prices is less consistent. Lumber prices are significantly more volatile and both the direction and size of price movements can differ from log prices. This is due to both demand and supply-side factors. On the demand side, mills will often have an inventory of logs in their yards, as well as an inventory of 'standing logs', so they do not always need to bid up stumpage prices to take advantage of high lumber prices. From the supply side, land owners often do not need to sell their timber, so when prices fall too far, they can withhold supply and allow their trees to grow and increase in quality.

Figure 12: Lumber, Log, and DNR Stumpage Price Seasonality



There are differences in price seasonality between lumber, logs, and stumpage, as illustrated in Figure 12. These prices are affected by a degree of seasonality that is largely the result of when each of these commodities will be used. For instance, lumber prices tend to peak in spring, when housing construction picks up, and decline through fall as demand wanes, while stumpage prices tend to be highest in January-March, when harvesters are lining up harvestable stock for the summer. DNR stumpage price volatility is also affected by the fire-fighting season and the quality of the stumpage

mix, which varies throughout the year but tends to be lower from July through September.

U.S. Housing Market

This section continues with a discussion of the U.S. housing market because it is particularly important to overall timber demand in the U.S.

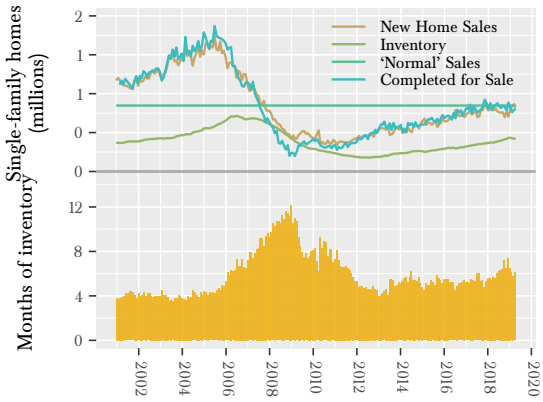
New residential construction (housing starts) and residential improvements are major components of the total demand for timber in the U.S. From 2000-2018 these sectors have averaged 69 percent of softwood consumption—37 percent going to housing starts and 32 percent to improvements—with the remainder going to industrial production and other applications.

The 2007 crash in the housing market and the following recession drastically reduced demand for new housing, which undermined the total demand for lumber. Since the 2009-11 trough, the increase in housing starts has driven an increase in lumber demand, though not to nearly the extent of the peak. Prolonged growth in starts is essential for a meaningful increase in the demand for lumber.

New Home Sales

Unsurprisingly, new home sales plummeted during the recession, reaching a record low of 306,000 (SAAR) in 2011 before beginning a slow rise (Figure 13). New home sales increased from 440,000 (SAAR) in 2014 to an average of 616,000 in 2017, still well below the long-term (1963-2010) 'normal' rate of 678,000 sales per year. New home sales averaged 651,000 (SAAR) through May 2018, before dropping meaningfully to average 593,000 for June-December. Through August, 2019 new home sales have averaged and annualized 661,000 (SAAR) sales.

Figure 13: New Single-Family Home Sales

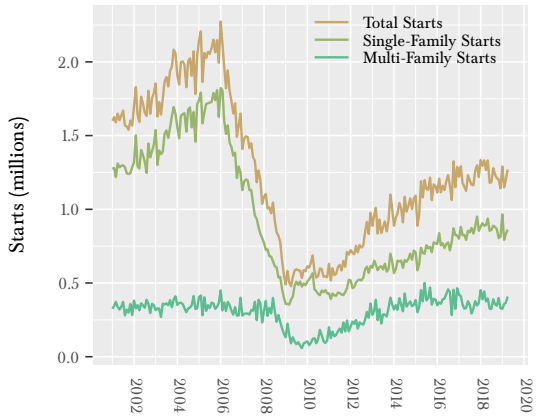


As low as new home sales fell, new home construction fell even lower from early 2007 through mid-2011, causing the inventory of newly built homes for sale to decline over the period. After bottoming out in July 2012 at 142,000 units, the inventory of new homes has crept up as construction slightly outpaced sales, averaging 314,000 homes in 2018. To-date 2019 average inventory is higher through April at 338,000 units.

Housing Starts

In April 2009, U.S. housing starts fell to record lows since the Census Bureau began tracking these data in 1959. U.S. housing starts picked up in 2011 and continued to rise, largely because of increases in multi-family starts. Single-family starts were more or less flat after the recession through 2012, but have been rising slowly since (Figure 14). Starts have averaged 1.25 million (SAAR) through August in 2019, slightly below the 1.25 million (SAAR) starts in 2018. Although these are well above the 2012 average of 0.78 million (SAAR), it is still well below the pre-recession long-term average of 1.6 million.

Figure 14: Housing Starts

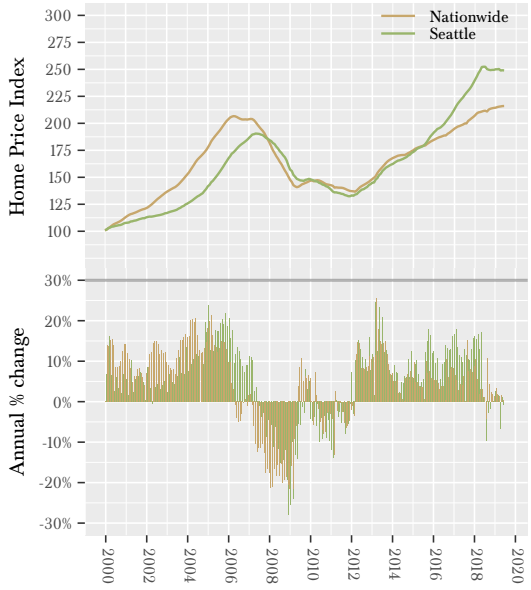


Since the recession, total housing starts have been made up of a larger portion of multi-family units than in the past—from 2000-2007 multi-family start were around 20 percent of the total starts, but increased to average around 30 percent of total starts for the last several years. This is pertinent because multi-family structures use much less lumber than single-family houses per unit, so the slow recovery in overall starts has had a more muted effect on timber prices than historical increases.

The recovery in house prices should facilitate the 'move-up' market, where homeowners sell their current home in order to buy a larger, more expensive one. An increase in the move-up market combined with low total inventories constraining the supply of existing housing should in general put upward pressure prices and provide incentives to build more houses. While that seems to be happening to a certain extent, it's effect appears to be limited because the price increases themselves are keeping people from the lower end of the market, meaning that prices have risen so much that homeowners are beginning to have difficulty selling at market rates.

Builder confidence is no longer an impediment to housing starts, as estimates of confidence are consistent with housing starts of over 1 million. However, there are significant supply impediments, such as the shortage of buildable lots and permit delays. Given the lead time necessary to build houses, these are likely to cause volatility in both prices and supply.

Figure 15: Case-Shiller Existing Home Price Index



Housing Prices

U.S. housing experienced six unprecedented years of falling or flat prices following the recession. House prices started rising again only in 2012 as economic and employment indicators continued to improve. Figure 15 charts the seasonally adjusted S&P/Case-Shiller Home Price Index for the 20-city composite, which estimates national existing home price trends.

Nationally, the 20-city composite index has increased in most months since bottoming out in January 2012—its lowest point since October 2002, but growth has slowed significantly since May 2018. Seattle house prices had been growing much faster than national prices, doubling from its low in February 2012 to July 2018, while nationally house prices increased by 62 percent. However, since from July 2018 to June 2019, Seattle house prices declined by a little over one percent. Despite the

recent decrease in prices, as of August, the average Seattle home was worth over 30 percent more than its peak price before the recession (in nominal terms).

Export Markets

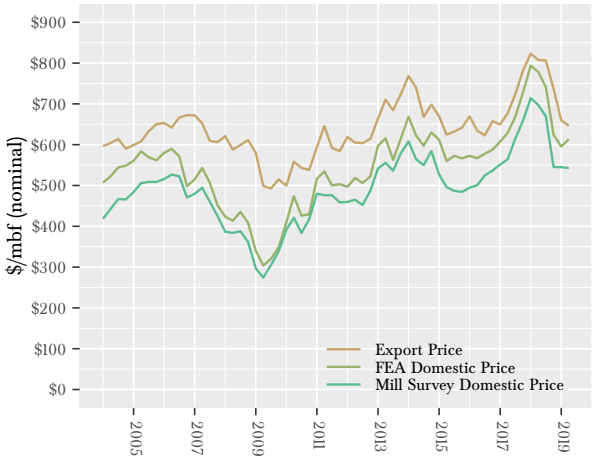
Although Federal law prohibits export of logs from public lands west of the 108th meridian, log exports still have a meaningful impact on DNR stumpage prices. Exports compete with domestic purchases for privately sourced logs and strong export competition pulls more of the supply from the domestic market, thereby raising all domestic prices. However, changes in export prices do not influence domestic prices in a one-to-one relationship.

Export prices are almost always higher than domestic prices, a difference which is referred to as the 'export premium' (Figure 16). The export premium is primarily due to the characteristics of the export markets, which can include a demand for higher quality wood, a high value placed on long-term contracts, and high transaction costs.

Note that the export prices shown in Figure 16 are weighted by DNR's typical species mix, not the species mix of actual export volumes.

Since 2010, demand from China has been a major support for log and lumber prices in Washington. That demand dropped in late 2014 as China's economic health wavered, the U.S. dollar appreciated while the value of the euro and ruble dropped (making U.S. timber comparatively more costly), and a 25 percent Russian tariff on log exports was reduced. The downward trend in Chinese demand continued since then (Figure 17). Exports to China from the Seattle and Columbia-Snake River Customs Districts for both Douglas-fir and Hemlock were 11 percent lower in 2016 than 2015, 1.9 million m^3, compared to 2.1 million m^3 in 2015 and 3.2 million m^3 in 2014.

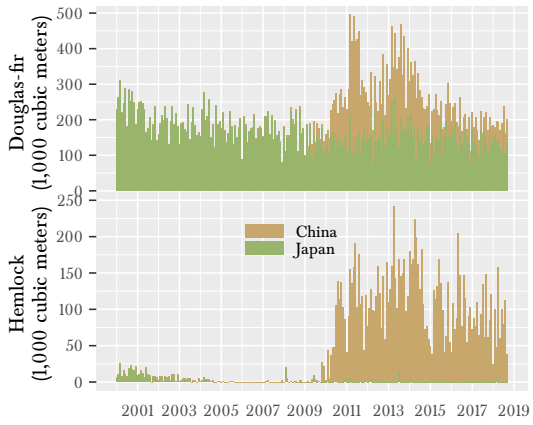
Figure 16: Log Export Prices



The trend of decreased exports to China continued in 2017 with hemlock exports from Seattle and the Columbia River Customs Districts falling from a peak of 1.7 million m^3 in 2014 to 1.1 million m^3 in 2017 and douglas-fir export falling from 2.2 million m^3 in 2013 to 0.6 million m^3 in 2017. Export volumes to China increased by two percent in 2018, while exports to Japan decreased by two percent. Year-to-date exports through August have decreased by 18 percent to both Japan and China.

The export premium appears to have shrunk since 2014 due to strong demand from recovering domestic markets and decreased demand from importing countries, China in particular. In the long run, the export premium may shrink further as West Coast log exports face stronger international competition and export prices are pushed down. Much will depend on supply constraints from key international suppliers, transportation constraints from the southeastern U.S, and whether tariffs are imposed on softwood logs.

Figure 17: Log Export Volume



Timber Supply

Since the beginning of the recession timber growth throughout the U.S. has generally exceeded timber harvest, increasing the timber inventory. However, strong log exports from the West Coast drove up harvests, so that inventory growth was slower than in other parts of the country, particularly the U.S. South. Harvests have rebounded strongly enough that timber harvest began to exceed growth in 2017, so the standing timber inventory is beginning to fall. Drawing down the standing timber inventory will constrain the region's ability to expand outputs—although harvests are expected to continue to increase for several years, they will not reach the levels of the mid-2000s, nor will the increased harvest push prices down.

Since the late 1990s British Columbian forests have been devastated by the mountain timber beetle, which affected about a third of the province's timber resources. Typically, timber killed by beetles must be harvested within 4 to 10 years so in 2007 the government increased the allowable harvest to ensure that the dead timber was not wasted, which increased British Columbia's harvestable timber supply. Most of the remaining beetle kill is now unviable and there will be no harvestable beetle kill after 2020.

The supply from Canada will be further diminished by Quebec's allowable annual cut being reduced by Bill 57, which was implemented in April 2013, and may be additionally reduced by the 'North for All' plan (formerly Plan Nord). These constraints will likely also reduce Canada's lumber production capacity by forcing mill closures.

Price Outlook

Lumber Prices

As shown in Figure 11, lumber prices increased in 2016 to average $341/mbf and increased sharply in 2017 to average $425/mbf. In June 2018, prices hit $635/mbf, higher in real terms than any since 2000. However, from June prices dropped dramatically to a low of $324/mbf in November—a 47 percent drop. Prices through August 2019 have partially recovered to average $367/mbf.

A drop in prices at the end of the third quarter 2018 was expected due to the end of the building season and increased supply from additional capacity being put online, but this drop was much larger than expected. In outlying years prices are expected to remain around the 2017 average, but will not reach the peaks of 2018.

Log Prices

Figure 18 presents prices for Douglas-fir, hemlock, and DNR's composite log. The latter is calculated from prices for logs delivered to regional mills, weighted by the average geographic location, species, and grade composition of timber typically sold by DNR. In other words, it is the price a mill would pay for delivery of the typical log harvested from DNR-managed lands. The dark green line for the DNR composite log price on Figure 18 is the same as the light green line on Figure 11.

Readily visible on the graph is the decline in the premium for Douglas-fir between 200 and 2009, due in large part to Chinese demand driving up hemlock prices. Also readily visible is the drop in prices from late 2014 to early 2016 which was primarily driven by the slowdown in demand from

China and ample regional supply of both logs and lumber.

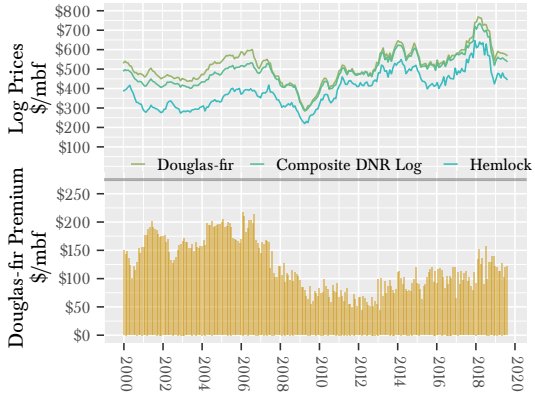
Stumpage Prices

Timber stumpage prices are the prices that successful bidders pay for the right to harvest timber from DNR-managed lands (Figure 19). At any time, the difference between the delivered log price and DNR's stumpage price is equivalent to the sum of logging costs, hauling costs, and harvest profit (Figure 11). Subtracting the average of these costs from the log price line gives us a derived DNR stumpage price.

When actual DNR stumpage prices differ significantly from the derived stumpage prices, a correction is likely to occur. For instance, in 2012 actual stumpage prices were generally lower than stumpage prices inferred from log prices, suggesting that an upward market 'correction' would be forthcoming. This correction seems to have occurred with generally higher stumpage in 2013 and 2014. In the November 2018 forecast, we noted that DNR actual stumpage prices were well above the inferred prices, suggesting that stumpage prices would be lower in the near future. That was correct—prices moved sharply lower from an October auction high of $430/mbf, to a December auction average of $340/mbf.

Since then, aside from higher prices in February and March 2019, stumpage auction prices have continued to fall. The first two auctions of the fiscal year had an average price $171/mbf, well below the derived stumpage price in Figure 11.

Figure 18: DNR Composite Log Prices

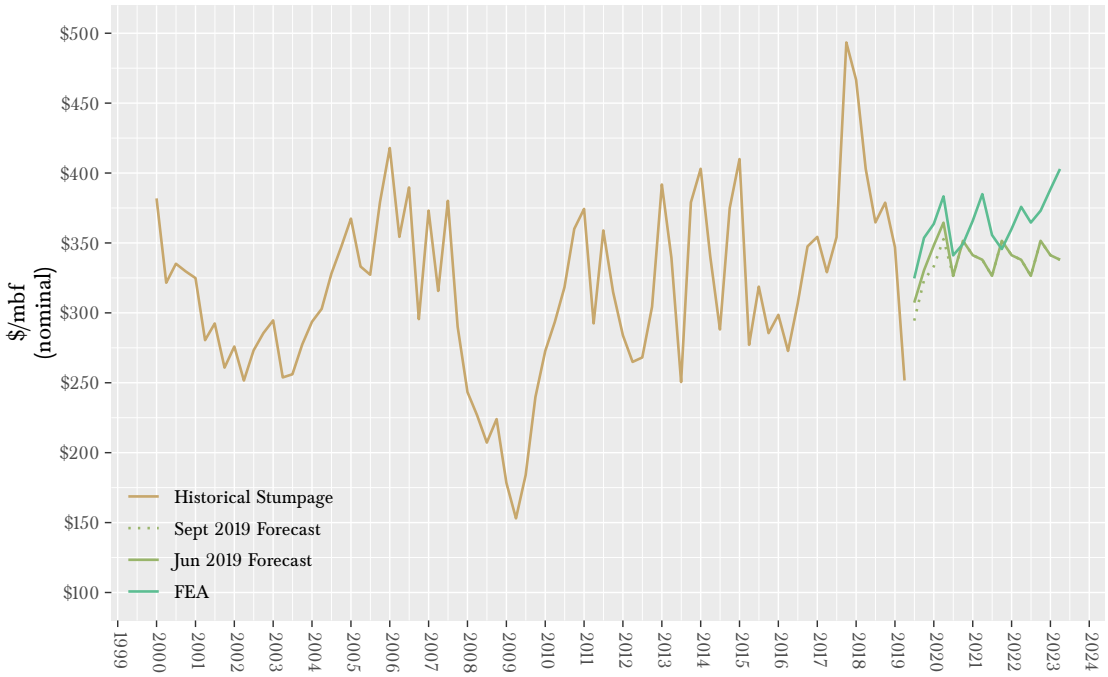


DNR Stumpage Price Outlook

DNR currently contracts with a forest economics consulting firm that provides log and timber stumpage price forecasts, as well as valuable insights into the housing, lumber, and timber markets. By modeling DNR's historical data on it's price forecasts, we arrive at a stumpage price outlook (Figure 19, note that the FEA 'forecast' series reflects the species and class characteristics of typical DNR timber; the original series were West Coast averages, and are not shown).

It is important to note that these are nominal price expectations.

Figure 19: DNR Timber Stumpage Price



DNR Revenue Forecast

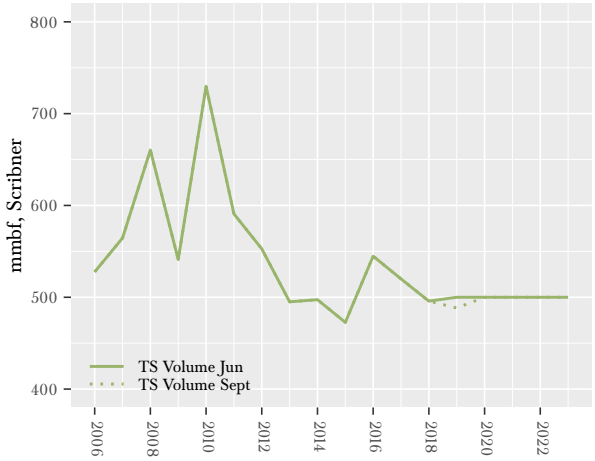
This Revenue Forecast includes revenue generated from timber sales on trust uplands, leases on trust uplands, and leases on aquatic lands. It also forecasts revenues to individual funds, including DNR management funds, beneficiary current funds, and beneficiary permanent funds. Caveats about the uncertainty of forecasting DNR-managed revenues are summarized near the end of this section.

Timber Revenue

DNR sells timber through auctioned contracts that vary in duration. For instance, contracts for DNR timber sales sold in FY 2014 needed to be harvested between three months and four and a half years from the date of sale, with an average (weighted by volume) of about 25 months. The purchaser determines the actual timing of harvest within the terms of the contract, which is likely based on perceptions of market conditions. As a result, timber revenues to beneficiaries and DNR management funds lag behind sales.

For the purposes of this chapter, timber that is sold but not yet harvested is referred to as 'inventory' or 'under contract'. Timber volume is added to the inventory when it is sold and placed under contract, and it is removed from the inventory when the timber is harvested.

Figure 20: Forecast Timber Sales Volume

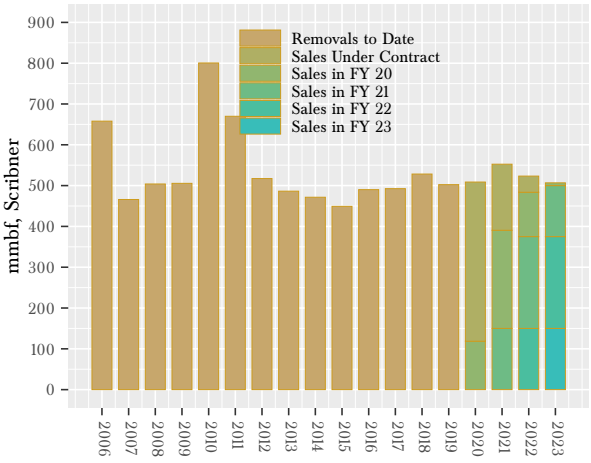


Timber Sales Volume

Sales volume forecasts for all years are unchanged (Figure 20). This is despite an increase in the number of contracts that were offered at auction that have been passed-in with no bids. DNR plans on offering for auction more than 500 mmbf, but our volume forecast builds in the probability that some of those contracts offered will not be sold in this fiscal year.

FY 15 was the first year of the new sustainable harvest decade (FY 15 through FY 24) for Western Washington; however, new harvest targets for this sustainable harvest decade have not yet been determined or approved by the Board of Natural Resources. Without an updated sustainable harvest limit, annual Westside sales volumes are forecast to be 450 mmbf for future years. Together with projected Eastside timber sales of 50 mmbf for each of the next several years, we arrive at a projected annual timber sales volume of about 500 mmbf for FYs 19-23.

Figure 21: Forecast Timber Removal Volume



Timber Removal Volume

In this forecast (and likely the next) we are revising the methods used to forecast harvest volume. Essentially, the previous method used likely harvest volumes estimated from a purchaser survey, as well as historical averages of volume harvested from

sales remaining in the year. Downward revisions in volume harvested in a given year are pushed into future years, because that volume is still in inventory and has a contractual time limit to when it must be harvested by. While this is conceptually sound, it has, in practice, led to apparently systematic overestimation of harvest volumes in future years. This problem propagates at the start of new fiscal years when we begin revising the volumes down based on recent harvest history, and pushing that volume out to future years. This issue is illustrated in the appendix review of historical forecasts.

Our new method for forecasting timber volume has not yet been finalized, but will likely still involve surveying purchasers and using their responses to scale our forecast, along with sales to-date and some estimate of the likely harvests from sales remaining. The effect of this method revision is a decrease in the forecast harvest volume for the current and all outlying fiscal years.

The forecast FY 19 removal volume was reduced to 500 mmbf, a decrease of 20 mmbf, in the June Forecast. The final harvest volume was 502 mmbf (Figure 21). Due to the change in forecast method, as well as updated to-date harvest volumes and the results of the purchaser survey, the removal volume in all outlying years is reduced.

Figure 22: Forecast Timber Sales Price

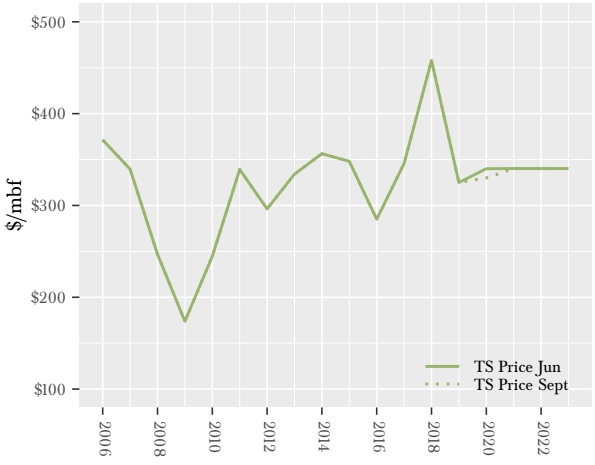
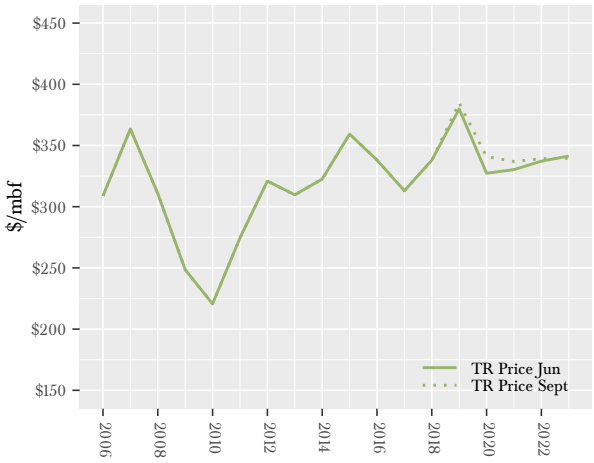


Figure 23: Forecast Timber Removal Price



Timber Sales Prices

The price results of monthly DNR timber sales are quite volatile (Figure 11). As discussed in the stumpage price outlook, the DNR sales price (stumpage) forecast uses estimates from a forest economics consulting firm. The sales price forecast for FY 20 is decreased by $10/mbf to $330/mbf due primarily to the very low prices from the July and August auctions, though these were on a relatively small auction volume. The forecasts in outlying years are unchanged as timber and lumber markets are expected to recover to near their 2017 levels.

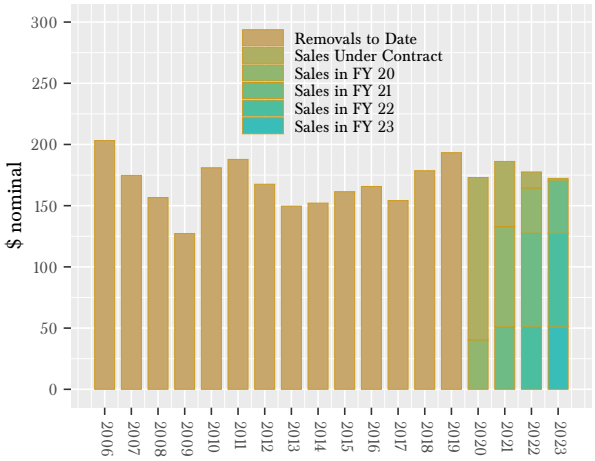
Timber Removal Prices

Timber removal prices are determined by sales prices, volumes, and harvest timing. They can be thought of as a moving average of previous timber sales prices, weighted by the volume of auctioned timber removed in each time period (Figure 23).

The timber removal price forecast for FY 19 was increased in June, but ended the year even higher than expected at $385/mbf. This revision and the end result were due entirely to an increased proportion of the harvest to-date being higher priced timber. The FY 19 increase in removal price forced

down the removal prices for FY 20, however, it appears that this revision was too much. Removal prices in FY 20 are increased by $14/mbf to $341. This is due to the high average price of timber removed to-date this fiscal year—which has had an average price of $384/mbf—and the value of remaining inventory and expiring contracts. There are 152 mmbf worth of contracts expiring in FY 20, with an average value of $372/mbf, and 304 mmbf worth of contracts expiring in FY 21, with an average value of $388/mbf.

Figure 24: Forecast Timber Removal Value



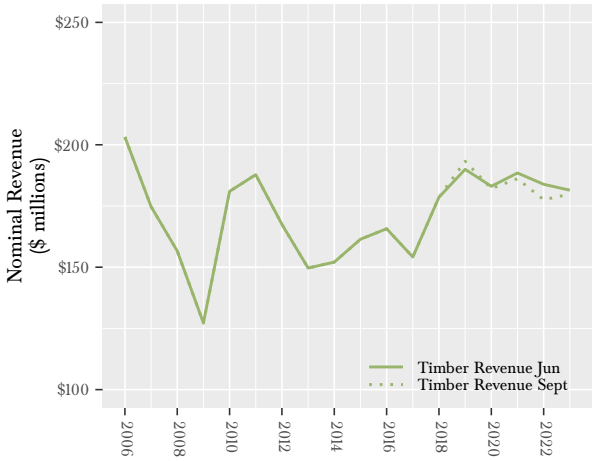
Timber Removal Revenue

Figure 24 shows projected annual timber removal revenues, broken down by the fiscal year in which the timber was sold ('sales under contract' were sold as of January 1st, 2019). Revenue estimates reflect all of the changes described above.

The downward revisions to harvest volume outweigh the upward revisions to price so that the forecast timber revenue are decreased in FY 20 and all outlying years. Revenue in FY 20 and FY 21 are reduced by $1 million and $2 million respectively.

Revenues for the 2019-2021 biennium are forecast to total $368 million, a decrease of 0.9 percent ($3 million) from the June Forecast, while revenues for the 2021-2023 biennium are decreased by 2.2 percent ($8 million) to $357 million.

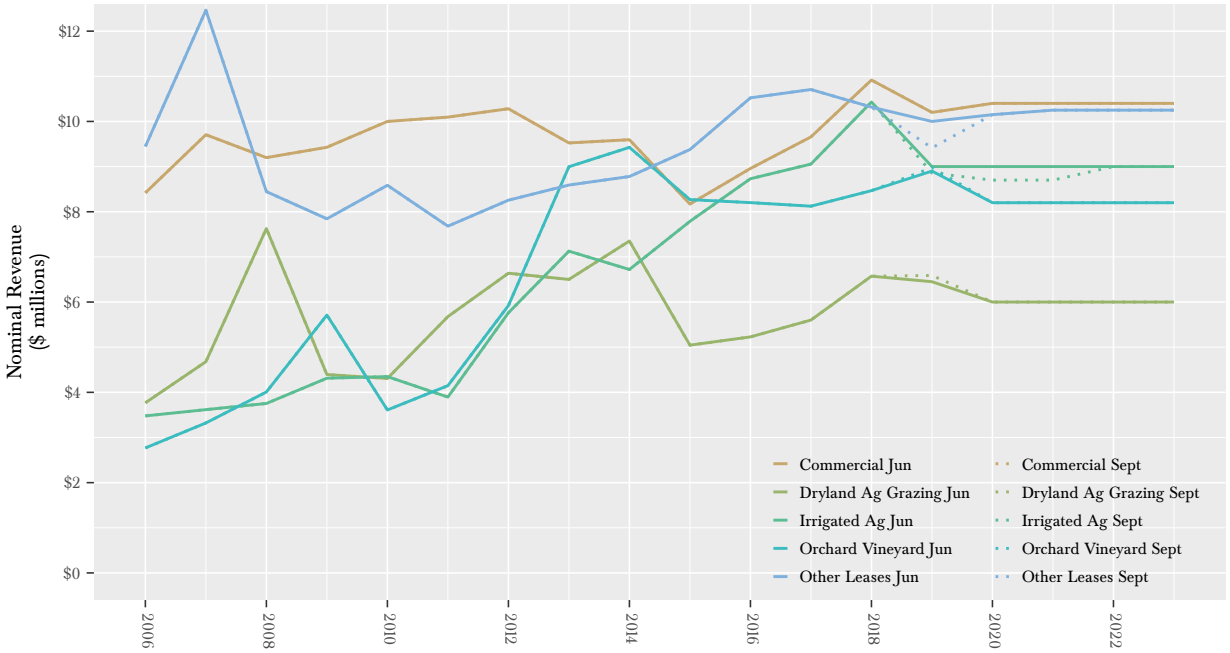
Figure 25: Forecast Timber Removal Revenue



Upland Lease Revenues

Upland lease revenues are generated primarily from leases and the sale of valuable materials, other than timber, on state trust lands (Figure 26). Projected revenue from irrigated agriculture is decreased by $0.3 million in FYs 20 and 21, due to weak agricultural prices. Although, orchard/vineyard products are similarly affected by weak prices, the revenue forecast for this source was already more conservative, so it was left. Revenue projections for all other sources remain unchanged.

Figure 26: Forecast Upland Lease Revenue



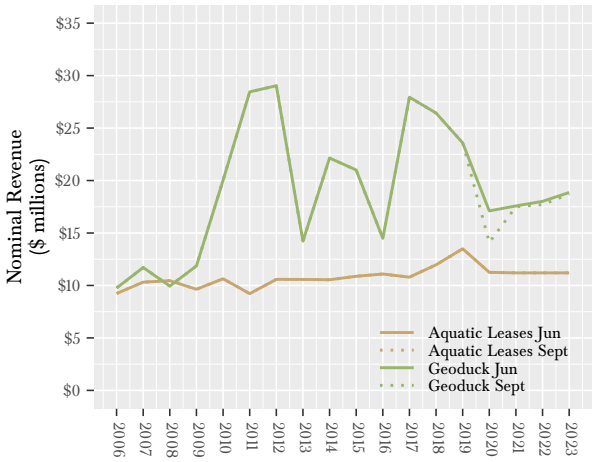
Aquatic Lands Revenues

Aquatic lands revenues are generated from leases on aquatic lands and from sales of geoduck. On average, leases account for one-third of the revenue while geoduck sales account for the remainder.

The aquatic lease revenue forecast is unchanged for all forecast years(Figure 27).

The geoduck revenue forecast has been revised downward for all forecast years due to very low prices in the first geoduck auction in August and updated auction volume expectations (Figure 28). Price weakness in geoduck auctions are expected to continue as long as the 25 percent tariff to China continues, though prices are expected to be higher than the average of the August auction.

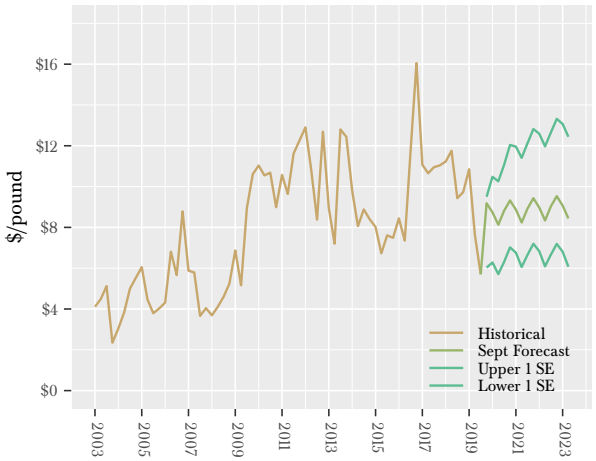
Figure 27: Aquatic Lands Revenues



There are significant downside and upside risks to geoduck revenues, even in the near term, that are important to consider but difficult to forecast. On the downside:

- Harvests (and therefore revenues) could be deferred or lost if geoduck beds are closed due to occurrence of paralytic shellfish poison.
- An escalation in the trade war could see tariffs increased
- A further slowdown in China's economic growth or the tariffs on geoduck could lower demand for this luxury export in its largest market.
- In light of recent WDFW surveys of closed South Puget Sound geoduck tracts showing declining recovery rates, and evidence of active poaching, future commercial harvest levels may be further reduced.

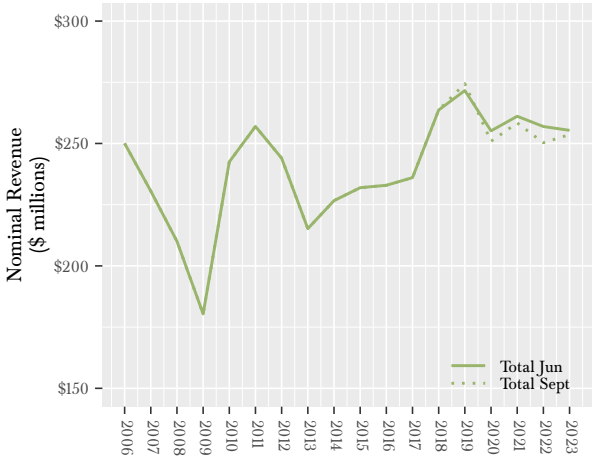
Figure 28: Geoduck Auction Prices



Total Revenues from All Sources

Forecast revenues for the 2019-2021 Biennium (FYs 20 and 21) are decreased by 1.4 percent ($7 million) to $509 million, and revenues for the 2021-2023 biennium are decreased by $8 million to $504 million (Figure 29).

Figure 29: Total Revenues



Some Caveats

DNR strives to produce the most accurate and objective projections possible, based on DNR's current policy directions and available information. Actual revenues will depend on future policy decisions made by the Legislature, the Board of Natural Resources, and DNR, as well as on market and other conditions beyond DNR's control.

See the Forecast Summary for more details.

Distribution of Revenues

The distribution of timber revenues by trust are based on:

- The volumes and values of timber in the inventory (sales sold but not yet harvested) by trust;
- The volumes of timber in planned sales for FYs 20 by trust, and relative historical timber prices by DNR region by trust; and
- The volumes of timber by trust for FYs 22-23 based on provisional output of the sustainable harvest model and relative historical timber prices by DNR region by trust.

Since a single timber sale can be worth more than $3 million, dropping, adding, or delaying even one sale can represent a significant shift in revenues to a specific trust fund.

Distributions of upland and aquatic lease revenues by trust are assumed to be proportional to historic distributions unless otherwise specified.

Management Fee Deduction. The underlying statutory management fee deductions to DNR as authorized by the Legislature are 25 percent or less, as determined by the Board of Natural Resources (Board), for both the Resources Management Cost Account (RMCA) and the Forest Development Account (FDA). In biennial budget bills, the Legislature has authorized a deduction of up to 30 percent to RMCA since July 1, 2005. In 2015, they authorized a deduction up to 31 percent.

At its April 2011 meeting, the Board adopted a resolution to reduce the RMCA deduction from 30 to 27 percent and the FDA deduction from 25 to 23 percent. At its July 2011 meeting, the Board decided to continue the deductions at 27 percent for RMCA (so long as this rate is authorized by the Legislature) and at 23 percent for FDA. At its October 2011 meeting, the Board approved a resolution to reduce the FDA deduction from 23 to 21 percent. The Board decided in July 2013 to raise the FDA deduction to 25 percent and the RMCA deduction to 29 percent. In August 2015 the Board raised the RMCA deduction up to 31 percent for the 2015-2017 biennium.

The Forecast uses the 31 percent deduction for the 2017-2019 and 2019-2021 biennia. This assumes that the Legislature will approve RMCA deductions of up to 31 percent.

Given this background of official actions by the legislature and the Board, the management fee deductions assumed in this Forecast are:

	FY 20	FY 21	FY 22	FY 23
FDA	25	25	25	25
RMCA	31	31	31	31

Appendix: Comparison of Forecast and Actual Values 2017-2019 Biennium

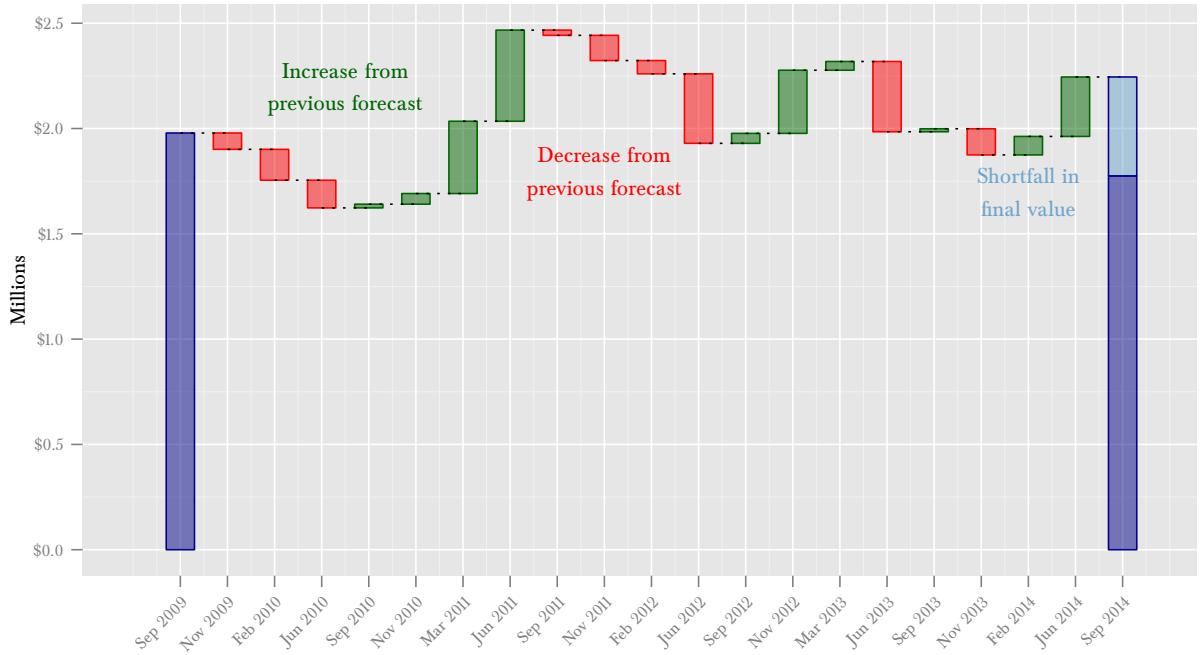
At the close of a biennium, DNR Economics publishes a comparison of all past projections with final realized values for each of the biennium's two years. We do this to assess forecast accuracy, and as an exercise in improving our understanding of the history of our projections and of the models underlying the forecast. This comparison is for the 2017-2019 biennium—FY 18 and FY 19.

The comparison is made graphically, via waterfall charts instead of within tables, to make changes between forecasts readily visible and easily understandable. The charts share the same order as the revenue sources and funds in the main tables of each forecast. We address major influences narratively.

Waterfall Chart Guide

- The blue bar on the left of the chart is the initial projection, while the one on the right is the final value for the fiscal year.
- Red bars indicate a decrease in the projection from the previous forecast.
- Green bars indicate an increase in the projection from the previous forecast.
- The light blue shading at the top of the final value shows the difference between the final value and the last forecast. In the example below, the light blue signifies a final value lower than our last forecast in June. In some cases the light blue is above the final forecast value, meaning the realized revenue was higher than expected.

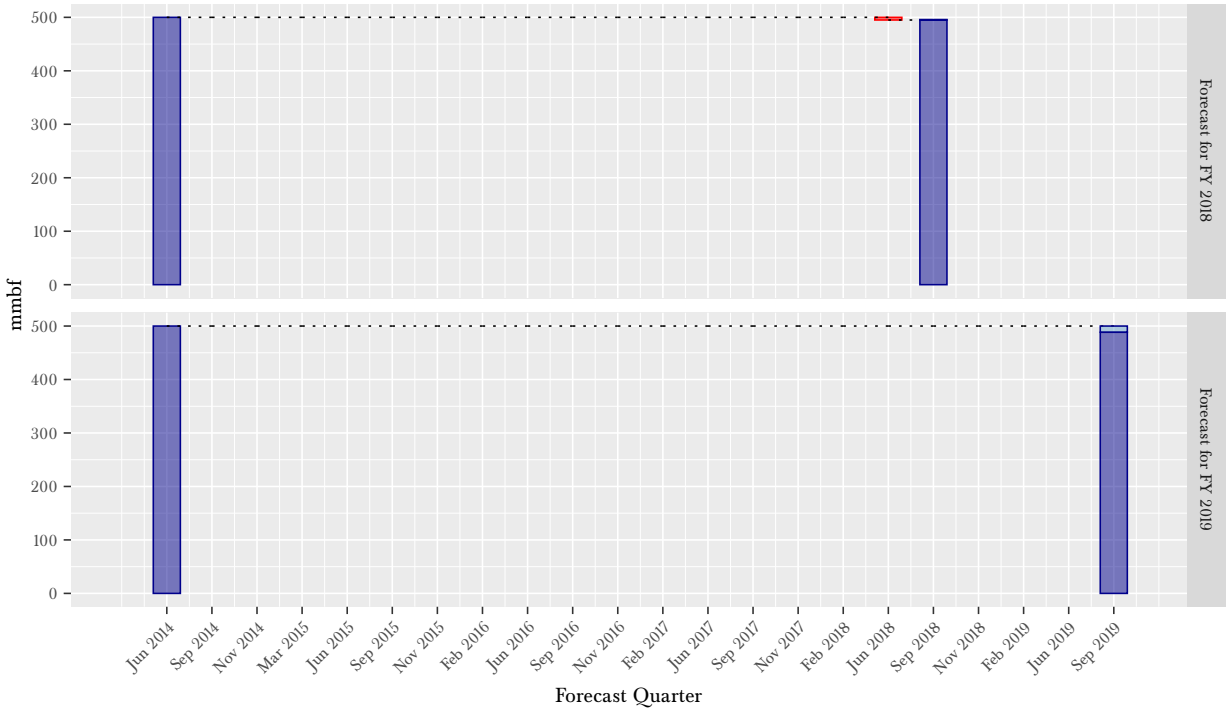
Figure 30: Example



Revenue by Source

Timber Sales Volume

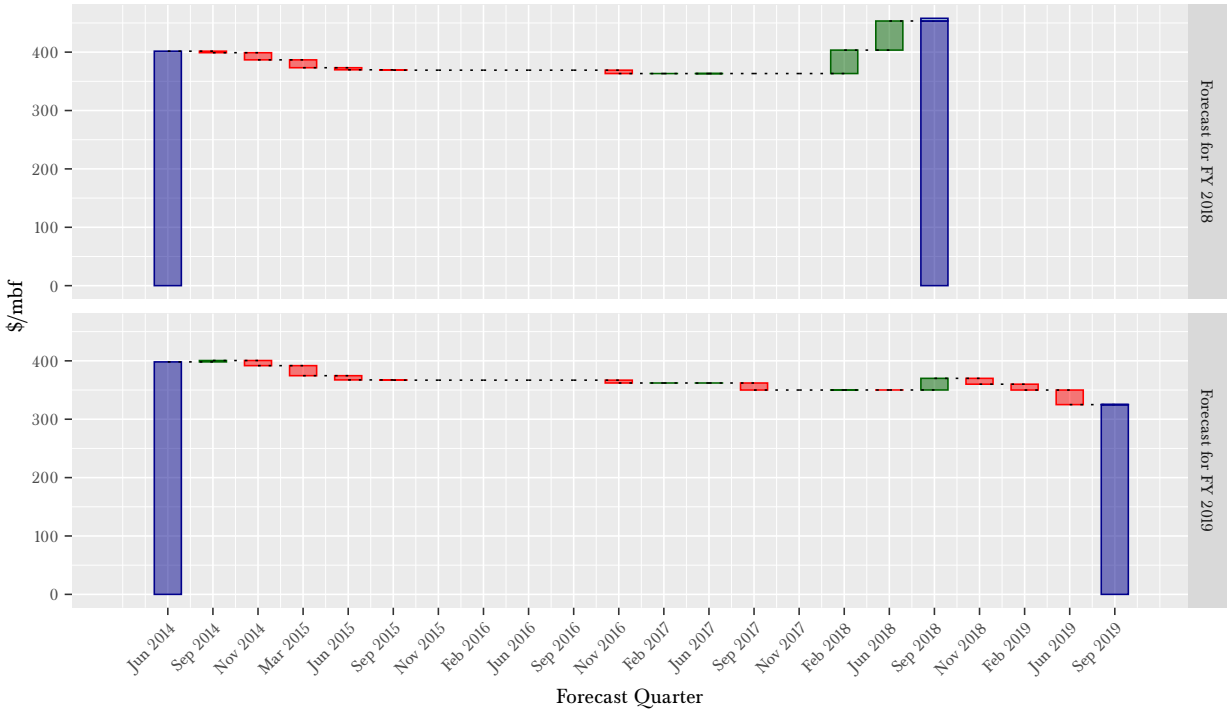
Figure 31: Timber Sales Volume



The timber sales volume targets for these fiscal years was set at 500 mmbf, so the sales forecasts were only changed when there is good evidence that they will be different from 500 mmbf. This means that the volume sales forecasts are likely to be fairly stable, until nearer to the end of a fiscal year, when it becomes clear whether the target is likely. In FY 18, it was apparent in the June 2018 forecast after 10 contracts between the February and May auction were passed-in with no bids that DNR would not hit the target and the volume was reduced. In FY 19, by the end of the year DNR needed to sell around 80 mmbf to reach the forecast 500 mmbf, but was offering 96 mmbf at the June auction. In the end, more than 31 mmbf of timber was no-bid.

Timber Sales Price

Figure 32: Timber Sales Price



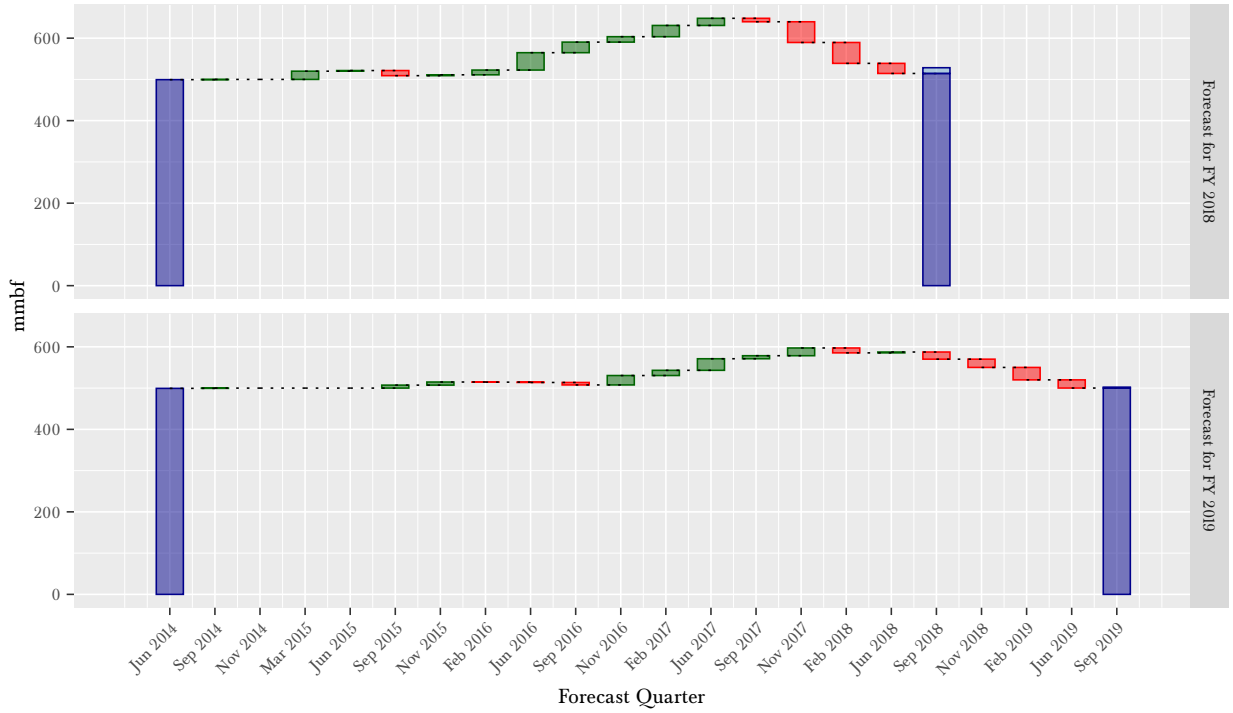
The timber sales price forecast for FY 18 was increased dramatically in the February and June 2018 Forecasts. This was because prior to February, it wasn't clear whether some of the higher priced auctions we were seeing were flukes, or part of a trend. For instance, the average price through the July and August auctions was only $308/mbf. It was debated whether to increase the prices in the November 2018 Forecast, but it was decided to leave the decision until February. By the time the February Forecast came, it was clear that the average price for the year would be much higher than previously predicted.

The price forecast for FY 19 was not meaningfully adjusted before the September 2018 Forecast, because prices were expected to be lower than the highs of FY 18, but it was unclear how much lower. However, the prices from the August 2018 was $429/mbf, well above the $350/mbf price that had been predicted, so the price forecast was adjusted upward in September, though this was still well below the FY 18 average. As an aside, the sales prices from the July auctions are often much lower than the average for the year and are generally not indicative of the prices that we'll see in a year, so the July 2018 auction results were not given much weight—at only $265/mbf, they seemed like something of an outlier.

By the November 2018 Forecast, it was clear that lumber and log prices were dropping quickly. So, despite an average sales price of $392/mbf through the October auction, the FY 19 price forecast was decreased. In the February 2019 Forecast, it was clear that prices were even weaker than expected and we reduced the price forecast back to its original $350/mbf. This was a reasonable forecast until the April and May auctions were held, when there were six contracts passed in with no bids and the average price across the auctions was $257 on around a fifth of the annual volume planned for sale.

Timber Removal Volume

Figure 33: Timber Removal Volume



These two charts illustrate the issue with our removal volume forecast discussed in the main forecast document. From the June 2016 forecast, the FY 18 removal volume forecast was increased. These changes were largely due to the structure of our volume forecast model, which estimates the volume harvested from inventory and futures sales, but pushes sales into outlying years for any downward revision. In June 2016, the sales volume was unexpectedly increased by a large 35 mmbf, primarily due to fire salvage. This pushed up the forecast inventory, which our model distributed to different forecast years. It was clear that the harvest volume forecast for FY 17 should not be increased as it was already at 632 mmbf, much more than had been harvested since 2010. So that volume was pushed out to FY 18. In the end, the FY 16 harvest volume was increased a little, the FY 17 volume was decreased a little (to 625 mmbf), and the FY 18 volume was increased a lot—eight percent or 42 mmbf.

Essentially, the previous method used likely harvest volumes estimated from a purchaser survey, as well as historical averages of volume harvested from sales remaining in the year. Downward revisions in volume harvested in a given year are pushed into future years, because that volume is still in inventory and has a contractual time limit to when it must be harvested by. While this is conceptually sound, it has, in practice, led to apparently systematic overestimation of harvest volumes in future years. This problem propagates at the start of new fiscal years when we begin revising the volumes down based on recent harvest history, and pushing that volume out to future years.

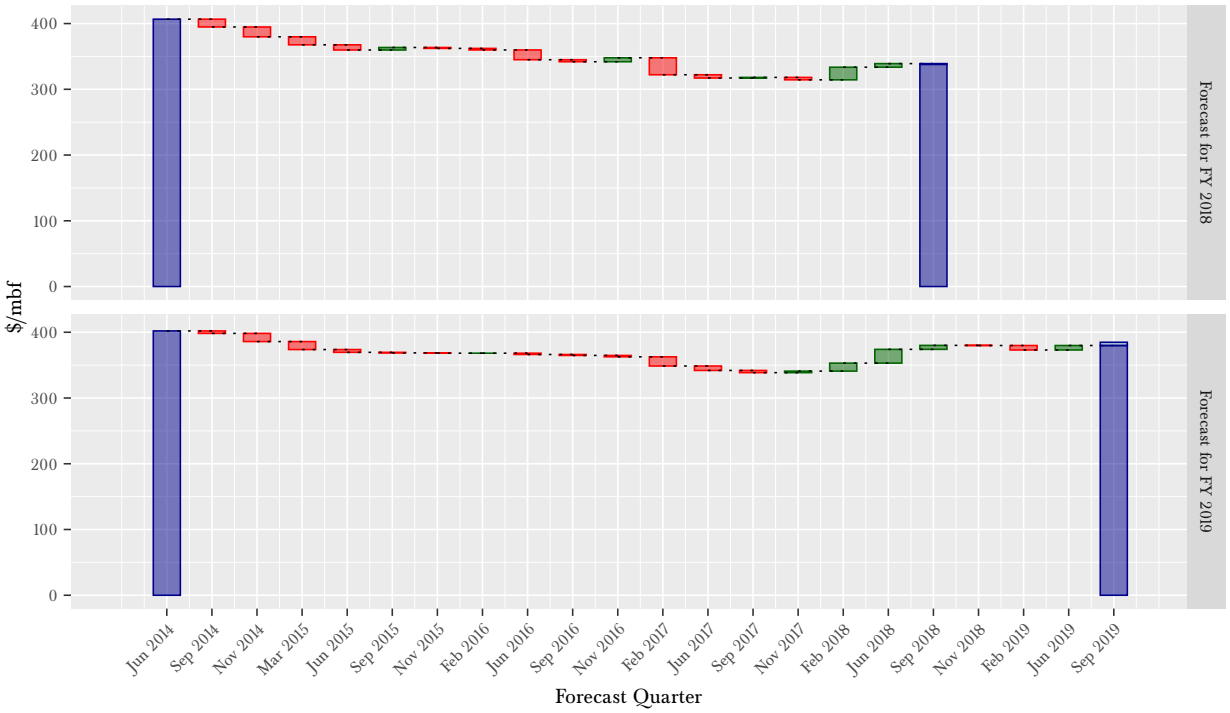
A similar situation can be seen for both FYs 18 and 19. Throughout the fiscal year prior, the volume forecast in increased. After the start of the fiscal year, the volume is gradually decreased.

Timber Removal Price

Timber removal price forecasts are a function of lagged sales prices or price forecasts, and the timing of harvests.

Removal price forecasts for both fiscal years were increased meaningfully starting in the February 2018 Forecast, when the high realized sales prices for FY 18 were apparent and integrated into the forecast sales prices.

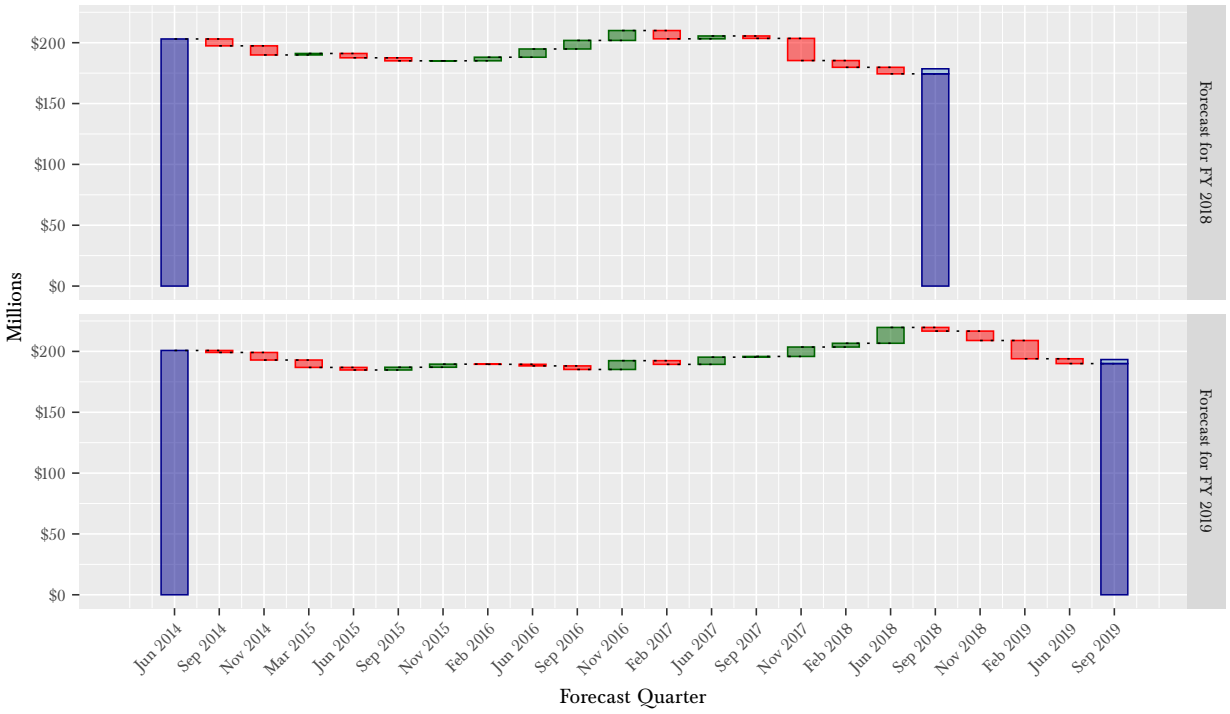
Figure 34: Timber Removal Price



Timber Removal Revenue

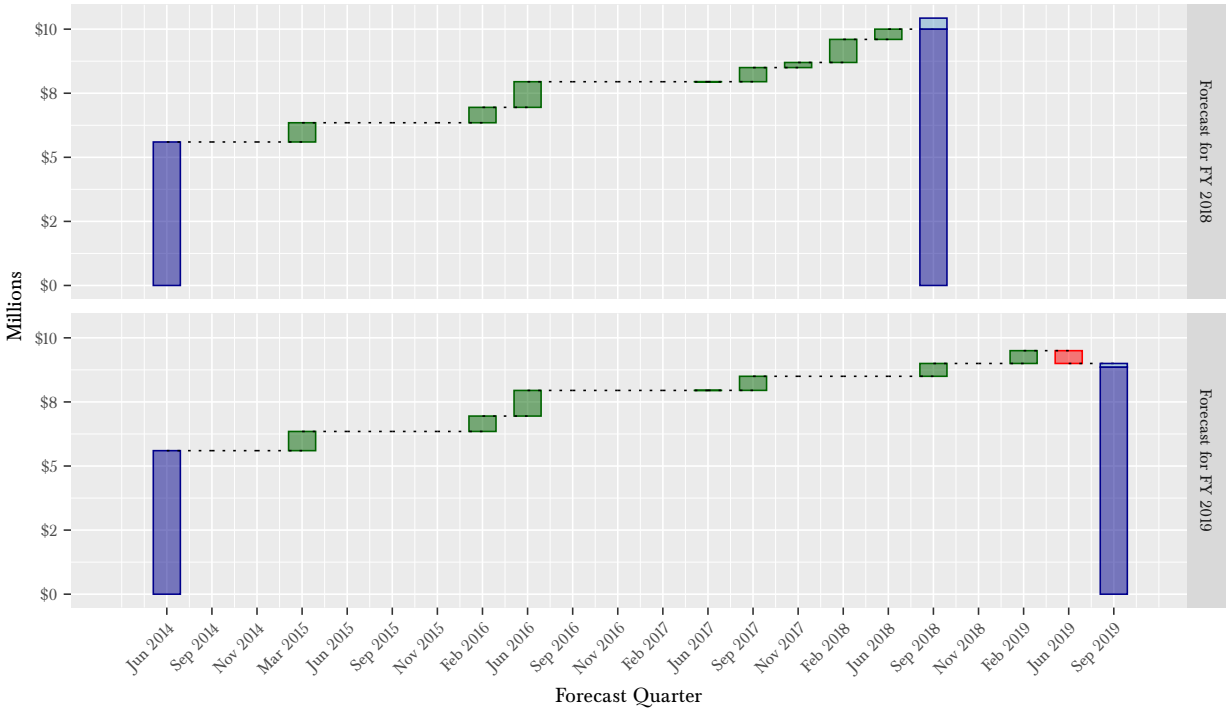
Timber removal revenue is a direct outcome of the removal price and the removal volume at a given time; the causes of changes in revenue can therefore be found in those sections above.

Figure 35: Timber Revenue



Irrigated Agriculture

Figure 36: Irrigated Agriculture



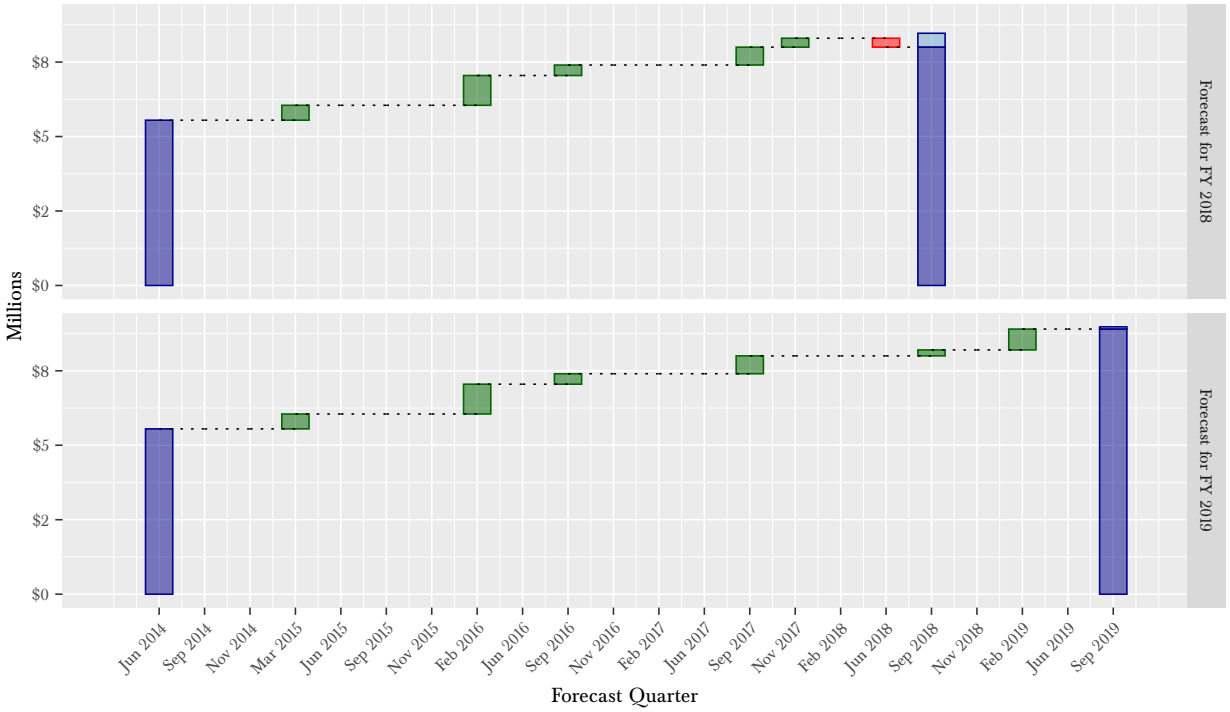
The initial forecasts for irrigated agriculture revenue were essentially no growth from the FY 17 revenue forecast, which was $5.6 million in July 2014. In March 2015, the forecast for both fiscal years was increased by $0.75 million due to progress made converting lease contracts from crop-share to more standard leases with annual rent pre-determined. The conversion of these leases increased the reliability of their revenue and by March 2015 it was clear that we were likely under-forecasting. Lease conversion and continued strong commodity prices drove the increased forecast in the February and June 2016 Forecasts.

The trend of strong returns on irrigated leases continued and the forecast revenue for both fiscal years was increased on this basis in September 2017. Throughout the rest of FY 18, strong returns drove repeated increases in the forecast. Even then, the final forecast for the year was still $0.4 million shy of the actual revenue.

Revenue through the beginning of January 2019 was higher than expected given historical revenue patterns, motivating an increase in the FY 19 forecast by %0.5 million. However, revenue between January and May were very poor and forced a reduction in the predicted revenue in the June 2019 Forecast.

Orchard/Vineyard Agriculture

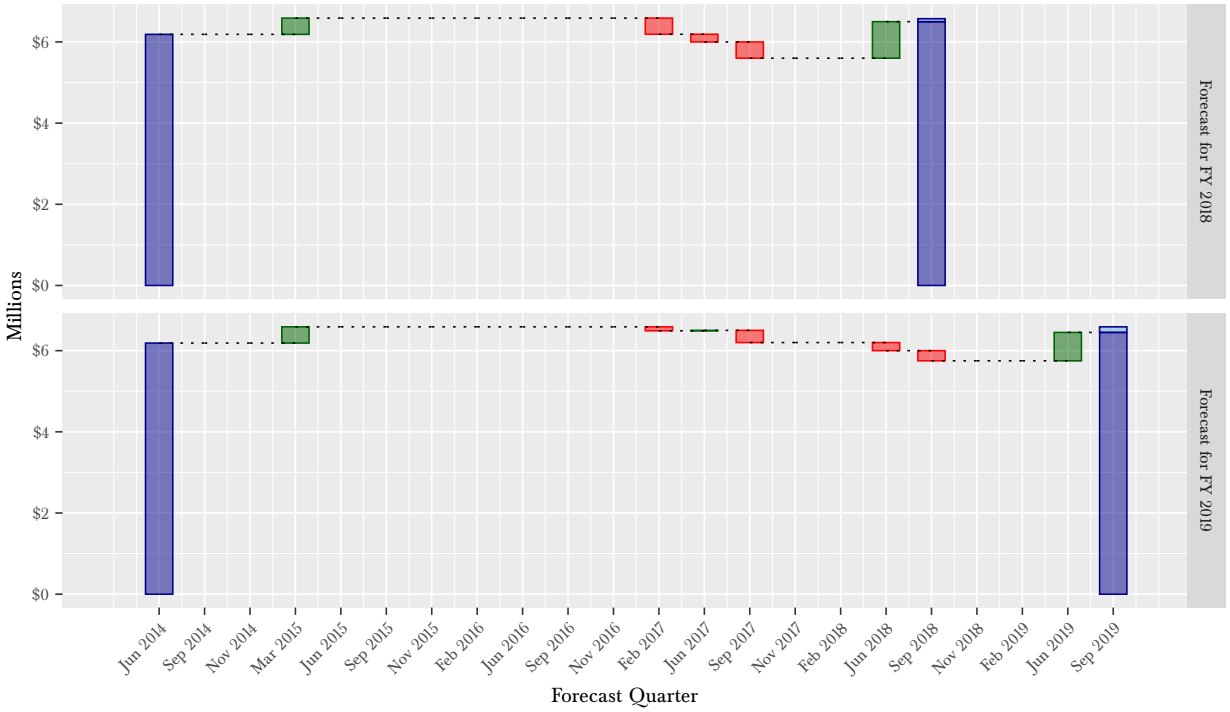
Figure 37: Orchard/Vineyard Agriculture



The orchard and vineyard revenue forecast follows a similar story to irrigated revenue. The initial forecast was for revenue to be constant at their FY 17 levels. The forecast was increased four times between March 2015 and September 2017, due to strong prices and progress on converting leases to cash-based rents creating an upward trend in revenue. In June 2018 the FY 18 revenue forecast was dropped due to unexpected and, at the time, unexplained lower receipts. At the time it was speculated that this could have been because some of the revenue had been inadvertently allocated to a cash-on-account (COA) account, which is not included in our revenue records. This appeared to be the case and in February 2019 the FY 19 forecast revenue was increased due to the resolution of the money in the COA account.

Dryland/Grazing Agriculture

Figure 38: Dryland/Grazing Agriculture



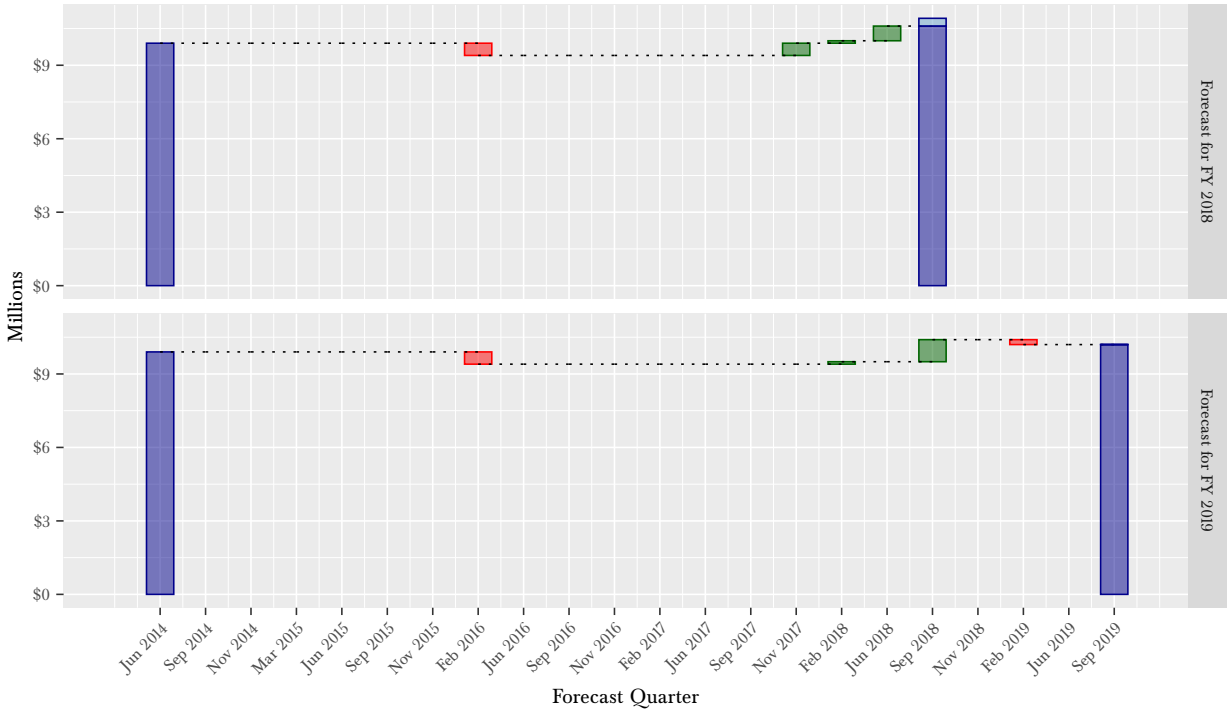
As with other agricultural sources, initial revenue forecast for dryland/grazing was set with no growth beyond FY 17. In March 2015, the forecast for both fiscal years was increased based on a change in expected growth for grazing lands. In February 2017, revenue for both fiscal years was reduced because wheat prices had dropped and seemed likely to stay low for a while. In June 2017, FY 18 revenue was reduced because grazing receipts were lower than expected. Additionally, there was still some grazing land that had still not been released from previous years fires. In September 2017, both fiscal years forecasts were again reduced due to continued low wheat prices.

In June 2018 the dryland/grazing revenue forecast for FY 18 was increased substantially, offsetting almost all of the previous years decreases. In January, all of the remaining wheat was sold so we expected some increase in revenue. However, given the revenue to-date and our understanding of the volume and prices received for those sales, dryland revenue was not expected to increase so dramatically. In June 2018 revenue to-date was $5.5 million, while the forecast was only $4.8 million. It is unclear why revenue was so much higher than we expected.

In June 2018 the forecast for FY 19 was reduced slightly to bring grazing revenues into line with expected FY 18. Prior to that grazing revenue had been expected to grow. In September 2018, FY 19 was further reduced due to weaker prices and the likely impacts of fire—11,000 acres of dryland had burned at that point. In June 2019 the dryland revenue forecast was increased substantially because it had been discovered that around $0.7 million in receipts had been improperly allocated to a COA account and not counted as revenue. Corrections to this error were to be finished by the end of the fiscal year.

Commercial

Figure 39: Commercial



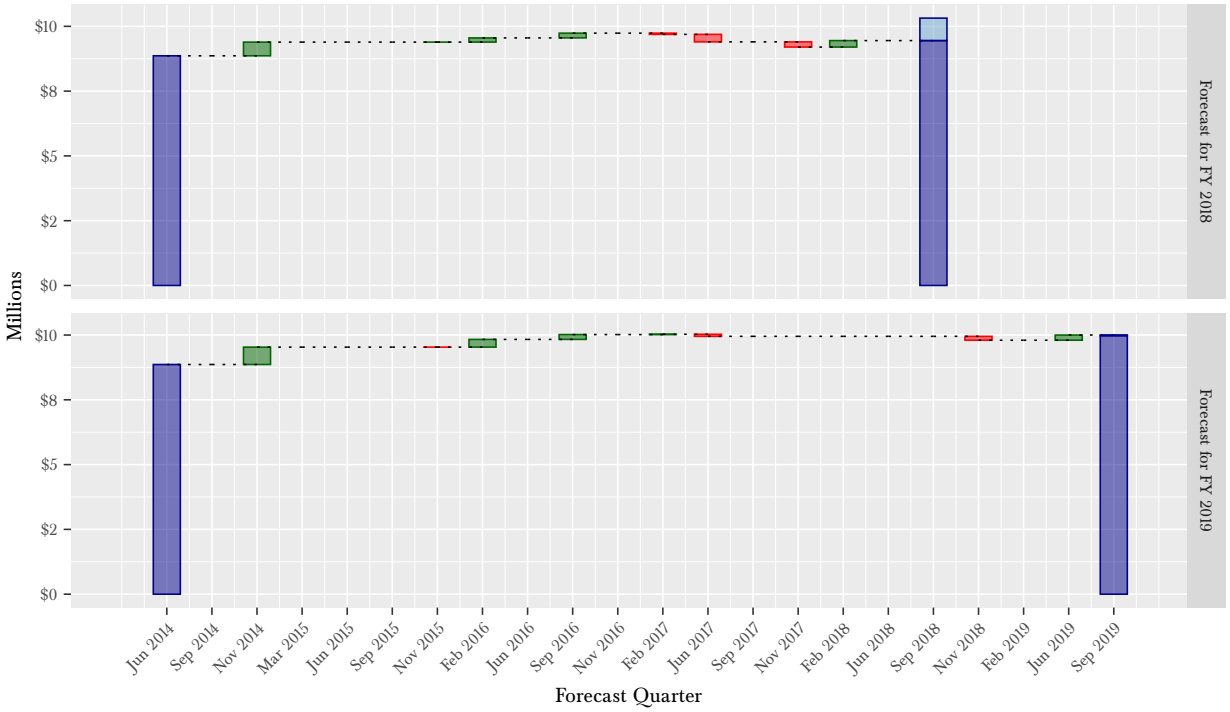
As with the other uplands revenue sources, the initial forecast of commercial revenue assumed no growth from FY 17. FY 15 revenues were substantially lower than FY 14 and by February 2016 it was clear that FY 16 was also going to be much lower. These revenues were low because of a loss of a tenant in an almost $1 million lease, as well as some maintenance, specifically $0.8 million for a roof. It was unclear when the lost lease would find a new tenant, so it was unclear when commercial revenues would recover. FYs 18 and 19 were reduced to take into account some of this downside risk.

In November 2017, a thorough review of commercial leases suggested that FY 18 and 19 revenue was likely to be around $10.4 million/year, barring any unforeseen issues. The forecast at the time for FY 18 was $9.4 million. The FY 18 forecast was increased in November to $9.8 million, building in some upside potential to mitigate risk. By June 2018 there had been no unforeseen costs and revenue-to-date made it clear that commercial lease revenue was likely to be closer to $10 million, so the forecast was increased.

In September 2018, commercial revenue for all outlying years was adjusted up from the previous $9.5 million to $10.4 million to better reflect the leases in place. Throughout FY 19 commercial revenue had been consistently less than expected. These had only been small amounts, but by the February 2019 forecast it seemed unlikely that revenue was going to meet the forecast, so it was reduced. It is unclear why these revenues were less than expected, but program managers suspect it was due to slower sales associated with profit-based rents.

Other Non-Timber Uplands

Figure 40: Other Non-Timber Uplands



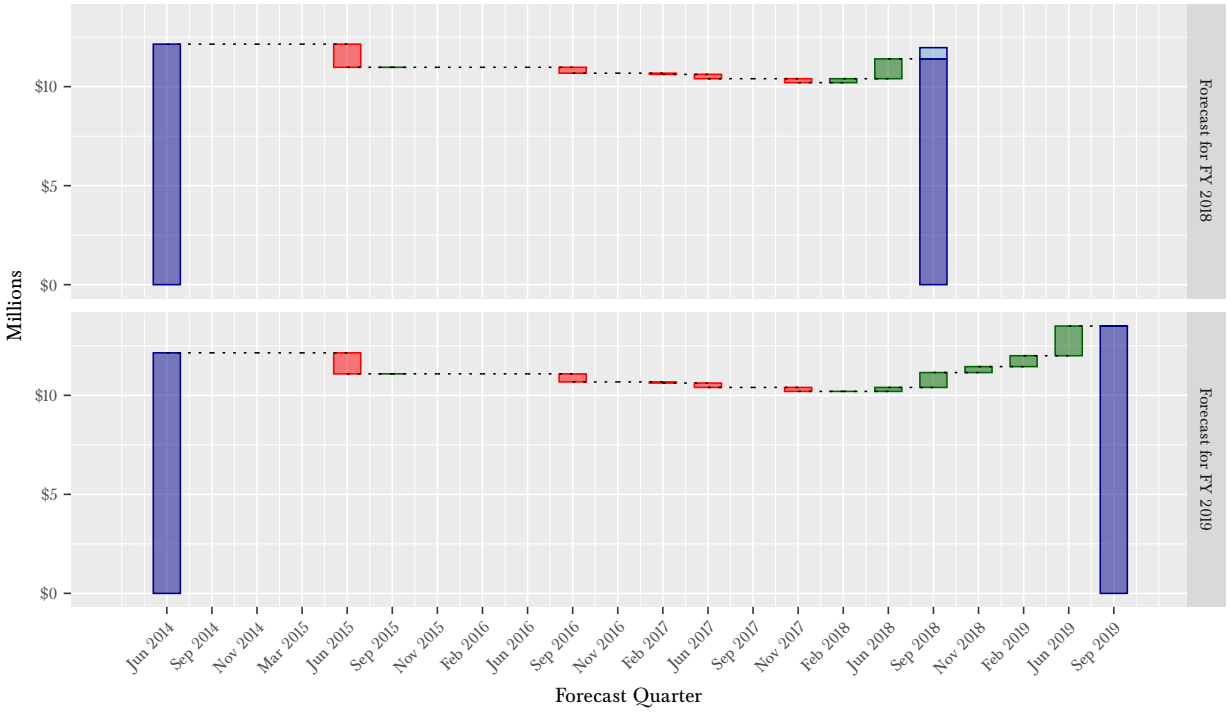
The other non-timber uplands sources of revenue include communications, minerals and hydrocarbon (rock, sand and gravel), and an assortment of low revenue sources. Changes to this category are largely due to changes in the forecast for communications or minerals and hydrocarbon revenue, as the other sources are small and highly variable so they are forecast simply as a historical average.

This source forecast revenue was increased in November 2014 because many of the communications leases were moving to a structure with a three percent annual increases written into the leases. For FYs 18 and 19 this meant an additional $1.2 and $1.5 million in expected revenue, respectively. Increases and decreases after that were generally small adjustments based on realized revenue and how that would be reflected at three percent per year.

The final reported revenue for the FY 18 was almost $0.6 million more than expected in June. This was an accounting error that artificially increased FY 18 revenue and, when it was reversed, decreased FY 19 reported revenue. Here, the FY 18 revenue is presented as it was originally published in the September 2018 Forecast. However, the FY 19 revenue has been corrected.

Aquatic Lands

Figure 41: Aquatic Leases



The initial forecasts for FYs 18 and 19 for aquatic lands had built in slightly higher revenue than FY 17, assuming some increase in the value of water-dependent, aquaculture, and non-water dependent leases. In June 2015, water-dependent lease revenue was well behind expectations so the FY 16 revenue was revised down. This revision drove a reassessment of the assumed growth rates, resulting in a meaningful reduction in FYs 18 and 19. In September 2016, a downward revision in water-dependent rents again pushed down the forecast, outweighing increased expectations for aquaculture leases.

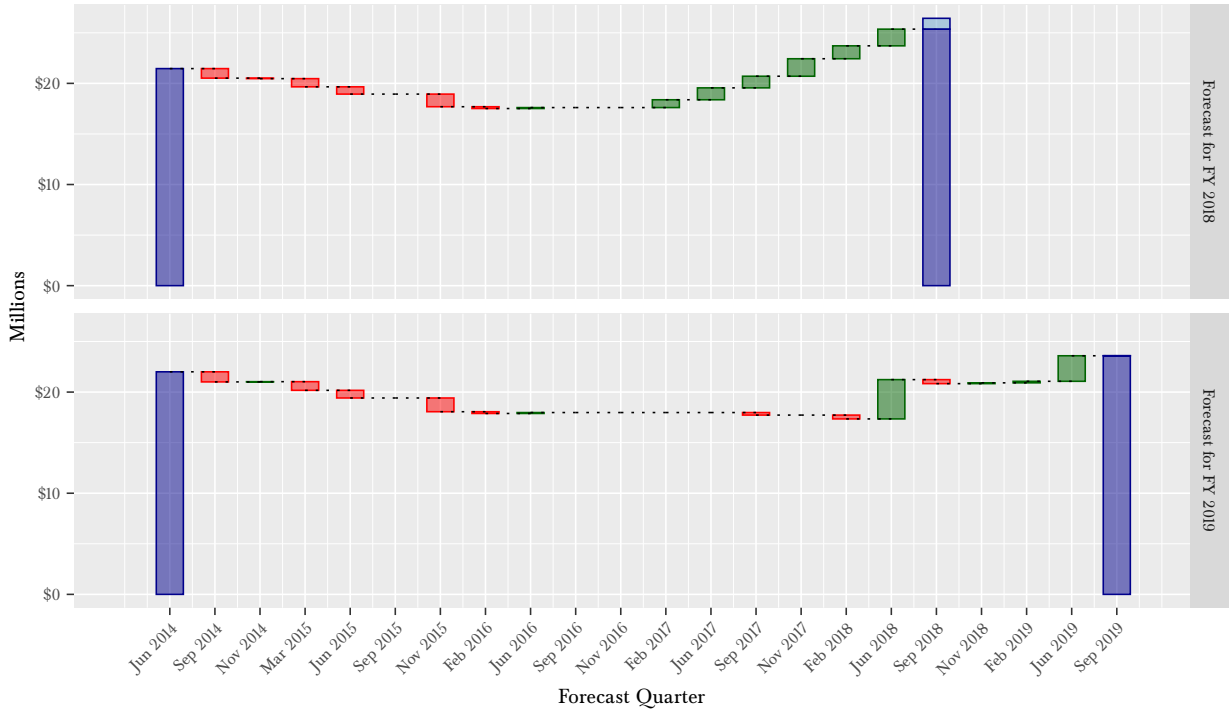
The small revisions to the forecast revenue were made from February 2017 through February 2018, were largely due to continued underperformance of water-dependent revenues.

In June 2018 the FY 18 revenue forecast was increased significantly due to higher than expected revenue is all source categories, other than water-dependent leases.

From September 2018 to June 2019, the FY 19 revenue forecast increased dramatically, from just over $10 million to over $13 million. Around half of this increase was due to water-dependent rents, which ended the year more than $1.5 million higher than we expected at the beginning of the year. Around $0.5 million was from a one-time payment, but the remainder was simply because leases were returning more than we expected. There were also meaningful increases in non-water-dependent leases, around $0.7 million, and easements, $0.5 million.

Geoduck

Figure 42: Geoduck



The initial forecasts for geoduck were based on assumptions of roughly constant volume sales per year and modelled prices that showed a gradual increase.

The forecast for both fiscal years was decreased between September 2014 and February 2016 based on updating the price model with realized prices. During this period, geoduck prices had fallen steeply from their average auction price of $10.60/lb in FY 14 to $8.20/lb in FY 15 and $7.50/lb in FY 16. This drop had a number of causes, including a ban on geoduck to China, a campaign in China to curb conspicuous luxury consumption, a Washington law limiting the number of geoduck diver licenses, and conflict between divers and boat owners. There was significant uncertainty about when, or whether, geoduck prices would recover.

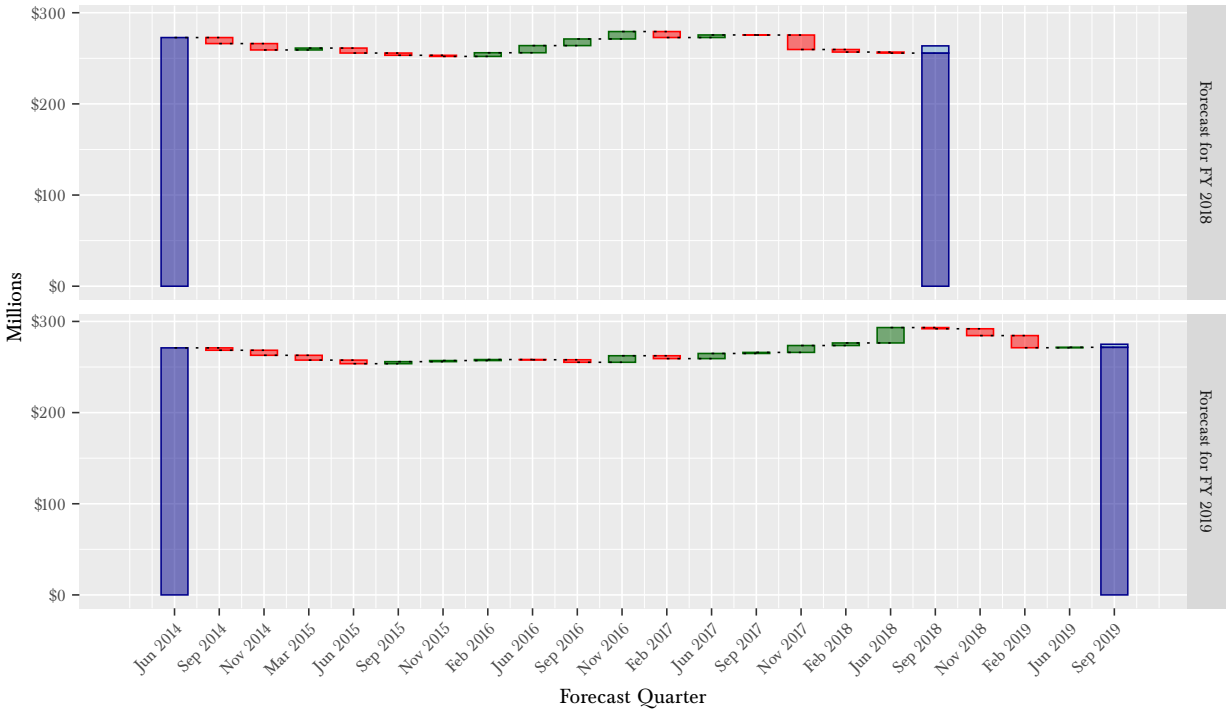
And then, starting in the first quarter of FY 17, prices recovered. It was unclear at the time whether the recovery in prices was indicative of a new normal or a fluke. We know very little about geoduck market's supply or demand at any time. By the February 2017 forecast we were confident enough that it wasn't a fluke to begin increasing our price, and therefore our revenue, forecasts for FY 18.

We were very cautious with our FY 19 forecast and didn't change it to reflect the increased prices until June 2018. In June 2019, we further increased the FY 19 forecast based on the auctions through the fiscal year.

Total Revenue

Changes in total revenue are largely driven by changes to timber removal volume or prices because timber revenue is such an overwhelming proportion of total revenue. Figure 43 presents a summary of all of the foregoing forecast changes.

Figure 43: Total All Sources



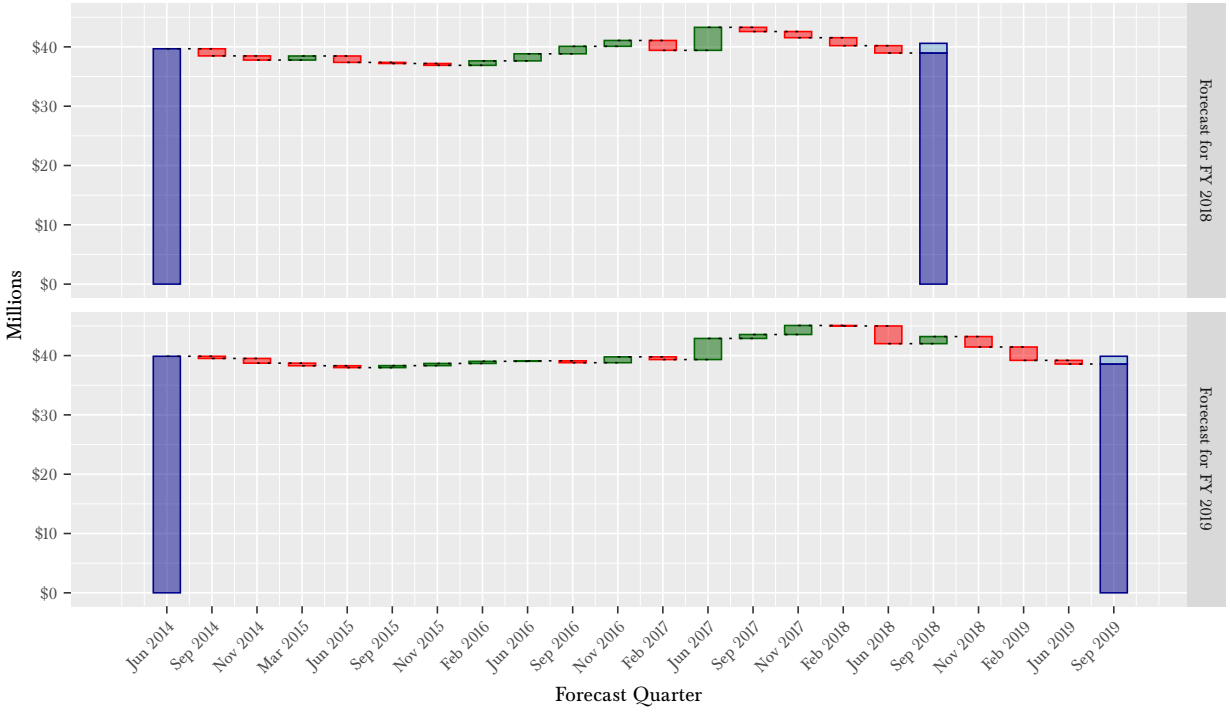
Revenue by Fund

Fund revenue is composed of revenue from several different sources. Disaggregating those sources is difficult, so the forecast changes are presented below without an explanation of how the individual source revenue changes affect specific funds.

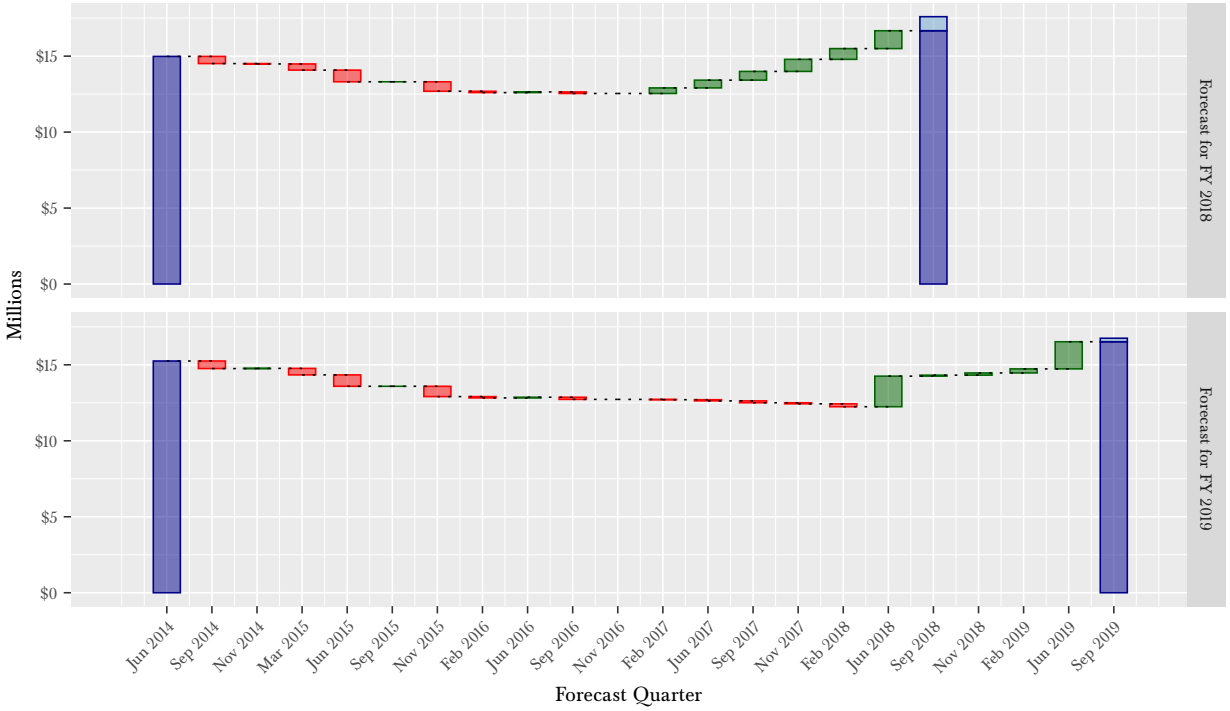
However, as a general guide, half of geoduck revenue goes to RMCA Aquatics and the other half to ALEA. Given that geoduck revenue is around two-thirds of aquatic revenue, changes to these funds are largely due to changes in geoduck revenue.

For the remainder of the funds, changes to timber are the largest drivers. These can be either through changes in the forecast revenue broadly, or through changes in the composition of sales. As noted in the forecast, a single multi-million dollar planned sale that gets moved from one set of trust lands to another can dramatically alter the expected revenue of some of the smaller funds.

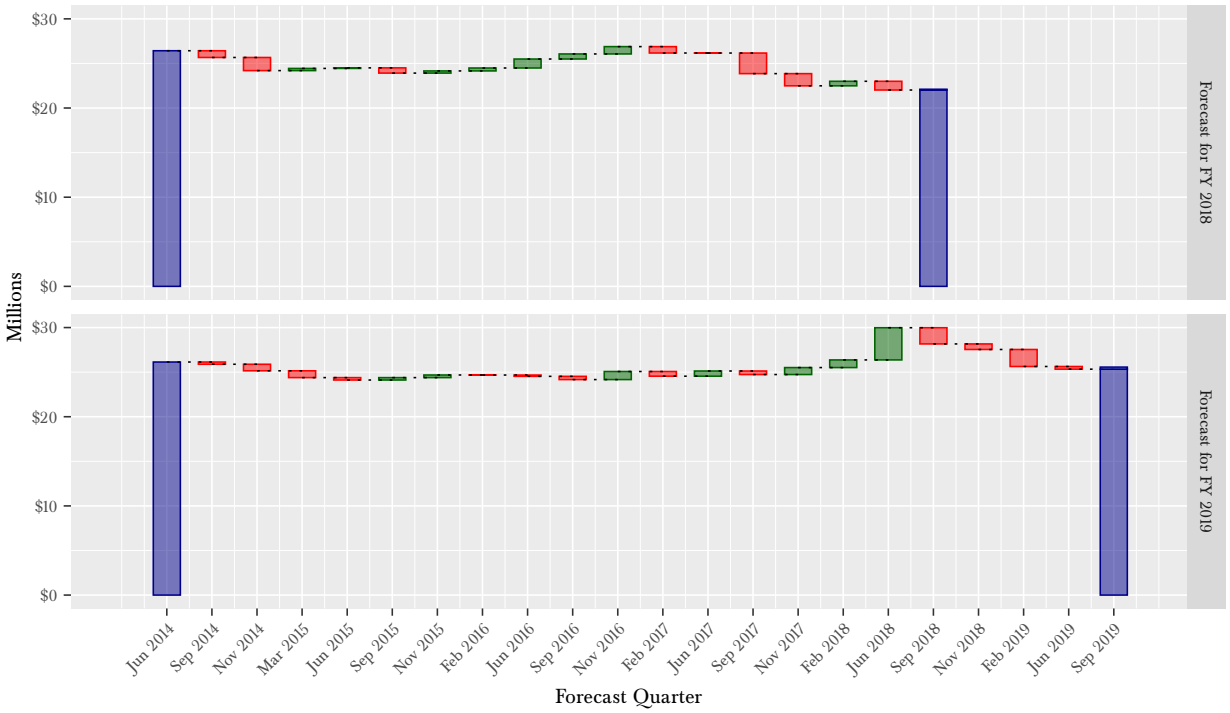
RMCA Uplands



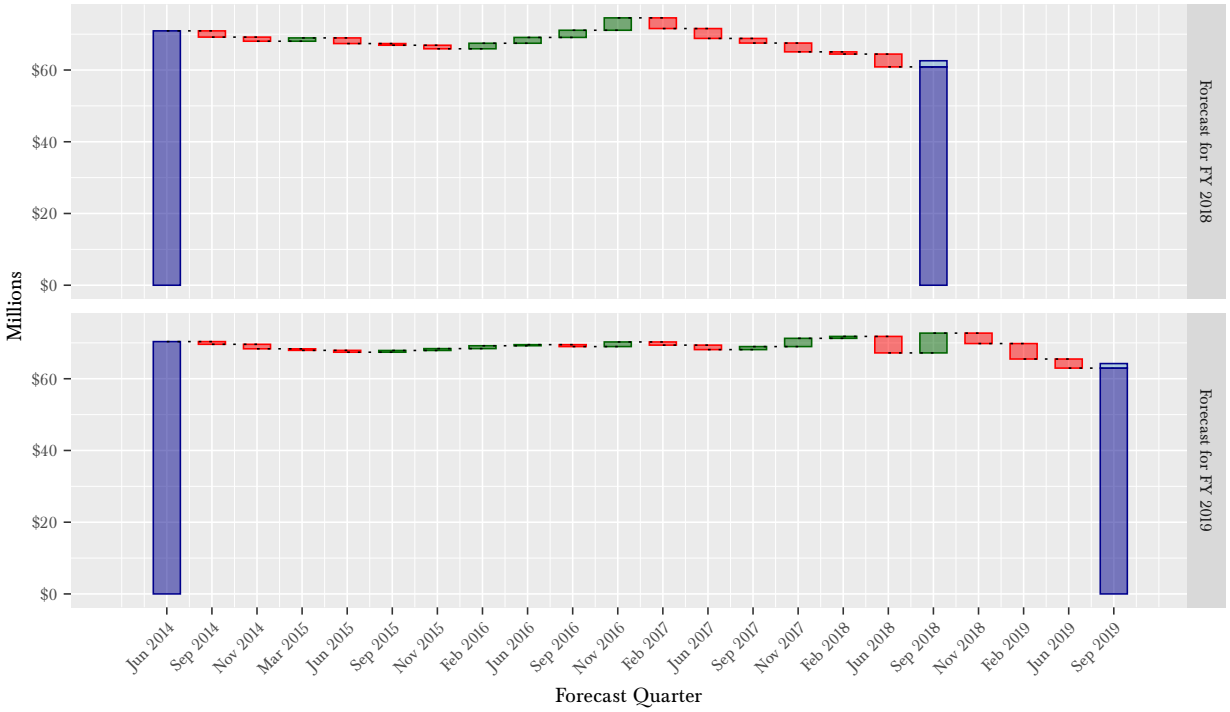
RMCA Aquatics



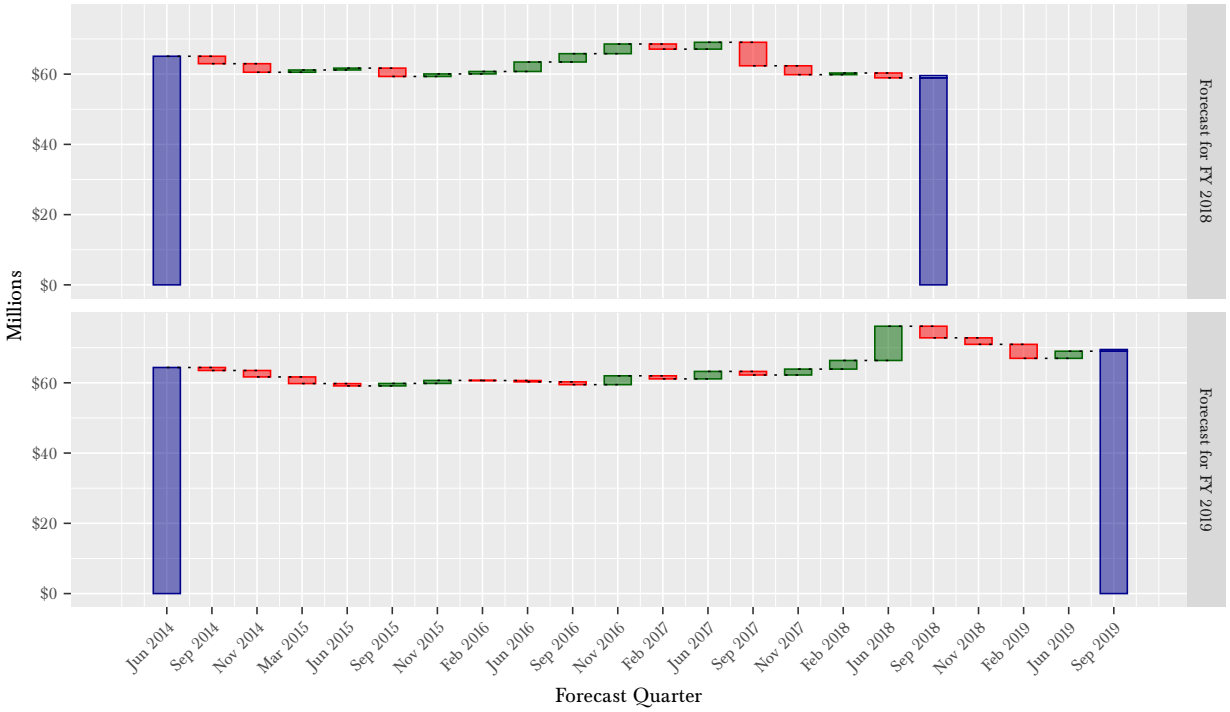
FDA



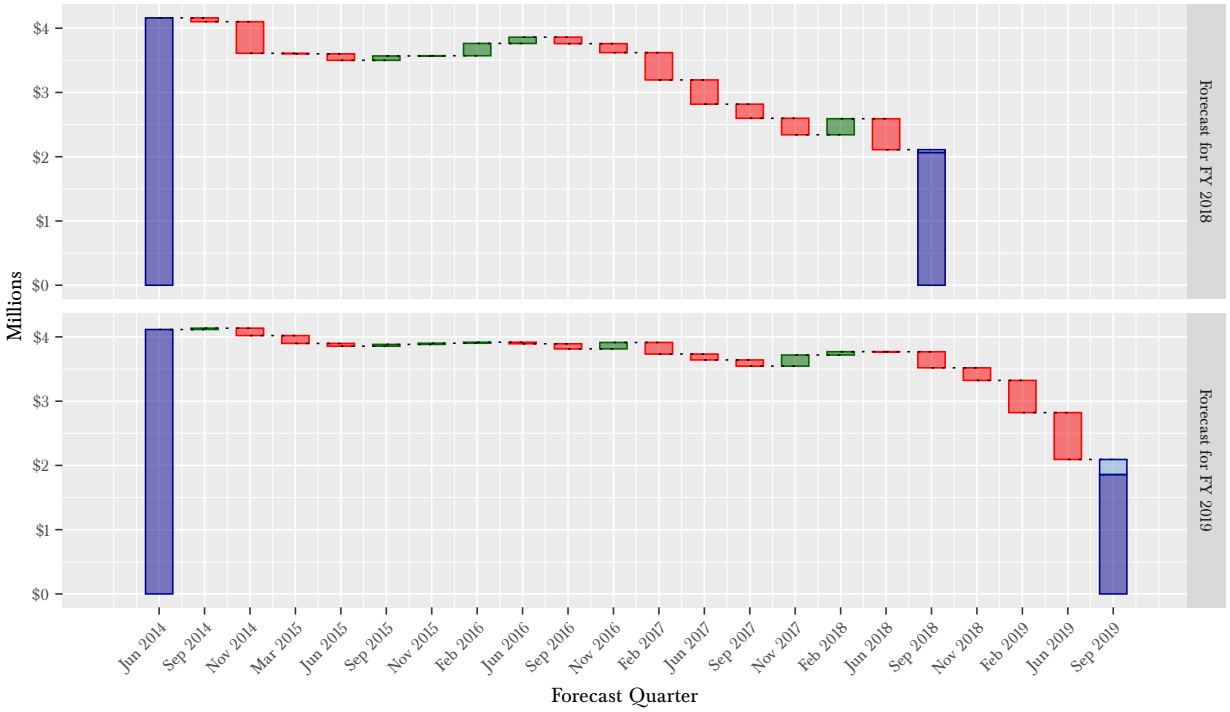
Common School Construction



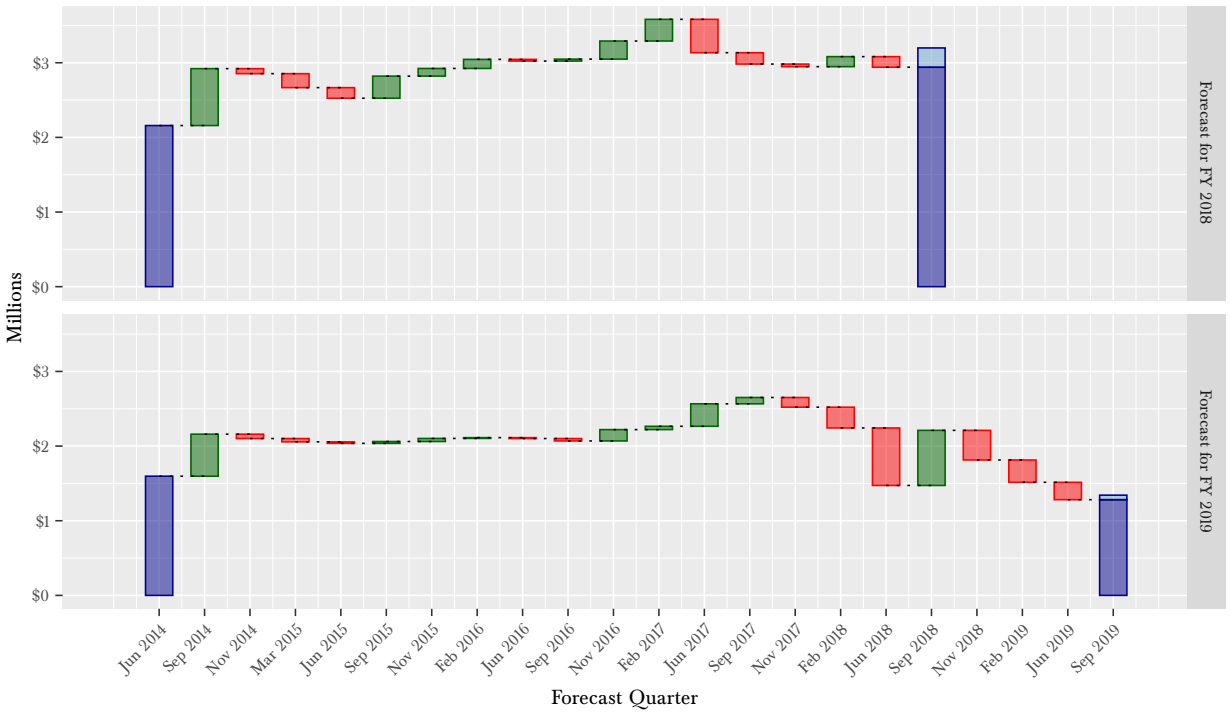
Forest Board Counties



General Fund



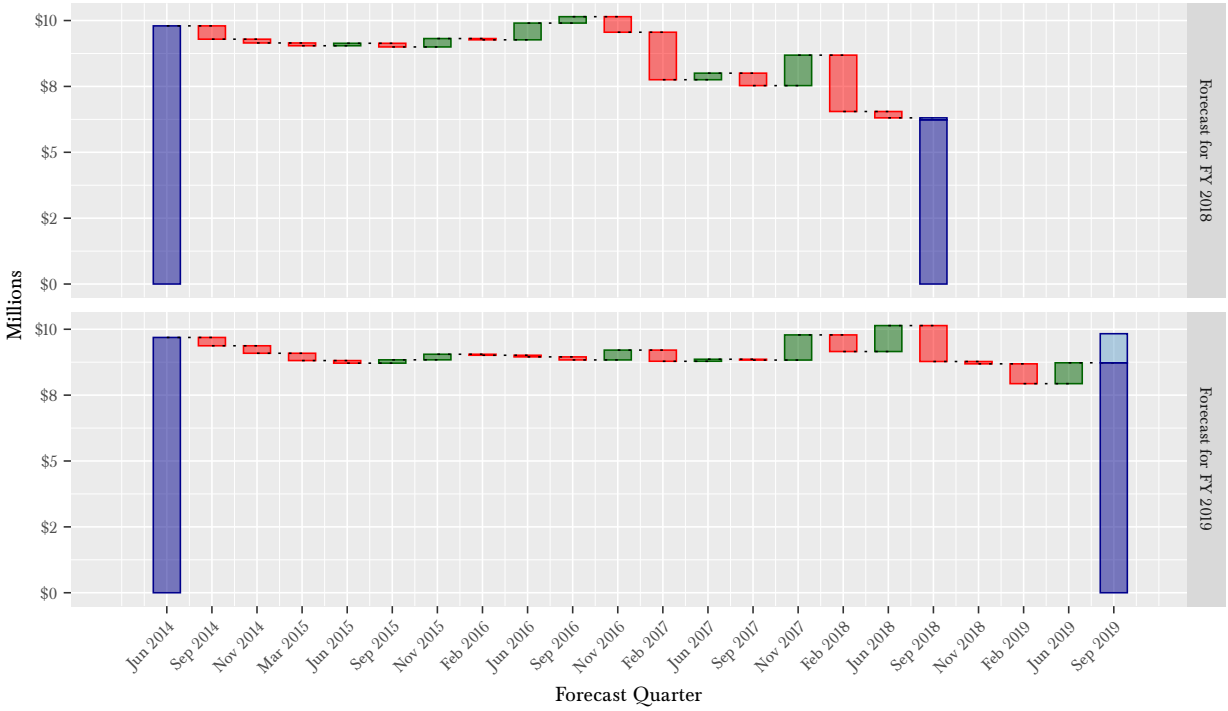
University Bond Retirement



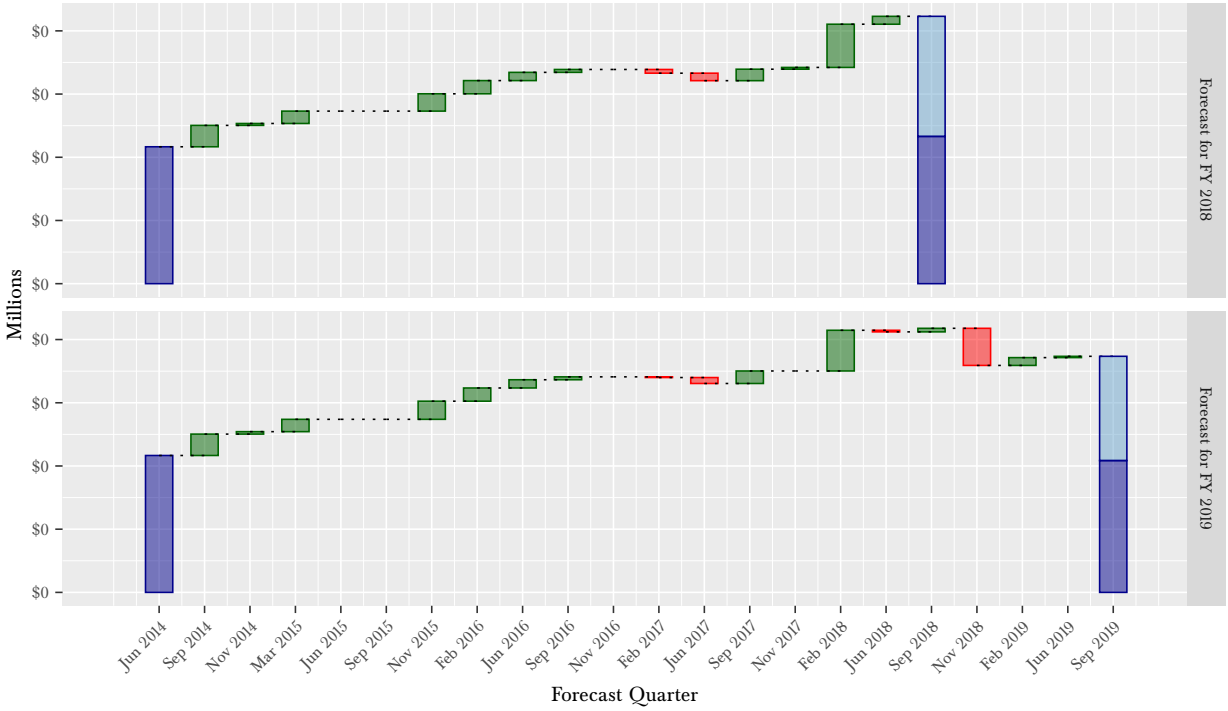
WSU Bond Retirement

CEP&RI

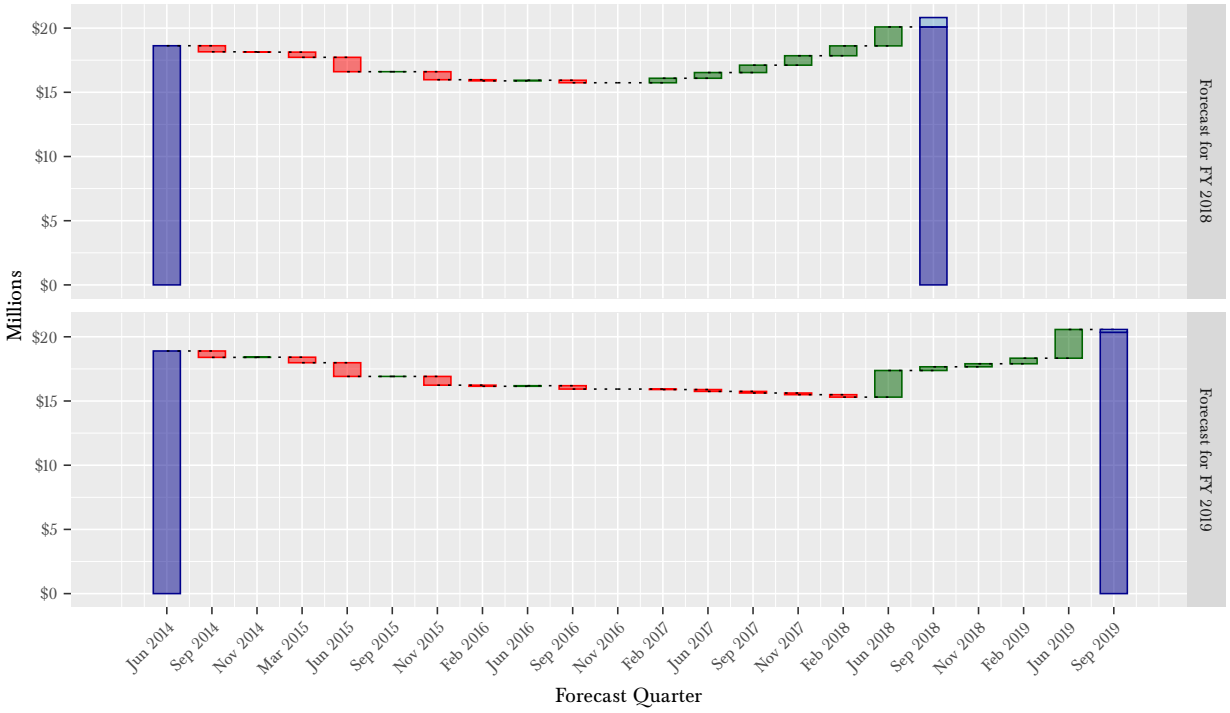
Capitol Building Construction



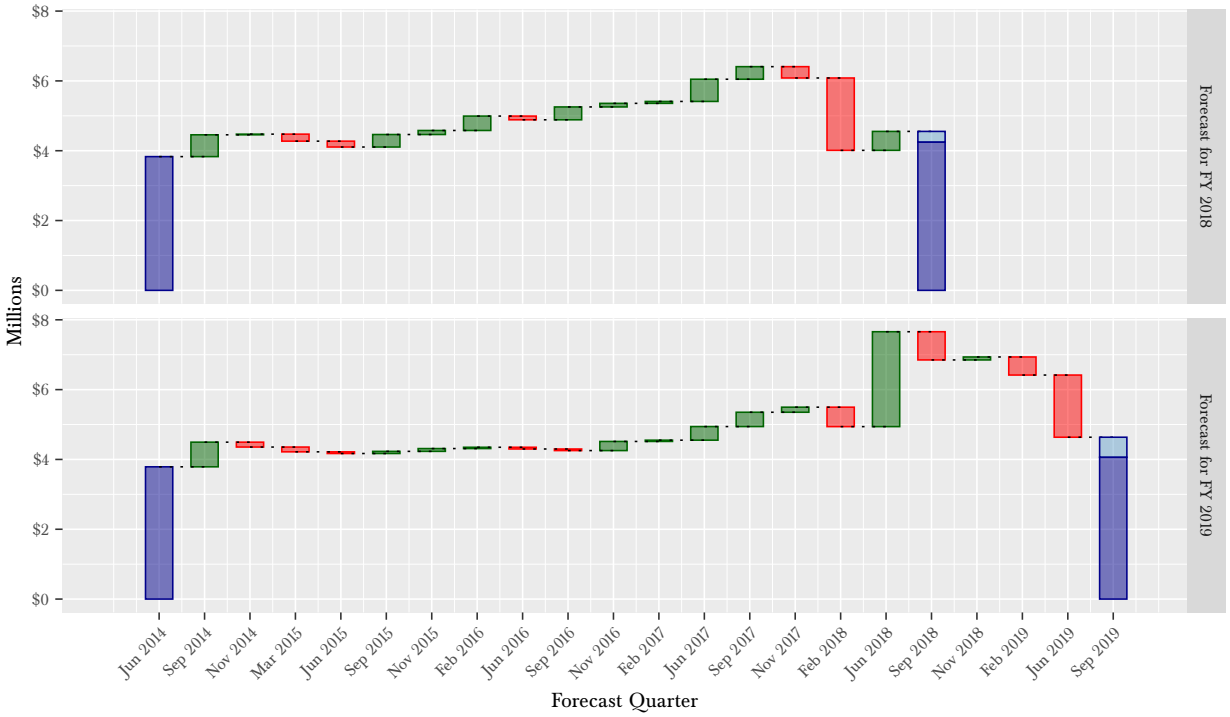
Normal School



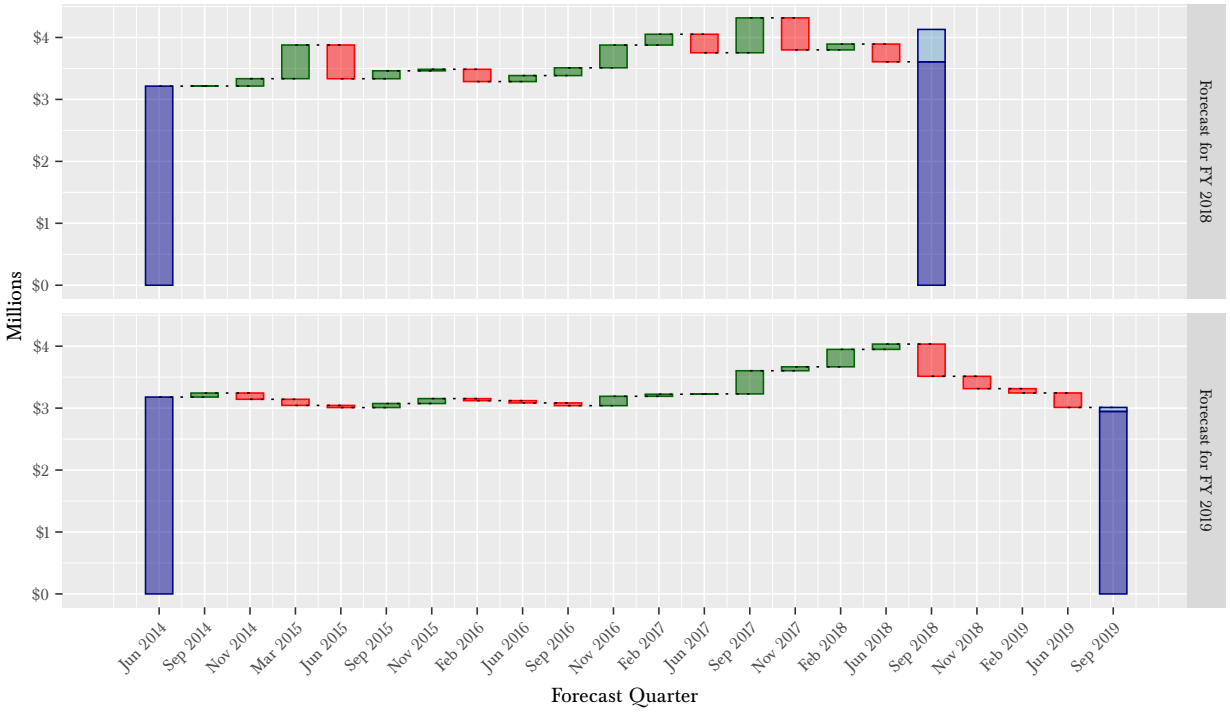
ALEA



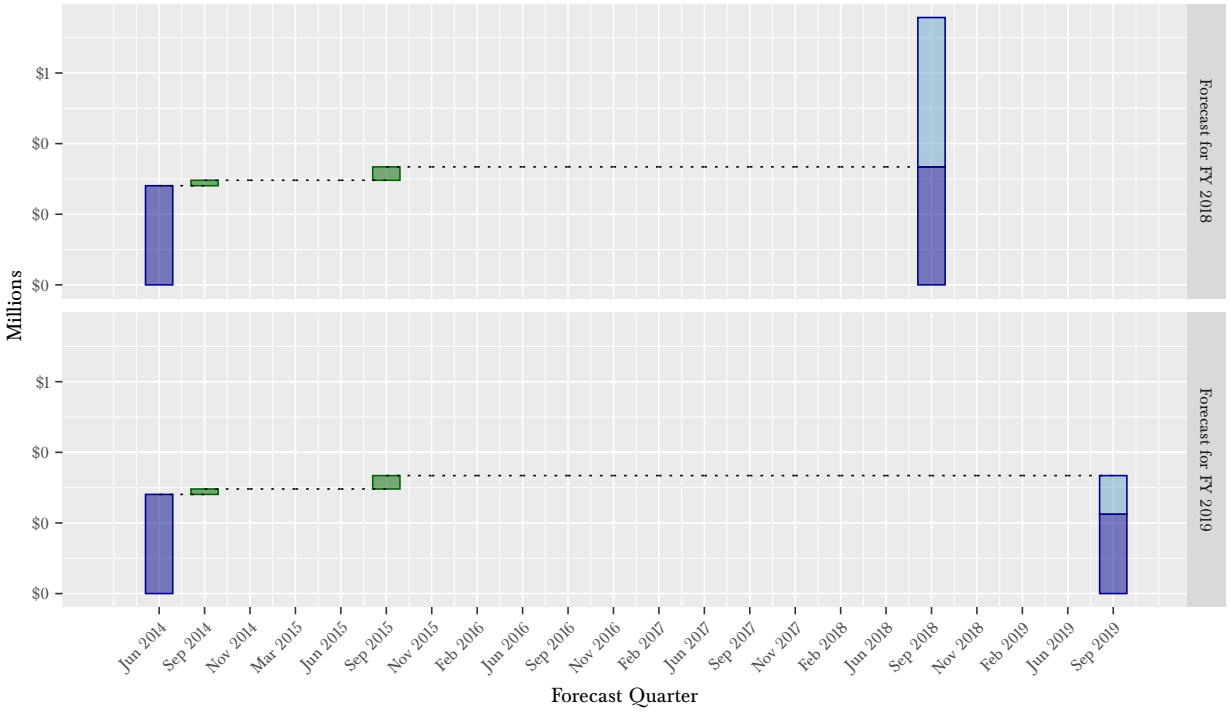
Agricultural College Permanent



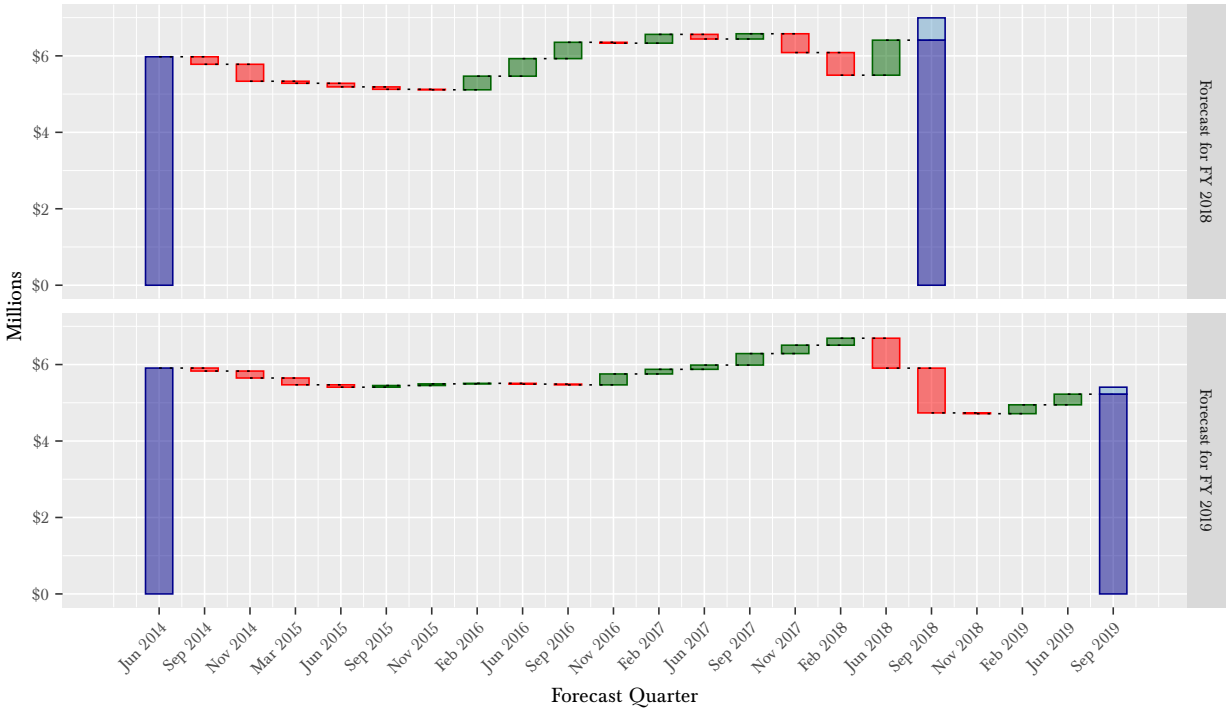
Normal School Permanent



Common School Permanent



Scientific Permanent



University Permanent