FINAL REPORT

Strategic Resource Evaluation Study Highway Construction Materials

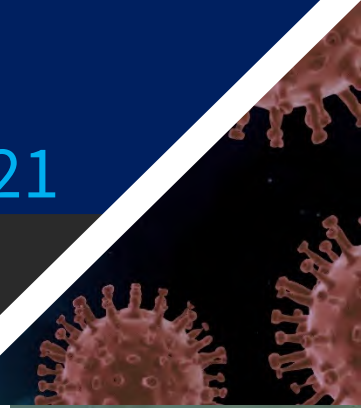
FDOT

Contract BE251

July 2021

The Balmoral Group

165 Lincoln Avenue
Winter Park, FL 32789



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The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the State of Florida Department of Transportation

Prepared in cooperation with the State of Florida Department of Transportation.

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Overview: Florida's Highway Construction Materials

The Roller Coaster of COVID/post-COVID/maybe-not economics is being keenly felt by Florida's Highway Construction Materials Sector. Competition from other sectors is driving input costs rapidly higher. Steel can't be manufactured fast enough to produce parts needed for equipment, while housing and real estate development are pushing up demands for construction resources. Cement producers are flat out, with virtually all production committed to existing customers and little room for immediate expanded production. Stimulus funding, increased investment for resiliency projects, and global competition for materials from recent catastrophes, all support continued demand, pricing pressures and potential lead time issues. Meanwhile, protracted COVID effects continue to inject uncertainty into the economy. While the public sees booming real estate markets and record revenues in some industries, the U.S. has still only recovered 70% of the jobs that were lost during the pandemic. The good news is there is light at the end of the tunnel, and most suppliers expect pressures to ease over the coming 12-24 months. Logistics hurdles are a common complaint, driven partly by the same issues – with a red-hot economy, transport of goods has had to adapt to unpredictable changes in consumer and business behavior. The ripple effects of labor shortages have exacerbated logistics challenges, with truckers and operators in short supply. While conventional wisdom holds that unemployment premiums are driving labor shortages, other countries with no unemployment premium during the pandemic are experiencing the same issues – essentially, lower-paid positions are harder to fill as people reconsider their priorities, indicating this is likely a long-term situation[1]. The Federal Reserve is expected to address inflation gradually over the coming year, and interest rates could rein in some demand and make room for costs to abate. BUY AMERICA revisions could have substantial impacts on price; expected results if enacted are summarized on the next page.

Construction Materials

1

Asphalt suppliers and contractors are experiencing higher input costs and expecting continued price pressures. While HMA plants were largely insulated from the initial COVID impacts, over 70% of suppliers now report concern about ability to meet increased demand. Suppliers cite labor shortages, binder costs, and trucking constraints as the driver for anticipated bid price increases of nearly 20% this year. After record low crude prices last year, binder production dropped and now competes with higher demand for fuel oil which is refined as an alternative to binder.

FDOT's concrete providers are caught in supply chain purgatory, with sufficient material but significant obstacles to delivery. Drivers are at a premium. Going into the pandemic, the cementitious material industry had the most capacity and experienced immediate impacts. After a brief but painful impact from COVID last year, the industry has resumed steady growth seen since 2016 with 490+ plants now operating. Fly ash continues to be an issue and costs are up, but many suppliers have or are in the process of developing alternatives which appear to be improving availability. Cement production is at its highest level since pre-recession, but producers anticipate achieving balance with demand in the second half of 2021.

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Steel fabricators are experiencing pressure from labor shortages, record high input prices, zinc/galvanizing delays, and unpredictable raw material. After nearly collapsing at the end of last year, scrap steel prices are at their highest since 2008. Steel has proven extremely volatile the last few years, and contractors experience some trauma – new tariffs, COVID, wild fluctuations in input costs – so frequently in this space that "uncertainty premiums" in bid prices are likely guaranteed going forward.

Earthwork costs are feeling the impact of shortages in labor and equipment and have reached pre-recession peaks. Unlike in prior reports, these trends appear to be statewide, rather than concentrated in specific regions. The bad news is the trend is expected to continue for another year to two before easing.

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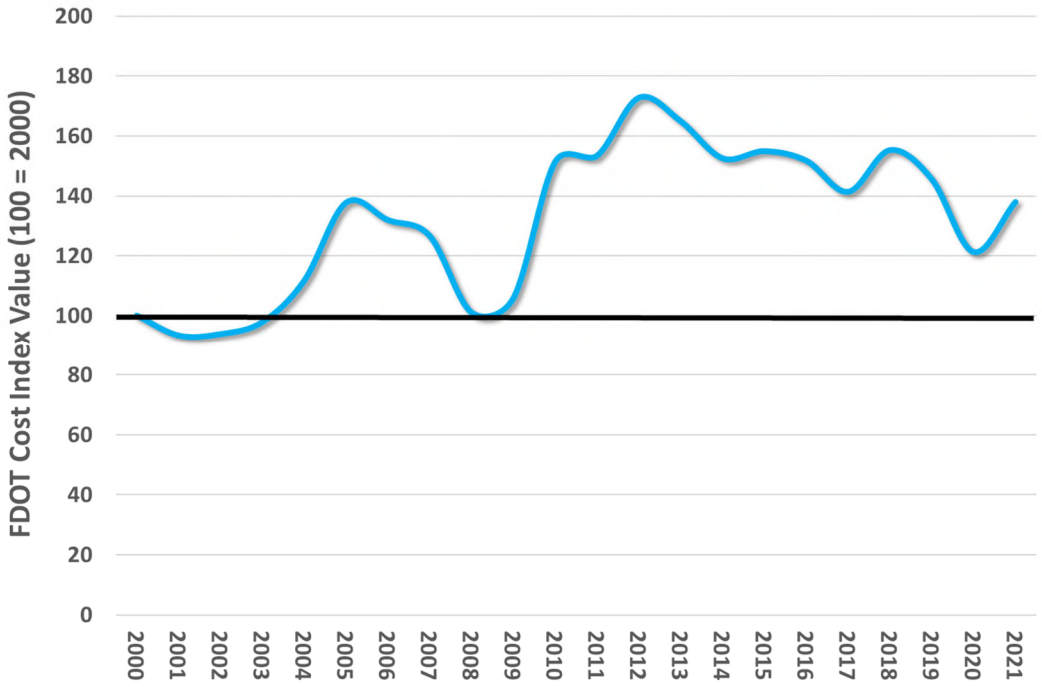
Aggregate production is approaching pre-recession levels. Material production is sufficient, but there are transportation hiccups in both trucking and rail due to overall demand. While trucking issues are likely to be protracted, rail is expected to adjust to post-COVID demand over the course of the next twelve months. Labor shortages are affecting aggregate as with other material. Producers expect increasing bids by 20% during the coming year.

Buy America provisions currently affect steel used by FDOT, but under proposed revisions this would expand to other materials. Estimates of the impacts range from 9% for asphalt products to 29% for aggregate, on top of increases already estimated herein for each material, if foreign sources were prohibited. Given the already tight markets in Florida, impacts on lead time are likely to be substantial for asphalt and aggregate. Barring a significant recession, prices are unlikely to return to pre-adjustment levels and would be expected to remain inflated after the new constraints are enacted if the revisions are passed by Congress. Further details are provided in this report.

An overall FDOT Cost Index was calculated by accessing historical pricing and the share of aggregate, asphalt, concrete, and steel dollars spent on FDOT projects. Compared to the baseline of prices and the cost composition in 2000, FDOT costs are currently on a similar trajectory to conditions seen after the 2008 global recession. However, it should be noted that the decline from 2018 to present is still well above the 2008 – 2010 period, indicating price increases that have accumulated over the last decade appear to be permanent (**Figure 1**).

Figure 1. FDOT Construction Cost Index, 2000 - 2021



Source: TBG calculated from data provided by FDOT Office of the Work Program and Budget, TBG Work Product.

Figures 2 and 3 show the likely scenario for FDOT materials costs relative to current conditions, including the upper bound estimate.

Figure 2. Cost Composition Forecast Using LRE Prices

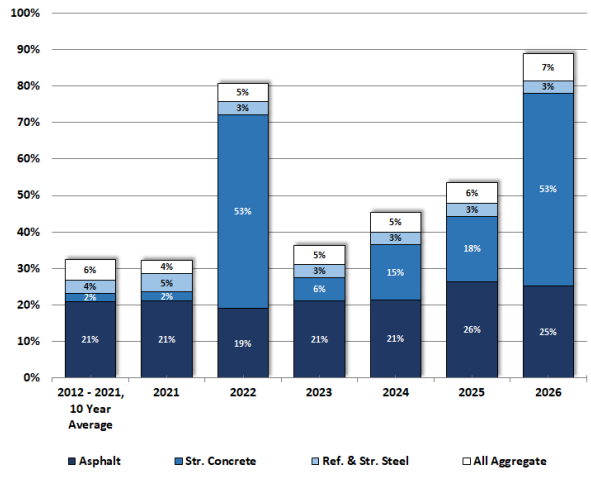
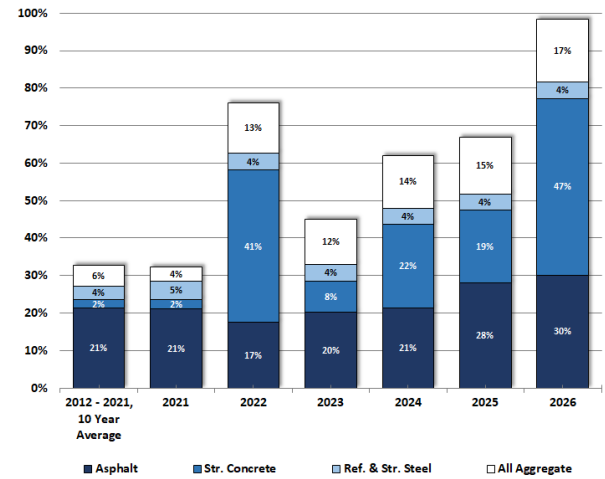


Figure 3. Cost Composition Forecast Using Forecast Prices



Source: TBG calculated from data provided by FDOT Office of the Work Program and Budget, TBG Work Product.

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Introduction

The Florida Department of Transportation commissioned The Balmoral Group (TBG) to evaluate the availability of critical highway construction materials in Florida. The evaluation includes an analysis of existing and planned supply of these materials, and an estimate of future costs and quantity requirements FDOT will face in fulfilling its five-year work program. Materials in the analysis include the bituminous, cement, steel, aggregate and earthwork markets. An annual assessment of the materials markets and significant trends affecting FDOT's supply availability and costs is included in this report.

The report is organized as follows:

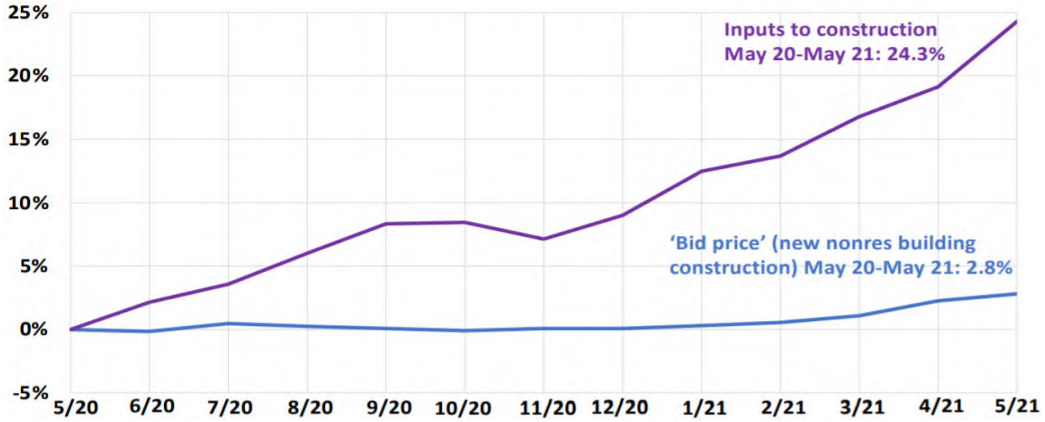
- General Economic Landscape for highway construction materials,
- Work Program Work Mix allocation and materials quantities estimates,
- Material-specific findings for supply chain variables, including
    - raw material sources,
    - existing and likely future transport and distribution methods,
    - potential impact of external forces including global markets, technological change, foreign materials, and environmental regulatory or permitting issues, as relevant,
    - forecasts of likely Florida supply and FDOT costs for the five-year work plan, and
- GIS maps of existing supplier locations.

General Outlook for Highway Construction Materials

Inflation?

Using data from the Bureau of Labor Statistics (BLS), the Associated General Contractors (AGC) highlighted in a new report how prices of different materials have risen this past year and how these are affecting producers. The trend shown in previous reports of input costs for construction rising significantly but bid prices not, continue. For instance, while input costs for construction industries rose 24% between May 2020 and May 2021, producer prices only increased only 2.8% during the same timeframe (**Figure 4**) suggesting that so far producers have absorbed the higher costs to secure jobs in a more competitive market.

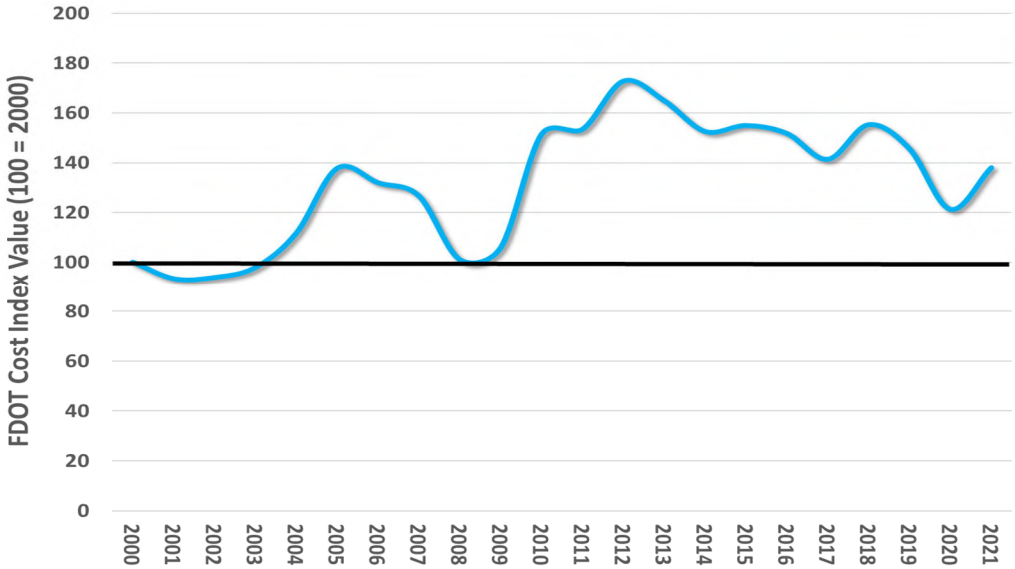
Figure 4. Change in Construction Input Costs and Bid Prices



Source: AGC

An analysis of FDOT material costs indicates price increases accumulated over the last decade appear to be permanent (**Figure 5**).

Figure 5. FDOT Construction Cost Index, 2000 - 2021



Source: TBG calculated from data provided by FDOT Office of the Work Program and Budget, TBG Work Product.

The BLS also releases the Producer Price Index (PPI) by commodity type. Nationally, steel products have increased the most with increases as high as 90% (iron and steel scrap) compared to a year ago. Asphalt and paving mixtures products have had significant increases since December 2020 (almost 60%) and are up 65% year-over-year, but are at similar levels compared to 2019. While this data shows that most aggregate and concrete products have increased less than 5% year-over-year, producers in Florida are seeing much higher price increases in 2021 as discussed in their respective sections. **Table 1** illustrates select PPI in the U.S. for relevant commodity types.

Table 1. Producer Price Index Percent Change by Commodity

Commodity	Dec 20 – Jun 21	Jan 21 – Jun 21	May 21 – Jun 21	Jun 20 – Jun 21
Construction sand and gravel (run of pit/bank, washed, screened, etc.)	2.2%	1.8%	0.2%	2.8%
Crushed and broken stone	4.4%	2.6%	0.2%	4.8%
Treated lightweight aggregate and crushed slag, minerals and earths	1.6%	1.8%	0.2%	1.7%
Cement, hydraulic	3.3%	2.8%	1.8%	3.8%
Ready-mix concrete	3.4%	3.2%	0.8%	3.1%
South region ready-mix concrete	4.4%	4.1%	1.2%	2.6%
Precast concrete products	6.0%	4.5%	0.2%	7.7%
Pre-stressed concrete products	11.1%	9.8%	6.7%	8.6%
Asphalt	58.1%	42.8%	10.9%	65.1%
Paving mixtures and blocks	5.5%	-3.2%	2.3%	5.0%
Iron and steel scrap	35.0%	10.4%	9.9%	90.7%
Steel mill products	72.6%	63.7%	6.2%	87.5%
Fabricated structural metal for bridges	26.4%	14.4%	1.0%	30.8%
Truck transportation of freight	8.9%	7.9%	0.3%	15.4%
Rail transportation of freight and mail	4.8%	4.0%	0.4%	6.2%

Source: BLS (Producer Price Index, not seasonally adjusted); TBG Work Product

Funding

Infrastructure has been a priority in congress after the Biden Administration released a $2 trillion American Jobs Plan, which has led to different proposals. Recently, President Biden endorsed a $1.2 trillion infrastructure framework developed by a group of bipartisan senators. This would provide an additional $579 billion of new spending over five years, $302 billion of which would go for transportation infrastructure ($109 billion for roads, bridges and major projects). The funding would not raise taxes as initially proposed but it would repurpose unused covid-19 relief funds, improving tax enforcement, public-private partnerships, and sales from the strategic petroleum reserves, among other things. While this proposal is the one that has made more progress, as of this writing, it is not law.

Additionally, the House approved the INVEST in America Act. This $715 billion surface transportation and water infrastructure bill would replace the FAST Act that is set to expire in September 2021. According to the Fact sheet, roads, bridges and safety would get the largest share of the funding ($343 billion). Transit would receive $109 billion, passenger and freight rail $95 billion and the remaining would go to water and wastewater infrastructure. If Florida received only 1/50th of the roads/bridges/safety funding in a linear fashion, $6 billion would be available.

Buy America

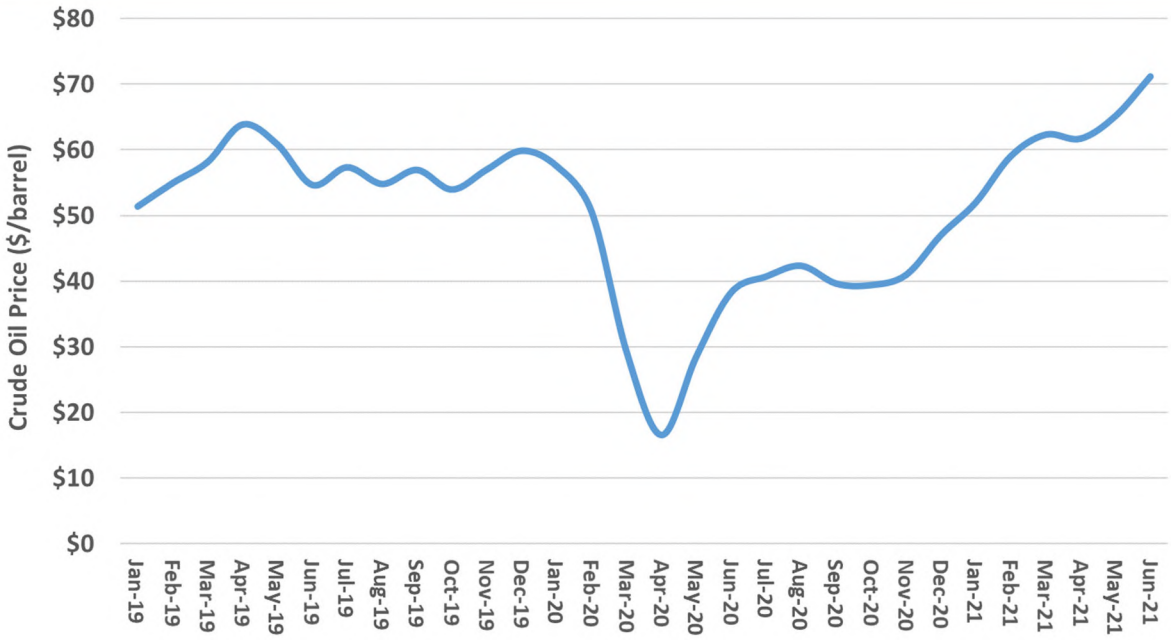
As part of the White House's "Made in America Week," President Biden has unveiled a new proposed rule of the Buy American Act. Currently, the Buy American Act requires products bought using taxpayer money should be 55% made up of goods in the United States. The new proposed rule would increase that percentage to 60% immediately, with a plan to get to 75% over 5 years. Additionally, the rule proposes new price preferences for products listed in the Critical Supply Chain review, as mandated in Executive Order 14017 and under the pandemic supply chain strategy in Executive Order 14001. There will also be a reporting requirement for critical products to enhance compliance and available data on the impact of the Act. Since January, the new "Made in America" office, which was created as part of Executive Order 14005 (Ensuring the Future is Made in All of America by All of America's Worker) has worked to reduce the amount of waivers annually as well.

The proposed rule is available for public comment. The Association of General Contractors (AGC) of America has been briefed by White House staff and gave feedback to inform the Federal Acquisition Regulation's process. AGC will also provide feedback on how this proposed rule should not exacerbate construction material shortages and price increases.

Energy Prices

The EIA Annual Energy Outlook 2021 projects that US crude oil prices could grow by 14% this year. Current monthly crude oil spot prices continued the upward trend seen through the end of 2020 (**Figure 6**), reaching $71 per barrel in March 2021 (highest since October 2018). Year-to-date, prices have increased 37% and year-over-year they have increased 86%, however the price recovery is coming off historic lows and returning to more normal levels.

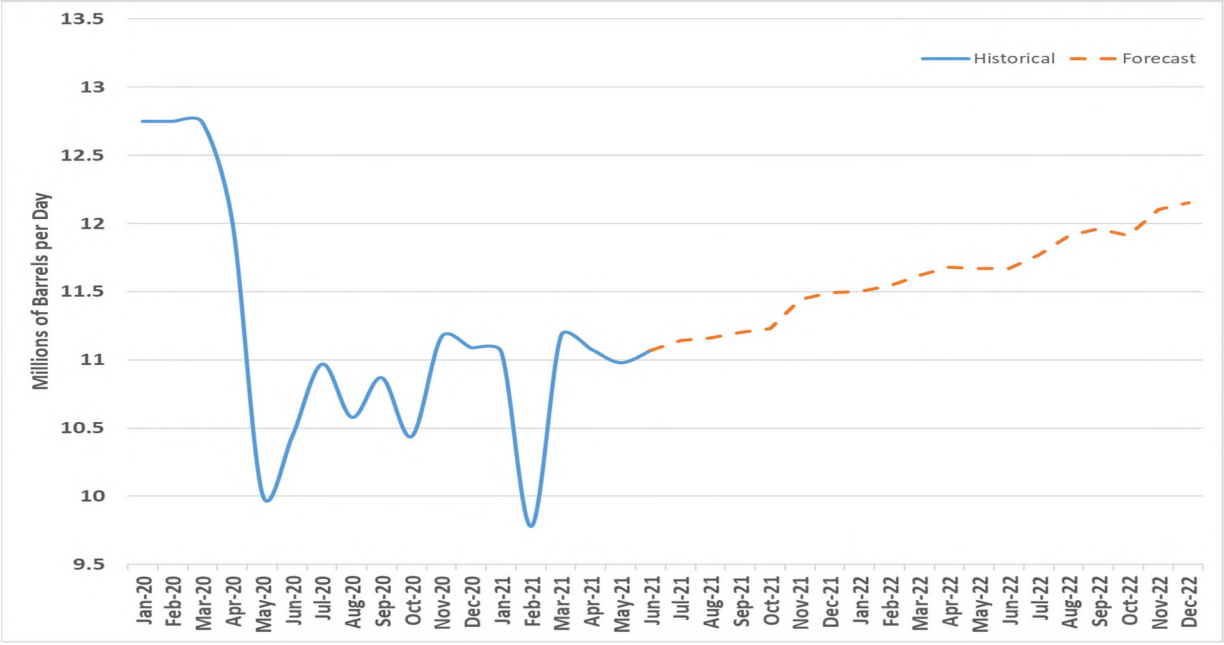
Figure 6. Monthly Crude Oil Price, 2019 to 2021



Source: EIA Average Monthly Spot Prices.

According to the EIA, U.S. crude oil production in 2021 is expected to average 11.1 5 million barrels per day in and this will increase to close to 12 million barrels per day in 2022. Beyond 2022, the EIA projected U.S. crude oil production to stabilize at around 13.5 million barrels per day up to 2040. **Figure 7** shows the short-term outlook crude oil projections.

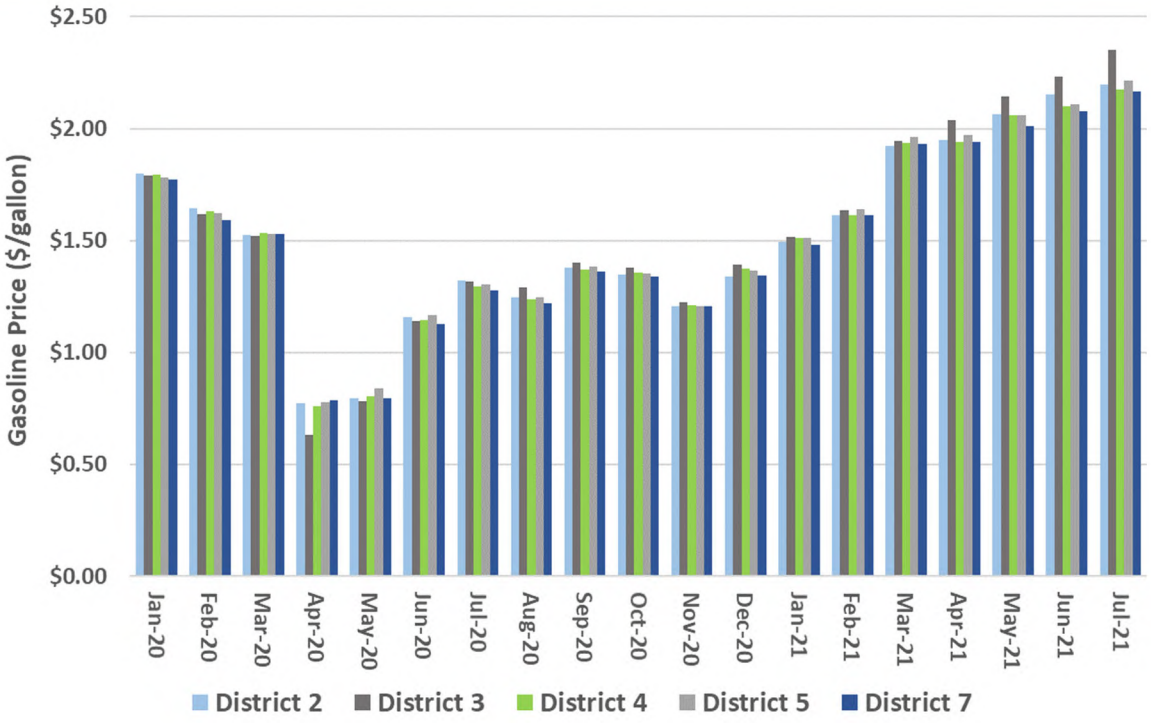
Figure 7. Total U.S. Crude Oil Production Projections (mil. barrels per day)



Source: EIA

Diesel price quotes from suppliers at terminals around the state show a steep decline in prices at the start of the COVID-19 pandemic (**Figure 8**). Since December, prices have steadily increased in all districts. In March 2021, almost all districts were at $2 per gallon, the highest since January 2020. Statewide, the Fuel and Bituminous Average Price Index for diesel has increased 42% year-to-date and 18% year-over-year to 2.28.

Figure 8. Average Diesel Price by District

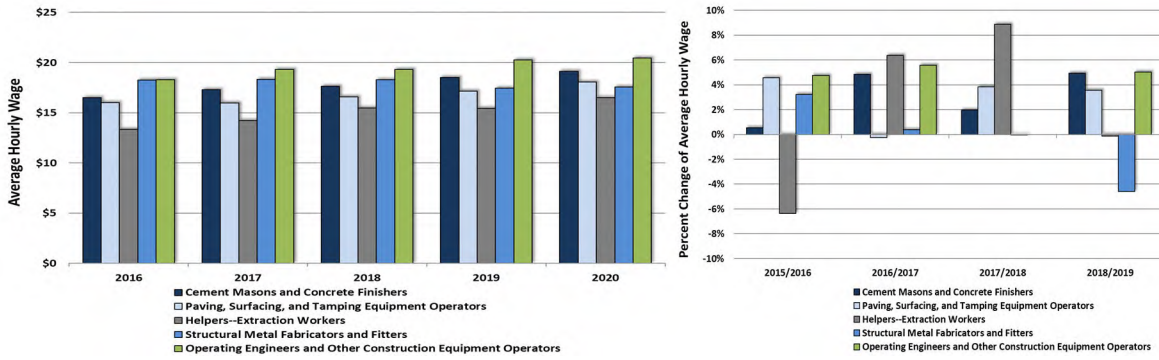


Source: FDOT, TBG Work Product (D1 and D6 terminals did not report data).

Relative Wages by Sector

Florida average hourly wages, along with the annual change in wages, is shown by materials sector for primary labor types in **Figure 9.** After a 5% decline in 2019, wages for structural metal fabricators grew by almost 1% in 2020. Workers in the asphalt and aggregate industries saw wage increases of more than 4%. Note, this data was just released for May 2020, which is the most recent available at this level of detail.

Figure 9. Hourly Wage Rates for Key Workers in Each Materials Industry in Florida, 2016 – 2020

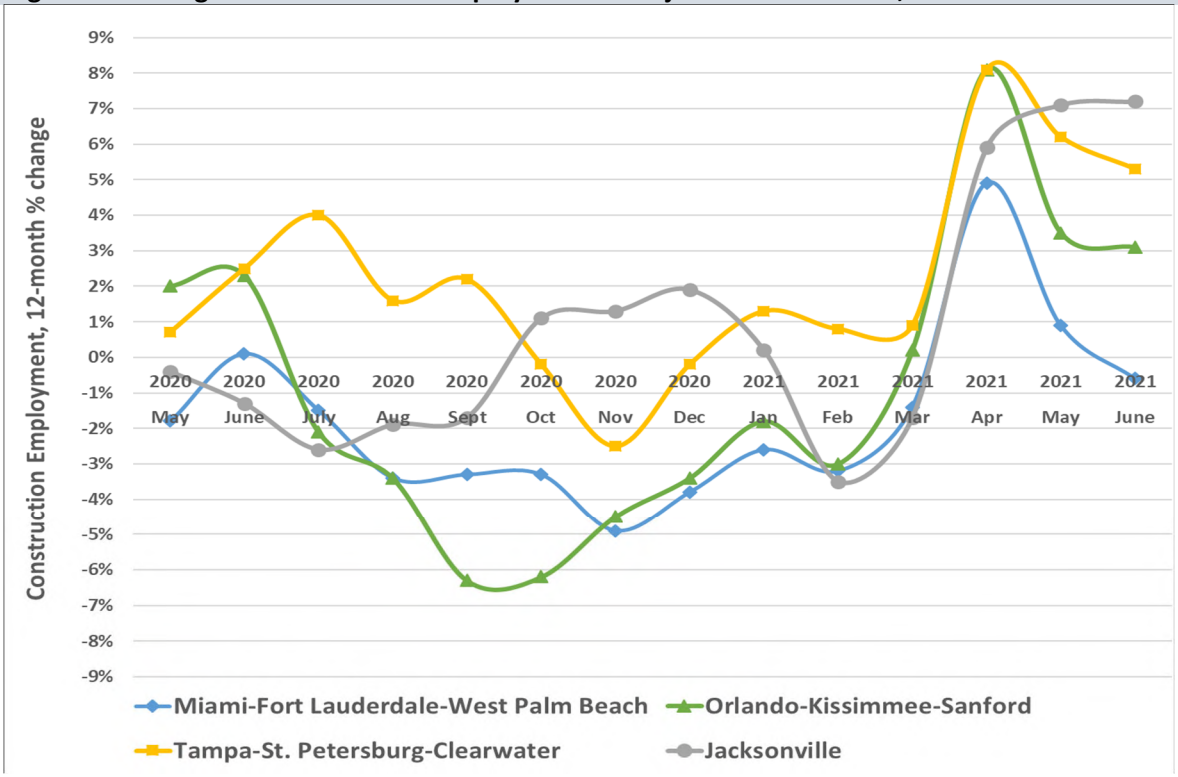


Source: U.S. Bureau of Labor Statistics

Construction Employment

Construction employment in the most populated areas of Florida have shown signs of recovery since November 2020 (**Figure 10**). All metro areas show significant increases in April 2021, as the initial effects of the pandemic began around April 2020. The Jacksonville metro area is the only one to continue its year-over-year growth for May and June 2021, while the Orlando and Tampa metro areas had a pull back for these months. Construction employment in the Miami metro area was 1% below from a year ago. According to UCF's forecasts, construction employment in Florida is expected to grow, on average, 1% per year until 2024.

Figure 10. Changes in Construction Employment in Major Florida Markets, Jun. 2020 – Jun. 2021



Source: Bureau of Labor Statistics.

Production Capacity

Table 2 provides a summary of plant counts for the primary materials types. The current inventory shows that aggregate producers have been stable in the last years, with concrete adding plants at a consistent pace. The number of asphalt producers has remained relatively stable since 2012, while approved steel plants were almost unchanged from a year ago.

Table 2. Number of Producers by Material

Material Type	2012	2018	2019	2020	2021
Aggregate	188	234	242	236	238
Asphalt	109	104	107	115	116
Concrete (Ready-mix Plants)	327	454	465	486	494
Steel	135	168	116	112	113

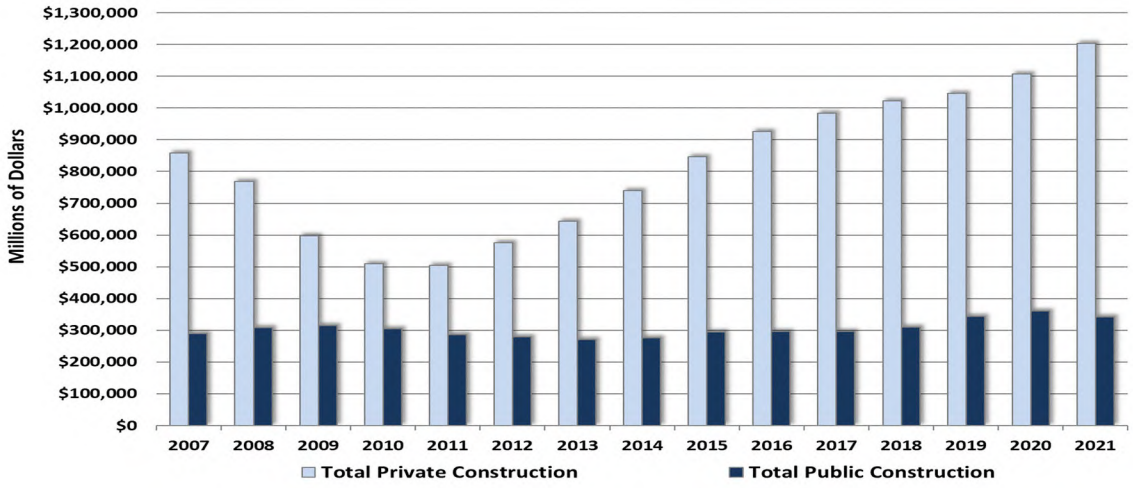
Source: FDOT Approved Producer List, 2021 as of June 1st

In the 2021 TBG survey, aggregate producers report that FDOT makes up 21% of their work (a decline from 25% in 2020). When analyzed for other materials, FDOT makes up 45% of all concrete work (up from 21% in 2020), 30% of all asphalt work (down from 40% in 2020) and 17% of all steel work (down from 26% in 2020).

Concrete respondents report increasing in operating capacity from 38% in 2020 to 56% in 2021. Aggregates producers are operating at a greater capacity (62%) than reported last year (52%). Steel producers have remained stable at 63% of total capacity in 2021, while asphalt producers slightly increased from 37% in 2020 to 40% in 2021.

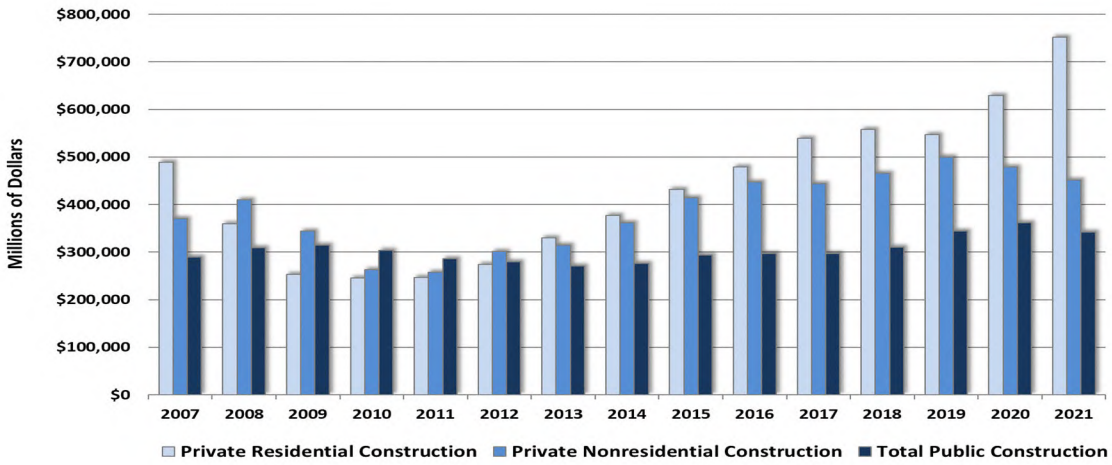
Nationally, construction has surpassed 2006 peaks over the last five-years (**Figure 11**); however, the work is spread unevenly across markets. Public construction has remained relatively stable since 2013, with a 5% increase in 2020; while non-residential construction fell 4% in 2020 and an additional 6% is expected for 2021 (**Figure 12**). Conversely, private residential construction increased by 15% in 2020 and is expected to continue in 2021. This scenario reflects the COVID dynamic, and the shift away from commercial property investment, which is likely to take a few years to recover. The decline in commercial investment is offset by public investment.

Figure 11. U.S. Construction Put in Place, 2007 – 2021



Source: U.S. Census Bureau

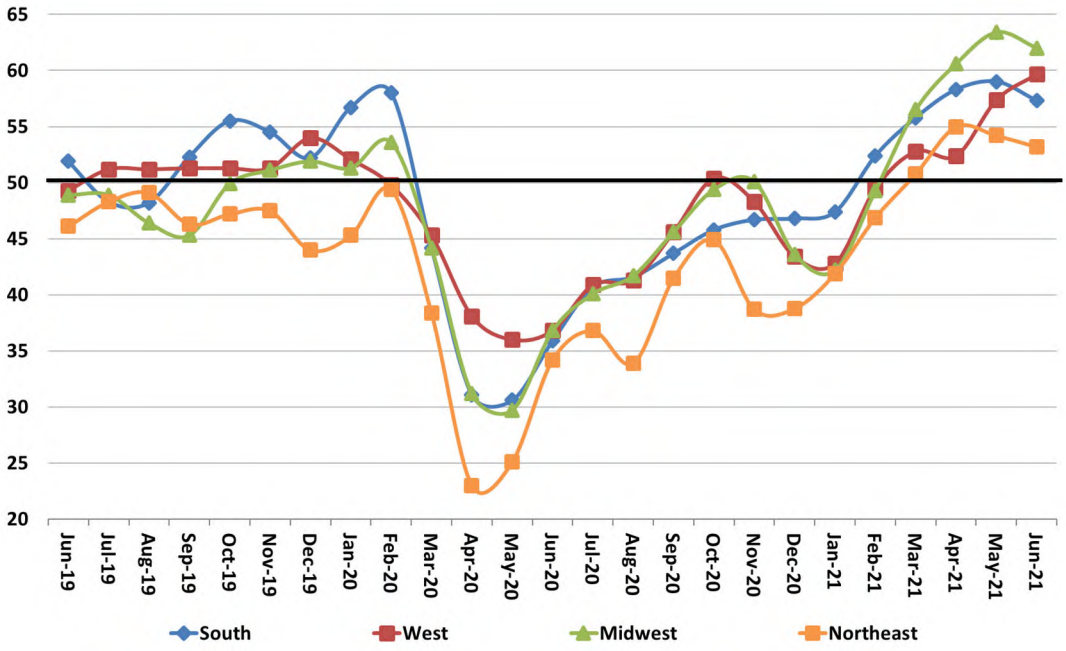
Figure 12. Residential Construction Put in Place, 2007 – 2021



Source: U.S. Census Bureau

As the Architecture Billings Index (ABI) shows in **Figure 13**, all markets continue recovering (all indicate increased billings) and are at similar or higher pre-pandemic levels. The southern region, which had four consecutive months increasing, had a slight pullback in June 2021, but it is still above 50 (indicating increased billings). All the other markets continue showing increased billings and are at similar or higher pre-pandemic levels. ABI Billings are considered a leading indicator, meaning that construction activity 6-12 months from now generally follows the current ABI billings activity. A score below 50 indicates declining firm billings.

Figure 13. ABI Billings Index, June 2019 – June 2021



Source: American Institute of Architects, Architecture Billings Index

Bid Data

Bid data between 2019 and 2021 was analyzed to assess competitive behavior in the districts (**Table 3**). In economic terms, the expected value is the average of all bids, and in this analysis, the average of all bids, or the mean, is compared to the official preliminary estimate (not the low bid or awarded bid). In the second quarter, the average deviation of bids from the mean bid was 8% (9% for bids above the mean bid and 8% for bids below the mean bid), slightly down from 10% in the first quarter of 2021. Average deviations in all districts continued at less than 15% in the second quarter of 2021, with Districts 2, 3 and 7 all having much tighter bids and dropping below 10%. Using a 3-month rolling average, while the gap between the average amount bid against the official preliminary estimate rose the first months of 2021, this was smaller during the second quarter at similar levels compared to the fourth quarter of 2020. The average bids for each project were 17% higher than the official preliminary estimate in the first quarter of 2021, but these were only 7% higher through the second quarter (**Figure 14**). Additionally, while high value contracts appeared to be increasing the gap during the first quarter, excluding contracts $100 million or more from the analysis for the second quarter show that the average of all bids were also 7% higher than the official preliminary estimate.

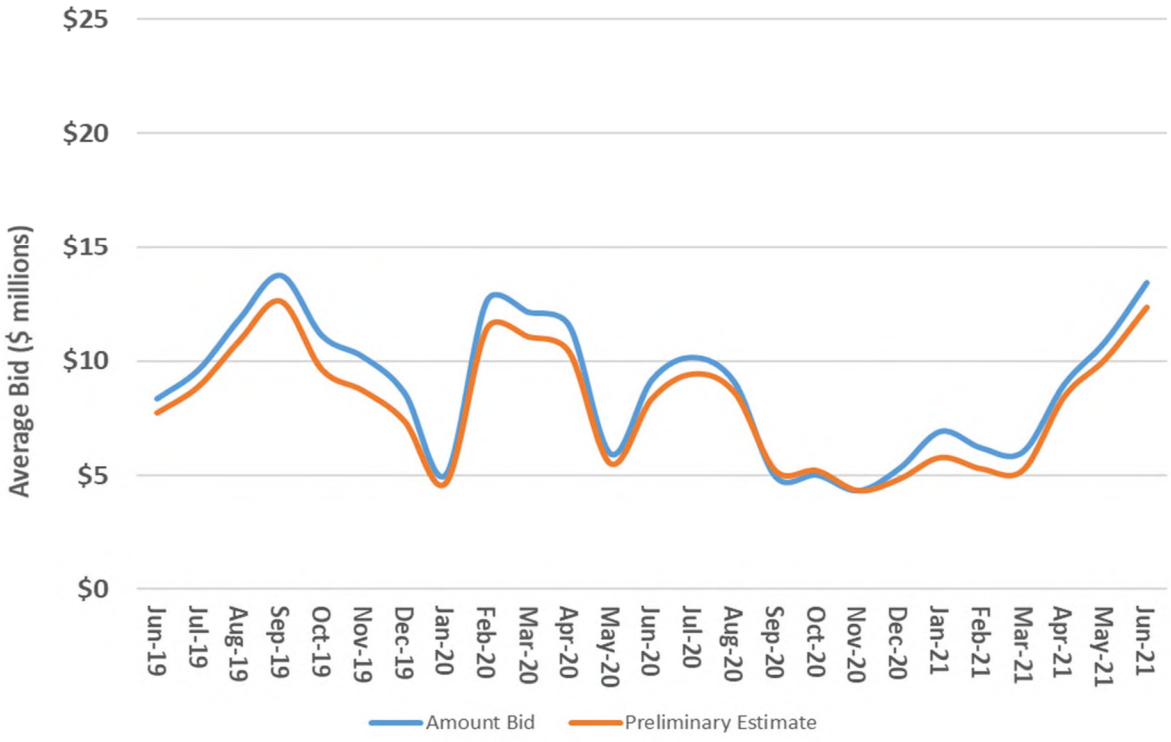
As a whole, looking at late 2020, it is evident that the uncertainty of COVID and shrinking backlogs was motivating more aggressive bidding, but this cycle reversed from December forward.

Table 3. Average Deviation from the Mean Bid by District

	District 1	District 2	District 3	District 4	District 5	District 6	District 7	District 8
1Q 2019	11%	6%	13%	14%	12%	9%	12%	-
2Q 2019	10%	10%	15%	9%	11%	9%	12%	7%
3Q 2019	9%	16%	11%	7%	19%	11%	11%	6%
4Q 2019	13%	11%	11%	8%	14%	10%	15%	9%
1Q 2020	15%	10%	16%	14%	16%	11%	16%	12%
2Q 2020	9%	13%	7%	8%	10%	11%	10%	14%
3Q 2020	10%	12%	15%	10%	11%	7%	20%	9%
4Q 2020	18%	8%	10%	6%	17%	10%	11%	13%
1Q 2021	12%	11%	11%	8%	9%	8%	14%	8%
2Q 2021	6%	13%	5%	8%	12%	7%	8%	10%

Source: FDOT; TBG Work Product

Figure 14. Average Bid vs. Preliminary Estimate. 3-month Rolling Average



Source: FDOT; TBG Work Product.

Work Program – Highway Construction

A summary of FDOT's Five-year Work Program (including P3 projects) by Work Mix Type is shown in **Table 4**. The Work Program totals in years 2025 and 2026 reflect approximately $1 billion (each year) in additional allocations for Resurfacing and Bridge Repair projects that are not yet programmed.

On the roadway maintenance side, resurfacing amounts are projected to reach record levels through the last four years of the Work Program. Add Lanes construction also increases substantially from 2022 to 2026. Work Mix Types follow typical allocations, though New Bridge/Bridge Replace projects have been front-loaded in 2022, driven by the Brooks Bridge project in Okaloosa County and the NASA Causeway Bridge project in Brevard County, with another jump in expenditures expected in 2026 for bridge repairs and replacements in Duval and Indian River counties, among others. Concrete requirements for FDOT are expected to increase substantially in 2022 and 2026 as a result.

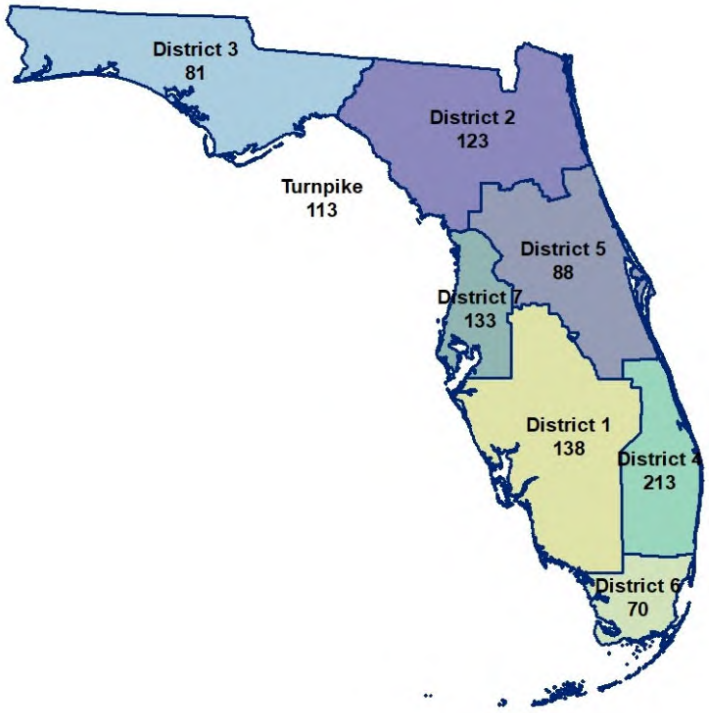
Table 4. Work Program Dollar Allocation by Work Mix Type

Work Mix Type	2022	2023	2024	2025	2026
Add Lanes	$1,064,597,568	$611,592,741	$1,166,156,569	$1,394,930,248	$1,093,052,695
Bikepath	$81,113,660	$19,320,833	$25,840,775	$37,827,756	$16,639,892
Bridge Replace/New	$559,457,747	$99,458,623	$266,766,674	$247,358,914	$731,503,429
Drainage	$11,296,199	$24,193,303	$11,006,981	$3,446,549	$18,475,023
Guardrail	$30,629,186	$19,973,219	$7,567,989	$3,722,996	$7,968,058
Interchange	$343,881,258	$133,066,161	$572,576,090	$409,984,430	$118,747,835
Intersection	$58,260,918	$36,677,734	$14,964,333	$21,436,427	$3,194,755
ITS	$36,315,824	$54,202,762	$34,992,240	$14,673,715	$9,373,008
Landscaping	$39,153,243	$40,592,766	$39,734,967	$37,407,418	$14,486,874
Miscellaneous	$91,683,608	$78,988,738	$47,579,771	$37,630,892	$47,584,491
New Road	$110,486,045	$957,129,408	$27,715,136	$34,621,794	$31,954,676
Resurfacing	$948,602,785	$1,062,755,881	$1,086,352,334	$1,475,170,023	$1,445,598,342
Rigidpave	$0	$52,008,225	$72,540,413	$44,218,623	$47,838,601
Signing/Pavement Markings	$2,209,571	$576,619	$1,169,756	$0	$3,000,000
Toll Plaza	$14,028,961	$30,637,241	$42,282,320	$34,902,434	$33,530,176
Traff Ops	$27,705,388	$34,719,004	$26,435,403	$35,127,849	$21,559,755
Widen/Resurface	$10,969,718	$28,785,583	$15,881,617	$6,931,296	$5,306,141
Total Work Program	**$3,430,391,679**	**$3,284,678,841**	**$3,459,563,368**	**$3,839,391,364**	**$3,649,813,751**

Source: TBG calculated from data provided by FDOT Office of the Work Program and Budget.

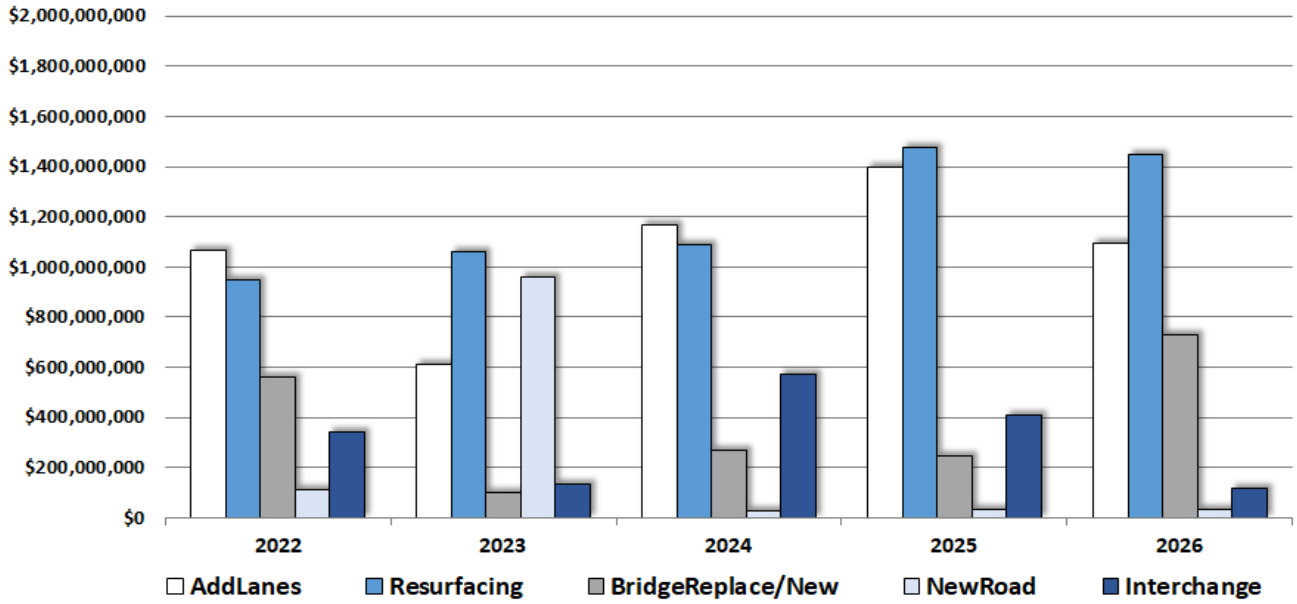
Figure 15 shows projects identified by the FDOT Five-year Work Program and bridge counts derived from Work Program data by district. **Figure 16** provides a comparison by Work Mix type of allocated work program funds for major projects over the five-year work program.

Figure 15. Work Program Roads and Bridges Count Estimates by District



Source: TBG calculated from data provided by FDOT Office of Program Management.

Figure 16. Work Program Allocation by Work Mix Type, Average Allocation > $250 million



Source: TBG calculated from data provided by FDOT Office of the Work Program and Budget.

Estimates of Future Quantities

Materials quantities estimates are provided in **Table 5**. Resurfacing projects for the out years of the work program as currently reported result in very large asphalt expenditures.

Table 5. FDOT Future Material Requirements[1]

Material	Units	2022	2023	2024	2025	2026
FDOT Work Program	$ millions	$3,391	$3,244	$3,420	$3,802	$3,635
Asphalt	000s TN	5,171	5,348	5,606	7,639	7,407
Concrete						
Structural Concrete	000s CY	1,491	269	698	678	1,852
Ancillary Concrete		432	631	743	642	541
Total Concrete		1,922	899	1,441	1,319	2,394
Steel						
Reinforcing Steel	TNs	13,226	12,165	12,331	13,182	12,119
Structural Steel		13,807	12,700	12,873	13,761	12,652
Other Steel		96,273	88,553	89,760	95,953	88,218
Total Steel		123,306	113,419	114,964	122,895	112,989
Aggregate						
Base Material/Other Aggregate	000s TN	1,807	1,649	1,904	2,427	2,287
Aggregate for Asphalt		4,375	4,524	4,743	6,463	6,266
Aggregate for Concrete		2,634	1,233	1,975	1,808	3,280
Total Aggregate		8,816	7,405	8,622	10,698	11,833

Source: Calculated by TBG, from FDOT Work Program & Estimates data.

FDOT asphalt binder specs have undergone substantial revision in recent years with more flexibility provided to contractors, who may choose their preferred binder in many instances. As a result, historical use of different binder types, which were dictated by design spec, will not reflect future use of different binder types. Based on survey results and data from current year lab volumes received for testing, estimates of likely scenarios for binder demand were prepared. The outlook includes no Ground Tire Rubber binder based on current reports. **Table 6** provides a breakdown by type of estimate binder demand for the five-year work program.

Table 6. FDOT Future Requirements of Asphalt Binder

Asphalt Binder (Tons)	2022	2023	2024	2025	2026
PG 52-28	32,672	33,786	35,421	48,265	46,796
PG 58-22	35,078	36,274	38,030	51,820	50,243
PG 67-22	12,575	13,003	13,633	18,576	18,011
PG 76-22 (PMA)	148,220	153,273	160,690	218,958	212,296
High Polymer	3,650	3,775	3,957	5,392	5,228

Source: Calculated by TBG, from FDOT Work Program & Estimates and SMO data.

[1] Tonnage for aggregate in asphalt is estimated at 94.54% of the asphalt total, and reduced by another 10% for RAP, based on historical FDOT data.

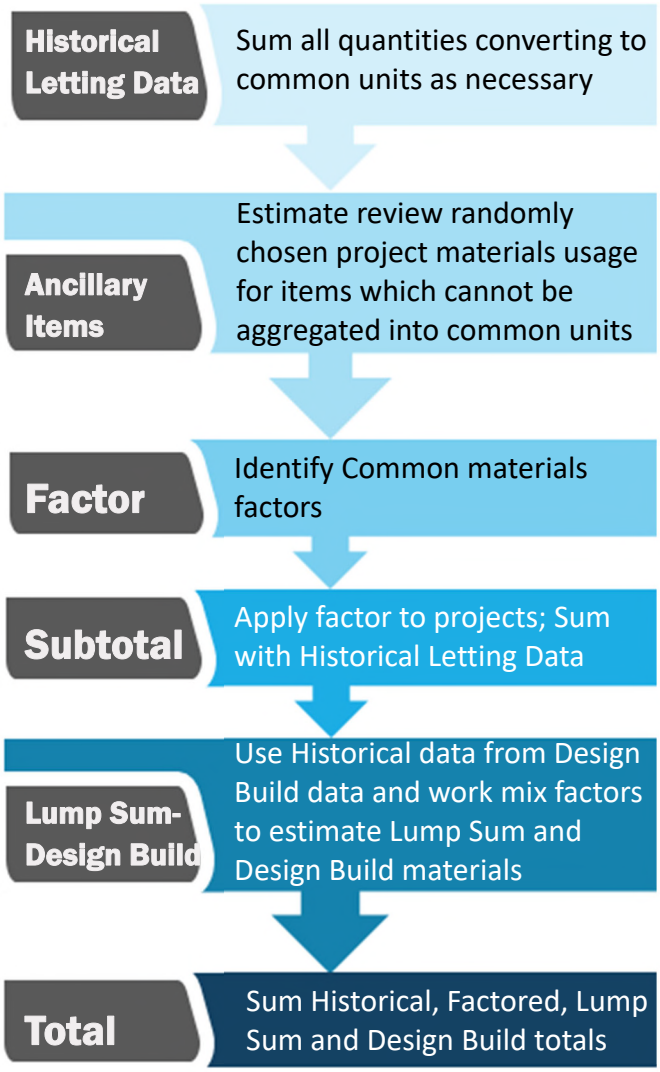
FDOT Data

Future quantities are estimated for the five-year work program (**Figure 17**). Historical Lettings and LRE data are received from the FDOT Offices of Work Program and Budget and Program Management/Estimates. Historical Lettings data contains pay item level lettings data from July 2009 through June 2021 (FDOT fiscal years 2010 – 2021) and LRE pay-item level data from June 2021 through March 2027 (fiscal years 2021 – 2027). FDOT Work Program and P3 data was received from the Office of Work Program and includes 2,199 unique projects.

Quantities are estimated using a factor approach. The factors were calculated by Balmoral economists and roadway engineers after evaluating several statistical relationships, including historical share of dollars spent for different project types, length of project and other variables depending on work mix type. The factors were originally created in 2007 from pay item data and most recently updated using pay item data through 2021 for the current study.

Raw Five-year Work Program data includes work mix level dollars for fiscal years 2022 – 2026. LRE data provided to Balmoral contains 1,498 unique projects. LRE price estimates for 2022 through 2026 were based on all projects types and used in conjunction with Work Program dollars to estimate future material quantities.

Figure 17. Basis of Calculations



Asphalt

Key Findings - Asphalt

- Binder prices have increased by 23% in 2021 due to higher oil prices and higher production costs. Expectations are that there could be further increases in the future as there is strong demand and supply continue being constrained.
- 71% of producers anticipate the industry having difficulties meeting demand. Labor and trucking are ongoing issues, with some reporting troubles with rail, raw materials and delays in shipments.

FDOT impacts

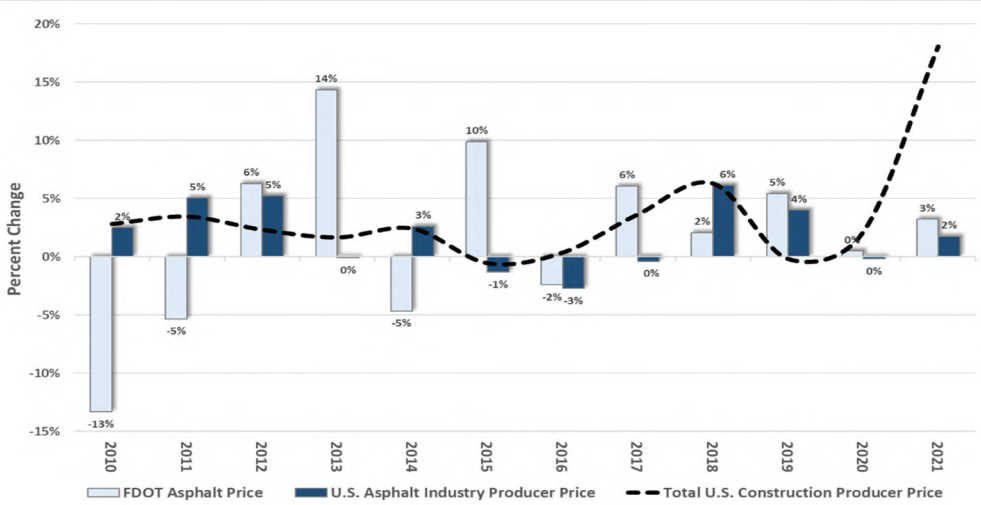
- FDOT HMA prices have increased 4% in fiscal year 2021.
- Competition has constrained cost increases; however, producers reported an average price increase of 18% from suppliers since March 2021 and expect to raise bid prices, on average, 19% by end of year.
- Under normal conditions, the share of domestic material accounts for 38% of the total and only 20% of the existing supply is available for roadway, which leaves 8% of domestic material for FDOT use. We estimate that proposed Buy America revisions as of July 2021 would restrict FDOT to only 6% of available binder.

Asphalt prices are currently at record highs for the period of FDOT data available (dating to 1993). A series of factors are supporting high prices. While the share of construction employees to all employees in FL and Chinese imports are near all-time high, U.S. asphalt refining and binder imports have significant declines in 2021.

Industry Outlook

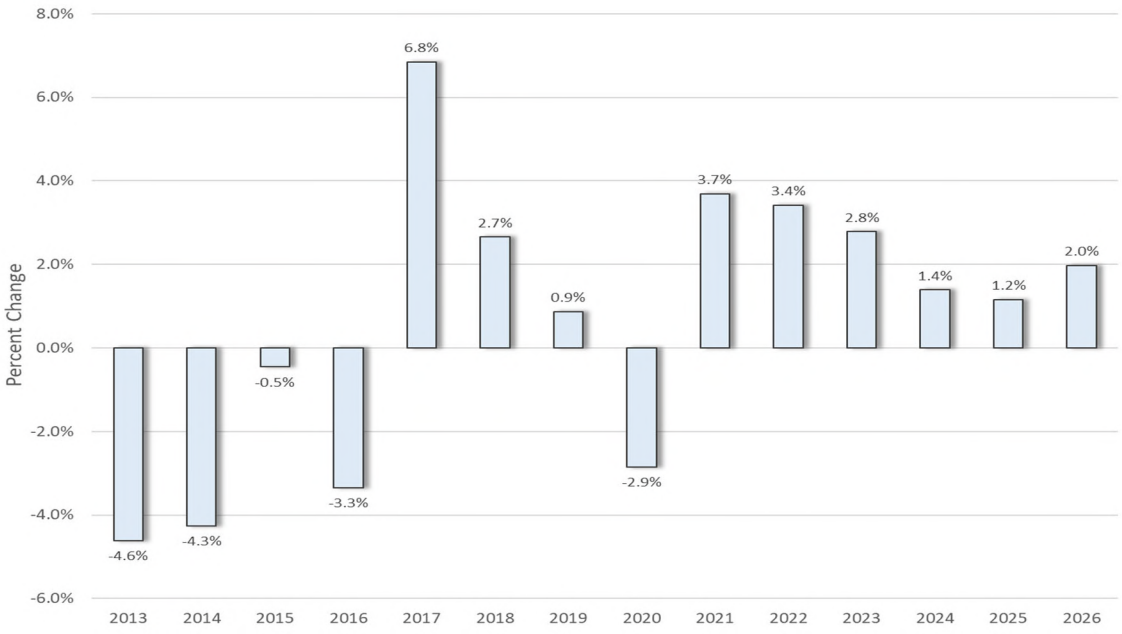
Nationally, while construction producer prices fluctuated between 0 and 5% in most years, they have drastically increased in 2021 with an 18% increase compared to 2020 prices. Meanwhile, FDOT's asphalt prices have increased 3% in 2021. A comparison of changes in producer prices since 2010 as well as FDOT's asphalt price is provided in **Figure 18.** Recent revenue projections through 2026 showed steady growth for the asphalt industry (**Figure 19**).

Figure 18. Change in Producer Prices, Asphalt Industry



Source: FDOT, U.S. Federal Reserve

Figure 19. Asphalt Manufacturing Industry Revenue Outlook

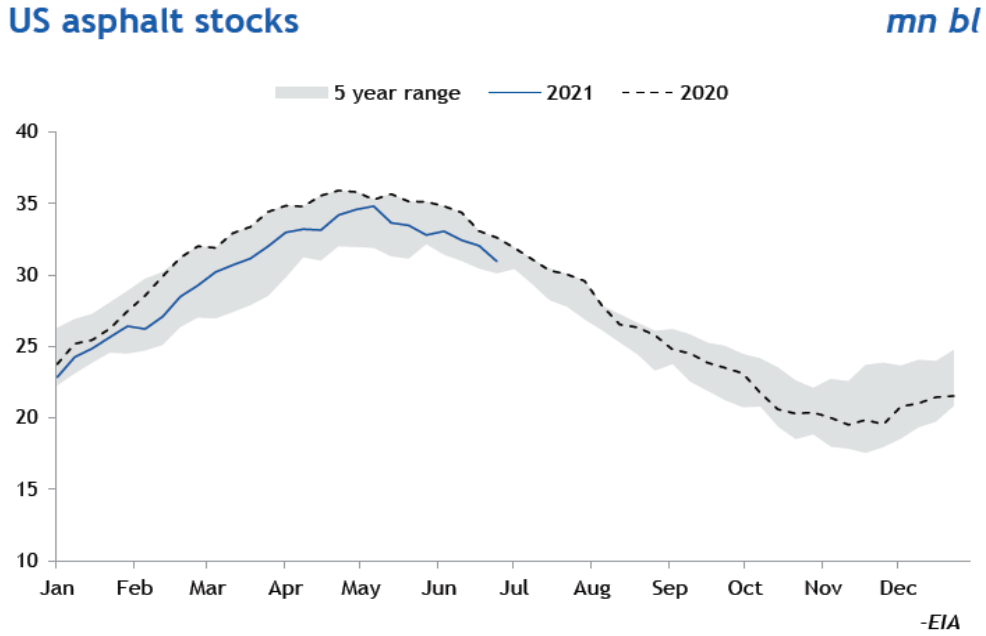


Source: IBIS Industry Reports, Asphalt Manufacturing, April 2021

Refinery Capacity

Since the start of the pandemic refiners have been forced to continuously adjust production in response to higher production costs and uncertainty over demand recovery. U.S. asphalt inventories in 2021 have been within the 5-year range after being at record high levels last year during the first months of the pandemic (**Figure 20**). In June

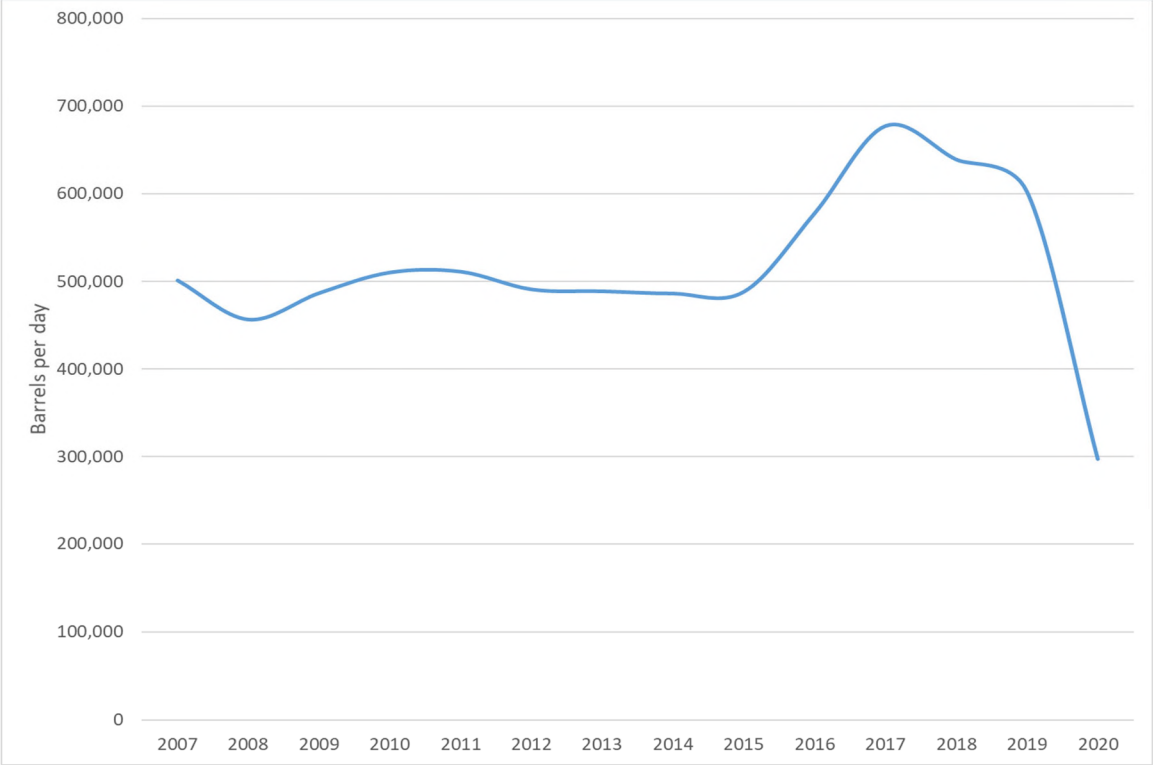
Figure 20. U.S. Asphalt Stocks, 2020 vs. 2021



Source: Argus

2021, Gulf coast refiners were at similar pre-pandemic levels with a 93% utilization (they were at 78% of capacity a year ago). However, according to the Oil & Gas Journal 2020 Worldwide refining capacity summary, asphalt refining in the U.S. in 2020 declined from over 600,000 bpd to approximately 300,000 bpd (**Figure 21**). This is a much steeper decline than the one that happened in the previous recession (approximately 10%). Argus reported late in 2020 that about 780,000 bpd of refinery capacity in the U.S. will be shut down and 821,000 bpd will be idled throughout 2021. 86% of the idled capacity is located in Louisiana and they were expected to resume when refining economics improve.

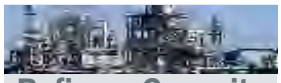
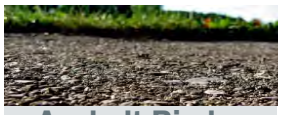
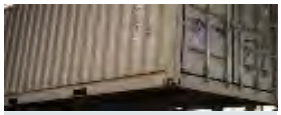
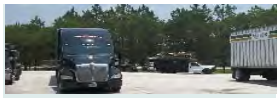
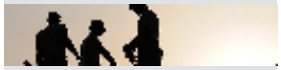
Figure 21. U.S. Asphalt (including road oil) refining as of Jan. 2021



Source: Oil & Gas Journal

Supply Chain Variables for Asphalt Pavement Materials

Table 7 provides the current status of selected variables of interest. **Table 8** provides a summary of relevant variables that have been found in the past to influence FDOT's costs at a statistically significant level from 2011 - 2021.

Table 7. Supply Chain Summary: Asphalt Materials		
 Aggregate	Sources for HMA are dominated by Georgia granite shipments and rock from South Florida Lake Belt mining area. There are no reports of issues with aggregate availability. Several HMA suppliers are vertically integrated to better manage their aggregate supply.	=
 Refinery Capacity	Refinery runs in the U.S. Gulf Coast have recovered to pre-pandemic levels, reaching 93% utilization in June 2021. Production costs continue to be affected by higher crude oil prices. The crude oil market is expected to be volatile as countries increase production with higher demand. Sanctions to Iran and Venezuela are still in place, but U.S.–Iran talks continue to ease sanctions.	↑
 Asphalt Binder	Unmodified (PG 67 & lower) asphalt binder prices have increased 23% since January 2021 and 11% year-over-year. Crude oil prices have increased with lower supply and higher fuel demand as economies continue reopening. Production costs have also increased as refiners have had to make constant adjustments	↑
 Polymers	With very few suppliers, polymers are a source of vulnerability. Companies reported production returning to near full capacity after weather related disruptions in the Gulf coast. Earning releases show significant price increases across different chemicals segments. Publicly traded companies expect strong demand and tight supply as inventories are low and backlogs continue to be predominant during the second half of 2021.	↑
 Imports	Cost of imports have risen while U.S. sanctions against other countries are still in place. As a result, importing materials from Europe or the Mediterranean are not viable options at this time. Data from the U.S. International Trade Commission shows limited amounts of bitumen were imported into Florida in 2021. In general, prices are expected to increase as bitumen used in Florida markets is primarily sourced from overseas.	↑
 Shipping	Reports do not indicate significant increases in shipping costs due to the implementation of the IMO 2020 rule. So far, compliance has been high and there are no indications of significant fuel shortages. Producers indicated backlogs and delays with deliveries of parts and materials.	=
 Rail	More shippers have used rail rather than trucking to stockpile inventories due to a tight trucking market. CSX quarterly report shows that shipments of chemicals in the first quarter of 2021 decreased by 8% vs. Q1 2020 with lower shipments of energy related products, but more shipments of plastics. Fuel costs increased 36% compared to December 2020, but they are still slightly lower compared to March 2020. CSX also reported that 67% of shipments are on time, with on-time arrivals being down 20% compared to the same quarter last year. Of the producers in the survey that expect the industry to struggle meeting demand, 60% indicated rail capacity as a factor that is getting worse.	↑
 Trucking	Asphalt suppliers may continue to face driver shortages as demand for drivers from various industries continue to be high. Reports of increasing pay rates have continued in 2021 as a way to address driver shortages and producers in the survey identified trucking as a main driver for industry having difficulties meeting demand. The producer price index for truck transportation was up 17% year-over-year in May and 4% up from April 2021. There have not been any further actions on the DRIVE Safe Act that was re-introduced in March 2021.	↑
 Pavement Markings	No reported issues with pavement markings.	=
 Labor	Skilled labor is an ongoing concern for asphalt plant operators as reflected in the 2021 survey, where 71% expected difficulties meeting demand this year and labor being one of the primary causes.	↑
 Competition	According to FDOT's approved producer list there is one additional producer in 2021 compared to 2020. While some plant-operators reported increased competition throughout 2020, there are no new reports that this has exacerbated this year	↓

↑	Exerting negative influence on FDOT's costs; monitor.
=	Currently stable; not influencing FDOT's costs.
↓	Exerting positive influence on FDOT's costs.

Table 8. Historical Asphalt Data, 2011 –2021

*(Maximum values indicated with *)*

Asphalt	Units	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Crude Oil (WTI Spot Price)[1]	$/Barrel	$94.88	$94.05	$97.98*	$93.17	$48.66	$43.29	$50.80	$65.23	$57.00	$39.23	$63.77
Total Chinese Imports[2]	Billions of $	$1,743	$1,818	$1,950	$1,959	$1,680	$1,588	$1,844	$2,136	2,078	$2,057	$2,200*
Refinery Capacity for U.S. Refineries[3]	000s Tons/Year	33,435	32,110	31,973	31,803	31,933	37,803	44,316*	41,811	39,405	19,436	20,393
Florida Diesel Prices[4]	$/Gallon	$3.08	$3.17*	$3.16	$3.00	$1.84	$1.44	$1.78	$2.22	$2.04	$1.78	$1.97
Estimated FDOT HMA Requirements[5]	000s of Tons	4,418	3,740	4,179	3,255	3,914	4,457	2,978	4,140	6,034*	3,981	3,702
Estimated Statewide HMA Produced[6]	000s of Tons	13,538	12,654	12,952	13,687	14,442	14,727	16,710	17,546*	16,567	14,320	13,586
FDOT's Estimated Consumption of HMA Production[7]	%	32.63%	29.56%	32.27%	23.78%	27.10%	30.26%	17.82%	23.59%	36.42%*	27.80%	27.25%
FL Heavy & Civil Engineering Employees/ All FL Construction Employees[8]	%	13.46%*	13.22%	12.95%	12.56%	12.28%	12.33%	12.90%	12.45%	12.73%	13.01%	13.04%
FL Construction Employees/All FL Non-Farm Employees[8]	%	4.63%	4.63%	4.83%	5.08%	5.33%	5.65%	5.89%	6.16%	6.32%	6.61%*	6.59%
FDOT Work Program[9]	Billions of $	$1.89	$2.22	$2.59	$3.29	$3.18	$3.51	$4.00*	$3.82	$3.83	$3.72	$2.66
Asphalt Binder Imports Serving Florida[10]	Tons	441,979*	396,706	68,137	120,932	312,817	169,918	227,656	204,525	183,255	226,507	24,705
Average Asphalt Binder Price[11]	$/Ton	$706.15	$783.54*	$736.88	$748.99	$602.30	$450.45	$460.74	$610.86	$641.94	$566.62	$578.57
FDOT HMA Cost[12]	$/Ton	$84.77	$89.96	$93.91	$93.25	$98.49	$96.22	$101.73	$104.01	$109.63	$109.83	$113.77*

Sources: 1. EIA – Annual Average Spot Price; for 2021, YTD average through June. 2. WTO's World Trade Statistical Review; 2021 estimated. 3. EIA, Oil & Gas Journal, 2021 estimated. 4. FDOT Construction Office, 2021 through July. 5. Calculated, from data provided by FDOT Estimates Office; 2021 through June. 6. DEP through 2018; calculated 2019 and 2020 per EIA forecast. 7. Calculated from 5 & 6. 8. Bureau of Labor Statistics - State and Local Employment, 2021 through May. 9. FDOT Office of Work Program. 10. U.S. I.T.C.; 2021 through May. 11. FDOT Office of Construction, Fuel and Bituminous Price Index; updated to Modified Binders 76 & Higher; 2020 through July 12. Calculated weighted average, from data provided by FDOT Estimates Office

Hot Mix Plant Production

During the peak of the housing boom, Florida production exceeded 20 million tons annually. After showing a steady increase year over year since 2012, HMA production started to decline in 2019, followed by a 14% decline in 2020. In 2021, HMA plant production is estimated to grow by 1% to approximately 14.5 million tons.

IMO 2020 Rule

The International Maritime Organization (IMO) began imposing a sulfur cap on fuel used for shipping starting January 1st, 2020. Known as IMO 2020, the rule encourages production of light and middle distillate fuels. As asphalt binder is made from fuels with higher sulfur content, there was some uncertainty about effects on asphalt pricing. While the pandemic has disrupted the oil market and fuel demand, there were few complaints of non-availability and lack of compliance during the first year of the rule.

Aggregate

Aggregate sources for HMA are dominated by Georgia granite shipments and rock from the South Florida Lake Belt mining area. However, several factors warrant monitoring. Further Buy America restrictions could increase competition for domestic aggregate sources and could limit the alternatives producers have to find material. Aggregate production in the Lake Belt region increased significantly in 2018 as surcharge rates declined, but declined by around 50% in the following years. Further information on the Lake Belt region, existing reserves, and new mining activities can be found in the Aggregate section.

Polymers

The polymer industry is highly concentrated with only a handful of suppliers servicing Florida asphalt producers. While some reports expect capacity expansions in Asia to occur throughout the next year, several factors have constrained production in the U.S. Argus reported in 2020 that about 780,000 bpd would shut down, 821,000 bpd would idle, and storm Uri in the Gulf Coast led to temporary shut downs that worsened backlogs. Additionally, recent reports indicated that Saudi Aramco have put on hold the construction of a multi-billion petrochemical facilities in Texas.

Because the number of suppliers is still low, suppliers hold pricing power and this is still a point of vulnerability. Earning reports from publicly traded companies show strong year-over-year increases in volumes and prices. While these companies report prices in different ways, they all report price increases of at least 15% for their different petrochemicals segments and as high as 70%. Overall, they expect similar conditions in the market with strong demand, low inventories and supply shortages. Producers did not indicate longer than normal lead times or disruptions with polymers.

Asphalt Binder

Until the Great Recession, asphalt binder prices were closely correlated with crude oil prices. **Figure 22** shows the relationship between crude oil and Florida asphalt binder prices dating to 2000. The gap between crude and binder costs may be widening but COVID adds a new element of uncertainty. Crude prices have increased around 40% year-to-date and rack prices[2] in Jacksonville (41%) have shown similar increases since the last week of 2020. Rack prices in Miami (31%) and Tampa (31%) have also increased significantly but by not as much. Producers indicated

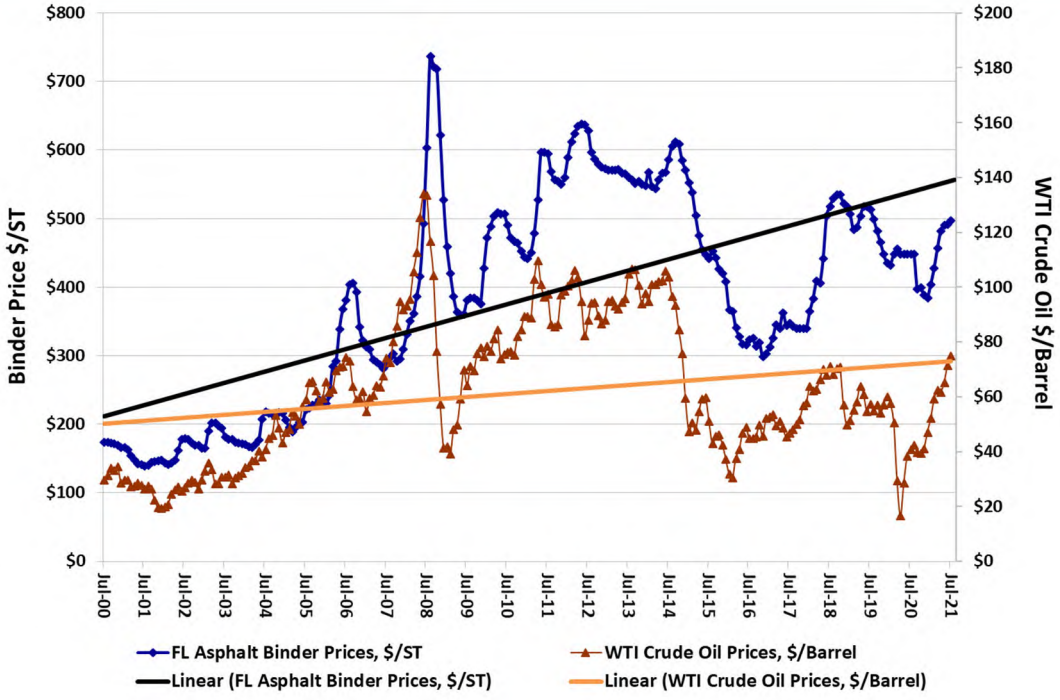
[2] Argus' asphalt rack prices reflect trades of different grades of asphalt within a defined region, which include where the seller commits to deliver to the buyer's truck, typically at a truck-loading rack.

that they have seen price increases from suppliers since March 2021. These have been on average 18%, but as high as 27%. Some expected further increases with higher crude oil prices.

OPEC+ members reached an agreement to increase monthly production by 400,000bpd to reverse last year's 5.8 million bpd production cuts. They also agreed to extend the cooperation agreement to adjust production depending on market conditions from April 2022 to December 2022. Additionally, China imposed a tax for bitumen imports that started this June and market estimates are that this will free another 400,000 bpd to the global market.

After PG-67 prices fell 11% to $384.5 per ton in 2020, year-to-date prices have increased 23% and 11% year-over-year to $497.35 per ton. While PG-76 binder prices decreased 13% in 2020, they have increased by 18% in 2021 and 5% year-over-year to $606.32 per ton.

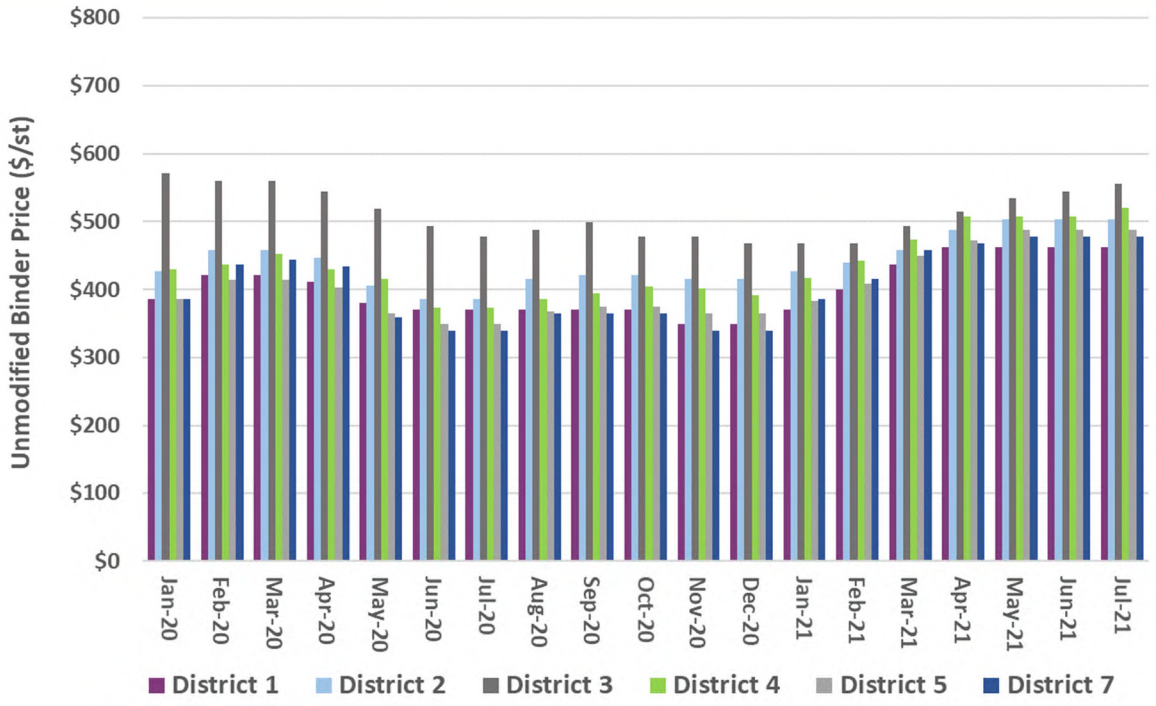
Figure 22. Crude Oil and Asphalt Binder Price Comparison



Source: EIA, FDOT

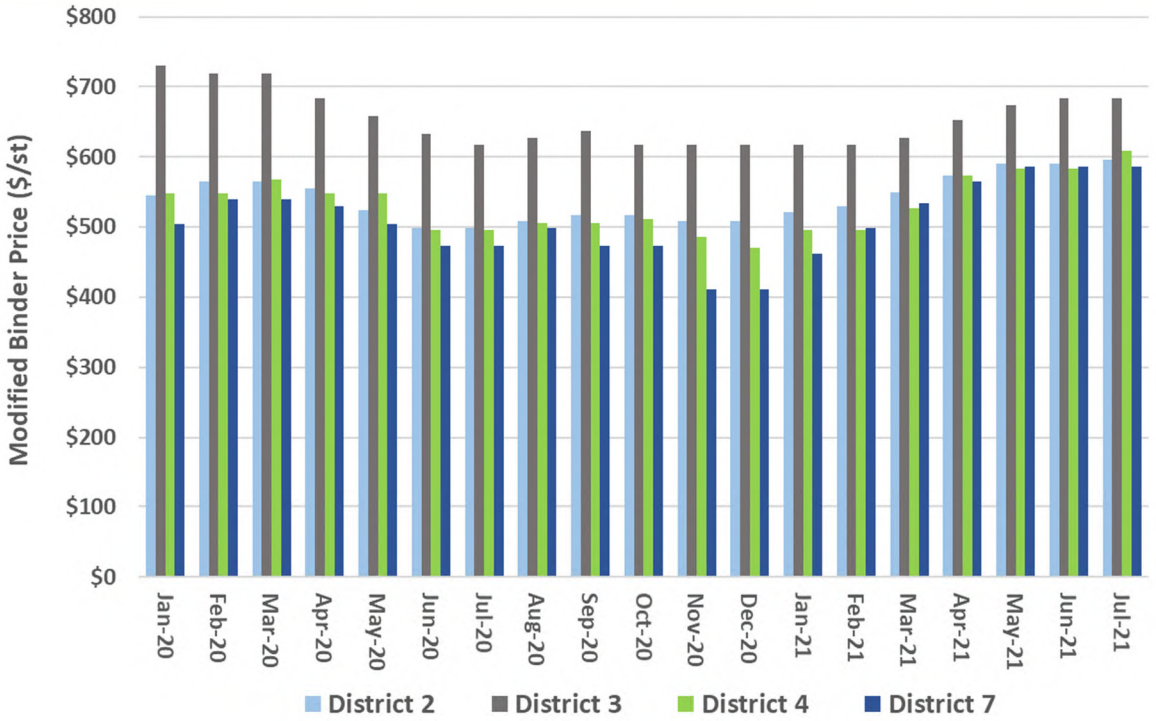
Where available, the average prices for unmodified (**Figure 23**) and modified (**Figure 24**) binder were calculated from monthly terminal price quotes at the district level. Unmodified binder is the average of PG 52-28 and PG 58-22 prices, while modified binder is a quote for the price of PG 76-22 (PMA) in the dataset. While unmodified binder prices have continuously increased in 2021 after the declines in 2020, prices have stabilized between May and July 2021 in all Districts except for District 3 (where prices have continued increasing up to $555 per ton). Modified binder prices have also increased in 2021, with prices in District 3 continue being markedly higher than in other areas of the State. This is likely due to terminal closures in District 3, both temporary and permanent, which have raised local costs. Price hikes are a mixture of decreased competition and supply constraints.

Figure 23. Unmodified Binder Price by District



Source: FDOT, TBG Work Product (D6 terminals did not report data).

Figure 24. Modified Binder Price by District



Source: FDOT, TBG Work Product (D1, D5, and D6 terminals did not report data).

In order to forecast future pricing, TBG researched asphalt binder prices from various locations in the southeast United States[3]. Using price ratios, further estimation was performed to estimate quarterly PG 76-22 Binder prices for Miami, Tampa, and Panama City over the last few years (**Table 9**). Temporal averages were found using estimated prices from all three locations to yield estimates.

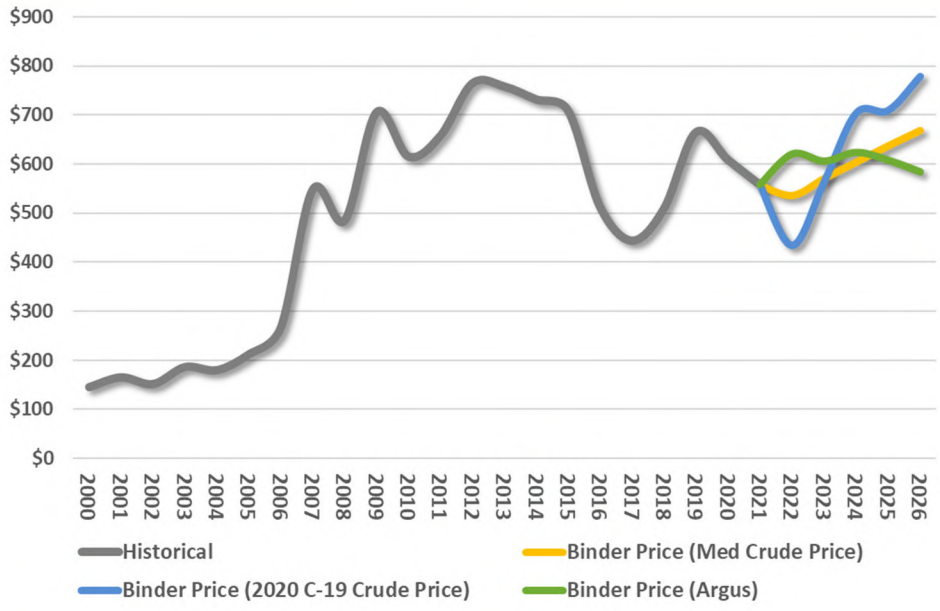
An analysis of weekly binder prices from July 2018 to July 2021 weighs heavily on the point of entry; all ports report varying levels of prices with significant increases over the past months. Using a variety of models for fit, historical FDOT binder prices were forecasted to 2026 under a medium crude oil price scenario and a low crude price scenario resulting from the pandemic. Statewide binder price outlooks are in **Figure 25**.

Table 9. Average Binder Prices

Quarter	Historical	Lower Bound Forecast	Midpoint Forecast	Upper Bound Forecast
Q1 2019	$606.32			
Q2 2019	$624.67			
Q3 2019	$608.43			
Q4 2019	$584.01			
Q1 2020	$559.10			
Q2 2020	$503.74			
Q3 2020	$489.67			
Q4 2020	$494.54			
Q1 2021	$528.67			
Q2 2021	$581.57			
Q3 2021		$551.85	$596.29	$640.72
Q4 2021		$551.96	$652.50	$753.03

Source: TBG calculated from Argus Binder Price Reports.

Figure 25. Average, PG 76-22 Binder



Source: TBG calculated from Argus Binder Price Reports.

[3] Argus' asphalt rack prices reflects trades of different grades of asphalt within a defined region, which include where the seller commits to deliver to the buyer's truck, typically at a truck-loading rack.

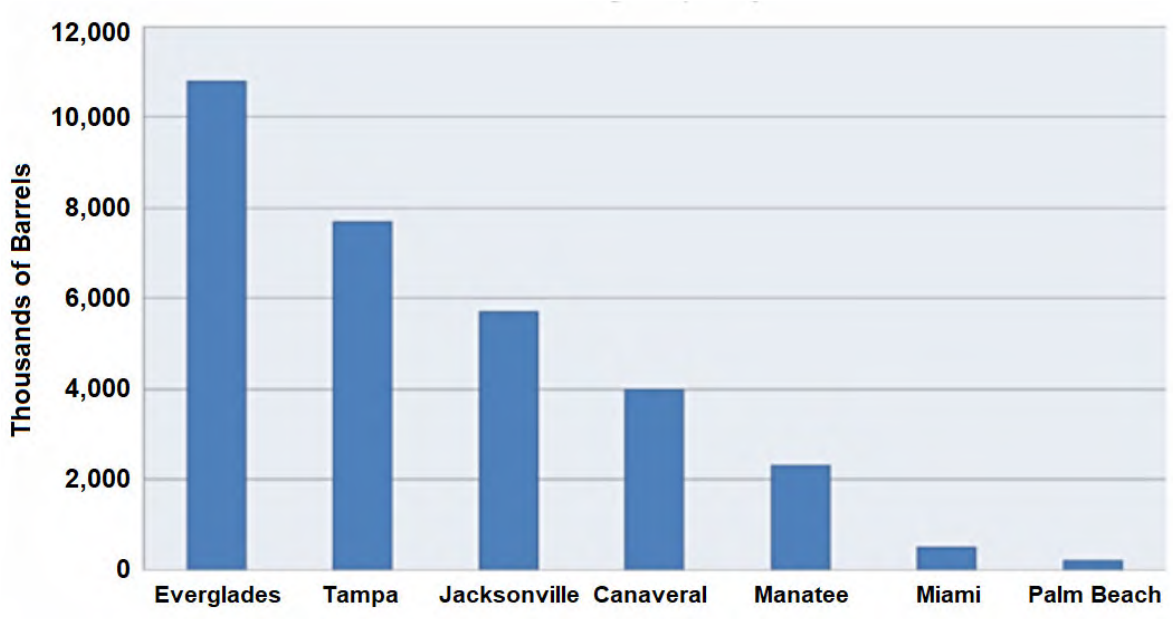
Imports

As global supply of binder tightens as demand for fuel increases, options for imports are limited. Even though the U.S. is in talks with Iran to ease all sanctions, U.S. sanctions to Venezuela and Iran are still in effect, restricting U.S. refiners in obtaining crude oil. Argus reports that imports to the U.S. east coast are down by half during the first six months of 2021, with imports from Europe, the Mediterranean and Turkey down 61%. For Florida, data from the U.S. International Trade Commission show limited activity, as there were no imports until April with 8,000 metric tons of bitumen arriving to Miami from Canada in May 2021. Argus has been reporting that imports from Europe and the Mediterranean have been unviable for the most part across producers in the east coast due to higher prices and costs. Producers did not indicate in the survey that binder availability is a primary concern.

If imports were restricted with the proposed requirements of Buy America, the impacts for the asphalt industry would worsen. The previous Buy America impacts estimates showed that, on average, asphalt imports over the last three years represented 62% of the material component and would increase prices by 9%. The proposed expansion of Buy America requirements would put more pressure on domestic supply and as such, the scenario using the minimum share of domestic supply over the past years (28%) is more feasible. This would further restrict what is available for FDOT from 8% to less than 6%.

Port Everglades and the Port of Tampa have the largest estimated petroleum storage capacity **Figure 26**. In fiscal years 2018 and 2019, Port Everglades processed around 120 million barrels (or 16.8 million tons) of petroleum and asphalt products accounted for approximately 0.5% of the total. While detailed data for fiscal year 2020 has not been released, Port Everglades petroleum cargo fell to 101 million barrels (14.3 million tons). Petroleum products at the Port of Tampa also fell in fiscal year 2020 by 10% to 14.9 million tons.

Figure 26. Estimated Petroleum Storage Capacity



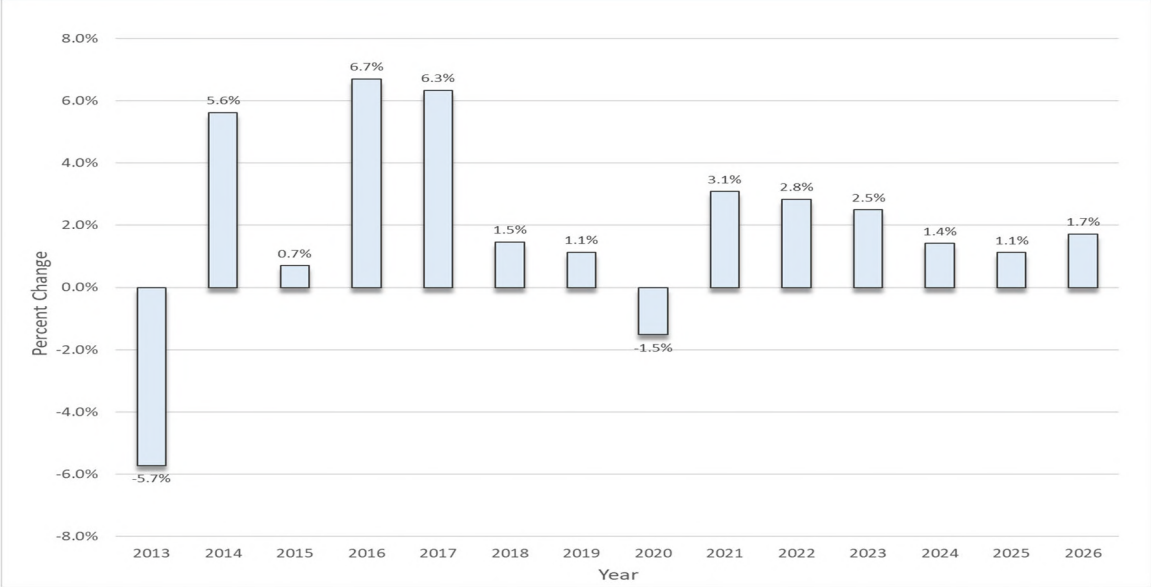
Source: Port Everglades

Labor

Availability of skilled labor has been a challenge for the asphalt industry in recent years. In TBG's 2020 survey, 57% of respondents indicated they would have a hard time meeting the anticipated high demand from FDOT and other state projects due to lack of available labor. However, in this year's survey 70% anticipated the industry having difficulties meeting demand, where labor and trucking are the main factors.

Figure 27 shows national trends in employment growth. Employment for the asphalt sector as a whole is up 26% since 2013, with corresponding wage increases of 31%. Employment fell in 2020 because of the pandemic and is expected to grow annually by 2% up to 2026.

Figure 27. Asphalt Industry Employment Growth



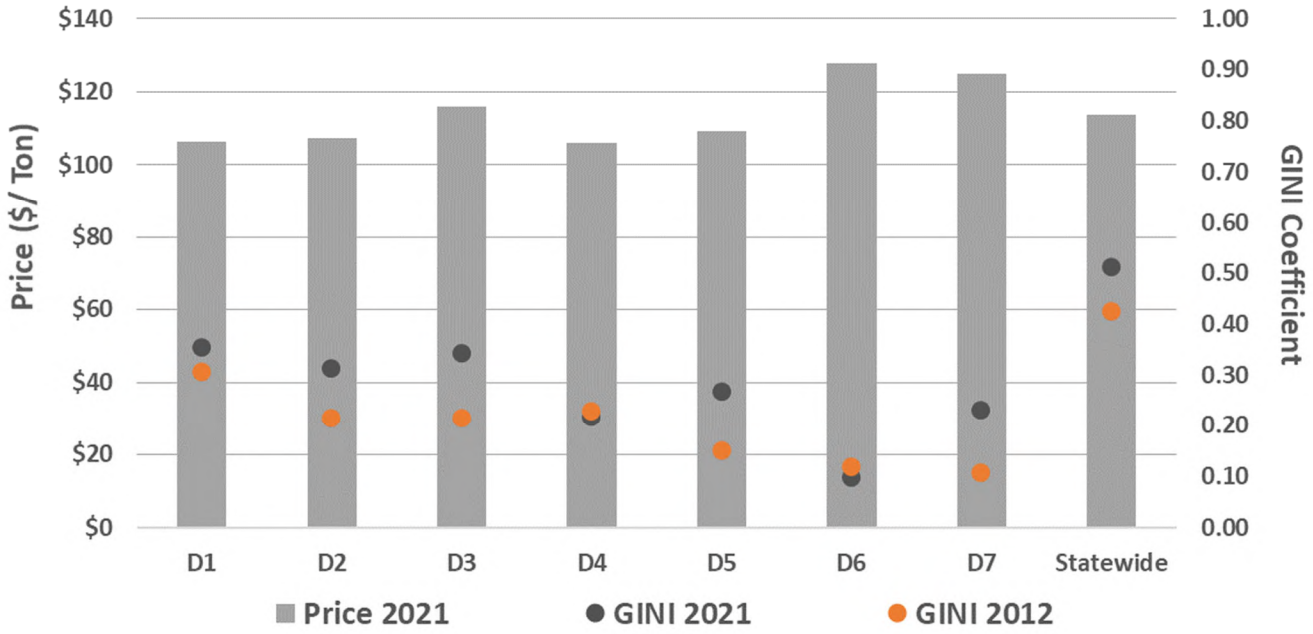
Source: IBIS Industry Reports, Asphalt Manufacturing, April 2021

Competition

FDOT's HMA costs vary by District across Florida, which reflects varying levels of work program as well as competition. **Figure 28** compares the level of competition in each District currently and in 2012, including the price and market share across Florida. A measure of competition is the Gini coefficient; if market share is perfectly distributed, the Gini coefficient would be 0 (perfect equality), and if monopoly conditions exist, the Gini would be 1 (perfect inequality) – the higher the Gini, the less competitive the industry.

The statewide Gini coefficient estimates market competition for all plant activity in Florida, aggregated to the company level. When added up statewide, 16% of the companies account for 59% of active plants, about the same as 15% of companies accounting for 57% of activity in 2020. This consolidation of owners leads to a higher statewide Gini coefficient than seen in the Districts, since the entire list of companies is considered instead of being divided relatively more evenly over the Districts.

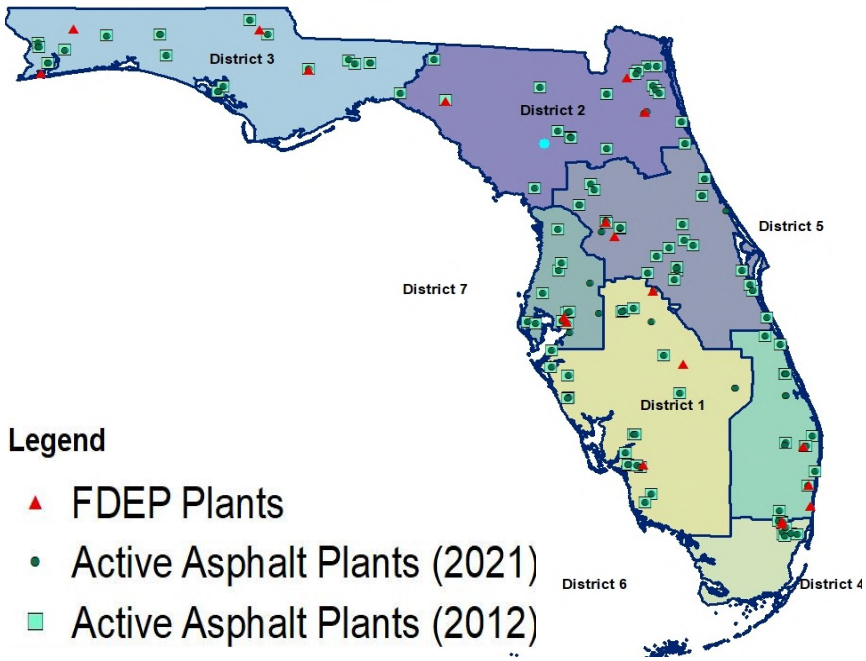
Figure 28. HMA Price and Market Share by District



Source: FDOT, TBG Work Product.

The majority of plants are situated in Central to North Florida, with only one new plant coming online in District 1. **Figure 29** shows the dispersion of active asphalt plants across the State, based on permit activity and/or survey updates. Additionally, FDEP's facilities list show 29 plants (28 active and one in construction in District 2) that are not in FDOT's approved list.

Figure 29. Active FDOT- Approved Asphalt Producer Facilities



Source: TBG, prepared from data provided by FDOT Office of Program Management and FDEP

Current Pricing

FDOT's HMA costs reflect a unique combination of asphalt binder costs, FDOT-specific requirements regarding manufacturing and installation, and non-FDOT competition for contractors and materials. Asphalt prices have increased 4% in fiscal year 2021 after sustaining a cost close to $110 per ton for the past two years (**Table 10**).

Table 10. HMA Price, 2016 - 2021

Year	2016	2017	2018	2019	2020	2021*
Price HMA, $/Ton	$96.22	$101.73	$104.01	$109.63	$109.83	$113.77

Source: TBG calculated from data provided by FDOT Estimates Office.

Consolidation of the asphalt industry in Florida has led to less competition and higher pricing in some districts. Since 2016, HMA prices have risen between 10 to 31% in all Districts. It appears that price increases that started taking shape before the onset of the COVID-19 pandemic are now baked in. However, there is a likelihood that prices will continue to rise further due to pandemic-related disruptions (**Table 11**).

Table 11. HMA Price by District, Dollars per Ton, 2018 vs 2021

District	Price 2018	Price 2019	Price 2020	Price 2021	Percent Change, 2018 to 2021
1	$103.23	$111.73	$109.44	$106.43	3%
2	$96.49	$107.27	$98.49	$107.21	11%
3	$101.40	$111.39	$108.39	$115.88	14%
4	$105.47	$130.67	$123.77	$106.10	1%
5	$105.10	$109.55	$110.09	$109.25	4%
6	$123.74	$122.83	$138.09	$127.94	3%
7	$102.63	$115.72	$105.57	$124.78	22%

Source: TBG calculated from data provided by FDOT Estimates Office.

Material Quantities

Balmoral has forecast FDOT's HMA Future Requirements, based on LRE and Work Program data. HMA Projections are shown in **Table 12**.

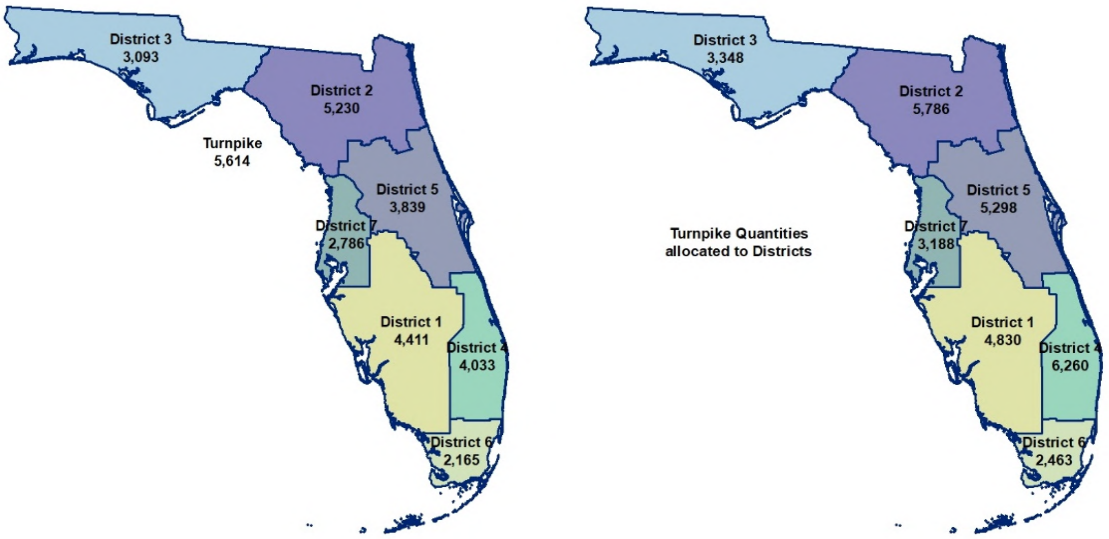
Total asphalt requirements for the Five-year Work Program are shown in **Figure 30** by District, with and without Turnpike allocation.

Quantities are estimated using a factor approach as discussed in the FDOT Data section. The factors were calculated by Balmoral economists and roadway engineers after evaluating several statistical relationships, including historical share of dollars spent on HMA for different project types. The factors were originally created from pay item data in 2007 and updated using pay item data through 2021 for the current study.

Table 12. FDOT Future Requirements of Hot Mix Asphalt					
District	2022	2023	2024	2025	2026
D1	753,511	659,082	725,919	1,100,400	1,171,896
D2	781,873	1,523,538	787,259	1,274,345	862,549
D3	546,964	659,124	745,973	572,150	568,733
D4	528,903	483,411	953,676	1,207,217	859,975
D5	936,874	506,842	613,496	808,387	973,898
D6	544,318	205,709	200,601	541,027	673,797
D7	572,450	509,853	395,388	566,139	742,585
D8	506,481	800,122	1,184,163	1,569,756	1,553,555
Total Tons	5,171,374	5,347,681	5,606,474	7,639,422	7,406,986

Source: TBG calculated from data provided by FDOT Office of the Work Program Budget

Figure 30. Total Asphalt Quantities for Five-year Work Program, 000s of Tons



Source: TBG calculated from data provided by FDOT Office of Program Management.

Forecast

Prices and consumption are projected in **Table 13** for the five-year construction work program. Regression modeling was performed using pay item data, supply chain variables and other macroeconomic indicators to identify models that best predicted FDOT's materials costs and quantities. For the current estimate, Florida GSP projections and projected housing starts have been substantially increased in the past two quarters, after relatively pessimistic prior estimates by both the Office of Economic and Demographic Research, and the Institute for Economic Forecasting. Florida GSP growth is an important factor in FDOT HMA costs, and GSP growth now ranges from 4.2% to more than 7% annually over the work program period, with lower growth in later years.

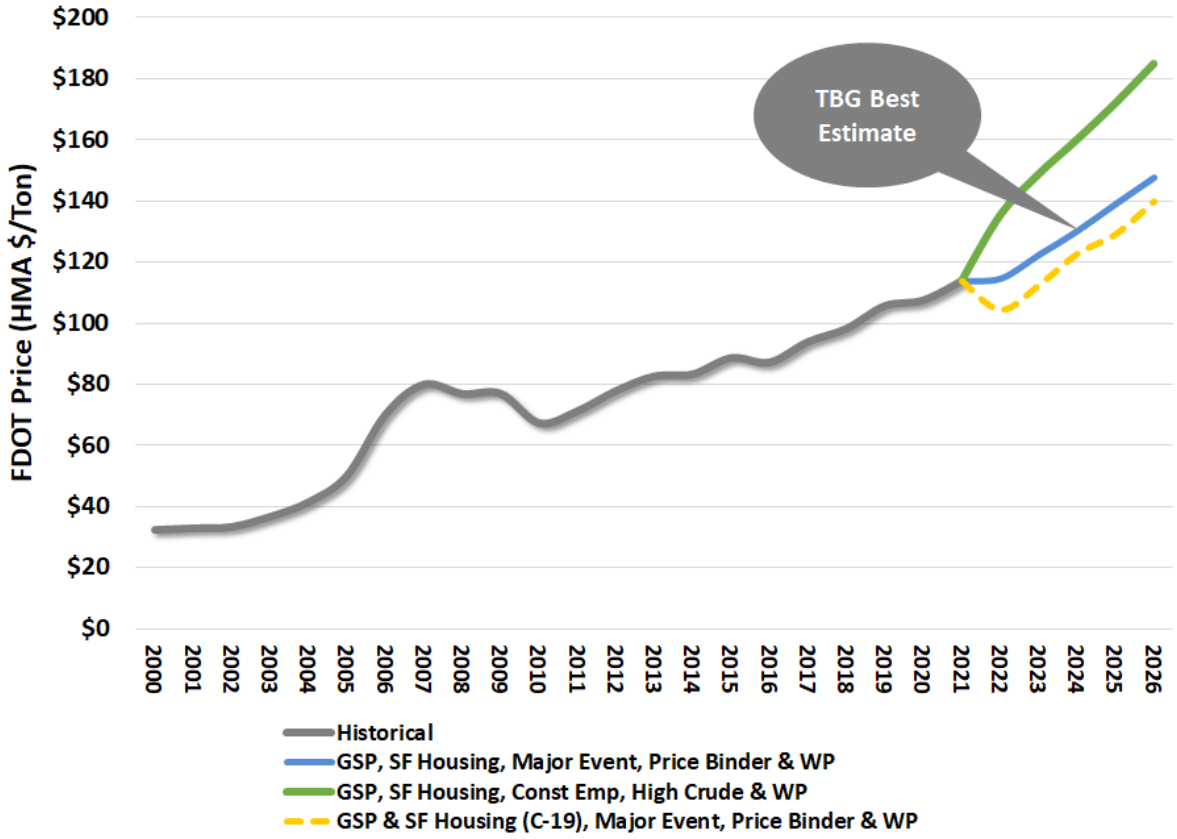
Housing starts are estimated to increase by 10%, with single family housing increasing 27% in the first year before moderating to a more normal pace of 4-5% in later years. The best estimate of asphalt pricing shows a 1% change in asphalt prices between 2021 and 2022, ending at about $148 per ton by 2026. The trajectory of the price projection is about 13% higher than the previous report. Based on newer economic data, the upper bound would end near $185 per ton by 2026 because of upward revisions in GSP, crude prices, and construction employment growth. The the lower bound reflects continued negative pandemic effects on the macro economy (**Figure 31**).

Table 13. HMA Price Forecast Results

Year	2021	2022	2023	2024	2025	2026
Price HMA, $/Tons	$113.77	$114.47	$122.29	$130.16	$139.09	$147.74

Source: TBG calculated from data provided by FDOT Estimates Office, various industry sources.

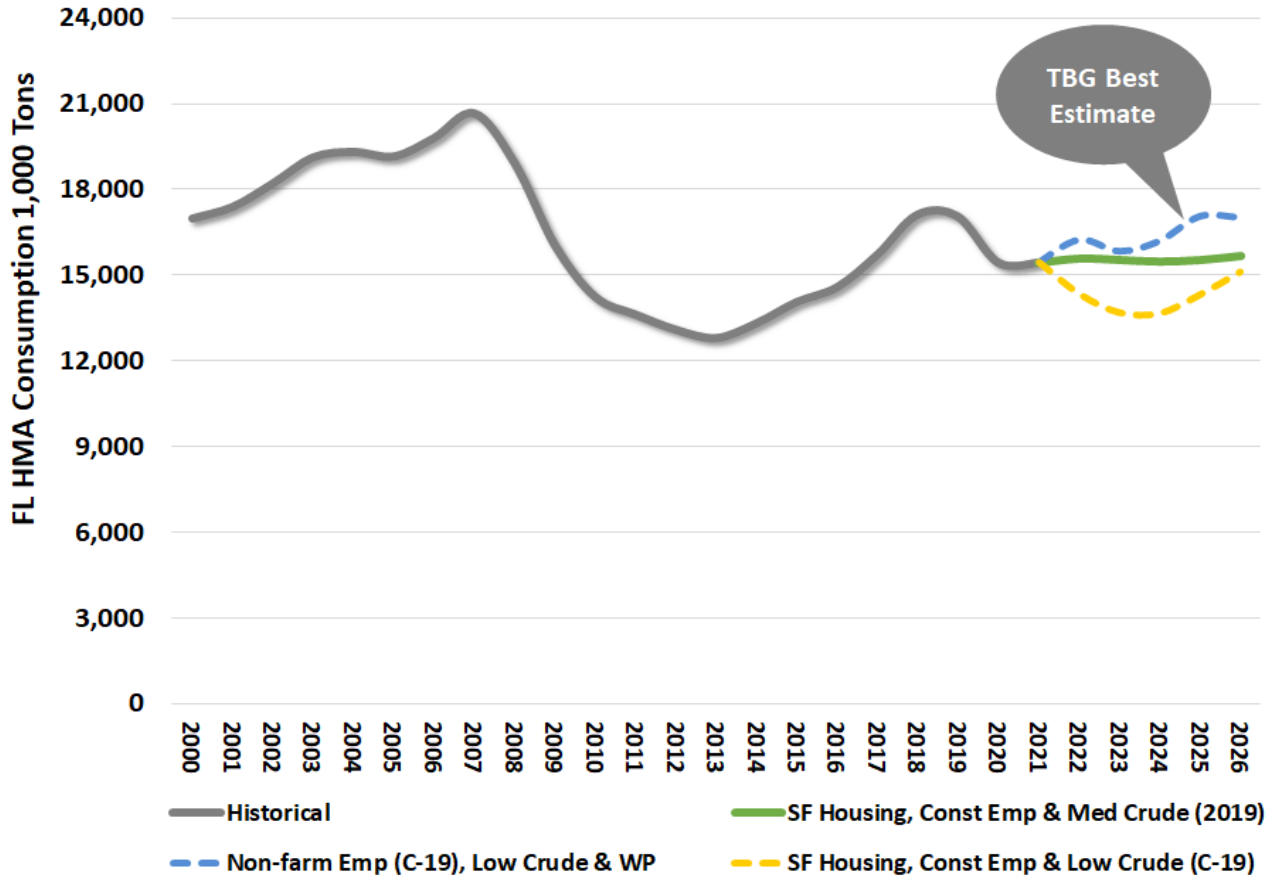
Figure 31. HMA Price, 2021 Forecast



Source: TBG calculated from data provided by FDOT Estimates Office, various industry sources.

Figure 32 provides a forecast of Florida HMA consumption. The estimate is based on current economic outlooks, which show improvement in employment and housing starts. If the pandemic continues into 2022, the trajectory would likely shift downward, following the lower bound.

Figure 32. Florida HMA Consumption, 2021 Forecast



Source: TBG calculated from data provided by FDOT Estimates Office, various industry sources.

Concrete

Key Findings – Cement and Concrete Products

Producers of Cementitious products for FDOT are feeling impacts from very high residential demand, supply chain issues, increasing cost of materials and transportation delays. Producers expect an average increase of 27% in bid prices by the end of 2021 due to these impacts.

- Increasing prices – high demand for residential construction has caused cement availability to be very tight. Prices of cement are increasing due to this and other increases in costs (shipping costs, transport costs, and costs related to supply chain issues). However, supply chain issues in the first half of the year appear to be easing. Production of cement has increased.
- Transportation costs – producers are reporting they need more drivers (specifically mixing drivers) to meet demand and trucking is the issue, not a lack of material. Gas prices are increasing and producers who import fly ash are suffering from large increases in shipping costs, sometimes of $20/ton.
- Supply chain issues heavily impacted producers in the first half of the year, but are now reported to be easing. In some cases, producers couldn't get simple items like bags to bag cement.

On average, most plant operators reported using a greater amount of concrete for FDOT work and less for municipal work than they did in 2020. **Table 14** shows the survey results over the past four years for producers' share of work to FDOT and to municipalities.

Table 14. Producers' Share of Production to FDOT and Municipalities

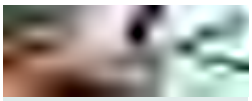
Year	FDOT	Municipality
2018	32%	47%
2019	21%	19%
2020	19%	18%
2021	45%	14%

Source: TBG Survey

Supply Chain Variables for Concrete Materials

Table 15 provides an overview of supply chain variables and a summary of their current status; items with current issues are further detailed in the subsequent text. Current and historical data has been prepared for selected variables that have historically influenced FDOT's costs for concrete products, including ready-mix and precast products. **Table 16** provides selected data for the period 2010 - 2021.

Table 15. Structural Concrete Supply Chain Variables & Current Status

 Cement	Cement prices are increasing and producers are reporting they are sold out of cement. Supply chain issues for cement producers are easing, but high demand keeps supply tight. Producers are increasing prices to keep their margins.	↑
 Aggregate	In the survey and interviews producers did not mention any specific problems with aggregate. However, they are experiencing issues with transportation, in some cases involving transport of aggregate. General issues relating to aggregate availability or cost are covered in the Aggregate section.	=
 Fly Ash	Producers who are importing fly ash from overseas are reporting heavily increasing prices for fly ash due to shipping cost increases. They can't pass off the increasing costs to the consumer quickly enough. Metakaolin prices are increasing and supply is tight, while slag prices are stable and supply is available. While hopes for Florida harvesting of fly ash are high, no plans appear to be close to implementation.	↑
 Rail	Depending on location in the state, rail is the primary transportation for aggregates. Producers report that rail is an issue and CSX reports that on-time arrivals are down 20% compared to the same quarter last year. Both FEC and CSX report bottlenecks due to intense macroeconomic growth, but aggregate shipments appear in line with long-term trends.	↑
 Truck	Trucking availability is an issue in some parts of the state due to driver shortages. Producers report a lack of mixer drivers and other CDL drivers to meet demand.	↑
 Labor	Labor costs continue to increase due to issues with skilled labor availability and trends still show increases in wages for employees in this industry.	↑
 Competition	Cement producers are reporting they are completely sold out of product, with all producers catching up from COVID disruptions. At the concrete level, the number of plants increased substantially, and competition will continue to constrain prices from fully passing on increased input costs.	↑

Note:

↑	Exerting negative influence on FDOT's costs; monitor.
=	Currently stable; not influencing FDOT's costs.
↓	Exerting positive influence on FDOT's costs.

Table 16. Historical Concrete Data, 2011 – 2021

*(Maximum values indicated with *)*

Concrete	Units	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Total Chinese Imports[1]	Billions of $	$1,743	$1,818	$1,950	$1,959	$1,680	$1,588	$1,844	$2,136	$2,078	$2,057	$2,200*
Florida Diesel Prices[2]	$/Gallon	$3.08	$3.17*	$3.16	$3.00	$1.84	$1.44	$1.78	$2.22	$2.04	$1.78	$1.97
Florida Portland Cement Year End Stocks[3]	000s of Tons	291	291	279	360*	338	322	307	335	279	304	332
U.S. Portland Cement Capacity[3]	000s of Tons	122,000*	120,000	121,000	121,000	121,000	118,967	121,000	121,000	121,000	121,000	121,000
Average Price of Portland Cement, U.S.[3]	$/Ton	$83.13	$83.38	$88.58	$89.94	$95.30	$99.33	$104.70	$108.28	$110.07	$110.96*	$108.86
Average Price of Portland Cement, Florida[3]	$/Ton	$81.12	$74.93	$77.98	$82.37	$91.00	$92.96	$97.71	$101.05	$102.72	$103.55*	$101.58
Florida Cement Production[3]	000s of Tons	3,643	4,172	5,157	5,496	6,060	6,455	6,548	6,549	6,872	7,014	7,066*
Florida Cement Capacity[3]	000s of Tons	10,987	11,020	10,601	10,767	11,130*	8,447	8,447	8,447	8,447	8,447	8,447
Florida Ready-Mix Production[4]	000s of Cubic Yards	11,649	11,882	12,952	12,952	13,858	14,829	15,081	15,714*	15,305	14,448	15,662
FDOT Work Program[5]	Billions of $	$1.89	$2.22	$2.59	$3.29	$3.18	$3.51	$4.00*	$3.82	$3.83	$3.72	$2.66
Cement Imports Serving Florida[9]	000s of Tons	374	418	274	662	799	1,385	1,319	1,635	1,962	2,155*	1,657
Estimated FDOT Concrete Consumption[6]	000s of Cubic Yards	876	1,002	982	1,318	1,405	1,556	1,832*	1,615	1,256	1,080	837
Estimated Statewide Concrete Consumption[7]	000s of Cubic Yards	16,173	17,450	18,301	19,969	20,642	21,199	21,750	22,359	23,164	23,628	24,147*
FDOT Structural Concrete Cost[6]	$/Cubic Yard	$544.63	$525.35	$691.03	$727.03	$625.70	$662.68	$608.14	$708.11	$746.88	$722.69	$932.76*

Sources: 1. WTO's World Trade Statistical Review, 2021 estimated. 2. FDOT Construction Office, 2021 through July. 3. United States Geological Survey (USGS), 2017-2021 estimated. 4. PCA, First Research, 2021 estimated. 5. FDOT Office of Work Program. 6. Calculated, from data provided by FDOT Estimates Office. 7. PCA, USGS, 2021 estimated. 8. Calculated weighted average, from data provided by FDOT Estimates Office.

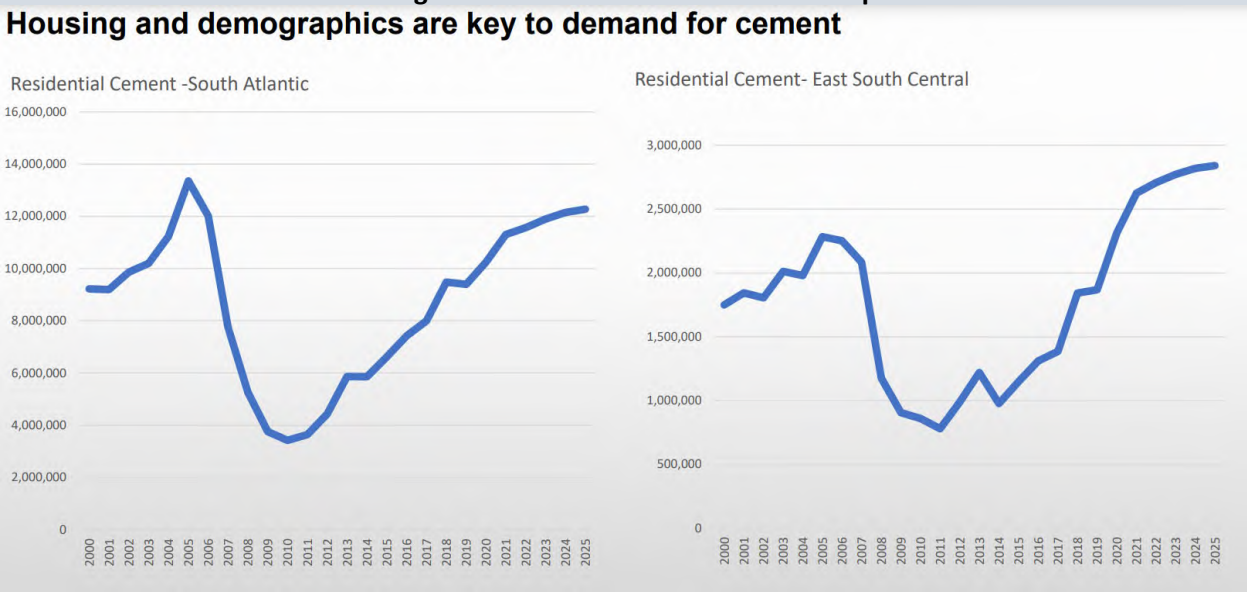
Cement

The tide has turned for cement over the last year. In 2020 TBG reported an expectation of declining prices, however, the environment just a year later is very different. Residential demand for construction has soared and while single family housing starts is expected to slow alongside lower income families being priced out of the market, multi-family and rental housing starts are expected to increase (PCA Southeast Spring Forecast, June 2021). **Figure 33** shows the Portland Cement Association's expectations for residential cement consumption into the future. Due to the large demand and the economy coming back online, cement producers servicing Florida are reporting they are sold out of cement. While supply chain issues are getting better and production has increased, availability of cement is very tight as producers are still overcoming the disruptions of 2020 and navigating large amounts of demand.

Due to this and increasing costs, Florida producers of cement report increasing prices of cement to maintain margins. However, others report increasing their prices due to standard annual raises and not from anything unusual. Either way, producers are reporting increasing prices for cement.

Additionally, producers are all reporting issues with all modes of transportation. They report the labor supply is not adequate for the transportation service providers to deliver the service that is demanded.

Figure 33. Residential Cement Consumption



Source: Portland Cement Association (PCA)

An analysis of FDEP Air Permits was conducted to identify whether there have been any changes to state wide clinker capacity since 2018. **Table 17** shows all active plants as of July 2021.

Table 17. Active Cement Kilns in Florida (Reported Capacity)			
Plant Name		Current Clinker Capacity	
		tons/hour	tons/year
American Cement Sumterville Plant		135	1,186,250
American Cement Suwannee Plant		125	965,425
Argos Newberry Cement Plant (Formerly Vulcan)		125	880,000
CEMEX Brooksville South (Formerly Rinker)	Kiln #1	83	727,800
	Kiln #2	156	1,277,500
CEMEX Miami Cement Plant (Formerly Rinker)		162	1,300,000
Titan Florida Pennsuco Cement Plant		250	2,190,000
Total Producing in 2021		**1,031**	**8,446,975**

Source: FDEP

As of July 2021, CEMEX Brooksville North was added to the list, but there are costly upgrades that will need to be completed in order to make the kilns active. These upgrades include a preconstruction review for the Prevention of Significant Deterioration (PSD) and air quality monitoring analyses for all current national ambient air quality standards (**Table 18**). Due to this, this facility may not come online and add to cement kiln capacity.

Table 18. Inactive Cement kilns in Florida, current and previously reported capacity			
Plant Name		Current Clinker Capacity	
		tons/hour	tons/year
*CEMEX Brooksville North (Formerly Rinker)	Kiln #1	100	780,000
	Kiln #2	**100**	**780,000**
Potential additional production in 2021		**200**	**1,560,000**

Source: FDEP

*Note: this plant has been renewed a permit to operate, but it may be an expensive and protracted process to bring online and is currently not active.

Fly Ash & Substitutes

Fly ash availability continues to be tight as coal-powered plants close. In this year's survey, 72% of concrete producers reported bottlenecks when obtaining fly ash compared to only 22% last year. Interestingly, producers who reported experiencing bottlenecks did not use any alternatives to fly ash. All other producers used slag or another alternative to fly ash and did not report bottlenecks. Most of the producers not using an alternative were in the process of testing alternatives for use. The trend seems to be that producers are working their way towards using alternatives, however, they still rely on fly ash.

The four largest producers of fly ash have stopped producing and those who need fly ash are importing it from outside of the state. Producers who import most of their fly ash are reporting skyrocketing shipping costs, in some cases increases of $20 per ton. The increases are happening so quickly they are having to absorb the cost increases because they can't pass it on to the consumer quickly enough.

Metakaolin producers report that their prices are also increasing and expect them to continue to slightly increase over time. Production does not appear to be changing as producers believe it is staying fairly stable and supply of metakaolin is tight. Availability of labor and raw materials costs are concerning producers. One metakaolin producer suggested FDOT should look at ternary or quaternary material blends if they aren't already. This process utilizes silica fume and fly ash in conjunction with one another.

On the other hand, slag prices are stable and are expected to remain stable through the next quarter. There is an annual standard increase, just like with cement, that should happen January 1. Production of slag has increased and there are no issues with availability. Producers may be concerned with sourcing raw material, however, those with long term contracts aren't concerned. Just like with cement producers, slag producers are having a hard time with obtaining enough truck transport, Slag producers appear to be expanding capacity.

Slag producers are suggesting FDOT reconsider their durability requirements. While it is more durable, they don't believe it is necessary to use 50% slag. They report that 30% could work well, especially since fly ash requirements are only 20%, which is less durable than 30% slag. Concrete producers report that they have passed on their concerns about the maximum allowable strength, FDOT mix designs and raw materials to FDOT.

Harvesting Fly Ash

Harvesting of fly ash has proven profitable in other states, and the promise of additional constituents including valuable rare earth minerals adds allure to the prospects. However, each coal ash pond or pit is the recipient of material from multiple sources. A power plant may have burned coal from West Virginia one year and Indonesia the next, with each coal source representing its own individual and unique combination of geological constituents. As a result, opening a coal ash pit or pond involves regulatory approval to undo the closure, followed by extensive engineering to tackle the approach. Geological sampling is then necessary to understand the composition, and legal mechanisms to provide protection to the operators. Before completing the testing of each site, the availability of valuable material is an unknown, and once valuable materials are stripped, the remaining material must be safely handled or stored. Currently, harvested rare earth minerals are processed in China, since facilities for secondary processing are not mature in the U.S. The entire process – from opening the closed pit to processing and permanent storage of the material – is one of several years and extensive investment. Geologists in Florida expect that harvesting, after identifying the highest concentrations of valuable material, will require federal funding support to achieve significant application to the 736 facilities across the U.S.

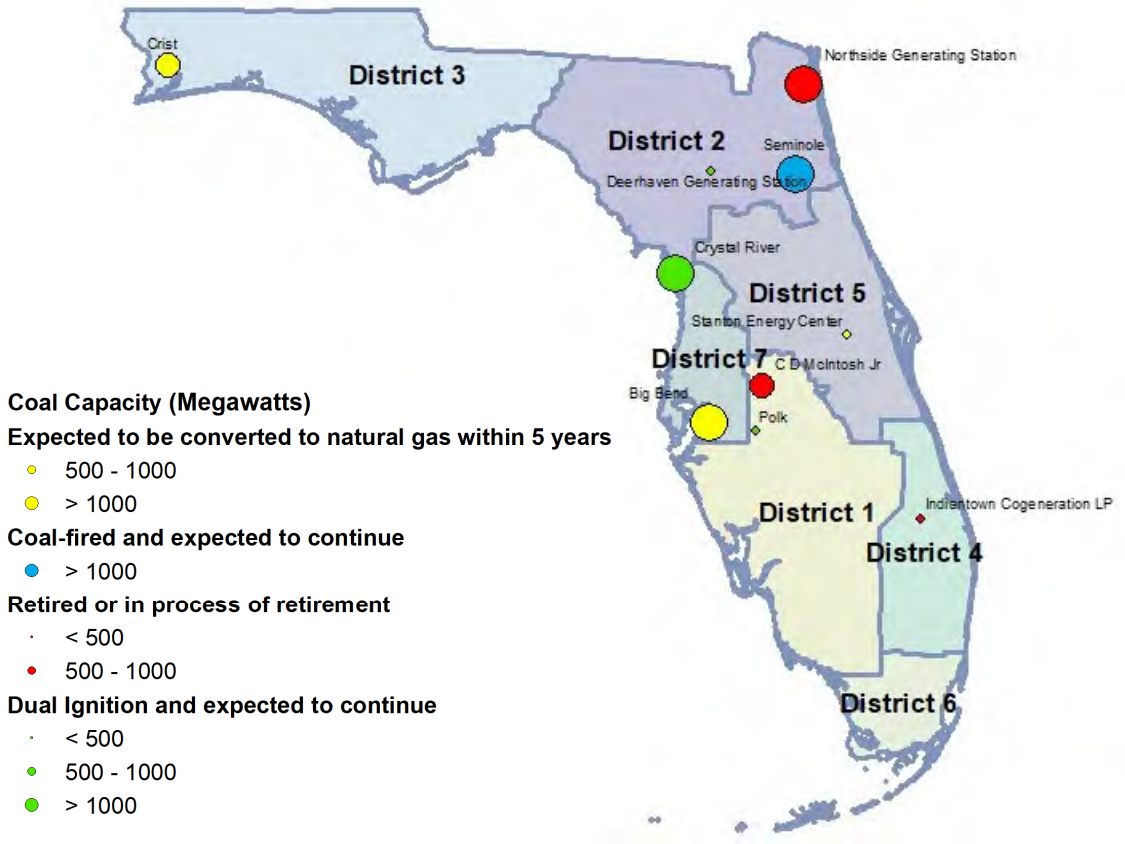
Table 19 provides a synopsis of likely impacts by FDOT district. Districts with access to the remaining coal-fired power plants in Florida are less impacted by in-state fly ash shortages. Districts 4 and 6 are more highly impacted from shortages because they have to depend on existing contracts in other districts or imports due to a lack of local coal capacity (**Figure 34**).

Table 19. Projected Impact from Potential Fly Ash Sources by District

District	All Concrete Plants*	Higher Impact from Fly Ash Shortages	Lower Impact from Fly Ash Shortages
1	86		x
2	62		x
3	76		x
4	76	x	
5	98		x
6	57	x	
7	39		x
Total	494		

Source: Estimated, The Balmoral Group 2021. *Includes both active and idle plants.

Figure 34. Coal-Fired Power Plant Capacity



Buy America

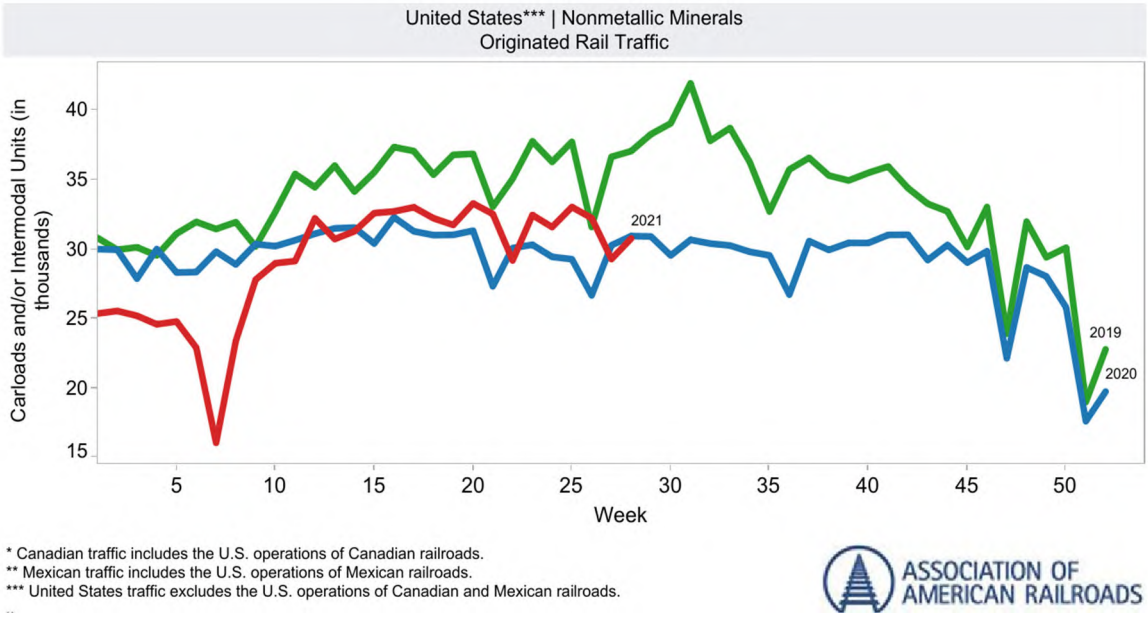
If the proposed new Buy America rule were enacted, this would potentially have a large impact. An estimated 92% of large firm cement production is foreign owned, which is significantly higher than asphalt at 41% and aggregate at 28%. The product is produced in the U.S., but with the new rule increasing the content that must be produced in the US, the transition could be complicated. Previous calculations found that, depending on final language, FDOT concrete costs could be impacted as much as 25%.

Rail

Producers are reporting issues with rail transportation, and transportation in general. In the CSX financial quarterly report ending June 30th 2021, on-time arrivals were down 20% compared to the same quarter in 2020; however, aggregate is typically not included in the on-time arrival calculations and reportedly normally ranges in the high 70%. CSX reports 68% of rail arriving on time in the quarter ending June 30th 2021. Rail is the primary mode of transport for aggregate shipments in the concrete space depending on location in the state.

Figure 35 shows the more variable nature of weekly national rail carloads for nonmetallic minerals over the past few years. Early 2021 levels were much lower than those in both 2019 (green line) and 2020 (blue line), but since week 15 of this year (red line), carloads have surpassed 2020 levels. Since week 10, weekly rail traffic has followed a similar pattern as 2019, but at a much lower volume.

Figure 35. Weekly U.S. Rail Traffic Data, Carloads of Non-Metallic Minerals, 2019, 2020 and 2021

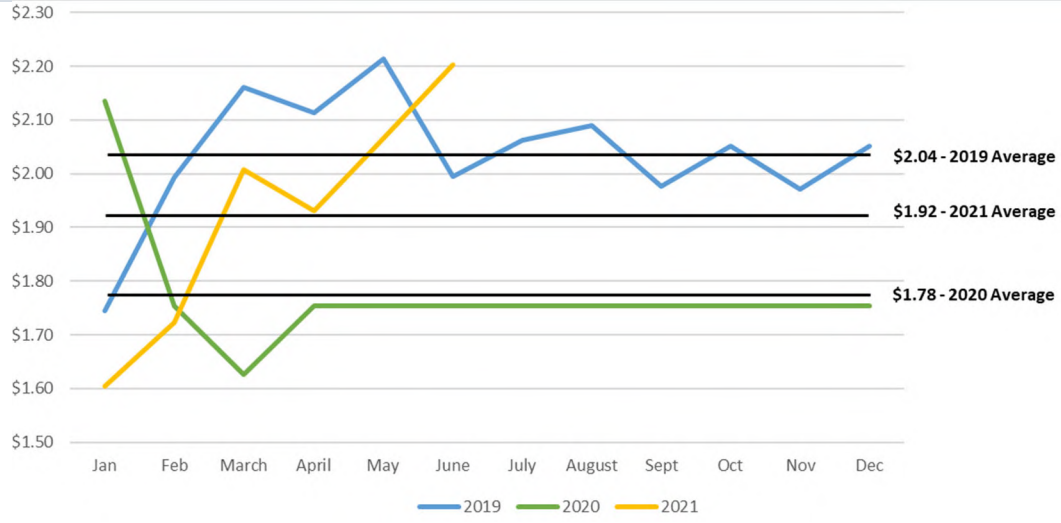


Source: Association of American Railroads

Truck Transport

Producers are reporting that there are issues with transportation. Fuel costs have increased since the beginning of 2021 alongside the reopening of the economy, making trucking a more expensive mode of transport. **Figure 36** shows the price of diesel to FDOT over the past three years and how on average prices have declined from 2019 to 2020 and then increased in 2021. Additionally, producers report that supply of trucking is tight and that there aren't enough drivers to meet their demand.

Figure 36. Historical FDOT Diesel Prices



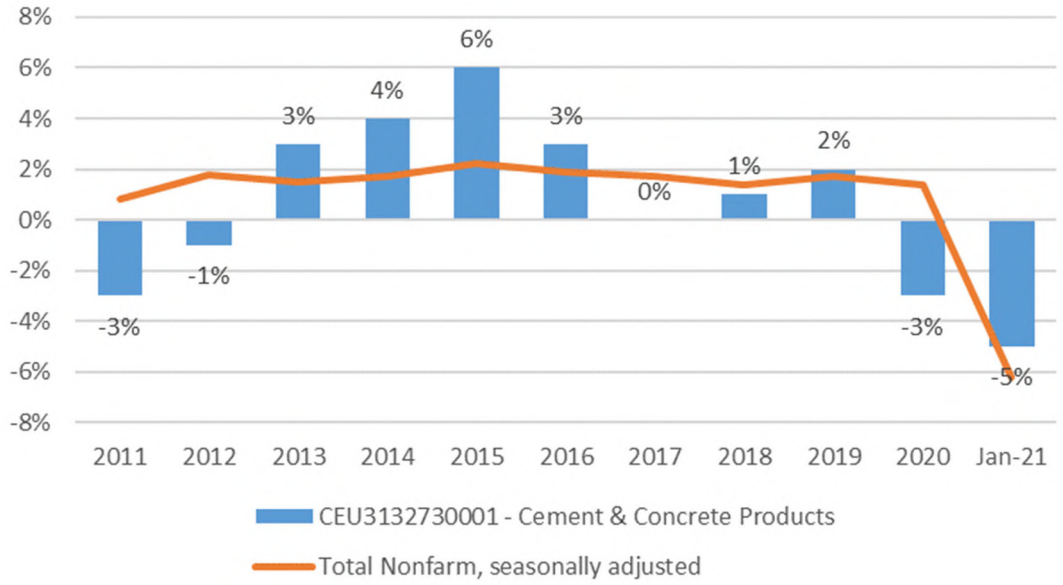
Source: FDOT Office of Construction, Fuel and Bituminous Price Index

Labor

Producers are reporting difficulty sourcing labor. Employment in the concrete industry has grown steadily since 2013, but declined in 2020 and early 2021 (**Figure 37**). Hourly wages are up 5% nationally 3% in

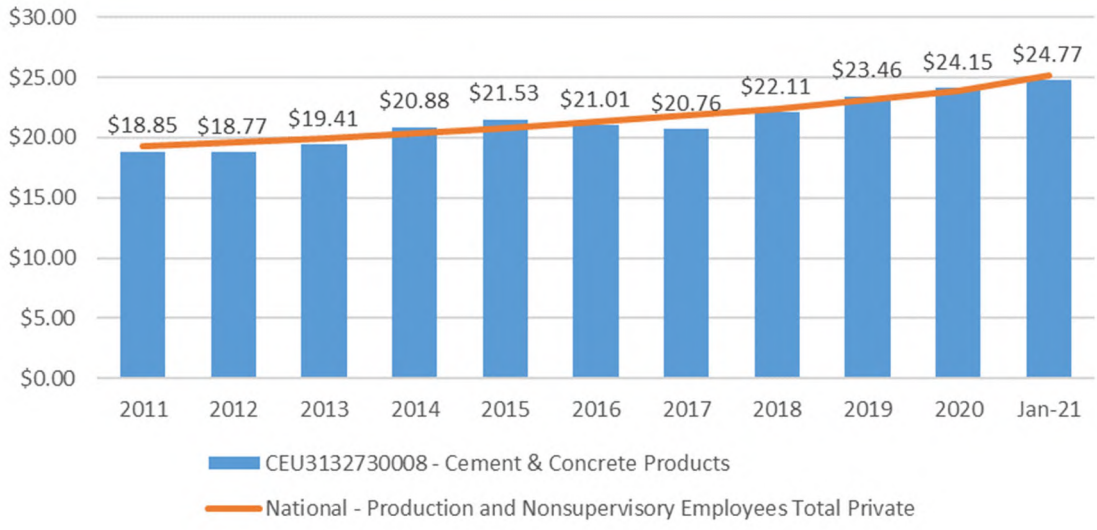
cement and concrete products in January 2021 compared to 2020 (**Figure 38**). National wages continued to increase through June 2021.

Figure 37. Cement & Concrete Products Industry Employment Growth



Source: Bureau of Labor Statistics

Figure 38. Average Hourly Earnings, Cement & Concrete Products, U.S. Average

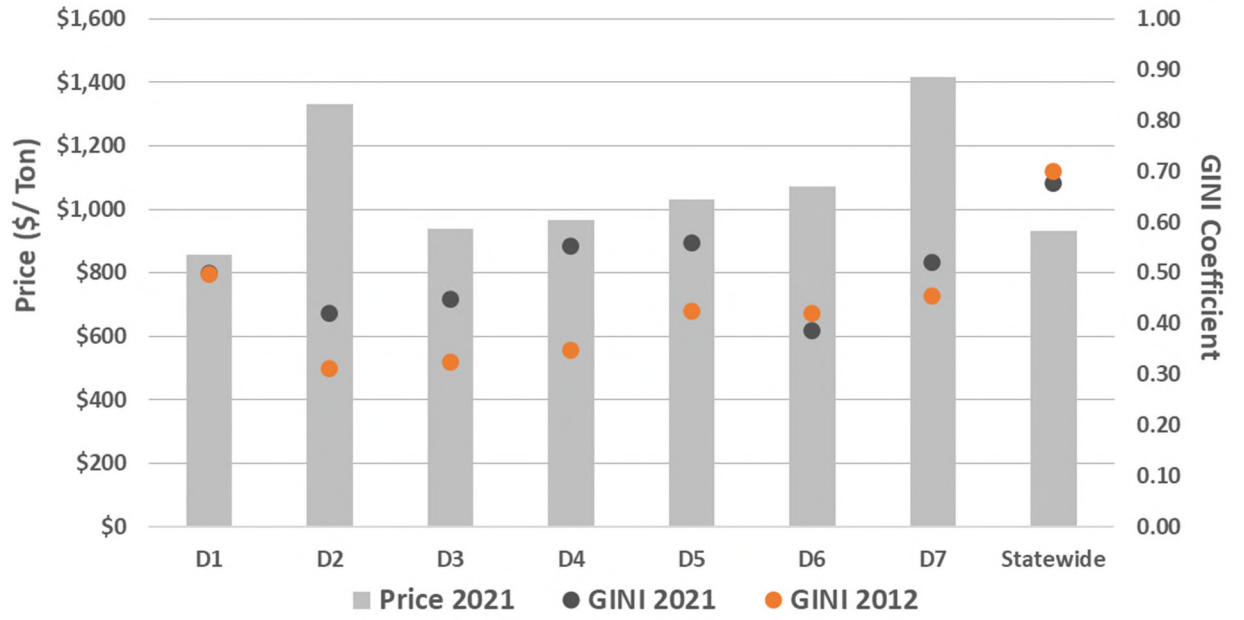


Source: Bureau of Labor Statistics

Competition

Concrete producers did not note significant changes in competition within the past year. The number of ready-mix plants has steadily increased since 2013, with 494 active plants currently reported, providing substantial competition at the plant level. The Gini coefficient, a metric of diffuse versus concentrated market power based on ownership shares, is shown for FDOT approved concrete suppliers by district in **Figure 39**.

Figure 39. Concrete Competition Gini by District



Source: FDOT, TBG Work Product.

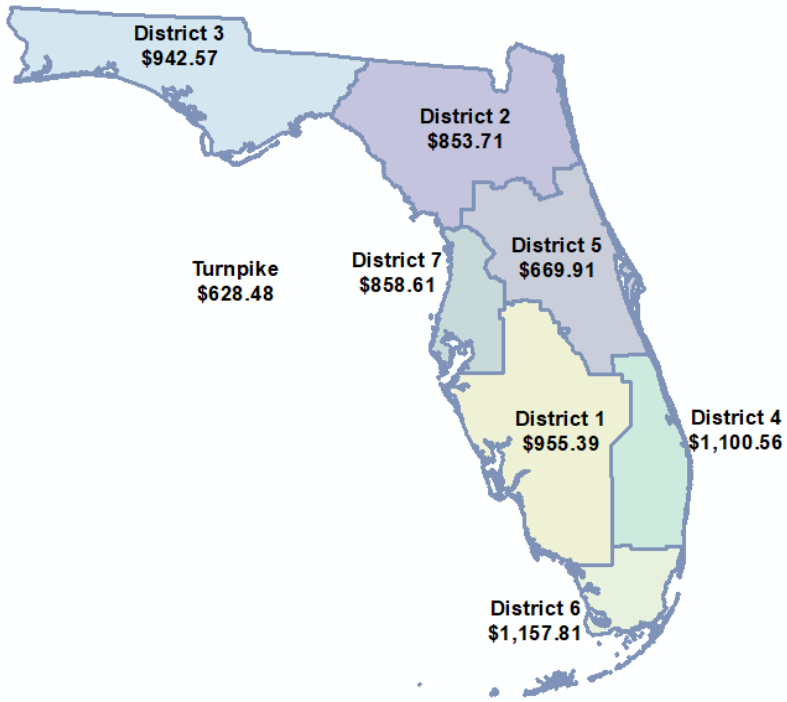
Capacity utilization has improved for both precast and ready-mix concrete producers since 2018 (**Table 20**). According to a survey of FDOT concrete producers, precast fabricators are utilizing 70% of their capacity in 2021, down 8% from 2020. Ready-mix producers, on the other hand, report that 38% of their capacity is currently being utilized, up from 29% in 2020.

Table 20. FDOT Approved Concrete Plant Capacity Utilization, 2018 – 2021

	2018	2019	2020	2021
Precast	40%	64%	78%	70%
Ready-Mix	20%	20%	29%	38%

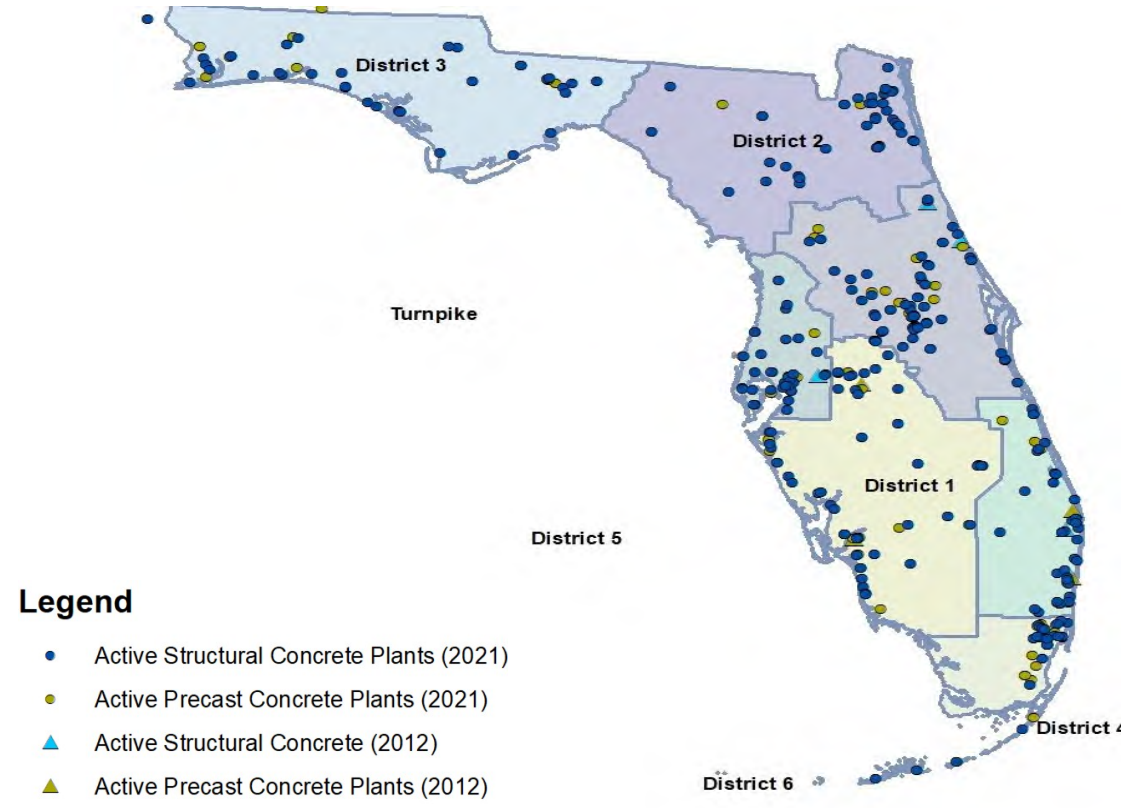
In 2012, FDOT approved facilities numbered 327 plants with 55 owners, while current data reflects 368 active plants with 91 owners. Cemex is still by far the largest firm, controlling about 90 active plants in 2021. Argos Ready Mix also owns about 50 plants. The next largest is Titan America with 36 plants. **Figure 40** shows the 2021 weighted average price for structural concrete across districts. **Figure 41** provides a location map of active approved concrete plants.

Figure 40. Structural Concrete Price by District, $/CY, 2021



Source: TBG calculated from data provided by FDOT Office of Program Management

Figure 41. Ready-Mix Plants 2012 vs 2021



Source: FDOT, TBG Work Product

Environmental Regulation Issues

Some producers are worried in the long term about increased regulations on carbon emissions. Producers anticipate long-term carbon targets. Most publicly-traded companies already have climate strategies. For example, CEMEX has committed to approximately a 40% reduction in carbon dioxide emissions by 2030, which is a higher level of carbon dioxide reduction than it had previously committed to. CEMEX also has a goal to be at net zero emissions by 2050. It plans to reach this target by utilizing alternative fuels with higher biomass content, hydrogen injection, low temperature and low carbon dioxide clinker, decarbonated raw materials, optimization of the kilns' heat consumption and the reduction of clinker factor through the higher utilization of blended cements. Plant-level impacts of new environmental regulations are likely to be reflected in additional monitoring or equipment requirements, rather than sweeping restrictions, within the next decade.

Material Quantities

Preliminary estimates of materials quantities for the FDOT work program were prepared from Estimates Office data. Quantities are estimated using a factor approach. The factors were calculated by Balmoral economists and roadway engineers after evaluating several statistical relationships, including historical share of dollars spent on concrete for different project types.

FDOT Work Program requirements are estimated to average around 1.6 million CY throughout the Five-Year Work Program (**Table 21**). A large uptick in concrete requirements are projected for 2022 and 2026 when several large add lanes and bridge projects begin construction. **Table 22** shows future FDOT concrete requirements by District. Differences in demand by District are reflected in pricing. **Figure 42** shows the distribution of materials requirements for the entire Five-year Work Program by District.

Table 21. FDOT Future Concrete Requirements

Year	2022	2023	2024	2025	2026
Structural Concrete	1,490,630	268,801	697,918	667,812	1,852,483
Ancillary Concrete	431,820	630,691	743,113	641,659	541,369
Total Cubic Yards	**1,922,450**	**899,492**	**1,441,031**	**1,319,471**	**2,393,852**

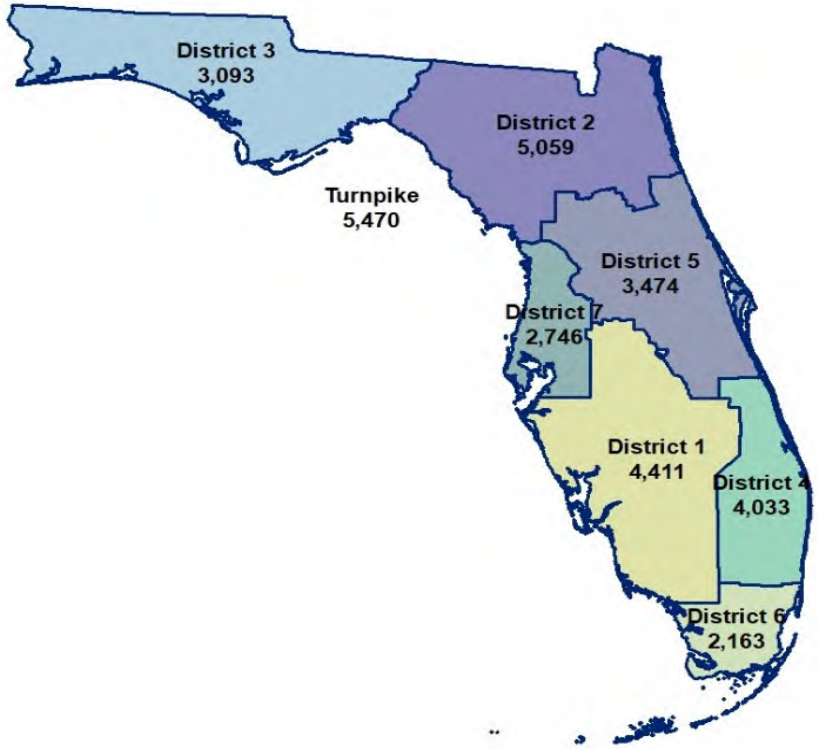
Source: TBG calculated from data provided by FDOT Office of the Work Program Budget.

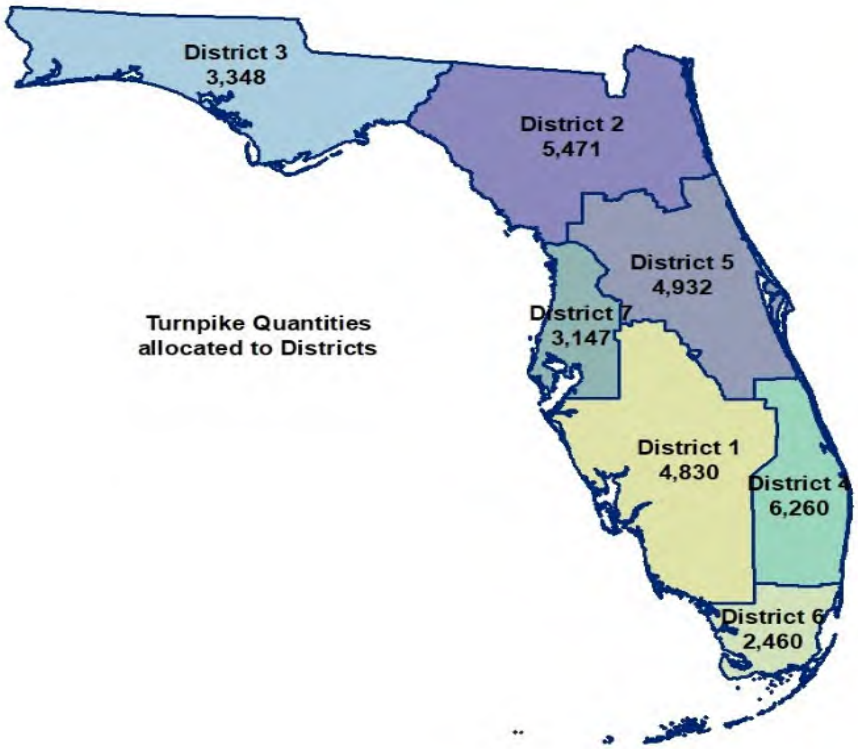
Table 22. FDOT Future Concrete Requirements by District

District	2022	2023	2024	2025	2026
D1	147,027	44,591	82,717	114,606	207,880
D2	141,802	344,928	82,972	240,483	288,994
D3	202,070	23,790	240,378	19,565	32,624
D4	292,813	52,484	337,344	280,587	380,424
D5	470,728	37,808	93,477	93,150	108,551
D6	220,684	24,932	22,152	134,386	437,132
D7	205,316	50,626	72,602	72,425	209,044
D8	242,010	320,333	509,389	364,268	729,203
Total Cubic Yards	**1,922,450**	**899,492**	**1,441,031**	**1,319,471**	**2,393,852**

Source: TBG calculated from data provided by FDOT Office of the Work Program Budget.

Figure 42. Total Concrete Quantities for Five-year Work Program, 000s Cubic Yard, 2021





Source: TBG calculated from data provided by FDOT Office of Program Management.

Forecast

Regression modeling was performed using pay item data, supply chain variables and other macroeconomic indicators to identify models that best predicted FDOT's materials costs and quantities. While Florida's concrete and concrete products industry has capacity and competition that should serve to constrain price increases, there are clouds on the horizon that could cause some hiccups for FDOT costs. Cement prices are expected to increase by another 6% in 2022 and 11.5% in 2023, before falling slightly and flattening in the out years of the work program. Continued competition for materials is likely from several sources, including over a billion dollars of resiliency projects expected each of the next three years in Florida, stimulus projects pumping another $6 billion of infrastructure demand into the state, and expected substantial increases in South Florida construction, owing to the Surfside disaster. To add insult, recent floods in Europe destroyed more than 50 bridges in Germany alone, a nation about twice the size of Florida now facing reconstruction costs in the billions – and demanding large quantities of concrete, aggregate and steel.

The best estimate currently considers a scenario with increased construction employment and GSP; energy prices remain virtually unchanged, but cement prices factor more prominently. The lower bound scenario sees COVID negatively impact construction employment and activity.

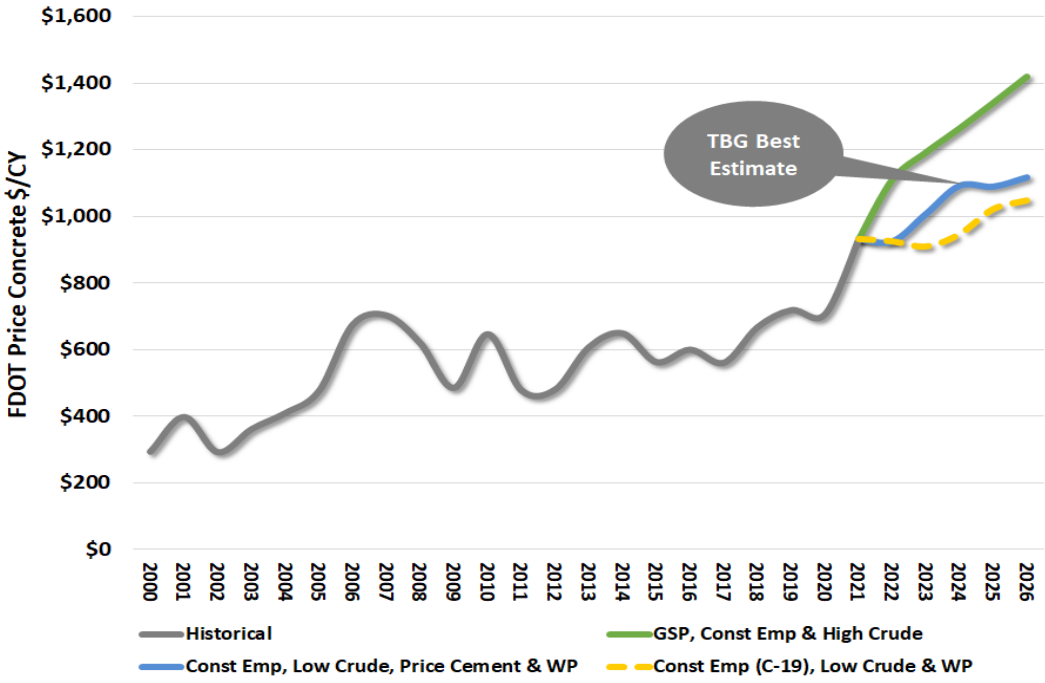
Table 23 provides the updated forecast average price for concrete. The trajectory of the price projection is about 2% higher than the one reported in the previous update due to updated macroeconomic variables, ending at about $1,118 per cubic yard by 2026 (**Figure 43**). **Figure 44** shows the output of several quantity models forecasting statewide consumption of concrete and the scenario identified as the best estimate.

Table 23. Concrete Price Forecast Results

Year	2021	2022	2023	2024	2025	2026
Price Concrete, $/CY	$932.76	$925.67	$1,008.41	$1,093.18	$1,090.33	$1,118.03

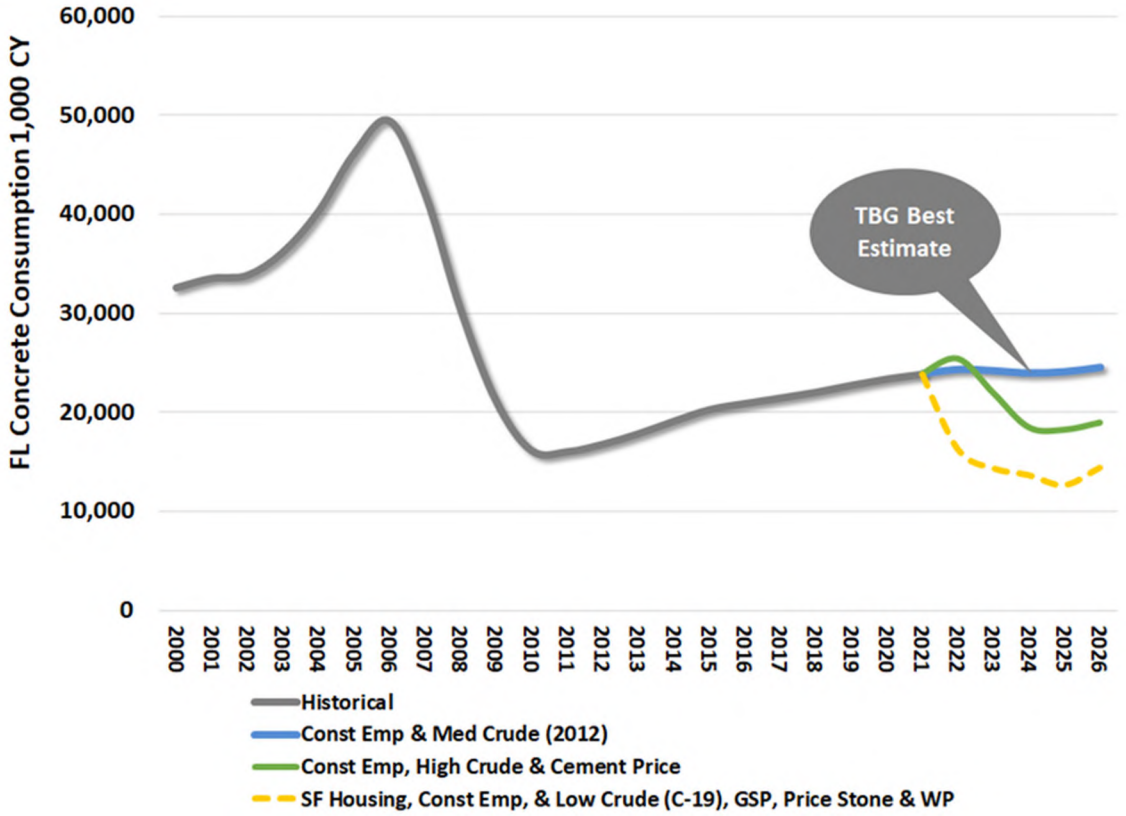
Source: TBG calculated from data provided by FDOT Estimates Office, various industry sources.

Figure 43. Concrete Price, 2021 Forecast



Source: TBG calculated from data provided by FDOT Estimates Office, various industry sources.

Figure 44. Florida Concrete Consumption, 2021 Forecast



Source: TBG calculated from data provided by FDOT Estimates Office, various industry sources.

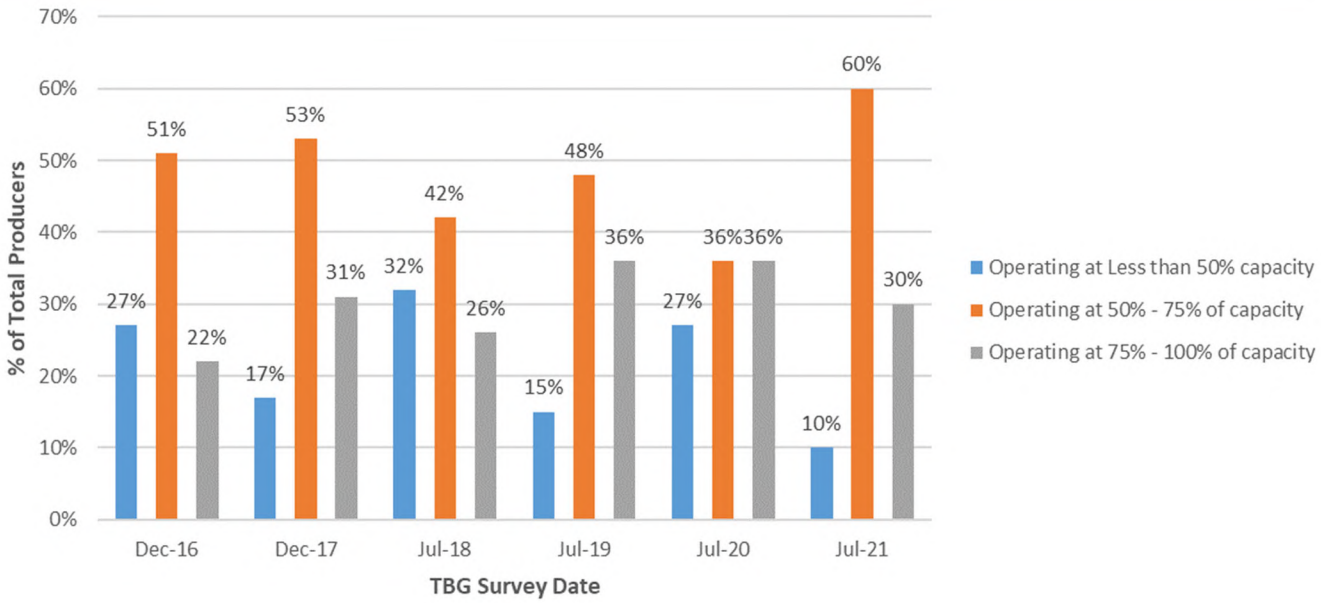
Steel

Key Findings

COVID-19 is still impacting global steel markets after disrupting demand and supply of steel in 2020. Leftover impacts include supply chain disruptions and raw material shortages.

- Prices for materials are soaring. In turn, producers on average are expecting bid prices to increase by 30% by the end of 2021. However, some producers report that prices may be levelling off as these issues improve. Additionally, 52% of producers surveyed reported that they were planning to implement technologies to increase efficiencies. However, COVID-19 has caused delays of 4 weeks to 9 months for many of those producers.
- Florida steel fabricators are operating at a higher capacity than previous years with 90% of producers operating at 50% capacity or greater. This is higher than at any point since December 2016 (**Figure 45**). Last year some producers were concerned about excess capacity increasing faster than demand, however, the opposite appears to have happened in the past year. Demand increased much faster than producers could keep up. It took time for mills to come back online and ramp up their production after the idling of some plants and pause in production last year. Supply chain issues and raw material shortages are delaying projects, but producers are doing as much as they can to keep up. In some cases, labor shortages are also holding back producers from increasing production.

Figure 45. Survey Respondents' Operating Capacity: Florida Steel Fabricators

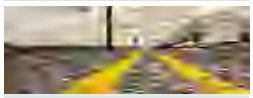
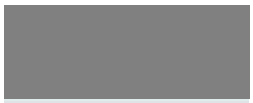


Source: TBG Survey, December 2016, December 2017, July 2018, July 2019, July 2020 and July 2021

On average, fabricators report that in 2021 P3 work will account for 6% of work completed (7% in 2019, 1% in 2020); Design-Build 23% (25% in 2019, 31% in 2020) and Design-Bid-Build accounts for 29% of work (28% in 2019, 36% in 2020).

Table 24 shows a summary of select variables and their current status, followed by historical variables in **Table 25.**

Table 24. Supply Chain Variables for Structural Steel

 Raw Materials	Raw materials prices are increasing and there are mixed expectations from producers as to whether prices will level out or keep increasing. Backlogs are still prevalent as producers try to catch up to demand. Shortages of raw materials are also occurring in many areas and are unpredictable.	↑
 Scrap Steel	Scrap steel prices are the highest they've been since the 2008 peak and aren't far from reaching those peak level prices again. Florida's mini-mill operations exclusively use scrap, which was in short supply briefly last year but is now in high demand.	↑
 Galvanizing Steel	Zinc prices have steadily increase from $.86 per pound in April of 2020 to $1.34 per pound in June of 2021. Producers are reporting long lead times and price increases for galvanized products.	↑
 China	China is feeling the impact of increased materials prices and there are reports that projects have been paused. China appears to be trying to become independent from Australia, which could be impacting prices. Additionally, reports indicate that Beijing is putting pressure on the industry to lower production to meet carbon neutral targets by 2060. They're trying to use higher grade iron ore so they don't have to use so much coking coal.	↑
 Transportation	Transportation is a factor at all stages of steel production. While FDOT products are primarily delivered through ship or truck, fabricators have not cited significant issues with transportation at the time of this writing.	↑
 Rail	In this update, there are no new issues identified. Some rail companies are reporting less on-time deliveries, but steel producers have not cited rail issues as a significant problem.	=
 Milling Capacity	Nationally, capacity utilization rates are back up to where they were pre-covid-19. Adjusted year-to-date production through July 10th, 2021 was 48.7 million net tons, at a capacity utilization rate of 79.2%. That is up 16.7% from the same period last year. While production is back to normal levels, it is still not enough to meet the backlog of pent up demand.	↑
 Labor	When interviewed, producers report that labor is one of the top issues they are worried about. They are unable to find skilled labor and in some cases this has caused producers to downsize their operations.	↑
 Competition	FDOT will not benefit from competition in this market. All producers are having similar problems obtaining raw materials and prices have increased. At the raw materials level, competition has been impacted by Cleveland-Cliffs acquisition of AK Steel. Now as one company, they occupy a large share of the market and have a lot of control over production.	↑

↑	Exerting negative influence on FDOT's costs; monitor.
=	Currently stable; not influencing FDOT's costs
↓	Exerting positive influence on FDOT's costs.

Table 25. Historical Steel Data, 2011 – 2021

*(Maximum values indicated with *, No data available indicated with **)*

Steel	Units	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
U.S. Price of Iron Ore[1]	$/Ton	$94.44	$105.67*	$79.31	$77.91	$73.65	$66.32	$71.25	$84.37	$84.31	$97.98	$96.14
U.S. Price of Coal[2]	$/Ton	$184.44	$190.55*	$156.99	$151.38	$153.65	$118.31	$130.89	$149.42	$118.19	$108.64	$104.00
Total Chinese Imports[3]	Billions of $	$1,743	$1,818	$1,950	$1,959	$1,680	$1,588	$1,844	$2,136	$2,078	$2,057	$2,200*
Domestic Milling Capacity[4]	Million Tons	128	130*	125	125	124	123	122	122	121	109	103
World Steel Production[5]	Million Tons	1,641	1,675	1,757	1,810	1,750	1,773	1,858	1,973	2,031*	2,021	910
Steel Production Used in Construction[4]	%	16%	16%	18%	23%*	18%	20%	19%	20%	20%	20%	19%
Florida Diesel Prices[6]	$/Gallon	$3.08	$3.17*	$3.16	$3.00	$1.84	$1.44	$1.78	$2.22	$2.04	$1.78	$1.97
FL Construction Employees/All FL Non-Farm Employees[7]	%	4.6%	4.6%	4.8%	5.1%	5.3%	5.6%	5.9%	6.16%	6.32%	6.61%*	6.59%
U.S. Price of Zinc[8]	Cents/lb	106	96	96	107	96	101	139	141*	124	111	132
World Price of Zinc[8]	Cents/lb	99	88	87	98	88	95	131	133*	116	103	125
FDOT Work Program[9]	Billions of $	$1.9	$2.2	$2.6	$3.3	$3.2	$3.5	$4.0*	$3.8	$3.8	$3.7	$2.7
Estimated FDOT Reinforcing Steel Consumption[10]	000s of lbs.	19,271	33,526	19,633	23,417	25,171	32,855	30,689	34,670*	32,174	23,092	18,923
FDOT Reinforcing Steel Cost[10]	$/lb	$0.78	$0.78	$0.85	$0.94	$0.81	$0.86	$0.81	$0.96	$1.00	$0.88	$1.20*
Estimated FDOT Structural Steel Consumption[10]	000s of lbs.	23,598	35,565	25,742	21,750	36,068	14,855	56,184*	20,893	33,435	28,979	27,991
FDOT Structural Steel Cost[10]	$/lb	$2.12	$2.22	$3.41	$2.75	$2.27	$5.12*	$2.80	$4.41	$2.79	$2.55	$3.92

Sources: 1. USGS, World Bank, 2020 and 2021 estimated 2. EIA. 3. WTO's World Trade Statistical Review, 2021 estimated. 4. Standard & Poor's Metals Industry Survey, 2021 estimated 5. World Steel Association. 6. FDOT State Construction Office, 2021 through July 7. Bureau of Labor Statistics. 8. USGS, through March 2021. 9. FDOT Office of Work Program. 10. Calculated, from data provided by FDOT Estimates Office; 2021 estimated.

Raw Materials

When shutdowns of non-essential businesses were ordered around the country in 2020, demand for raw materials plummeted. This led to many furnaces to be idled and raw materials were difficult to obtain during the shutdown. Reports from trucking saw a decline in transport of steel materials. Prices felt the downward pressure of decreased demand and decayed during this time period. However, in mid-June 2020 demand started increasing and idled mills began to reopen. In the recent months of 2021, demand and prices have skyrocketed. Anecdotal reports suggest that backlogs from high demand and idled mills are causing the obstacles as well as logistics issues and an inability to obtain raw materials.

Iron ore prices have historically lagged behind hot-rolled steel and rebar prices (**Figure 46**). During the global financial crisis, hot-rolled steel and rebar prices peaked in 2008 at $967 per metric ton and $1,037 per metric ton, respectively, three years before iron ore peaked. As a result, iron ore prices remained high for several years after the crisis, while steel prices were suppressed. As of February 2021, hot-rolled steel prices are approximately 100% higher than 2009 lows and have just reached their 2008 peaks. Some producers are reporting that prices are leveling off and that the price increases were due to backlog issues at mills that are beginning to ease since materials are coming back in stock. However, others expect that prices may continue to increase because bottlenecks are still an issue for some materials, particularly plate, while raw material prices and gas prices are increasing.

Rebar prices are 60% higher than 2009 lows, and 36% higher than they were 12 months ago.

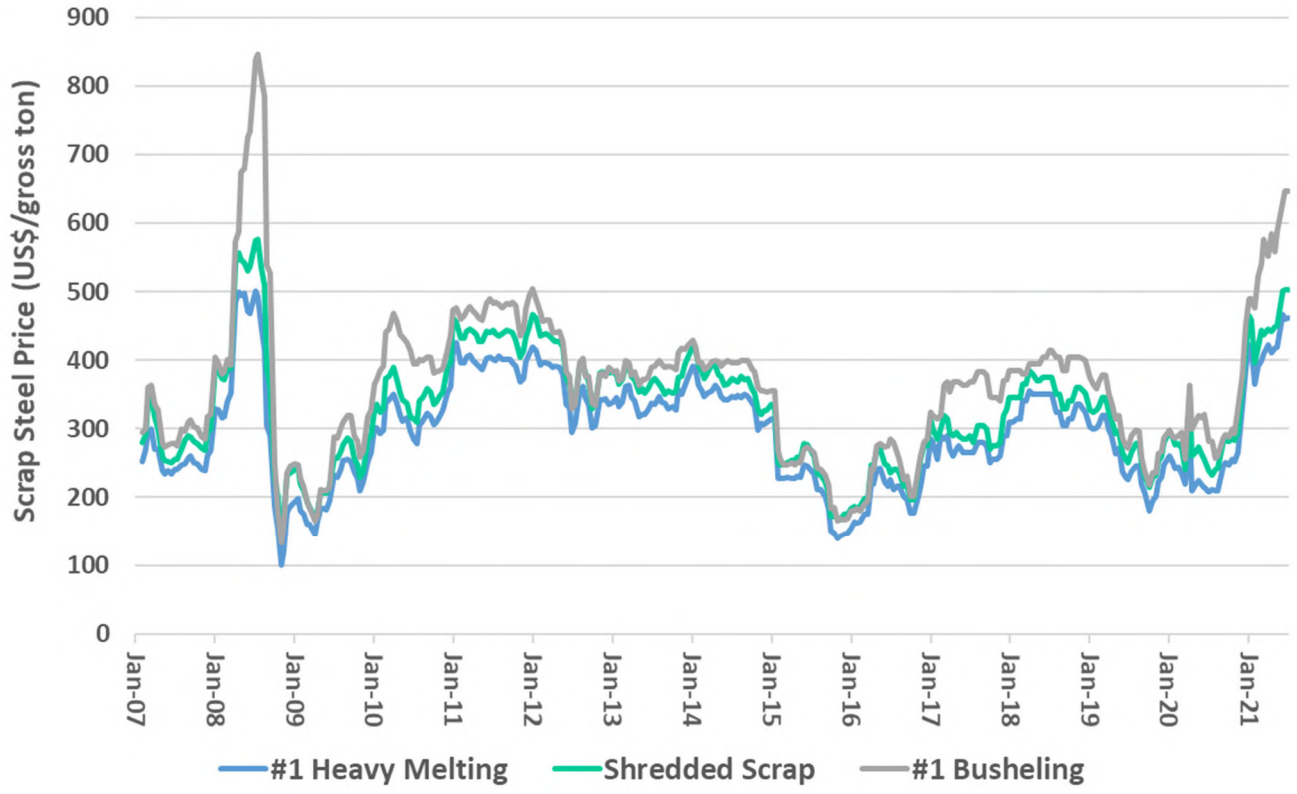
Figure 46. Historical Hot-rolled Steel and Iron Ore Prices

Source: World Bank, MEPS

Scrap Steel

Scrap steel prices have increased considerable over the past year. **Figure 47** shows the prices of steel scrap at US steel mills from 2007 through July of 2021. Shredded scrap and #1 heavy melting prices are almost at their 2008 highs, while #1 busheling scrap prices still have about $200 per gross ton until they hit their 2008 highs. However, all three types of scrap metal are the highest prices they've been since 2008. The new mini-mill in Frostproof Florida and proposed Homestead mill both use scrap steel as primary input.

Figure 47. Scrap Steel Prices, January 2007 – July 2021



Source: Steelbenchmarker

Structural Steel

U.S. steel capacity utilization rose to a high of 80.1% in 2019, building on gains seen in 2018 and 2017. However, the capacity utilization rate for the U.S. dropped in 2020 due to COVID-19. For the year 2021, **Figure 48** shows data through April.

Figure 48. U.S. Steel Production, Capacity, Utilization and Consumption

U.S. STEEL PRODUCTION, CAPACITY,AND UTILIZATION vs WORLD PRODUCTION AND USE

YEAR	OPERATING RATE (%)	CAPACITY *in millions of tons*	PRODUCTION *in millions of tons*	TOTAL WORLD *in millions of tons* PRODUCTION‡	TOTAL WORLD *in millions of tons* APPARENT USE†‡	U.S. PRODUCTION AS % OF TOTAL WORLD PRODUCTION
2021ϒ	78.1	38.5	30.1	730.6	NA	4.1
2020	67.0	119.6	80.1	2,054.7	1,953.1	3.9
2019	80.1	100.0	80.1	2,067.1	2,082.2	3.9
2018	78.2	122.1	95.5	2,012.3	2,023.6	4.7
2017	74.0	121.6	90.0	1,913.5	1,940.0	4.7
2016	70.5	122.7	86.5	1,799.9	1,808.2	4.8
2015	70.1	124.0	86.9	1,791.4	1,792.5	4.9
2014	77.5	125.4	97.2	1,845.3	1,850.1	5.3
2013	76.7	124.9	95.8	1,821.3	1,834.4	5.3
2012	75.2	130.0	97.8	1,722.1	1,718.4	5.7
2011	74.5	127.8	95.2	1,697.4	1,687.3	5.6
2010	70.4	126.0	88.7	1,582.1	1,564.8	5.6

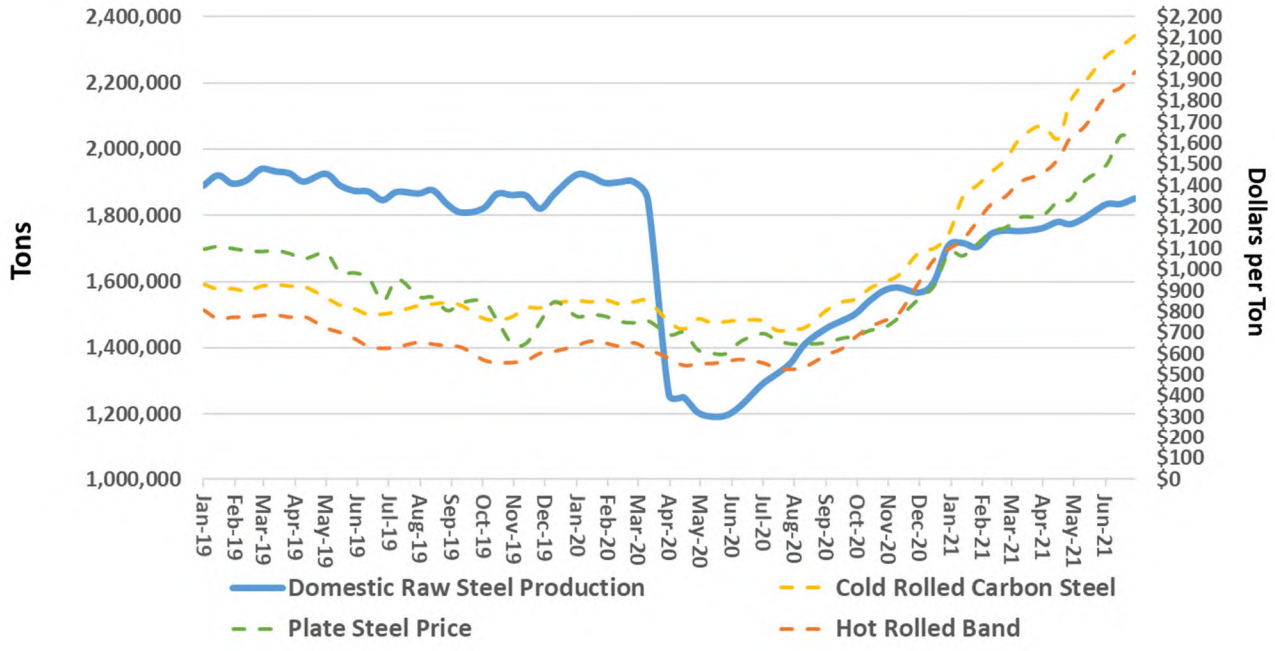
ϒData through April.

*Consumption. †Consumption; 2020 and 2021 data are forecasted. ‡Original data in tonnes (metric) are converted to U.S. tons; (1 metric ton/tonne = 1.10231 U.S. ton).

Source: American Iron and Steel Institute, World Steel Association

Figure 49 depicts U.S. steel production and pricing through July 2021 and the impacts from COVID-19 on the steel market are visible. The declines in production and pricing start to show in March 2020. Production levels are almost at the pre-COVID-19 levels and the price increases are very visible.

Figure 49. U.S. Steel Production and Pricing, January 2019 - July 2021



Source: AISI Weekly Raw Steel Production, SteelBenchmarker

Figure 50 depicts historical CRC, HRB and Plate prices back to the spring of 2006. The trends and comparisons to other major economic events are clear, prices have soared past or met the 2008 peaks.

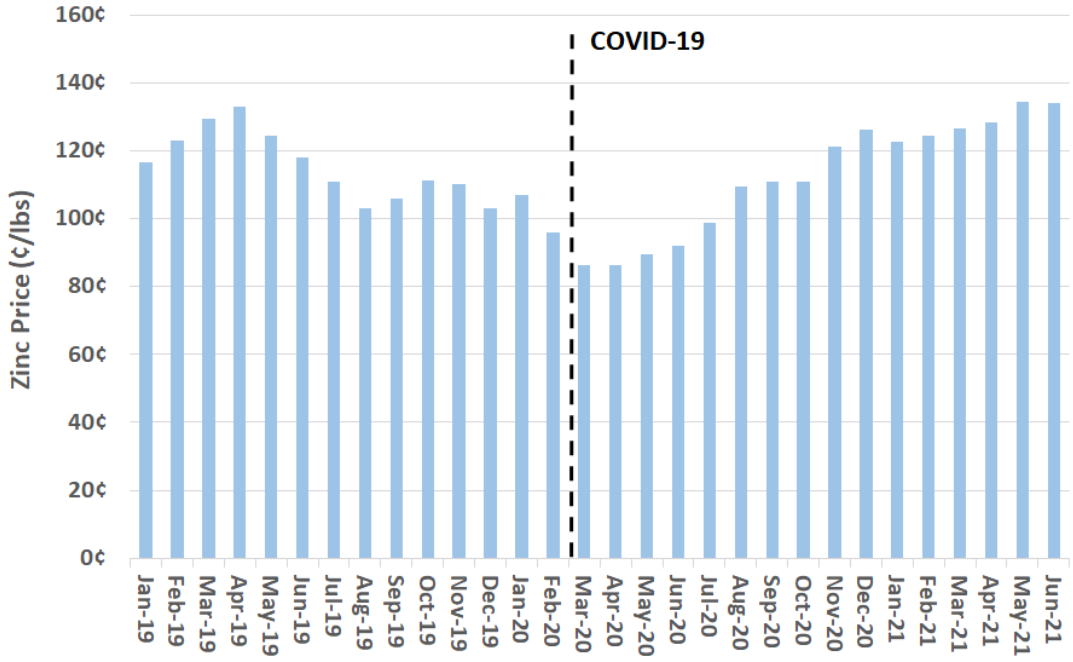
Figure 50. Historical CRC, HRB and Plate Prices

Source: Steelbenchmarker

Galvanizing Materials

Zinc prices have steadily increased from a low of 86 cents per pound in April 2020 to $1.34 per pound in June 2021. **Figure 51** shows zinc prices through the end of fiscal year 2021. Producers are reporting long lead times, delays in shipments, and price increases for galvanized products like galvanized bolts and hardware.

Figure 51. Zinc Prices



Source: World Bank

Tariffs

Reports indicate that the Section 232 tariffs will remain in place under the Biden Administration. The United States Mexico Agreement removed the tariffs on steel from Canada and Mexico last year and those two countries now make up most of US imports of steel. U.S. exports and imports continue to decline, due to higher amounts of domestically produced steel being consumed domestically (**Figure 52**).

Figure 52. U.S. Exports and Imports of Steel Mill Products, By Group

U.S. EXPORTS AND IMPORTS OF STEEL MILL PRODUCTS, BY GROUP

(in thousands of net tons)

PRODUCTS	2013	2014	2015	2016	2017	2018	2019	2020	2021*
Exports									
Flat Products	6,107	5,885	5,383	5,197	5,812	4,744	4,388	4,038	1,216
Long Products	3,023	2,763	2,025	1,826	2,028	1,950	1,391	1,336	433
Pipe and Tube Products	1,865	1,724	1,196	943	1,130	993	756	608	150
Stainless Products	727	884	867	855	1,011	705	468	342	101
Semi-Finished Products	392	245	108	84	117	68	60	119	46
Total exports	12,114	11,503	9,580	8,905	10,098	8,461	7,064	6,442	1,945
Imports									
Ingots, blooms, billets, slabs	6,642	9,605	6,617	6,063	7,770	7,291	6,247	5,334	1,965
Wire rods	797	1,474	1,442	1,446	1,434	1,046	856	643	173
Structural shapes & piling	634	963	950	878	881	580	586	457	134
Plates	1,989	3,713	3,222	2,330	1,990	2,019	1,579	1,051	336
Rails & accessories	345	338	338	324	239	178	150	69	15
Bars & tool steel	3,285	3,491	3,850	3,577	3,252	2,753	2,275	1,980	577
Pipe & tubing	7,044	7,998	6,473	4,199	7,617	6,595	5,516	3,157	763
Wire & wire products	686	810	940	907	838	740	715	705	200
Tin mill products	1,330	1,609	1,795	1,906	1,904	1,628	1,631	1,686	438
Sheets & strip	7,102	11,032	10,457	9,233	9,386	8,483	6,449	5,656	1,620
Total imports	29,853	41,033	36,084	30,864	35,310	31,313	26,006	20,737	6,220

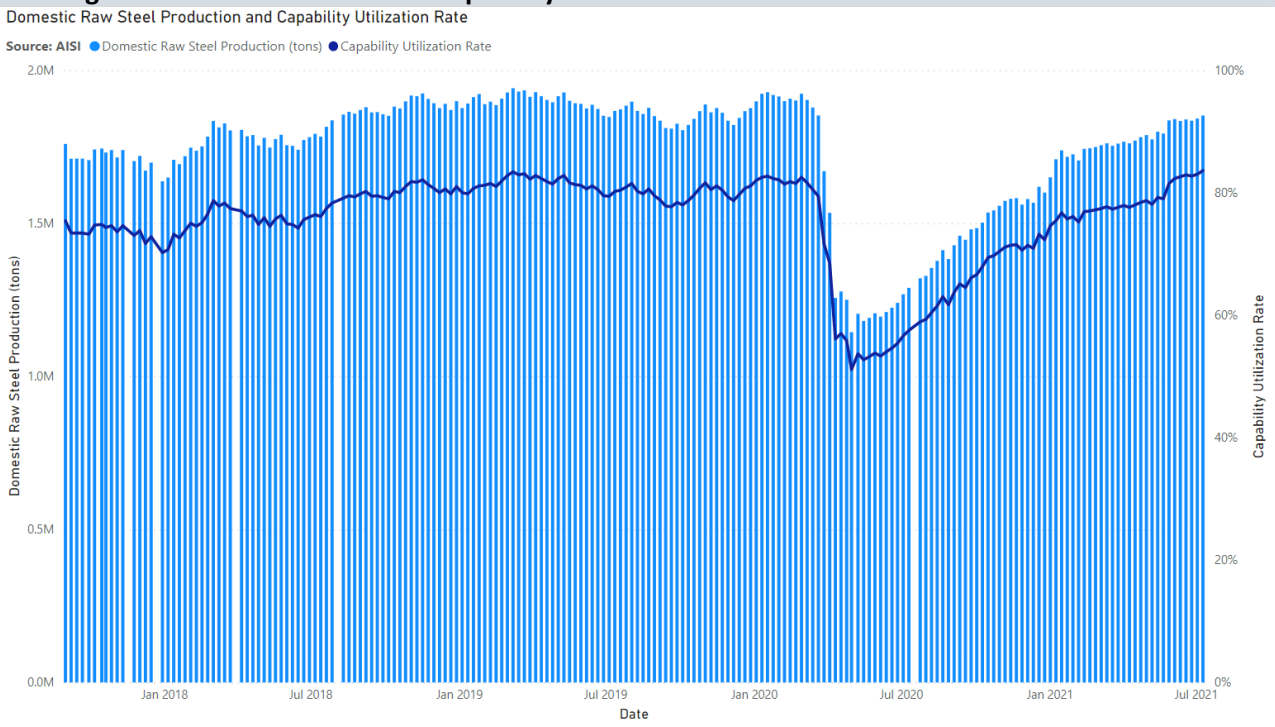
*Data through March for Imports and Exports.

Source: U.S. Census, International Trade Administration

Steel Mill Capability

U.S. capability utilization rates have increased from their low of 51.1% in May of 2020 to back up to over 80%. In Florida, recent fabricator surveys show an average utilization rate of 63%. **Figure 53** shows historical capability utilization rates alongside domestic raw steel production. Naturally, capability utilization rate trends follow production trends. Capability utilization rates are back up to pre-COVID-19 levels, however, domestic production is still slightly lower than levels before March of 2020.

Figure 53. Historical U.S. Steel Capability Utilization Rates and Domestic Raw Steel Production



Source: AISI

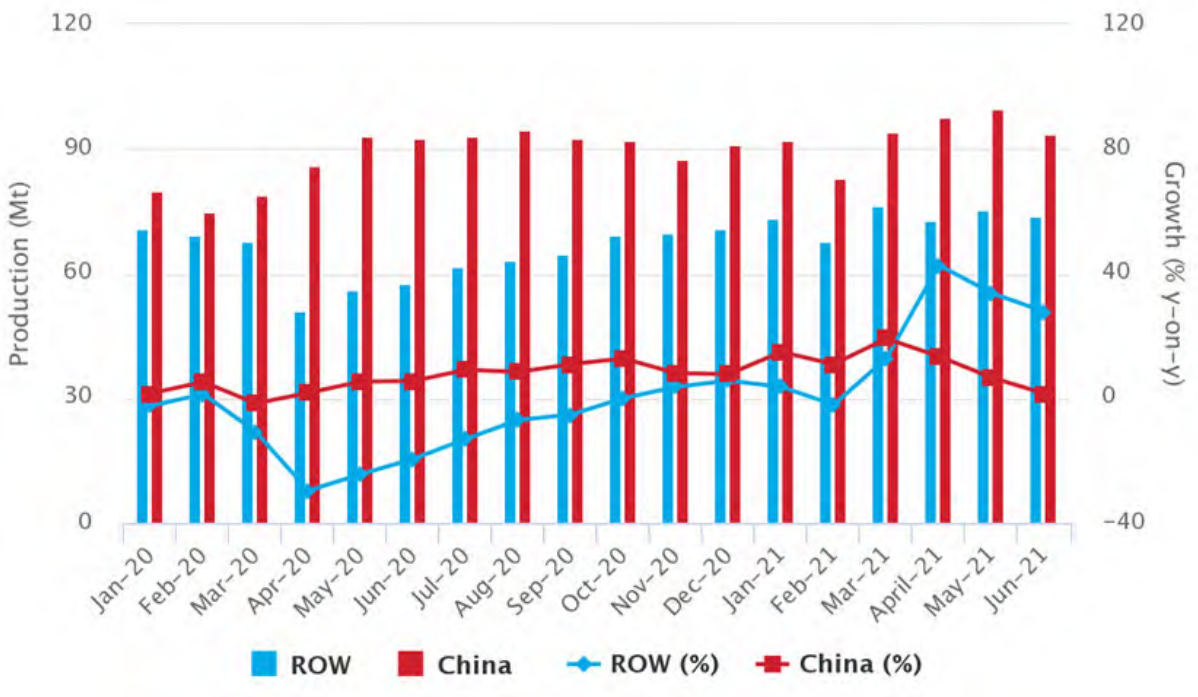
China

China continued to produce over half of the world's steel over the last year. China also rebounded from the impacts from COVID-19 much faster than the rest of the world and the steel market was supported by a Chinese infrastructure stimulus. Therefore, Chinese demand for steel was, and remains, high. Interestingly, China has cut some tax rebates on exports of specific steel products as well as cutting some import tariffs as well, which exemplifies their increased demand for steel. However, there are reports that higher materials prices are impacting China and projects are being put on pause.

Additionally, China has imposed some barriers on goods imported from Australia. While iron ore is not included in these, China is attempting to become more independent from Australia, which could be impacting prices. There are also reports that Beijing is putting pressure on the steel industry to reduce output to help meet a 2060 carbon neutral target. As a result, China is expected to prefer higher grade iron ore products. Higher grade products have a higher concentration of iron and can produce more steel per ton while using less coking coal. S&P Global Platts expects the price premiums on higher grade iron ore will continue.

Figure 54 shows China's crude steel production and year over year percent change versus the rest of the world. While Chinese steel production did decline in January and February of 2020, year over year production was up consistently in the following months and through June of 2021. COVID-19 had a greater impact on the crude steel production from the rest of the world than it did on China. The rest of the world consistently produced less steel than the prior year from March 2020 until November, when it finally had a year over year gain of 3.6%. S&P Global Platts believes that China will increase its steelmaking capacity through 2023, however, even as they shut down some capacity from 2016 – 2018.

Figure 54. Crude Steel Production, China versus the Rest of the World



Source: World Steel Association

Transportation

Producers did not mention any problems with transportation in this round of interviews and surveys. However, fuel prices are increasing and a driver shortage remains a problem for many industries. In general, the cost of transportation is increasing and steel producers are likely feeling some cost increases. One producer mentioned prices for their finished product may rise by the end of the year because of the increase in gas prices.

Buy America

Since the Buy America Act already covered iron and steel, the only potential impact is the higher percentage content requirement in the proposed new rule. However, generally speaking FDOT requires entirely domestic material to avoid any issues and the impact should be minimal.

Rail

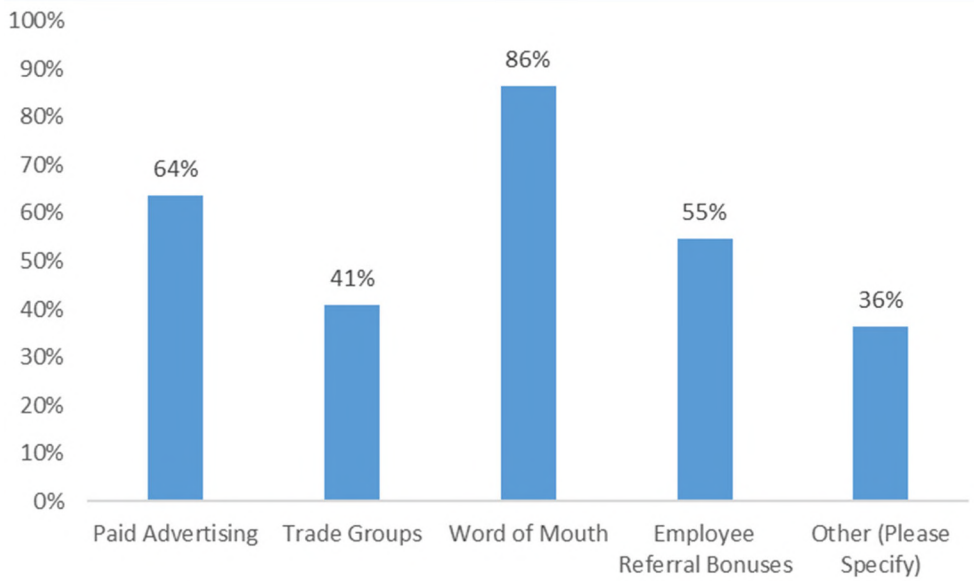
Steel producers did not raise rail access as a critical issue during the survey period. CSX quarterly report indicates that rail deliveries have only been on time 68% of the time, which is 20% lower than the same period last year. However, FEC did not report anything unusual in terms of delivery times for relevant materials.

Labor

A shortage of skilled labor is a concern for many steel producers and the issue appears to have worsened since last year. 61% of survey respondents reported that they have job openings they are unable to fill due to a lack of qualified labor. This compares to 18% in 2020 and 46% in 2019. In 2021, producers report that the openings have been vacant anywhere from 15 to 600 days. When producers were able to link these openings to lost production they indicated their openings cost them at least 3% of production and anywhere from $900,000 to $10 million.

86% of survey respondents stated Word-of-Mouth (75% in 2020, 68% in 2019) and 64% stated that paid advertising (67% in 2020, 63% in 2019) as one of the measures being used to recruit employees. Interestingly, the use of trade groups and employee referral bonuses as a technique to recruit labor increased greatly from 2020 to 2021. 55% of producers are now using employee referral bonuses as a technique compared to only 17% in 2020. 41% of producers reported using trade groups as a recruitment tactic in 2021, compared to 17% in 2020. A breakout of the recruitment measured being used by producers is below (**Figure 55**).

Figure 55. Employee Recruitment Measures



Source: TBG Survey 2021

Competition

Despite a bump in approved facilities over the last few years, the pool of fabricators has decreased from 135 in 2012 to 95 in 2021 (**Table 26**). The overall number of bridge, guardrail, and sign structure fabricators has remained stable, while miscellaneous metal providers have decreased to 23 suppliers. **Table 27** summarizes FDOT approved steel facility concentration by location over the last few years. Steel fabricators serving FDOT can be found in nearly every state, but are largely concentrated in the eastern half of the country due to transportation costs.

Table 26. FDOT Approved Steel Facilities by Type

Location and Type	2012	2021
Florida		
Bridge	5	6
Guardrail	0	0
Miscellaneous Metal	16	15
Sign Structures	6	6
Out of State		
Bridge	32	22
Guardrail	11	7
Miscellaneous Metal	44	23
Sign Structures	21	16
Total	135	95

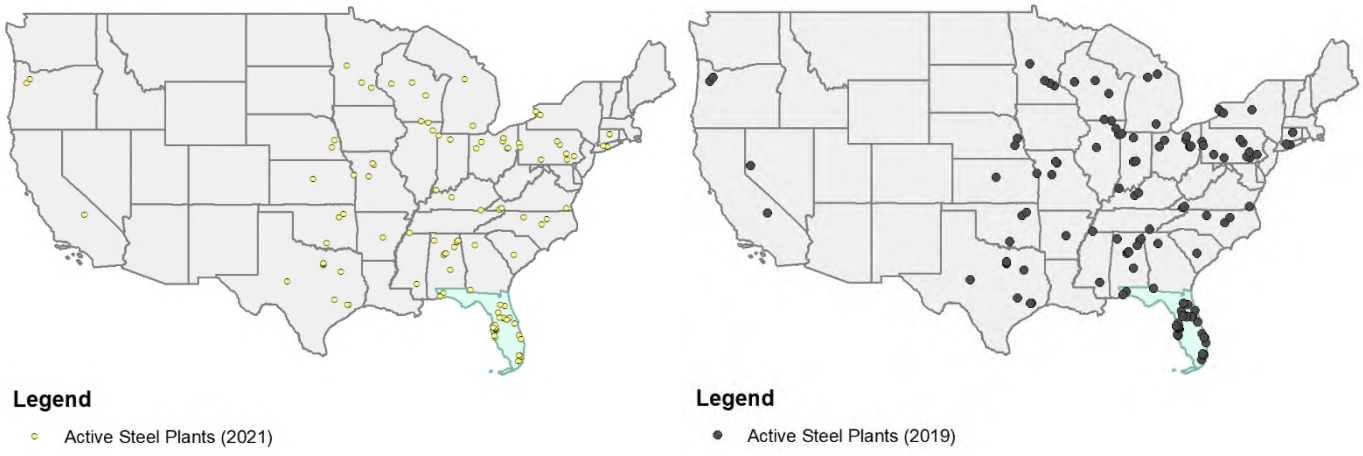
Table 27. FDOT Approved Steel Facilities by Location

Location	2012	2021
Local		
Florida	27	27
National		
East Coast*	29	20
Midwest	41	28
Gulf Coast	30	18
Rocky Mountains	3	0
West Coast	3	2
Outside U.S.		
Canada	2	0
Total	135	95

Source: FDOT Approved Producer List, 2021 as of June 1st

Figure 56 maps steel plant locations visually, with a comparison between active plants in 2019 vs 2021.

Figure 56. FDOT Approved Steel Producer Facilities



Source: FDOT, TBG Work Product

Current Pricing

Based on FDOT bid prices, structural and reinforcing steel prices are up 54% and 37% in 2021 compared to 2020, respectively (**Table 28**). It is not clear if prices are leveling off or will continue to increase.

Table 28. Steel Price, 2016 – 2021

Year	2016	2017	2018	2019	2020	2021
Price Structural Steel, $/lb.	$5.12	$2.80	$4.41	$2.79	$2.55	$3.92
Price Reinforcing Steel, $/lb.	$0.86	$0.81	$0.96	$1.00	$0.88	$1.20

Source: TBG calculated from data provided by FDOT Estimates Office, various industry sources.

Material Quantities

Materials quantities estimates have been prepared for Reinforcing and Structural Steel. FDOT's overall steel consumption has been found to hold a valid statistical relationship with overall FDOT expenditures. However, there is potential for substantially higher quantities of steel and metal products to be considered, and an additional line item labelled Other Steel material is included in the Future Quantities tables herein. The "Other Steel" category is estimated from all pay items that have a steel or metal product component, excluding reinforcing and structural steel.

There are about 2,250 steel pay items currently under consideration, with an accompanying total dollar amount of more than $191 million in fiscal year 2021. This total represents FDOT's exposure to tariff-impacted materials.

To help understand the impact of potential price swings relating to skilled labor shortages, industry consolidation, and supply constraints, steel prices calculated from traditionally let projects were compared to those reported in recent surveys. The survey data was compiled from monthly questionnaires sent to FDOT approved steel fabricators throughout 2021. The analysis shows that prices from recent projects reflect average input costs for structural steel rising as much as 100% higher than original bid prices. Reinforcing steel costs are reported to have increased between 30 to 50% compared to traditionally let contracts in 2021.

Reinforcing and Structural Steel quantities are estimated using historical ratios. Using reinforcing, structural and other steel pay-items, the ratio of total steel dollars to total project dollars is calculated. The average of annual project ratios has been updated to the last ten years to better reflect changes in the market since the global recession. The mean steel dollar ratio is applied to the total Work Program for a given year to estimate total dollars. For example, if the average share of historical dollars spent on reinforcing steel projects equals 0.86%, then it is assumed that 0.86% of the Work Program will pay for reinforcing steel costs in the future. The weighted average price of each steel type, separated into structural, reinforcing, guardrail, casing, steel grid, piling, and steel arm, is used to estimate quantities from total dollar amounts spent on steel. Statewide results are in **Table 29**, while results by District are provided in **Table 30**.

Table 29. FDOT Future Steel Material Requirements

FY	2022	2023	2024	2025	2026
Reinforcing Steel	13,226	12,165	12,331	13,182	12,119
Structural Steel	13,807	12,700	12,873	13,761	12,652
Other Steel	96,273	88,553	89,760	95,953	88,989
Total Tons	**123,306**	**113,419**	**114,964**	**122,895**	**112,989**

Source: TBG calculated from data provided by FDOT Office of Program Management.

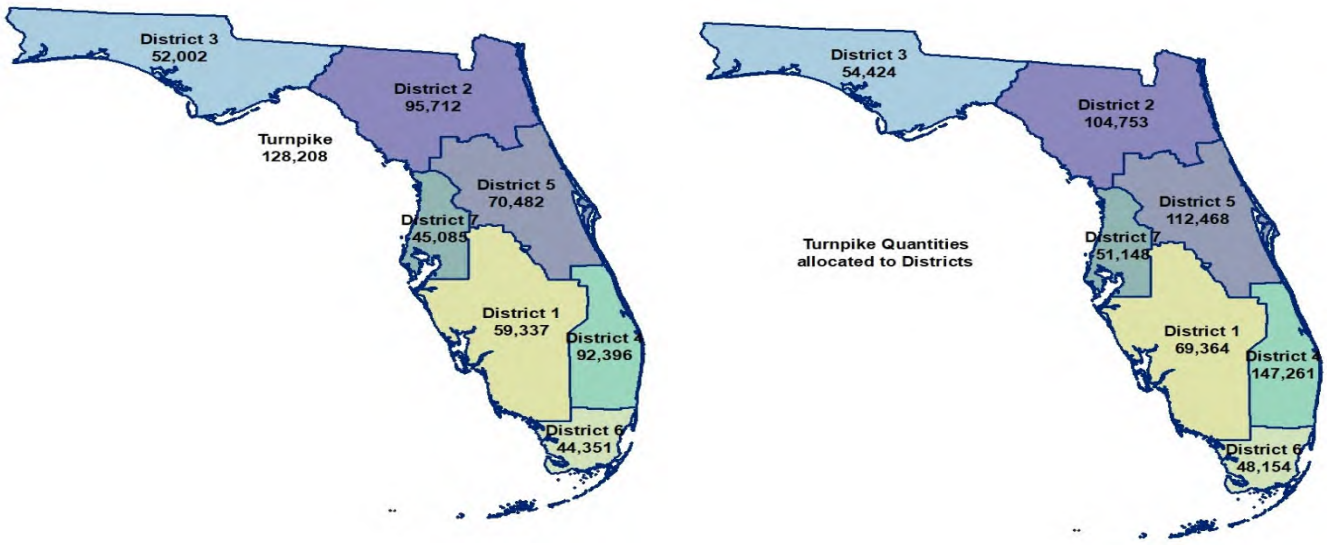
Table 30. FDOT Future Steel Material Requirements by District

District	2022	2023	2024	2025	2026
D1	11,091	8,981	9,525	13,865	15,875
D2	10,873	34,988	10,278	21,864	17,709
D3	13,763	7,859	18,895	5,881	5,603
D4	19,395	10,400	23,368	23,014	16,219
D5	27,583	9,201	10,507	12,250	10,941
D6	13,274	4,808	3,458	9,936	12,875
D7	12,989	8,457	6,685	7,765	9,188
D8	14,339	28,724	32,248	28,319	24,579
Total Tons	**123,306**	**113,419**	**114,964**	**122,895**	**112,989**

Source: TBG calculated from data provided by FDOT Office of the Work Program Budget.

Figure 57 shows total FDOT steel requirements over the Five-year Work Program.

Figure 57. Total Steel Quantities for Five-year Work Program, Tons



Source: TBG calculated from data provided by FDOT Office of Program Management.

Forecast

Prices and consumption are forecast for the five-year work program. Regression modeling was performed using pay item data, supply chain variables and other macroeconomic indicators to identify models that best predicted FDOT's materials costs. Projections for structural steel consider the impact of COVID disruptions that were largely expected to resolve over the coming year, but may have been offset by the industry consolidation controlling production and pricing of raw materials. The estimate considered most likely ends at about $4.76 by 2026. On the upper bound, very Florida-centric factors including stimulus-induced demand, increased resiliency funding for infrastructure and general economic euphoria driving labor and logistics issues, result in prices ending at about $5.33. A more aggressive but possible scenario not shown here ends at about $6.00 by 2026, based on high work program spending, higher prices for zinc, and continued China growth pressuring steel prices. The lower bound relies on reduced spending and cooling economic activity as well as lower energy costs.

For Reinforcing Steel, global coal prices and the price of cement are considered in the most likely estimate, which ends at $1.51 by the end of the work program. With more robust GDP growth, the upper bound ends up closer to $1.80, while constrained construction employment and a medium crude price outlook drive the lower bound which is under $1.40 by 2026.

Table 31 provides the forecast average price for structural and reinforcing steel.

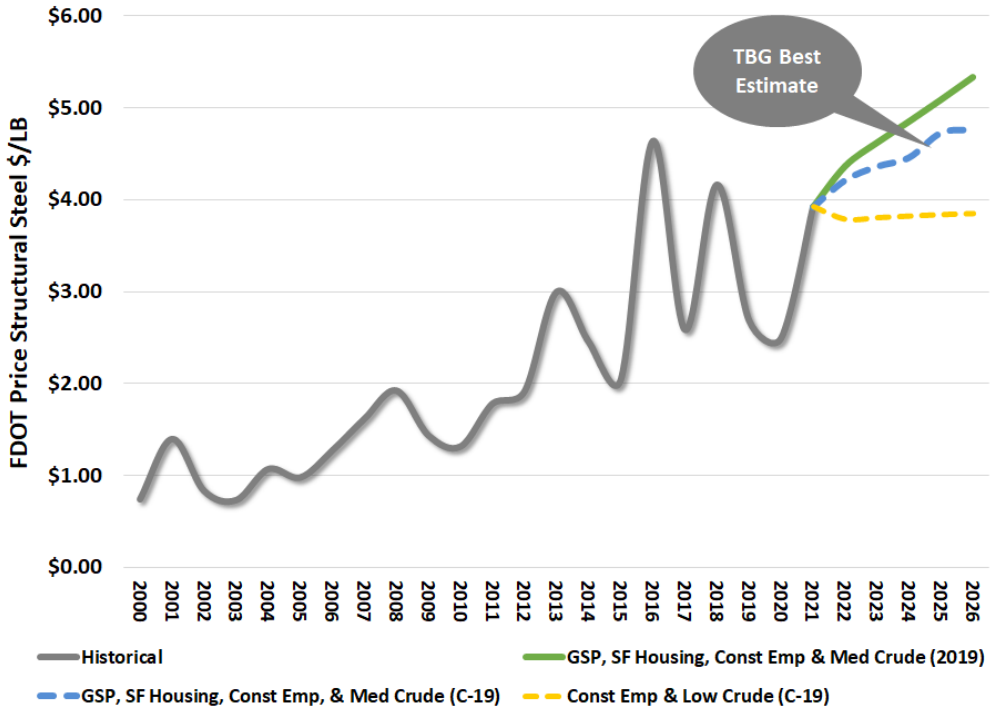
Figure 58 and **Figure 59** show the output of several price models and the scenario identified as best estimate for structural steel and reinforcing steel, respectively. The best estimates for both structural and reinforcing steel prices remain relatively flat through 2025.

Table 31. Steel Price Forecast Results

Year	2021	2022	2023	2024	2025	2026
Price Structural Steel, $/lb.	$3.92	$4.21	$4.36	$4.46	$4.72	$4.76
Price Reinforcing Steel, $/lb.	$1.20	$1.26	$1.31	$1.35	$1.42	$1.51

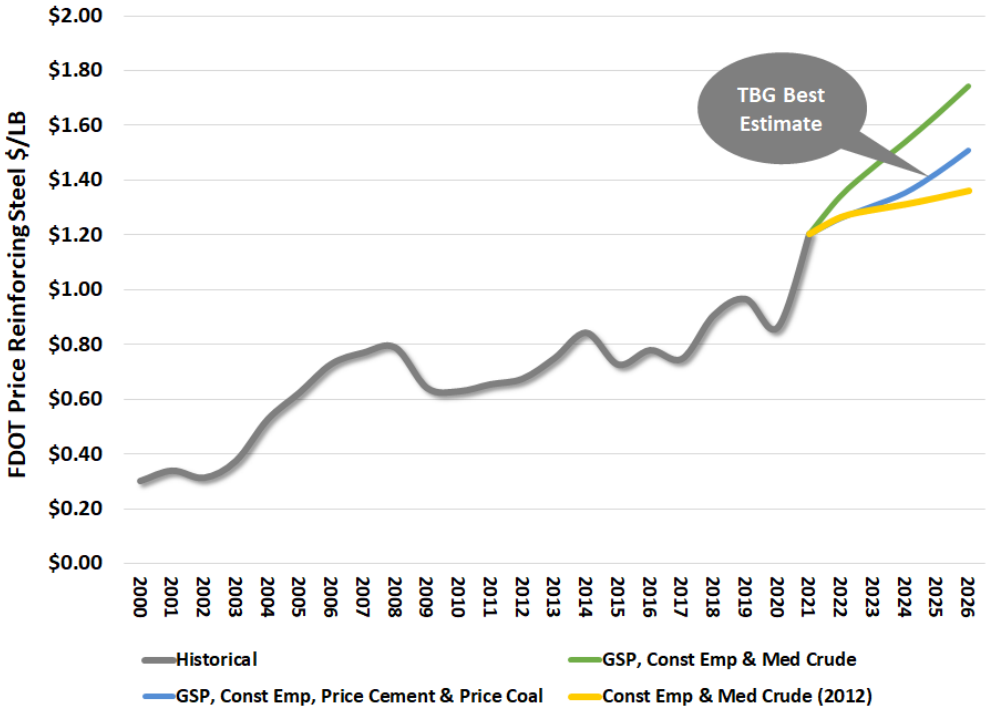
Source: TBG calculated from data provided by FDOT Estimates Office, various industry sources.

Figure 58. Structural Steel Price, 2021 Forecast



Source: TBG calculated from data provided by FDOT Estimates Office, various industry sources.
(Variable descriptions available in the **Appendix**.)

Figure 59. Reinforcing Steel Price, 2021 Forecast



Source: TBG calculated from data provided by FDOT Estimates Office, various industry sources.
(Variable descriptions available in the **Appendix)**

Aggregate

Key Findings

- Aggregate production in Florida increased 2.4% in the first quarter, while national production fell. Construction aggregates production in Florida fell by less than 1%. Only 17% of producers indicated that production was impacted by Covid-19.
- Crushed stone production is over 100 million tons for the first time since 2007. Most producers anticipate continued revenue increases through 2022, with higher interest rates the most likely fly in the ointment. The concern is that private sector demand slows due to higher rates.
- 35% of producers expect difficulties meeting demand with labor and trucking as the main reasons.

FDOT Impacts

- FDOT's Optional Base prices are up 9% through fiscal year 2021 (down from 22% since the previous quarterly report) due to transportation costs and increased demand. Producers in the survey indicated that they expect bids to be, on average, 20% higher by the end of 2021.
- Material supply is sufficient to meet demand

Aggregate prices are currently at record highs for the period of FDOT data available (dating to 1993). A series of factors are supporting high prices. Of the key variables tracked, Chinese imports and average crushed stone prices are at all-time highs. Average hourly earnings of stone mining and the share of construction employees to all employment are near all-time highs. FDOT's aggregate optional base price increased to $46.54 per ton in 2020 and is currently at $50.64 per ton.

Industry Outlooks

According to Pit & Quarry and Dodge Data & Analytics, overall aggregate consumption in 2020 fell by 2% and forecast a 3.3% increase in 2021 and a further 3.6 increase in 2022. Non-building construction is expected to grow the most with a 7% increase in 2022 as they expect funds from different levels of the government to continue. For residential, they expect this sector to continue being strong this year, but plateau in 2022. On the other hand, non-residential building will continue being the most impacted, but the bottom is expected in 2021 with a 3% growth in 2022.

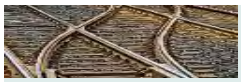
Additionally, publicly traded companies that have released first quarter results show mixed results in shipments of aggregate, but all reported pricing increases of up to 4%. Overall, these companies expect strong performance during 2021. Most producers in the survey indicated that they expect bids to be, on average, 20% higher by the end of 2021.

Regarding markets, respondents in the 2021 survey expected smaller share of FDOT work and non-FDOT public roadway work for 2021 than they did for 2020. While in 2020, respondents expected that, on average, 34% of work will be for non-FDOT public roadways and 25% for FDOT work; in 2021 the shares were, on average, 25% and 21%, respectively. Almost half of the share is for non-roadway work. Overall, production has not been impacted due to Covid-19 as only 17% of respondents indicated that they have been impacted and utilization and average utilization of the respondents increased (62% in 2021 vs. 52% in 2020).

Supply Chain Variables for Aggregate

Table 32 provides current status of selected supply chain variables, and **Table 33** provides historical data for variables impacting FDOT's aggregate costs.

Table 32. Aggregate Supply Chain Variables

 Raw Materials	Shortages or delays of aggregate sources have not been noted. A newly FDOT approved mine in Newfoundland, Canada could provide additional access to stone used in asphalt and concrete, rip rap, and granodiorite. A second granite mine in New Brunswick is also under review, which aims to export granite to Port Manatee. The Rebuilding Our Communities by Keeping Aggregates Sustainable (ROCKS) Act, which was introduced in previous legislatures, has been included as part of the INVEST in America Act that was recently approved by the House.	=
 Access to Land	Access to land with suitable deposits is key to cost-effective material extraction for FDOT Aggregate. The Saving America's Mines Act was introduced to the House early in 2021. There have been no further actions since then. Additionally, the Biden administration began the process to repeal the Navigable Waters Protection Rule to develop a new Waters of the United States rule.	=
 Rail	Rail is the primary transportation for aggregates, from Georgia, and from Lake Belt to Central and Northeast Florida. CSX reported that shipments of minerals declined 9% in the first quarter of 2021 due to lower shipments of aggregates, but revenues from this sector only fell 2%. Fuel costs increased 36% compared to December 2020, but they are still slightly lower compared to March 2020. Overall, aggregate on-time deliveries are reportedly around 70-75% currently.	↑
 Trucking	Constrained truck/driver availability is a major cost increasing factor. Rates have increased as capacity is still tight and competition for drivers have increased. The producer price index for truck transportation was up 17% year-over-year in May and 4% up from April 2021. There have not been any further actions on the DRIVE Safe Act that was re-introduced in March 2021. Producers indicated that trucking is an ongoing issue for the industry to meet demand.	↑
 Labor	Labor demand has been increasing since the recovery in aggregate demand. Employment needs for local, state, & municipal projects, and shrinkages of skilled labor in the U.S southeast are likely to decrease long term supply of labor and thus increase the competition for worker power.	↑
 Competition	Competition has been steady. FDOT's approved list shows a 1% increase in aggregate producers between 2020 and 2021	=
 Capital Costs	The Federal Reserve System adjusting the interest rates influences equipment purchases might cause disruptions in construction projects. Given the current market uncertainties and reports indicating pricing increases, it is unlikely that companies expand their facilities or investment. Half of the producers in the survey indicated no plans of expansion in the next years.	=

↑	Exerting negative influence on FDOT's costs; monitor	↓	Exerting positive influence on FDOT's costs
=	Currently stable; not influencing FDOT's costs		

Table 33. Historical Aggregate Data, 2011 – 2021

*(Maximum values indicated with *)*

Aggregate	Units	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Crude Oil (WTI Spot Price)[1]	$/Barrel	$94.88	$94.05	$97.98*	$93.17	$48.66	$43.29	$50.80	$65.23	$57.00	$39.23	$63.77
Total Chinese Imports[2]	Billions of $	$1,743	$1,818	$1,950	$1,959	$1,680	$1,588	$1,844	$2,136	$2,078	$2,057	$2,200*
Florida Diesel Prices[3]	$/Gallon	$3.08	$3.17*	$3.16	$3.00	$1.84	$1.44	$1.78	$2.22	$2.04	$1.78	$1.97
Estimated Statewide Crushed Stone Produced or Used[3]	000s of Tons	44,851	51,904	59,398	63,585	74,275	80,446	83,532	83,642	95,764	101,384	104,730*
Average Crushed Stone Price Florida[4]	$/Ton	$11.50	$11.02	$10.64	$10.71	$10.80	$11.55	$11.89	$11.92	$12.01	$12.43	$13.92*
FL Heavy & Civil Engineering Employees/ All FL Construction Employees[5]	%	13.46%*	13.22%	12.95%	12.56%	12.28%	12.33%	12.90%	12.45%	12.73%	13.01%	13.04%
FL Construction Employees/All FL Non-Farm Employees[5]	%	4.63%	4.63%	4.83%	5.08%	5.33%	5.65%	5.89%	6.16%	6.32%	6.61%*	6.59%
Average Hourly Earnings Stone Mining and Quarrying[5]	$/Hour	$19.54	$20.68	$21.61	$21.28	$20.65	$21.41	$22.14	$23.44	$26.50*	$26.33	$26.20
FDOT Work Program[6]	Billions of $	$1.9	$2.2	$2.6	$3.3	$3.2	$3.5	$4.0*	$3.8	$3.8	$3.7	$2.7
Crushed Stone Imports Serving Florida[7]	000s of Tons	4,721	5,135	5,153	6,501	6,604	6,311	7,387	8,185	8,484*	8,483	3,266
FDOT Optional Base Price Index[8]	$/Ton	$24.46	$30.09	$33.97	$35.87	$32.68	$38.02	$43.55	$38.40	$37.92	$46.54	$50.64*
FDOT Earthwork Cost[8]	$/Cubic Yards	$3.50	$5.14	$6.00	$4.46	$7.64	$6.96	$6.95	$7.66	$5.90	$8.39	$12.85*

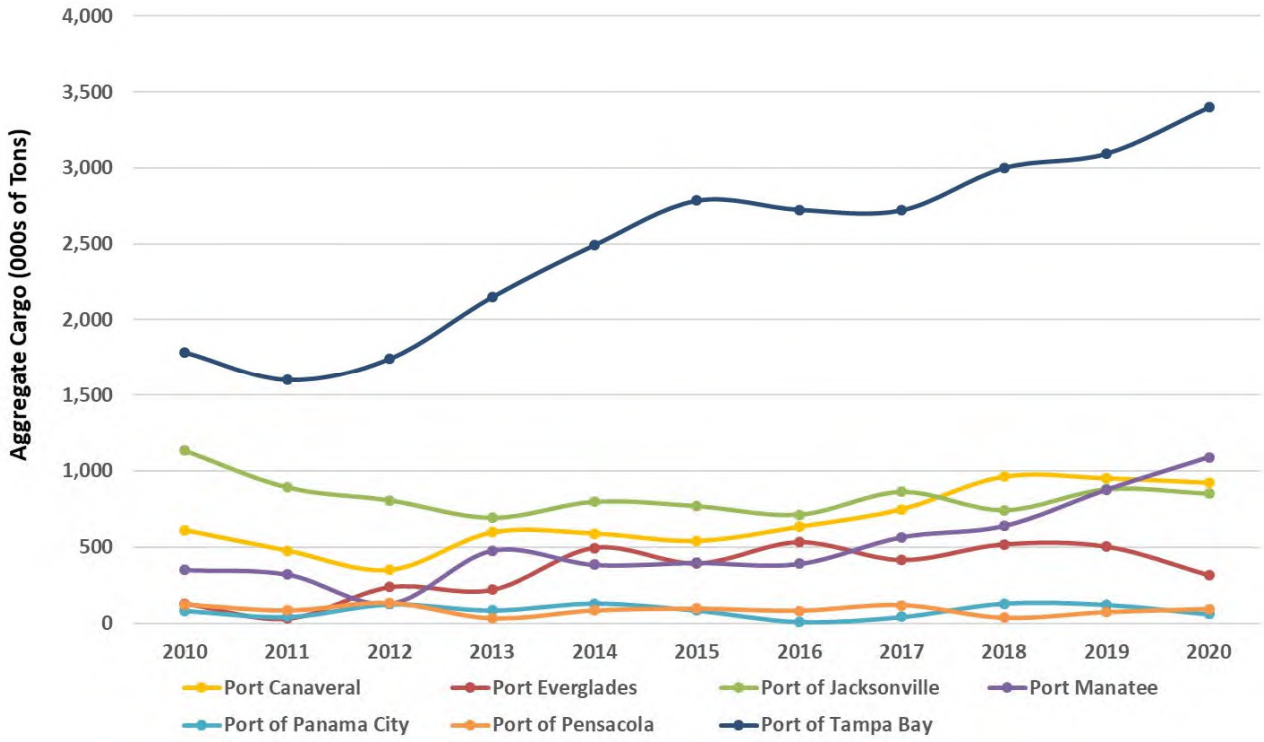
Sources: 1. EIA – Annual Average Spot Price; for 2021, YTD average through June. 2. WTO's World Trade Statistical Review, 2021 estimated. 3. FDOT Construction Office, 2021 through July. 4. US Geological Survey. 5. Bureau of Labor Statistics. 6. FDOT Office of Work Program. 7. U.S. I.T.C.; 2021 through May. 8. Calculated from FDOT Estimates Office data.

Raw Materials

Aggregate sources for FDOT are pre-approved mining locations throughout Florida, Georgia, Alabama and a few offshore sites, including a recently approved mine in Newfoundland, Canada and a granite mine in New Brunswick Canada that plans to export to Port Manatee. Rock suitable for FDOT specs shipped by US companies through Canadian ports could expand aggregate supply without violating the Jones Act, which prohibits foreign built or flagged ships from coastwise trading within the US.

Port terminals accept and store materials from Mexico, Nova Scotia, and the Caribbean. Import data for incoming aggregate has been compiled from each Port's annual report (**Figure 60**). Overall, aggregate imports increased by 4% in 2020. While Port Everglades saw a 37% decline in shipments, Port of Tampa Bay and Port Manatee saw significant increases. Shipments to Port of Tampa increased by 10% to 3.4 million tons and Port Manatee increased 24% to reach one million tons import for the first time.

Figure 60. Aggregate Cargo through Florida Ports

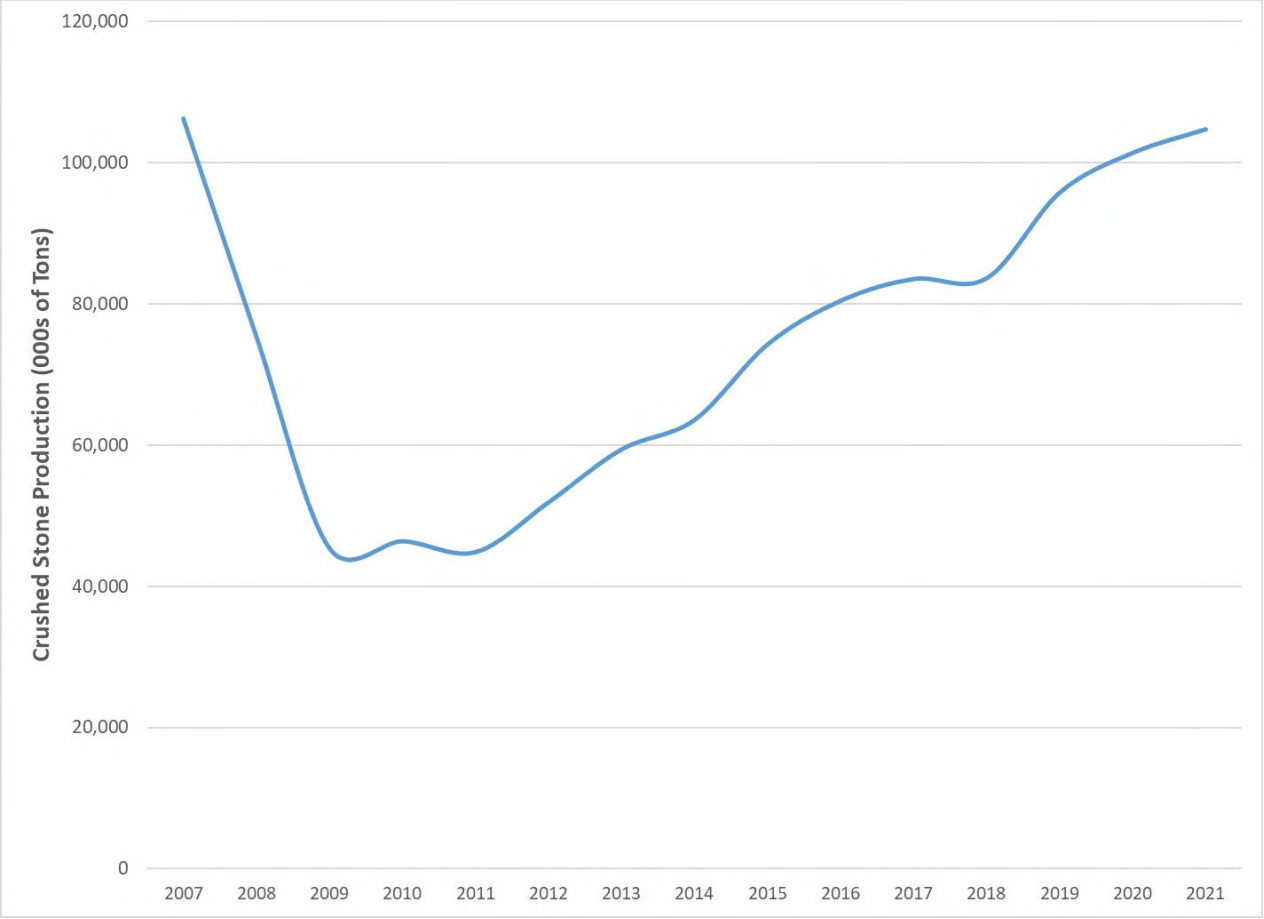


Sources: 1. Canaveral Port Authority Comprehensive Financial Annual Report. 2. Port Everglades Annual Commerce Report, U.S. Army Corps of Engineers Annual Waterborne Commerce of the United States. 3. Jacksonville Port Authority Historical Bulk Information. 4. Manatee Port Authority Annual Financial Report. 5. U.S. Army Corps of Engineers Annual Waterborne Commerce of the United States. 6. Port Tampa Bay Comprehensive Annual Financial Report.

The USGS[4] has released estimated construction aggregate produced for consumption numbers for 2020. Overall, while the U.S. crushed stone and construction aggregates production fell by 2 and 1%, respectively; production in Florida increased by 6% for both. Florida's crushed stone production was over 100 million tons for the first time since 2007 (**Figure 61**). For the first quarter of 2021, crushed stone production in Florida grew 2.4% year over year, but construction aggregates fell by 0.5%.

[4] United States Geological Society

Figure 61. Florida Crushed Stone Production



Sources: USGS; 2021 estimated

Access to Land with Suitable Material

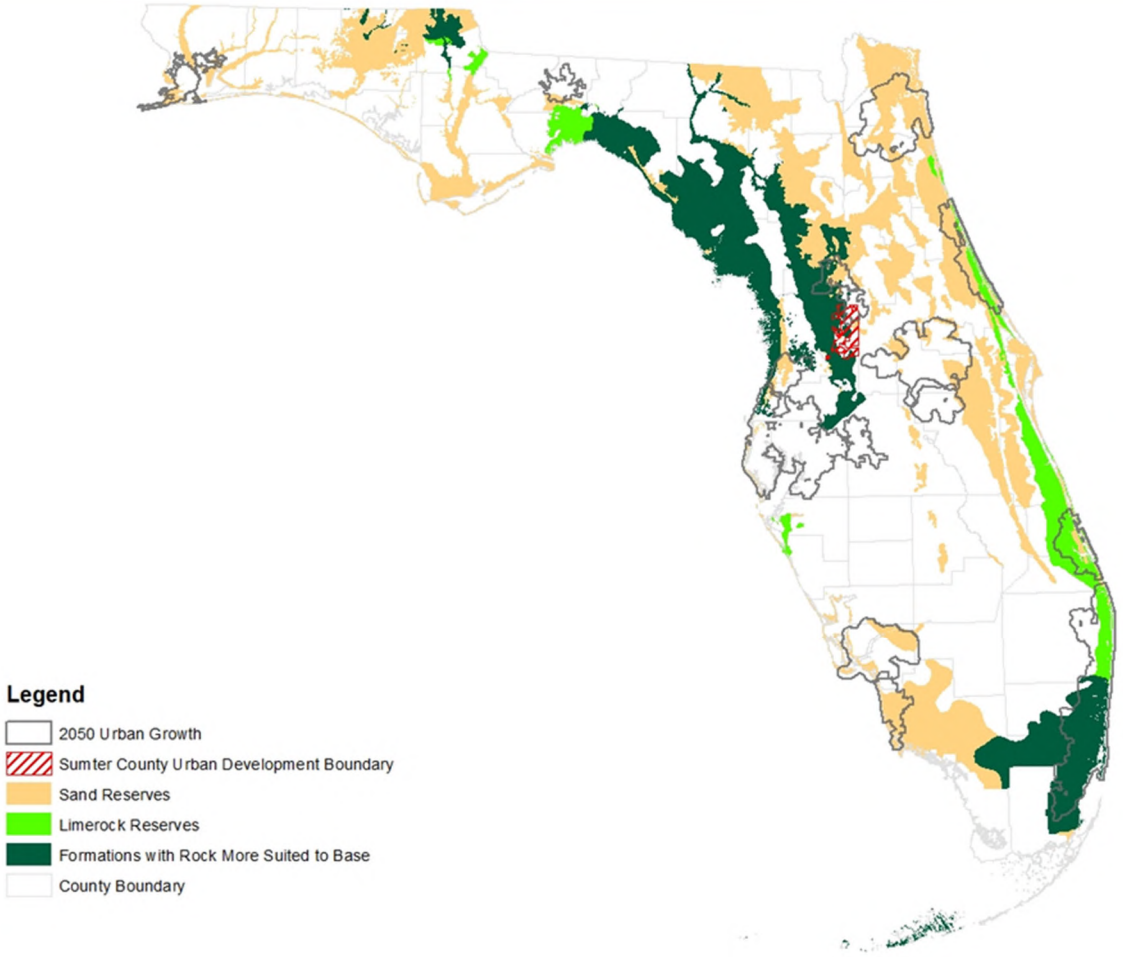
Several Florida mine operators are publicly traded companies with land holdings in multiple states and overseas. For some owners, Florida mines represent a small share of total revenues, and interstate shipments of material from mines situated outside of Florida are a routine part of their internal operations.

Spatial data from USGS reveals the location of sand and limerock reserves statewide (**Figure 62**). The USGS data generalizes formations into several geological types, including limerock, which can be more or less suitable for use as base rock in construction activities. The formations identified as being more suitable for base rock uses have known regions of moderate-to-well indurated (hardened) rock. Florida's limestone formations vary throughout, and the map is provided as a coarse guide to the generalized extent of these formations, recognizing that specific sub-areas and substrata throughout the formations may not all be suitable for FDOT needs.

Urban growth rings representing projected urban boundaries were applied to show where sand or limerock mining could be in conflict with other land uses in the future. Likewise, Sumter County's Urban Development Boundary[5] was included to illustrate an area where urban developments are encouraged that intersect with sand reserves or formations with rock.

[5] Sumter County's Urban Development Boundary (UDB) is an area adopted as part of the Future Land Use Map that is intended for urban type use and development is encouraged

Figure 62. Sand and Limerock Reserves



Sources: USGS; FDEP; TBG Work Product

Rail

Rail is an important mode of transport for aggregate shipments from ports, from Georgia, and from the Lake Belt region to Central and Northeast Florida. In 2020, CSX transported 27 million tons of aggregate, a 7% decline compared to 2019. In the first quarter of 2021, CSX reported that shipments of minerals declined 9% due to lower shipments of aggregate as they transported 5.4 million tons on aggregate (down more than 20% compared to a year ago). In this year's survey, respondents who used rail indicate that they have had issues with the frequency and amount of cars.

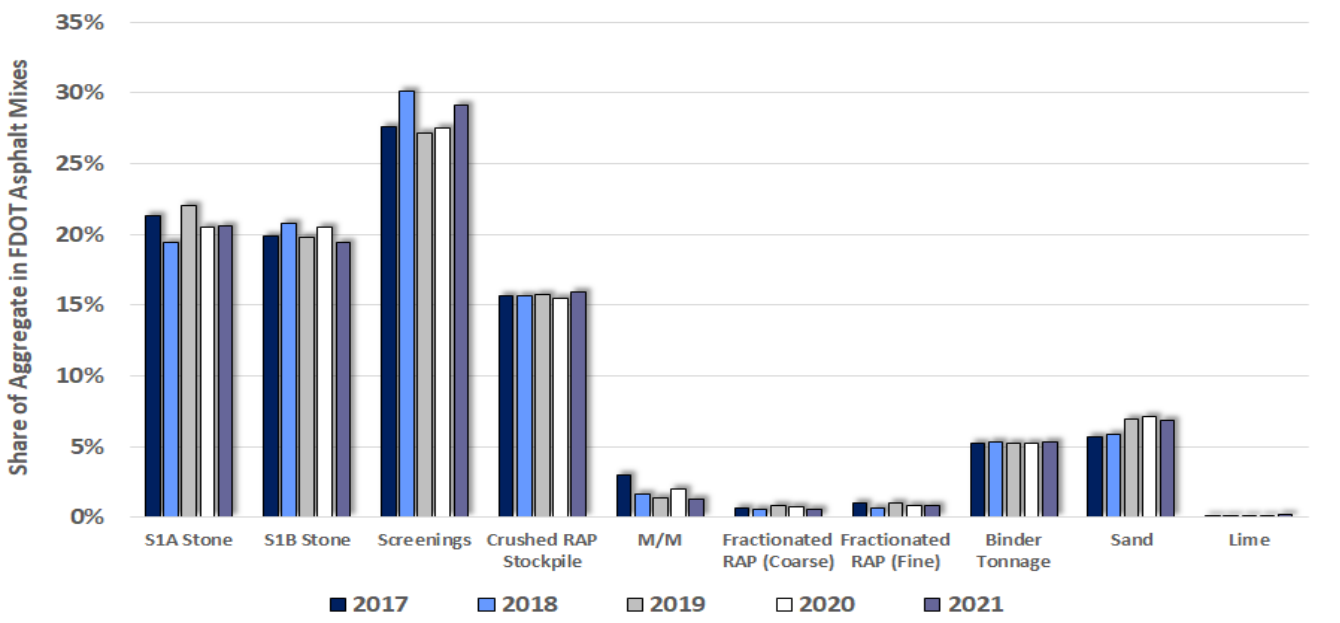
Rail sources indicate several factors are at work. Firstly, volumes are down, making it more difficult to justify committing cars to aggregate; "a moving car generates revenue, and a parked one does not", as one source put it, and turning fewer cars more frequently is a trade-off with turning more cars less frequently. This can create hiccups in spot markets, but overall sufficient cars are available and reportedly parked in yards currently. A second factor is simply the economy; with GDP growth at twice the normal rate, it is reasonable to expect some chokepoints in the logistics cycle. Finally, like other sectors, staffing and equipment is becoming an issue. A generation of rail workers is retiring, and training to produce new rail operators takes 6-18 months depending on the position. Employee retention is a focus for rail currently. Lead times for new hopper cars is long, but for

aggregate, volumes are only just returning to pre-recession levels. Investment in new equipment has not been a priority, and sufficient hopper cars have been available.

Overall, aggregate on-time deliveries are reportedly around 70-75% currently; it is important to note that aggregate on-time deliveries normally run in the high 70's, as the material is considered less time-sensitive than freight. The reason is that freight has to make several subsequent deadlines, for example a UPS sorting deadline each day – currently freight is backed up in yards of full trains, and delivery is behind schedule, as almost everyone has experienced ordering anything in the past year for their household. Under normal conditions, freight would be in the high 90's, and currently is in the 70-75% range. Ultimately, rail recognizes that trucking is an alternative, which constrains their ability to raise rates.

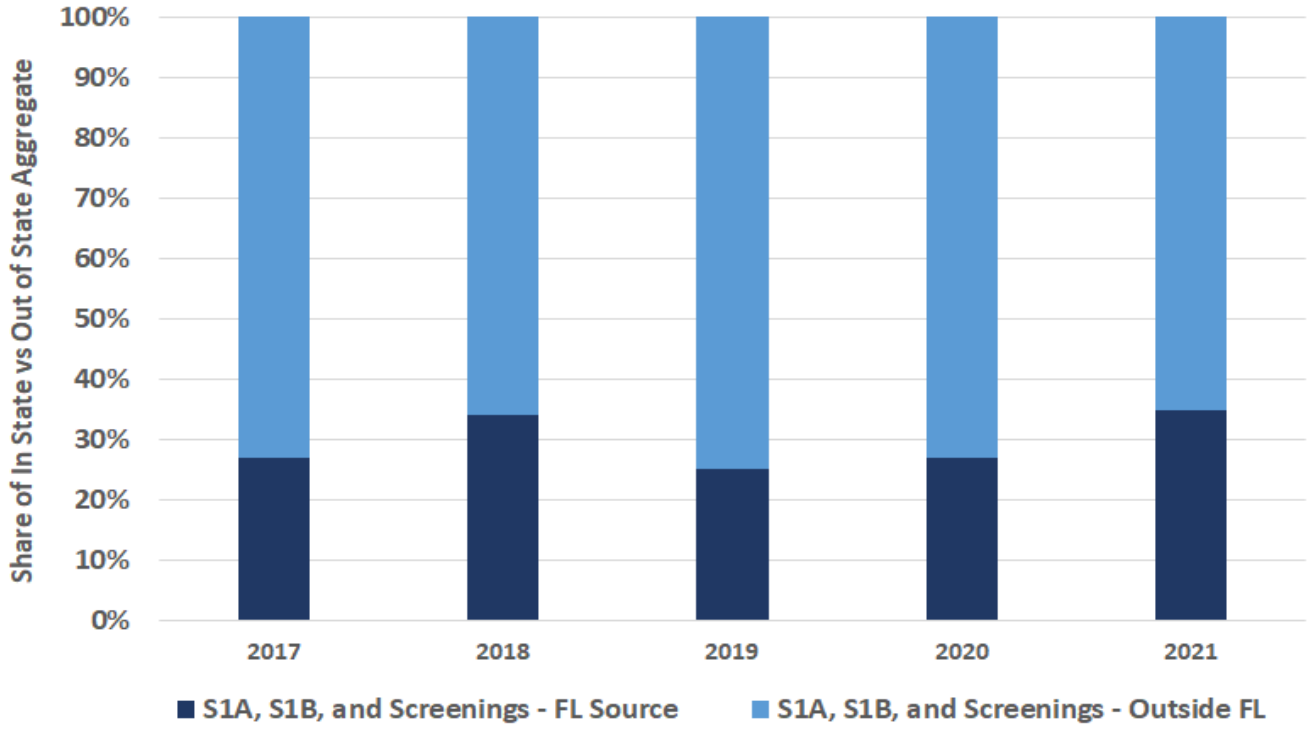
As reported in FDOT's MAC (Materials Acceptance and Certification) system, aggregate used in FDOT asphalt mix designs has maintained a similar composition over the past few years, with screenings, S1A stone, S1B stone, and crushed RAP stockpiles amounting to a majority of aggregate used in asphalt mixes (**Figure 63**). Of the top three aggregate types used in asphalt mixes reported in MAC, the majority is sourced from mines outside the state (**Figure 64**), revealing a point of concern as skilled CDL drivers and consistent rail access remain in short supply to transport rock across the state.

Figure 63. Share of Aggregate in FDOT Asphalt Mixes



Source: FDOT Materials Acceptance and Certification System.

Figure 64. Share of Aggregate in FDOT Asphalt Mixes - S1A S1B Screenings by Location



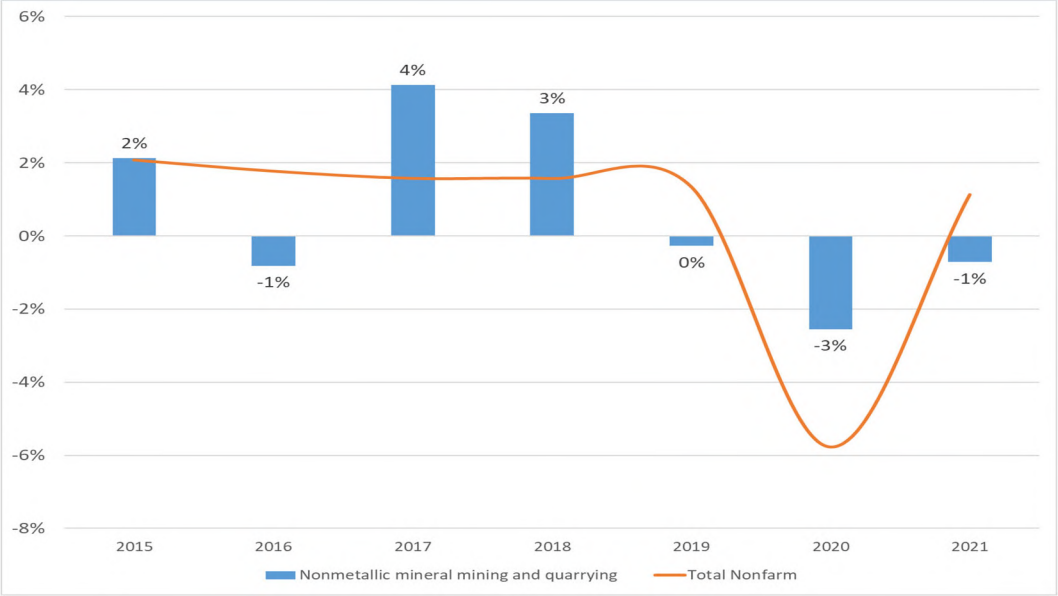
Source: FDOT Materials Acceptance and Certification System.

Labor

While in 2020, 30% of survey respondents anticipated issues with meeting demand, this year's survey showed that 35% expect difficulties in meeting demand, where labor shortages and trucking availability are the major setbacks.

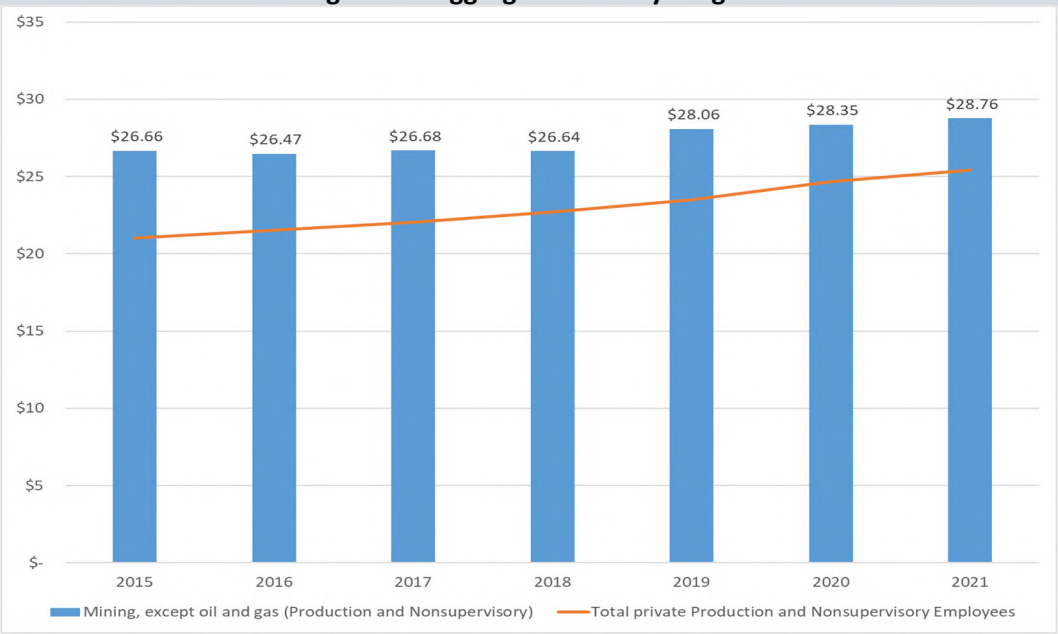
The recovery in demand for aggregate has increased demand for labor over the last few years and in 2020 employment fell less than the total nonfarm employment (**Figure 65**). Nationally, while average hourly wages remained stagnant at about $26.50 since 2013 (**Figure 66**), they have been above $28 since 2019. Higher unemployment rates caused by the pandemic did not lower average hourly wages in 2020 as the labor supply continues being constrained and producers continue reporting labor shortages.

Figure 65. Aggregate Industry Employment Growth



Source: Bureau of Labor Statistics

Figure 66. Aggregate Industry Wages



Source: Bureau of Labor Statistics

Lake Belt

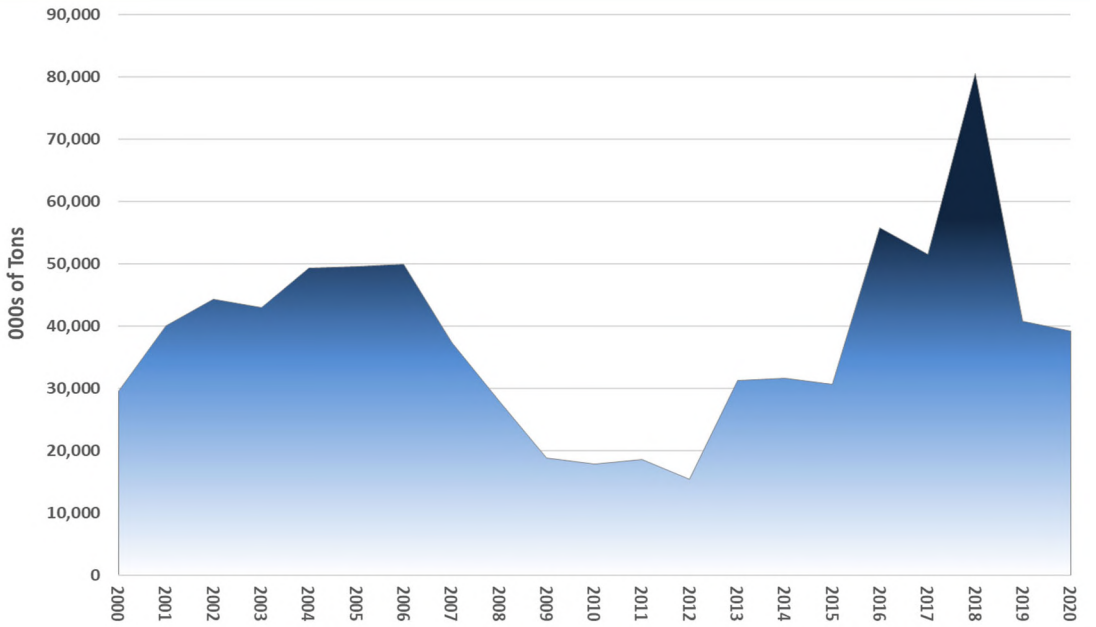
The Lake Belt region of South Florida is an important source of aggregate for FDOT. Aggregate production in Lake Belt fell in fiscal year 2019-20 after a significant decline in the previous year as well. The per ton mitigation fee rate that mines must pay in the Miami-Dade County Lake Belt Area to extract limerock and sand have decreased from a peak of $0.45 in fiscal year 2012 to $0.05 since 2018 (**Table 34**).

Table 34. Lake Belt Fee Rates, 2012 – 2020					
Fiscal Year	Per-Ton Fee Rate	Total Collections	Percent Change	Total Tons Extracted	Percent Change
2011-12	0.45	$6,931,856	48%	15,404,125	-17%
2012-13	0.45	$14,084,101	103%	31,298,003	103%
2013-14	0.45	$14,237,681	1%	31,639,292	1%
2014-15	0.45	$13,811,791	-3%	30,692,868	-3%
2015-16	0.25	$13,937,265	1%	55,749,058	82%
2016-17	0.15	$7,724,044	-45%	51,493,627	-8%
2017-18	0.05	$4,027,804	-48%	80,556,081	56%
2018-19	0.05	$2,042,183	-49%	40,843,667	-49%
2019-20	0.05	$1,962,442	-4%	39,248,843	-4%

Source: FL DOR

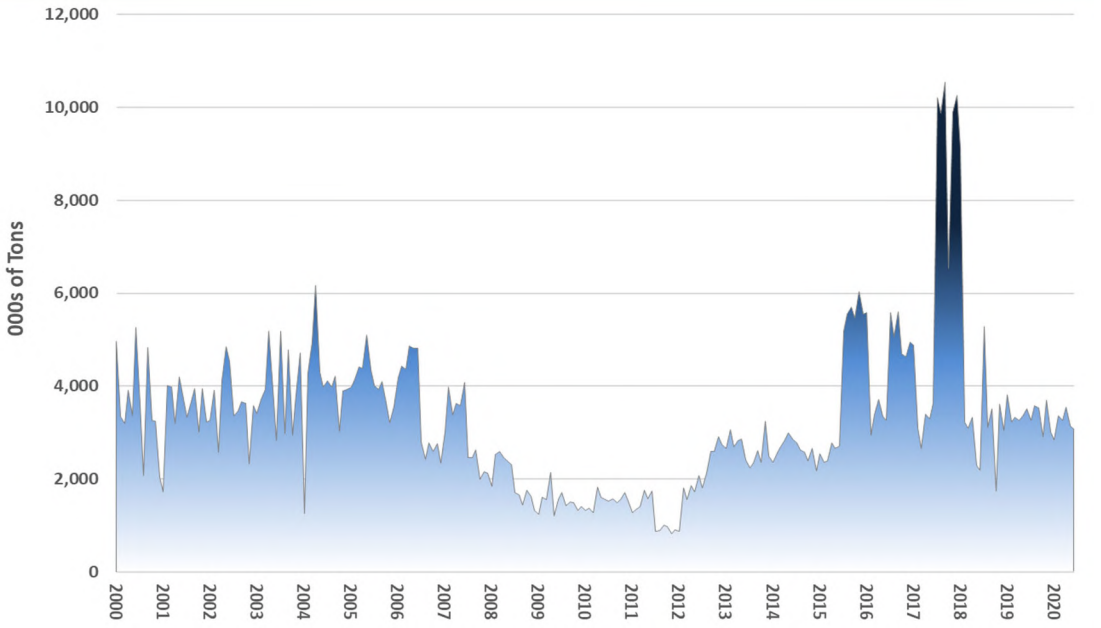
Figure 67 provides a snapshot of production over the past 20 years, followed by **Figure 68**, which shows production on a monthly basis for the same timeframe. As the fee rate decreased over the last few years, production of crushed stone has eclipsed housing boom peaks in the Lake Belt Region.

Figure 67. Annual Lake Belt Production, 2000 – 2020



Source: FL DOR

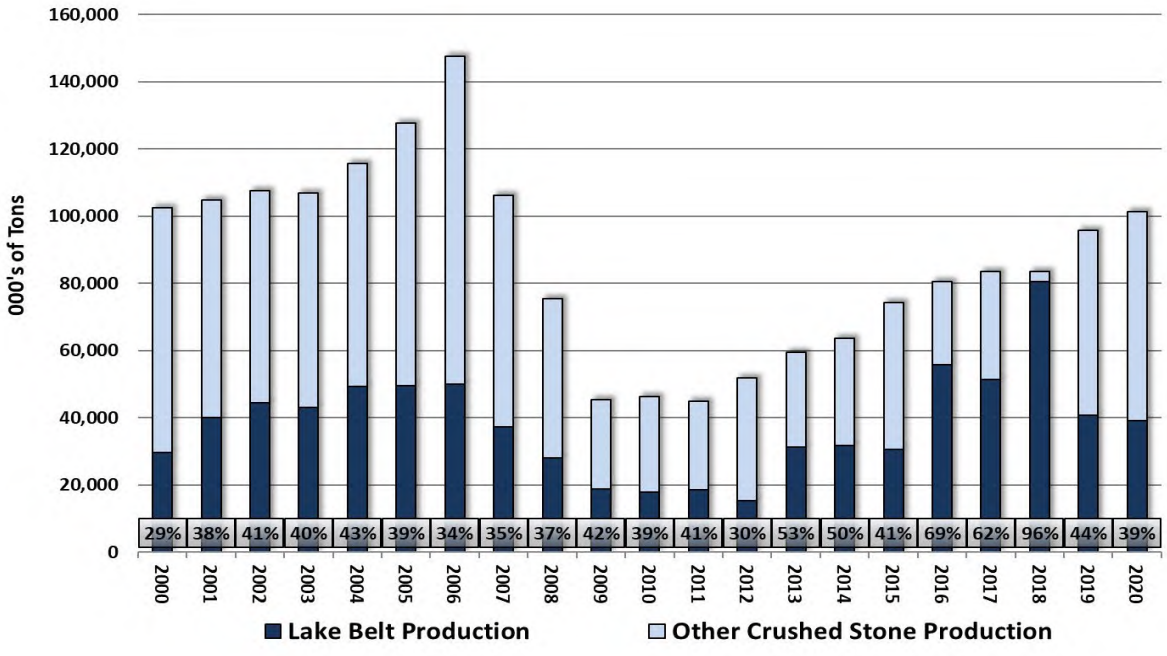
Figure 68. Monthly Lake Belt Production, January 2000 - June 2020



Source: FL DOR

Figure 69 provides a comparison of Lake Belt production to other Florida production of crushed stone. While 2018 exceeded peak production in the Lake Belt region, production in 2019 and 2020 showed patterns similar to previous years where fee rates were higher.

Figure 69. Crushed Stone Produced or Consumed in Florida, by Region (1,000 Tons)

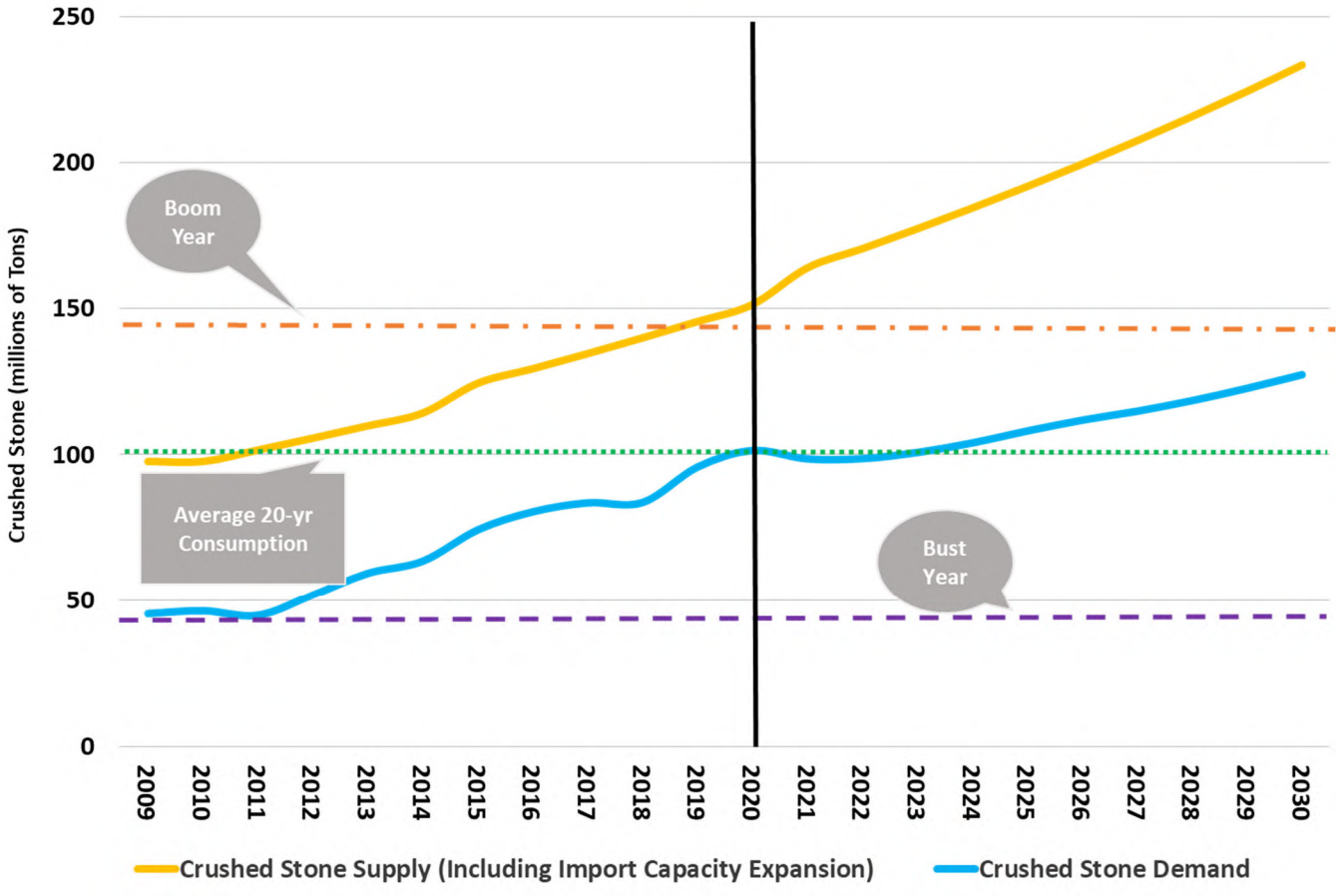


Source: USGS and FDOR

An analysis of Florida's crushed stone supply and demand shows no capacity issues within the next decade (**Figure 70**). The analysis used Pit & Quarry's aggregate demand and growth rates by sector. In 2020, 24% of U.S. aggregate demand was for residential work, 28% for non-residential and 48% non-building work. Forecasting to 2030, aggregate demand in Florida would approach 130 million tons and the share of non-residential work would fall below 20% while residential and non-building would grow to approximately 28% and 52%, respectively.

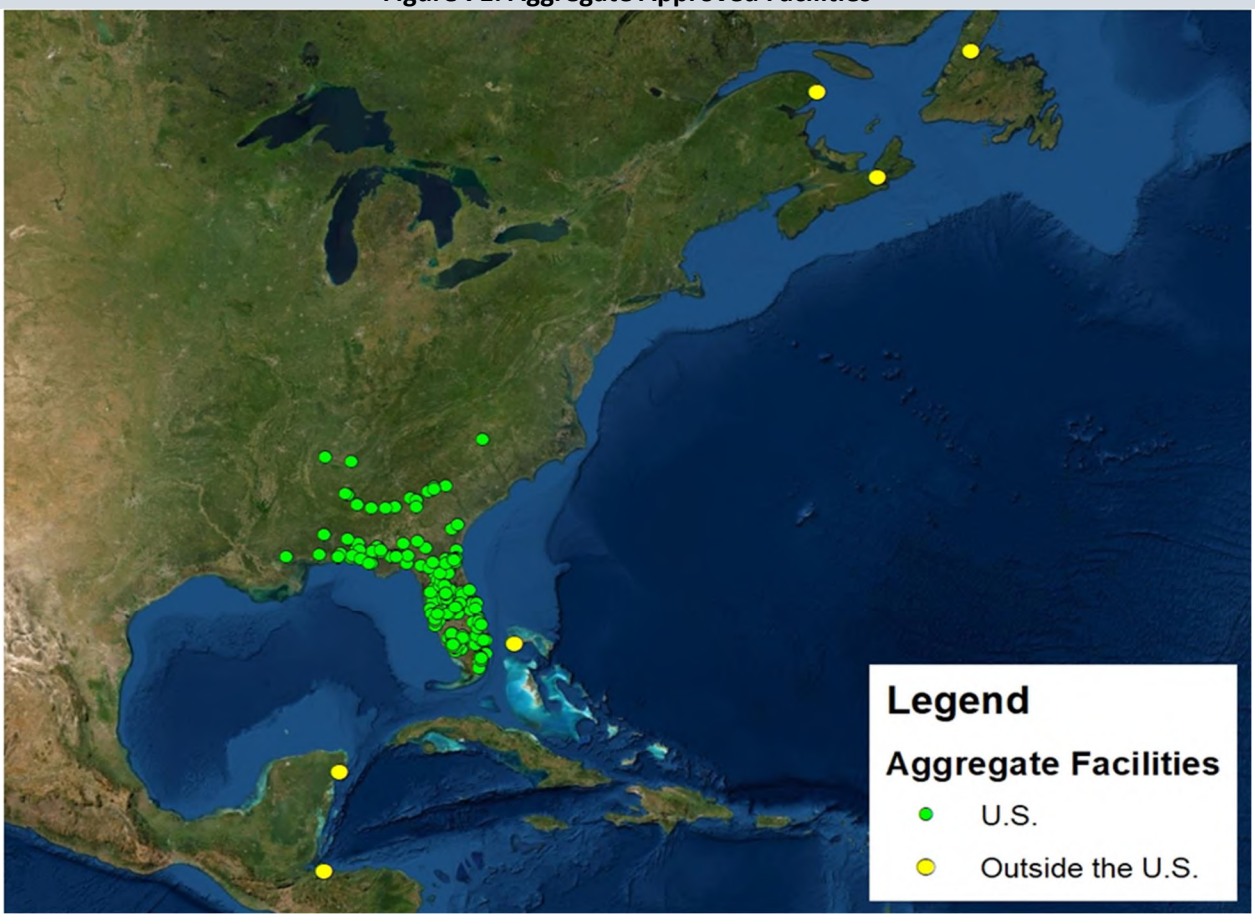
Other construction forecasts from the Office of Economic and Demographic Research, UCF, and industry reports from First Research (a market research company) were considered; significantly higher estimates were considered less feasible given long-run trends, historical data, and likely periodic market corrections. In all scenarios, the available supply exceeds FDOT requirements by an order of magnitude. If imports were restricted due to the Buy America requirements, the available supply will be affected as imports have accounted for between 8% and 10% in prior years. Additionally, about 4% of FDOT's approved aggregate facilities are outside the U.S. (**Figure 71**). About 460,000 tons are imported each year by rail, representing approximately 1% of Florida's total production and 9% of FDOT's material quantities. However, supply is still expected to be sufficient to meet demand even if Buy America restrictions were introduced.

Figure 70. Crushed Stone Production Trends



Source: USGS and FDOR

Figure 71. Aggregate Approved Facilities



Source: FDOT; TBG Work Product

Environmental and Land Use Regulations

On December 2020, Congress passed the Water Resources Development Act (WRDA), which authorizes the U.S. Army Corps of Engineers to complete water infrastructure improvement studies and construction projects. Additionally, the ROCKS Act has been included as a part of the INVEST in America Act (which would replace the FAST Act) that was recently approved by the House. The bill aims to guarantee that communities have sustainable access to locally sourced aggregate. In 2021 TBG's survey producers indicated a 28% likelihood of environmental/land use obstacles affecting production this year (up from 17% from last year). However, their perception of these over the next 5 years had minimal change (47% this year vs. 41% last year).

Waters of the United States Rule

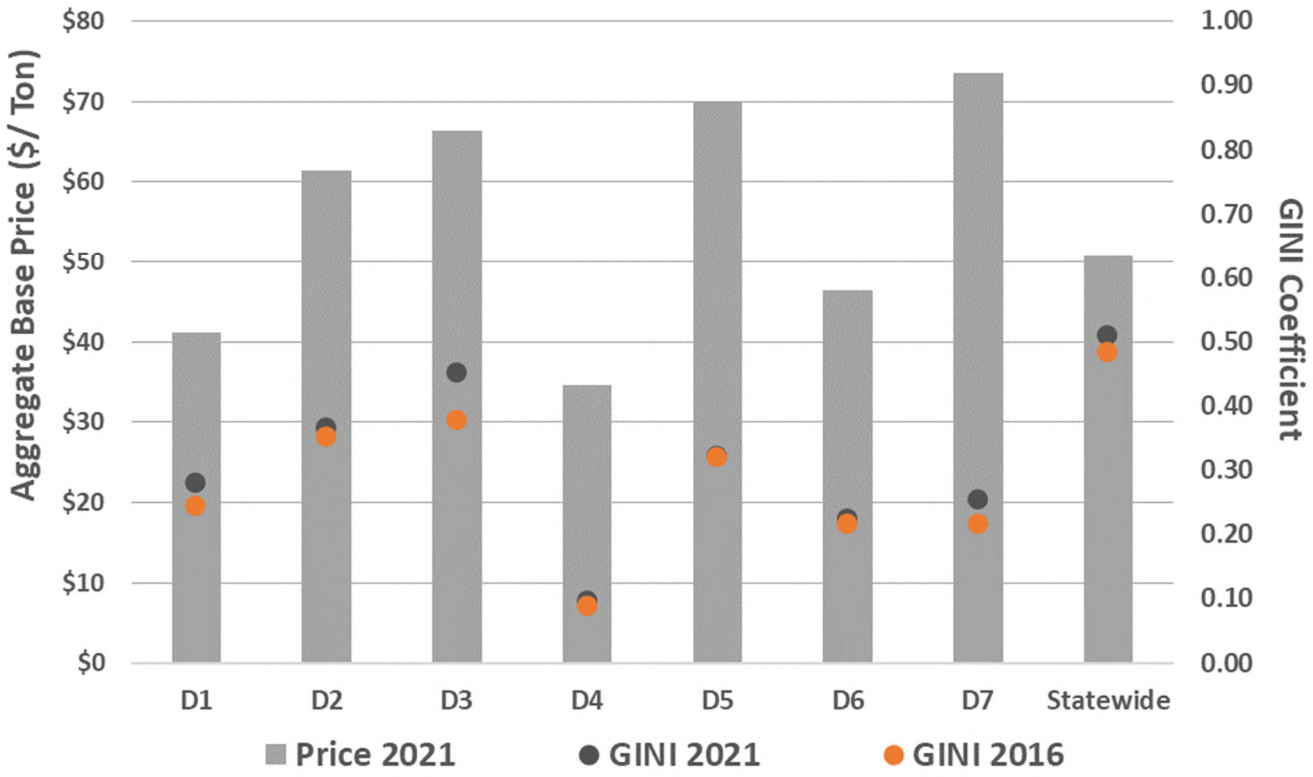
The Biden Administration began the process to develop a new Waters of the United States rule with the EPA's request to repeal the Navigable Waters Protection Rule approved during the previous administration. This rule replaced the 2015 water of the United States rule and narrowed the types of waterways that qualify for federal protection under the Clean Water Act.

Competition

Producers did not report significant changes in competition within this past year. This competitive stability is reflected through Gini coefficients in **Figure 72**, where coefficients between 2016 and 2020 have remained stable

for several Districts. The markets in Districts 2 and 3 have become more competitive compared to last year, while Districts 6 is slightly less competitive. Differences in demand are reflected in pricing.

Figure 72. Aggregate Competition Gini by District



Source: FDOT, TBG Work Product. Price is a composite of optional base and earth works.

Current Pricing

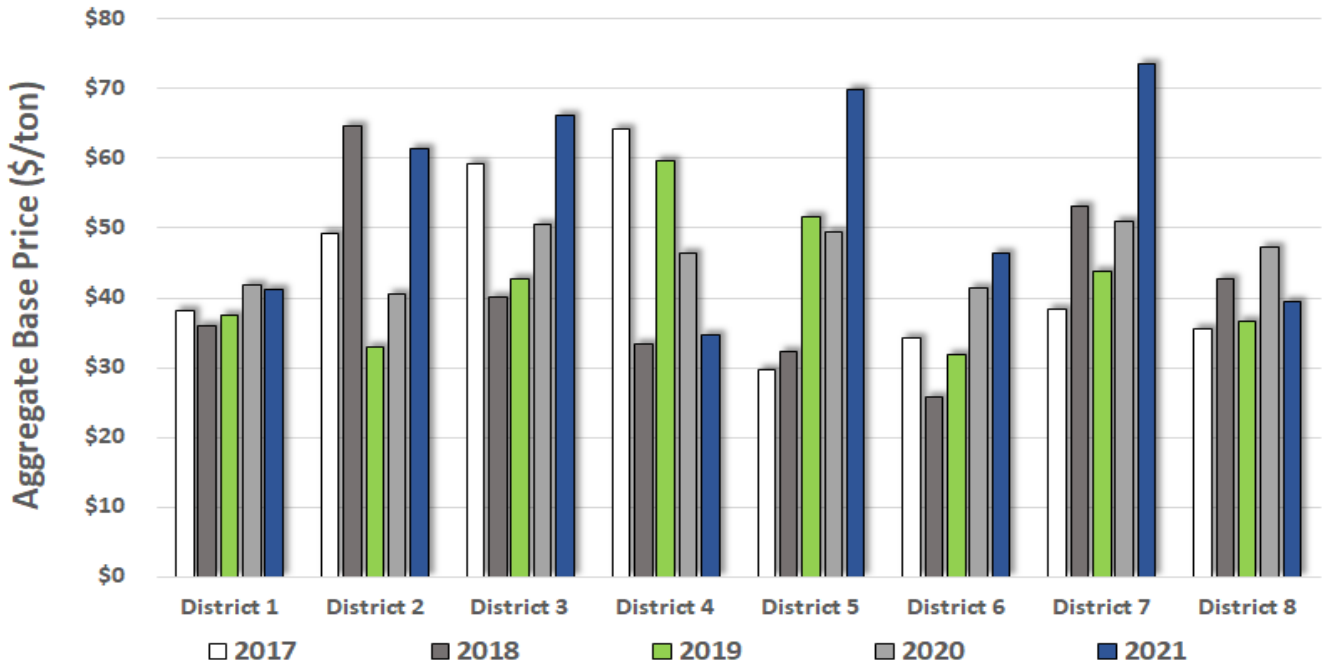
Based on FDOT bid prices, aggregate optional base prices are up 9% in fiscal year 2021 (**Table 35**). The highest prices are being experienced in Districts 3 due to transportation costs and Districts 5 and 7 due to increased demand for construction activities and a shortage of skilled labor and drivers (**Figure 73**). Producer interviews indicate higher prices are expected into fiscal year 2022.

Table 35. Aggregate Base Price, 2016 – 2021

Year	2016	2017	2018	2019	2020	2021
Price Aggregate Base, $/Ton	$38.02	$43.55	$38.40	$37.92	$46.54	$50.64

Source: TBG calculated from data provided by FDOT Estimates Office, various industry sources.
*Estimates through June 2021.

Figure 73. Aggregate Base Price by District, 2017 – 2021



Source: TBG calculated from data provided by FDOT Estimates Office, various industry sources.

Material Quantities

Materials requirements have been estimated for the five-year work program. Pay item data from 1994 forward was evaluated to calculate the share of project expenditures attributable to aggregate within asphalt and concrete quantities, as well as pure base requirements. **Table 36** provides the results statewide. Future FDOT aggregate requirements by District are shown in **Table 37.**

FDOT demand for aggregate for Base, Asphalt and Concrete is expected to increase by about 3 million tons over the five-year work program. Total demand of FDOT's five-year Work Program for aggregate is about 46.7 million tons. Total FDOT aggregate requirements for the five-year Work Program by District are shown in **Figure 74**.

Table 36. FDOT Future Aggregate Material Requirements, in Tons

Year	2022	2023	2024	2025	2026
Base Material and Other Aggregate	1,806,571	1,648,805	1,904,057	2,427,152	2,286,633
Aggregate for Asphalt	4,374,983	4,524,138	4,743,077	6,462,951	6,266,311
Aggregate for Concrete	2,634,237	1,232,529	1,974,572	1,808,005	3,280,176
Total Aggregate	**8,815,791**	**7,405,472**	**8,621,706**	**10,698,108**	**11,833,119**

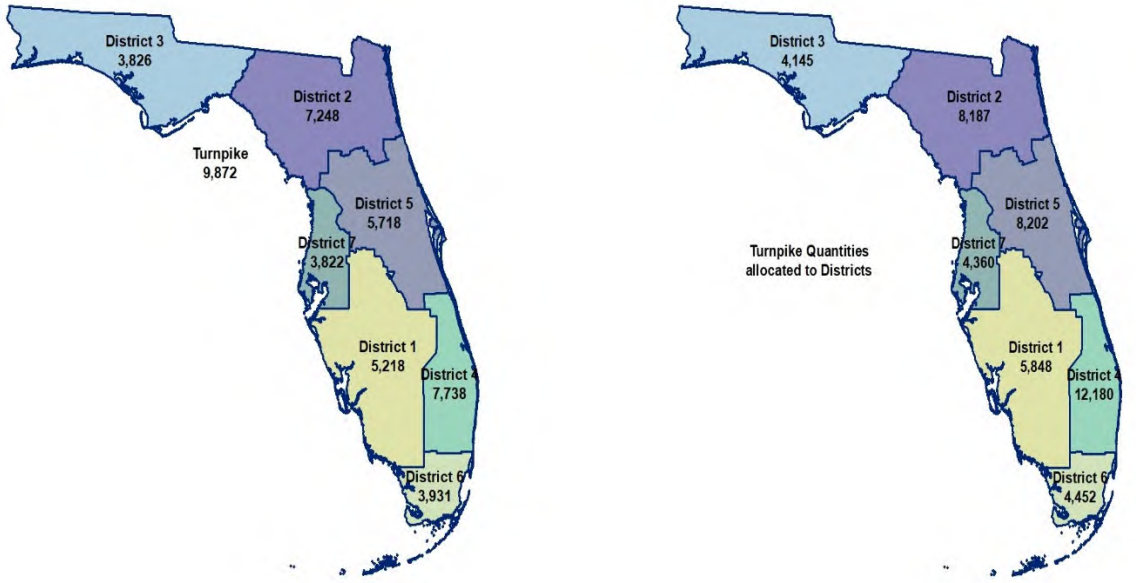
Source: TBG calculated from data provided by FDOT Office of Work Program and Budget.

Table 37. FDOT Future Aggregate Material Requirements by District

District	2022	2023	2024	2025	2026
D1	1,033,378	829,163	877,430	1,160,160	1,317,943
D2	1,031,764	2,237,892	954,059	1,835,293	1,189,437
D3	936,749	725,294	1,149,160	500,324	514,837
D4	1,128,837	672,273	1,667,030	2,231,869	2,038,069
D5	1,744,277	726,822	1,061,854	981,455	1,203,309
D6	977,302	266,364	263,158	848,141	1,575,983
D7	978,574	640,364	516,923	642,823	1,043,683
D8	984,909	1,307,299	2,132,091	2,498,044	2,949,857
Total Tons	**8,815,791**	**7,405,472**	**8,621,706**	**10,698,108**	**11,833,119**

Source: TBG calculated from data provided by FDOT Office of the Work Program Budget.

Figure 74. Total Aggregates Quantities for Five-year Work Program, 000s Tons



Source: TBG calculated from data provided by FDOT Office of Program Management.

Forecast

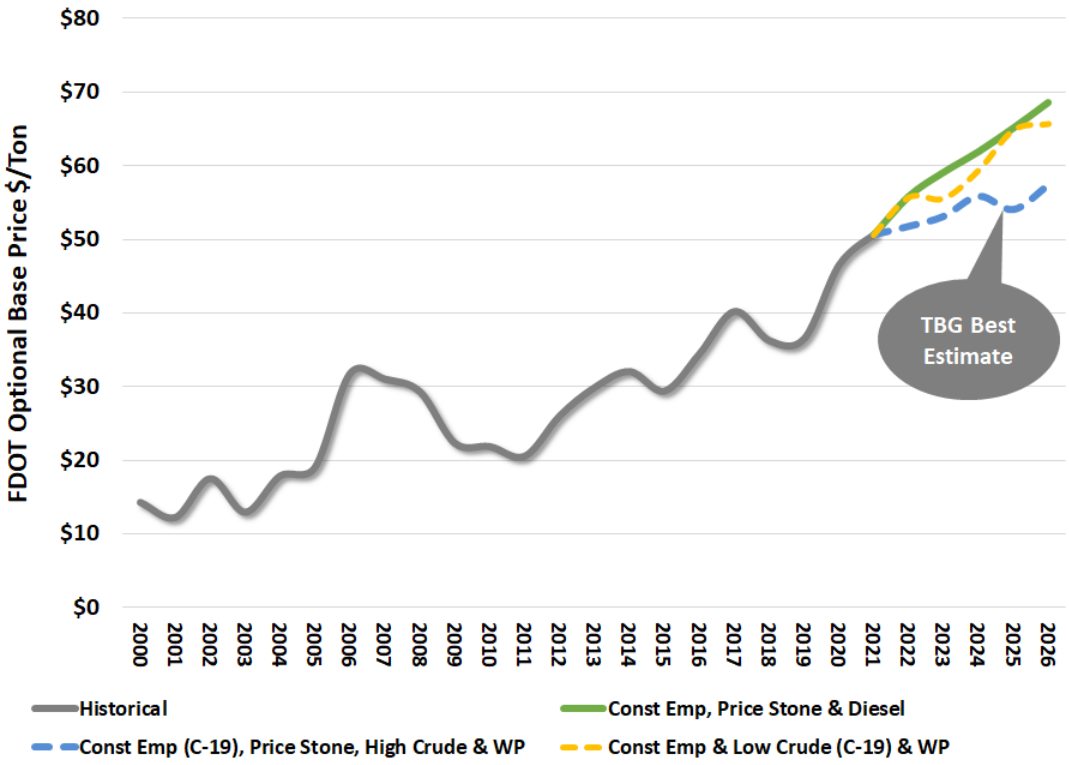
Regression modeling was performed to estimate aggregate base costs using pay item data, Work Program funding, and supply chain variables and other macroeconomic indicators. The most likely trajectory sees continued COVID-affected construction employment, crushed stone pricing overall and FDOT work program as heavy influences, resulting in annual average increases of about 3%. An upper bound with unconstrained construction employment, crushed stone pricing and rising energy costs results in increases of almost 4 times the 20-year average; while feasible, it is considered less likely. Finally, an alternative model with lower energy prices constrained by COVID and work program driving costs also results in a higher trajectory.

Table 38 provides the forecast average price for aggregate base. **Figure 75** shows the output of several price models and the scenario identified as best estimate for aggregate base.

Table 38. Aggregate Base Price Forecast Results						
Year	2021	2022	2023	2024	2025	2026
Price Aggregate Base, $/Ton	$50.64	$51.78	$53.13	$55.89	$54.06	$57.37

Source: TBG calculated from data provided by FDOT Estimates Office, various industry sources.

Figure 75. Aggregate Base Price, 2021 Forecast



Source: TBG calculated from data provided by FDOT Estimates Office, various industry sources.
(Variable descriptions available in the **Appendix**.)

Earthworks

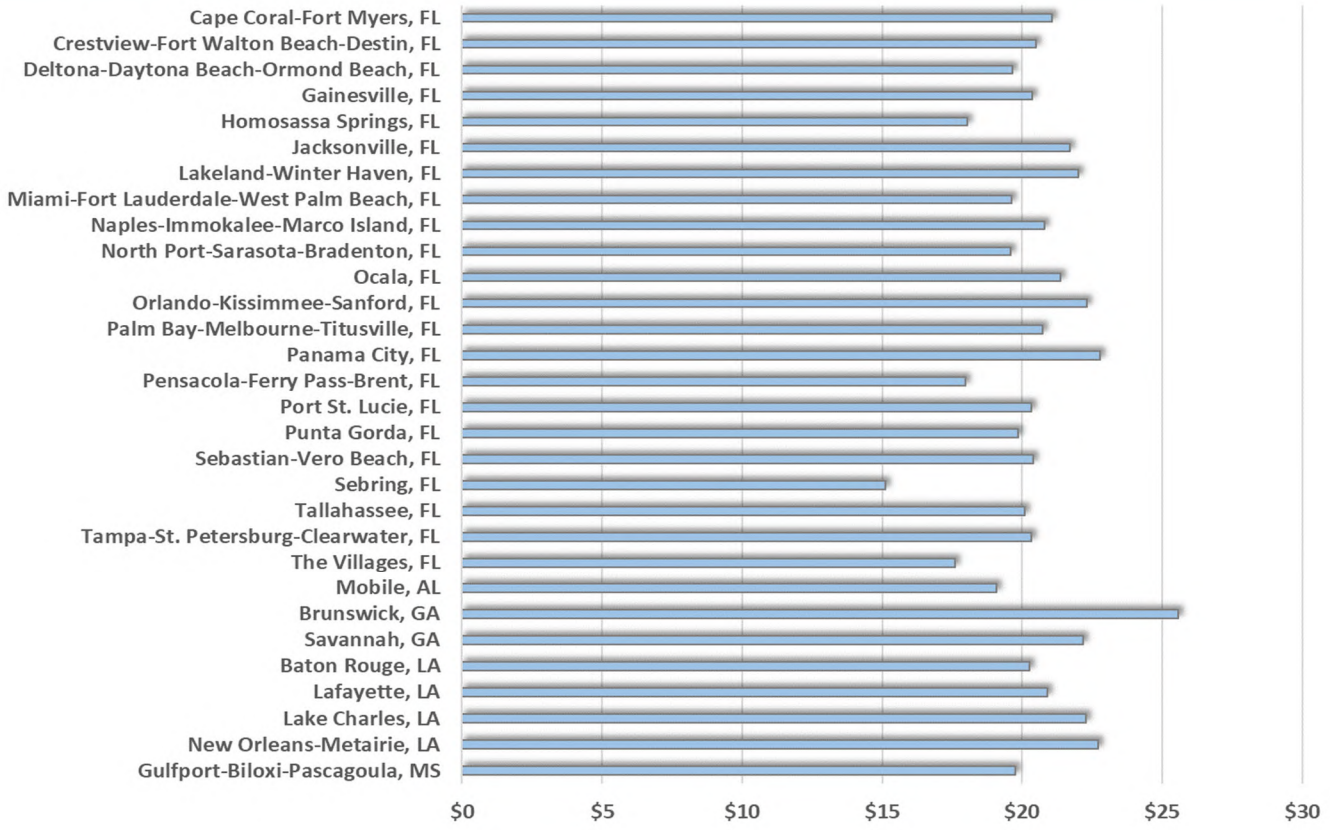
Key Findings – Earthworks

- Driver and operator shortages are affecting earthwork contractors as with other sectors.
- Providers report issues obtaining equipment and parts, owing to COVID disruptions. Heavy off-road vehicles are hard to come by, owing to competition from booming development across the state.
- SB 1194 updated rules on FDOT purchases of borrow pit material. While not expected to increase costs, bureaucratic administration may increase.

Trucking

Competition for truck drivers continues being high across industries. As mentioned throughout the report, the labor market for driver and equipment operators is still tight which has put upward pressure on wages to attract labor. Comparing Florida Metropolitan Areas with port cities and high trucking activity to similar locations in other states, the average hourly wage for heavy truck drivers in Florida is slightly behind. While the average across all Florida metro areas is $20 per hour, the average for select out-of-state locations is close to $22 per hour. Only the Orlando-Kissimmee-Sanford, Lakeland-Winter Haven and Panama City metro areas have an hourly average above $22 (**Figure 76**).

Figure 76. Hourly Average Wage for Heavy Truck Drivers by Metropolitan Area, 2020



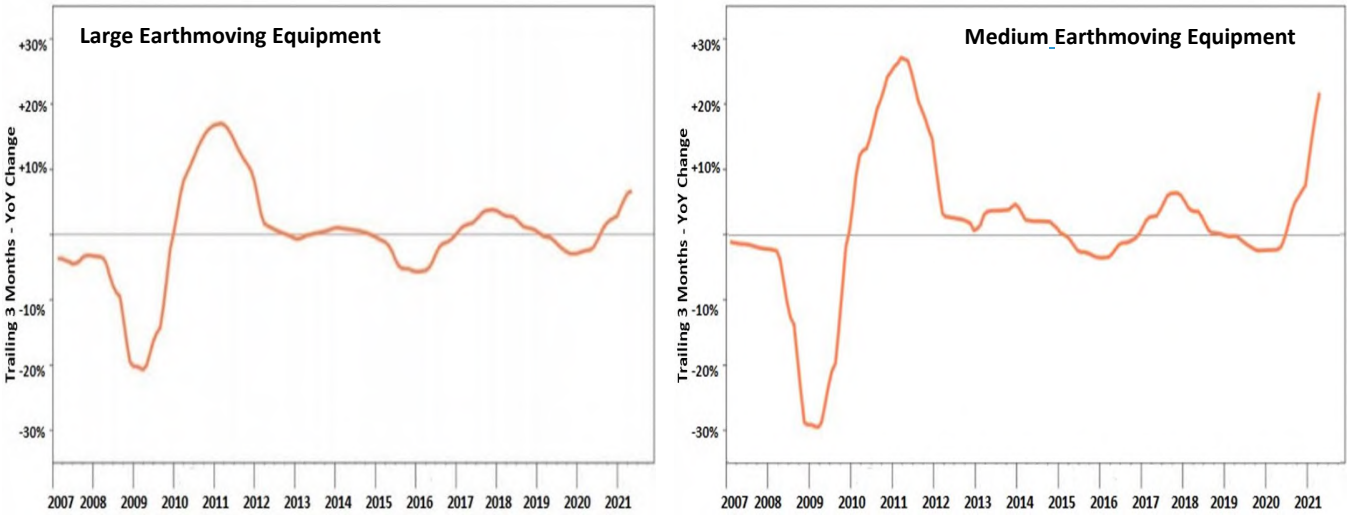
Source: BLS Occupational Employment Statistics May 2020.

Fuel prices in 2021 have increased significantly in all Districts as demand has increased. Higher competition for drivers and increased fuel costs will continue to support higher trucking costs.

Equipment

Inflationary pressures that have been affecting other sectors are also present in the construction equipment industry. The June 2021 used equipment market trends report released by Ritchie Bros. Auctioneers showed significant price increases across all categories. For instance, the price indexes for medium and large earthmoving equipment sold in the U.S. for the quarter ending in June 31 of 2021 continued the upward trend by increasing 25% and 8%, respectively. **Figure 77** illustrates the historical trends for these, with medium earthmoving equipment being near 2010-11 levels. Truck tractors and vocational trucks also increased by more than 25%. High demand and delays in shipments have contributed to higher prices. Additionally, the Equipment Leasing & Finance Foundation reported that construction equipment investment rose by an annualized 33% in the first quarter of 2021, but is only up 4% year-over-year. According to their Construction Momentum Index, there could be growth in the next six months but with limited upside potential.

Figure 77. Percent Change in Price Indexes for Large and Medium earthmoving equipment



Source: Ritchie & Bros. Used Equipment Market Report.

Environmental Regulation and Other Legislation

During the 2021 Florida legislative session, SB 1194 passed which included a number of provisions. One item of note was the new requirement that increases FDOT compliance requirements.

The language defines the term “borrow pit” and requires a borrow pit operator to provide a notice of intent to extract to the FDEP. A new category of “other resources” in the definition separates borrow pits from mines, through F.S. 378.801.

> *378.801 Other resources; notice of intent to mine required.—*
>
> *(1) No operator may begin the process of extracting clay, peat, gravel, sand, or any other solid substance of commercial value found in natural deposits or in the earth, except fuller’s earth clay, heavy minerals, limestone, or phosphate, which are regulated elsewhere in this chapter, at a new mine without notifying the secretary of the intention to mine.*

(2) The operator's notice of intent to mine shall consist of the operator's estimated life of the mine and the operator's signed acknowledgment of the performance standards provided by s. 378.803.

The FDOT (and its contractors and subcontractors) are then prohibited from purchasing material from borrow pits that are not in compliance with statutory and permitting requirements. The FDOT is further required to cease accepting material from a noncompliant borrow pit within 48 hours of determination of noncompliance.

The Department already has specs and standards for contractors to follow in ensuring authorized borrow pit material. The new rules appear to place an additional compliance burden on FDOT, but beyond administration, do not appear to impose additional costs to either the contractor or owner (since the borrow pits are already supposed to be in compliance). The rules apply to material purchased from a borrow pit, as opposed to on-site material.

The new legislation may have arisen from a highly controversial incident in Lake County, wherein borrow pit material used for the Wekiva Parkway was sold by a property owner without permitting. The owner cited Florida's Right to Farm Act in defense. The St. Johns River Water Management District and Lake County disagreed and filed suit. The SJRWMD suit accused the property owner of operating without permits and asked the courts to levy fines against the owner of $10,000-$15,000 a day, exceeding $4 million.

In recent years, there have been anecdotal reports of NIMBY (not in my backyard social movements) opposition to borrow pits, largely because of the associated heavy truck traffic near otherwise residential areas. The attention paid to this particular case was initiated by angry neighbors.

Current Pricing

According to updated lettings data, earthworks prices are up 25% year to date in fiscal year 2021 after removing outliers for very small quantity jobs (**Table 39**). The shortage in labor availability continues to be an issue, boosting prices alongside an increasing demand from the single-family residential building sector. Based on district-level data, earthwork prices are ranging higher in districts with increased transportation costs and construction demand (**Table 40**).

Table 39. Earthwork Price, 2016 – 2021

Year	2016	2017	2018	2019	2020	2021
Price Earthwork, $/Ton	$6.96	$6.95	$7.66	$5.90	$8.39	$10.51

Source: TBG calculated from data provided by FDOT Estimates Office, various industry sources.

Table 40. Earthwork Price by District, 2016 – 2021

Year	2016	2017	2018	2019	2020	2021
District 1	$7.19	$7.20	$5.86	$7.62	$6.73	$10.32
District 2	$6.13	$6.44	$13.63	$4.84	$6.17	$17.85
District 3	$5.00	$7.40	$7.60	$5.66	$6.51	$21.54
District 4	$6.65	$10.04	$8.53	$13.60	$15.45	$7.97
District 5	$7.22	$4.58	$7.04	$8.67	$9.84	$13.04
District 6	$11.46	$16.07	$10.00	$7.38	$14.68	$16.78
District 7	$7.56	$7.76	$6.68	$4.22	$5.55	$11.21
District 8	$6.93	$7.66	$10.46	$14.13	$10.50	$8.71

Source: TBG calculated from data provided by FDOT Estimates Office, various industry sources.
*Estimates through June 2021.

Forecast

Regression modeling was performed to estimate Earthworks costs using pay item data, supply chain variables and other macroeconomic indicators. For this update, record low crude prices were considered in a scenario with pandemic impacted employment and housing starts and work program dollars, leading to a more moderate forecast through the end of 2025. Updated historical lettings for 2020 produced a starting price of $5.86 for the projection period, about 4% lower than reported previously. The best estimate is based on consideration of underlying economic variables as well as anecdotal information from contractors and suppliers, and reflect earthworks costs creeping up gradually.

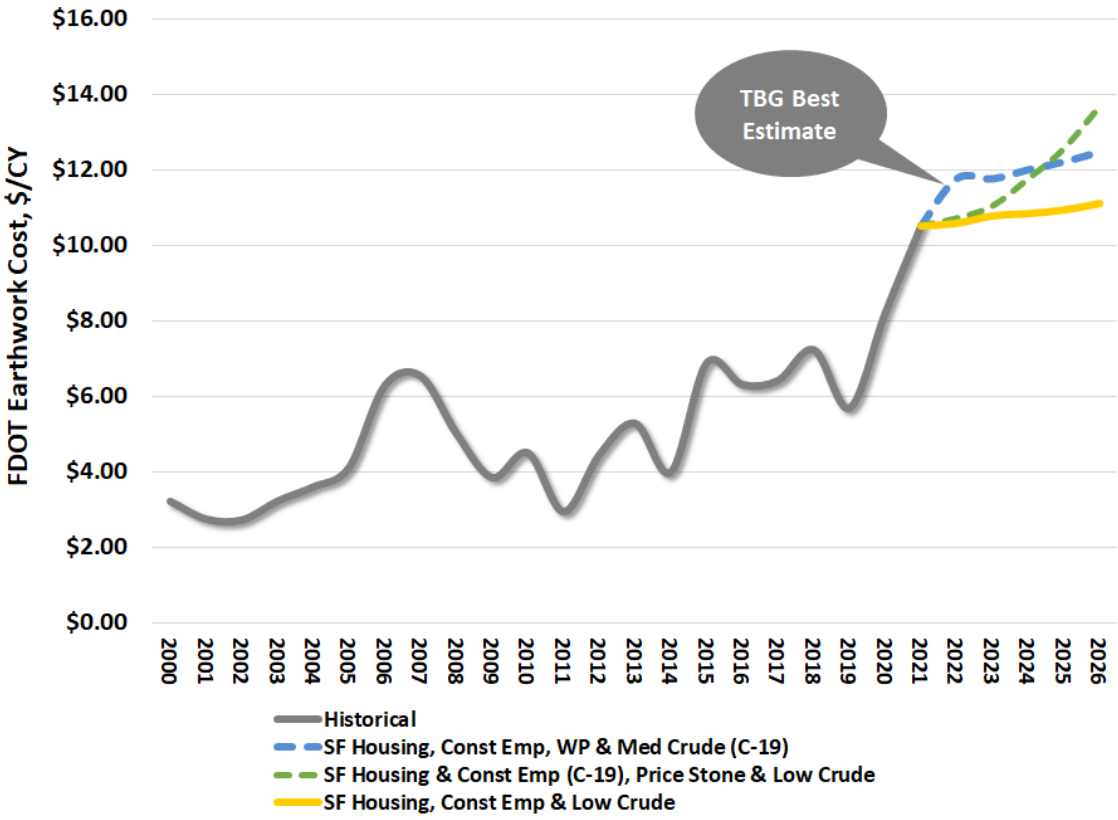
Table 41 provides the forecast average price for earthworks. **Figure 78** shows the output of potential price models and the scenario identified as best estimate for earthworks.

Table 41. Earthworks Price Forecast Results

Year	2021	2022	2023	2024	2025	2026
Price Earthwork, $/Ton	$10.51	$11.76	$11.75	$11.99	$12.19	$12.46

Source: TBG calculated from data provided by FDOT Estimates Office, various industry sources.

Figure 78. Earthworks Price Estimates, 2021 Forecast



Source: TBG calculated from data provided by FDOT Estimates Office, various industry sources.
(Variable descriptions available in the Appendix.)

Appendix

Table A- 1. Forecast Variable Descriptions

Variable Reference	Description
Const Emp	FL construction employment.
Diesel	Average diesel price.
GSP	FL Gross State Product.
Historical	Historical pricing or quantity.
Housing Starts	FL housing starts.
Low/Med/High Crude	Average crude price (low, medium, or high forecast).
Major Event	Major geo-political, health, or weather related events that strongly affect market forces; i.e. 9/11, the Great Recession, Hurricane Katrina, the COVID-19 pandemic.
Non-farm Emp	FL Non-Farm employment.
Price Binder	Average price of HMA binder (PG-76 & higher).
Price Cement	Average price of cement.
Price Coal	Average price of coal.
Price Iron Ore	Average price of iron ore.
Price Stone	Average price of crushed stone.
SF Housing	FL Single-Family housing starts.
WP	FDOT Five-Year Work Program .
C-19	Refers to COVID-19; some variables adjusted for pandemic impacts.

Pay items that are partially or wholly used in the analysis are listed in the next five tables by material type. It should be noted that the lists may include some pay items that are no longer in use by FDOT, or are not represented in the lettings data every year, but are retained for historical record.

Table A- 2. Asphalt Pay Items

Pay Item Number				
0102 2200	0334 1 52	0337 7 22	0337 7 48	0337 7 93
0286 2	0334 1 53	0337 7 23	0337 7 54	0337 7 94
0287 1	0334 1 54	0337 7 24	0337 7 55	0339 1
0305 1	0334 1 55	0337 7 25	0337 7 58	0341 70
0315 1	0334 1 56	0337 7 26	0337 7 71	0525 1
0334 1 11	0334 1 57	0337 7 29	0337 7 72	0908333 1
0334 1 12	0334 1 58	0337 7 30	0337 7 73	0909335 1
0334 1 13	0334 1100	0337 7 31	0337 7 74	0909335 2
0334 1 14	0334 1101	0337 7 32	0337 7 80	0911325 1
0334 1 15	0334 1102	0337 7 33	0337 7 81	0914337 2
0334 1 22	0334 1103	0337 7 35	0337 7 82	0914337 4
0334 1 23	0334 1104	0337 7 40	0337 7 83	0914337 5
0334 1 24	0334 1105	0337 7 41	0337 7 85	
0334 1 25	0334 1106	0337 7 42	0337 7 88	
0334 1 33	0334 1107	0337 7 43	0337 7 90	
0334 1 34	0337 7 5	0337 7 45	0337 7 91	

Table A- 3. Concrete Pay Items				
Pay Item Number				
0173 79 1	0425 1584	0430721504	0521 8 1	0700 10122
0350 1 1	0425 1585	0430830	0521 8 2	0700 10123
0350 1 3	0425 1587	0430982120	0521 8 3	0700 10124
0350 1 4	0425 1589	0430982121	0521 8 4	0700 21 11
0350 1 5	0425 1601	0430982123	0521 8 5	0700 21 12
0350 1 8	0425 1602	0430982125	0521 8 6	0700 21 13
0350 1 10	0425 1603	0430982129	0521 8 20	0700 21 14
0350 1 11	0425 1604	0430982133	0521 72 2	0700 21 15
0350 1 12	0425 1605	0430982138	0521 72 3	0700 21 16
0350 1 13	0425 1609	0430982140	0521 72 4	0700 21 17
0350 1 14	0425 1611	0430982141	0521 72 5	0700 21 31
0350 1 20	0425 1619	0430982142	0521 72 6	0700 21 32
0350 2 3	0425 1701	0430982143	0521 72 7	0700 21 33
0350 2 10	0425 1702	0430982144	0521 72 10	0700 21 34
0350 3 1	0425 1703	0430982145	0521 72 11	0700 21 35
0350 3 2	0425 1704	0430982501	0521 72 20	0700 21 36
0350 3 3	0425 1705	0430982502	0521 72 21	0700 22121
0350 3 5	0425 1711	0430982505	0521 72 22	0700 22122
0350 3 7	0425 1712	0430982506	0521 72 23	0700 22123
0350 3 8	0425 1713	0430982510	0522 1	0700 22124
0350 3 9	0425 1714	0430982519	0522 2	0700 22131
0350 3 10	0425 1715	0430982623	0522 3	0700 22132
0350 3 11	0425 1719	0430982625	0522 4	0700 22133
0350 3 12	0425 1725	0430982629	0524 1 1	0700 22134
0350 3 13	0425 1801	0430982633	0524 1 2	0700 22141
0350 3 14	0425 1802	0430982638	0524 1 3	0700 22142
0350 3 17	0425 1803	0430982640	0524 1 4	0700 22143
0350 4 1	0425 1804	0430982641	0524 1 19	0700 22144
0350 4 5	0425 1805	0430982642	0524 1 29	0700 22154
0350 4 11	0425 1811	0430982643	0524 1 49	0700 22220
0350 4 13	0425 1812	0430982645	0524 2 1	0700 22250
0350 30 5	0425 1813	0430984120	0524 2 2	0700 23111
0350 30 13	0425 1814	0430984121	0524 2 4	0700 23112
0353 70	0425 1815	0430984123	0524 2 29	0700 23113
0400 0 11	0425 1841	0430984125	0524 2 49	0700 23114
0400 0 13	0425 1842	0430984129	0524 3	0700 23121
0400 1 1	0425 1843	0430984133	0526 1 1	0700 23122
0400 1 2	0425 1844	0430984138	0526 1 2	0700 23123
0400 1 11	0425 1845	0430984140	0530 4 4	0700 23131
0400 1 15	0425 1851	0430984141	0530 4 9	0700 23132
0400 1 25	0425 1852	0430984142	0530 78	0700 23133
0400 2 1	0425 1853	0430984143	0534 72101	0700 23142
0400 2 2	0425 1855	0430984144	0534 73	0700 23143
0400 2 4	0425 1861	0430984147	0536 7 3	0700 23144

0400 2 5	0425 1863	0430984504	0542 70	0700 23210
0400 2 8	0425 1865	0430984623	0547 70 1	0700 23220
0400 2 10	0425 1881	0430984625	0547 70 2	0700 38045
0400 2 11	0425 1882	0430984629	0548 12	0700 38056
0400 2 12	0425 1883	0430984633	0548 14	0700 38057
0400 2 24	0425 1884	0430984638	0548 20	0700 38063
0400 2 25	0425 1885	0430984640	0641 1	0700 38064
0400 2 41	0425 1887	0430984641	0641 2 11	0700 38065
0400 2 46	0425 1891	0430984642	0641 2 12	0700 38066
0400 2 47	0425 1892	0430984645	0641 2 13	0700 38068
0400 3 1	0425 1893	0430990	0641 2 14	0700 38086
0400 3 8	0425 1894	0430991	0641 2 15	0700 38097
0400 3 20	0425 1895	0450 1 1	0641 2 16	0700 39 23
0400 4 1	0425 1899	0450 1 2	0641 2 17	0700 39 26
0400 4 2	0425 1901	0450 1 3	0641 2 18	0700 39 27
0400 4 4	0425 1902	0450 1 5	0641 2 19	0700 39 36
0400 4 5	0425 1903	0450 1 7	0641 3163	0700 39 37
0400 4 6	0425 1904	0450 1 78	0641 3169	0700 39 43
0400 4 8	0425 1905	0450 1124	0641 3175	0700 39 46
0400 4 11	0425 1909	0450 1130	0641 3180	0700 41 10
0400 4 22	0425 1910	0450 1201	0641 3186	0700 41 11
0400 4 24	0425 2 41	0450 1202	0641 3263	0700 43055
0400 4 25	0425 2 42	0450 1203	0641 3269	0700 44066
0400 4 40	0425 2 43	0450 1250	0641 3275	0700 45 32
0400 4 41	0425 2 61	0450 1251	0641 3286	0714 1123
0400 4 47	0425 2 62	0450 2 36	0641 14150	0715 4 11
0400 6	0425 2 63	0450 2 45	0641 14152	0715 4 12
0400 8 5	0425 2 71	0450 2 54	0641 14154	0715 4 13
0400 8 25	0425 2 72	0450 2 63	0641 14156	0715 4 14
0400 8 39	0425 2 73	0450 2 72	0641 14158	0715 4 15
0400 8106	0425 2 91	0450 2 78	0641 15150	0715 4 21
0400 8107	0425 2 92	0450 2 84	0641 15152	0715 4 23
0400 10	0425 2 93	0450 2 96	0641 15154	0715 4 24
0400 32	0425 2101	0450 3 11	0641 15156	0715 4 25
0400 72	0425 2102	0450 3 15	0641 15158	0715 4 31
0400153	0425 2103	0450 3 21	0641 17150	0715 4 32
0404 1	0425 2110	0450 3 25	0641 17152	0715 4 33
0404 5 11	0425 3 41	0450 3 26	0641 17154	0715 4 42
0404 5 12	0425 3 42	0450 3 66	0641 17156	0715 4 50
0404 5 22	0425 3 43	0450 3 76	0641 17158	0715 4011
0404 5 25	0425 3 61	0450 3 91	0641 45150	0715 4012
0405 70 1	0425 3 62	0450 3 95	0641 45152	0715 4013
0405 70 2	0425 3 63	0450 4 4	0646 1 11	0715 4019
0405 71	0425 3 81	0450 5	0646 2115	0715 4021
0407 1 11	0425 3 82	0450 6	0649 1 10	0715 4022
0407 1 21	0425 3 83	0450 6 25	0649 1 11	0715 4023

0407 1 52	0425 3 91	0450 8 12	0649 1 12	0715 4029
0425 1201	0425 3 92	0450 8 13	0649 1 13	0715 4031
0425 1202	0425 11	0450 8 21	0649 1 14	0715 4032
0425 1203	0425 78	0450 8 22	0649 1 15	0715 4033
0425 1204	0430141504	0450 8 23	0649 1 16	0715 4111
0425 1205	0430171103	0450 8 24	0649 1 17	0715 4112
0425 1209	0430171104	0450 8 33	0649 2150	0715 4113
0425 1211	0430171125	0450 82	0649 2170	0715 4119
0425 1212	0430171140	0450 83 1	0649 2250	0715 4121
0425 1213	0430171141	0450 88 15	0649 2255	0715 4122
0425 1214	0430171142	0450 88 18	0649 21 1	0715 4123
0425 1215	0430172102	0450 88 20	0649 21 3	0715 4129
0425 1311	0430172125	0455 3 1	0649 21 4	0715 4131
0425 1312	0430172138	0455 3 2	0649 21 6	0715 4132
0425 1315	0430173112	0455 3 3	0649 21 7	0715 4133
0425 1319	0430173115	0455 3 4	0649 21 8	0715 4139
0425 1321	0430173118	0455 3 5	0649 21 9	0715 4300
0425 1322	0430173124	0455 3 6	0649 21 10	0715 10 2
0425 1325	0430173130	0455 3 8	0649 21 12	0715 19 13
0425 1329	0430173136	0455 4 1	0649 21 13	0715 19111
0425 1331	0430173218	0455 4 2	0649 21 14	0715 19112
0425 1332	0430174112	0455 4 3	0649 21 15	0715 19113
0425 1335	0430174115	0455 4 4	0649 21 17	0715 19119
0425 1341	0430174118	0455 4 5	0649 21 18	0715 19121
0425 1342	0430174124	0455 4 6	0649 21 19	0715 19122
0425 1345	0430174129	0455 14 2	0649 21 20	0715 19123
0425 1349	0430174130	0455 14 3	0649 21 21	0715 19131
0425 1351	0430174136	0455 14 4	0649 21 24	0715 19132
0425 1352	0430174142	0455 14 5	0649 21 26	0715 19133
0425 1355	0430174148	0455 14 23	0649 21 27	0715 19300
0425 1359	0430174154	0455 14 24	0649 31101	0715511315
0425 1361	0430174160	0455 34 2	0649 31102	0715511320
0425 1362	0430174172	0455 34 3	0649 31103	0715511325
0425 1365	0430174215	0455 34 4	0649 31104	0715511330
0425 1369	0430174218	0455 34 5	0649 31105	0715511335
0425 1411	0430174224	0455 34 6	0649 31106	0715511340
0425 1412	0430174230	0455 34 8	0649 31107	0715511345
0425 1415	0430174236	0455 34 23	0649 31108	0715511350
0425 1419	0430174242	0455 34 25	0649 31109	0715512315
0425 1421	0430174248	0455 34203	0649 31110	0715512325
0425 1422	0430175101	0455 34205	0649 31111	0715512330
0425 1425	0430175102	0455 34301	0649 31112	0715512340
0425 1431	0430175103	0455 88 1	0649 31113	0715512350
0425 1432	0430175104	0455 88 2	0649 31114	0715516315
0425 1435	0430175105	0455 88 3	0649 31115	0715516320
0425 1441	0430175112	0455 88 4	0649 31116	0715516325

0425 1442	0430175115	0455 88 5	0649 31117	0715516330
0425 1445	0430175118	0455 88 6	0649 31118	0715516345
0425 1451	0430175124	0455 88 7	0649 31119	0715517325
0425 1452	0430175130	0455 88 8	0649 31201	0715518315
0425 1455	0430175136	0455 88 12	0649 31202	0715518330
0425 1459	0430175142	0455 88 15	0649 31203	0751 32 11
0425 1461	0430175148	0455 88 19	0649 31204	0751 32 12
0425 1462	0430175154	0455 88 20	0649 31205	0751 32 13
0425 1465	0430175160	0455 88 21	0649 31206	0751 32 14
0425 1469	0430175166	0455112 1	0649 31207	0751 32 15
0425 1471	0430175172	0455112 3	0649 31208	0785 1 11
0425 1472	0430175184	0455112 4	0649 31209	0785 1 13
0425 1473	0430175201	0455112 5	0649 31210	0905455343
0425 1474	0430175202	0455112 6	0649 31211	0905455345
0425 1475	0430175203	0455143 3	0649 31212	0908350 1
0425 1479	0430175215	0455143 4	0649 31213	0908350 2
0425 1481	0430175218	0455143 5	0649 31214	0908350 3
0425 1483	0430175224	0455143 6	0649 31215	0913548 1
0425 1484	0430175230	0455143 23	0649 31216	2425 1415
0425 1485	0430175236	0455143 25	0649 31217	2425 1435
0425 1489	0430175242	0455143203	0649 31218	2425 1455
0425 1501	0430175248	0455143205	0649 31219	2425 1465
0425 1502	0430175254	0455143301	0649 31299	2425 1515
0425 1503	0430175260	0519 78	0649 31301	2425 1715
0425 1504	0430175266	0520 1 7	0649 31302	2430984504
0425 1505	0430175272	0520 1 8	0649 31303	2455 3 1
0425 1511	0430200 23	0520 1 10	0649 31304	2455 3 2
0425 1512	0430200 25	0520 1 11	0649 31305	2455 3 3
0425 1513	0430200 29	0520 1 12	0649 31306	2455 3 4
0425 1514	0430200 33	0520 2 1	0649 31307	2455 3 5
0425 1515	0430200 38	0520 2 2	0649 31308	2455 3 8
0425 1519	0430200 40	0520 2 4	0649 31309	2455 4 6
0425 1521	0430200 41	0520 2 5	0649 31310	2455 4 8
0425 1522	0430200 42	0520 2 8	0649 31311	2455 14 3
0425 1523	0430200 43	0520 2 9	0649 31312	2455 14 5
0425 1524	0430600125	0520 3	0649 31313	2455 14 11
0425 1525	0430602123	0520 5 11	0649 31314	2455 14 12
0425 1529	0430602125	0520 5 12	0649 31315	2455 34 2
0425 1531	0430602129	0520 5 16	0649 31316	2455 34 3
0425 1532	0430610123	0520 5 21	0649 31317	2455 34 4
0425 1533	0430610125	0520 5 22	0649 31318	2455 34 5
0425 1534	0430610129	0520 5 26	0649 31319	2455 34 6
0425 1535	0430610133	0520 5 41	0649 31999	2455 36 1
0425 1541	0430610225	0520 5 42	0649 33000	2455 88 2
0425 1542	0430610325	0520 5 46	0649415003	2455 88 3
0425 1543	0430610329	0520 5 51	0649417006	2455 88 4

0425 1544	0430611023	0520 6	0659109	2455 88 5
0425 1545	0430611025	0520 70	0659309	2455 88 6
0425 1547	0430611029	0521 1	0700 2 11	2455 88 7
0425 1549	0430611123	0521 1 1	0700 2 12	2455 88 8
0425 1551	0430611125	0521 5 1	0700 2 13	2455 88 9
0425 1552	0430611129	0521 5 2	0700 2 14	2455 88 20
0425 1553	0430611133	0521 5 3	0700 2 15	2455140 11
0425 1554	0430611223	0521 5 4	0700 2 16	2455140 12
0425 1555	0430611225	0521 5 5	0700 2 17	2455140 13
0425 1557	0430611229	0521 5 6	0700 2 18	2455140 14
0425 1559	0430611233	0521 5 7	0700 2 50	2455140 15
0425 1561	0430611323	0521 5 8	0700 4111	2455140 43
0425 1562	0430611325	0521 5 9	0700 4112	2455140 44
0425 1563	0430611329	0521 5 10	0700 4113	2455140 56
0425 1564	0430611333	0521 5 11	0700 4114	2455143 2
0425 1565	0430612025	0521 5 13	0700 4122	2455143 3
0425 1569	0430612029	0521 5 20	0700 4123	2455143 4
0425 1571	0430612033	0521 6 1	0700 4124	2455143 5
0425 1572	0430613025	0521 6 2	0700 4125	2455143 6
0425 1573	0430613029	0521 6 3	0700 4126	2455145 1
0425 1574	0430613033	0521 6 11	0700 4127	2659109
0425 1575	0430613125	0521 6 12	0700 4128	2659309
0425 1579	0430613129	0521 6 31	0700 4132	
0425 1581	0430613225	0521 6 32	0700 10115	
0425 1582	0430613229	0521 6 34	0700 10116	
0425 1583	0430613325	0521 7 1	0700 10121	

Table A- 4. Steel Pay Items

Pay Item Number				
0415 1 1	0649 31108	0700 38056	0715516240	2649121202
0415 1 10	0649 31109	0700 38057	0715516315	2649122102
0415 1 11	0649 31110	0700 38058	0715516320	2649122203
0415 1 12	0649 31111	0700 38063	0715516330	2649122212
0415 1 13	0649 31112	0700 38064	0715516340	2649122304
0415 1 2	0649 31113	0700 38065	0715516435	2649122512
0415 1 3	0649 31114	0700 38066	0715516615	2649123103
0415 1 4	0649 31115	0700 38068	0715517125	2649123105
0415 1 5	0649 31116	0700 38075	0715517135	2649123204
0415 1 6	0649 31117	0700 38086	0715517150	2649123205
0415 1 7	0649 31118	0700 38097	0715517325	2649123305
0415 1 8	0649 31119	0700 39 23	0715518120	2649124105
0415 1 9	0649 31199	0700 39 24	0715518130	2649124205
0415 2 4	0649 31201	0700 39 25	0715518140	2649124306
0415 2 5	0649 31202	0700 39 26	0715518145	2649124312
0415 2 6	0649 31203	0700 39 27	0715518150	2649124407
0415 2 9	0649 31204	0700 39 36	0715518315	2649125512

0435 22250	0649 31205	0700 39 37	0715521135	2649131008
0435 22359	0649 31206	0700 39 43	0715521140	2649132009
0435 22369	0649 31207	0700 39 44	0715521145	2649133010
0435 22445	0649 31208	0700 39 46	0715521150	2649134011
0435 22484	0649 31209	0700 39 47	0715521340	2649135012
0435 32856	0649 31210	0700 39 57	0715522140	2649135512
0435 52 1	0649 31211	0700 39 74	0715526120	2649141101
0435 52 2	0649 31212	0700 41 10	0715530100	2649143102
0435413537	0649 31213	0700 41 11	0715530101	2649145012
0435422439	0649 31214	0700 43055	0715530102	2649145512
0435522224	0649 31215	0700 44066	0715530103	2649311001
0435725675	0649 31216	0700 45 32	0715530104	2649313003
0451 70	0649 31217	0700 48 12	0715536115	2649314004
0455 3 1	0649 31218	0700 48 13	0715536340	2649345012
0455 3 2	0649 31219	0700 48 14	0715540000	2649345512
0455 3 3	0649 31299	0700 48 15	0715550000	2649411001
0455 3 4	0649 31301	0700 48 17	0715560000	2649412002
0455 3 5	0649 31302	0700 48 18	0715561140	2649413002
0455 3 6	0649 31303	0700 48 19	0715571145	2649415003
0455 3 8	0649 31304	0700 48 22	0715571150	2649416004
0455 4 1	0649 31305	0700 48 28	0715572145	2649417006
0455 4 2	0649 31306	0700 48 32	0715572150	2649422203
0455 4 3	0649 31307	0700 48 33	0715573135	2649425203
0455 4 4	0649 31308	0700 48 34	0715573140	2649425504
0455 4 5	0649 31309	0700 48 35	0715573145	2649426504
0455 4 6	0649 31310	0700 48 38	0715573150	2649440
0455 7 2	0649 31311	0700 48 39	0715574140	2649515003
0455 7 4	0649 31312	0700 48 52	0715574145	2649516004
0455 7 5	0649 31313	0700 48 53	0715574150	2649517006
0455 7 6	0649 31314	0700 48 54	0715575115	2649540
0455 7 9	0649 31315	0700 48 55	0715575125	2649711001
0455 7 34	0649 31316	0700 48 56	0715575130	2649713002
0455 8 2	0649 31317	0700 48 57	0715575135	2649715003
0455 8 4	0649 31318	0700 48 58	0715575140	2649716004
0455 8 5	0649 31319	0700 48 59	0715575145	2649717006
0455 8 6	0649 31399	0700 70	0715575150	2649721101
0455 8 9	0649 31999	0700 82	0715575210	2649723102
0455 8 34	0649 32000	0700 83	0715576135	2649724403
0455 14 2	0649 33000	0700 89 2	0715576140	2649725504
0455 14 3	0649 34000	0700 89111	0715576145	2649726504
0455 14 4	0649 36100	0700 89113	0715576150	2649731007
0455 14 5	0649 36300	0700 89121	0715577115	2649733008
0455 14 24	0649 36500	0700 89123	0715577130	2649735009
0455 17 1	0649 36700	0700 89131	0715577145	2649736010
0455 17 2	0649 38 3	0700 89141	0715577150	2649737006
0455 17 3	0649 38000	0700 89143	0715578150	2649740

0455 17 4	0649 40101	0700 90 11	0715611201	2650 51511
0455 17 5	0649111001	0700 90 12	0715611401	2650 51512
0455 17 13	0649111008	0700 90 13	0715612102	2650 51513
0455 17 14	0649112002	0700 90 14	0715612202	2650 51521
0455 17 16	0649112009	0714 1123	0715612302	2659101
0455 17 34	0649112012	0715 1 11	0715612402	2659103
0455 17 40	0649113003	0715 1 12	0715614404	2659106
0455 34 2	0649113010	0715 1 13	0715615402	2659107
0455 34 3	0649114004	0715 1 14	0715616306	2659108
0455 34 4	0649114011	0715 1 15	0715616406	2659109
0455 34 5	0649114012	0715 1 16	0715619309	2659110
0455 34 6	0649115012	0715 1 19	0715619409	2659112
0455 34 8	0649121202	0715 1 40	0715621403	2659118
0455 34 23	0649121212	0715 1 50	0715622104	2659119
0455 34 25	0649121303	0715 1 60	0715622204	2659120
0455 34203	0649121412	0715 1 70	0715622304	2659307
0455 34205	0649122102	0715 1 80	0715622404	2659308
0455 34301	0649122203	0715 1110	0715623405	2659309
0455 35 4	0649123103	0715 1111	0715624204	2676110501
0455 35 5	0649123203	0715 1112	0715624304	2715 2123
0455 35 6	0649123204	0715 1113	0715624404	2715 2131
0455 35 7	0649123303	0715 1114	0715624406	2715 2132
0455 35 8	0649123305	0715 1115	0715625107	2715 2133
0455 35 9	0649123312	0715 1116	0715625307	2715 2222
0455 35 20	0649124105	0715 1117	0715625407	2715 2231
0455 35 21	0649124205	0715 1118	0715626408	2715 2232
0455 35 22	0649124306	0715 1119	0715627409	2715 2233
0455 35 23	0649125212	0715 1121	0715628410	2715 2321
0455 39	0649125412	0715 1122	0715631305	2715 2322
0455 81	0649125512	0715 1123	0715631401	2715 2331
0455 81101	0649131001	0715 1124	0715631405	2715 2332
0455 81102	0649131008	0715 1125	0715632406	2715 2333
0455 81104	0649132009	0715 1128	0715636406	2715 2431
0455 81105	0649133010	0715 1129	0715637411	2715 2432
0455 81106	0649133011	0715 1131	0715712402	2715 2433
0455 87	0649134011	0715 1132	0730 76101	2715 2522
0455107 1	0649135012	0715 1135	0730 76102	2715 2532
0455107 2	0649141012	0715 1137	0730 76103	2715 5 11
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0649 21 25	0700 23111	0715514325	2649 1536	2825136120
0649 21 26	0700 23112	0715515115	2649 1538	2825136210
0649 21 27	0700 23113	0715515120	2649 1636	2825136220
0649 21101	0700 23114	0715515125	2649 1638	2825141210
0649 21102	0700 23121	0715515130	2649 1644	2825142210
0649 21103	0700 23122	0715515135	2649 1646	2825151210
0649 21104	0700 23123	0715515140	2649 11001	3050120415
0649 21105	0700 23124	0715515145	2649111001	3050130415
0649 21106	0700 23131	0715515150	2649111002	3050150411
0649 21108	0700 23132	0715515225	2649111003	3050150419
0649 22 3	0700 23133	0715515250	2649111004	3622536301
0649 26 1	0700 23134	0715516110	2649111012	3633131415
0649 26 3	0700 23142	0715516115	2649112002	3633145505
0649 26 5	0700 23143	0715516120	2649112012	3634141415
0649 26 7	0700 23144	0715516125	2649113003	3635122415
0649 31101	0700 23210	0715516130	2649113004	3637151606
0649 31102	0700 23220	0715516135	2649114004	3637151615

0649 31103	0700 38033	0715516140	2649115004	3637700
0649 31104	0700 38036	0715516145	2649115005	3644600
0649 31105	0700 38044	0715516150	2649115012	3694715
0649 31106	0700 38045	0715516155	2649115512	E460111900
0649 31107	0700 38048	0715516210	2649121101	

Table A- 5. Aggregate Pay Items

Pay Item Number				
0121 70	0285701007	0285707994	0285714527	0547 70 3
0125 3	0285701031	0285708283	0285714538	0443 71 1
0210 1 1	0285701032	0285708287	0285715567	0443 72 10
0210 1 8	0285701701	0285708295	0285715982	0443 72 11
0210 1 9	0285702047	0285708991	0285716606	0443 72 12
0210 2	0285702055	0285709327	0285716610	0443 72 13
0285701	0285702999	0285709335	0285716615	0443 72 14
0285702	0285703087	0285709338	0285716631	0443 72 20
0285703	0285703095	0285709352	0285716632	0142 70
0285704	0285703703	0285709709	0285716716	0160 4
0285705	0285703984	0285709989	0285716980	0102 3
0285706	0285703998	0285709990	0285716981	0162 1 11
0285707	0285704123	0285710363	0530 1	0162 1 12
0285708	0285704127	0285710367	0530 1 1	0162 1 21
0285709	0285704152	0285710392	0530 1 2	0162 1 33
0285710	0285704704	0285710983	0530 3 3	0173 77 1
0285711	0285704985	0285711407	0530 3 4	0173 77 2
0285712	0285705166	0285711711	0530 3 5	0173 77 3
0285713	0285705167	0285711986	0530 3 8	0286 1
0285714	0285705170	0285711987	0530 3 9	0288001
0285715	0285705997	0285712441	0530 5 2	0520 7 1
0285716	0285706201	0285712443	0530 74	0530 5 1
0285720	0285706203	0285712447	0530 76 2	0530 5 12
0285721	0285706207	0285712458	0530 76 3	0549 3
0285722	0285706208	0285712472	0530 76 4	0823 11 6
0285724	0285706216	0285712712	0530 76 5	0823 11 8
0285726	0285707247	0285713481	0530 77 2	0823 11 12
0285729	0285707250	0285713487	0530 77 3	0520 7 2
0285730	0285707255	0285713498	0530 77 4	
0285701001	0285707272	0285714521	0547 70 1	
0285701003	0285707993	0285714523	0547 70 2	

Table A- 6. Earthwork Pay Items

Pay Item Number				
0120 71	0120 6	0120 1900	0120 5	0120 6900
0120 72	0120 2 2	0120 3	0120 6101	0120 11
0120 73	0102 2300	0120 4	0120 6102	
0120 74	0120 1	0120 4900	0120 6103	

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