DOUGLAS R. HOFFER
Vermont State Auditor

Vermont Agency of Transportation Paving Projects

Significant Deviations in Cost and Schedule Estimates for Complex Projects Underscores the Need for Performance Measures

March 15, 2023 Rpt. No. 23-2

DOUGLAS R. HOFFER
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Mission Statement

The mission of the Auditor's Office is to hold State government accountable by evaluating whether taxpayer funds are being used effectively and identifying strategies to eliminate waste, fraud, and abuse.

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Dear Colleagues,

One of the goals in Vermont's State Strategic Plan is to "improve transportation project planning" by continuously improving "project development efficiency by reducing the time and cost for planning, engineering, permitting, right-of-way acquisition and construction management."

The importance of this goal is underscored when considering that cumulatively the Legislature has approved $590 million for paving projects from fiscal years 2019 through 2023.

However, we found that the Agency of Transportation (VTrans) lacks key mechanisms for transparency and accountability as to the cost and schedule performance of its paving projects, especially in the preliminary engineering phase – the planning phase leading up to the construction phase. As a result, the state is missing important tools with which to meet its Strategic Plan goals.

We assessed the cost and schedule performance for 14 paving projects against the estimates VTrans initially presented to the Legislature and found significant deviations, primarily in the preliminary engineering phase. We also found a lack of consistent record-keeping that would allow thorough assessment of what caused these deviations. For instance, VTrans delayed the completion of preliminary engineering for some projects by as much as 3 to 6 years and could not fully explain what caused the delays.

One possible cause for delaying a paving project is the reallocation of funds from one project to another. VTrans is required by statute to the notify the Legislature in such cases. Lacking consistent records, VTrans was unable to tell us if any of the projects we reviewed were delayed due to such funding reallocation and whether they informed the Legislature, as required.

On the other hand, in the construction phase we found that outcomes were better, and construction projects generally came in within cost and schedule requirements specified in the contract.

We also found that VTrans has not established measures to consistently assess the cost and schedule of its paving projects. While construction contracts provide de-facto baselines which VTrans uses internally to manage that effort, the Agency lacks a systematic way to assess and report paving cost and schedule performance that includes both the construction phase *and the preliminary engineering phase*.

The lack of performance measures limits transparency into the cost deviations and delays of paving projects – key information for VTrans senior management and Legislators making funding decisions. Without performance measures it is unclear how VTrans can ascertain whether they met the State's strategic goal.

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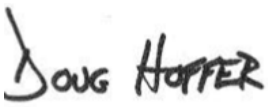
We made several recommendations to VTrans to improve paving cost and schedule assessment and reporting. Until VTrans implements a more disciplined process to measure, document, and consistently report performance against cost and schedule baselines in each phase, the decision-makers at VTrans, as well as the Legislature and the public, do not have important information about the cost-effectiveness and timeliness of its paving projects.

VTrans accepted all of the facts presented in the audit, but their management letter does not commit to adopting two of our three recommendations. Instead, they indicate that they will "investigate development" of performance measures concerning cost and schedule. Without adopting these two recommendations, VTrans will fall short of furthering the Administration's own Strategic Plan goal for transportation project planning.

I would like to thank the staff at VTrans for their cooperation and professionalism throughout the course of this audit.

This report is available on the state auditor's website.

Sincerely,



DOUGLAS R. HOFFER
State Auditor

ADDRESSEES

The Honorable Jill Krowinski
Speaker of the House of Representatives

The Honorable Phil Baruth
President Pro Tempore of the Senate

The Honorable Phil Scott
Governor

Ms. Kristin Clouser
Secretary, Agency of Administration

Mr. Adam Greshin
Commissioner, Department of Finance and Management

Mr. Joe Flynn
Secretary, Vermont Agency of Transportation

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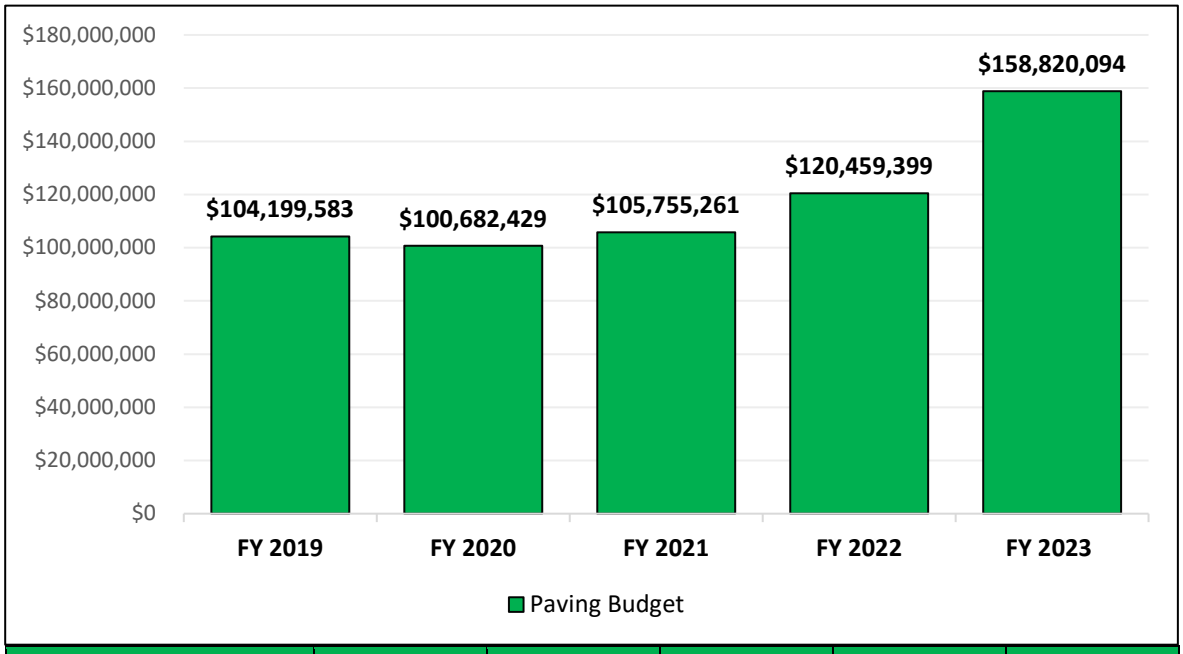
Highlights

The Vermont Agency of Transportation (VTrans) received approval from the Legislature to spend up to $159 million on paving projects in fiscal year 2023. Cumulatively, the Legislature has approved $590 million for paving projects from fiscal years 2019 through 2023.

Exhibit 1 below shows the budget growth from fiscal year 2019 through 2023 and the amount of the budget that is federally funded.

Exhibit 1: Paving Budget Growth from Fiscal Years (FY) 2019 through 2023



Fiscal Year	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023
Federally Funded	$85,128,961	$82,317,913	$85,532,436	$102,298,777	$130,742,764
State Funded	$19,070,622	$18,364,516	$20,222,825	$18,160,622	$28,077,330
Percent Federally Funded	82%	82%	81%	85%	82%

Our audit focused on VTrans' cost and schedule performance for paving projects. Our specific objectives were to determine (1) if VTrans completed paving projects at their estimated costs and completion dates and (2) whether VTrans utilized and reported sufficient performance measures to systematically assess deviations. As part of this review, we judgmentally selected 14 paving projects that VTrans completed in fiscal year 2020.[1] In total these projects cost $98.6 million. Appendix III contains information about the routes and miles paved by each of these projects.

Objective 1 Finding

VTrans completed most of their simpler projects within 30 percent of their original cost estimate and on schedule. However, **for the more complex projects, VTrans always exceeded the initial cost estimates provided to the Legislature by more than 50 percent and completed them up to six years late.**

The Manchester-Peru project was significantly delayed, but the cost increases were due to added mileage, not complexity. Exhibit 2 below shows the amount the actual final project costs and schedule changed from the original cost and schedule estimates. Orange highlights indicate projects with cost growth exceeding 50 percent or delays longer than one year.

Exhibit 2: Original Cost and Schedule Overrun by Project

Project Name	Amount Final Costs Varied from the Original Estimate		Years Projected Completion Exceeded Original Estimate	Percent Paved Mileage Changed from Original Estimate		Actual Final Project Cost
Essex-Richmond[a]	201%	$8,280,819	3	No change		$12,410,819
Manchester-Peru	174%	$4,587,586	5	433%	Added	$7,217,586
Waterbury-Stowe	136%	$14,186,411	4	18%	Added	$24,606,411
Jamaica-Winhall	74%	$5,847,442	6	No change		$13,798,442
Waterbury-Richmond	59%	$2,983,895	2	22%	Added	$8,033,895
Bethel-Royalton	27%	$624,857	0	4%	Reduced	$2,937,357
Essex-Underhill	17%	$977,737	0	No change		$6,637,262
Brandon-Goshen	11%	$1,050,959	3	No change		$10,450,959
Brighton	7%	$173,205	0	No change		$2,485,705
Springfield-Hartland	-21%	-$885,085	0	No change		$3,399,915
Williston	-22%	-$436,515	0	2%	Added	$1,558,166
Morristown	-23%	- $776,149	0	No change		$2,563,851
Rutland-Pittsford	-27%	-$925,053	0	25%	Reduced	$2,492,947

[a] VTrans initially requested funding for Essex-Richmond in fiscal year 2014. Three years later VTrans split this into two projects, Essex and Jericho-Richmond to take advantage of different federal funds that were available for the Essex section of the project. The amounts in the table are assessments of both projects combined against the original project request in 2014.

[1] VTrans completed one of these projects two days into fiscal year 2021.

The estimates VTrans used to obtain their initial funding were insufficient to provide a reliable assessment of expected cost and schedule for its most complex projects. VTrans did not maintain records that identified why there were cost and schedule overruns from original estimates. According to the Government Accountability Office's (GAO's) project management and assessment best practices, keeping thorough documentation helps with analyzing changes in the program schedule and identifying the reasons for variances between estimates and results, thereby contributing to the collection of cost and schedule data that can be used to support or refine future estimates. While VTrans officials identified some of the reasons, they could not always explain project delays.

We found that most of the schedule delays, especially for the complex projects, took place during the preliminary engineering phase. During this phase construction plans are developed, as are detailed estimates of materials needed and other costs. **VTrans officials were also unable to tell us if any of the project delays resulted from a need to use funds for another project, even though a State law requires VTrans to inform the Legislature whenever this happens.**

After preliminary engineering, VTrans awarded the paving construction contracts to the lowest bidders. These contracts are the largest expense on each paving project, significantly greater than the other cost components such as contracted engineering costs. As shown in Exhibit 3 below, only one contract grew by more than 10 percent (highlighted in orange) while nine contracts were completed under the original contract award amount. Most final price variations stemmed from changes to the materials and labor needed on the projects.

Exhibit 3: Construction Contract Cost Growth After Award

Project Name	Original Contract Award Amount	Final Contract Cost Amount	Percent and Amount Final Contract Cost Varied from Contract Award	
Bethel-Royalton	$2,119,316	$2,458,063	16%	$338,747
Jamaica-Winhall	$11,443,080	$12,360,349	8%	$917,268
Essex	$5,007,055	$5,119,041	2%	$111,986
Morristown	$1,942,759	$1,980,001	2%	$37,242
Springfield-Hartland	$3,171,921	$3,108,763	-2%	-$63,159
Brighton	$2,172,175	$2,098,587	-3%	-$73,588
Jericho-Richmond	$5,817,946	$5,573,412	-4%	-$244,534
Waterbury-Richmond	$7,668,408	$ 7,355,947	-4%	-$312,461
Essex-Underhill	$6,199,547	$5,860,278	-5%	-$339,269
Manchester-Peru	$6,765,192	$6,407,596	- 5%	-$357,596
Brandon-Goshen	$9,649,260	$9,135,769	-5%	-$513,491
Waterbury-Stowe	$23,346,284	$ 21,889,588	-6%	-$1,456,696
Williston	$1,385,449	$1,268,311	-8%	-$117,139
Rutland-Pittsford	$2,210,588	$1,913,805	-13%	-$296,783

Objective 2 Finding

VTrans did not have sufficient performance measures to systematically assess how cost and schedule estimates deviated from actual results. In fact, VTrans did not have *any* performance measures for cost and only a single schedule measure that assessed the percent of projects that they advertised on time each year. This does not measure schedule performance throughout the entire project process, just one piece of it.

According to GAO's "Leading Practices in Capital Decision-Making," capital investment projects should be evaluated by comparing the actual results to goals; specifically, whether the projects were completed on schedule, came within expected costs, and provided the benefits intended. GAO also notes that after the results are evaluated, lessons learned should be incorporated into the decision-making process.

Matters for Legislative Consideration

Since 2016, Vermont law requires VTrans to inform the Legislature of any projects for which the total estimated costs increased by more than 100 percent or by at least $8 million from the previous year. However, VTrans does not have to report increases that occur over multiple years. Nor does VTrans have to inform the Legislature when a project does not begin work for more than a year after it received funds. As a result, the Legislature may be uninformed about significant project cost increases and schedule delays. Based on our findings, we suggested the following for Legislative consideration:

1. Amend statute to require VTrans to report when estimated project costs exceed the original projections by more than 50 percent even if this happens across more than one year.

2. Amend statute to require VTrans to report significant project delays for funded paving projects, and the causes of those delays, in a manner that is transparent, timely, and accessible to Legislators.

Recommendations

We made the following three recommendations to the Secretary of the Agency of Transportation:

1. Develop and implement a process to consistently record what caused cost and schedule deviations. If any of the delays are due to reallocating the funds to another project, inform the Legislature as required by State law.

2. Develop and implement performance measures to assess cost deviations for paving projects in the preliminary engineering and construction phases. Report the measures to the Legislature and the public at least annually.

3. Develop and implement performance measures to assess schedule deviations for paving projects in the preliminary engineering and construction phases. Report these measures to the Legislature and the public at least annually.

Background

Annually, VTrans submits funding requests to the Legislature for paving projects in a document referred to as the Transportation Program. This document includes a budget request for the paving projects in the upcoming fiscal year, cost projections for the next three years, and the total estimated cost and schedule.[2]

VTrans also provides a breakdown of cost and schedule estimates for the following primary project phases:[3]

- **Preliminary engineering** — also referred to as design or development activities. This phase consists of planning work that leads up to construction, including the development of construction plans and a detailed assessment of the required materials, quantities, and cost calculations.

- **Construction** — also referred to as delivery. This phase consists of the execution of the plans developed in the preliminary engineering phase. The construction contract is the largest project cost, amounting to between 77 and 92 percent of all expenses in the projects we reviewed. Construction may include other improvements to the roadway such as culvert replacements, ledge/slope stabilization, etc.

VTrans' initial funding request for paving projects are preliminary estimates of how much the projects will cost based on the average historical per mile cost for that type of project. VTrans also shows the last year they will need funding for each project (i.e., planned completion year) as shown in Exhibit 4 below.

Exhibit 4: Funding Request Example for An Individual Paving Project in the Transportation Program

PROJECT INFORMATION	PHASE AND FUNDING	ESTIMATED TOTAL COST	ACTUAL EXPENDED THRU FY 2016	ESTIMATED CURRENT YEAR FY 2017	ESTIMATED BUDGET YEAR FY 2018	PROJECTED FY 2019	PROJECTED FY 2020	PROJECTED FY 2021	ESTIMATED COST TO COMPLETE
PAVING	PE	100,000	0	0	60,000	40,000	0	0	0
RUTLAND-PITTSFORD	ROW	0	0	0	0	0	0	0	0
NH 2963(1)	CONST	3,318,000	0	0	0	829,500	2,488,500	0	0
	OTHER	0	0	0	0	0	0	0	0
Route: US-7	TOTAL	3,418,000	0	0	60,000	869,500	2,488,500	0	0
Year Added: 2018	Description:	RESURFACING OF US 7 FROM RUTLAND TOWN MM 1.77 TO PITTSFORD MM 2.746.							
Project Manager: Michael Fowler 802-828-0160	Comments								

Total project cost estimate

Funding request for upcoming year

Last year VTrans projects funds needed for project

[2] See Appendix IV for a detailed explanation of each of the fields in the Transportation Program.
[3] VTrans also may request Right-of-Way funding. In our review, we encountered only one project that had Right-of-Way funding.

During the preliminary engineering phase, either VTrans or its contracted engineers assess the requirements to develop construction plans including a detailed cost estimate for constructing the paving project. VTrans then advertises the project for bid and awards the contract to the lowest bidder.

After awarding the construction contract, VTrans may make changes to the price and schedule of the contract. VTrans documents changes to construction contracts via a process called change orders. Change orders reflect adjustments to the original contract specifications and the resulting change to cost and schedule. Change orders can increase or decrease the contract amount as result of (1) changes to the scope of the project that alter the materials and labor required, (2) asphalt and fuel price adjustments, or (3) penalties assessed for paving materials that did not meet the standards established in the contract.

Construction contracts have a completion date by which the contractor is supposed to have all work substantially completed, referred to as substantial completion. This is the date the contractor is to have all work completed with the exception of project clean-up and other minor items.

Federal regulations require VTrans to reduce the payment for construction contracts that exceed the contract completion date due to the fault of the contractor. These reductions are referred to as liquidated damages and are a daily rate assessed for contract work that must be completed after the completion date agreed to in the construction contract.[4] These rates vary depending on the contract award value. The Agency is required by FHWA to incorporate these provisions into federally funded contracts.

[4] The deduction is meant to defray the cost to VTrans to administer the contract, including but not limited to the cost of engineering, inspection, supervision, inconvenience to the public, obstruction of traffic, and interference with business.

Objective 1: VTrans Needs to Improve Cost and Schedule Estimates for Complex Projects

VTrans completed most of their simpler projects within 30 percent of their original cost estimate and on time. However, for their more complex projects, VTrans *always* exceeded the initial cost estimates by more than 50 percent and completed them up to six years late. Based on our analysis, the estimates VTrans uses to obtain their initial funding from the Legislature was insufficient to provide a reliable assessment of expected cost and schedule for its most complex projects. VTrans did not maintain records that identified why there were cost and schedule overruns from original estimates. Conversely, once VTrans awarded the paving construction contracts, they had only one cost overrun exceeding 10 percent and no delays exceeding one year.

Cost Growth from Original Estimates More Than Doubled for Some Projects

Almost half of the of paving projects we assessed significantly exceeded the cost and schedule estimates VTrans presented to the Legislature with the first funding request. Exhibit 5 below shows the variance between the original cost estimates provided to the Legislature, the actual project costs, and highlights projects with cost growth of 50 percent or more. While the other projects performed substantially better, including on-time delivery, generally they were less complex (addressing only the top layer of pavement). The projects with cost growth in excess of 74 percent were those that required more expansive repairs. The one exception was the Manchester-Peru for which the increase in miles paved drove the cost increase.

Exhibit 5: Comparison of Actual Project Cost to the Initial Projected Cost and Change in Miles Paved

Project Name	Percent and Amount Final Costs Varied from the Original Estimate		Original Cost Estimate	Actual Final Project Cost	Percent Paved Mileage Changed from Original Estimate	
Essex-Richmond[a]	201%	$8,280,819	$4,130,000	$12,410,819	No change	
Manchester-Peru	174%	$4,587,586	$2,630,000	$7,217,586	433%	Added
Waterbury-Stowe	136%	$14,186,411	$10,420,000	$24,606,411	18%	Added
Jamaica-Winhall	74%	$5,847,442	$7,951,000	$13,798,442	No change	
Waterbury-Richmond	59%	$2,983,895	$5,050,000	$8,033,895	22%	Added
Bethel-Royalton	27%	$624,857	$2,312,500	$2,937,357	4%	Reduced
Essex-Underhill	17%	$977,737	$5,695,525	$6,637,262	No change	
Brandon-Goshen	11%	$1,050,959	$9,400,000	$10,450,959	No change	
Brighton	7%	$173,205	$2,312,500	$2,485,705	No change	
Springfield-Hartland	-21%	-$885,085	$4,285,000	$3,399,915	No change	
Williston	-22%	-$436,515	$1,994,681	$1,558,166	2%	Added
Morristown	-23%	- $776,149	$3,340,000	$2,563,851	No change	
Rutland-Pittsford	-27%	-$925,053	$3,418,000	$2,492,947	25%	Reduced

[a] VTrans initially requested funding for Essex-Richmond in in fiscal year 2014. Three years later VTrans split their budget request for this project into two projects – (1) Essex and (2) Jericho-Richmond – to take advantage of federal funds that were available for the Essex portion of the project. Based on estimates reported for these projects in the fiscal year 2017 budget, Essex increased in cost by $699,663 (13 percent) and Jericho-Richmond increased in cost by $408,803 (7 percent).

VTrans officials told us that prior to starting the preliminary engineering work they underestimated the scope, cost, and schedule implications of the complexity of the Jamaica-Winhall, Essex-Richmond (the combined Essex and Jericho-Richmond), Brandon-Goshen and Waterbury-Stowe projects. These projects improved the subsurface layer beneath the pavement unlike the simpler projects which generally tracked closer to initial estimates. For example, Waterbury-Stowe removed the concrete layer beneath the pavement, which VTrans does not often do, in addition to repaving the roadway.[5]

Regardless of project complexity, VTrans bases the first estimate they present to the Legislature on a very high-level average historical cost-per-mile for the type of paving project and roadway class (Appendix V). VTrans estimators that develop the original estimate consult with paving project managers about current trends in contract pricing to adjust these high-level estimates before they are presented to the Legislature. However, they do not systematically consider any other factor, such as culvert or other improvements that VTrans may identify later during preliminary engineering, which may drive the cost or schedule for a particular project. Appendix V shows current cost per mile costs used to develop estimates for

[5] See here for a Waterbury Works website and a 2019 VTrans project factsheet here regarding the Waterbury-Stowe project.

the initial funding request.

According to VTrans officials, the intent of these estimates is to secure initial funding, rather than to develop a realistic projection of expenditures through project development and delivery. Officials added that estimates start becoming more credible after preliminary engineering begins to identify detailed project requirements. These estimates are completed *after* the Legislature approves and funds the project.

While recognizing that less information is available when the VTrans initially requests funding than at the end of preliminary engineering, the Federal Highway Administration (FHWA) notes that important project decisions are made early in project development, and public expectations are set at this time. Therefore, according to FHWA, these estimates must be complete and adequate to support these decisions and expectations. As previously discussed, the actual cost for the more complex paving projects varied from the initial estimate provided by VTrans to the Legislature by more than 50 percent, in one case rising as high as 201 percent.

Almost All of The Delays Happened During Preliminary Engineering

Except for Waterbury-Richmond, all the projects that increased by more than 50 percent from their original estimate were also delayed by three or more years. Exhibit 6 below shows how long each project exceeded the original expected completion year, and the variance between the original cost estimate and the actual cost. Projects that exceeded the original expected completion year by three or more years are highlighted in orange.

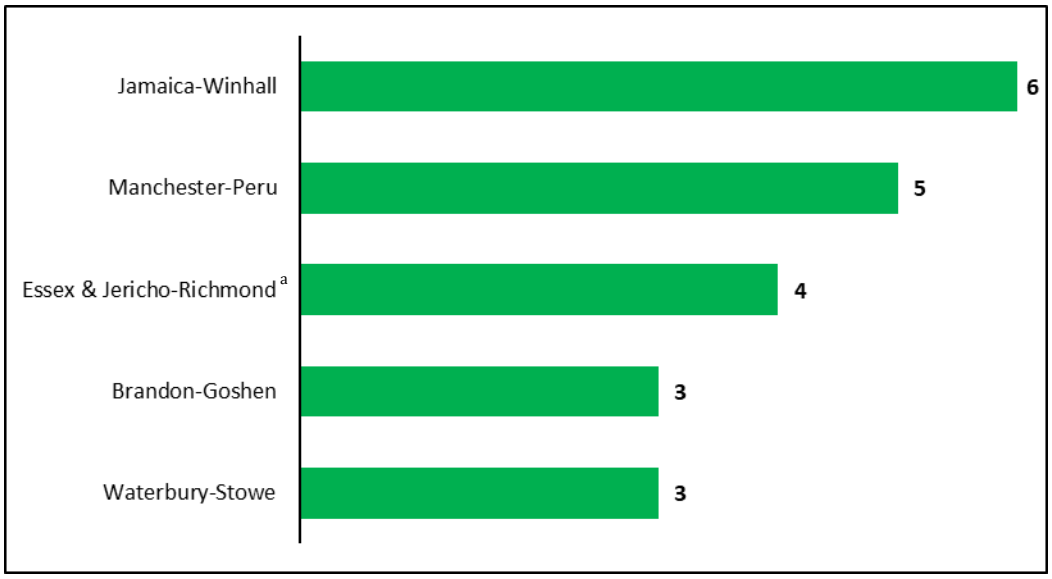
Exhibit 6: Comparison of Overall Project Delays to Cost Variance

Project Name	Years Exceeded Original Projected Completion	Actual Cost More/Less Than Original Estimate and By How Much	
Jamaica-Winhall	6	74%	$5,847,442
Manchester-Peru	5	174%	$4,587,586
Waterbury-Stowe	4	136%	$14,186,411
Brandon-Goshen	3	11%	$1,050,959
Essex & Jericho-Richmond[a]	3	201%	$8,280,819
Waterbury-Richmond	2	59%	$2,983,895
Bethel-Royalton	0	27%	$624,857
Essex-Underhill	0	17%	$977,737
Brighton	0	7%	$173,205
Springfield-Hartland	0	-21%	-$885,085
Williston	0	-22%	-$436,515
Morristown	0	-23%	-$776,149
Rutland-Pittsford	0	-27%	-$925,053

[a] VTrans initially requested funding for Essex-Richmond in fiscal year 2014. Three years later VTrans split their budget request for this project into two projects – (1) Essex and (2) Jericho-Richmond -- because the Essex portion of the project was eligible a separate type federal funding. The completion date of these two projects exceeded the original estimate in 2014 by three years.

Most of the project delays happened during the preliminary engineering phase. Exhibit 7 below shows the projects that had three or more years delay during this phase.

Exhibit 7: Projects Delayed Three Years or More During Preliminary Engineering



[a] Both of these projects were initially planned as Essex-Richmond. The delay for these projects is a comparison to the original projection for Essex-Richmond.

VTrans Did Not Systematically Record Reasons for Delays

VTrans could not provide us with information to explain some of these delays because they did not systematically keep such records. Responding to our inquiries, VTrans identified some partial reasons for delays, such as coordination challenges with towns or their initial underappreciation of all that the project would entail. However, among five projects with significant delays (3 years or more), we identified three that did not start preliminary engineering for at least a year after the Legislature initially approved its funding. Put another way, there was no explanation for the delay. Most notably, VTrans received funding in fiscal year 2013 to start work on the Manchester-Peru project but they undertook no activity until fiscal year 2017, as shown in Exhibit 8 below. VTrans could not explain why they never started work on the project despite receiving funding for it multiple times between fiscal years 2013 and 2016.

Exhibit 8: Delays Due to Simply Not Starting Project Despite Receiving Funds

Project Name	Years Preliminary Engineering Delayed	How Much of That Delay was Due to Not Starting Project	
		Years	Percent
Jamaica-Winhall	6	1	17%
Manchester-Peru	5	4	80%
Essex & Jericho-Richmond	4	1	25%

VTrans also lacked records to indicate whether any of the delays were caused by the reallocation of funds to another project. Statute requires the Secretary of the Agency of Transportation to notify the Legislature if work is suspended or delayed on approved projects due to the need to reallocate funds to other projects because no other funds are available. The VTrans Highway Safety & Design Program Manager indicated that they do modify project schedules when they develop their budgets to align with cost estimates and available funding, but VTrans does not maintain any records indicating whether they complied with this statutory requirement or the extent to which budget decisions drove project delays.

Without consistent records of reasons for project delays and their impact, VTrans lacks key tools to identify and prioritize the most important cost and schedule drivers. According to the GAO's Schedule Assessment Guide, keeping thorough documentation helps program managers analyze changes in schedule and identifying the reasons for variances between estimates and results, thereby improving future estimates.[6]

Construction Bids

The preliminary engineering phase results in a detailed construction cost estimate. Once VTrans has these estimates they advertise the job for bid. When VTrans receives the bids, they compare each bid to the detailed cost estimates as part of their process to decide whether they should accept the bids.

VTrans has a goal to have most of their detailed cost estimates be within 10 percent of the lowest bid price.[7] We compared the construction cost estimates to bids and identified that 11 of the 14 projects were within 10 percent of the lowest bid, as shown in Exhibit 9 below. The largest outlier was the Waterbury-Richmond project which had a 26 percent variance

6 The U.S. Government Accountability Office (GAO) is responsible for assisting the Congress in its oversight of the federal government, including agencies' stewardship of public funds and their performance management practices, including the assessment of program cost and schedule.

7 This goal is not limited to paving projects and includes other construction projects such as bridges.

between the detailed cost estimate and the bid. This project was one of two in our sample for which VTrans developed the detailed cost estimate rather than a consultant. During the construction phase, the contractor completed the project five percent below the bid amount.[8] The estimate for the other project in our scope that VTrans planned, Springfield-Hartland, stayed within the 10 percent deviation threshold.

Exhibit 9: Detailed Construction Estimates Compared to Construction Lowest Bid

Project	Detailed Cost Estimate	Lowest Bid Amount	Percent Bid Over/Under Estimate	Amount Bid Over/Under Cost Estimate
Waterbury-Richmond	$6,070,855	$7,668,408	26%	$1,597,554
Essex-Underhill	$5,508,778	$6,199,547	13%	$690,769
Waterbury-Stowe[a]	$22,325,811	$24,634,061	10%	$2,308,250
Brighton	$1,995,915	$2,172,175	9%	$176,260
Bethel-Royalton	$1,951,564	$2,119,316	9%	$167,753
Jamaica-Winhall	$10,671,284	$11,443,080	7%	$771,796
Morristown	$1,841,146	$1,942,759	6%	$101,613
Brandon-Goshen	$9,173,311	$9,649,260	5%	$475,949
Essex	$4,791,848	$5,007,055	4%	$215,207
Jericho-Richmond	$5,743,001	$5,817,946	1%	$74,945
Manchester-Peru	$6,863,843	$6,765,192	-1%	-$98,650
Rutland-Pittsford	$2,248,995	$2,210,588	-2%	-$38,407
Springfield-Hartland	$3,445,992	$3,171,921	-8%	-$274,070
Williston	$1,576,574	$1,385,449	-12%	-$191,125
Totals	**$84,208,917**	**$90,186,757**	**7%**	**$5,977,844**

[a] Waterbury-Stowe calculations included a $1.29 million bid for a separate sidewalk construction project in Stowe because VTrans did not have a separate cost estimate for that aspect of this project. Additionally, VTrans rejected the initial bids for the project because of disagreement regarding the total costs of some materials the contractor would have to purchase for the projects. After rejecting initial bids VTrans solicited feedback from vendors. It then reassessed and updated the cost estimate and readvertised the project. The variation in this table is based on the comparison of that last cost estimate and the low bid that VTrans accepted to award the construction contact.

Better Outcomes and Better Records in the Construction Phase

Schedule and cost performance during the construction phase was much better than for full project or preliminary engineering performance. Once VTrans awarded a construction contract, the vendors generally completed

[8] For each project we reviewed, the bid amount was the same as the contract award amount.

the project on time and there was usually little variance between the original contract award and the final contract price.

While five projects had an actual construction cost that was greater than the original contract amount, only one exceeded a 10 percent cost increase as shown in orange in Exhibit 10 below. Based on our analysis, most of these changes stemmed from increases in materials and labor used in construction. Additionally, VTrans adjusted one contract due to a market price increase for asphalt and assessed penalties for substandard materials against four projects (two of these were on one contract).[9] VTrans also issued payments *below* the original contract award for 9 of 13 contracts.

Exhibit 10: Construction Contract Cost Growth for Each Project

Project Name	Original Contract Award Amount	Final Contract Cost Amount	Percent and Amount Final Contract Cost Varied from Contract Award	
Bethel-Royalton	$2,119,316	$2,458,063	16%	$338,747
Jamaica-Winhall	$11,443,080	$12,360,349	8%	$917,268
Essex	$5,007,055	$5,119,041	2%	$111,986
Morristown	$1,942,759	$1,980,001	2%	$37,242
Springfield-Hartland	$3,171,921	$3,108,763	-2%	-$63,159
Brighton	$2,172,175	$2,098,587	-3%	-$73,588
Jericho-Richmond	$5,817,946	$5,573,412	-4%	-$244,534
Waterbury-Richmond	$7,668,408	$ 7,355,947	-4%	-$312,461
Essex-Underhill	$6,199,547	$5,860,278	-5%	-$339,269
Manchester-Peru	$6,765,192	$6,407,596	- 5%	-$357,596
Brandon-Goshen	$9,649,260	$9,135,769	-5%	-$513,491
Waterbury-Stowe	$23,346,284	$ 21,889,588	-6%	-$1,456,696
Williston	$1,385,449	$1,268,311	-8%	-$117,139
Rutland-Pittsford	$2,210,588	$1,913,805	-13%	-$296,783

VTrans managed the construction schedule against a baseline schedule target in the contract and issued liquidated damages to vendors for unwarranted delays. For the projects we assessed, VTrans collected liquidated damages for three contracts due to delays between two and 26 days. Exhibit 11 shows the number of days and the amount VTrans assessed against the delayed contracts, as well as the rate for assessing liquidated damages contracts in a particular price range.

[9] VTrans may award multiple projects on a single contract. For example, VTrans awarded the Essex and Jericho-Richmond projects under the same contract. However, VTrans records expenditures for the projects separately in their accounting system.

Exhibit 11: Liquidated Damages for Construction Contract Delays

Project	Award Amount	Liquidated Damages	Assessed Days Delayed	Liquidated damages rate in the contract
Jamaica-Winhall	$11,443,080	$12,600	2	$6,300 per day for a $10 to $20 million contract
Waterbury-Richmond	$7,668,408	$104,000	26	$4,000 per day for a $5 to $10 million contract
Essex-Underhill	$6,199,547	$36,000	9	$4,000 per day for a $5 to $10 million contract

Objective 2: VTrans Did Not Measure Total Cost and Schedule Performance of Paving Projects

VTrans does not have performance measures to systematically assess and report whether paving projects deviated excessively on cost or schedule. According to GAO, capital investment projects should be evaluated by comparing the actual results to the original cost and schedule goals established to obtain funding. When assessed regularly for changes and the reasons that cause changes, these indicators can be valuable tools for improving insight into and oversight of individual programs as well as VTrans' overall portfolio.

VTrans Does Not Have Cost and Schedule Performance Measures

According to GAO's guide "Leading Practices in Capital Decision-Making," capital investment projects (such as paving), should be evaluated by comparing the actual results to the original goals, primarily for whether the projects came within expected costs, were completed on schedule, and provided the benefits intended. Actual cost and schedule are typically measured against a baseline of original goals established to obtain funding. After the results are evaluated, lessons learned should be incorporated into the decision-making process.

VTrans does not have cost performance measures that specifically measure how well VTrans completes paving projects within expected costs.[10]

Similarly, VTrans reports just one schedule-related performance measure specific to paving. However, this measure does not assess how well the Agency did in delivering the project on schedule. Instead, it measures how many projects VTrans *advertised* within 30 days of their planned date. Annually, the Agency develops a bid advertising schedule to solicit bids for projects ready for construction. They then measure how many projects they advertised within 30 days of that planned advertisement date. The performance goal is to have at least 80 percent of paving projects advertised within 30 days of the planned advertisement date. VTrans reports this performance measure to the Legislature.[11]

While this measure provides valuable information about delays that could disrupt the timely transition to construction, it misses significant portions of schedule performance in preliminary engineering and construction. Consequently, this measure would not indicate to VTrans, the Legislature, and the public that **five projects in our selection missed the original preliminary engineering completion date by three or more years**.

QUOTE FROM THE 2017 TRI-STATE PERFORMANCE MEASURES ANNUAL

As agents of State government, the most important asset we can build and maintain is the trust of the people we serve. Trust in our agencies not only makes projects go easier, it makes legislative and executive funding decisions a more straightforward process…

That trust is built by *consistently* doing three simple things: say what we intend to do, do it, and when necessary, clearly explain why something was not done as expected. In the realm of capital project development, it begins and ends with schedules, budgets, and the quality of our final products.

[10] While the VTrans highway division that oversees paving has a goal of having 50 percent of the lowest bids to be within 10 percent of their detailed cost estimate, VTrans does not use it to assess paving specifically. This measure includes the performance of other construction projects, masking the performance of paving projects alone.

[11] FY 2022 Programmatic Performance Measures Budget Report, dated February 26, 2021 (see page 120 of 124).

Performance Measurement Starts with Baselines

Performance measures can provide valuable information about potential problems, but they are of limited value if VTrans does not establish and maintain stable baselines, especially for preliminary engineering. As we noted above, for the construction phase, VTrans has established a process to track, evaluate, and record deviations from contract target cost and planned completion dates, which serve as de facto baselines. However, VTrans does *not* have a similar mechanism to track, evaluate and record deviations in the preliminary engineering phase, which had the most significant cost and schedule fluctuations among the projects we assessed.

GOAL IN VERMONT'S STATE STRATEGIC PLAN 2018-2023

GOAL:
Improve Transportation Project Planning

Continuously improve project development efficiency by reducing the time and cost for planning, engineering, permitting, right-of-way acquisition and construction management.

According to VTrans officials, measuring actual project development and delivery costs and schedules against baselines has not been required so they don't do it. However, without baselines VTrans lacks a valuable tool to assess the extent to which its paving projects were developed and delivered in a cost efficient and timely manner once they receive funding.

Examples of Cost and Schedule Tracking in Both Project Phases

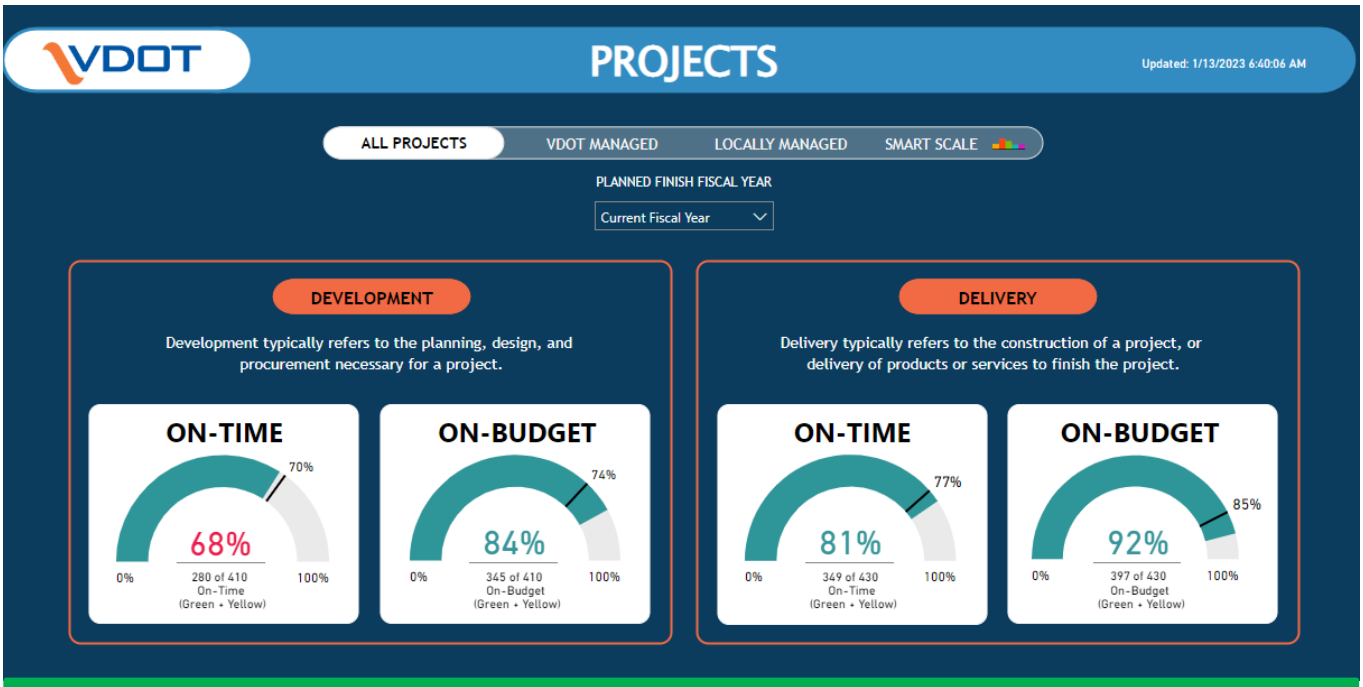
VTrans can learn from their counterparts in the Virginia Department of Transportation. Virginia reports on cost and schedule performance in the development phase (VTrans' preliminary engineering phase) as well as the delivery phase (VTrans' construction phase) of its projects.

- In the development phase, Virginia, *unlike* VTrans, monitors performance by comparing actual time and expenditures to original expectations. See Appendix VI for further information on Virginia's preliminary engineering schedule measures.

- In the delivery phase, Virginia, *also unlike* VTrans, monitors performance by comparing actual project completion date and actual expenditures to the original construction contract terms.

Exhibit 12 below shows Virginia's dashboard with cost and schedule performance measures in the development and delivery phases.

Exhibit 12: Virginia Department of Transportation's Project Dashboard



Click on the image above to go to the VDOT projects dashboard website.

Matters for Legislative Consideration

Statutory Reporting on Significant Increases in Paving Projects

The current legislative cost reporting requirement omits many significant cost fluctuations in paving projects. A 2016 law that required VTrans to inform the Legislature in the Transportation Program of any projects that have total estimated costs that have increased by more than 100 percent or by at least $8 million from the previous year estimate, which they did for one of the projects we reviewed (Waterbury-Stowe). However, statute is silent about increases that occur over multiple years. As a result, the Legislature may be uninformed about significant project cost increases.

Similarly, while statute does not require VTrans to report significant cost increases if they happen over multiple years, statute also does not require VTrans to inform the Legislature of significant project delays. This can result in the Legislature continually approving funds for projects that have minimal or no progress. For example, VTrans received $350,000 for the Manchester-Peru paving project over a span of four years but never performed any work on that project.

Suggestions for Legislative Considerations

- Amend statute to require VTrans to report when estimated project costs exceed the original projections by more than 50 percent even if this happens across more than one year.

- Amend statute to require VTrans to report significant project delays for funded paving projects, and the causes of those delays, in a manner that is transparent, timely, and accessible to Legislators.

Conclusions

For the last five fiscal years VTrans' paving budget exceeded $100 million each year. Despite these significant appropriations, the VTrans lacked performance measures to assess and inform the Legislature and the public about how well they completed their paving projects within budget and on schedule. We found that VTrans did not accurately estimate cost and schedule for the more complex paving projects we reviewed. These **actual costs of these projects ranged from 74 to 201 percent more than their original estimates. Additionally, these projects exceeded their original schedules by up to six years.**

Until VTrans implements a more disciplined process that measures and reports performance against cost and schedule baselines and maintains consistent records of all reasons for deviations and their impact, the decision-makers at VTrans, as well as the Legislature and the public, cannot ascertain the extent to which Vermont's paving projects are delivered in a cost-effective and timely manner.

Recommendations

We make the recommendations in Exhibit 13 to the Secretary of the Agency of Transportation.

Exhibit 13: Recommendations and Related Issues

Recommendation	Report Pages	Issue
1. Develop and implement a process to consistently record what caused cost and schedule deviations. If any of the delays are due to reallocating the funds to another project, inform the Legislature as required by State law.	11-13	VTrans did not maintain thorough records of cost and schedule deviations, including if delays were due to reallocation of funds. Vermont law requires VTrans to report project delays if those delays were due to reallocating funds to other projects.

Recommendation	Report Pages	Issue
2. Develop and implement performance measures to assess cost deviations for paving projects in the preliminary engineering and construction phases. Report the measures to the Legislature and the public at least annually.	17-18	VTrans does not have measures regarding the extent to which its project costs grew after the Legislature approved its funding, limiting the insights of VTrans, the Legislature, and the public into how cost effective its projects were.
3. Develop and implement performance measures to assess schedule deviations for paving projects in the preliminary engineering and construction phases. Report these measures to the Legislature and the public at least annually.	17-18	VTrans does not have measures regarding the extent to which projects were delayed after the Legislature approved its funding, limiting the insights of VTrans, the Legislature, and the public into how timely its project deliveries were.

Management's Comments and Our Evaluation

On March 13, 2023, the Secretary of the Agency of Transportation provided written comments on a draft of this report, which are reprinted in Appendix VII. Our evaluation of these comments is in Appendix VIII.

To address both objectives, we reviewed the State of Vermont and federal legislation and regulations for the requirements related to cost and schedule estimates, including performance tracking and reporting. We reviewed VTrans policies and guidance. We interviewed VTrans officials about how paving projects are planned and executed and about their use of cost and schedule performance measures.

The following describes the specific methodology used for each objective. Our internal control work was limited to the work performed under these methodologies and we considered internal control criteria[12] when evaluating the results of our work.

Objective 1

To assess cost and schedule variances for paving projects we selected all projects that were funded for the last time in 2020 and that had a projected cost over $2,000,000 in the last budget request. Because VTrans does not have stable cost and schedule baselines for its paving projects, we baselined each of these 14 projects according to the cost and schedule projections presented to the Legislature in the first Transportation Program requesting funding. Per GAO's best practices for managing capital investment projects, and because VTrans does not have stable cost and schedule baselines to assess their process of developing and delivering a project we chose the original estimates as baselines for our assessment.

We obtained financial information from VTrans financial information system, called the State Transportation Accounting and Reporting System (STARS). We interviewed VTrans officials to gain an understanding of how they reconcile the electronic exchange of information between the States financial information system and the STARS data to ensure proper functionality and assurance of data quality. We performed various data reliability checks of the data to look for anomalies and errors. We also obtained invoice documents and compared the amount paid in STARS to those documents. We concluded that the VTrans financial information was sufficiently reliable for the purposes of our audit.

We compared initial estimates in budget requests to total expenditures reported in STARS. We also compared these initial schedule projections to the actual construction substantial completion date reported in the extension of time memos and final project schedules for projects that did not have these memos issued because the contracts were completed on time. Extension of

[12] 2013 Internal Control – Integrated Framework© Committee of Sponsoring Organizations of the Treadway Commission (COSO). All rights reserved. Used with permission. Internal Control Standards: A Guide for Managers (Vermont Department of Finance and Management, Edition 2.0, September 3, 2019).

time memos are where VTrans documents construction delays and decisions on liquated damages.

To determine the extent that preliminary engineering delays drove the variances we found when assessing the schedules for the entire projects, we compared the initial plans to complete preliminary engineering, to when VTrans began issuing payments for construction, as documented in STARS. We reviewed amendments to scope and fees for design contracts in instances where those were detailed enough to provide insights into what drove the variances. We also interviewed VTrans officials about the cost and schedule variances we found in our analysis. We interviewed officials about whether they informed the Legislature when delays were due to reallocating funds to other projects. Since VTrans' method for estimating initial cost and schedule are done at a very high-level, we focused our follow-up on projects that exceeded initially estimated costs by 50 percent or schedule delay of three years or more.

To assess the extent to which VTrans informed the Legislature of any projects that have total estimated costs that have increased by more than 100 percent or by at least $8 million from the previous year estimate, we also reviewed 19 V.S.A. reports in all Transportation Programs that included funding requests for the 14 projects we selected for assessment.

We assessed the impact of change in project distance, which we noted during our review of VTrans budget requests, by reviewing project descriptions provided with each Transportation Program funding request and bids. In instances where we could not determine or were uncertain of initial mileage from Transportation Program descriptions, VTrans provided the data. We then calculated changes to the mileage for all years the projects requested funding. We also assessed average cost per mile for each project.

To assess performance in the construction phase alone, we compared the costs and schedule projections baselined in the initial contract to the actual costs reported in STARS and substantial completion dates reported in extension of time memos and final project schedules. We reviewed construction contract change orders to identify the most significant construction cost and schedule drivers, as well as impacts of drivers like price fluctuations and penalties. We verified that the construction contract included liquidated damages clauses. We also reviewed extension of time memos for VTrans' assessment of liquidated damages. Finally, we assessed the extent to which detailed construction contract estimates varied from construction bids and contract awards and verified that all bids equaled contract award amounts.

Objective 2

To determine how VTrans measures cost and schedule performance we reviewed VTrans' Programmatic and Performance Measure Budget Reports, as well as the VTrans Strategic Plan and the Transportation Asset Management Plan to gain an understanding of VTrans performance measures and operational goals. We also reviewed performance reports that compare VTrans performance to the transportation agencies of New Hampshire and Maine, as well as Virginia DOT's measures for assessing cost and schedule performance in preliminary engineering and construction phases. We also reviewed GAO and FHWA guidance on managing capital projects and developing reliable cost and schedule estimates to determine the extent to which VTrans' current performance measures and management practices reflect best practices. We also interviewed VTrans officials about its current measures related to cost and schedule performance, as well as the extent to which they measure cost and schedule. We compared VTrans' responses to best practices for managing capital projects.

We conducted this performance audit in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Appendix II
Abbreviations

FHWA	Federal Highway Administration
FY	Fiscal Year
GAO	Government Accountability Office
SAO	State Auditor's Office
VDOT	Virginia Department of Transportation
V.S.A.	Vermont Statutes Annotated
VTrans	Vermont Agency of Transportation

Appendix III
Paving Projects Reviewed

Exhibit 14 below displays the routes and miles paved in the 14 paving projects we reviewed. Jericho-Richmond and Essex were originally combined under Essex-Richmond.

Exhibit 14: Routes and Miles Paved in the Projects We Reviewed

Project Name	Route(s)	Miles Paved (Rounded to the nearest tenth)	Cost per mile	Substantial Completion Date
Waterbury-Stowe	VT Route 100	9.6	$2,574,700	10/18/2019
Essex	VT Route 117	3.2	$1,869,297	10/16/2019
Jericho-Richmond	VT Route 117	3.6	$1,801,355	10/16/2019
Jamaica-Winhall	VT Route 30	8.9	$1,546,217	11/6/2019
Brighton	VT Route 105, VT Route 114	1.7	$1,441,824	9/27/2019
Brandon-Goshen	VT Route 73	7.5	$1,400,557	11/27/2019
Morristown	VT Route 100, VT Route 12, VT Route 15A	2.8	$909,167	9/12/2019
Bethel-Royalton	VT Route 107, VT Route 12	3.4	$855,873	10/3/2019
Manchester-Peru	VT Route 11	9.6	$755,215	5/29/2020
Williston	US Route 2	2.3	$665,598	8/4/2019
Rutland-Pittsford	US Route 7, VT Route 3	4.2	$600,565	11/21/2019
Essex-Underhill	VT Route 15	13.0	$513,328	10/30/2019
Waterbury-Richmond	Interstate Route 89	31.6	$254,237	7/2/2020
Springfield-Hartland	Interstate Route 91	21.3	$159,620	7/26/2019

Appendix IV
Explanation of the Fields in the Transportation Program

Exhibit 15 below is an explanation of the fields used in the Transportation Program.

Exhibit 15: Explanation of the Multiyear Transportation Program

		(7)	(8)	(9)	(10)	(11)			(12)
PROJECT INFORMATION	PHASE AND FUNDING	ESTIMATED TOTAL COST	ACTUAL EXPENDED THRU FY 2021	ESTIMATED CURRENT YEAR FY 2022	ESTIMATED BUDGET YEAR FY 2023	PROJECTED FY 2024	PROJECTED FY 2025	PROJECTED FY 2026	ESTIMATED COST TO COMPLETE
(1)	PE		0	0	0	0	0	0	0
(2)	ROW		0	0	0	0	0	0	0
(3)	CONSTR		0	0	0	0	0	0	0
	OTHER		0	0	0	0	0	0	0
Route:	TOTAL		0	0	0	0	0	0	0
(4)	Description:	(13)							
Year Added: (5)									
Project Manager: (6)	Comments:	(14)							

Key:

(1)	**Program**	Major Program Category
(2)	**Project Name**	The official name of the project, usually the town(s) in which the project is located.
(3)	**Project Number**	A unique number, generally reflecting the Federal appropriation and route system number.
(4)	**Route**	Route number or street name for highway projects; or name of airport or railroad.
(5)	**Year Added**	The Fiscal Year in which a project first appeared in the Transportation Program.
(6)	**Project Manager**	Name and phone number of the person to contact for project-related information.
(7)	**Estimated Total Cost**	The estimated total cost of the project.
(8)	**Actual Expended thru FY2021**	The actual amount expended on the project through 6/30/2021.
(9)	**Estimated Current Year FY2022**	The amount anticipated to be expended in the current state fiscal year (ending 6/30/2022).
(10)	**Estimated Budget Year FY2023**	The amount anticipated to be expended in the state fiscal year 2023 (ending 6/30/2023).
(11)	**Projected Cash Requirements**	The estimated costs for each year of the Multiyear Transportation Plan.
(12)	**Estimated Cost to Complete**	The estimated cost to complete the project.
(13)	**Description**	A description of the type of project and its location.
(14)	**Comments**	General comments regarding project status, etc.

Appendix V
Pavement Treatment Costs by Work Type (in Millions)

Exhibit 16 below is the average historical cost per mile VTrans used to estimate the cost of various types of paving projects as of January 5, 2023.

Exhibit 16: Pavement Treatment Costs by Work Type (in Millions)

Work Type	Treatment	Class1 National Highway System 2 Lanes	Class1 Non-National Highway System 2 Lanes	Interstate National Highway System 2 Lanes	State National Highway System 2 Lanes	State Non-National Highways System 2 Lanes
Rehabilitation	"Mill and fill" paving 2" +/-	$1.3	$0.85	$0.5	$0.55	$0.43
	Pulverize and overlay or reclaim	$15.0	$15.0	$1.25	$0.85	$.75
	Major rehabilitation	$15.0	$15.0	$7.5	$5.0	$4
Reconstruction	Reconstruction via the VTrans roadway program	$0.5	$0.5	$0.3	$0.25	$0.2
Preservation	Thin pavement overlay				$3.0	$2.5
Maintenance	Overlay of poor pavement to provide serviceability				$0.15	$0.15

Appendix VI
Preliminary Engineering Schedule Measures Used by Another State

Exhibit 18 below shows how the Virginia Department of Transportation (VDOT) measures their on-time performance for activities in the preliminary engineering phase. Most of these schedule activities are baselined after the project's scope has been approved for design.

Exhibit 18: Development Phase Schedule Tracker at Virginia Department of Transportation

Activity	Activity Code	Early Finish			Late Finish
Local Agreement	10	> 30 days early	≤ 30 days early	Baseline Finish Date	> 0 days late
Start Development (Authorize PE)	12				
Determine Requirements (Scope Project)	22/70R				
Engage Public (Approve Willingness, Adopt Location/Design)	47, 49				
Start Purchasing Right-of-Way (Authorize R/W & UT Funds)	52				
Utility Relocation	67U				
Complete Purchasing Right-of-Way (Acquire Right-of-Way)	69	> 60 days early	≤ 60 days early		
Obtain Permits	70				
Solicit Bids (Advertise Project)	80				
Start Delivery (Award Contract)	84	> 30 days early	≤ 30 days early		> 0 days late

From the VDOT's Dashboard Projects User Guide

A project is considered Green until the next scheduled activity gets within a certain number of days of its planned finish. At that time, the project will be reported as Yellow on the Dashboard. If the activity is completed on or before the Planned Finish date, it will turn back to Green. If an activity is one day late, the project will turn Red. A project will also turn Red if critical data is missing.

If an activity completes in the Red status (i.e., exceeds the baseline), the project will remain in that status until another activity is completed on time. Please note that the activity names in parentheses reference the name in VDOT's data systems.

VDOT has a goal is to have at least 70% of projects developed On-Time (i.e., in Green or Yellow status).

The following is a reprint of management's response to a draft of this report. Our evaluation of these comments is contained in Appendix VIII.

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Agency of Transportation

March 10, 2023

Douglas R. Hoffer
Vermont State Auditor
132 State Street
Montpelier, Vermont 05633-5101

Re: Report of the Vermont State Auditor – *Vermont Agency of Transportation Paving Projects: Significant Deviations in Cost and Schedule Estimates for Complex Projects Underscores the Need for Performance Measures*

Dear Mr. Hoffer,

This letter intends to convey Vermont Agency of Transportation (VTrans) management comments related to the findings and recommendations contained within the report from the Vermont State Auditor titled: *Vermont Agency of Transportation Paving Projects: Significant Deviations in Cost and Schedule Estimates for Complex Projects Underscores the Need for Performance Measures.* I would first like to recognize the process that went into this report and data collection, it is understood that there was a significant effort and time commitment from representatives of the Office of the Vermont State Auditor as well as representatives from multiple Sections within VTrans.

It is VTrans understanding that this audit was conducted as a neutral and unbiased performance audit, meaning the intent of the audit was to perform an assessment of operations to determine if a specific program or functions are working as intended and provide recommendations for improvement. VTrans was not consulted to assist in the development of the two audit objectives and the resulting process, report, and recommendations are being utilized by VTrans to review current processes and implement changes that may improve the delivery of projects.

The *Vermont Agency of Transportation Paving Projects: Significant Deviations in Cost and Schedule Estimates for Complex Projects Underscores the Need for Performance Measures* report focused on two primary objectives:

- Determine if VTrans completes paving projects within their estimated cost and completion dates.

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- Determine whether VTrans utilizes sufficient performance measures to systematically assess deviations.

VTrans does not dispute the data collected as part of this effort or the fact that select projects within the Paving Program experience cost increases and/or schedule delays.

To keep Vermont's infrastructure in a state of good repair, VTrans Project Managers are constantly managing numerous projects, often designing and delivering more than twenty projects annually. The Paving Program delivers projects that are focused on preserving and improving our roadway surfaces, addressing safety, mobility and asset condition. These projects directly contribute to meeting VTrans' mission to provide for the safe and efficient movement of people and goods. Based on current 2022 data, VTrans has only 8% of its mileage in very poor condition which meets our performance goal of keeping the percentage of miles in very poor condition below 25% and has a travel weighted average condition of 68 which is slightly below the performance goal of keeping the travel weight average condition above 70. Paving projects have evolved in recent years and many projects contain elements or features that improve or manage additional assets. These includes features such as bicyclist/pedestrian improvements, culvert replacements, shoulder widening, guardrail improvements, and the installation of centerline rumble stripes.

Project estimates and schedules are dynamic during the development phase of a project and can be influenced by a number of factors. Estimates and schedules are continuously updated throughout the course of a project's development, either at determined project milestones or based on the presence of contributing factors including but not limited to; additional project scope, concurrent or adjacent projects, re-evaluation of needs/priorities within the network, budgetary constraints, and resource constraints. Being that schedules and estimates are managed dynamically, the report is accurate in its' statement that all changes or modifications throughout the life of a project are not formally documented. However, VTrans does implement an on-time performance measure, that baselines and sets project advertisement expectations for the upcoming calendar year and works to advertise projects within thirty days of that targeted advertisement date. Additionally, VTrans performs a comprehensive bid analysis of all construction low bids, ultimately comparing them against the contract plans estimate and justifying the award and advancement of that contract. As noted within the report the construction phase of a project is the most substantial cost within the program, and while the existing on-time performance measure and the bid analysis process do not measure performance versus initial schedule or the initial estimate, they do help to ensure that there is alignment between the program and the approved budget which is approved by the Legislature for the upcoming fiscal year only.

The audit report is focused on a subset of projects that were completed within a selected fiscal year. The report identified two objectives that explore cost increases and/or schedule delays, and the conclusions within the report are focused on documentation and transparency related to cost and schedule beginning at the initiation of a project. Looking at the cost progression and schedule modifications for this subset of projects is a contributing factor to the delivery of a Program, however it does not gage the performance and success of the overall program or of the delivery of

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See our comment 1 on page 33.

See our comment 2 on page 33.

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projects. VTrans is analyzing the content of the report and viewing this as an opportunity to understand and make improvements focused on the documentation and transparency of project estimates and schedules from project initiation through construction. The report contained three recommendations for VTrans to consider, all of which are understood by the Agency. These are repeated, with corresponding actions noted below.

1. *Develop and implement a process to consistently record what caused cost and schedule deviations. If any of the delays are due to reallocating the funds to another project, inform the Legislature as required by State law.*
    a. VTrans' Project Manager team will work to evaluate the most efficient manner to collect and report this data and develop any business rules associated with requirements of the data/justification. VTrans project teams will complete a memorandum to the project file that will include reasons/justification for paving project cost increases and/or paving project schedule delays. This will be completed at minimum, on an annual basis and should be aligned with budget development process.
2. *Develop and implement performance measures to assess cost deviations for paving projects in the preliminary engineering and construction phases. Report the measures to the Legislature and the public at least annually.*
    a. The VTrans Performance Section in coordination with the Project Delivery and Construction and Materials Bureaus will investigate development of a performance measure and associated tool that assesses project cost estimates throughout the duration of a project's development and construction. This investigation will consider development cost, data needs, resource requirements associated with development, and reporting needs.
3. *Develop and implement performance measures to assess schedule deviations for paving projects in the preliminary engineering and construction phases. Report these measures to the Legislature and the public at least annually.*
    a. VTrans, beginning with any capital improvement project programmed from 5/1/2023 on, will save a baseline of the initial schedule that can be utilized for comparison throughout the duration of a project's development and construction. Additionally, the VTrans Performance Section in coordination with the Project Delivery and Construction and Materials Bureaus will investigate development of a performance measure and associated tool that assesses project schedule delay throughout the duration of a project's development and construction. This investigation will consider development cost, data needs, resource requirements associated with development, and reporting needs.

Again, VTrans appreciates the work, by all parties, that went into the completion of this audit report. VTrans accepts this report as it relates to the documentation and transparency of project estimates and project schedules throughout the project development phase, as well as the recommendations for additional performance measures/tracking. VTrans notes that this report is focused on documentation, transparency, and performance measures and does not reflect overall success or delivery of the Legislature approved annual Paving Program. VTrans is looking forward to taking steps to improve and address the VTrans recommendations contained within the

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See our comment 3 on page 33.

See our comment 4 on page 33.

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report and look forward to our follow up meeting next year. Please contact me with any additional questions or comments.

Best regards,

DocuSigned by:
Joe Flynn
EBBFF896AB5C4E8...

Joe Flynn
Secretary
Vermont Agency of Transportation

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Appendix VIII
SAO Evaluation of Management's Comments

In accordance with generally accepted government auditing standards, the following tables contain our evaluation of management's comments.

Comment #	Management's Response	SAO Evaluation
1	In their response to our comments, VTrans stated that our second audit objective was: "*Determine whether VTrans utilizes sufficient performance measures to systematically assess deviations."*	VTrans description of our second objective is incomplete. The objective actually was: "Determine whether VTrans utilized *and reported* sufficient performance measures to systematically assess deviations." The inclusion of reporting in our objective is important for transparency to the Legislature and the public.
2	*VTrans does implement an on-time performance measure, that baselines and sets project advertisement expectations for the upcoming calendar year and works to advertise projects within thirty days of that targeted advertisement date.*	In the report we acknowledge that VTrans reports this performance measure related to their advertising schedule. We also point out, however, that this measure does not address project schedule performance. While it provides information about delays in advertising the job that could disrupt the timely transition to construction, it misses significant portions of schedule performance for which VTrans is responsible in preliminary engineering.
3	*The VTrans Performance Section in coordination with the Project Delivery and Construction and Materials Bureaus will investigate development of a performance measure and associated tool that assesses project cost estimates throughout the duration of a project's development and construction. This investigation will consider development cost, data needs, resource requirements associated with development, and reporting needs.*	As we reported on page 17, Vermont's State Strategic Plan has a goal to "improve transportation project planning" by continuously improving "project development efficiency by reducing the time and cost for planning, engineering, permitting, right-of-way, acquisition and construction management" by a 2023 deadline. Implementing our recommendations would measure improvements sought by the strategic plan and improve overall management and transparency into paving projects cost and schedule.
4	*VTrans Performance Section in coordination with the Project Delivery and Construction and Materials Bureaus will investigate development of a performance measure and associated tool that assesses project schedule delay throughout the duration of a project's development and construction. This investigation will consider development cost, data needs, resource requirements associated with development, and reporting needs.*	