# 2021 GAINESVILLE VIRGINIA RAILWAY EXPRESS (VRE) EXTENSION CAPITAL & OPERATING ANALYSI

Virginia Department of Rail and Public Transportation

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# 1. Executive Summary

Item 443(f) of Chapter 1289 of the 2020 Acts of Assembly (the Bi-annual Budget Bill) directed DRPT to "…evaluate the operating and capital costs associated with an extension of the Virginia Railway Express (VRE) commuter rail service from Manassas to Gainesville." DRPT developed the 2021 Gainesville VRE Extension Capital and Operating Cost Analysis (2021 Cost Analysis) to fulfill this requirement. DRPT used VRE's *Gainesville Haymarket Extension Study* (GHX Study), released in 2018, as a baseline for the 2021 analysis and built upon this earlier alternatives analysis with updated cost information and methodology considerations to produce an independent cost estimate.

## 1.1. Project Description

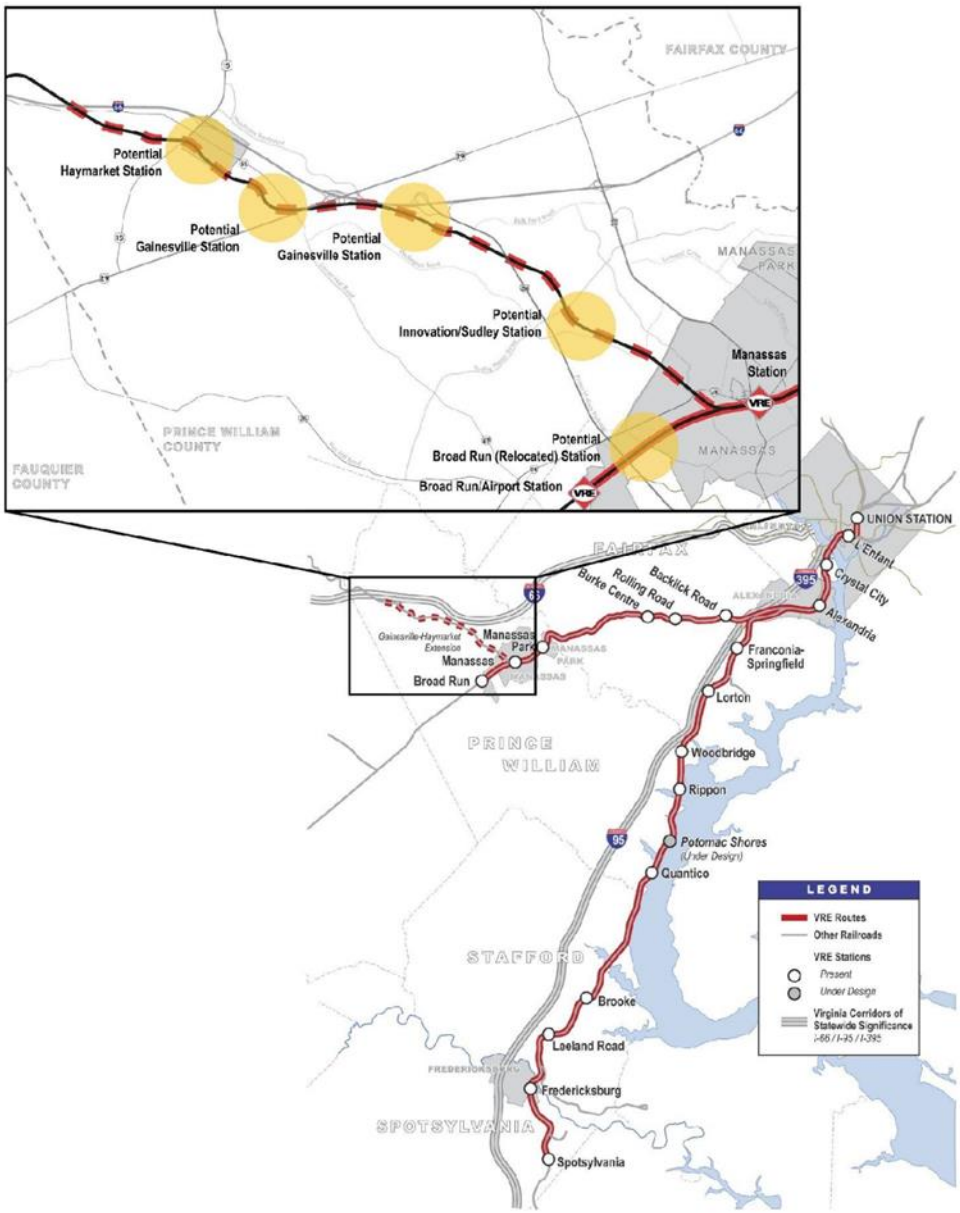
VRE operates a commuter rail network that links Northern Virginia to Washington, DC. As part of this network, VRE's Manassas Line trains run on Norfolk Southern Railroad (NSR) tracks between Alexandria and the end of the Manassas Line at Broad Run Station, as shown in the VRE Service Map, Figure 1.1. The corridor is experiencing rapid population growth with more people forecasted to live and work in the corridor by 2040[1]. VRE provides a cost-effective and reliable transportation option to residents, while increasing the person-carrying capacity of the corridor. The 2021 Cost Analysis evaluates costs associated with potential future increased Manassas Line service, including an extension that would take trains west from the Manassas Station toward Gainesville along NSR's B-Line. The 2021 Cost Analysis presents capital and operating costs for a number of alternatives established and refined in earlier studies. Figure 1.2 2018 VRE Alternatives Analysis Report Corridor Map shows early alternatives and highlights NSR's B-Line with a red dashed line.

**FIGURE 1.1: VRE SERVICE MAP**


Source: www.vre.org

[1] "VRE Gainesville-Haymarket Extension, Technical Memorandum - Travel Market Analysis, Section 5" issued January 12, 2016.

**FIGURE 1.2: 2018 VRE ALTERNATIVES ANALYSIS REPORT CORRIDOR MAP***



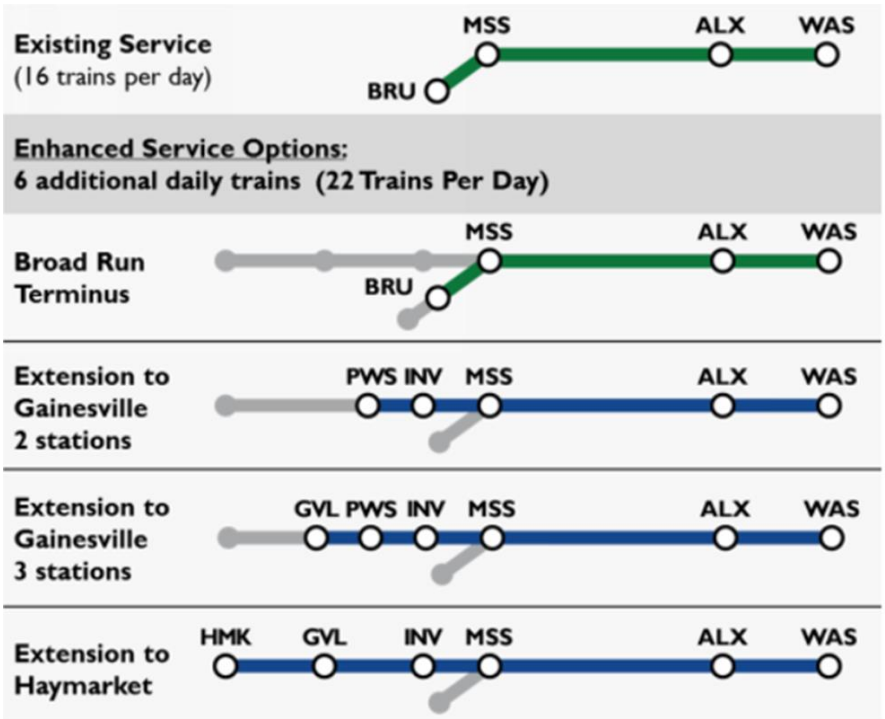

Source: 2018 VRE Alternatives Analysis Report
NSR's B-Line is represented by the red dashed line.

## 1.2. Alternatives Considered

The 2021 Cost Analysis built upon VRE expansion alternatives analyses developed in previous studies and focused on the top finalist alternatives for comparative purposes. The alternatives include an expanded Broad Run terminus station, a one-station extension with Gainesville terminus, a two-station extension with Gainesville terminus, and a 3-station extension with Haymarket terminus. Each of the alternatives assume that service would increase from the current 16 VRE trains per day to 22 VRE trains per day.

A list of alternatives with enhanced service is shown in Figure 1.3.

**FIGURE 1.3: ALTERNATIVE SERVICE SCHEMATIC**




| STATION CODES | |
|---|---|
| ALX | Alexandria |
| BRU | Broad Run |
| GVL | Gainesville (western) |
| INV | Innovation |
| MSS | Manassas |
| PWS | Gainesville (eastern) |

## 1.3. Capital Cost Estimate

**TABLE 1.1: CAPITAL COST ESTIMATES**

| Terminus | Number of Stations | High Build Estimate (2020 $M) | Low Build Estimate (2020 $M) |
|---|---|---|---|
| Haymarket | 3 | 915 | 832 |
| Gainesville | 3 | 865 | 816 |
| Gainesville | 2 | 850 | 783 |
| Broad Run | 1 | N/A | 466 |

Source: Moffatt & Nichol

The high build estimates in Table 1.1 include the cost for a third track, and the low build estimates show the cost for a two track option. Both estimates include the cost of infrastructure optimization to maintain interoperability between freight and passenger trains, and a new maintenance and storage facility (MSF) for the alternatives that terminate at Haymarket or Gainesville. As background, host railroad NSR conducted an independent assessment in 2015 of track and signal design for a potential VRE Gainesville-Haymarket extension and concluded that an additional third track would be necessary in order to preserve NSR's B-Line freight operations for the options that terminate in Gainesville or Haymarket. The Broad Run terminus alternative does not require an extension to the B-Line, and therefore does not have a high build estimate.

## 1.4. Operations and Maintenance Cost Estimate

DRPT developed the methodology and analysis to validate previous reports on the annual operations and maintenance (O&M) costs of a potential VRE service extension to Gainesville.

The model distributes expense types by functions as reported by the National Transit Database (NTD) to reflect how costs are incurred and accounted for. This approach resulted in annual O&M costs of $118 per train mile for VRE. This result is close to the $101 in total operating cost per train mile reported by the National Transit Database for comparable agencies in 2019. Therefore, annual O&M estimates for the alternatives ranged from $19.4 million per year to $29.9 million per year.

## 1.5. Ridership Forecast Review

DRPT built upon previous VRE forecasts by comparing datasets with actual VRE ridership, Amtrak origin-destination data, and American Community Survey Journey to Work survey data.

The analysis supports observed trends that show a combination of continued economic growth and roadway congestion making rail service more attractive to customers, and the entry of special employer generators such as Amazon's HQ2 in Crystal City will likely lead to an increase in the number of people for whom VRE is a viable option. The COVID-19 situation remains dynamic and rapidly evolving with no real precedent. More monitoring on the degree to which businesses and the major federal employers return to regular commuting patterns after the pandemic is needed to understand the implications for VRE.

## 1.6. Summary

In summary, the evaluation found that extending VRE service beyond an improved Broad Run Station would attract up to 7% more riders by 2030. The difference in capital investment would be at least $317M more than an improved Broad Run Station, approximately 70% higher, with additional annual O&M costs of approximately $3.2 million more. This points to the conclusion that a while a robust service expansion would yield higher ridership, there would be fewer returns for O&M costs as route miles are added beyond Broad Run.

# 2. Capital Cost Estimate

DRPT generally followed the Federal Transit Administration (FTA) New Starts Standard Cost Categories (SCC) Work Breakdown Structure (WBS) as a template to prepare a high and a low capital cost estimate for each of the four alternatives below. Estimates are based on conceptual designs from VRE's GHX Study.

**TABLE 2.1: EXPANSION ALTERNATIVES**

| EXPANSION ALTERNATIVES | |
|---|---|
| **Terminus** | **Number of Stations** |
| Haymarket | 3 |
| Gainesville | 3 |
| Gainesville | 2 |
| Broad Run | 1 |

## 2.1. Overview & Methodology

The cost estimates for each alternative include a number of design elements, each of which is included in the following FTA cost sections:

- Guideway & Track Elements
- Stations, Stops Terminals, Intermodal
- Support Facilities: Yards Shops, Administration Buildings
- Site work & Special Conditions
- Systems
- Right-of-Way, Land, Existing Improvements
- Vehicles
- Professional Services
- Contingency

Within each of these cost sections, individual cost categories are further detailed with some cost categories being divided into subcategories. The GHX Study developed costs using this tool. For the 2021 Cost Analysis, DRPT estimated capital costs for each alternative based on quantity take-offs and conceptual designs from the GHX Study and refined the estimates through assembly-driven models derived from the available conceptual designs.

## 2.2. Base Year

Base year dollars are a critical analysis element for comparing capital cost estimates. This analysis calibrated for 2020 base year dollars and used a three percent per year escalation rate to update costs from earlier years.

## 2.3. Contingency

DRPT based contingency estimates on the level of project development. In this case, the designs for refined expansion alternatives from the GHX Study developed to a concept level. A Concept Study is considered a Class 4 Estimate as defined by the Association for the Advancement of Cost Engineering (AACE) International Recommended Practice No. 56R-08, an industry recommended standard shown in Table 2.2.

**TABLE 2.2: ESTIMATE CLASS PER AACE INTERNATIONAL PRACTICE NO. 56R-08**

| Estimate Class | Maturity Level of Project Definition Deliverables (%) | End Usage (Purpose of Estimate) | Methodology (Typical Estimating Method) | Expected Accuracy Range (%) |
|---|---|---|---|---|
| 5 | 0 to 2 | Functional Area for Concept Screening | Parametric Models, Judgement, or Analogy | -20 to +50 |
| 4 | 1 to 15 | Schematic Design or Concept Study | Parametric Models or Assembly-Driven Models | -10 to +30 |
| 3 | 10 to 40 | Design Development | Semi-detailed unit costs with assembly-level line items | -5 to +20 |
| 2 | 30 to 75 | Control or Bid / Tender, Semi-Detailed | Detailed Unit Cost with Forced Detailed Take-off | -5 to +15 |
| 1 | 65 to 100 | Check Estimate, Pre-Bid / Tender, Change Order | Detailed Unit Cost with Detailed Take-off | -3 to +10 |

Source: http://web.aacei.org/docs/default-source/toc/toc_56r-08.pdf

The level of design that was conducted by VRE for the GHX Study was up to approximately 15%, as is recommended for a planning-level concept study and shown in Table 2.2. As recommended by AACE, the 2021 Cost Analysis uses a single 30% applied to combined construction and professional service costs to capture unidentified improvement needs and other costs or risks not otherwise captured in the standard cost items.

## 2.4. Anomalies Due to COVID-19 Impacts on Economy

Direct construction impacts due to COVID-19 have ranged from a slowdown of available goods and labor through to suspensions and, in some instances, terminations of entire projects.

Sufficient data has neither been collected nor analyzed to fully determine the near-term or long-term impacts of the COVID-19 pandemic on capital costs or construction activities related to this potential VRE service extension. These impacts, along with government recovery efforts to offset the impacts of the pandemic, also will need to be evaluated once those recovery programs are completed.

## 2.5. Low Build and High Build Estimates

DRPT continued the GHX Study approach by presenting a capital cost range with a low build estimate and a high build estimate.

The 2021 Cost Analysis follows a similar format to the GHX Study by presenting a reasonable range of likely capital costs, from "high-build" to "low-build." Differences between the high and low build estimates are related to infrastructure that may be necessary to preserve freight capacity as commuter rail service is added to this shared-use corridor.

NSR is a critical partner in any service expansion project on its tracks. As the host railroad, NSR reviews new service proposals and determines the infrastructure needs to allow for additional capacity. NSR conducted an independent assessment of track and signal design for a potential VRE Gainesville-Haymarket extension and concluded that an additional third track would be necessary in order to preserve NSR's B-Line freight operations for the options that terminate in Gainesville or Haymarket. Additional coordination with NSR will be necessary as expansion plans develop in order to confirm and refine this and other potential track infrastructure improvements.

As with the earlier study, the 2021 Cost Analysis includes the cost of an additional third track for the B-Line in its high-build for the options terminating in Gainesville and Haymarket. The low build assumes a two-track B-Line.

In contrast with the GHX Study, the 2021 Cost Analysis includes in both the high and low build estimates DRPT-identified costs that will preserve freight and passenger network fluidity, such as track connections to the existing quarry yard, grading, rail turnouts and crossovers, and associated right of way acquisition. The DRPT team identified these additional freight/passenger interoperability costs based on experience in recent years working with NSR on freight and passenger projects in this area and through the agency's work to extend Amtrak service from DC to Lynchburg, Roanoke, and eventually the New River Valley along NSR-owned freight tracks. Again, NSR will require additional review and approval of the track and signal design if a VRE Manassas Line extension were implemented.

## 2.6. Maintenance and Storage Facility Cost Estimates

Cost estimates include a Maintenance and Storage Facility (MSF) for each of the alternatives. MSF costs were taken directly from the GHX Study, as listed in Table 2.3 and shown in Figure 2.1. The recommended MSF site for a Gainesville terminus is identified as Y-3. The recommended MSF site for a Haymarket terminus is Y-5 as shown below. The Broad Run extension does not require a new MSF, only an expansion of the existing facility; it is called out as site Y-1 in Figure 2.1. Note that VRE is currently designing an expansion of the Broad Run MSF that is generally consistent with MSF site alternative Y-1, but limited to existing service levels with longer trains, rather than additional trainsets. The proposed MSF expansion will take place mostly in the footprint of the existing MSF, with limited expansion adjacent to the existing facility.[2]

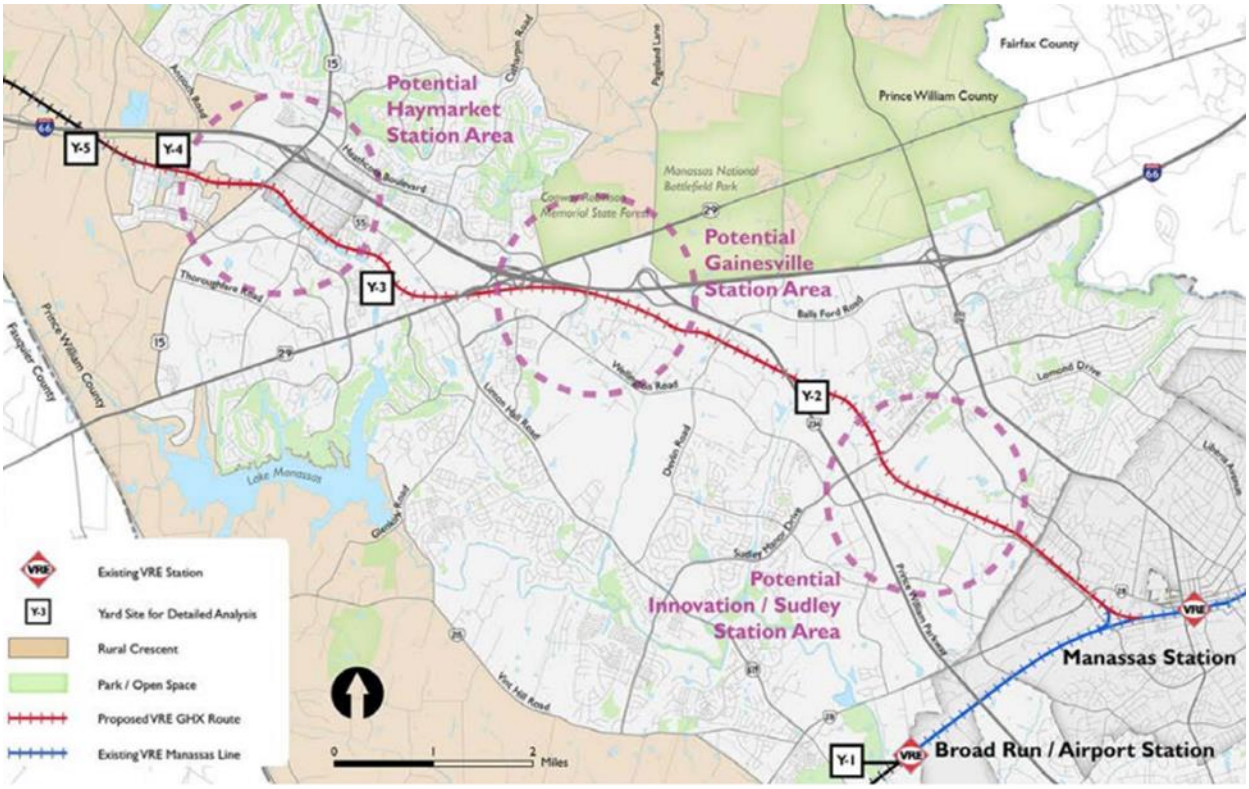
[2] For more information, see the VRE project website (www.projects.vre.org).

**TABLE 2.3: MAINTENANCE AND STORAGE FACILITY CAPITAL COSTS FROM GHX STUDY, 2020**

| MSF Site Alternative | Capital cost* (2020 $ M) |
|---|---|
| Y-1 | 50.7 |
| Y-3 | 79.4 |
| Y-5 | 66.5 |

Note: Costs are from GHX Study escalated to 2020 dollars. MSF sites Y-2 and Y-4 were eliminated from further analysis in the 2015 study.

**FIGURE 2.1: COMPOSITE MAINTENANCE AND STORAGE FACILITY SITES MAP**




## 2.7. Freight and Passenger Interoperability Elements

DRPT identified the following infrastructure improvements that will facilitate rail network fluidity to maintain the quality of NSR freight operations as VRE service expands. These improvements are independent of the third track B-Line identified by NSR. The 2021 Cost Analysis includes the following improvement costs for both the low build and high build estimates for each alternative, as appropriate:

- Double track approximately 0.5 miles of existing single track at the Manassas Wye to avoid a bottleneck that has the potential to result in delays to VRE schedules and impacts to NSR freight operations.
- Replace Vulcan siding for one of the three new tracks to maintain NS service to Vulcan.

- Replace approximately ten existing industry spurs to maintain NSR service to the industries served by these spurs.
- Improve at-grade crossings for the increased number of trains as well as the higher operating speeds of the commuter trains.
- Position crossovers between each station to minimize impacts to NSR operations.

## 2.8. Results

Based on the review of information provided by VRE, comparisons to similar projects, and the factors presented in the preceding sections, capital costs projected for each alternative range from $466 million $915 million, as shown in Table 2.4.

**TABLE 2.4: CAPITAL COST ESTIMATES**

| Terminus | Number of Stations | Low Build Estimate (2020 $ M) | High Build Estimate (2020 $ M) |
|---|---|---|---|
| Broad Run | 1 | 466 | N/A |
| Gainesville | 2 | 783 | 850 |
| Gainesville | 3 | 816 | 865 |
| Haymarket | 3 | 832 | 915 |

Source: Moffatt & Nichol

# 3. Operations and Maintenance Costs

## 3.1. Overview & Methodology

DRPT developed the methodology and analysis to calculate estimates for annual O&M costs for potential VRE service extension to Gainesville. VRE's GHX Study provided the most recent O&M cost estimates and served as a starting point for the 2021 Cost Analysis. DRPT disaggregated the GHX Study's O&M cost estimates, showing costs per NTD cost category.

**TABLE 3.1: NATIONAL TRANSIT DATABASE COST CATEGORIES AND DESCRIPTIONS**

| Cost Category | Description |
|---|---|
| Operators Wages | Operators' salaries and wages include the cost of labor, excluding paid absences and fringe benefits, for the transit agency's employees who are classified as revenue vehicle operators or crewmembers. |
| Other Salaries & Wages | This category includes the cost of labor, excluding paid absences and fringe benefits, of employees of the transit agency who are not classified as revenue vehicle operators or crewmembers (e.g., maintenance workers, administrative staff, and transit managers). |
| Other Paid Absences | Other paid absences include vacation leave, sick time, and other paid time off not contingent on a specific event outside the control of the transit agency for its employees who are not classified as revenue vehicle operators or crewmembers. |
| Fringe Benefits | Fringe benefits are the expenses for employment benefits that an employee receives in addition to his or her base salaries and wages. Fringe benefits include payments associated with the employee's labor that do not arise from the performance of work but still arise from the employment relationship. |
| Services | Services are the labor and other work provided by outside organizations for fees and related expenses, such as host railroad track access fees. Outside organizations may be private companies or public entities. |
| Fuel and Lube | This object class includes fuel used to propel revenue and non-revenue vehicles and lubricants such as motor oil, transmission fluid, and grease. |
| Other Materials and Supplies | The cost of materials and supplies other than fuel, lubricants, or tires. |
| Utilities | This object class includes expenses for electricity, gas, water, telephone, heating oil, fuel for backup generators, and broadband/communication services. |
| Casualty and Liability | Casualty and liability costs are expenses related to loss protection and losses incurred by the transit agency. |
| Purchased Transportation [3] | Purchased Transportation (PT) expenses include the payments or accruals to sellers or providers of service, including fare revenues retained by the seller. |

Source: Federal Transit Administration National Transit Database https://www.transit.dot.gov/ntd

[3] For VRE, this cost type includes costs associated with outsourcing operations to Keolis.

DRPT examined VRE's actual expenses for the six years ending with 2019 to gauge the average breakdown of expenses per category over time. DRPT analyzed the changes to develop a set of unique expense categories driven by similar factors. These categories, also known as "expense functions" are shown on the top row of Table 3.2 2019 VRE Expenses by Type and Function, and include vehicle operations, vehicle maintenance, facility maintenance, and general administration. The costs in this table are actual costs that contributed to the understanding of how the NTD's expense types relate to the expense functions developed for the 2021 Cost Analysis.

**TABLE 3.2: 2019 VRE EXPENSES BY TYPE AND FUNCTION**

| | | Expense Functions | | | | |
|---|---|---|---|---|---|---|
| | Virginia Railway Express | Vehicle Operations (2019 $ M) | Vehicle Maintenance (2019 $ M) | Facility Maintenance (2019 $ M) | General Administration (2019 $ M) | Totals by Type (2019 $ M) |
| Expense Types | Operators' Salaries and Wages | - | - | - | - | - |
| | Other Salaries & Wages | - | - | - | 5.3 | 5.5 |
| | Other Paid Absences | - | - | - | 0.6 | 0.5 |
| | Fringe Benefits | - | - | - | 1.6 | 1.5 |
| | Services | 17.1 | 3.8 | 4.8 | 7.8 | 33.5 |
| | Fuel and Lube | 3.7 | - | - | - | 3.5 |
| | Other Materials & Supplies | - | - | 0.1 | 0.1 | 0.1 |
| | Utilities | - | - | - | 1.3 | 1.5 |
| | Casualty and Liability | - | - | - | 3.9 | 4.0 |
| | Purchased Transportation in Report | 16.7 | 8.6 | 0.8 | 0.8 | 27.0 |
| | Total | 37.5 | 12.4 | 5.7 | 21.4 | |

Source: NTD, VRE Financial Reports

Different function costs were assigned an elasticity factor to reflect how each function would increase or stay the same for the various service alternatives. This elasticity-based approach accounted for nonlinearities and economies of scale in the expansion of transportation systems.

DRPT used cost elasticities shown in Table 3.3 to account for the aforementioned non-linear relationship between changes in service (measured as train miles) and its effect on costs. Cost elasticities for the Gainesville-Haymarket extension were based on existing VRE operations and data observed on comparable European systems.[4] The following table presents cost elasticities for each expense function. A cost elasticity of 1.00 for vehicle operations costs implies a linear relationship or perfect correlation to changes in service (train miles). On the other hand, a cost elasticity of 0.20 for general administration costs indicates that this cost function does not react linearly to changes in service not it is perfectly

[4] Steer Group assisted in the preparation of a 2015 European Commission *Study on the Cost and Contribution of the Rail Sector*, and used research on this topic to inform the chosen cost elasticities in the 2021 Cost Analysis. As no published US studies touch on commuter rail cost factors, Steer used best judgement gleaned from the EU report preparation effort. https://ec.europa.eu/transport/sites/default/files/modes/rail/studies/doc/2015-09-study-on-the-cost-and-contribution-of-the-rail-sector.pdf

correlated to it. These elasticities are not expected to remain constant in time, as economies of scale and learning effects create cost efficiencies.

**TABLE 3.3: COST ELASTICITIES PER EXPENSE FUNCTIONS**

| Virginia Railway Express | Elasticity Factor |
|---|---|
| Vehicle Operations Costs | 1.00 |
| Vehicle Maintenance Costs | 0.60 |
| Facility Maintenance Costs | 0.40 |
| General Administration Costs | 0.20 |

Source: Steer

Elasticity factors were applied to O&M costs from the GHX Study. Costs for each alternative were divided by the number of train miles traveled annually for each alternative (including deadhead), which yielded the per-rail-mile O&M cost estimate for the 2021 Cost Analysis.

## 3.2. Results

The 2021 Cost Analysis broke out costs in four categories for each alternative, applied cost elasticity factors, totaled the O&M costs for the different service lines, and then divided by the existing length of the corridor for that service to get the cost per mile. This approach resulted with annual O&M costs of approximately $118 per train mile for VRE. DRPT validated these results by comparing the per-mile cost results from this exercise to other systems and the average result is approximately $101 per train mile, per the NTD for compatible agencies in 2019. Overall annual O&M estimates for the alternatives ranged from $19.4 million per year to $29.9 million per year.

**TABLE 3.4: ANNUAL AND COST PER TRAIN MILE O&M COST ESTIMATES FOR REFINED ALTERNATIVES**

| Virginia Railway Express | Existing Service (2020 $ M) | Broad Run Relocated Terminus (2020 $ M) | Gainesville Terminus (3 Stations) (2020 $ M) | Gainesville Terminus (2 stations) (2020 $ M) | Haymarket Terminus (2020 $ M) |
|---|---|---|---|---|---|
| Vehicle Operations | 14.2 | 17.4 | 19.6 | 19.6 | 21.8 |
| Vehicle Maintenance | 2.8 | 3.4 | 3.9 | 3.9 | 4.3 |
| Facility Maintenance | 0.8 | 1.0 | 1.2 | 1.2 | 1.3 |
| General Administration | 1.6 | 2.0 | 2.3 | 2.3 | 2.5 |
| **Annual O&M Totals** | **19.4** | **23.8** | **27.0** | **27.0** | **29.9** |
| **Train Miles**[5] | 164,925 | 201,575 | 227,975 | 227,975 | 253,275 |
| **O&M Dollars per train mile for each category comes to $118 per mile.** | | | | | |

Source: Steer

[5] VRE's GHX Study was the source for train miles for each alternative.

# 4. Ridership Review

DRPT built upon previous ridership forecasts by comparing VRE GHX Study datasets with actual VRE Manassas Line ridership between 2015 and 2019, 2019 Amtrak origin-destination data specific to the study area, and American Community Survey Journey to Work: Census Transportation Planning Products (CTPP) survey data from 2012 to 2016.

DRPT concluded that ridership forecasts from VRE's previous study were consistent with actual route performance from other recent data sources. Data was interpolated to obtain 2030 values in the table below.

**TABLE 4.1: RIDERSHIP PROJECTIONS**

| Description | Daily Trains | Daily Ridership (2015) | Daily Ridership (2030)[6] | % Increase to Baseline |
|---|---|---|---|---|
| Baseline Ridership (existing service) | 16 | 8,510 | 9,498 | - |
| **'Broad Run Alternative'**<br>**Broad Run Terminus**<br>• Relocated Broad Run Station<br>• Expands existing yard | 22 | 13,190 | 14,447 | 52% |
| **'Alternative Gainesville 2 Stations'**<br>**Extension to Gainesville (2 stations)**<br>• Realigns Manassas Line to Gainesville-Prince William terminus<br>• Eliminates Broad Run station<br>• New end-of-line yard | 22 | 13,770 | 15,124 | 59% |
| **'Alternative Gainesville 3 Stations'**<br>**Extension to Gainesville (3 stations)**<br>• Realigns Manassas Line to Gainesville US 29 terminus<br>• Eliminates Broad Run station<br>• New end-of-line yard | 22 | 13,910 | 15,231 | 61% |
| **'Alternative Haymarket'**<br>**Extension to Haymarket**<br>• Realigns Manassas Line to Haymarket terminus<br>• Eliminates Broad Run station<br>• New end-of-line yard | 22 | 13,920 | 15,393 | 62% |

Source: VRE GHX Study

[6] The October 2017 'Ridership Forecasting Technical Memorandum' provided ridership levels for 2015 and 2040. Data was interpolated to obtain 2030 values.

The analysis supports observed trends that show a combination of continued economic growth and roadway congestion making commuter rail service more attractive to customers, and the entry of special employer generators such as Amazon's HQ2 in Crystal City will likely lead to an increase in the number of people for whom VRE is a viable option. This is balanced by the fact that the COVID-19 situation remains dynamic and rapidly evolving with no real precedent. More monitoring on the degree to which businesses and the major federal employers return to regular commuting patterns after the pandemic is needed to understand the implications for VRE.

The 2021 Cost Analysis did not use this ridership data to develop a ridership and revenue balance sheet to offset the O&M costs with revenue. This additional analysis could be conducted to further refine O&M costs and may be warranted in the future. It is reasonable to assume that while the most robust service expansion would yield the greatest ridership, there would be fewer returns for O&M costs as route miles are added outside the system's core geography.

## 5. Conclusion

In summary, the evaluation found that extending VRE service beyond an improved Broad Run Station would attract up to 7% more riders by 2030. The difference in capital investment would be at least $317M more than an improved Broad Run Station, approximately 70% higher, with additional annual O&M costs of approximately $3.2 million more. This points to the conclusion that a while a robust service expansion would yield higher ridership, there would be fewer returns for O&M costs as route miles are added beyond Broad Run.

**TABLE 5.1: CONCLUSION SUMMARY**

| Description | Daily Trains | Low Build Estimate (2020 $M) | High Build Estimate (2020 $M) | Annual O&M Costs (2020 $M) | Daily Ridership (2030) |
|---|---|---|---|---|---|
| **Baseline** (existing service) | 16 | N/A | N/A | 19.4 | 9,498 |
| **'Broad Run Alternative'**<br>**Broad Run Terminus**<br>• Relocated Broad Run Station<br>• Expands existing yard | 22 | 466 | N/A | 23.8 | 14,447 |
| **'Alternative Gainesville 2 Stations'**<br>**Extension to Gainesville (2 stations)**<br>• Realigns Manassas Line to Gainesville-Prince William terminus<br>• Eliminates Broad Run station<br>• New end-of-line yard | 22 | 783 | 850 | 27 | 15,124 |
| **'Alternative Gainesville 3 Stations'**<br>**Extension to Gainesville (3 stations)**<br>• Realigns Manassas Line to Gainesville US 29 terminus<br>• Eliminates Broad Run station<br>• New end-of-line yard | 22 | 816 | 865 | 27 | 15,231 |
| **'Alternative Haymarket'**<br>**Extension to Haymarket**<br>• Realigns Manassas Line to Haymarket terminus<br>• Eliminates Broad Run station<br>• New end-of-line yard | 22 | 832 | 915 | 29.9 | 15,393 |