FINAL

US 522 Realignment Study

Phase 2 Summary Findings Report: Preferred Cross-Section

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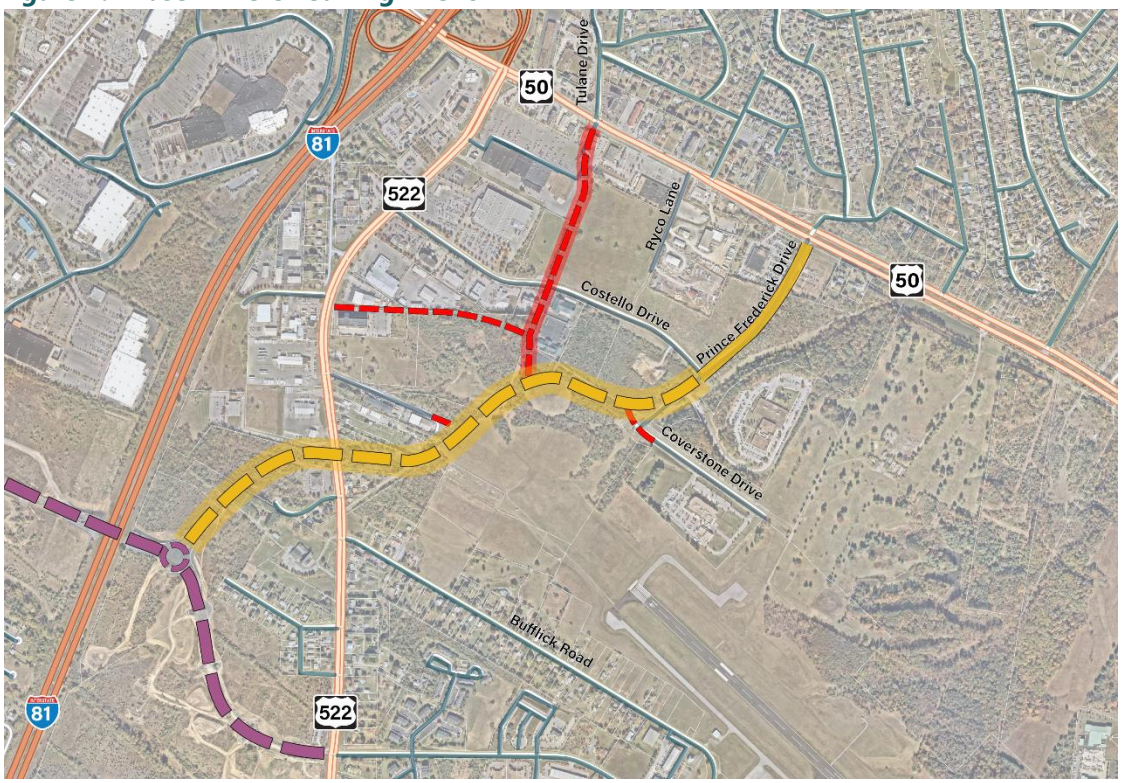
Study Background

The signalized intersection of US 522 (Front Royal Pike) at US 17/50 (Millwood Pike) and the northbound entrance to I-81 is located in Frederick County, VA, just east of downtown Winchester. The relocation of US 522 along a new alignment incorporating Prince Frederick Drive was among the ancillary network improvements identified in the planning and development of the I-81 Exit 313/US 50 improvements to mitigate existing congestion and accommodate future development. Relocation of US 522 was included in the 2035 Frederick County Comprehensive Plan and was also included in the Vision Plan for the Winchester Frederick County Metropolitan Planning Organization (WinFred MPO) 2040 Metropolitan Transportation Plan.

With traffic volumes at this intersection projected to exceed capacity in the near future, Northern Shenandoah Valley Regional Commission (NSVRC) initiated a study in 2020 to explore options for relocating the connection of US 522 at US 17/50 and thus reduce traffic volumes at this intersection. The first phase of this study, completed in 2021, identified a preferred alignment, shown in Figure 1. The second phase of the work has evaluated future cross-sections, identified a preferred cross-section and evaluated potential impacts to the airport. The intended outcome of this study is both a finding to allow the airport to codify the preferred alternative in its master plan and a preliminary design concept and cost estimate to allow for future planning and eventual design.

Figure 1: Phase 1 Preferred Alignment



This report presents the findings from the second phase of the study, which identified a preferred cross-section for the future alignment of a relocated US 522 connection to US 50. As part of Phase 2, the study team conducted the following activities:

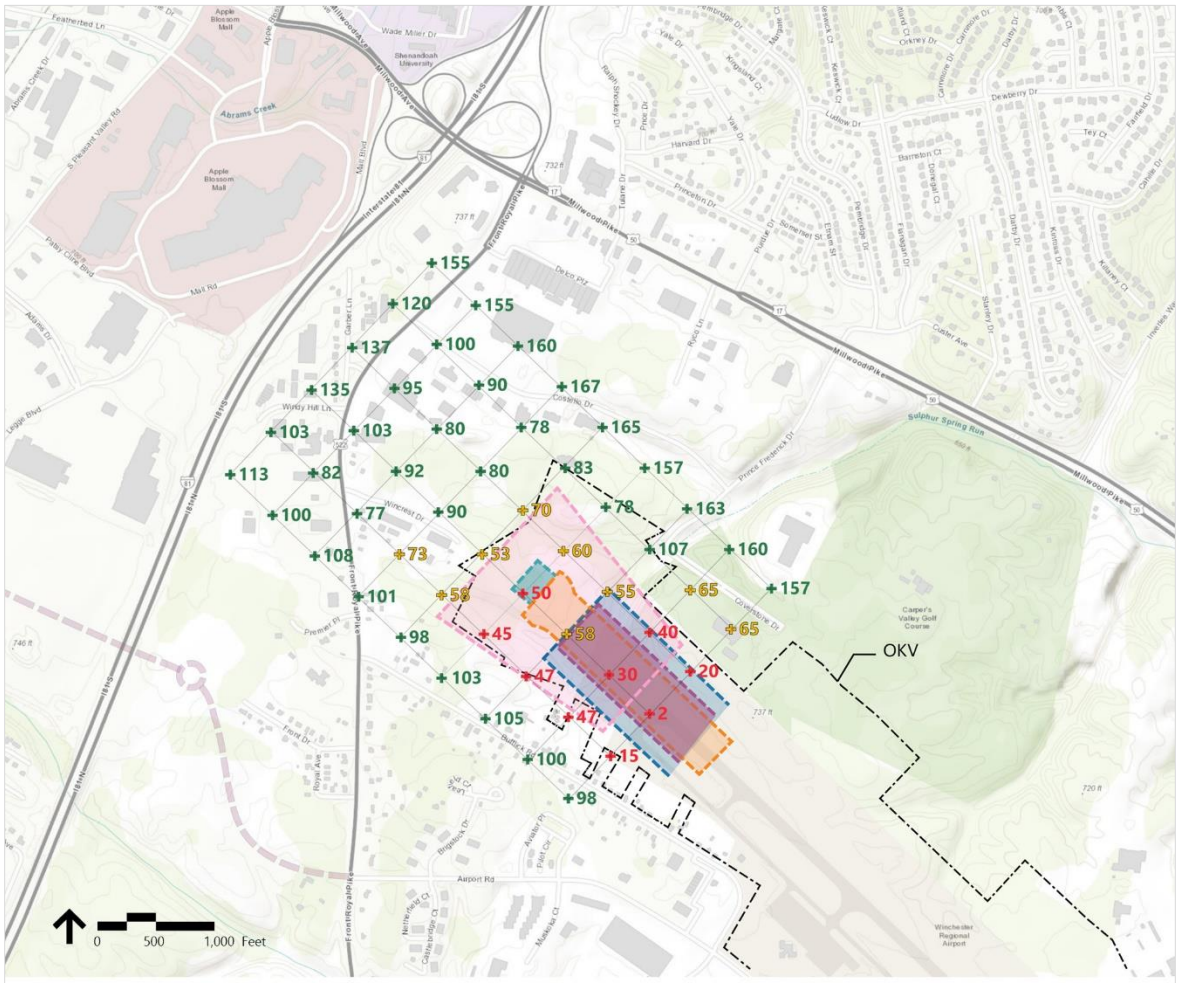
- performed a basic travel forecast using the regional travel demand model to understand likely volumes on new facility;
- evaluated traffic conditions at key intersections to identify potential future improvements that might be required in association with the realignment;
- developed preliminary design concepts for review by stakeholders;
- identified and finalized a preferred design concept;
- reviewed impacts of the preferred concept to the runway protection zone (RPZ) and other controlled surfaces;
- received letter of determination from the FAA that the impacts were acceptable and could be codified in the Airport Layout Plan (ALP, its master plan);
- developed cost estimates for the alignment and connector and evaluated independent utility of the segments.

The US 522 Realignment Study team was comprised of representatives from NSVRC, Frederick County, the Virginia Department of Transportation (VDOT), and the consultant, VHB. Throughout the first phase of the study, the study team coordinated with the Winchester Regional Airport, Federal Aviation Administration (FAA), and the Virginia Department of Aviation (VDOA) to assess potential impacts to the airport resulting from any proposed roadway realignment scenarios. The City of Winchester also participated in the process.

Winchester Regional Airport

Winchester Regional Airport is a general aviation facility located approximately a half-mile southeast of the existing intersection of US 522 and US 17/50. The airport itself is approximately 370 acres in size, with additional protection areas that may not be impinged upon for safety and security purposes. For planning purposes as they relate to this study, the most essential of these protected areas is the Runway Protection Zone (RPZ), which is a two-dimensional land use area intended to enhance protection of people and property on the ground. The RPZ may be crossed by a roadway facility but doing so requires justification and FAA approval. Additional protected areas – the Runway Safety Area (RSA), Runway Object Free Area (ROFA), and the Localizer Critical Area (LCA) – may not be impinged upon. Lastly, there is a three-dimensional Approach Surface which must be maintained clear of obstructions. Figure 2 shows a map of the Winchester Regional Airport's protection areas.

Figure 2 Winchester Regional Airport Protection Areas



Scenario Evaluations

The first task in the Phase 2 study was a series of scenario evaluations to identify the likely range of future roadway volumes and the appropriate design cross-section for the roadway.

Travel Demand Modeling

Working with VDOT, VHB obtained the current travel demand model for the MPO. VHB reviewed the model volumes with VDOT planning staff and jointly concurred that the model base year (2015) reasonably reproduces observed volumes in the vicinity of the project. Additionally, volume growth in the future year model (2040) was deemed reasonable. Because specific traffic forecasts were not being generated, rather a general understanding of order of magnitude volumes (2 lanes vs 4 lanes) was required, VDOT and VHB jointly agreed that the model was fit for use for this purpose.

In addition to checking for reasonableness, VHB edited links in the model network to provide additional detail in the vicinity of the project. This included adding Costello Drive and Prince Frederick Drive and adjusting centroid connectors in the vicinity. VHB re-ran the base year model to confirm that the volumes on adjacent roadways were similar following the network revisions as to the original calibrated model. The revised networks and volumes were shared with VDOT for review and concurrence which was received.

Scenario Identification

With input from the project team, VHB identified five future year (2040) scenarios for testing:

1. No-build: existing conditions without the realigned connector
2. Build 2-lane connector: new connector along the preferred alignment with one travel lane in each direction
3. Build 4-lane connector: new connector along the preferred alignment with two travel lanes in each direction
4. Build 4-lane connector with turn restrictions at existing US 522/US 50 intersection: restrict traffic to eastbound right turns and northbound right turns
5. Build 4-lane connector and US 522 cut off at US 522/50 intersection: cut off the existing US 522 just south of the existing US 50/522 intersection

Scenario Evaluation

For each scenario the volumes were compared with the no-build and other scenarios to understand the impacts. Figure 3 shows the projected growth in model volumes from 2015 to 2040 on study area roadways. US 50/17 and existing US 522 are starting to approach capacity at the segment level. Figure 4 compares volumes on the realigned US 522 in the 2- and 4-lane configurations (Scenario 2 and 3). The small increase in volumes in Scenario 3 compared with Scenario 2 indicates that the limitations of a 2-lane facility will have some but not necessarily substantial impact on route choice.

Figure 3 Rounded Model Volumes for Existing and Scenario 1

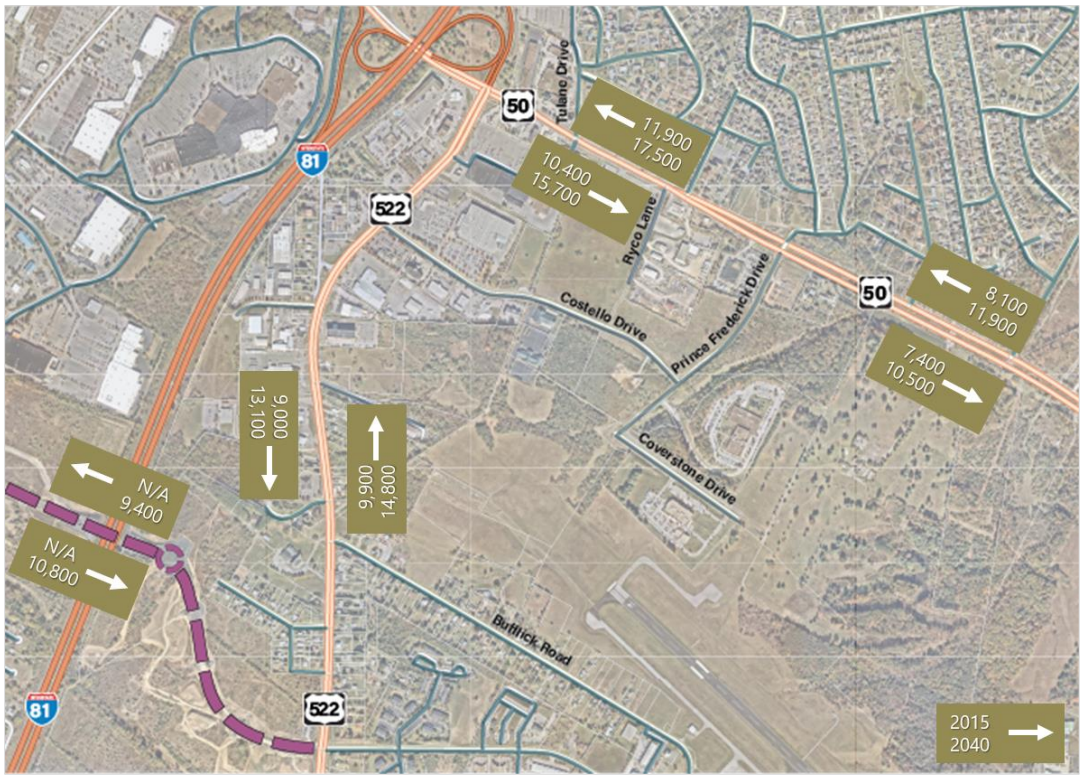


Figure 4 Rounded Model Volumes for Scenarios 2 and 3

The impacts of the potential turn restrictions at the existing US 522/US 50 intersection are substantial, however. As seen in Figure 5 the elimination of the northbound thru and left turns at this intersection doubles the volume on the eastbound direction of the realigned US 522. It also results in a substantial increase in westbound traffic on Crossover Boulevard. When fully cut off, as in Figure 6, a similar volume shift occurs to both directions of the new US 522 and Crossover Boulevard.

Figure 5 Rounded Model Volumes for Scenarios 3 and 4

Figure 6 Rounded Model Volumes for Scenarios 3 and 5

Tulane Drive Extension and Other Connections

It is important to note that the travel modeling focused on major roadways in the study area and did not attempt to estimate volumes on all of the segments in the study area. As noted above, the original model did not include any segments in the study area other than US 50 and US 522. While Prince Frederick Drive and Costello Drive were added, additional links could not be accurately modeled without substantial additional investment in evaluation, validation, and calibration of a revised model.

An extension of Tulane Drive to Costello Drive would be expected to draw traffic from Costello Drive for certain trips and could reduce volume on existing and future US 522 between US 50 and Costello Drive relative to a no-build condition. The extension would likely have minimal impact on volumes elsewhere along a realigned US 522. If Tulane Drive were extended to US 522, it could divert trips from a realigned US 522 as well.

Scenario Evaluation Conclusions

With turn restrictions, the travel model predicts volumes along the new US 522 that would exceed the typical capacity of a 2-lane facility. For example, the model showed volume to capacity ratios in Scenario 2 in excess of 0.5; directional volumes roughly double in Scenarios

4 and 5 indicating these volumes would exceed the capacity of a 2-lane facility. The total daily volumes for each scenario are summarized in the table below.

Scenario	Modeled US 522 Daily Volume
1. No-build	N/A
2. 2-Lane Connector	12,200
3. 4-Lane Connector	12,800
4. 4-Lane Connector with turn restriction at US 50 & Front Royal Pike	18,700
5. 4-Lane Connector with no connection between US 50 & Front Royal Pike	23,300

As part of the goal of the US 522 realignment is to reduce vehicle volume in the existing US 522/US 50 intersection, it is very likely that the future configuration will include some amount of turn restrictions. That is the daily volumes associated with Scenarios 4 and 5 most likely represent future demand along the roadway.

For these reasons the design team recommended a 4-lane cross-section as the basis of design. As future design progresses it is always possible to build the roadway in stages (only one carriageway) if updated travel forecasts show lower demand. The project team concurred with this recommendation.

Corridor Assessment

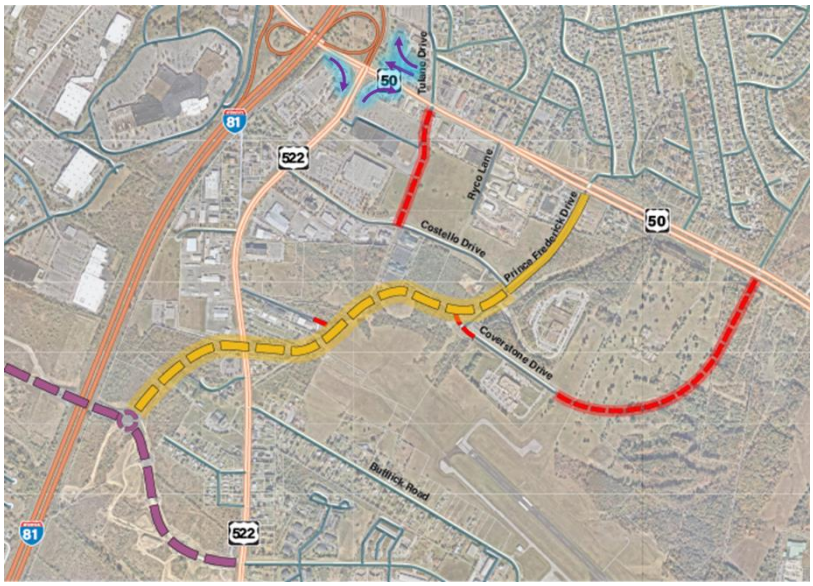
In addition to the travel modeling, the design team performed a planning level traffic analysis of the project to understand potential traffic operations concerns within and adjacent to the proposed roadway. As this was largely considered a due diligence effort, the design team was not tasked with operational evaluations. Rather, existing traffic studies were used to identify existing and likely future peak hour volumes and compare these to planning guidelines for operational capacity.

Assessment Assumptions

The One Logistics Park Winchester TIS had been recently completed and provided a comprehensive evaluation of existing and near-future volumes. The logistics park is planned for just east of Prince Frederick Drive along US 50. This document's build condition was used as the basis of existing 'no build' volumes. Specifically, the 2028 Total Traffic with Site (Figure 26A) volumes were used.

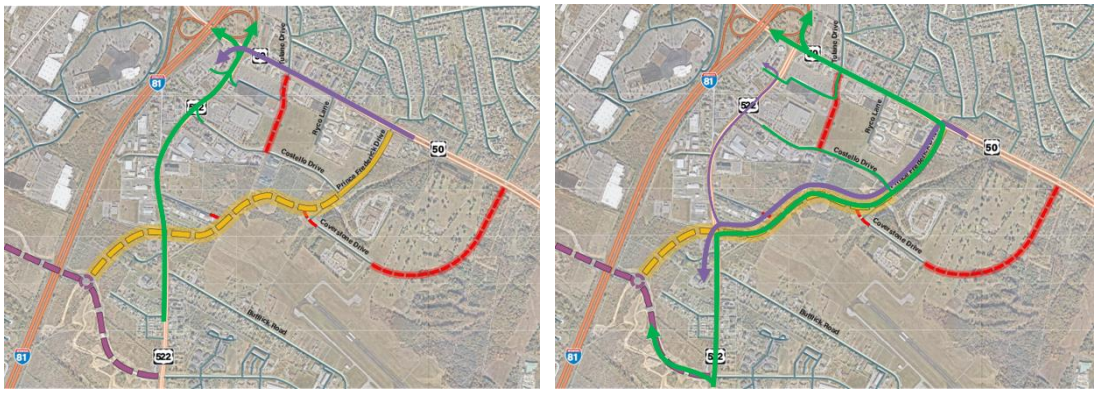
The US 522 realignment was assumed to be complete and in-place as was the completion of Crossover Boulevard for the additional analysis. Based on project team discussions, turn restrictions at the existing US 522/US 50 intersection were assumed to be the same as in Scenario 4, above. That is the northbound left and through movements are not allowed nor is the westbound left movement. This is summarized in Figure 7.

Figure 7 Roadway Network for Corridor Assessment



This results in shifts in travel patterns as summarized in Figure 8.

Figure 8 Existing Travel Patterns (l) and Assumed Future Travel Patterns (r)



Findings

VHB identified several key findings for the study area:

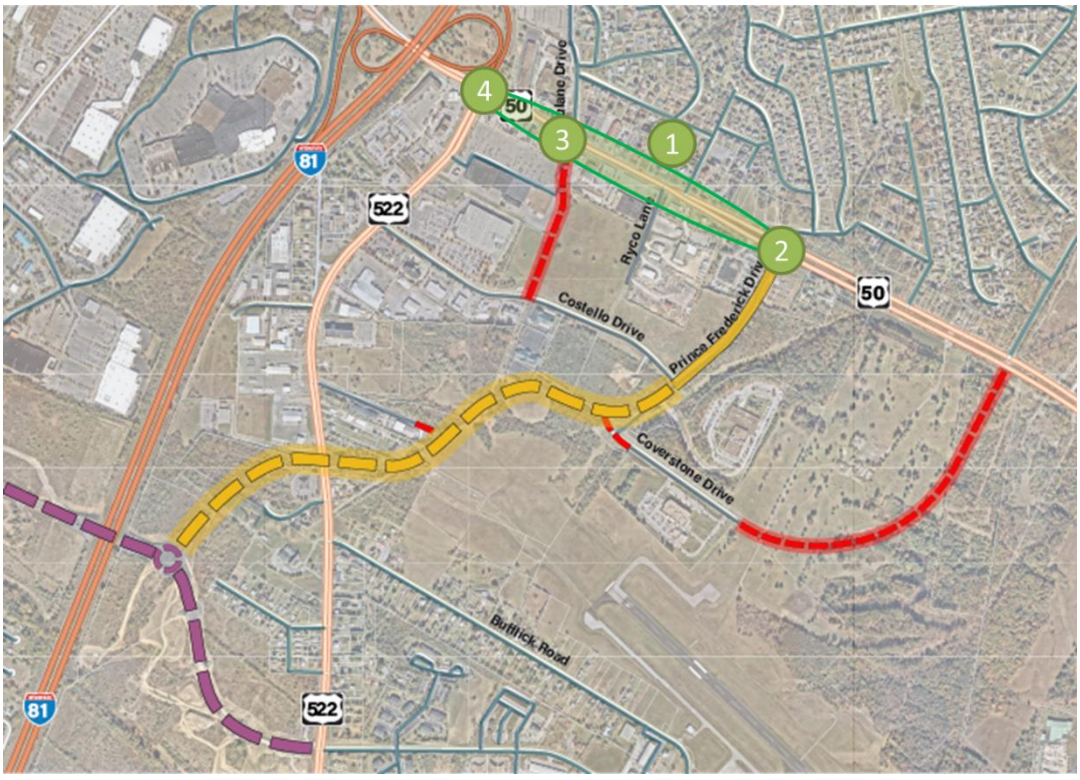
- The existing traffic flow on US 50/17 is directional within the study area. It is primarily eastbound in the morning and westbound in the evening.
- The US 522 realignment will impact vehicles traveling northbound on US 522 more than those traveling southbound
- As an outcome of these patterns, the turn restrictions and realignment will result in a large increase in traffic turning left on to US 50/17 westbound, particularly from the new US 522 (existing Prince Frederick Drive). An increase is also expected at the Tulane Drive extension/Delco Plaza.
- This left-turning traffic will result in 30 to 40 percent increases in westbound afternoon peak hour volumes on US 50. This also translates to an increase in the westbound approach volume at the US 50/I-81 ramps intersection.
- At the southern end of the new alignment, the northbound right turn volumes onto the new section and the southbound left turn volumes from the new alignment to existing US 522 south will be high. While much of the traffic is expected to continue across Front Royal Pike (existing US 522) to/from Crossover Boulevard, additional changes at the intersection to ease the northbound right/southbound left movement may be necessary as part of the final design.

Potential Additional Improvements

Based on this review and the planning-level operations analysis, the study team identified four additional possible needs beyond the US 522 new alignment. These are summarized in Figure 9.

1. Widen US 50 between the realigned US 522/Price Frederick Drive and the I-81 northbound ramps. While a specific capacity analysis was not completed, an additional lane, for a total of three, would be a mitigation alternative for each direction. It should be noted that traffic flows are directional by peak period, therefore six lanes of roadway capacity is unlikely to be needed at one time during the day.
2. Adjust signal timings and possibly add or extend left turn lane(s) of the northbound approach at the intersection of the new US 522 and US 50. There is a significant increase in volume at the Relocated US 522/US 50 intersection, particularly northbound left-turning traffic. A traffic study was not conducted to determine the appropriate control of the future intersection based on the volume projections. However, an initial VDOT Junction Screening Tool (VJuST) study was conducted as part of this effort and determined multiple intersection configurations (conventional, center turn overpass, continuous green T, etc) are likely able to accommodate the expected demand.
3. Adjust signal timings and possibly add or extend left turn lane(s) of the northbound approach at the intersection of the Delco Plaza/Tulane Drive intersection.
4. Add, extend, or make free-flowing the westbound right turn lane at the intersection of US 50 and the I-81 northbound ramps.

Figure 9 Potential Additional Improvements to Accommodate the US 522 Realignment



Concept Design

Following the scenario analysis and corridor assessment, the study team completed a concept design for the new alignment. This included the entire alignment from Crossover Boulevard to US 50/17. The design developed plan and profile as well as typical sections along the length of the corridor.

The design concept also included a connection from Costello Drive to US 50 along the eastern edge of Delco Plaza. The original planning concept developed in Phase 1 included a connection between the realigned US 522 and the intersection of US 50 and Tulane Drive. As the design team explored concepts and constructability further, it concluded that the connection between Costello Drive and realigned US 522 would be challenging and likely impact the fire station and/or community center. Additionally, the FAA, VDOA and OKV all expressed concern that this connection would require an intersection adjacent to the RPZ and could result in stopped vehicles within the RPZ. For these reasons, the design team and stakeholders concluded that the concept design should only include a connection between Costello Drive and the US 50/Tulane Drive intersection. The elimination of this connector eliminated the need and benefit of a Phase 1 proposal of an extension of Windy Hill Lane.

For the design effort, the design team developed two alternatives. The first minimizes impact to the community center but encroaches on a sliver of the RPZ. The second completely avoids impacting the RPZ but impacts the parking lot of the community center. The key areas of difference are shown below in Figure 10 and Figure 11. The full concept designs are included in the Appendix.

The two options were presented to the project committee as well as the Winchester Airport (OKV) board for comment. The preferred concept was identified as Alternative 1, as it minimizes the impact to the community center, subject to FAA concurrence.

Figure 10 Design Alternative 1 Inset

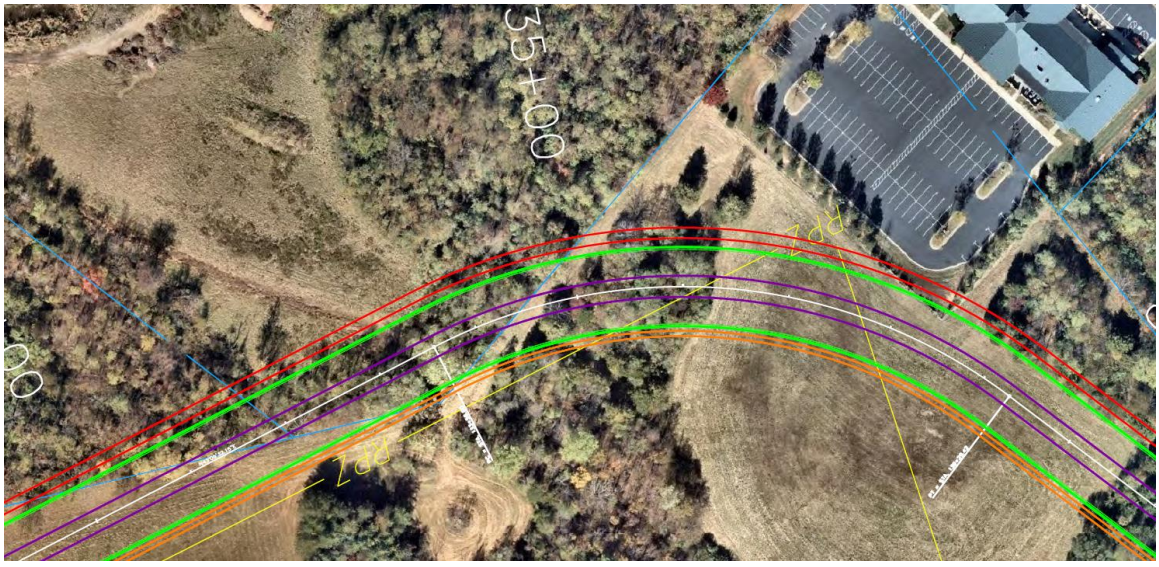


Figure 11 Design Alternative 2 Inset

RPZ Impact Report

Following the development of the concept designs, the design team prepared an RPZ Impact Report. The report analyzed the potential impacts to the RPZ of the proposed roadway. Its findings concluded that the impacts were minimal and acceptable.

The design team submitted the report to the FAA on behalf of the County and airport. The FAA reviewed the report and on August 3, 2022, issued a concurrence letter that found the process and preferred alternative (Alternative 1) acceptable. The letter is included in the Appendix.

The concurrence is not a formal approval. The letter notes several steps are required prior to VDOT moving forward the elements of the project that impact airport property:

- The final design must work to minimize the exposure of people traversing the RPZ by eliminating driveways and intersections that may introduce vehicle queuing in the RPZ. While none are proposed the FAA understands the evaluated design is a concept and will evolve; maintaining this element will be critical to future approvals. [This is a reference to elimination of the Tulane Drive extension between Costello Drive and the new alignment.]
- The Winchester Regional Airport must submit an update to the Airport Layout Plan (ALP)

requesting FAA approval of the change.

- Subsequent design efforts must coordinate the National Environmental Policy Act (NEPA) requirements with the FAA.
- The airport must submit a request to the FAA to release dedicated airport property from federal obligations. If any of this property was purchased using federal funds those funds may need to be reimbursed.

Cost Estimate and Phasing

Following FAA concurrence, the study team developed an initial cost estimate for the project. The cost estimate was reviewed with the project team. As part of the costing exercise, the design team reviewed the project for potential phasing and independent utility.

Phasing

Given the planned roadway and current development patterns, two primary phases were identified as having independent utility ready ability to construct independently. The two segments could be constructed in any order, with Segment 1 largely dependent upon potential development of the adjacent parcels by those landowners.

- Segment 1: The connector roadway from Crossover Boulevard to US 522 and the realigned roadway.
- Segment 2: The realigned US 522 from current US 522 to US 50/17 at the intersection of Prince Frederick Drive

Separately, a connector from Costello Drive to the intersection of US 50/17 and Tulane Drive, along the east edge of Delco Plaza was identified as a standalone project. This connector was identified as part of the Phase 1 project as playing an important role in the future development of the parcels in the area.

Cost Estimate

This estimate was developed using estimated construction item quantities. These quantities were derived from a combination of conceptual level sketches and corridor models created using existing contour layers obtained from Frederick County Geographic Information System (GIS) data. Assumptions were made based on the project length and area to obtain quantities and costs for items such as drainage structures, roadway lighting, landscaping, and stormwater management. The prices used for this estimate were derived using Virginia Department of Transportation (VDOT) Two Year Historical Bid Price Listing and focused on bids received on projects in the first quarter of 2022.

The estimated right-of-way (ROW) costs were developed using land values based on Frederick County Tax Maps and includes costs for damages to private property, demolition costs, and administrative costs for property acquisitions. ROW costs were informed by additional input from VDOT. All acquisitions of Winchester Regional Airport (OKV) property

were assumed to not leave any remnant parcels outside of the necessary land area needed to construct the new roadway and associated facilities, therefore, all OKV acquisitions were estimated based on acquiring all property out to the existing property line.

No costs for subsurface utility relocations were included in this estimate due to a lack of data. Cost associated with identifiable above ground utility impacts were included as part of this estimate.

Preliminary Engineering (PE) costs were assumed to be 30% of construction costs for segments 1 and 2. This relatively high percentage was used due to assumed above average effort needed to acquire NEPA Document approval.

Contingencies of 50% were applied to both the construction and ROW phases to account for unknown construction and ROW items and costs as well as required construction contingencies.

Total costs were identified as follows in current year dollars:

- Segment 1 – Crossover Boulevard to US 522: $16.2MM
- Segment 2 – US 522 to US 50/17: $55.2MM
- Segment 3 – Costello Drive to US 50/Tulane Drive: $9.3MM

Inflation was assumed to average 3.5% per year. Inflated to a future year of 2035, costs would be as follows:

- Segment 1 – Crossover Boulevard to US 522: $25.3MM
- Segment 2 – US 522 to US 50/17: $86.3MM
- Segment 3 – Costello Drive to US 50/Tulane Drive: $14.6MM

In addition to the new alignment, two other items were identified as part of the study process. The US Army Corps of Engineers maintains a facility currently accessed off of Prince Frederick Drive. Given the likely access management requirements for the new US 522, in order to maintain full access to this driveway, it would be necessary to relocate it to connect either opposite Costello Drive or as a driveway connecting to Coverstone Drive. It was outside the study scope to provide outreach to the facility and work through a future preferred design direction as this is a military facility and realigning the driveway will require extensive coordination with the facility. Rather, in the total project cost an additional $750,000 was set aside as potential construction costs for this connection.

Additionally, while this study did not include detailed analysis of the potential future needs along US 50, it did identify that widening may be required between the Front Royal Pike and Prince Frederick Drive intersections. While the nature of such improvements will depend on other projects, VHB has included an allowance of $17M in the total project cost. This cost is for adding one lane in each direction for the roughly 3,000 feet, guardrail replacement, stormwater management, and replacement of signal equipment at three intersections. Utility and right-of-way costs are not included though a future design could minimize these costs as most of this segment already has right turn lanes in both directions.

Combined, all three segments plus the allowances would require $98.4MM in 2022 dollars or $154MM in 2035 dollars when escalated for inflation.

Next Steps

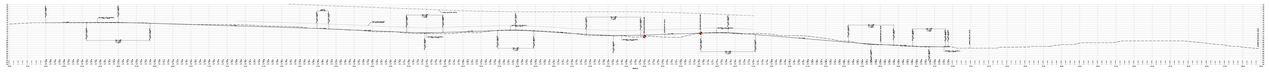
The key next steps were identified in the FAA letter. First, the plan must be codified in the Winchester Regional Airport's ALP. Following codification in the ALP, project development and subsequent design may advance as funding is identified. The updated alignment must also be documented in the Frederick County Comprehensive Plan. The project development process will be required to comply with federal NEPA requirements and prepare appropriate documentation.

Appendix

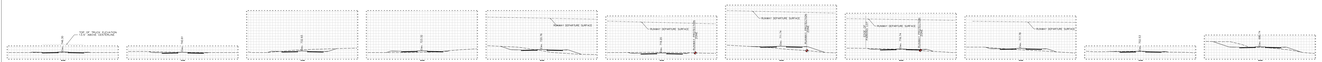
- Design Concepts
- RPZ and Part 77 Analysis Memo
- FAA Response Letter
- Planning Level Cost Estimates

ROUTE 522 (FRONT ROYAL PIKE)
REALIGNMENT ALTERNATIVE 1

ROUTE 522 (FRONT ROYAL PIKE)
REALIGNMENT
TYPICAL SECTION



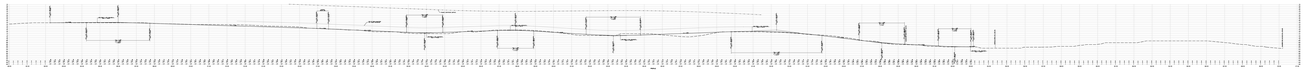
ROUTE 522 (FRONT ROYAL PIKE)
REALIGNMENT ALTERNATIVE 1
PROFILE



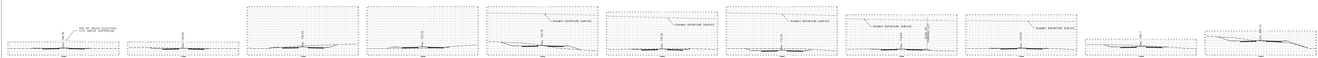
ROUTE 522 (FRONT ROYAL PIKE)
REALIGNMENT ALTERNATIVE 1
CROSS SECTION

ROUTE 522 (FRONT ROYAL PIKE)
REALIGNMENT ALTERNATIVE 2

ROUTE 522 (FRONT ROYAL PIKE)
REALIGNMENT
TYPICAL SECTION



ROUTE 522 (FRONT ROYAL PIKE)
REALIGNMENT ALTERNATIVE 2
PROFILE



ROUTE 522 (FRONT ROYAL PIKE)
REALIGNMENT ALTERNATIVE 2
CROSS SECTION

Memorandum

To: Federal Aviation Administration

Date: June 14, 2022

Project #: 39147.00

From: Nat Grier, VHB
Sierra LePore, VHB

Re: US 522 Realignment – RPZ & Part 77 Analysis

The purpose of this analysis is to assess the potential impacts of the US 522 realignment project as it relates to the Runway Protection Zone (RPZ) and 14 CFR Part 77 airspace surfaces at Winchester Regional Airport (OKV).

Runway Protection Zone

The Runway Protection Zone (RPZ) is defined by the FAA as "an area at ground level prior to the threshold or beyond the runway end to enhance the safety and protection of people and property on the ground."[1] The Central Portion of the RPZ (primarily the approach RPZ) is the portion that typically "governs property interests and clearing requirements" that which the airport owner should undertake. On September 2012, the FAA issued *Interim Guidance on Land Uses Within a Runway Protection Zone*. The document provides guidance to the FAA and Airport Sponsors when changes are made that could affect an airport's RPZ, including the following land uses shown in **Table 1** below:

Table 1: Land Uses Requiring Coordination with APP-400

Table 1: Land Uses Requiring Coordination with APP-400

• Buildings and structures (Examples include, but are not limited to: residences, schools, churches, hospitals or other medical care facilities, commercial/industrial buildings, etc.)
• Recreational land use (Examples include, but are not limited to: golf courses, sports fields, amusement parks, other places of public assembly, etc.)
• Transportation facilities. Examples include, but are not limited to:
  ○ Rail facilities – light or heavy, passenger or freight
  ○ Public roads/highways
  ○ Vehicular parking facilities
• Fuel storage facilities (above and below ground)
• Hazardous material storage (above and below ground)
• Wastewater treatment facilities
• Above-ground utility infrastructure (i.e. electrical substations), including any type of solar panel installations.

Source: FAA Interim Guidance on Land Uses Within a Runway Protection Zone, September 27, 2012. Page 2.

The Interim Guidance also states that the FAA Regional Office and Airport District Office must work with the Airport Sponsor to "identify and document a range of alternatives that could":

- Avoid introducing the land use issue within the RPZ
- Minimize the impact of the land use in the RPZ (i.e., routing a new roadway through the controlled activity area, move farther away from the runway end, etc.)

[1] https://www.faa.gov/documentLibrary/media/Advisory_Circular/150-5300-13B-Airport-Design.pdf

- Mitigate risk to people and property on the ground (i.e. tunneling, depressing and/or protecting a roadway through the RPZ, implement operational measures to mitigate any risks, etc.)."[2]

In addition, when airport owners or sponsors, planning agencies, or other organizations accept funds from FAA-administered airport financial assistance programs, they must agree to certain obligations (or assurances). These obligations require the recipients to maintain and operate their facilities safely and efficiently and in accordance with specified conditions. The assurances may be attached to the application or the grant for Federal assistance and become part of the final grant offer or in restrictive covenants to property deeds. In terms of grant obligations related to RPZ control, this is covered under Grant Assurance[3] 21, where the airport sponsor is federally obligated to:

"take appropriate action, to the extent reasonable, including the adoption of zoning laws, to restrict the use of land adjacent to or in the immediate vicinity of the airport to activities and purposes compatible with normal airport operations, including landing and takeoff of aircraft."[4]

Additionally, the FAA Central Region Airports Division developed an AIP Sponsor Guide for Airport Sponsors, which includes Section 550- Runway Protection Zones.[5] It states that the airport "must own the landing area, …have sufficient interest in the Runway Protection Zones to protect the Runway Protection zones from both obstructions and incompatible land use" and "…must strive to attain compatible zoning around the airport in order to prevent incompatible land uses that:

- Could cause sufficient conflict that endangers the airport
- Cause it to be closed or
- Require substantial remedial investment to purchase conflicting developed property."[6]

The sponsor may attain the land within the RPZ via three methods:

1. Purchase the approach areas in fee allowing the airport full control of the land
2. Purchase an easement (or combination of easement and zoning)
3. Rely upon sufficient zoning[7]

[2] FAA Interim Guidance on Land Uses Within a Runway Protection Zone, September 27, 2012. Page 2-3.

[3] *Grant Assurances* are obligations in which if an Airport Sponsor receives funds from FAA-administered airport financial assistance programs, the Airport Sponsor must "maintain and operate their facilities safely and efficiently and in accordance with specified conditions." Applicability of grant assurances depends on the type of funding received by FAA. Airport Sponsors must comply with the conditions specified in the grant assurance. (Federal Aviation Administration – Grant Assurances-Obligations-Airports. Accessed June 5, 2021. https://www.faa.gov/airports/aip/grant_assurances/

[4] FAA Airports, Assurances Airport Sponsors, 21, Page 9. February 2020. https://www.faa.gov/airports/aip/grant_assurances/media/airport-sponsor-assurances-aip-2020.pdf

[5] FAA Central Region Airports Division, AIP Sponsor Handbook, 550-Runway Protection Zones, Page 500-14. September 1, 2020. https://www.faa.gov/airports/central/aip/sponsor_guide/media/0500.pdf

[6] Ibid.

[7] Ibid.

Compatible land use is defined within FAA Order 5190.6B FAA Airport Compliance Manual, as land that "neither adversely affects flight operations from the airport nor is itself adversely affected by such flight operations".[8] To the extent any "compatible land uses" are located within an RPZ, they could be considered incompatible. The FAA Order states, in part, as follows:

"incompatible land uses can include wastewater ponds, municipal flood control channels and drainage basins, sanitary landfills, solid waste transfer stations, electrical power substations, water storage tanks, golf courses, and other bird attractants. other incompatible uses would be towers or buildings that penetrate part 77 surfaces or are located within a runway protection zone (rpz), runway object free area (rofa), object free zone (ofz), clearway or stopway."[9]

In a FAA document titled "Land Use Compatibility and Airports," airports may designate Airport Impact Zones when noise exposure contours are not available. Airport Impact Zones are defined as "areas on and off airport property that are zoned to ensure airport compatible land uses. Low activity airports without significant aircraft noise exposure contours can benefit by identifying and implementing land use controls in Airport Impact Zones.[10] The Airport Impact Zone dimensions are based on aircraft incident investigation data provided by the National Transportation Safety and Research Board (NTSB) and are adjusted based on specific airport conditions. The following are typical Airport Impact Zones:

- **Airport Impact Zone 1 – Runway Protection Zone**
- Airport Impact Zone 2 – Inner Safety Zone
- Airport Impact Zone 3 – Inner Turning Zone (60-degree sector)
- Airport Impact Zone 4 – Outer Safety Zone
- Airport Impact Zone 5 – Sideline Safety Zone
- Airport Impact Zone 6 – Traffic Pattern Zone

In the case of OKV, if *Airport Impact Zone 1 – Runway Protection Zone* was implemented, the FAA would prohibit residential development within the area, but allow low-density (***less than five people per acre***) industrial development.[11]

[8] FAA Order 5190.6B FAA Airport Compliance Manual, Chapter 20. Compatible Land Use and Airspace Protection, *20.2 Zoning and Land* Use Planning, e. Definition of Compatible Land Use, Page 20-5. September 30, 2009.
https://www.faa.gov/airports/resources/publications/orders/compliance_5190_6/media/5190_6b_chap20.pdf

[9] FAA Order 5190.6B, Chapter 21, 21.6, Land Use Inspection Guidance, f. Problem Areas, (6) Incompatible Land Uses, Page 21-9. September 30, 2009.
https://www.faa.gov/airports/resources/publications/orders/compliance_5190_6/media/5190_6b_chap21.pdf

[10] Land Use Compatibility and Airports, *Airport Impact Zones.* Glossary-Page 1.
https://www.faa.gov/about/office_org/headquarters_offices/apl/noise_emissions/planning_toolkit/media/iii.b.pdf

[11] Land Use Compatibility and Airports, *Land Use Controls at General Aviation Airports.* Page V-38.
https://www.faa.gov/about/office_org/headquarters_offices/apl/noise_emissions/planning_toolkit/media/iii.b.pdf

Proposed Project Impacts to RPZ

The Project Team evaluated two alternatives for the realignment. Alternative 1 (the Preferred Alternative; see **Attachment 1 and 2**) and Alternative 2 (see **Attachment 3**).

Two alternatives were evaluated to provide adequate traffic flow, avoid impacts to existing land use, and consider impacts to OKV. As shown in **Table 1** below, Alternative 1 (Preferred Alternative) impedes on OKV's Runway 14 Approach RPZ by 0.39 acres and avoids impacts to the OKV Runway 14 Departure RPZ and the Millwood Station Volunteer Fire Department. Alternative 2 does not impact neither the Approach nor the Departure RPZ, however it would require condemnation of approximately half of the parking at the fire station and community center. Such elimination would greatly reduce the usability of the community center, possibly requiring abandonment, as there is no ability to add parking to the site and the adjacent parcels are anticipated to be developed in the near future, leaving no ability to replace the parking. Alternative 2 also requires a greater use of private property and, given the rate of current development in the area, this land may not be available by the time funds are available to construct the project.

Table 1 – US 522 Realignment Alternative Impacts

Acres Impacted	**Alternative 1 (Preferred Alternative)**	**Alternative 2**
Millwood Station Volunteer Fire Department & Banquet Hall Parking	None	1.1 acres
OKV Runway Protection Zone	0.39 acres	None

In designing the roadway, the planning team has carefully considered intersection and driveway locations. An early alternative considered an access road along the west edge of the fire station, but this was rejected given the possibility of vehicles queuing within the RPZ. As envisioned, the facility would be access-managed with no driveway to the fire station. As most if not all of the parcels in the vicinity of the RPZ are anticipated to be developed prior to the construction of the roadway, few, if any, driveways are anticipated between existing US 522 and Costello Drive.

It is the Project Team's understanding that much of the project will be built within the airport property, including incursion into the RPZ, and that the airport is fully supportive of the project. The Project Team understands the potential project's location is within the RPZ and is inherent to the associated airport obligations and risks listed above. Based solely on fact-finding, interpretation of existing federal and local guidelines, and existing conditions, the proposed project site may be deemed acceptable for the following reasons described above; however, as an RPZ and its associated surfaces exist to protect people and property on the ground, the Project Team recommends caution in terms of impacts to overall safety of any people (vehicles) that may be travelling through proposed project site. Subsequent liabilities and insurance should be considered for such development, as well as disapproval from the FAA on record.

As the Proposed Project impacts a minimal area of the RPZ, the Project Team believes the project to be acceptable to FAA investigation with a likely positive outcome and minimal impact OKV's RPZ.

Airspace Analysis

Federal Aviation Regulation (FAR) Part 77 established by the FAA defines an obstruction to navigable airspace in the vicinity of airports. The FAA uses the concept of "imaginary surfaces" to define volumes of airspace that are around an airport that are not visible. The purpose of imaginary surfaces is to identify objects (natural or man-made) that could potentially affect aircraft operations at an airport. Imaginary surfaces are layered over an airport and its associated runway(s), and an object that penetrates these surfaces may be identified as a potential obstruction and could present a potential hazard to air navigation as determined by the FAA.

Not all objects that exceed an obstruction height are considered hazards to air navigation. The FAA conducts aeronautical studies for proposed development projects that are planned to occur within the vicinity of public airports. As part of this aeronautical study, the FAA examines the effects the proposed development may have on factors such as aircraft operational capabilities, navigational aids, and procedural requirements to determine the impact the proposed development could have on navigable airspace. If the study shows that the proposed development, when evaluated against these standards, poses no adverse effect upon the safe and efficient use of navigable airspace, then the development is not considered to be a hazard to air navigation.

FAR Part 77 Non-Precision Approach Surface: The FAR Part 77 runway approach surface for Runway 14 at OKV is identified as a non-precision approach. The non-precision approach begins 200 feet from the runway end (i.e. the paved surface of the runway), and extends for a total length of 10,000 feet. The surface is trapezoidal-shaped, with an inner width of 500 feet and an outer width of 3,500 feet. The approach surface slope is 34:1 (rises one foot vertically for each 34 feet horizontally).

Instrument Departure Surface (40:1): Runway 32 at OKV has an instrument departure surface. The departure surface begins at the usable end of the runway (i.e. the paved surface of the runway), and extends for a total length of approximately 12,152 feet. The surface is trapezoidal-shaped, with an inner width of 1,000 feet and an outer width of 7,512 feet. The departure surface slopes at 40:1 (rises one foot vertically for each 40 feet horizontally).

Project Impacts to Airspace

VHB reviewed the elevations of the Part 77 Approach and Departure surfaces along the Alternative 1 (Preferred Alternative) realignment corridor. A total of 5 locations were selected within Part 77 Approach Surface and Departure Surface (see **Attachment 4**). Alternative 1 (Preferred Alternative) does not impact the non-precision approach nor departure surface for Runway 14 at OKV. It is recommended per FAA guidance to maintain a minimum of 20-feet between the roadway grade and the Part 77 surfaces. If light poles are installed along the roadway, the airspace elevations at each of the identified locations are shown in **Table 2** below. Although it is important to stay below these elevations, analysis by the FAA by filing an FAA 7460-1, *Notice of Proposed Construction/Alteration* would be required to determine actual impacts to radar, airspace and other operational impacts.

VHB determined that a standard light pole height of approximately 15-feet would not exceed the Runway 14/32 surfaces for the FAR Part 77 Approach Surface (50:1) nor the Instrument Departure Surface (40:1).

Conclusions

After review of Alternative 1 and Alternative 2, **Table 3** below provides a summary of impacts of Alternative 1 (Preferred Alternative) and Alternative 2.

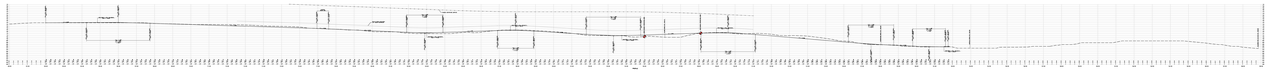
Table 3 – Summary of Impacts

Alternative	Impact to Runway 14 Runway Protection Zone	Impact to Millwood Station Volunteer Fire Department	Impact to Approach or Departure Surface for Runway 14/32
Alternative 1 (Preferred Alternative)	Yes (0.39 acres)	No	No
Alternative 2	No	Yes (1.1 acres)	No

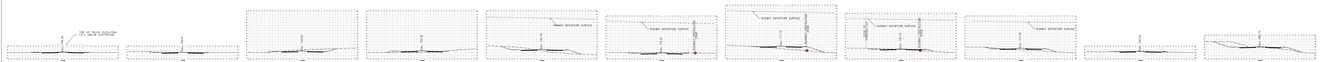
VHB recommends review and approval by FAA and OKV on all Part 77 and RPZ matters prior to moving forward with further design, permitting, and construction.

ROUTE 522 (FRONT ROYAL PIKE)
REALIGNMENT ALTERNATIVE 1

ROUTE 522 (FRONT ROYAL PIKE)
REALIGNMENT
TYPICAL SECTION



ROUTE 522 (FRONT ROYAL PIKE)
REALIGNMENT ALTERNATIVE 1
PROFILE



ROUTE 522 (FRONT ROYAL PIKE)
REALIGNMENT ALTERNATIVE 1
CROSS SECTION

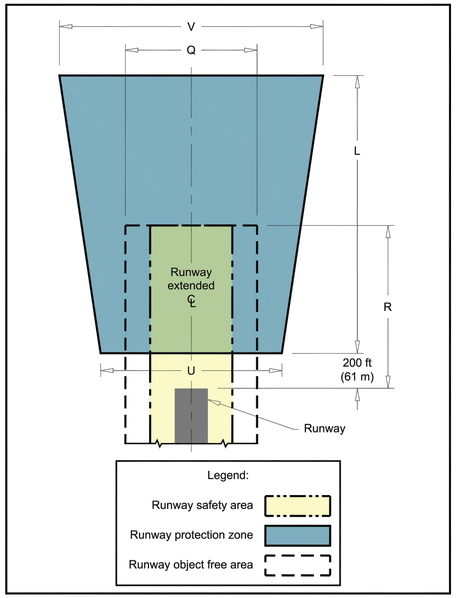


Table G-9. Runway Design Standards Matrix, C/D/E-III

Aircraft Approach Category (AAC) and Airplane Design Group (ADG):		C/D/E – III			
ITEM	DIM [1]	VISIBILITY MINIMUMS			
		Visual	Not Lower than 1 mile	Not Lower than 3/4 mile	Lower than 3/4 mile
RUNWAY DESIGN					
Runway Length	A	*Refer to paragraphs* 3.3 *and* 3.7.1			
Runway Width [12]	B	100 ft	100 ft	100 ft	100 ft
Shoulder Width [12]		20 ft	20 ft	20 ft	20 ft
Blast Pad Width [12]		140 ft	140 ft	140 ft	140 ft
Blast Pad Length		200 ft	200 ft	200 ft	200 ft
Crosswind Component		16 knots	16 knots	16 knots	16 knots
RUNWAY PROTECTION					
Runway Safety Area (RSA)					
Length beyond departure end [9, 10]	R	1,000 ft	1,000 ft	1,000 ft	1,000 ft
Length prior to threshold [11]	P	600 ft	600 ft	600 ft	600 ft
Width	C	500 ft	500 ft	500 ft	500 ft
Runway Object Free Area (ROFA)					
Length beyond runway end	R	1,000 ft	1,000 ft	1,000 ft	1,000 ft
Length prior to threshold [11]	P	600 ft	600 ft	600 ft	600 ft
Width	Q	800 ft	800 ft	800 ft	800 ft
Obstacle Free Zone (OFZ)					
Runway, Inner-approach, Inner-Transitional		*Refer to paragraph* 3.11			
Precision Obstacle Free Zone (POFZ)					
Length		N/A	N/A	N/A	200 ft
Width		N/A	N/A	N/A	800 ft
Approach Runway Protection Zone (RPZ)					
Length	L	1,700 ft	1,700 ft	1,700 ft	2,500 ft
Inner Width	U	500 ft	500 ft	1,000 ft	1,000 ft
Outer Width	V	1,010 ft	1,010 ft	1,510 ft	1,750 ft
Departure Runway Protection Zone (RPZ)					
Length	L	1,700 ft	1,700 ft	1,700 ft	1,700 ft
Inner Width	U	500 ft	500 ft	500 ft	500 ft
Outer Width	V	1,010 ft	1,010 ft	1,010 ft	1,010 ft
RUNWAY SEPARATION					
Runway centerline to:					
Parallel runway centerline	H	*Refer to paragraph* 3.9			
Holding Position [8]		250 ft	250 ft	250 ft	250 ft
Parallel taxiway/taxilane centerline [2]	D	400 ft	400 ft	400 ft	400 ft
Aircraft parking area	G	*Refer to paragraph* 5.4.1.2			
Helicopter touchdown pad		*Refer to* AC 150/5390-2			

Note: Values in the table are rounded to the nearest foot. 1 foot = 0.305 meters.

Note: See the Footnotes on the page after Table G-12.

NOTES:
1. RPZ DIMENSIONS RETRIEVED FROM FAA ADVISORY CIRCULAR 150/1300-13B (MARCH 31, 2022).
2. RUNWAY 14 DESIGN CRITERIA: AIRCRAFT APPROACH CATEGORY - D, AIRPLANE DESIGN GROUP - III.

0 200 400 800 Feet

vhb.com
vhb
1775 Greenboro Station Place, Suite 200
Tysons, VA 22102
703.847.3071

No.	Revision	Date	Appvd.
0	FOR DISCUSSION PURPOSES	04/22/2022	

Designed by

Checked by SLEPORE

FOR DISCUSSION PURPOSES ONLY

US 522 REALIGNMENT PLANNING STUDY
CONCEPT PLAN
WITH RPZ SURFACES

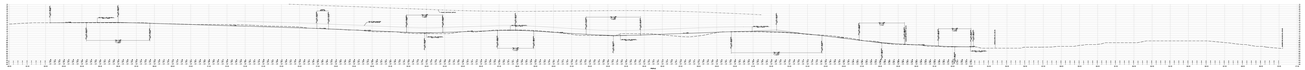
Drawing Number (N/A)

1 Sheet (N/A) 2 of (N/A)

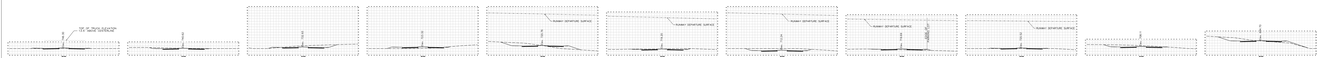
39147.00
Project Number

ROUTE 522 (FRONT ROYAL PIKE)
REALIGNMENT ALTERNATIVE 2

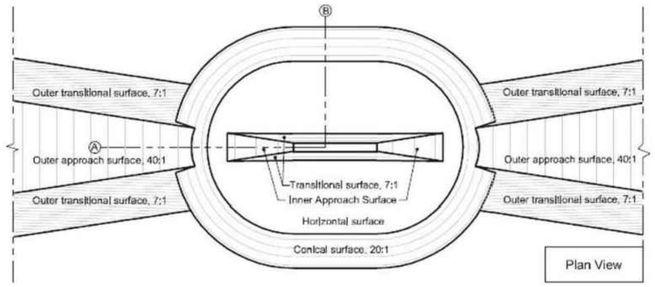
ROUTE 522 (FRONT ROYAL PIKE)
REALIGNMENT
TYPICAL SECTION

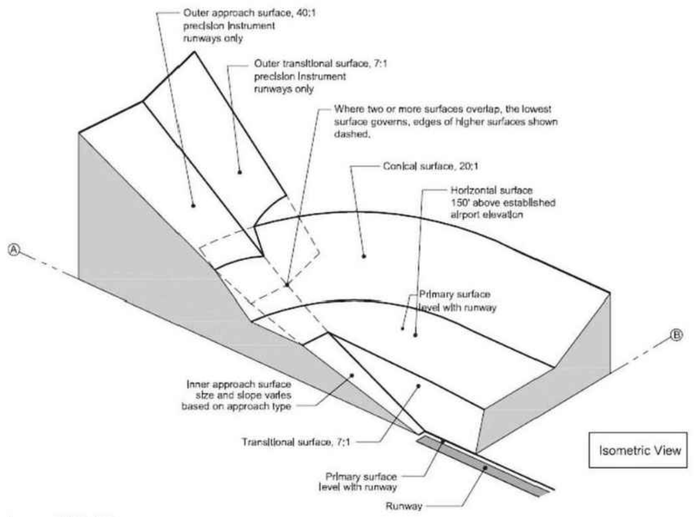


ROUTE 522 (FRONT ROYAL PIKE)
REALIGNMENT ALTERNATIVE 2
PROFILE



ROUTE 522 (FRONT ROYAL PIKE)
REALIGNMENT ALTERNATIVE 2
CROSS SECTION





AIRSPACE ANALYSIS NOTES:

1. AIRPORT GEOMETRY RETRIEVED FROM HTTPS://WWW.AIRNAV.COM/AIRPORT/KOKV:
   1.1. AIRPORT REFERENCE POINT ELEVATION =726.2 FEET
   1.2. RUNWAY 14 ELEVATION = 726.2 FEET
   1.3. RUNWAY 32 ELEVATION = 700.8 FEET

2. DIMENSIONS OF PART 77 IMAGINARY SURFACES ARE BASED ON FORMULAS CONTAINED IN 14 C.F.R. § 77.19.
   2.1. PRIMARY SURFACE - 1,000 FOOT WIDTH , 200 FEET BEYOND RUNWAY END.
   2.2. TRANSITIONAL SURFACE - SLOPE 7:1 GOING UPWARD AND OUTWARD FROM THE SIDE OF THE PRIMARY SURFACE AND INTERSECTING WITH APPROACH SURFACE
   2.3. APPROACH SURFACE RUNWAY 14 - SLOPE 34:1 FOR 10,000 FEET

3. TERPS 40:1 DEPARTURE SURFACE CHECKED. PART 77 SURFACES ARE MORE CONSTRAINING AT THE BUILDING LOCATION.

4. PART 77 REFERENCE IMAGE FROM *ACRP REPORT 38: UNDERSTANDING AIRSPACE, OBJECTS, AND THEIR EFFECTS ON AIRPORTS* (PAGE 15).

5. BASEMAP IMAGE RETRIEVED FROM MICROSOFT CORP 2022.

0 200 400 800 Feet

vhb.com

No.	Revision	Date	Appvd.
0	FOR DISCUSSION PURPOSES	04/22/2022	

Designed by

Checked by S.LEPORE

FOR DISCUSSION PURPOSES ONLY

US 522 REALIGNMENT PLANNING STUDY
CONCEPT PLAN
WITH PART 77 SURFACES

Drawing Number (N/A)

2 Sheet (N/A) 2 of (N/A)

39147.00
Project Number

U. S. Department
of Transportation

**Federal Aviation
Administration**

WASHINGTON AIRPORTS DISTRICT OFFICE
13873 Park Center Road, Suite 490 S
Herndon, Virginia 20171
Telephone: 703/487-3980
Fax: 703/487-3982

August 3, 2022

VIA EMAIL to okvsabo@comcast.net

Mr. Nicholas Sabo, A.A.E.
Executive Director
Winchester Regional Airport Authority
491 Airport Road
Winchester, Virginia 22602

Re: Runway 14 Protection Zone (RPZ) Analysis
VDOT US Route 522 Realignment
Winchester Regional Airport

Dear Mr. Sabo:

Our office received the June 14, 2022 Runway Protection Zone (RPZ) & Part 77 Analysis prepared by Vanasse Hangen Brustlin, Inc. (VHB). The analysis supports the Virginia Department of Transportation's (VDOT) planned improvements to the realign US Route 522 through the north end of Winchester Regional Airport's (OKV) property, including the Runway 14 RPZ.

The analysis included an evaluation of two alternatives with one alignment through the Runway 14 RPZ and the other alignment around the RPZ. We concur that the Authority performed a sufficient level of analysis to establish the preferred Alternative One in accordance with the Federal Aviation Administration's (FAA) Interim Guidance on Land Uses Within a Runway Protection Zone. The FAA's concurrence is based on the understanding VDOT will work to minimize the exposure of people traversing the RPZ by eliminating driveways and intersections that may introduce vehicle queuing in the RPZ.

The FAA's concurrence is not a formal approval of the proposed project. The Authority must complete the following actions prior to VDOT moving forward with the elements of the project that impact Winchester Regional Airport property:

- Submit an update to the Airport Layout Plan (ALP) requesting FAA approval;
- Coordinate the National Environmental Policy Act (NEPA) requirements with Ms. Susan Stafford, FAA Environmental Protection Specialist (Susan.Stafford@FAA.Gov, 304.252.6216 x130);
- Submit a request to FAA to release dedicated airport property from federal obligations. The request must include the content referenced in Paragraph 22.24 of FAA Order 5190.6B *Airport Compliance Manual.*

Should you have any questions concerning this matter please do not hesitate to contact me.

Sincerely,

Chad Carper, Engineer
Washington Airports District Office

cc: Ms. Susan Stafford, FAA (via email)
Mr. Scott Denny, DOAV (via email)
Mr. Nat Grier, VHB (via email)

Computations

Project:	US Rt. 522 Realignment	**Project #**	39147.00
Location:	Front Royal Pike, Winchester, VA	**Sheet:**	1 of 4
Calculated by:	CRB	**Date:**	4/20/2023
Checked by:	BEM	**Date:**	4/21/2023
Title:	Planning Level Cost Estimates		

US Route 522 (Front Royal Pike) Realignment
Build new 4 lane divided roadway with adjacent 10' shared use path and 5' sidewalk.
From Crossover Blvd to existing Route 522

Assumptions:

- 12' lanes with concrete curb and gutter
- 20' grassed median
- 35 MPH design speed
- New roadway pavement section for Rte. 522 is 1.5" of SM-9.5, 6" of BM-25.0, 9" of Agg base 25A or B
- Shared Use Path (10' path, 2' shoulders), crossing required, leaving the intersection on south side
- Shared Use Path pavement section is 2" of asphalt on 6" Agg base 25A or B
- Sidewalk is to be 4" of concrete on 4" of agg base 25A or B
- Subsurface utitlities have not been included witht this estimate
- 474 Front Royal Pike will be a full take and require building demolition
- 461 Front Royal Pike will be a full acquisition
- BMP size is based on 20% of total land disturbance
- This estimate does not include any work along existing Route 522

CONSTRUCTION ITEMS	UNIT	AREA (SF)	LENGTH (SF)	WIDTH (SF)	DEPTH (SF)	FACTOR	% OCCURING	QUANTITY	UNIT COST	TOTAL
SEGMENT 1 (BYPASS ROAD TO EXISTING 522)										
ROADWAY									**SUBTOTAL:**	**$ 1,169,929.03**
ASPHALT PAVEMENT - 7.5" (Roadway)	TONS	92,700.00	-	-	0.63	0.07407		4,292	$ 100.00	$ 429,167
AGGREGATE BASE - 9" (Roadway and curb and gutter)	TONS	104,900.00	-	-	0.75	0.07407		5,828	$ 35.00	$ 203,972
ASPHALT PAVEMENT - 2" (SUP)	TONS	17,200.00	-	-	0.17	0.07407		212	$ 100.00	$ 21,235
AGGREGATE BASE - 6" (SUP)	TONS	17,200.00	-	-	0.50	0.07407		637	$ 35.00	$ 22,296
HYDR. CEMENT CONC. SIDEWALK 4"	CY	8,300.00	-	-	0.33	0.03704		102	$ 125.00	$ 12,796
AGGREGATE BASE - 4" (Sidewalk)	TONS	8,300.00	-	-	0.33	0.07407		205	$ 35.00	$ 7,166
CURB (CG-2)	LF	-	3,400.00	-	-	-		3,400	$ 25.00	$ 85,000
CURB AND GUTTER (CG-6)	LF	-	3,500.00	-	-	-		3,500	$ 40.00	$ 140,000
SAW CUT	LF	-	320	-	-	-		320	$ 11.00	$ 3,520
TREES	EA	-	-	-	-	-		37	$ 1,000.00	$ 37,000
LIGHTING (Foundation, pole,luminair, and electrical service)	EA	-	1700	-	-	0.01111	200%	38	$ 5,500.00	$ 207,778
HYDRAULICS									**SUBTOTAL:**	**$ 1,440,633.33**
24" CONCRETE PIPE (Storm sewer)	LF	-	2,900	-	-	-		2,900	$ 110.00	$ 319,000
CURB DROP INLET (Storm sewer, two per 200')	EA	-	1,700	-	-	0.00500	200%	17	$ 5,500.00	$ 93,500
MINOR STRUCTURE EXCAVATION (Drop inlets)	CY	-	6	6	8	0.03704	1700%	181	$ 100.00	$ 18,133
STORMWATER MANAGEMENT (Approx. 3.3 acres of disturbance)	LS	-	-	-	-	-		1	$ 1,010,000.00	$ 1,010,000
TRAFFIC									**SUBTOTAL:**	**$ 58,200.00**
4" SOLID LINE PAVEMENT MARKING	LF	-	10,200.00	-	-	-		10,200	$ 5.00	$ 51,000
24" SOLID LINE PAVEMENT MARKING	LF	-	400.00	-	-	-		400	$ 10.00	$ 4,000
PAVEMENT MESSAGE MARKING	EA	-	8.00	-	-	-		8	$ 400.00	$ 3,200
MATERIALS/GEOTECH									**SUBTOTAL:**	**$ 295,076.78**
EXCAVATION (Roadway, SUP & Sidewalk)	CY	-	-	-	-	-		8,620	$ 27.00	$ 232,740
SELECT MATERIAL	CY	-	-	-	-	-		750	$ 17.00	$ 12,750
2" TOPSOIL	ACRE	67,500.00	-	-	-	0.00002		1.55	$ 32,000.00	$ 49,587
									SUBTOTAL A	**$ 2,963,839**
ROW										
ROW ACQUISITION (From PCES): Perm - 5 parcels, 209,400 SF (From VDOT)	LS	-	-	-	-	-		1	$ 5,097,920.00	$ 5,097,920
UTILITY RELOCATIONS: (From VDOT)	LS	-	-	-	-	-		1	$ 257,544.00	$ 257,544
ROW PHASE CONTINGENCY (50%)										$ 2,677,732
									RIGHT-OF-WAY SUBTOTAL B	**$ 8,033,196**

EROSION AND SEDIMENT CONTROL 5% SUBTOTAL A	$ 148,192
MAINTENANCE OF TRAFFIC 5% SUBTOTAL A	$ 148,192
MISCELLANEOUS ITEMS 15% SUBTOTAL A	$ 444,576
SUBTOTAL C (Excludes Subtotal B)	**$ 3,704,799**
CONSTRUCTION SURVEYING 1% SUBTOTAL C	$ 1,482
MOBILIZATION	$ 37,484
SUBTOTAL D (Excludes Subtotal B)	**$ 3,743,765**
CONTINGENCY 50% SUBTOTAL D	$ 1,871,882
CONST. ENG. 17% SUBTOTAL D	$ 636,440
CONSTRUCTION SUBTOTAL (Excludes Subtotal B)	**$ 6,252,087**
PRELIMINARY ENGINEERING 30% OF CONSTRUCTION COST	**$ 1,875,626**
SUBTOTAL E (Excludes Subtotal B)	**$ 8,127,713**
GRAND TOTAL COST (Includes Subtotal B)	**$ 16,161,000**

TOTAL COST

$ 16,170,000

TOTAL COST ADJUSTED FOR INFLATION

$ 25,280,000

CURRENT YEAR	2022
CONSTRUCTION YEAR	2035
ANNUAL INFLATION RATE	3.5%
INFLATED GRAND TOTAL COST	**$ 25,275,000**

Computations

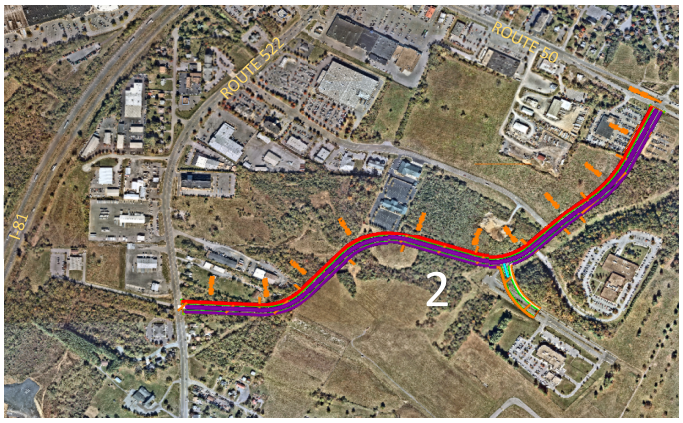
Project:	US Rt. 522 Realignment	**Project #**	39147.00
Location:	Front Royal Pike, Winchester, VA	**Sheet:**	2 of 4
Calculated by:	CRB	**Date:**	4/20/2023
Checked by:	BEM	**Date:**	4/21/2023
Title:	Planning Level Cost Estimates		

US Route 522 (Front Royal Pike) Realignment
Build new 4 lane divided roadway with adjacent 10' shared use path and 5' sidewalk.
From existing Route 522 to Route 50

Assumptions:

•12' lanes with concrete curb and gutter
•20' grassed median
•35 MPH design speed
•New roadway pavement section for Rte. 522 is 1.5" of SM-9.5, 6" of BM-25.0, 9" of Agg base 25A or B
•Shared Use Path (10' path, 2' shoulders), crossing required, leaving the intersection on south side
•Shared Use Path pavement section is 2" of asphalt on 6" Agg base 25A or B
•Sidewalk is to be 4" of concrete on 4" of agg base 25A or B

•Subsurface utitlities have not been included with this estimate.
•BMP size is based on 20% of total land disturbance
•No improvements along Route 50 have been included in this estimate, see summary sheet for rough order of magnitude stimate for improvemtns along Route 50.
•No improvements to Costello Drive, Coverston Drive, and USACOE access have been included in this estimate, see summary sheet for rough order of magnitude stimate for these potrntial improvements.



CONSTRUCTION ITEMS	UNIT	AREA (SF)	LENGTH (SF)	WIDTH (SF)	DEPTH (SF)	FACTOR	% OCCURING	QUANTITY	UNIT COST	TOTAL
SEGMENT 2 (EXISTING 522 TO ROUTE 50)										
ROADWAY									**SUBTOTAL:**	**$ 4,359,723.77**
ASPHALT PAVEMENT - 7.5" (Roadway)	TONS	318,000.00	-	-	0.63	0.07407		14,722	$ 100.00	$ 1,472,222
AGGREGATE BASE - 9" (Roadway and curb and gutter)	TONS	360,000.00	-	-	0.75	0.07407		20,000	$ 35.00	$ 700,000
ASPHALT PAVEMENT - 2" (SUP)	TONS	50,000.00	-	-	0.17	0.07407		617	$ 100.00	$ 61,728
AGGREGATE BASE - 6" (SUP)	TONS	50,000.00	-	-	0.50	0.07407		1,852	$ 35.00	$ 64,815
HYDR. CEMENT CONC. SIDEWALK 4"	CY	25,000.00	-	-	0.33	0.03704		308	$ 125.00	$ 38,542
AGGREGATE BASE - 4" (Sidewalk)	TONS	25,000.00	-	-	0.33	0.07407		617	$ 35.00	$ 21,583
CURB (CG-2)	LF	-	10,100.00	-	-	-		10,100	$ 25.00	$ 252,500
CURB AND GUTTER (CG-6)	LF	-	11,000.00	-	-	-		11,000	$ 40.00	$ 440,000
SAW CUT	LF	-	850	-	-	-		850	$ 11.00	$ 9,350
DEMOLITION OF PAVEMENT (EXISTING PAVEMENT INSIDE PROPOSED WORK)	SY	103,500.00	-	-	-	0.11111		11,500	$ 15.00	$ 172,500
PAVEMENT OBLITERATION (OUTSIDE PROPOSED WORK)	UNIT	40,500.00	-	-	-	0.00100		41	$ 400.00	$ 16,200
4" SOLID LINE PAVEMENT MARKING	LF	-	35,000.00	-	-	-		35,000	$ 5.00	$ 175,000
24" SOLID LINE PAVEMENT MARKING	LF	-	1,200.00	-	-	-		1,200	$ 10.00	$ 12,000
PAVEMENT MESSAGE MARKING	EA	-	18.00	-	-	-		18	$ 400.00	$ 7,200
REMOVE GUARDRAIL	LF	-	250	-	-	-		250	$ 50.00	$ 12,500
INSTALL NEW GUARDRAIL	LF	-	1250	-	-	-		1,250	$ 100.00	$ 125,000
INSTALL GUARDRAIL TERMINAL	EA	-	6	-	-	-		6	$ 4,000.00	$ 24,000
TREES	EA	-	-	-	-	-		120	$ 1,000.00	$ 120,000
DEMOLITION OF LIGHT POLE FOUNDATION	EA	-	9	-	-	1.00000		9	$ 1,250.00	$ 11,250
LIGHTING (Foundation, pole,luminair, and electrical service)	EA	-	5,100	-	-	0.01111	200%	113	$ 5,500.00	$ 623,333
HYDRAULICS									**SUBTOTAL:**	**$ 4,891,300.00**
24" CONCRETE PIPE (Storm sewer)	LF	-	9,700	-	-	-		9,700	$ 110.00	$ 1,067,000
CURB DROP INLET (Storm sewer, two per 200')	EA	-	5,700	-	-	0.00500	200%	57	$ 5,500.00	$ 313,500
MINOR STRUCTURE EXCAVATION (Drop inlets)	CY	-	6	6	8	0.03704	5700%	608	$ 100.00	$ 60,800
STORMWATER MANAGEMENT (Approx. 11.3 acres of disturbance)	LS	-	-	-	-	-		1	$ 3,450,000.00	$ 3,450,000
TRAFFIC									**SUBTOTAL:**	**$ 1,400,000.00**
NEW TRAFFIC SIGNAL (Front Royal Pike and Prince Frederick Drive)	LS	-	-	-	-	-		1	$ 700,000.00	$ 700,000
NEW TRAFFIC SIGNAL (Existing Rte 522 intersection and propose re-alignment)	LS	-	-	-	-	-		1	$ 700,000.00	$ 700,000
MATERIALS/GEOTECH									**SUBTOTAL:**	**$ 1,197,158.49**
EXCAVATION (Roadway, SUP & Sidewalk)	CY	-	-	-	-	-		24,500	$ 27.00	$ 661,500
SELECT MATERIAL	CY	-	-	-	-	-		21,700	$ 17.00	$ 368,900
2" TOPSOIL	ACRE	227,000.00	-	-	-	0.00002		5.21	$ 32,000.00	$ 166,758
							SUBTOTAL A			**$ 11,848,182**
ROW										
ROW ACQUISITION (From PCES): Perm - 16 parcels, 863,500 SF (From VDOT)	LS	-	-	-	-	-		1	$14,128,609.00	$ 14,128,609
UTILITY RELOCATIONS: (From VDOT)	LS	-	-	-	-	-		1	$ 1,120,703.00	$ 1,120,703
ROW PHASE CONTINGENCY (50%)										$ 7,624,656
									RIGHT-OF-WAY SUBTOTAL B	**$ 22,873,968**

EROSION AND SEDIMENT CONTROL 5% SUBTOTAL A	$ 592,409
MAINTENANCE OF TRAFFIC 5% SUBTOTAL A	$ 592,409
MISCELLANEOUS ITEMS 15% SUBTOTAL A	$ 1,777,227
SUBTOTAL C (Excludes Subtotal B)	**$ 14,810,228**

CONSTRUCTION SURVEYING 1% SUBTOTAL C	$ 5,924
MOBILIZATION	$ 59,917
SUBTOTAL D (Excludes Subtotal B)	**$ 14,876,069**

CONTINGENCY 50% SUBTOTAL D	$ 7,438,034
CONST. ENG. 17% SUBTOTAL D	$ 2,528,932
CONSTRUCTION SUBTOTAL (Excludes Subtotal B)	**$ 24,843,035**

PRELIMINARY ENGINEERING 30% OF CONSTRUCTION COST	$ 7,452,910
SUBTOTAL E (Excludes Subtotal B)	**$ 32,295,945**
GRAND TOTAL COST (Includes Subtotal B)	**$ 55,170,000**

TOTAL COST

$ 55,170,000

CURRENT YEAR	2022
CONSTRUCTION YEAR	2035
ANNUAL INFLATION RATE	3.5%
INFLATED GRAND TOTAL COST	**$ 86,283,000**

TOTAL COST ADJUSTED FOR INFLATION

$ 86,290,000

Computations

Project:	US Rt. 522 Realignment	Project #	39147.00
Location:	Front Royal Pike, Winchester, VA	Sheet:	3 of 4
Calculated by:	CRB	Date:	4/20/2023
Checked by:	BEM	Date:	4/21/2023
Title:	Planning Level Cost Estimates		

US Route 522 (Front Royal Pike) Realignment

Construct Tulane Drive extension to connect to Costello Drive

Assumptions:

- 12' lanes with concrete curb and gutter
- 35 MPH design speed
- New roadway pavement section for Tulane Drive is 1.5" of SM-9.5, 6" of BM-25.0, 9" of Agg base 25A or B
- 10' of tie in behind Tulane, 8-12" deep
- Demolition of pavement in parking lot to nearest drive aisle
- Subsurface utitlities have not been included witht this estimate
- BMP size is 20% of total land disturbance
- No improvements along Route 50 have been included in this estimate, see summary sheet for rough order of magnitude stimate for improvemtns along Route 50.

CONSTRUCTION ITEMS	UNIT	AREA (SF)	LENGTH (SF)	WIDTH (SF)	DEPTH (SF)	FACTOR	% OCCURING	QUANTITY	UNIT COST	TOTAL
SEGMENT 3 (TULANE DRIVE EXTENTION)										
ROADWAY									**SUBTOTAL:**	**$ 649,522.22**
ASPHALT PAVEMENT - 7.5" (Roadway)	TONS	37,500.00	-	-	0.63	0.07407		1,736	$ 100.00	$ 173,611
AGGREGATE BASE - 9" (Roadway and curb and gutter)	TONS	42,500.00	-	-	0.75	0.07407		2,361	$ 35.00	$ 82,639
ASPHALT PAVEMENT - 2" (SUP)	TONS	0.00	-	-	0.17	0.07407		0	$ 100.00	$ -
AGGREGATE BASE - 6" (SUP)	TONS	0.00	-	-	0.50	0.07407		0	$ 35.00	$ -
HYDR. CEMENT CONC. SIDEWALK 4"	CY	0.00	-	-	0.33	0.03704		0	$ 125.00	$ -
AGGREGATE BASE - 4" (Sidewalk)	TONS	0.00	-	-	0.33	0.07407		0	$ 35.00	$ -
CURB (CG-2)	LF	-	0.00	-	-	-		0	$ 25.00	$ -
CURB AND GUTTER (CG-6)	LF	-	2,700.00	-	-	-		2,700	$ 40.00	$ 108,000
SAW CUT	LF	-	250	-	-	-		250	$ 11.00	$ 2,750
DEMOLITION OF PAVEMENT (EXISTING PAVEMENT INSIDE PROPOSED WORK)	SY	36,500.00	-	-	-	0.11111		4,056	$ 15.00	$ 60,833
PAVEMENT OBLITERATION (OUTSIDE PROPOSED WORK)	UNIT	4,500.00	-	-	-	0.00100		5	$ 400.00	$ 1,800
4" SOLID LINE PAVEMENT MARKING	LF	-	5,200.00	-	-	-		5,200	$ 5.00	$ 26,000
24" SOLID LINE PAVEMENT MARKING	LF	-	40.00	-	-	-		40	$ 10.00	$ 400
PAVEMENT MESSAGE MARKING	EA	-	4.00	-	-	-		4	$ 400.00	$ 1,600
REMOVE GUARDRAIL	LF	-	0	-	-	-		0	$ 50.00	$ -
INSTALL NEW GUARDRAIL	LF	-	0	-	-	-		0	$ 100.00	$ -
INSTALL GUARDRAIL TERMINAL	EA	-	0	-	-	-		0	$ 4,000.00	$ -
TREES	EA	-	-	-	-	-		33	$ 1,000.00	$ 33,000
DEMOLITION OF LIGHT POLE FOUNDATION	EA	-	0	-	-	1.00000		0	$ 1,250.00	$ -
LIGHTING (Foundation, pole,luminair, and electrical service)	EA	-	1300	-	-	0.01111	200%	29	$ 5,500.00	$ 158,889
HYDRAULICS									**SUBTOTAL:**	**$ 715,366.67**
24" CONCRETE PIPE (Storm sewer)	LF	-	2,000	-	-	-		2,000	$ 110.00	$ 220,000
CURB DROP INLET (Storm sewer, two per 200')	EA	-	1,300	-	-	0.00500	200%	13	$ 5,500.00	$ 71,500
MINOR STRUCTURE EXCAVATION (Drop inlets)	CY	-	6	6	8	0.03704	1300%	139	$ 100.00	$ 13,867
STORMWATER MANAGEMENT (Approx. 1.3 acres of disturbance)	LS	-	-	-	-	-		1	$ 410,000.00	$ 410,000
TRAFFIC									**SUBTOTAL:**	**$ -**
NEW TRAFFIC SIGNAL (Front Royal Pike and Prince Frederick Drive)	LS	-	-	-	-	-		0	$ -	$ -
SIGNAL MODIFICATIONS (Prince Frederick Drive and Millwood Pike)	LS	-	-	-	-	-		0	$ -	$ -
MATERIALS/GEOTECH									**SUBTOTAL:**	**$ 380,825.09**
EXCAVATION (Roadway, SUP & Sidewalk)	CY	-	-	-	-	-		9,100	$ 27.00	$ 245,700
SELECT MATERIAL	CY	-	-	-	-	-		6,825	$ 17.00	$ 116,025
2" TOPSOIL	ACRE	26,000.00	-	-	-	0.00002		0.60	$ 32,000.00	$ 19,100
									SUBTOTAL A	**$ 1,745,714**
ROW										
ROW ACQUISITION (From PCES): Perm - 4 parcels, 74,500 SF (From VDOT)	LS	-	-	-	-	-		1	$ 2,311,637.00	$ 2,311,637
UTILITY RELOCATIONS: (From VDOT)	LS	-	-	-	-	-		1	$ 689,685.00	$ 689,685
ROW PHASE CONTINGENCY (50%)										$ 1,500,661
									RIGHT-OF-WAY SUBTOTAL B	**$ 4,501,983**

EROSION AND SEDIMENT CONTROL 5% SUBTOTAL A	$ 87,286
MAINTENANCE OF TRAFFIC 5% SUBTOTAL A	$ 87,286
MISCELLANEOUS ITEMS 15% SUBTOTAL A	$ 261,857
SUBTOTAL C (Excludes Subtotal B)	**$ 2,182,142**
CONSTRUCTION SURVEYING 1% SUBTOTAL C	$ 873
MOBILIZATION	$ 34,408
SUBTOTAL D (Excludes Subtotal B)	**$ 2,217,423**
CONTINGENCY 50% SUBTOTAL D	$ 1,108,712
CONST. ENG. 17% SUBTOTAL D	$ 376,962
CONSTRUCTION SUBTOTAL (Excludes Subtotal B)	**$ 3,703,097**
PRELIMINARY ENGINEERING 30% OF CONSTRUCTION COST	$ 1,110,929
SUBTOTAL E (Excludes Subtotal B)	**$ 4,814,026**
GRAND TOTAL COST (Includes Subtotal B)	**$ 9,317,000**

TOTAL COST

$ 9,320,000

CURRENT YEAR	2022
CONSTRUCTION YEAR	2035
ANNUAL INFLATION RATE	3.5%
INFLATED GRAND TOTAL COST	**$ 14,571,000**

TOTAL COST ADJUSTED FOR INFLATION

$ 14,580,000

Computations

Project:	**US Rt. 522 Realignment**	**Project #**	39147.00
Location:	**Front Royal Pike, Winchester, VA**	**Sheet:**	4 of 4
Calculated by:	**CRB**	**Date:**	4/30/2023
Checked by:	**BEM**	**Date:**	4/30/2023
Title:	**Planning Level Cost Estimates**		

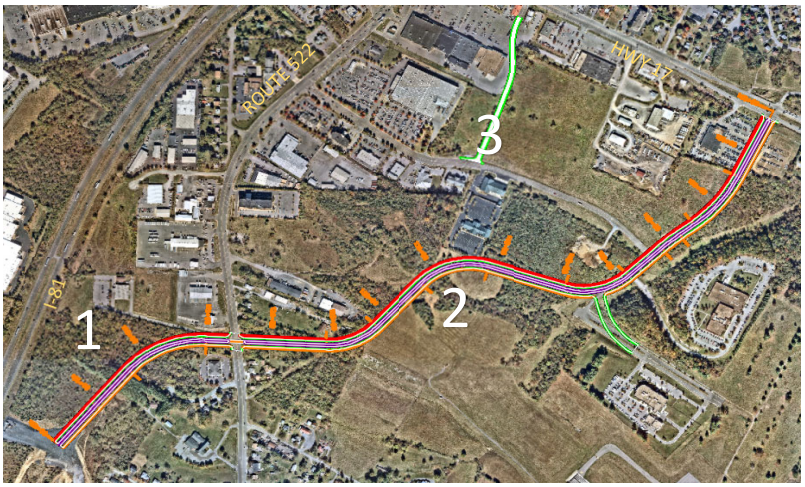
US Route 522 (Front Royal Pike) Realignment
Build new 4 lane divided roadway with adjacent 10' shared use path and 5' sidewalk.
Construct Tulane Drive extension to connect to Costello Drive

Assumptions:

•12' lanes with concrete curb and gutter
•20' grassed median
•35 MPH design speed.
•New roadway pavement section for Rte. 522 is 1.5" of SM-9.5, 6" of BM-25.0, 9" of Agg base 25A or B
•Shared Use Path (10' path, 2' shoulders), crossing required, leaving the intersection on south side.
•Shared Use Path pavement section is 2" of asphalt on 6" Agg base 25A or B.
•Sidewalk is to be 4" of concrete on 4" of agg base 25A or B
•10' of tie in behind Tulane, 8-12" deep
•Demolition of pavement in parking lot to nearest drive aisle

•Subsurface utitlities have not been included witht this estimate.

•474 Front Royal Pike will be a full take and require building demolition.
•BMP size is 20% of total land disturbance.



PROJECT TOTALS

CONSTRUCTION ITEMS (SUBTOTAL A)	**SUBTOTAL:**	**$**	**16,557,735.38**
SEGMENT 1 (CROSSOVER BLVD TO EXISTING 522)		$	2,963,839
SEGMENT 2 (EXISTING 522 TO ROUTE 50)		$	11,848,182
SEGMENT 3 (TULANE DRIVE EXTENSION)		$	1,745,714
RIGHT-OF-WAY, UTILITIES FROM VDOT (SUBTOTAL B)	**SUBTOTAL:**	**$**	**35,409,147.00**
SEGMENT 1 (CROSSOVER BLVD TO EXISTING 522)		$	8,033,196
SEGMENT 2 (EXISTING 522 TO ROUTE 50)		$	22,873,968
SEGMENT 3 (TULANE DRIVE EXTENSION)		$	4,501,983
SUBTOTAL A + E&S, MOT, MISC. ITEMS (SUBTOTAL C)	**SUBTOTAL:**	**$**	**20,697,169.23**
SEGMENT 1 (CROSSOVER BLVD TO EXISTING 522)		$	3,704,799
SEGMENT 2 (EXISTING 522 TO ROUTE 50)		$	14,810,228
SEGMENT 3 (TULANE DRIVE EXTENSION)		$	2,182,142
SUBTOTAL C + SURVEYING, MOBILIZATION (SUBTOTAL D)	**SUBTOTAL:**	**$**	**20,837,256.38**
SEGMENT 1 (CROSSOVER BLVD TO EXISTING 522)		$	3,743,765
SEGMENT 2 (EXISTING 522 TO ROUTE 50)		$	14,876,069
SEGMENT 3 (TULANE DRIVE EXTENSION)		$	2,217,423
SUBTOTAL D + CONTINGENCY, CEI (CONSTRUCTION SUBTOTAL)	**SUBTOTAL:**	**$**	**34,798,218.15**
SEGMENT 1 (CROSSOVER BLVD TO EXISTING 522)		$	6,252,087
SEGMENT 2 (EXISTING 522 TO ROUTE 50)		$	24,843,035
SEGMENT 3 (TULANE DRIVE EXTENSION)		$	3,703,097
CONSTRUCTION SUBTOTAL + PRELIMINARY ENGINEERING (SUBTOTAL E)	**SUBTOTAL:**	**$**	**45,237,683.59**
SEGMENT 1 (CROSSOVER BLVD TO EXISTING 522)		$	8,127,713
SEGMENT 2 (EXISTING 522 TO ROUTE 50)		$	32,295,945
SEGMENT 3 (TULANE DRIVE EXTENSION)		$	4,814,026
PROJECT GRAND TOTALS (SUBTOTAL E + SUBTOTAL B)			
SEGMENT 1 (CROSSOVER BLVD TO EXISTING 522)		$	16,161,000
SEGMENT 2 (EXISTING 522 TO ROUTE 50)		$	55,170,000
SEGMENT 3 (TULANE DRIVE EXTENSION)		$	9,317,000
SUPPLEMENTAL WORK TO ADJACENT ROADWAYS (NOT INCLUDED IN GRAND TOTALS)			
WIDENING IMPROVEMENTS FROM I-81 TO US ROUTE 50 (NOT INCLUDING ROW AND UTILITIES)		$	17,000,000
RELOCATION OF USACE ENTRANCE (NOT INCLUDING ROW AND UTILITIES)		$	750,000

TOTAL COST

$ 98,400,000

GRAND TOTAL COST **$ 98,398,000**

TOTAL COST
ADJUSTED FOR INFLATION

$ 153,890,000

CURRENT YEAR	2022
CONSTRUCTION YEAR	2035
ANNUAL INFLATION RATE	3.5%
INFLATED GRAND TOTAL COST	**$ 153,890,000**