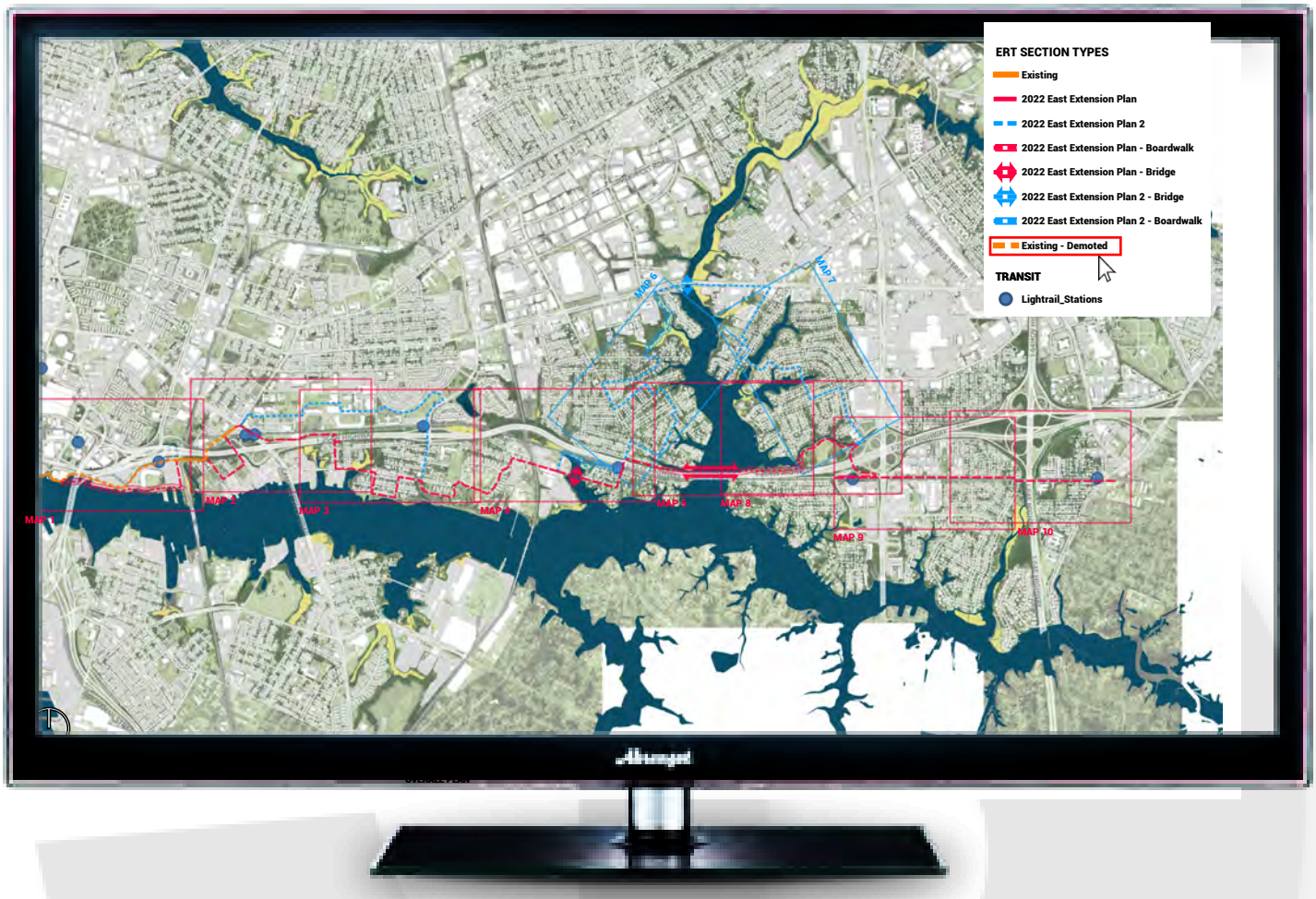
HAMPTON ROADS TPO

JULY 2023

Extending the Elizabeth River Trail



Cost Model and Cost Estimates

T23-08

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REPORT DOCUMENTATION

TITLE
Extending the Elizabeth River Trail-
Cost Model and Cost Estimates

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REPORT DATE July 2023

ABSTRACT
In response to a request from the City of Norfolk, HRTPO staff estimated the costs of the two routes identified by Work Program Architects (for the Elizabeth River Trail Foundation) to redirect and extend the Elizabeth River Trail from Dominion Tower to the western terminus of the Virginia Beach Trail. This report documents the preparation of a trail cost model, the application of that model to the subject routes, and route issues noticed in the process.

The model can be used by engineers/planners to cost other trails, and the estimates and issues can be used by the City of Norfolk to guide the extension of the Elizabeth River Trail.

ACKNOWLEDGMENT & DISCLAIMERS
Prepared in cooperation with U.S. Department of Transportation (USDOT), Federal Highway Administration (FHWA), Virginia Department of Transportation (VDOT), the Elizabeth River Trail Foundation (ERTF), and the City of Norfolk. The contents of this report reflect the views of the Hampton Roads Transportation Planning Organization (HRTPO). The HRTPO is responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of FHWA, VDOT, ERTF, Norfolk, or the Hampton Roads Planning District Commission. This report does not constitute a standard, specification, or regulation. FHWA or VDOT acceptance of this report as evidence of fulfillment of the objectives of this planning study does not constitute endorsement/approval of the need for any recommended improvements nor does it constitute approval of their location and design or a commitment to fund any such improvements. Additional project level environmental impact assessments and/or studies of alternatives may be necessary.

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Background and Purpose

The Elizabeth River Trail (ERT) is a multi-use path which currently runs between the Norfolk Naval Station area (intersection of Hampton Blvd and Terminal Blvd) and Norfolk State University (NSU) (intersection of Brambleton Blvd and Park Ave).

FIGURE 1 Elizabeth River Trail
Source: www.elizabethrivertrial.org

Work Program Architects (WPA) recently prepared routes for the Elizabeth River Trail Foundation (ERTF)—the "2022 East Extension Plan"—for **extending the Elizabeth River Trail** from the existing ERT at Dominion Tower[1] **to the western terminus of the proposed Virginia Beach trail** at the Norfolk / Virginia Beach corporate limit. Virginia Beach plans to build a multi-use path in the old Norfolk Southern railroad right-of-way from the Norfolk/Virginia Beach border near Norfolk's Newtown Road LRT station all the way to the oceanfront. The ERT Extension is part of a planned system of trails that—when complete—will run from Richmond to the Virginia Beach oceanfront.

As part of the Unified Planning Work Program (UPWP), the City of Norfolk asked HRTPO staff to estimate the costs of the two ERT Extension routes identified by WPA, **a recommended route and an alternative route**. This report documents the preparation of a trail cost model, the application of that model to the subject routes, and the route issues noticed in the process.

The model can be used to cost other trails, and the estimates and issues can be used to guide the extension of the Elizabeth River Trail.

[1] Given that the existing ERT does not terminate at Dominion Tower, the prepared routes represent changes to the portion of the current ERT between Dominion Tower and NSU.

ERT Extension Routes

As shown below, the recommended route (dashed red line) follows the Elizabeth River, requiring the construction of a long bridge across Broad Creek. The alternative route (dashed blue line) crosses Broad Creek farther north where the creek is more narrow, requiring a much shorter bridge. In order to reach this crossing, however, the alternative route must be longer, more circuitous, and more distant from the Elizabeth River.

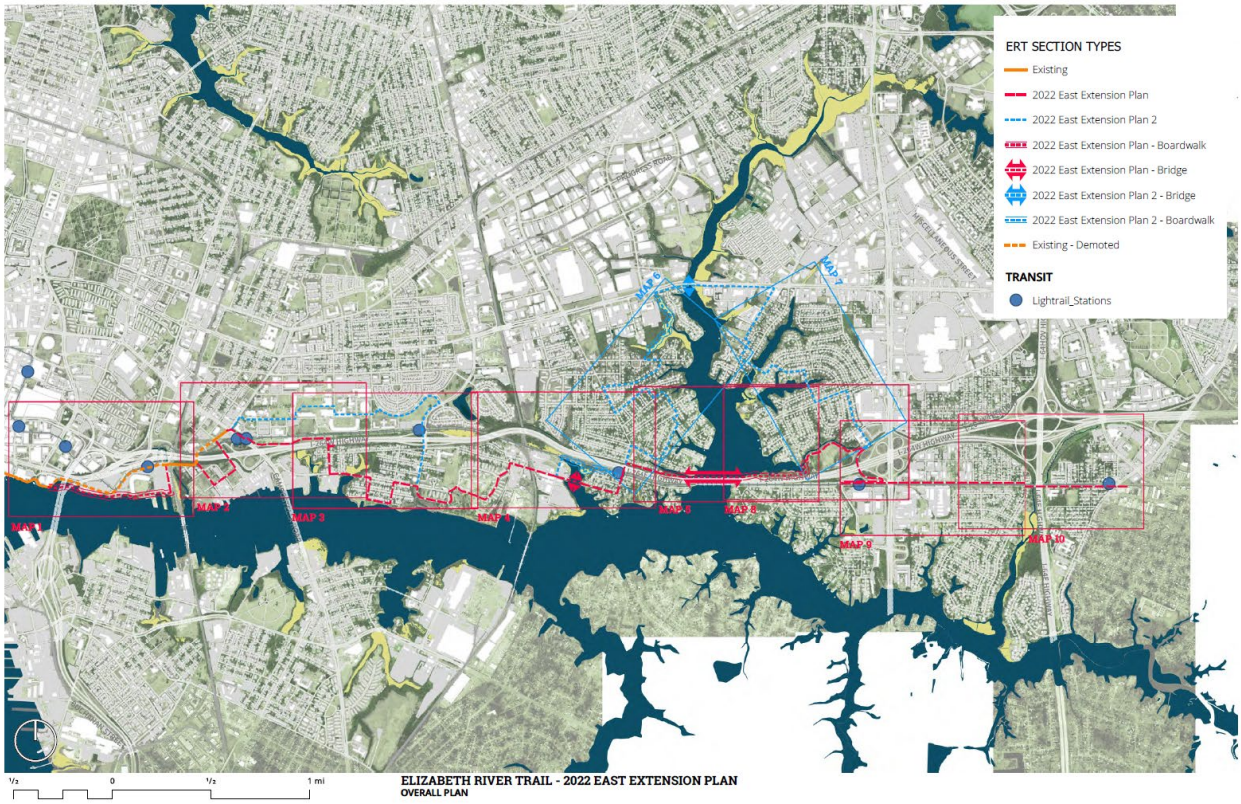


FIGURE 2 Elizabeth River Trail – 2022 East Extension Plan, Overall Plan
Source: "Elizabeth River Trail – 2022 East Extension Plan" (WPA, 2022)

Cost Model Preparation

In order to estimate the costs of the proposed ERT Extension routes, staff developed a cost model. Because the recommended route for the ERT Extension includes a long bridge across Broad Creek, staff researched the cost of bridges in addition to "regular trail costs", i.e. the cost of non-bridge trail segments. Regular trail costs and bridge costs are treated separately below.

Regular Trail Costs

Staff developed per-mile regular trail costs from projects without bridges. First, staff gathered the costs of trail projects from VDOT's Six-Year Improvement Program (SYIP). The SYIP contains projects of various statuses (programmed, under construction, and complete), and includes location and cost information. Costs are shown in three components: Preliminary Engineering [PE], Right-of-Way [RW], and Construction [CN]. Secondly, because the costs of trails vary by their location, staff categorized the 120 trail projects found in the SYIP by their **environment**, e.g.:

- Across field/woods
- Across wetlands
- Boardwalk
- Bridge
- Hybrid (multiple environments)
- Includes an underpass
- Parallel to creek/river
- Parallel to road (rural)
- Parallel to street (urban/suburban)
- Rail trail
- Walkway

Thirdly, to estimate the cost of the ERT Extension—whose *segments* vary by environment—staff used per-mile costs for each environment type derived from groups of *projects* of that type. For example, the cost of the ERT Extension segments which run across field/woods can be estimated using the per-mile costs of projects which run across field/woods. Thus projects which included multiple types of environments were excluded from the cost model. In addition, for statistical reliability, staff excluded projects with environments having a low number of projects. For example, one cannot assume that the per-mile cost of the one "across wetlands" project is reliable for estimating the cost of "across wetlands" segments of future projects. As a result of these exclusions, the 64 remaining projects (on following page)—representing five (5) remaining environment types—were used to develop per-mile costs for those five environment types.

TABLE 1 Data used in Development of Regular Trail Costs

Source: HRTPO staff

UPC	trail	location	length, mi	environment type	total cost (PE, RW, CN)
17563	Greenbelt Trail	Big Stone Gap	0.74	along creek/river	$2,171,000
56454	Round Hill - Franklin Park Trail	Loudoun Co	1.01	along street (urban/suburban)	$5,285,000
70632	Soapstone Drive Trail	Fairfax Co	0.5	along street (urban/suburban)	$2,160,000
78247	Tobacco Heritage Trail (Ph One, Trail 1 and 2A)	Lawrenceville	5.09	rail trail	$2,981,000
81562	Virginia Capital Trail- Sherwood Forest Phase	Charles City Co	10.4	along road (rural)	$13,894,000
83254	Mariners Museum Multi-Purpose Trail	Newport News	1	across field/woods	$2,124,000
86280	Virginia Capital Trail- Varina Phase	Henrico Co	8.085	along road (rural)	$17,975,000
87005	New River Trail Extension	Pulaski Co	1.26	rail trail	$1,125,000
91219	Pedestrian/Bicycle Trail	Isle of Wight Co	0.9	along street (urban/suburban)	$8,006,000
97837	Pohick Stream Valley Trail- Ph I	Fairfax Co	0.8	along creek/river	$1,468,000
103393	Ashland Trolley Line Trail	Ashland	0.27	along road (rural)	$1,710,000
105563	Van Dorn St - Beauregard St Multi-Use Trail	Alexandria	0.74	along street (urban/suburban)	$3,577,000
106055	Green Circle Trail- Jubal Early Segment	Winchester	0.33	along street (urban/suburban)	$1,007,000
106145	Chesapeake Trail- Ph 1	Chesapeake	0.87	rail trail	$1,063,000
106157	Portsmouth Rail to Trail	Portsmouth	1.81	rail trail	$2,952,000
106159	Chesapeake Ave Bike Trail	Newport News	1.05	along street (urban/suburban)	$1,748,000
106184	Virginia Capital Trail- Dorey Park Connection	Henrico Co	0.4	across field/woods	$130,000
106268	Hanging Rock Battlefield Trail	Salem	0.46	along street (urban/suburban)	$810,000
106490	Potomac Heritage Trail at Featherstone Wildlife Refuge	Prince William Co	1.2	across field/woods	$750,000
106581	Braddock Rd Pleasant Forest Trail	Fairfax Co	0.28	along street (urban/suburban)	$471,000
107013	Old Lee Highway Bikeway & Trail	Fairfax	2.04	along street (urban/suburban)	$26,800,000
107300	Riverlawn Court Trail	Pulaski Co	0.49	across field/woods	$553,000
107513	Tobacco Heritage Trail- Alberta Section	Alberta	0.47	rail trail	$530,000
107533	Appomattox River Trail- Ph 5	Colonial Heights	0.58	along creek/river	$1,275,000
107547	Rte 250 Bypass Commuter Trail	Charlottesville	0.30	along street (urban/suburban)	$897,000
109074	Monticello Ave Multi-Use Trail	Williamsburg	0.8	along street (urban/suburban)	$1,025,000
109469	Old Cameron Run Trail	Alexandria	0.54	along creek/river	$7,546,000
110101	Tinker Creek Trail Extension Ph 2A	Roanoke	2	along street (urban/suburban)	$5,861,000
111314	Depot Park Trail Extension	Christiansburg	0.17	across field/woods	$406,000
111425	Waynesboro South River Greenway Trail- Ph 3	Waynesboro	0.5	along street (urban/suburban)	$1,092,000
112602	Grayson County Trail- Ph III	Grayson Co	0.24	along road (rural)	$589,000
112664	Multi-Use Connector Trail- High Knob Access Enhancements	Norton	0.25	along street (urban/suburban)	$1,046,000
112816	George T Snyder Trail	Fairfax	1.78	along creek/river	$16,953,000
112935	Jackson River Trail Ph 5	Alleghany Co	1.6	along creek/river	$2,079,000
113428	Big Stone Gap Trail	Appalachia	0.45	rail trail	$208,000
113461	Three Oaks Elementary Multi-Use Path	Va. Beach	0.3	across field/woods	$537,000
113469	Violet Bank Trail	Va. Beach	0.6	across field/woods	$462,000
113472	Seaboard Coastline Trail Ph II	Suffolk	1.58	rail trail	$1,176,000
113473	Francis St Sidewalk/Trail	Williamsburg	0.225	along street (urban/suburban)	$298,000
113614	Judicial Trail Connection	Fairfax	0.09	along creek/river	$436,000
113710	Riverwalk Trail- South Bank Extension	Danville	0.47	along creek/river	$561,000
113861	Washington Park / Madison Ave Bicycle Connector Trail	Charlottesville	0.07	along street (urban/suburban)	$188,000
113895	Abrams Creek Trail	Frederick Co	1	along creek/river	$1,090,000
115182	Appomattox River Trail- Ph IV	Colonial Heights	0.34	along creek/river	$534,000
115525	Seaboard Coastline Trail Segment 1	Suffolk	1.32	rail trail	$4,223,000
115952	Cape Charles Multi-Use Trails, Ph III	Cape Charles	0.172	along street (urban/suburban)	$966,000
118153	Brook Rd and Hilliard Rd Trail	Henrico Co	0.6	along street (urban/suburban)	$4,757,000
118871	Rte 29 Shared Use Path	Albemarle Co	0.5	along street (urban/suburban)	$3,524,000
118943	James River Branch- Rail to Trail Greenway	Richmond	2	rail trail	$13,125,000
118966	Fall Line Trail- Dupuy Rd to Westover Ave	Chesterfield Co	0.47	rail trail	$1,416,000
119219	Western Branch Rails to Trails Ph 2	Chesapeake	1.2	rail trail	$2,576,000
119230	Seaboard Coastline Trail Ph 3A	Suffolk	1.75	rail trail	$3,452,000
119598	Ashland Petersburg Trail- Walmsley to Bellemeade	Richmond	2.1	along street (urban/suburban)	$16,171,000
119600	Ashland Petersburg Trail- Falling Crk Ave to Food Lion	Chesterfield Co	0.54	along street (urban/suburban)	$12,547,000
120974	Bankside Trail- Ph 1	Fredericksburg	0.5	along creek/river	$2,050,000
121044	Farmville Riverwalk Trail- Ph I	Farmville	0.123	across field/woods	$1,075,000
121104	Chesapeake Trail- Ph 2	Chesapeake	0.93	rail trail	$998,000
121107	Chesapeake Trail- Ph 3	Chesapeake	1	rail trail	$2,610,000
121109	Seaboard Coastline Trail Ph 3B	Suffolk	1.33	rail trail	$2,270,000
121110	BoAT MUP Warwick, Elmhurst, & Yorktown	Newport News	1.06	along street (urban/suburban)	$2,909,000
121208	Riverwalk Ph III	Bridgewater	0.25	along creek/river	$480,000
121411	Courthouse Trail	Chesterfield Co	0.22	along street (urban/suburban)	$549,000
121760	N 21st St Multiuse Trail Ph 1	Purcellville	0.13	along street (urban/suburban)	$1,506,000
T26683	Arlington Blvd Trail- Edison St to George Mason Dr Ph 1	Arlington Co	0.76	along street (urban/suburban)	$1,999,000

Averaging sets of projects by environment type, staff developed the following costs-per-mile by type. Some of the projects were complete, and some were not, so staff assumed that costs averaged from these projects could be considered current (2023) costs.

TABLE 2 Average per-mile Costs of 64 SYIP Trail Projects, by Environment
Source: HRTPO staff

environment type	Projects	Sum of length, mi	PE cost per mile	RW cost per mile	CN cost per mile	Total cost per mile	**total cost per mile, rounded (2023)**
across field/woods	8	4	$243,054	$29,652	$1,136,587	$1,409,526	**$1,400,000**
parallel to road (rural)	4	19	$219,584	$272,440	$1,306,818	$1,798,789	**$1,800,000**
rail trail	15	22	$248,398	$318,672	$1,323,502	$1,890,618	**$1,900,000**
parallel to creek/river	12	9	$640,046	$322,900	$3,253,970	$4,216,686	**$4,200,000**
parallel to street (urban/suburban)	25	18	$654,218	$1,239,736	$4,103,642	$5,997,652	**$6,000,000**
	64						

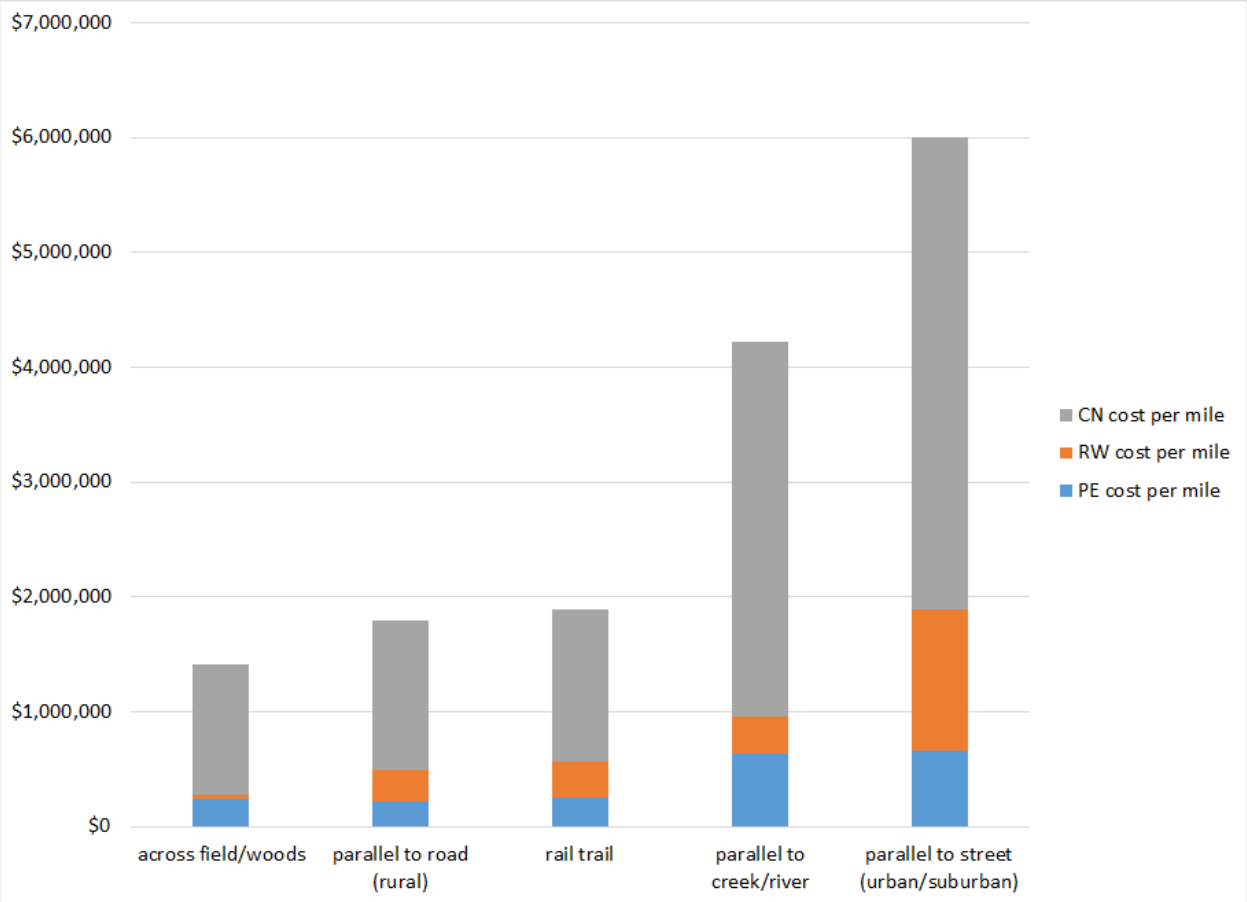


FIGURE 3 Regular Trail Costs, by Environment (2023)
Source: HRTPO staff based on VDOT SYIP cost estimates

Note the higher construction costs for the last two environment types, and the higher right-of-way cost for "parallel to street (urban/suburban)".

Bridge Costs

To develop the bridge portion of the trail cost model, staff researched the cost of *trail* bridges (i.e. the elevated portion of trails) and *highway* bridges (i.e. the elevated portion of highways). Understanding that trail bridges are built to carry the weight of maintenance trucks, staff assumed that the cost of highway bridges is applicable to trail bridges.

Highway Bridges

To research the cost of highway bridges, staff examined VDOT's spreadsheet-based cost estimating tool for highway projects entitled "Statewide Planning Level Cost Estimates". The 2015 version of this tool includes the following range of costs per square foot for bridges over 12,500 sq. ft.[2] in Northern Virginia and Hampton Roads:

- $180 (low) to $250 (high)

Inflating the average cost ([180+250]/2 = $215) for eight years at 4%[3] annual increase renders a 2023 cost of $295 / sq. ft. (215 x 1.04^8 = 294.2).

Staff checked the VDOT tool using a set of bridge projects from the SYIP, comparing the SYIP cost estimates to cost estimates calculated (by HRTPO staff) using the VDOT tool[4]. All 14 of the non-Interstate bridges in the Fredericksburg, Northern Virginia, and Hampton Roads Districts in the SYIP comprised the subject set of bridge projects. As shown at the bottom of the table on the following page, staff found that—on average—the SYIP estimates are **twice as high as those from the cost tool**.

[2] The Broad Creek bridge proposed for the ERT Extension is 1,650' long by (say) 14' wide, or 23,100 sq. ft.
[3] The VDOT tool uses a 3% inflation rate. To account for higher rates during the COVID period, staff used 4%.
[4] Because the 14 bridge projects included road work, calculating "per square foot" costs by simply dividing the project cost by the square footage of the included bridge would have led to meaningless results.

TABLE 3 Non-Interstate SYIP Bridge Projects in Fredericksburg, Northern Virginia, and Hampton Roads Districts

Source: HRTPO staff

UPC [A]	project [B]	location [C]	total project length, ft [D]	bridge length, ft [E]	bridge width, ft [F]	bridge area, sqft [G=E*F]	length of non-bridge road work, ft [H=D-E]	road unit cost (VDOT tool), $m per mile, rough, 2022 [I]	road cost (VDOT tool, assuming no utility cost) [J=H*I]	bridge unit cost (VDOT tool), per sqft, rough, 2022 [K]	bridge cost (VDOT tool) [L=G*K]	total project construction cost (w/o utilities) (VDOT tool) [M=J+L]	SYIP construction cost (CN) [N]	ratio, SYIP cost / tool cost [O=N/M]
98823	Rte 601 over Diascund Crk	James City Co	700	65	12	780	635	$3	$360,795	$500	$390,000	$750,795	$4,418,000	6
101279	Bridge over Lake Maury	Newport News	1,400	205	90	18,450	1,195	$20	$4,526,515	$250	$4,612,500	$9,139,015	$7,763,000	1
102936	Rt 1 over Potomac Creek	Stafford Co	1,200	125	24	3,000	1,075	$10	$2,035,985	$330	$990,000	$3,025,985	$5,537,000	2
107287	Paradise Creek Bridge	Portsmouth	200	170	56	9,520	30	$15	$85,227	$330	$3,141,600	$3,226,827	$9,513,000	3
110097	Rt 14 over Poropotank Crk	King & Queen Co	600	45	26	1,170	555	$3	$315,341	$500	$585,000	$900,341	$2,219,000	2
110111	Rt 207 WB over Mattaponi Rvr	Caroline Co	1,000	310	38	11,780	690	$3	$392,045	$330	$3,887,400	$4,279,445	$6,564,000	2
111406	Rt 1 over Chopawamsic Creek	Stafford Co	1,500	75	64	4,800	1,425	$15	$4,048,295	$330	$1,584,000	$5,632,295	$6,730,000	1
113030	Rt 178 over Occohannnock Crk	Accomack Co	1,000	100	24	2,400	900	$3	$511,364	$330	$792,000	$1,303,364	$4,742,000	4
113850	Rt 607 Dragon Run Creek	Essex County	100	35	20	700	65	$3	$36,932	$330	$231,000	$267,932	$2,100,000	8
118306	Mt Vernon Ave Bridge	NoVa MPO	300	270	66	17,820	30	$15	$85,227	$250	$4,455,000	$4,540,227	$19,929,000	4
118374	Indian Creek Bridge	Chesapeake	900	72	24	1,728	828	$3	$470,455	$500	$864,000	$1,334,455	$2,863,000	2
119263	Pocaty Creek Bridge	Chesapeake	100	42	22	924	58	$3	$32,955	$500	$462,000	$494,955	$2,512,000	5
119383	Rte 611 over Pohick Creek	Fairfax Co	1,100	52	24	1,248	1,048	$10	$1,984,848	$500	$624,000	$2,608,848	$10,485,000	4
121572	Rte 614 over Exol Swamp	King & Queen Co	200	50	24	1,200	150	$3	$85,227	$500	$600,000	$685,227	$3,651,000	5
												$38,189,712	$89,026,000	**2**

Assuming that the SYIP cost estimates are more reliable than the estimates from VDOT's tool, staff doubled the tool-based unit cost and thereby assumed that highway bridges cost $590 per sq. ft. in 2023 ($295 [above] x 2 = $590).

Trail Bridges

HRTPO staff found the cost of six (6) long trail bridges in Virginia and Washington DC:

- Trail bridge over I-495 at Tysons Corner
- Washington & Old Dominion (W&OD) bridge over US 29
- Two Anacostia River Trail (ART) bridges over CSX railroad
- Arboretum Bridge of the Anacostia River Trail (ART)
- Eddy Ave active transportation bridge in Salem

TABLE 4 Long Trail Bridges in Virginia and Washington DC
Source: HRTPO staff

bridge	year	length, ft	width, ft	area, sf	cost	cost/sf
Bridge over I-495 at Tysons	2017	300	14	4,200	$2,150,000	$512
W&OD over US 29	2020	623	21	13,083	$6,000,000	$459
Two ART bridges over CSX	2013	1,755	14	24,570	$12,000,000	$488
ART Arboretum Bridge	2022	400	14	5,600	$6,000,000	$1,071
Eddy Ave AT bridge (Salem)	2018	188	12	2,256	$1,088,308	$482
					say	$500/sf

To reflect higher construction inflation rates during the COVID period, staff inflated this $500 figure (assumed to represent 2018, the average year of the subject projects) for five years at 4% annual increase[5], and thus assumed that these trail bridges would cost $610 per sq. ft. in 2023 (500 x 1.04^5 = 608.3).

Averaging the *highway* bridge cost ($590/sqft, from previous section of this report) and the VA/DC *trail* bridge cost ($610/sqft, above), staff used **$600/sqft** for the cost model and **$45m/mile** for the Broad Creek bridge (600 x 5280' x 14' = $44,352,000).

[5] To reflect COVID inflation, staff used an annual rate higher than that used by the 2015 VDOT tool (3%). Staff recommends revisiting this rate as COVID-related inflation rates are published in the future.

Other Costs used for ERT Extension

Boardwalk Cost

Both ERT Extension routes included approximately one mile of boardwalk. Permatrak, a concrete boardwalk company, estimates that boardwalks cost between $50 and $120 per square foot[6]. For the ERT Extension, staff used $100 per sq. ft., or $7,400,000 per mile (100 * 5280' * 14' = $7,392,000). Because of the limited research, staff did not include a per-mile boardwalk cost in the cost model provided at the end of this report.

Cost of Minimal Improvements

For the ERT Extension cost estimates, staff assumed that route segments with minimal improvements—where a path exists, or where the route simply uses the existing street—have zero cost.

FIGURE 4 Elizabeth River Trail
Source: elizabethrivertrail.org

[6] https://www.permatrak.com/news-events/bid/97419/boardwalk-construction-estimates-how-much-does-a-boardwalk-cost

Applying the Cost Model to the ERT Extension

Having calculated per-mile costs above, staff used the document WPA prepared of the **recommended** and **alternative** routes to determine the lengths of each trail segment by environment type, whether "parallel to street", "bridge", "bikes use street", etc.

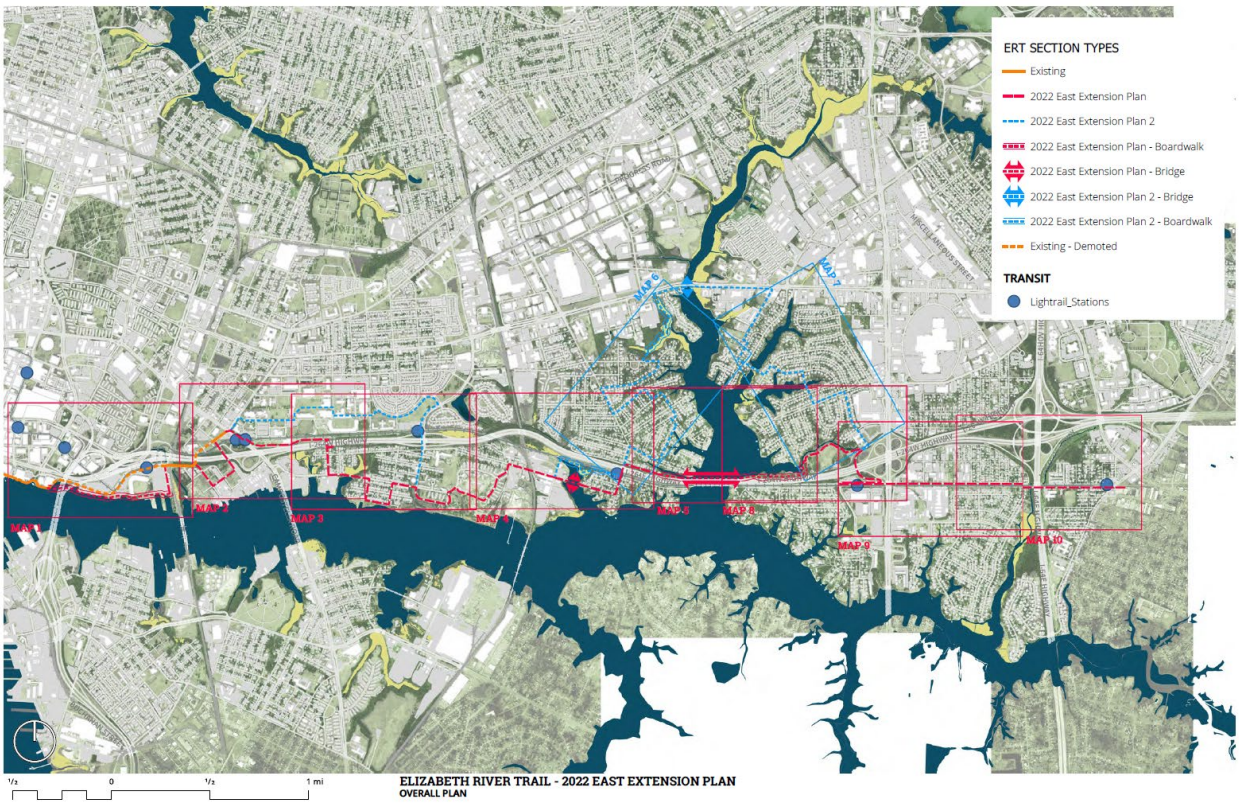


FIGURE 5 Elizabeth River Trail 2022 East Extension Plan
Source: WPA

In determining segment type, staff followed the document's indications (e.g. whether running on or beside a street), with the following exceptions:

- Where WPA showed the ERT Extension running on a street:
    - For **medium-volume streets** (Park Ave, Claiborne Ave, Kimball Terrace, Wiley Dr, Ingleside Rd, and Curlew Dr), staff assumed that the trail would actually be built parallel to the street, and costed it as such.
    - For **Westminster Ave**, staff assume that the trail would actually be built parallel to the street due to its **high truck volume**.
    - For **Reeves Ave**, staff costed the segment as being built "parallel to street" due to **vehicles being parked** along both sides of the street.
- Whereas WPA showed a proposed "boardwalk" **under the Berkley Bridge**, staff costed that segment as a "bridge", given the nearby marine traffic.
- Whereas WPA showed the trail using **Poplar Halls Elementary School** driveway and parking lot (as shown in the figure below), staff assumed a path parallel to the school's existing pavement.

FIGURE 6 Proposed Usage of Poplar Halls Elementary Property for ERT Extension
Source: WPA

Note that staff assumed **zero cost for segments running on a street**.

The environment type used for costing each segment of the ERT Extension is indicated on the tables in the following sections.

Recommended Route

The following table shows the cost estimate inputs for the recommended route.

TABLE 5 Cost Estimate Inputs for ERT Extension, recommended route

Source: HRTPO staff

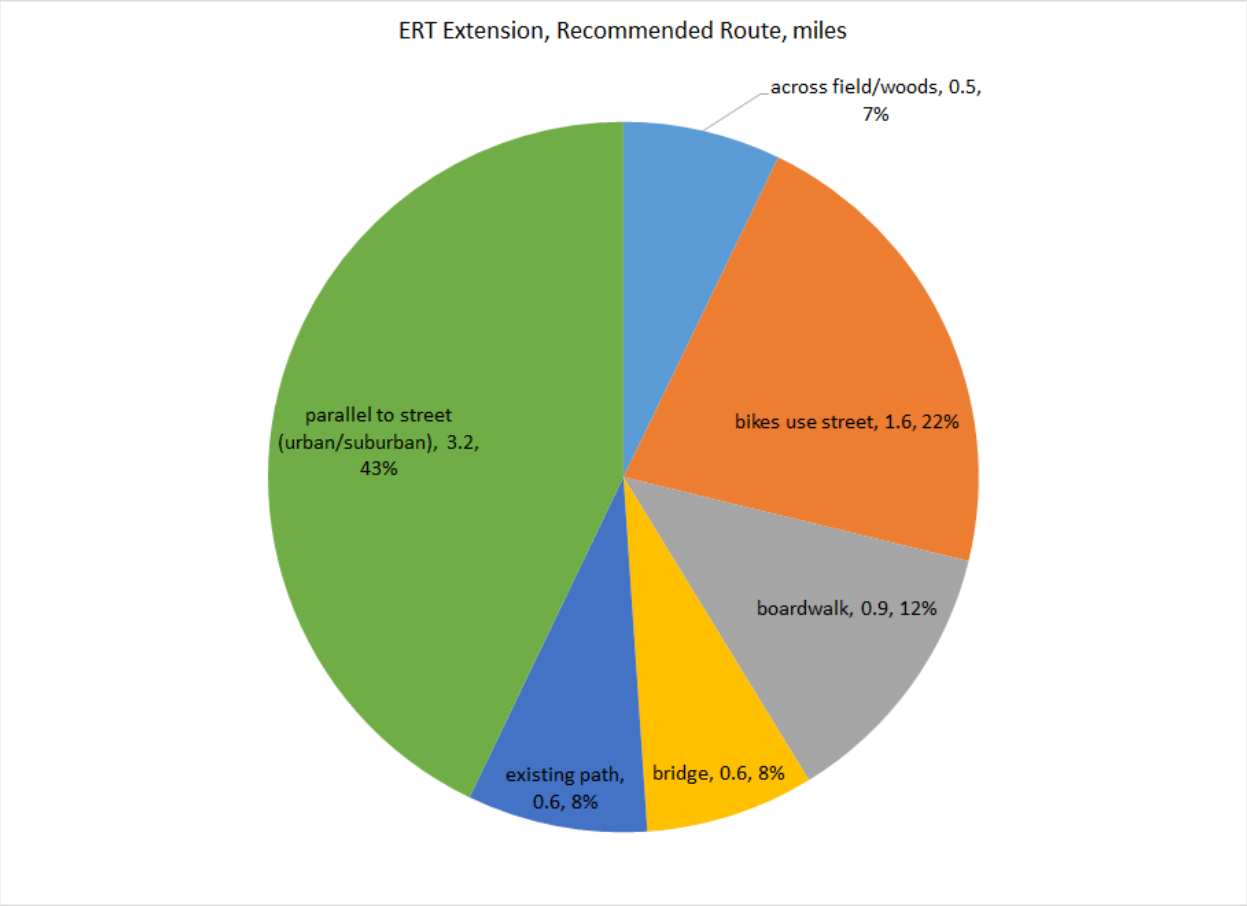
Segment	Length, mi	Environment Type	Cost/mi (2023)	Cost (2023)
bridge under I-264	0.13	bridge	$45,000,000	$6,072,443
across Harbor Pk area	0.47	boardwalk	$7,400,000	$3,461,742
parallel to railroad track	0.13	parallel to street (urban/suburban)	$6,000,000	$809,659
Park Ave- Holt St to Lovitt Ave	0.10	parallel to street (urban/suburban)	$6,000,000	$620,739
Park Ave- Lovitt Ave to Brown Ave	0.06	parallel to street (urban/suburban)	$6,000,000	$350,852
Brown Ave	0.14	bikes use street (no cost)	$0	$0
Reeves Ave	0.13	parallel to street (urban/suburban)	$6,000,000	$809,659
Claiborne Ave	0.18	parallel to street (urban/suburban)	$6,000,000	$1,079,545
Park Ave- Claiborne Ave to Brambleton Ave	0.08	existing path (no cost)	$0	$0
across the Park Ave / Brambleton Ave Int'n	0.02	parallel to street (urban/suburban)	$6,000,000	$134,943
Brambleton Ave- Park Ave to LRT	0.08	parallel to street (urban/suburban)	$6,000,000	$485,795
LRT Maintenance Facility (LRTMF) driveway	0.27	bikes use street (no cost)	$0	$0
Existing ped path- LRTMF to ped bridge	0.13	across field/woods	$1,400,000	$188,920
Existing ped bridge	0.18	existing path (no cost)	$0	$0
Thayor St	0.14	bikes use street (no cost)	$0	$0
Kimball Terrace- Thayor to Majestic	0.21	parallel to street (urban/suburban)	$6,000,000	$1,241,477
Majestic Ave	0.11	bikes use street (no cost)	$0	$0
Chesterfield Blvd	0.12	bikes use street (no cost)	$0	$0
Norchester Ave	0.11	bikes use street (no cost)	$0	$0
Kimball Terrace- Norchester to Kimball Loop	0.12	parallel to street (urban/suburban)	$6,000,000	$728,693
Kimball Loop	0.27	bikes use street (no cost)	$0	$0
Kimball Terrace- Kimball Loop to Wiley Dr	0.04	parallel to street (urban/suburban)	$6,000,000	$269,886
Wiley Dr (map 3 portion)	0.09	bikes use street (no cost)	$0	$0
Wiley Dr (map 4 portion)	0.19	parallel to street (urban/suburban)	$6,000,000	$1,133,523
Kimball Terrace- Wiley to Westminster	0.09	parallel to street (urban/suburban)	$6,000,000	$539,773
Westminter Ave- Kimball to bridge	0.31	parallel to street (urban/suburban)	$6,000,000	$1,835,227
Moseley Creek	0.07	bridge	$45,000,000	$3,238,636
Westminter Ave- bridge to Ingleside	0.18	bikes use street (no cost)	$0	$0
Ingleside Rd	0.16	parallel to street (urban/suburban)	$6,000,000	$944,602
Kentucky Ave (map 4 portion)	0.12	bikes use street (no cost)	$0	$0
Kentucky Ave (map 5 portion)	0.07	bikes use street (no cost)	$0	$0
between I-264 and finger of Broad Creek	0.10	boardwalk	$7,400,000	$732,292
Broad Creek	0.31	bridge	$45,000,000	$14,062,159
between I-264 and finger of Broad Creek	0.37	boardwalk	$7,400,000	$2,729,451
along finger of Broad Creek	0.36	existing path (no cost)	$0	$0
Military Hwy / Curlew Dr Conn (MCC) (at grade)	0.07	parallel to street (urban/suburban)	$6,000,000	$404,830
Military Hwy / Curlew Dr Conn (br over I-264)	0.06	bridge	$45,000,000	$2,556,499
Military Hwy / Curlew Dr Conn (MCC) (at grade)	0.13	parallel to street (urban/suburban)	$6,000,000	$809,659
Curlew Dr- MCC to Corp Blvd to MCC	0.40	across field/woods	$1,400,000	$566,761
Curlew Dr- MCC to Kidd Blvd	0.71	parallel to street (urban/suburban)	$6,000,000	$4,264,205
Curlew Dr- Kidd Blvd to Newtown Rd	0.48	parallel to street (urban/suburban)	$6,000,000	$2,860,795
	7.5			$52,932,768

A summary of this cost estimate for the recommended route follows.

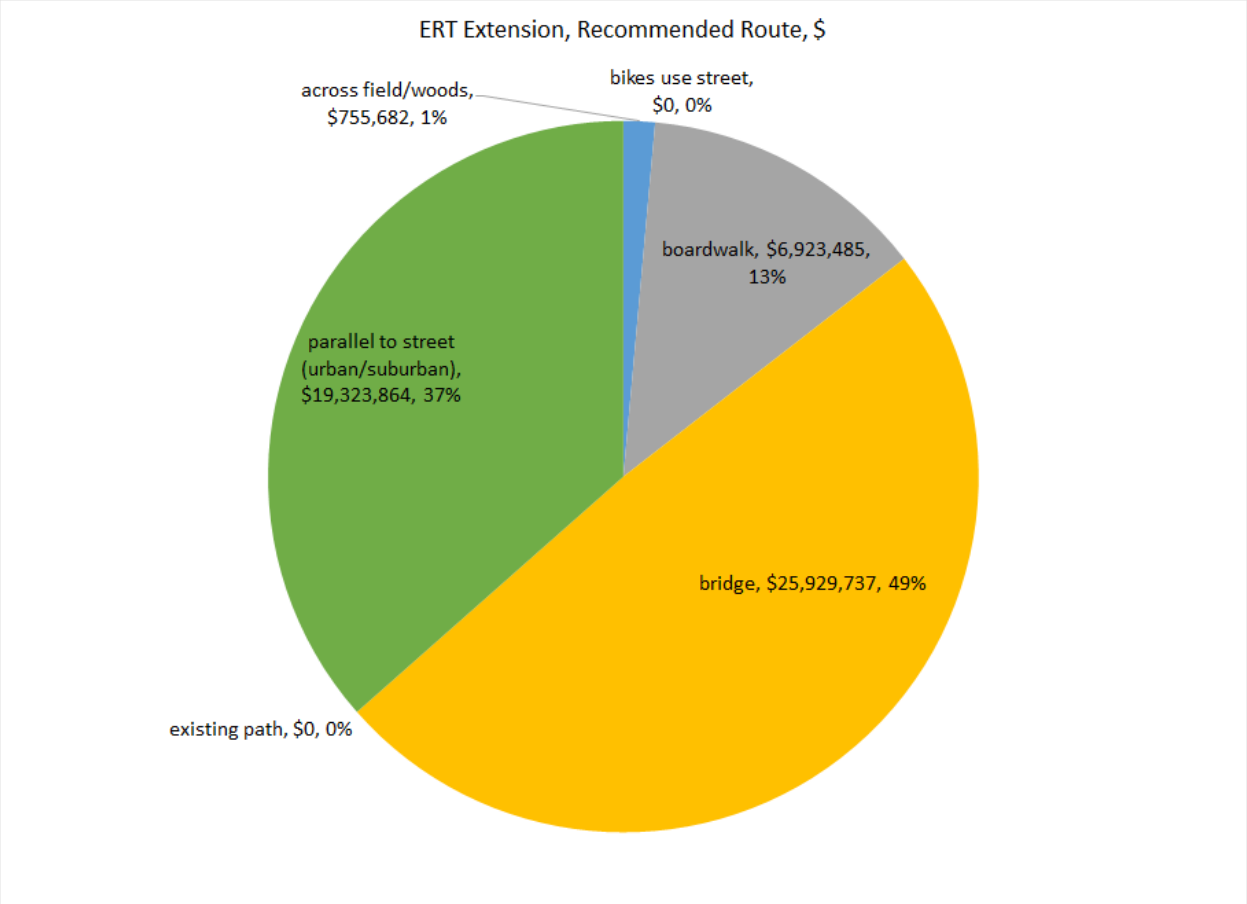
TABLE 6 Cost Estimate Summary for ERT Extension, recommend route

Source: HRTPO staff

Environment Type	Sum of Length, mi	Sum of Cost (2023)
across field/woods	0.5	$755,682
bikes use street	1.6	$0
boardwalk	0.9	$6,923,485
bridge	0.6	$25,929,737
existing path	0.6	$0
parallel to street (urban/suburban)	3.2	$19,323,864
	7.5	$52,932,768



Even with the exceptions noted above, 22% of the recommended route falls on existing streets.



The bridges comprise half of the cost of the recommended route, including $14m for the Broad Creek Bridge.

Alternative Route

TABLE 7 Cost Estimate Inputs for Elizabeth River Trail Extension, alternative route

Source: HRTPO staff

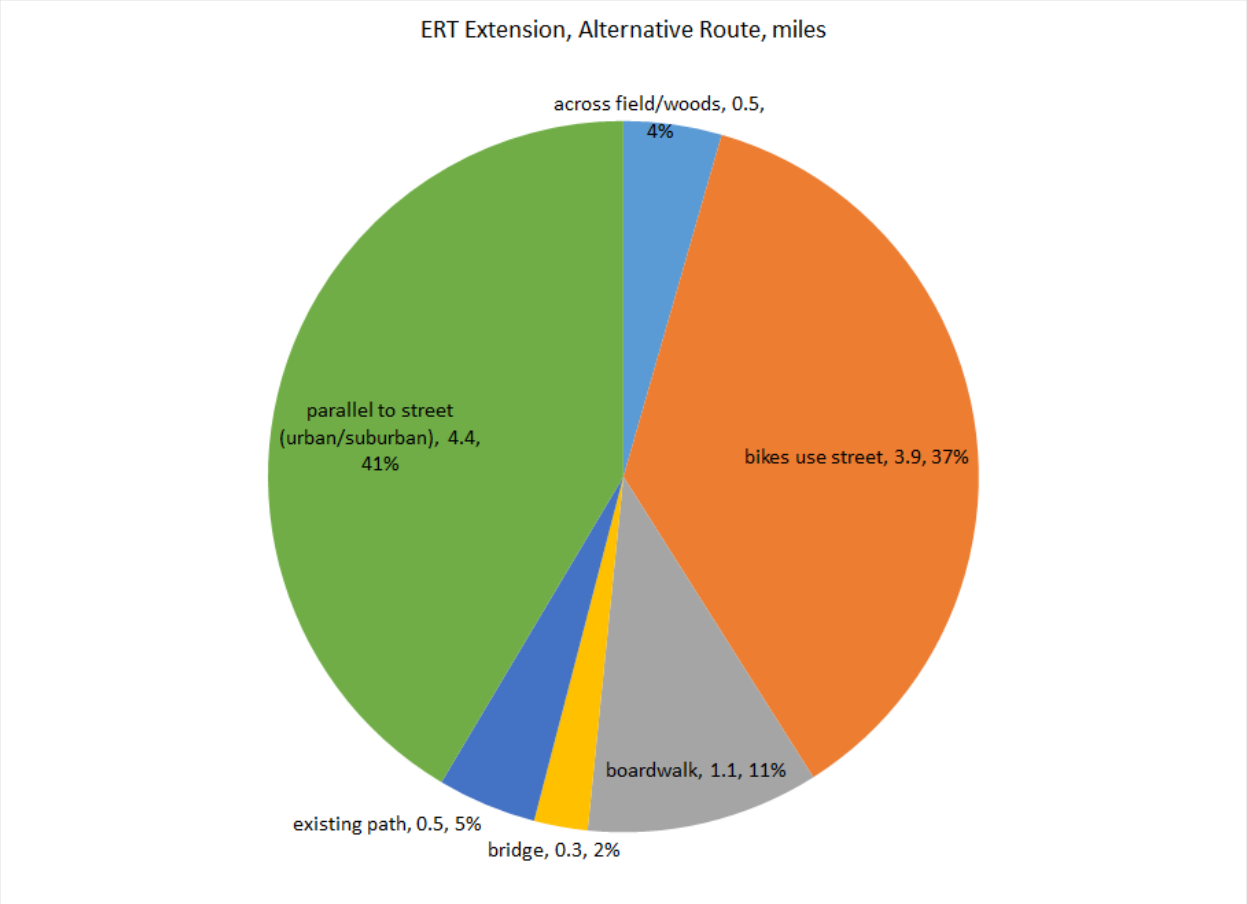
Segment	Length, mi	Environment Type	Cost/mi (2023)	Cost (2023)
bridge under I-264	0.13	bridge	$45,000,000	$6,072,443
across Harbor Pk area	0.47	boardwalk	$7,400,000	$3,461,742
parallel to railroad track	0.13	parallel to street (urban/suburban)	$6,000,000	$809,659
Park Ave- Holt St to Lovitt Ave	0.10	parallel to street (urban/suburban)	$6,000,000	$620,739
Park Ave- Lovitt Ave to Brown Ave	0.06	parallel to street (urban/suburban)	$6,000,000	$350,852
Brown Ave	0.14	bikes use street (no cost)	$0	$0
Reeves Ave	0.13	parallel to street (urban/suburban)	$6,000,000	$809,659
Claiborne Ave	0.18	parallel to street (urban/suburban)	$6,000,000	$1,079,545
Park Ave- Claiborne Ave to Brambleton Ave	0.08	existing path (no cost)	$0	$0
across the Park Ave / Brambleton Ave Int'n	0.02	parallel to street (urban/suburban)	$6,000,000	$134,943
Park Ave- Brambleton to Presidential	0.08	parallel to street (urban/suburban)	$6,000,000	$485,795
Presidential Pkwy	0.28	bikes use street (no cost)	$0	$0
path running behind library	0.03	existing path (no cost)	$0	$0
path running to bell tower	0.04	existing path (no cost)	$0	$0
path running from bell tower to Gym Rd	0.16	existing path (no cost)	$0	$0
Gym Rd	0.04	bikes use street (no cost)	$0	$0
Pres'l Pkwy- fr Gym Rd to Middle Towne Cres	0.24	bikes use street (no cost)	$0	$0
Middle Towne Crescent	0.36	parallel to street (urban/suburban)	$6,000,000	$2,159,091
Ballentine Blvd	0.45	parallel to street (urban/suburban)	$6,000,000	$2,698,864
Kimball Loop	0.27	bikes use street (no cost)	$0	$0
Kimball Terrace- Kimball Loop to Wiley Dr	0.04	parallel to street (urban/suburban)	$6,000,000	$269,886
Wiley Dr (map 3 portion)	0.09	bikes use street (no cost)	$0	$0
Wiley Dr (map 4 portion)	0.19	parallel to street (urban/suburban)	$6,000,000	$1,133,523
Kimball Terrace- Wiley to Westminster	0.09	parallel to street (urban/suburban)	$6,000,000	$539,773
Westminter Ave- Kimball to Stapleton	0.24	parallel to street (urban/suburban)	$6,000,000	$1,457,386
Stapleton St	0.09	parallel to street (urban/suburban)	$6,000,000	$539,773
Moseley Creek	0.01	bridge	$45,000,000	$425,071
along Moseley Creek	0.27	boardwalk	$7,400,000	$1,997,159
Mississippi Ave	0.08	bikes use street (no cost)	$0	$0
Ingleside Rd- Mississippi to Riverside	0.16	parallel to street (urban/suburban)	$6,000,000	$944,602
Riverside Dr- Ingleside to Oak	0.12	bikes use street (no cost)	$0	$0
Riverside Dr- Oak to Jasmine	0.05	bikes use street (no cost)	$0	$0
Jasmine Ave	0.21	bikes use street (no cost)	$0	$0
Townsend Pl	0.04	bikes use street (no cost)	$0	$0
Peake Rd	0.03	bikes use street (no cost)	$0	$0
Fontaine Ave	0.14	bikes use street (no cost)	$0	$0
Garfield Ave	0.05	bikes use street (no cost)	$0	$0
Hadley Rd	0.06	bikes use street (no cost)	$0	$0
North Ingleside Dr (NID)	0.21	bikes use street (no cost)	$0	$0
Ingleside Rd- NID to Karlin Ave	0.15	parallel to street (urban/suburban)	$6,000,000	$890,625
Karlin Ave	0.36	bikes use street (no cost)	$0	$0
Trant Ave	0.08	bikes use street (no cost)	$0	$0
woods on north side of Trant Ave	0.05	across field/woods	$1,400,000	$75,568
along fingers of Broad Creek	0.38	boardwalk	$7,400,000	$2,829,309
frontage road along VB Blvd	0.18	bikes use street (no cost)	$0	$0
Broad Creek	0.06	bridge	$45,000,000	$2,556,903
VB Blvd- proposed bridge to Pecan Point Rd	0.39	parallel to street (urban/suburban)	$6,000,000	$2,321,023
Pecan Point Rd	0.29	bikes use street (no cost)	$0	$0
Doswell St	0.03	bikes use street (no cost)	$0	$0
Red Mill Rd	0.10	bikes use street (no cost)	$0	$0
River Edge Rd	0.15	bikes use street (no cost)	$0	$0
Bayberry Dr	0.06	bikes use street (no cost)	$0	$0
Barnhollow Rd	0.18	bikes use street (no cost)	$0	$0
Duck Pond Rd	0.18	bikes use street (no cost)	$0	$0
Poplar Hall Dr	0.17	existing path (no cost)	$0	$0
Piping Rock Rd- Poplar Hall to Pebble	0.21	bikes use street (no cost)	$0	$0
Poplar Halls Elem Sch driveway and parking lot	0.08	parallel to street (urban/suburban)	$6,000,000	$485,795
between sch parking lot and MCC (see below)	0.01	across field/woods	$1,400,000	$18,892
Military Hwy / Curlew Dr Conn (MCC) (at grade)	0.11	parallel to street (urban/suburban)	$6,000,000	$647,727
Military Hwy / Curlew Dr Conn (br over I-264)	0.06	bridge	$45,000,000	$2,556,499
Military Hwy / Curlew Dr Conn (MCC) (at grade)	0.13	parallel to street (urban/suburban)	$6,000,000	$809,659
Curlew Dr- MCC to Corp Blvd to MCC	0.40	across field/woods	$1,400,000	$566,761
Curlew Dr- MCC to Kidd Blvd	0.71	parallel to street (urban/suburban)	$6,000,000	$4,264,205
Curlew Dr- Kidd Blvd to Newtown Rd	0.48	parallel to street (urban/suburban)	$6,000,000	$2,860,795
	10.6			$46,874,268

The cost of the alternative route ($47m) is similar to that of the recommended route ($53m). The alternative route's large number of segments (64 segments, vs. 41 segments for the recommended route) would make it more difficult for a cyclist to follow. The alternative route (10.6 mi.) is much longer than the recommended route (7.5 mi.). A summary of the cost estimate for the alternative route follows.

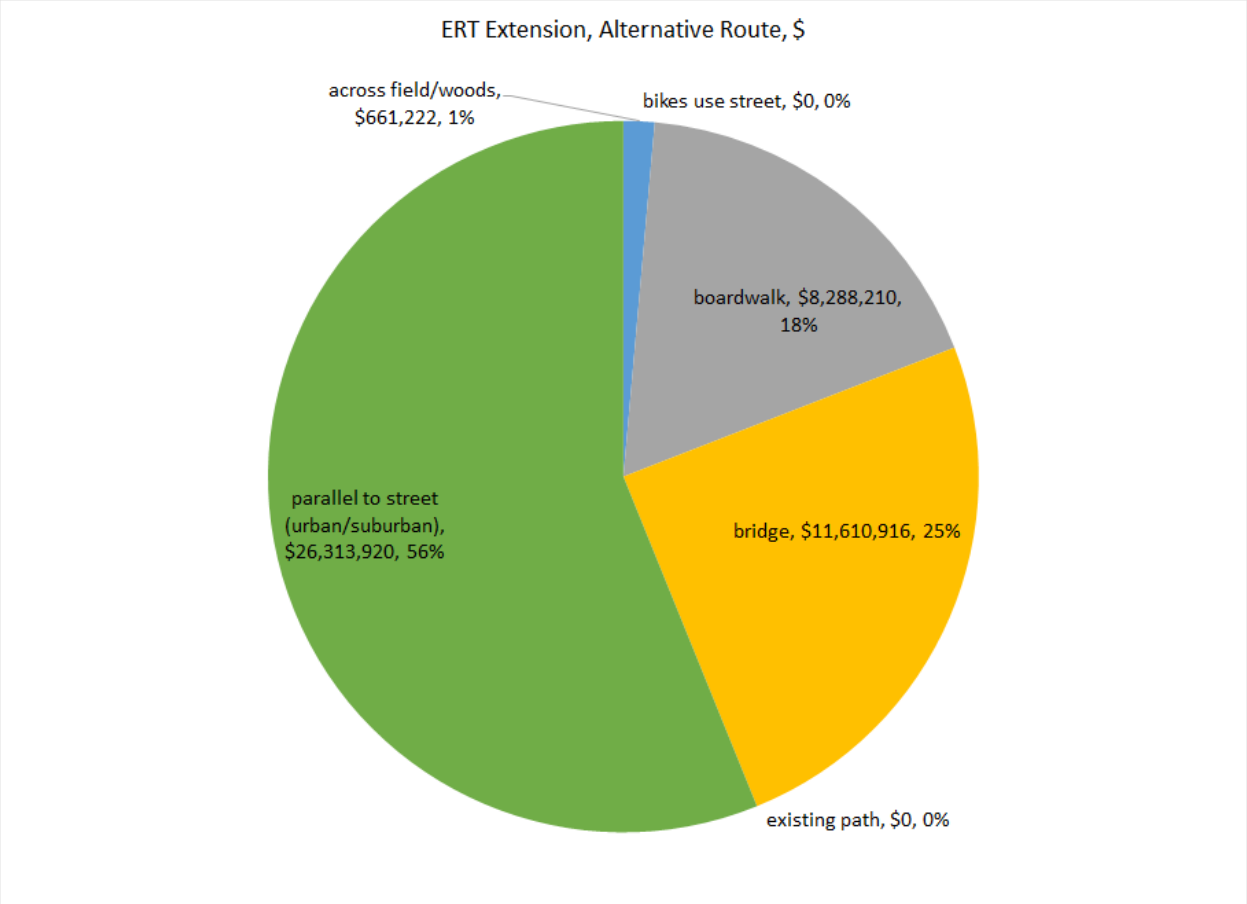
TABLE 8 Cost Estimate Summary for ERT Extension, alternative route
Source: HRTPO staff

Environment Type	Sum of Length, mi	Sum of Cost (2023)
across field/woods	0.5	$661,222
bikes use street	3.9	$0
boardwalk	1.1	$8,288,210
bridge	0.3	$11,610,916
existing path	0.5	$0
parallel to street (urban/suburban)	4.4	$26,313,920
	10.6	$46,874,268

FIGURE 7 Street Proposed for Usage on Alternative Route of ERT Extension
Source: Google Maps



Even with the exceptions noted above, 37% of the recommended route falls on existing streets.



The bridges being much shorter on the alternative route, they comprise only 25% of the cost of the alternative route.

Issues Found

Although the purpose of the project was simply to estimate the cost of the two routes, staff also documented issues related to the proposed routing, as described in the section below.

Comfort/Safety Issues

As discussed in the section above, for the cost estimates staff deviated from the WPA plan in the following ways:

- Instead of the trail using the existing pavement of **medium volume streets**, providing a path parallel to these streets may be safer and more comfortable for cyclists. (An example [Kimball Terrace] is shown in the figure below.)
- Instead of the trail using a street which has significant **truck traffic**, providing a path parallel to this street may be safer and more comfortable for cyclists.
- Instead of the trail using the existing pavement of a street which has **autos parked along both sides**, providing a path parallel to this street may be safer and more comfortable for cyclists.
- Instead of the trail using the **driveway and parking lot of a school**, providing a path parallel to the driveway may be safer and more comfortable for cyclists.

See the cost estimation section above for the specific streets/segments involved.

FIGURE 8 Proposed ERT Extension on Existing Pavement of Kimball Terrace
Source: WPA

Feasibility Issues

Although the WPA document shows the ERT Extension using the driveway of **HRT's light rail maintenance facility** near Norfolk State University, the feasibility of routing across the property is uncertain.

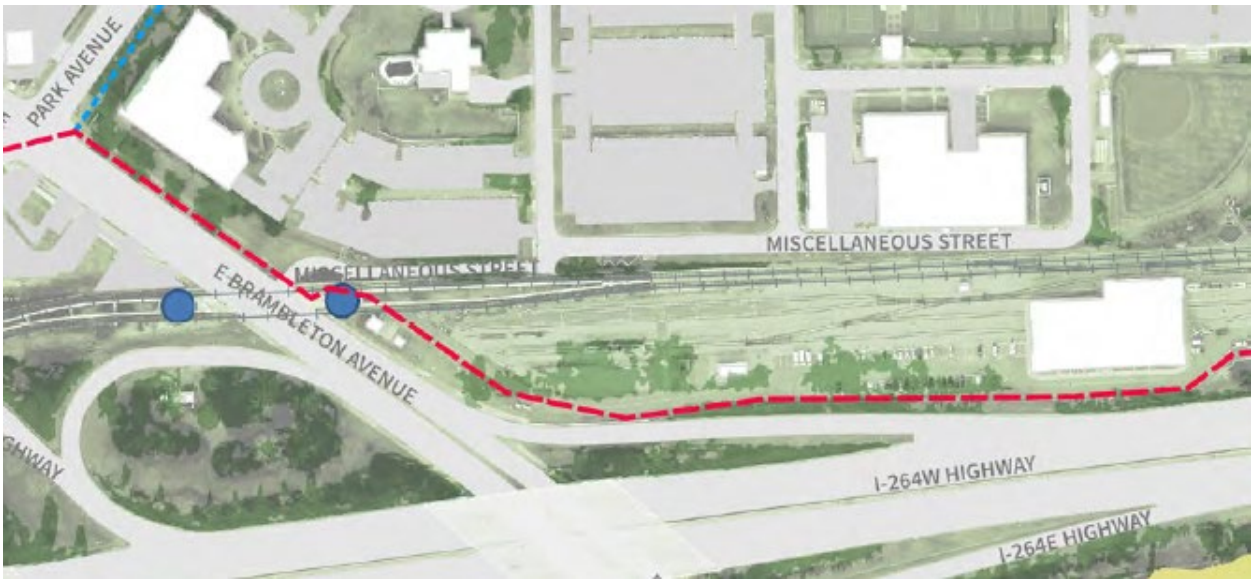


FIGURE 9 Proposed ERT Extension through HRT Light Rail Maintenance Facility
Source: WPA

Aesthetic Issues

Although the WPA document (below) shows the ERT Extension running on **Brown, Reeves, and Claiborne Avenues** near industrial areas, running it along[7] **Park Avenue** would be a more scenic (and direct) route.

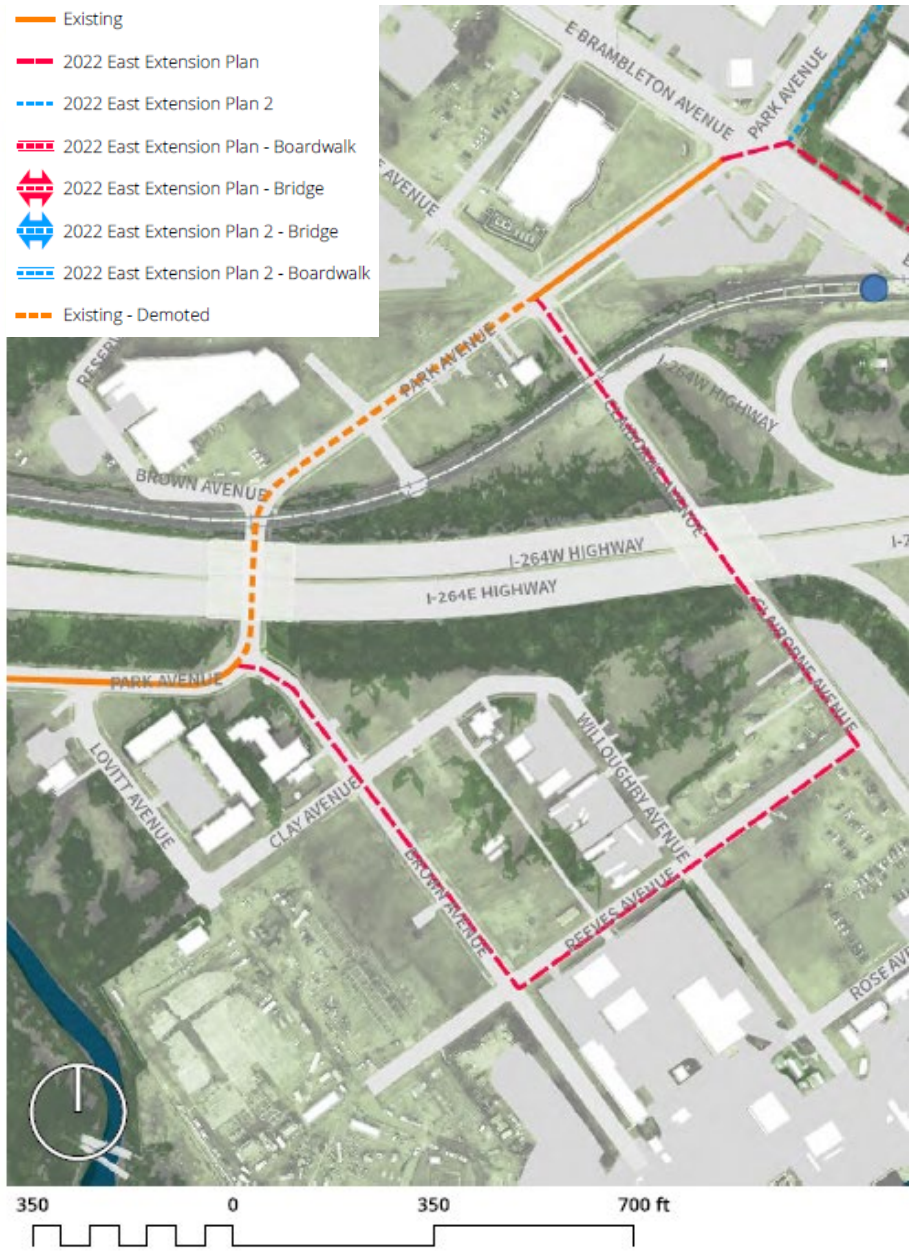


FIGURE 10 Brown Ave, Reeves Ave, and Park Ave
Source: Google Maps

[7] Although WPA shows segments of the ERT Extension running ON Park Avenue (solid orange lines), due to Park Avenue's vehicular volume, staff assumed that the Park Avenue segments of the ERT Extension would be built PARALLEL to Park Avenue's pavement (as noted in the "Applying the Cost Model" section above).

Cost Issues

Instead of constructing a boardwalk or bridge for the ERT Extension under the Berkley Bridge, it would be less expensive to use the existing ERT route (a path parallel to Water Street).

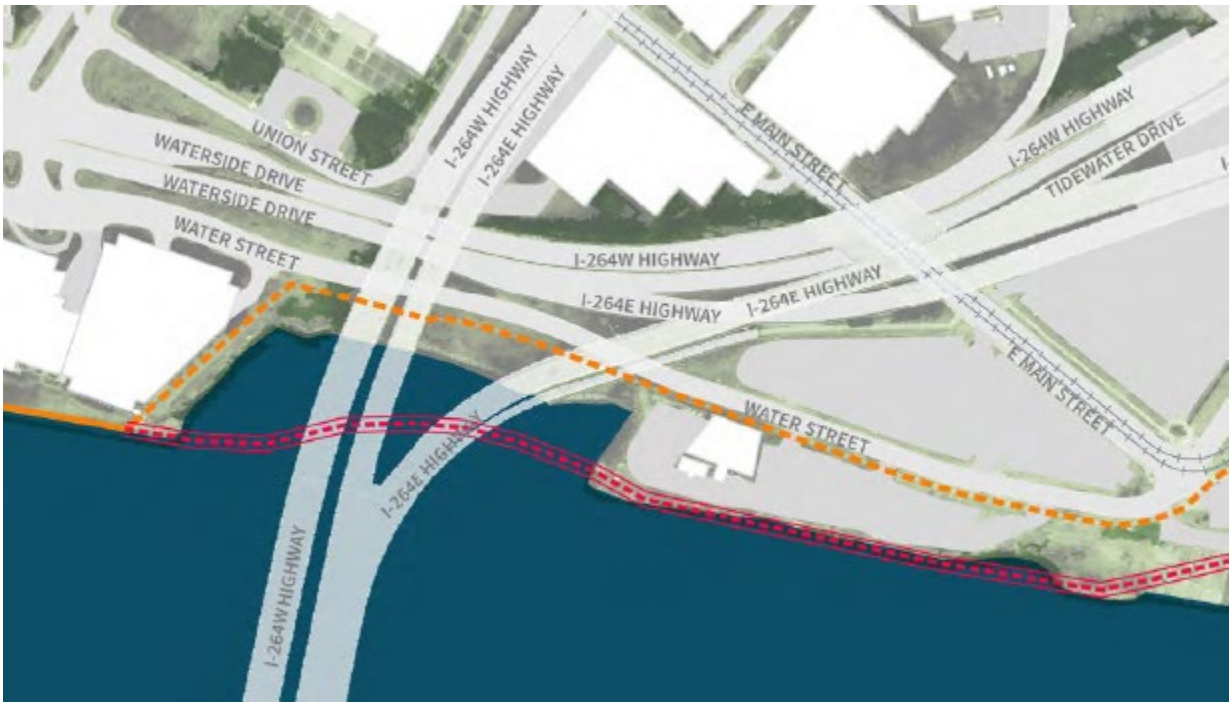


FIGURE 11 Existing and Proposed Elizabeth River Trail
Source: WPA

Summary and Next Steps

Trail Cost Model Summary

The cost model developed here is based on a detailed review of:

- Trail projects in VDOT's SYIP
- VDOT's highway bridge cost estimation tool
- Highway bridge projects in VDOT's SYIP
- Trail bridge projects in Virginia and DC

The key components of the cost model developed for, and used in, estimating the cost of the subject trail are provided in the table below for use by engineers and planners in costing other trails.

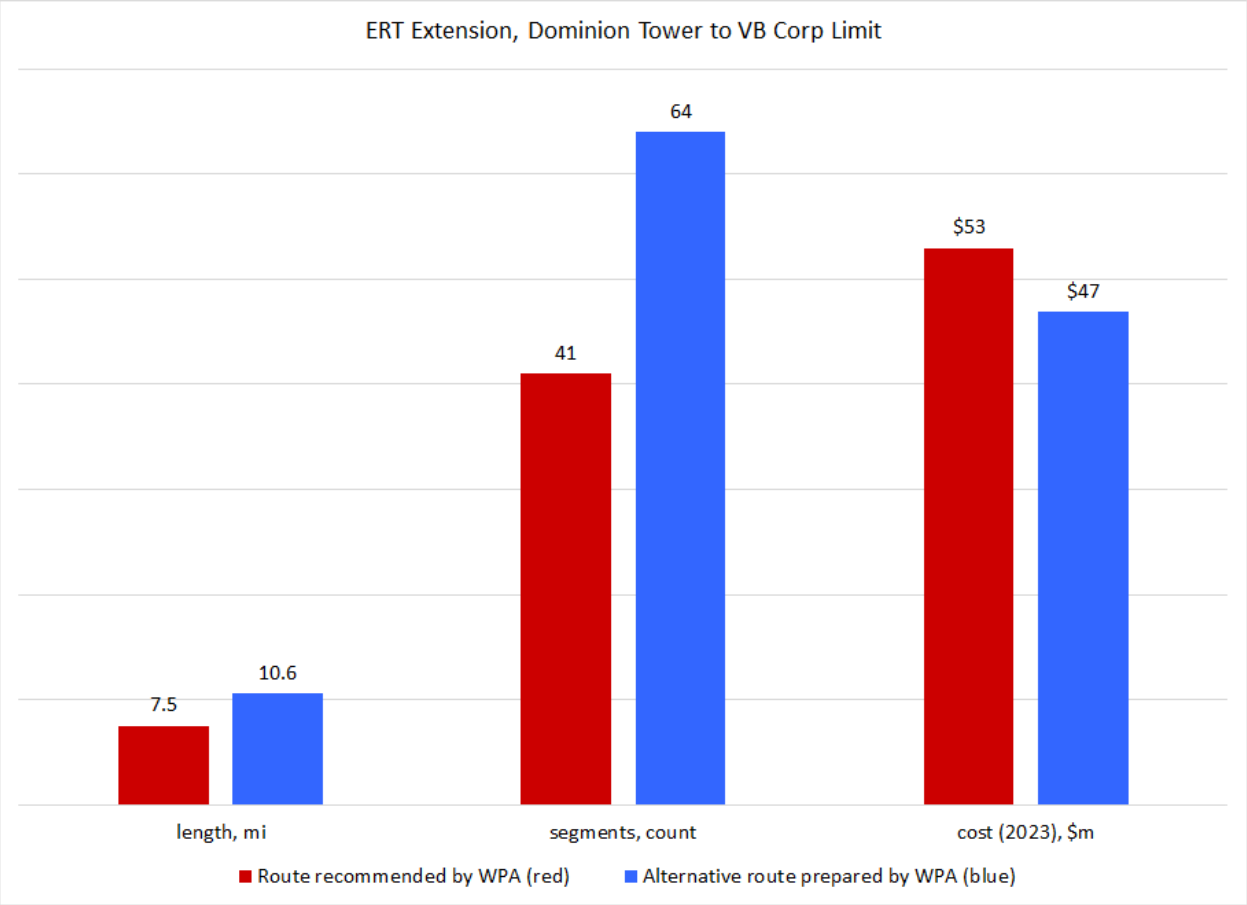
TABLE 9 Trail and Bridge Cost Model
Source: HRTPO staff

I. regular trail cost (i.e. without bridges)

environment type	PE cost per mile	RW cost per mile	CN cost per mile	Total cost per mile	**total cost, rounded (2023)**	
across field/woods	$243,054	$29,652	$1,136,587	$1,409,526	**$1,400,000**	per mile
parallel to road (rural)	$219,584	$272,440	$1,306,818	$1,798,789	**$1,800,000**	per mile
rail trail	$248,398	$318,672	$1,323,502	$1,890,618	**$1,900,000**	per mile
parallel to creek/river	$640,046	$322,900	$3,253,970	$4,216,686	**$4,200,000**	per mile
parallel to street (urban/suburban)	$654,218	$1,239,736	$4,103,642	$5,997,652	**$6,000,000**	per mile

II. bridge cost **$600** per sqft

ERT Extension Summary



Although approximately the same cost, the recommended route is significantly shorter and less circuitous (has fewer segments) than the alternative route.

Next Steps for the ERT Extension

HRTPO staff met with the City of Norfolk staff in January 2023 to present these findings. The Norfolk staff plan to meet with the ERT Foundation to discuss these findings and identify next steps. HRTPO staff will continue to work with the city staff, as needed, in support of the ERT Extension.