

A New Cost Model for Trails

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To VASITE
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Impetus

- The City of Norfolk asked the HRTPO to **estimate the cost** of two routes extending the Elizabeth River Trail (ERT) to the Va. Beach line.
 - The ERT currently runs 10.5 miles along the Norfolk waterfront.
 - It runs from Norfolk International Terminals to Norfolk State University.
 - One of the proposed extension routes includes a **long bridge** (1,650').
- So HRTPO staff **developed a cost model**—based on other trails and bridges—to use for estimating route costs.



Components of the cost model

- Regular trail cost
 - i.e. cost excluding bridges
- Bridge cost



Regular trail costs

- Source: VDOT Six-Year Improvement Program (**SYIP**)
 - 64 trails of various statuses (programmed, under construction, complete)
 - trails from across the Commonwealth of Virginia
- Focus: trails that **exclude bridges**
- Technique: categorize trails **by type of environment**, e.g.:
 - “across fields/woods”
 - “parallel to creek/river”
 - “parallel to road (rural)”
 - “parallel to street (urban/suburban)”
 - “rail trail”

Regular trail data

Blowup of excerpt

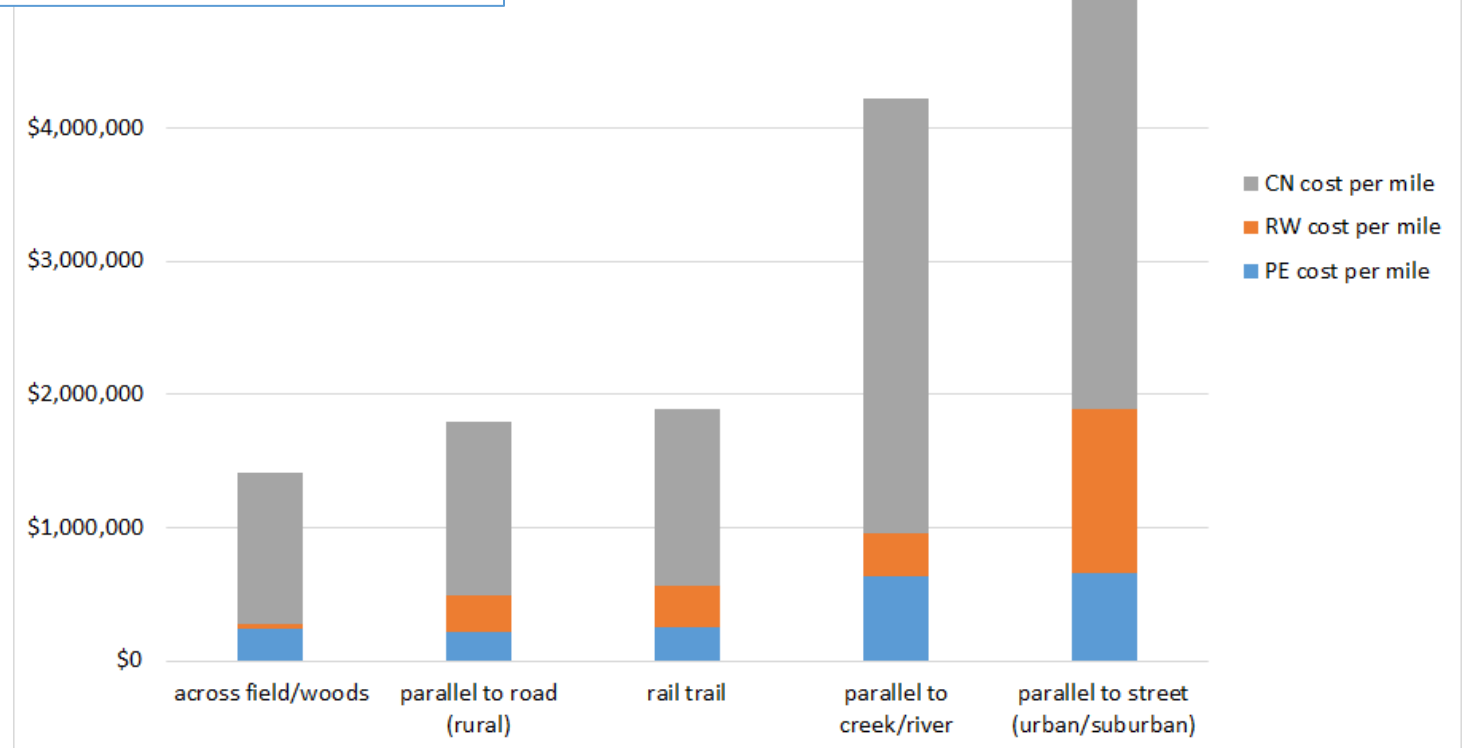
| <u>UPC</u> | <u>trail</u> | <u>location</u> | <u>length,</u> <u>mi</u> | <u>environment type</u> | <u>total cost</u> <u>(PE, RW, CN)</u> |
|------------|--|-------------------|-----------------------------|-------------------------------|--|
| 17563 | Greenbelt Trail | Big Stone Gap | 0.74 | along 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 | Pottick Stream Valley Trail- Ph 1 | 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 - Beaugard 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 |

| <u>UPC</u> | <u>trail</u> | <u>location</u> | <u>length,</u> <u>mi</u> | <u>environment type</u> | <u>total cost</u> <u>(PE, RW, CN)</u> |
|------------|---|------------------|-----------------------------|-------------------------------|--|
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| | | | | | |
|--------|---|-----------------|-------|-------------------------------|--------------|
| 10975 | James River Branch Rail to Trail Greenway | Richmond | 0.54 | along creek/river | \$7,546,000 |
| 10975 | James River Branch Rail to Trail Greenway | Richmond | 2 | along street (urban/suburban) | \$5,861,000 |
| 10975 | James River Branch Rail to Trail Greenway | Richmond | 0.17 | across field/woods | \$406,000 |
| 118966 | Fall Line Trail- Dupuy Rd to Westover Ave | Chesterfield Co | 0.5 | along street (urban/suburban) | \$1,092,000 |
| 119219 | Western Branch Rails to Trails Ph 2 | Chesapeake | 0.24 | along road (rural) | \$589,000 |
| 119230 | Seaboard Coastline Trail Ph 3A | Suffolk | 0.25 | along street (urban/suburban) | \$1,046,000 |
| 119598 | Ashland Petersburg Trail- Walmsley to Bellemeade | Richmond | 1.78 | along creek/river | \$16,953,000 |
| 119600 | Ashland Petersburg Trail- Falling Crk Ave to Food Lion | Chesterfield Co | 1.6 | along creek/river | \$2,079,000 |
| 120974 | Bankside Trail- Ph 1 | Fredericksburg | 0.45 | rail trail | \$208,000 |
| 121044 | Farmville Riverwalk Trail- Ph 1 | Farmville | 0.3 | across field/woods | \$537,000 |
| 121104 | Chesapeake Trail- Ph 2 | Chesapeake | 0.6 | across field/woods | \$462,000 |
| 121107 | Chesapeake Trail- Ph 3 | Chesapeake | 1.58 | rail trail | \$1,176,000 |
| 121109 | Seaboard Coastline Trail Ph 3B | Suffolk | 0.225 | along street (urban/suburban) | \$298,000 |
| 121110 | BoAT MUP Warwick, Elmhurst, & Yorktown | Newport News | 0.09 | along creek/river | \$436,000 |
| 121208 | Riverwalk Ph III | Bridgewater | 0.47 | along creek/river | \$561,000 |
| 121411 | Courthouse Trail | Chesterfield Co | 0.07 | along street (urban/suburban) | \$188,000 |
| 121760 | N 21st St Multiuse Trail Ph 1 | Purcellville | 1 | along creek/river | \$1,090,000 |
| T26683 | Arlington Blvd Trail- Edison St to George Mason Dr Ph 1 | Arlington Co | 0.34 | along creek/river | \$534,000 |
| | | | 1.32 | rail trail | \$4,223,000 |
| | | | 0.172 | along street (urban/suburban) | \$966,000 |
| | | | 0.6 | along street (urban/suburban) | \$4,757,000 |
| | | | 0.5 | along street (urban/suburban) | \$3,524,000 |
| | | | 2 | rail trail | \$13,125,000 |
| | | | 0.47 | rail trail | \$1,416,000 |
| | | | 1.2 | rail trail | \$2,576,000 |
| | | | 1.75 | rail trail | \$3,452,000 |
| | | | 2.1 | along street (urban/suburban) | \$16,171,000 |
| | | | 0.54 | along street (urban/suburban) | \$12,547,000 |
| | | | 0.5 | along creek/river | \$2,050,000 |
| | | | 0.123 | across field/woods | \$1,075,000 |
| | | | 0.93 | rail trail | \$998,000 |
| | | | 1 | rail trail | \$2,610,000 |
| | | | 1.33 | rail trail | \$2,270,000 |
| | | | 1.06 | along street (urban/suburban) | \$2,909,000 |
| | | | 0.25 | along creek/river | \$480,000 |
| | | | 0.22 | along street (urban/suburban) | \$549,000 |
| | | | 0.13 | along street (urban/suburban) | \$1,506,000 |
| | | | 0.76 | along street (urban/suburban) | \$1,999,000 |

Average per-mile regular trail costs, by environment

| environment type | Projects | Sum of | PE cost per | RW cost per | CN cost per | Total cost | total cost per |
|-------------------------------------|----------|---------|-------------|-------------|-------------|-------------|--------------------|
| | | length. | mile | mile | mile | per mile | mile, rounded |
| 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 | | | | | | |



Bridge costs

- Sources examined:

- Trail bridges
- Highway bridges

- Process followed:

1. Examined the cost of **highway bridges** via VDOT tool
2. Checked the VDOT tool, obtaining a modified cost of **highway bridges**
3. Examined the cost of **trail bridges** via six actual trail bridges
4. Averaged hwy. and trail bridge unit costs, obtaining a **unit cost for the model**

Highway bridges

- VDOT tool: “Statewide Planning Level Cost Estimates”
 - \$180-\$250 per square foot (2015)
 - Inflating to today: **\$295/sqft (2023)**



Modifying VDOT tool cost

- For 14 non-Interstate bridges, compared:
 - **VDOT-Tool-based** cost estimate prepared by HRTPO staff
 - **VDOT Six-Year Improvement Program (SYIP)** cost estimate

| UPC [A] | project [B] | location [C] | total project length [D] | bridge length [E] | bridge width [F] | bridge area [G=E*F] | bridge work [H=D-E] | road unit cost [I] | bridge unit cost [J] | total project construction cost [K] | 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 Occohannock 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 | |

Found the SYIP estimates to be **twice** the tool-based estimates, therefore highway bridges: $\$295 \times 2 = \mathbf{\$590/sqft}$.

Trail bridges (long) in Virginia and Washington DC

| <u>bridge</u> | <u>year</u> | <u>length, ft</u> | <u>width, ft</u> | <u>area, sf</u> | <u>cost</u> | <u>cost/sf</u> |
|-----------------------------|-------------|-------------------|------------------|-----------------|--------------|----------------|
| 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 |

Inflated to today: **\$610/sf (2023)**



Bridge costs

- **Trail** bridges \$610/sqft (above)
- **Highway** bridges \$590/sqft (above)
- For **new trail model**, use **\$600/sqft** (avg.)

Example application of new cost model

- Subject trail
 - ERT Extension
- Note
 - Unit costs vary by **environment**
 - **Bridge** segments are included

| <u>Segment</u> | <u>Length</u> mi | <u>Environment Type</u> | <u>Cost/mi</u> (2023) | <u>Cost</u> (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 |
| Westminster 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 |
| Westminster 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 |
| | <u>7.5</u> | | | <u>\$52,932,768</u> |

Summary

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

| <u>environment type</u> | <u>PE cost per mile</u> | <u>RW cost per mile</u> | <u>CN cost per mile</u> | <u>Total cost per mile</u> | <u>total cost, rounded (2023)</u> |
|-------------------------------------|-------------------------|-------------------------|-------------------------|----------------------------|-----------------------------------|
| 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



Engineers can use it to 1) **choose** between alternatives, and 2) **prepare** cost estimates for planned projects.