

I-95/I-64 Corridor – Low Bridge Warning Systems

ESTIMATED PROJECT COSTS

Map ID Number	Proposed Location*	Preliminary Engineering	ROW and Utility Relocation	Construction	Total
1	SB I-95 North of Bryan Park Interchange	\$10,000	-	\$30,000	\$40,000
2	NB I-95 South of the James River	\$10,000	-	\$30,000	\$40,000
3	EB I-64 West of Bryan Park Interchange	\$10,000	-	\$30,000	\$40,000
4	WB I-64 East of the Shockoe Valley Bridge	\$10,000	-	\$30,000	\$40,000
Total Cost =		\$40,000	\$0	\$120,000	\$160,000

*Final locations should consider low bridges adjacent to the study corridor and alternate routes that can accommodate heavy vehicle traffic.

EXISTING CONDITIONS

Many existing bridges throughout the I-95/I-64 study corridor do not meet the geometric standard for vertical clearance on an urban interstate of 16.5 feet; these bridges are identified on the maps below in red.

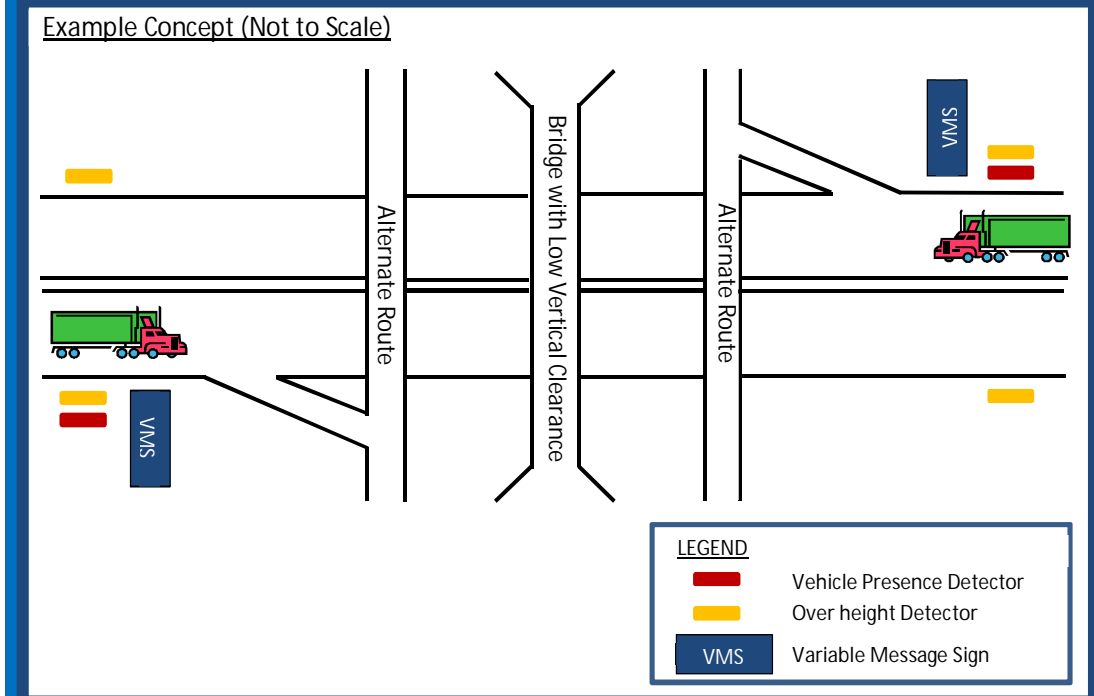
PROJECT BENEFITS

The benefits of installing a low bridge warning system include improvements to safety and operations throughout the corridor.

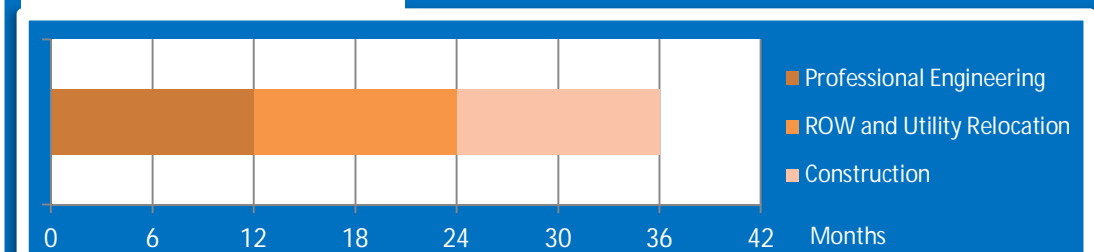
- Minimizes the risk of high vehicles striking low bridges.
- Avoids traffic delays experienced due to a bridge strike.

PROJECT DESCRIPTION

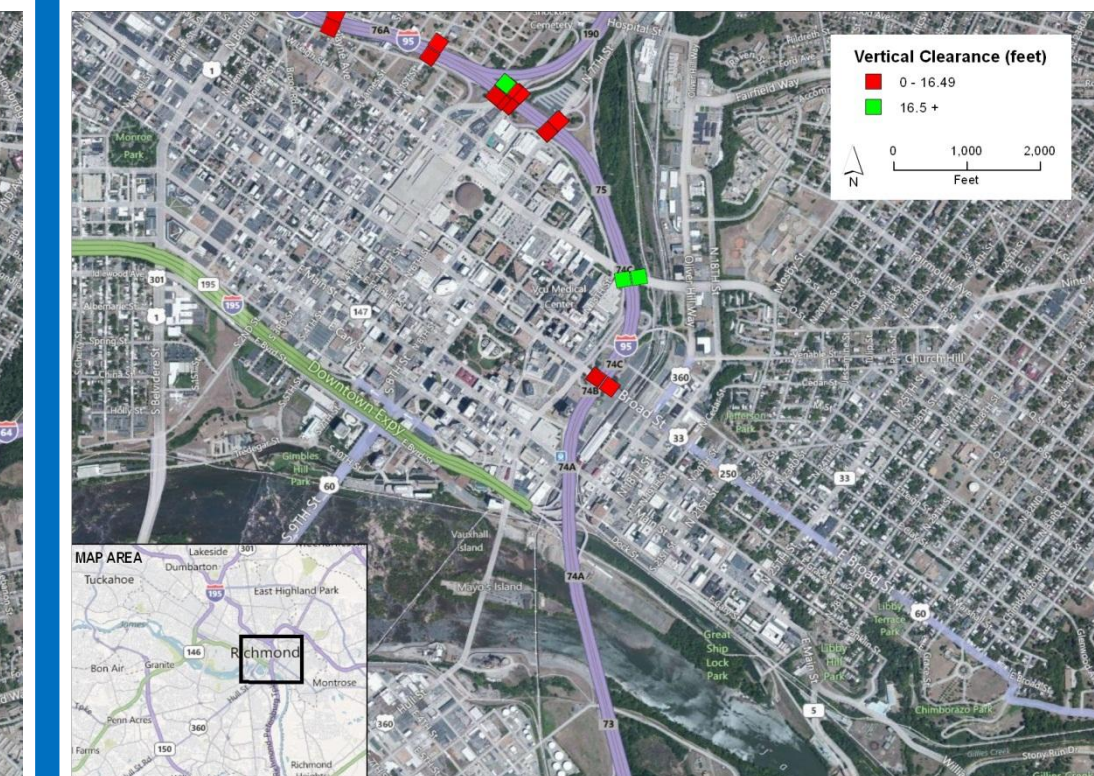
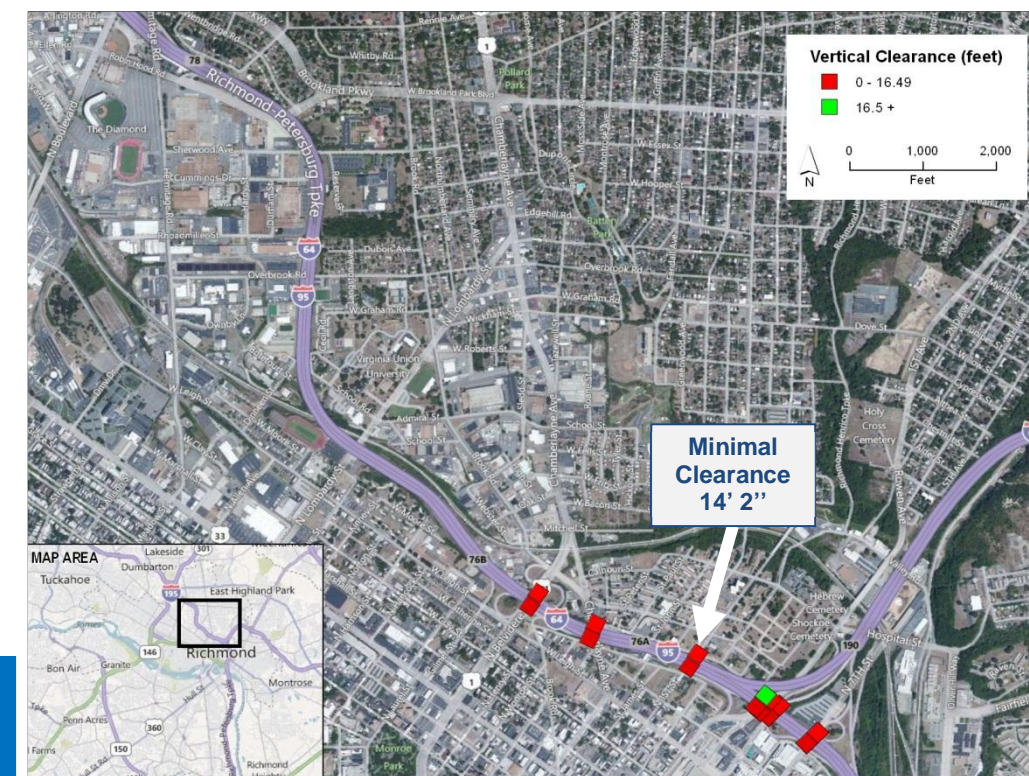
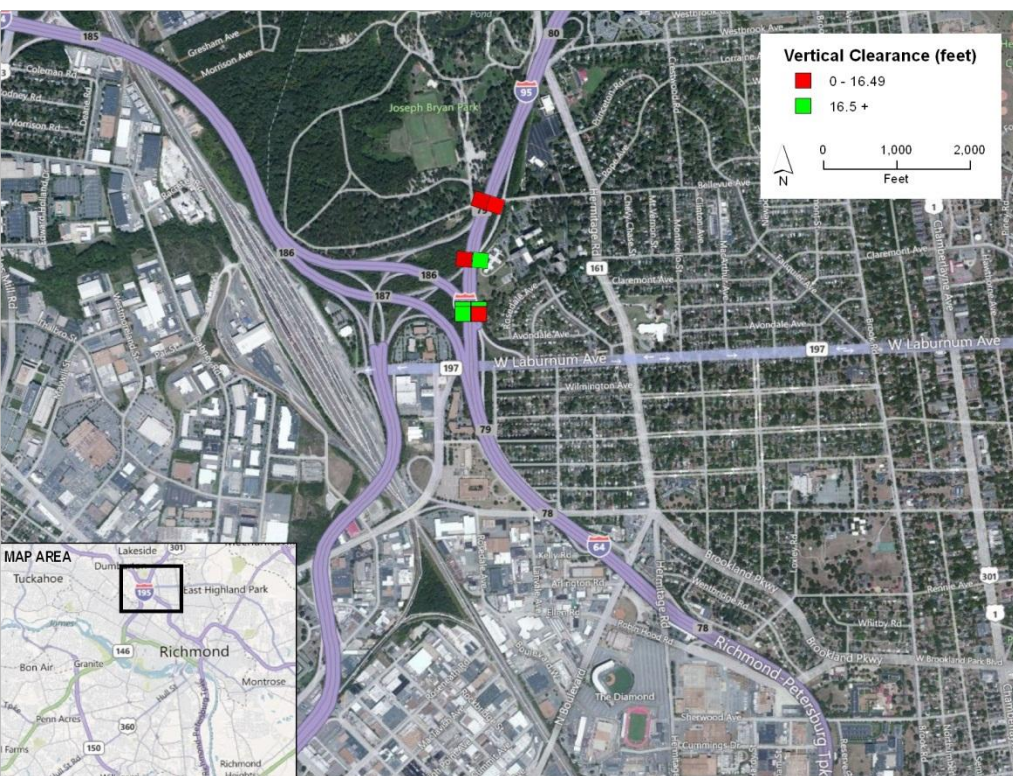
Install low bridge warning systems on the NB and SB I-95 and EB and WB I-64 approaches to the I-95/I-64 overlap section. Each system will consist of a pole mounted vehicle presence detector and an over height vehicle sensor installed upstream of the low bridge structure. When an over height vehicle is detected, a signal is transmitted to a variable message sign (VMS) which then displays a message advising the driver to take an alternate route. Potential locations on I-95 may include prior to I-195 in the NB direction and prior to I-295 in the SB direction, both could serve as alternate routes around the I-95/I-64 overlap corridor which contains a number of low bridge structures. Similarly, potential locations on I-64 may include prior to the Bryan Park interchange in the EB direction and I-295 in the WB direction.



ANTICIPATED SCHEDULE



PROJECT GRAPHICS



SB I-95 Exit Ramp/15th Street at Franklin Street – Various Improvements

ESTIMATED PROJECT COSTS

Preliminary Engineering	\$224,000
ROW and Utility Relocation	\$290,000
Construction	\$1,275,000
Total Cost =	\$1,789,000

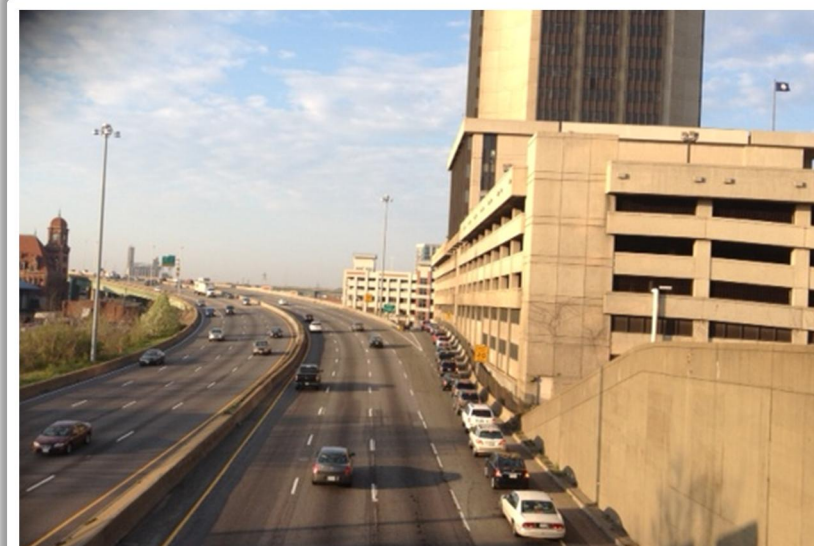
ESTIMATED BENEFITS

Traffic Operations Measures	AM and PM Peak Hour Intersection Delay (Seconds)
2022 No-Build	130.8
2022 Build	50.5
Reduction in Delay	80.3
Annual Cost Savings	\$166,000
Benefit-to-Cost Ratio	0.73
	Maximum Queue Length (Feet)
	SB I-95 Exit Ramp
2022 No-Build	AM = 1,489, PM = 127
2022 Build	AM = 277, PM = 40
Safety Measure	# of Related Crashes
Between 2007 - 2009	4
Crash Reduction Factor	0.35
Reduction in Crashes	1

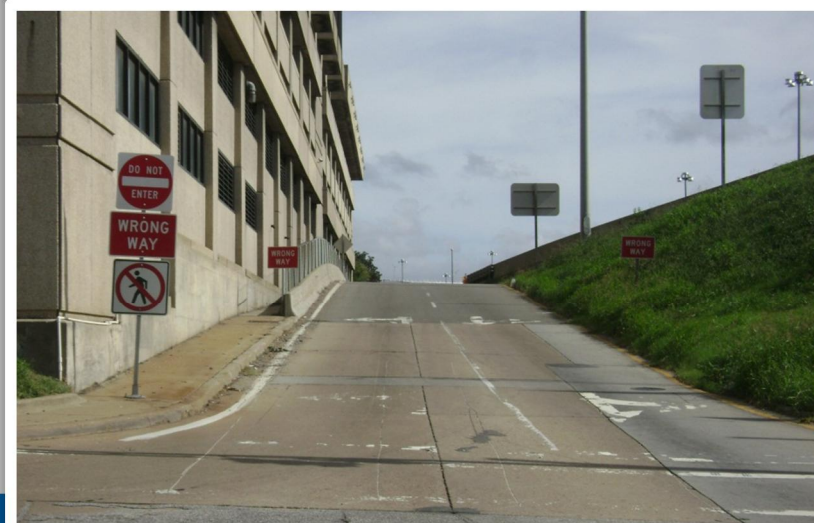
PROJECT PHOTOS



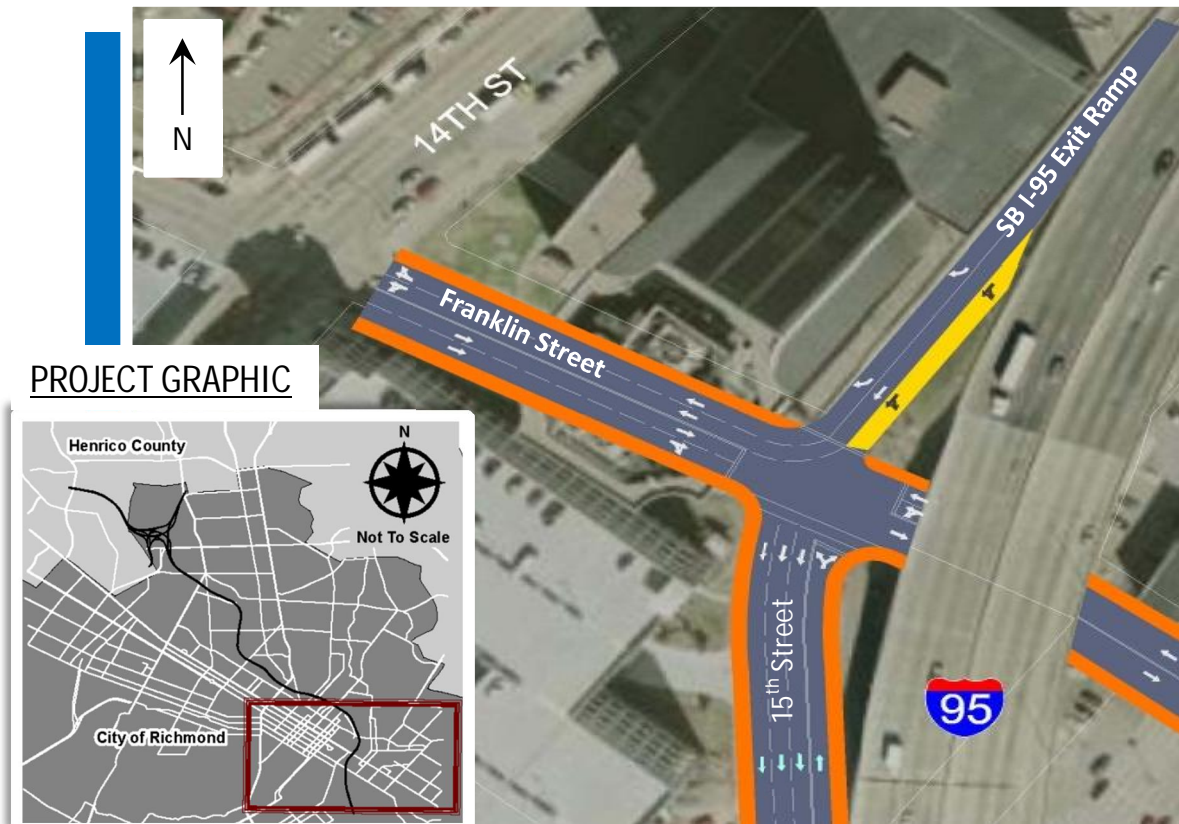
Photograph 1 – SB I-95 Exit Ramp to Franklin Street/15th Street



Photograph 2 – SB I-95 Exit Ramp to Franklin Street/15th Street

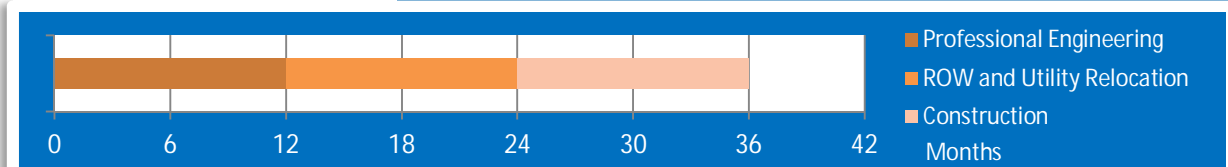


Photograph 3 – Looking North at SB I-95 Exit Ramp to Franklin Street/15th Street



PROJECT GRAPHIC

ANTICIPATED SCHEDULE



PROJECT DESCRIPTION

SB I-95 Off-Ramp at Franklin Street:

1. Widen the southbound approach from 2 lanes to 3 lanes. The additional lane will allow for more efficient signal timing operations and provide more storage for queued vehicles.
2. Install ramp pre-emption at the intersection. Once the SB queue reaches a specific point (e.g. 250 ft. from stop bar) then the intersection controller can prioritize demand from the ramp and clear the queue before it spill back onto mainline I-95.
3. Install actuated pedestrian push buttons on each signal pole on each quadrant of the intersection.

* The NB approach of 15th street will be restriped from 2 NB lanes and 2 SB lanes to 3 SB lanes and 1 NB lane as shown in the project graphic above under a separate City of Richmond project.

Franklin Street:

1. Coordinate with Monroe building management to restrict loading/unloading during the peak hours.

PROJECT BENEFIT

This project proposes to reduce peak hour queuing on the southbound I-95 exit ramp, improve traffic flow on Franklin Street, and ultimately improve the overall safety and operation of the study area.

EXISTING CONDITIONS

- The existing southbound I-95 off-ramp to Franklin Street experiences queuing during the peak hours, as noted in the table above, particularly during the AM peak (Photograph 2).
- The existing ramp length is approximately 380 feet, which is insufficient to store queues during the AM peak hour. Vehicles spilling back onto mainline I-95 are a safety issue due to the high-speed differential between the exit and mainline traffic.
- Geometric conditions of the ramp such as the change in grade provide poor intersection visibility to exiting drivers, as shown in Photograph 1.
- Vehicles on Franklin Street were observed during the AM peak hour stopping to drop off passengers to the Monroe Building located on the northwest quadrant of the intersection. This negatively impacted westbound thru traffic on Franklin contributing to the queuing issue on the ramp.
- The pedestrian crossing on the west leg of the intersection in combination with the existing signal timing contributes to the queuing issue on the ramp.

NB I-95/WB I-64 at Hermitage Road (Exit 78) - Install Deceleration Lane

ESTIMATED PROJECT COSTS

Preliminary Engineering	\$330,000
ROW and Utility Relocation	\$190,000
Construction	\$2,020,000
Total Cost =	\$2,540,000

ESTIMATED BENEFITS

Safety Measure	# of Related Crashes [^]
Between 2007 - 2009	373
Crash Reduction Factor	0.75
Reduction in Crashes	280

[^]Number of crashes on links within influence area of proposed improvement

PROJECT PHOTOS

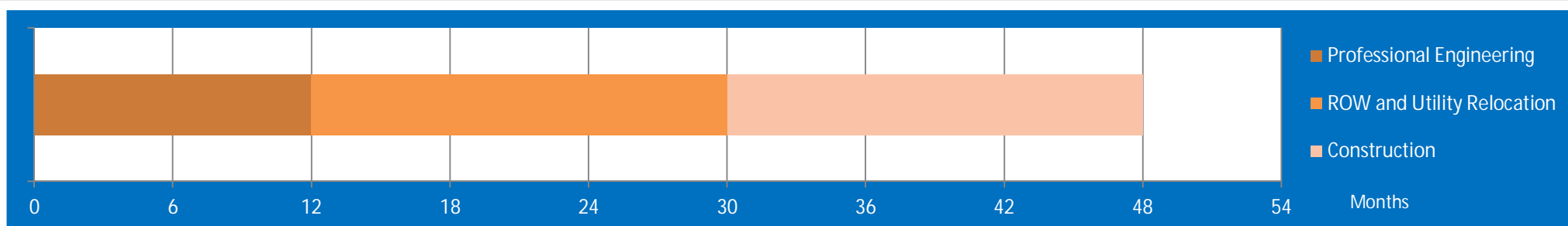


Photograph 1 – NB I-95/WB I-64 Off-Ramp to Hermitage Road (Exit 78)



Photograph 2 – NB I-95/WB I-64 Approach to Hermitage Road Off-Ramp (Exit 78)

ANTICIPATED SCHEDULE



PROJECT GRAPHIC



EXISTING CONDITIONS

- There is no existing deceleration lane from NB I-95/WB I-64 to Hermitage Road (Exit 78).
- Located in a high crash location of NB I-95/WB I-64

PROJECT BENEFIT

Construction of a deceleration lane will allow vehicles to exit the interstate with minimal effect on the through traffic stream and will improve safety operations.

PROJECT DESCRIPTION

- Construct NB I-95/EB I-64 deceleration lane to Hermitage Road.
- Create emergency pull-off area in conjunction with the construction of the deceleration lane.

NB I-95/WB I-64 at Belvidere Street - Extend Acceleration Lane

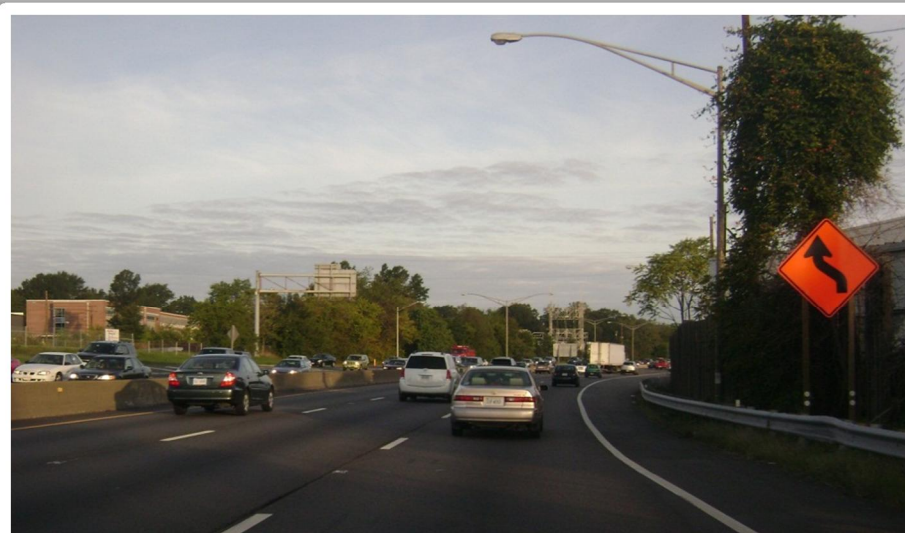
ESTIMATED PROJECT COSTS

Preliminary Engineering	\$400,000
ROW and Utility Relocation	\$530,000
Construction	\$2,530,000
Total Cost =	\$3,460,000

PROJECT PHOTOS



Photograph 1 - I-95/I-64 NB Approaching the Belvidere Street On-Ramp



Photograph 2 - I-95/I-64 NB at the Existing Belvidere Street On-Ramp End-of-Taper

ESTIMATED BENEFITS

Traffic Operations Measure	AM and PM Peak Hour Travel Time* (Seconds)
2022 No-Build	490.9
2022 Build	484.1
Travel Time Savings	6.9
Annual Cost Savings	\$60,000
Benefit-to-Cost Ratio	0.17

*Travel time on links within influence area of proposed improvement

Safety Measure	# of Related Crashes^
Between 2007 - 2009	350
Crash Reduction Factor	0.75
Reduction in Crashes	263

^Number of crashes on links within influence area of proposed improvement

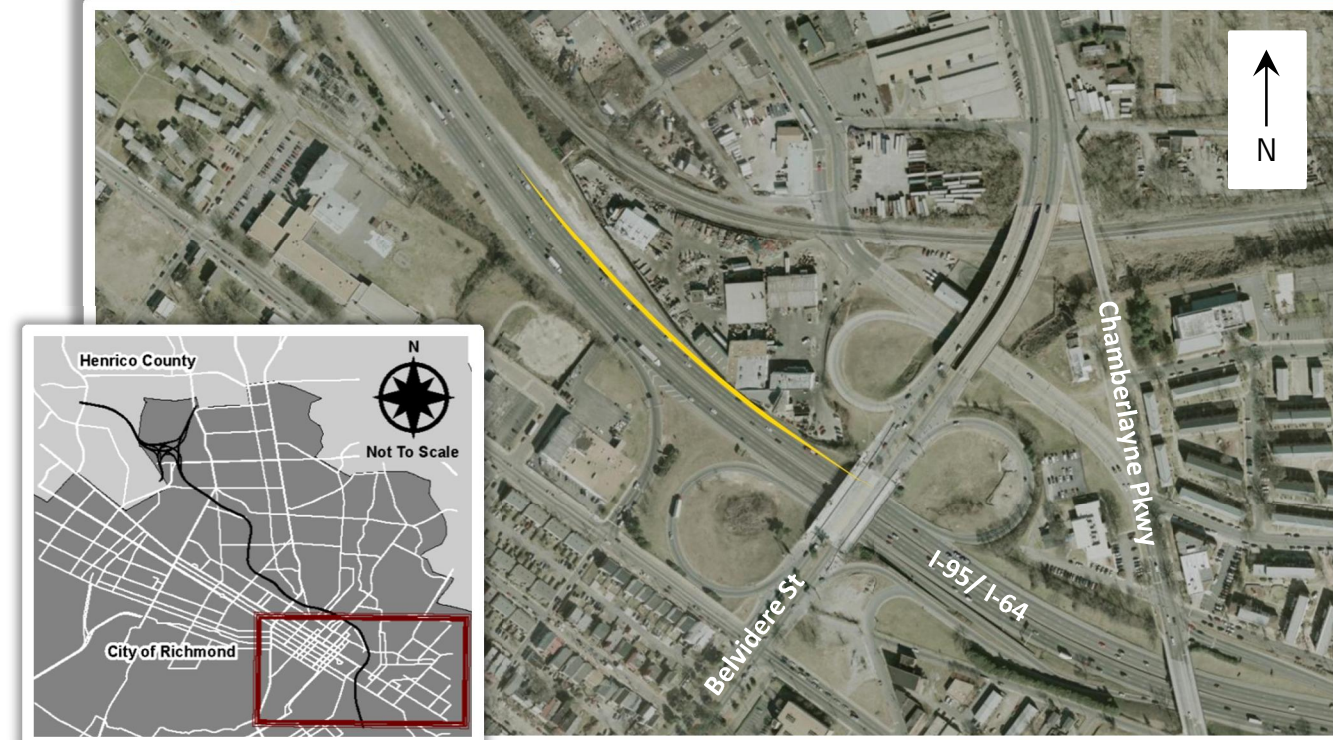
EXISTING CONDITIONS

- The existing northbound acceleration lane from the Belvidere Street I-95 on-ramp is approximately 400 feet long and does not meet current design standards
- The standard for full-length acceleration lane with a ramp speed of 25 MPH is 1,020 feet.
- The existing acceleration lane is approximately 620 feet deficient, conveys approximately 350 vehicles per hour in the AM peak, and carries approximately 1,030 vehicles per hour in the PM peak.

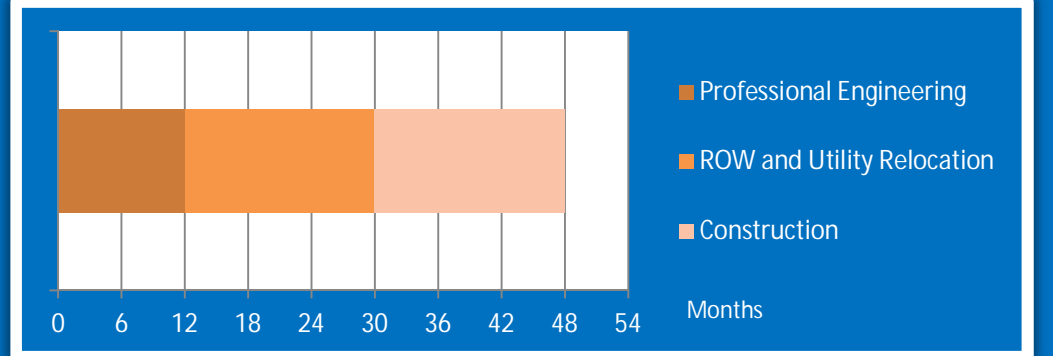
PROJECT BENEFIT

Extending the acceleration lane will provide safer access to NB I-95/WB I-64 northbound from the Belvidere Street on-ramp by providing a longer weave length. Vehicles merging onto northbound I-95/WB I-64 will also have an additional 620 feet of full-width lane to accelerate to the mainline design speed of 60 MPH. This will improve the operations of mainline I-95/I-64 and the northbound on-ramp from Belvidere Street as it approaches the recommended design capacity of 1,200 vehicles per hour during the PM peak hour.

PROJECT GRAPHIC



ANTICIPATED SCHEDULE



PROJECT DESCRIPTION

- This project proposes to extend the acceleration lane of the northbound on-ramp from Belvidere Street to a length of 1,020 feet to meet current design standards.
- The construction of the acceleration lane extension will impact right-of-way and require some land acquisition from the property on the northwest quadrant of the Belvidere Street interchange. Ample right-of-way is available adjacent to this property where the I-95/I-64 toll booths use to be and can be used to maximize the length of the acceleration lane.

I-95/I-64 Corridor - Emergency Pull-Offs

ESTIMATED PROJECT COSTS

Map ID Number	Proposed Location	Preliminary Engineering	ROW and Utility Relocation	Construction	Total
1	Bryan Park Interchange – NB Direction	\$390,000	\$95,000	\$1,560,000	\$2,045,000
2	Bryan Park Interchange – SB Direction	\$390,000	\$95,000	\$1,560,000	\$2,045,000
3	Just south of Boulevard – NB Direction	\$390,000	\$100,000	\$1,560,000	\$2,050,000
4	Just north of Belvidere – NB Direction	\$155,000	-	\$1,560,000	\$1,715,000
5	Just north of Belvidere – SB Direction	\$155,000	-	\$1,560,000	\$1,715,000
Total Cost =		\$1,480,000	\$290,000	\$7,800,000	\$9,570,000

EXISTING CONDITIONS

- The I-95/I-64 study corridor has minimal left and right shoulders ; some sections have no shoulders
- There are no designated emergency pull off areas within the study corridor

PROJECT DESCRIPTION

Create emergency pull-off areas throughout the I-95/I-64 overlap section.

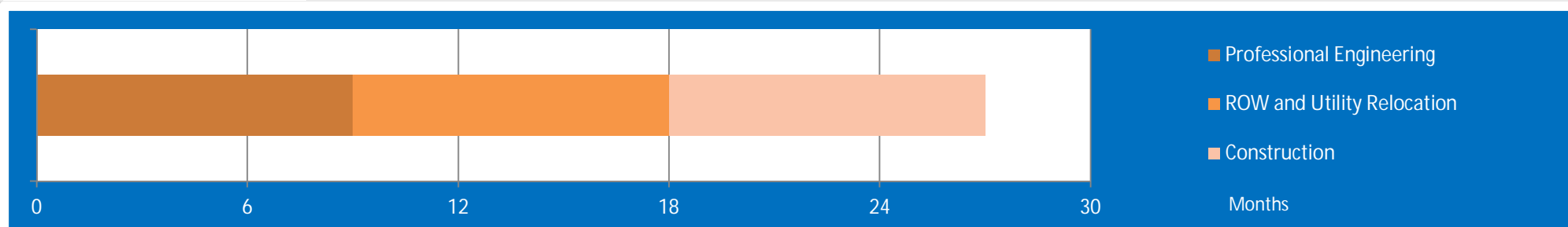
Frequently-spaced pull-off areas increase the likelihood that they will be used; therefore, proposed locations were considered throughout the study corridor. Selected locations were primarily determined based on available right-of-way and constructability.

PROJECT BENEFITS

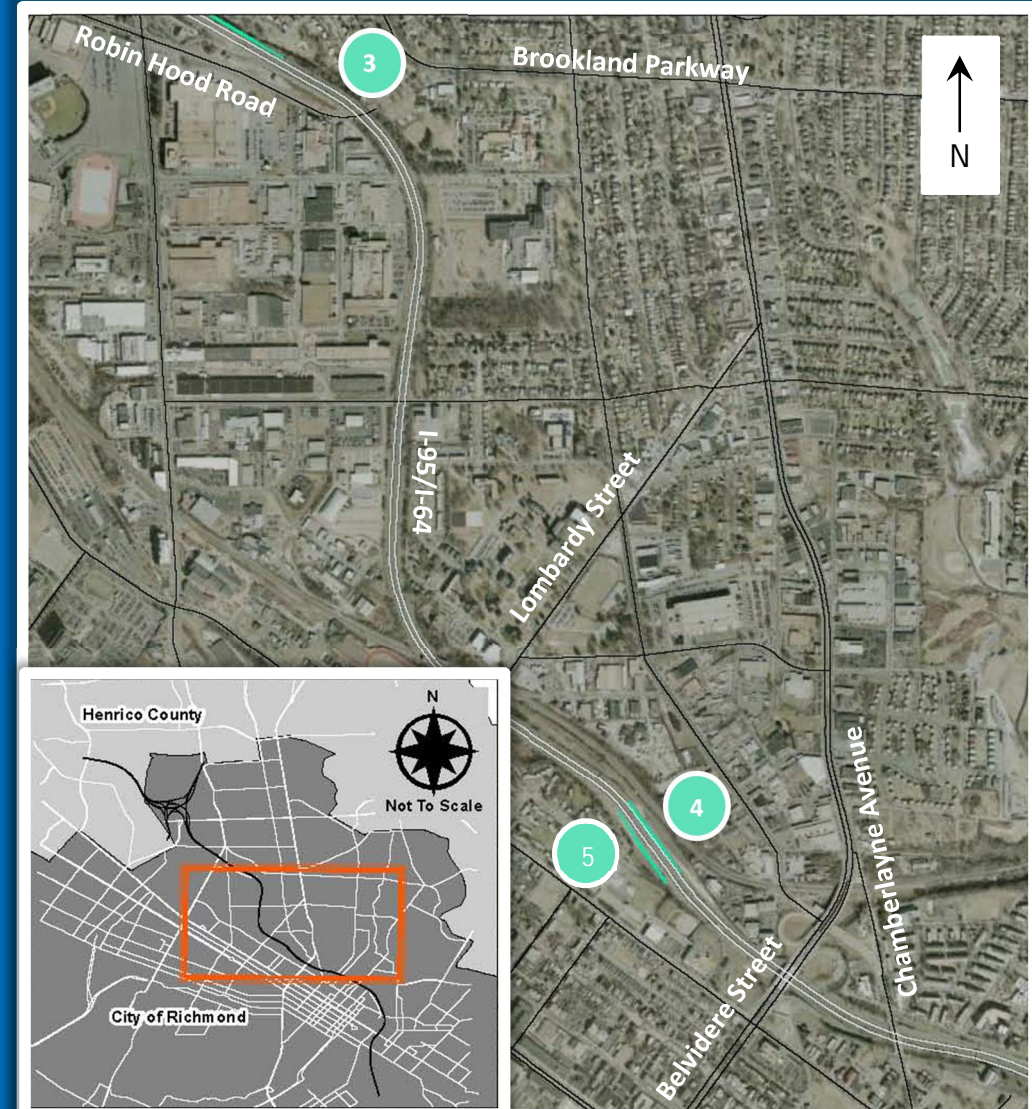
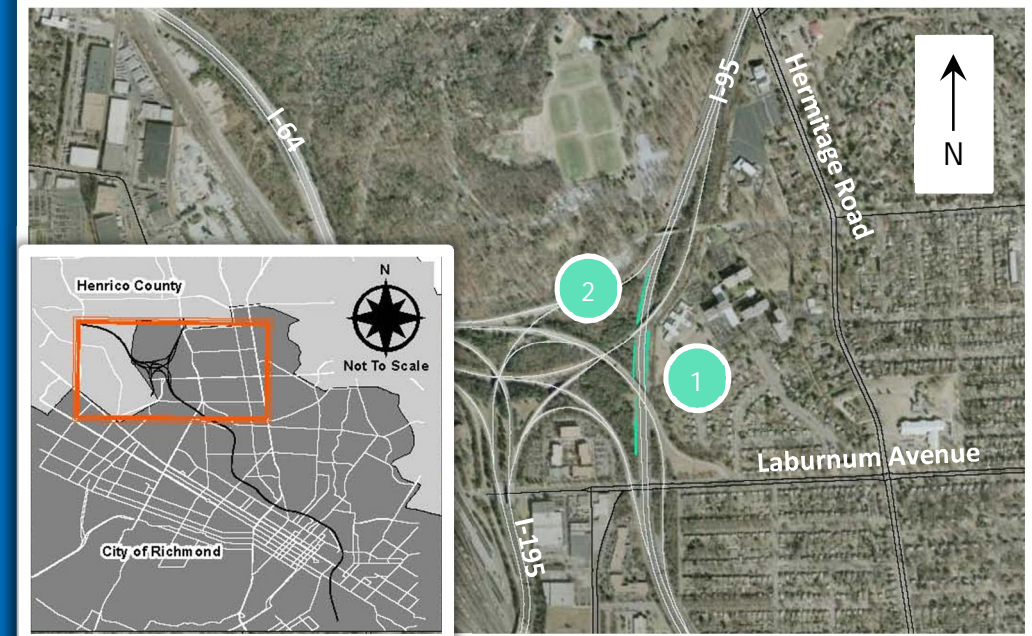
Improve incident management and safety throughout the corridor.

- Allows motorists experiencing problems to exit the roadway without blocking through traffic. Reduces the duration of traffic congestion and related crashes that occur due to a disabled vehicle.
- Provides a designated area for crash clearing and/or investigation. When crashes occur , vehicles need to be cleared to the shoulder quickly in order to minimize the amount of upstream traffic congestion. Additionally, a pull-off area may provide emergency response vehicles with adequate space to aid victims after a crash without taking up a traffic lane.
- Provide additional acceleration and deceleration for disabled and emergency response vehicles.
- Provides areas for law enforcement officers to apprehend non-compliant motorists.
- Provide area for law enforcement officers and incident management personnel to respond to a crash that has been moved out of the travel lanes.

ANTICIPATED SCHEDULE



PROJECT GRAPHIC



I-95/I-64 – Guide Signs with Option Lane Issue

ESTIMATED PROJECT COSTS

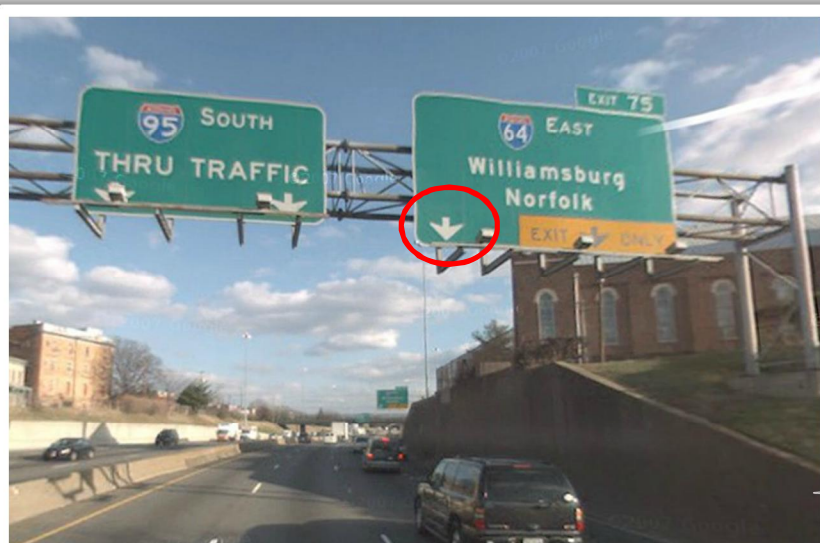
Map ID Number	Proposed Location	Preliminary Engineering	ROW and Utility Relocation	Construction	Total
1	NB I-95 to WB I-64/SB I-195	-	-	\$258,000	\$258,000
2*	SB I-95 to WB I-64	-	-	-	-
3	SB I-95 to EB I-64	-	-	\$258,000	\$258,000
4	EB I-64 to NB I-95/SB I-195	-	-	\$258,000	\$258,000
5	WB I-64 to NB I-95/SB I-95	-	-	\$258,000	\$258,000
Total Cost =		\$0	\$0	\$1,032,000	\$1,032,000

* Cost for this guide sign was not included because it will be replaced as part of a statewide directive to remove all signing from bridge structures.

EXISTING CONDITIONS

- There are 5 guide signs with option lanes located within the study corridor. An option lane is defined as a lane from which both the exit destination and the mainline destination can be reached. Each option lane is identified in the photographs below.
- Existing signing creates expectancy problems for drivers who are unfamiliar with the area.
- The existing guide signs with option lanes issue do not meet current standards and should be upgraded to meet the Manual on Uniform Traffic Control Devices (MUTCD) Overhead Arrow-per-Lane standard.

PROJECT PHOTOS



Photograph 1: SB I-95 to EB I-64



Photograph 2: NB I-95 to WB I-64/SB I-195

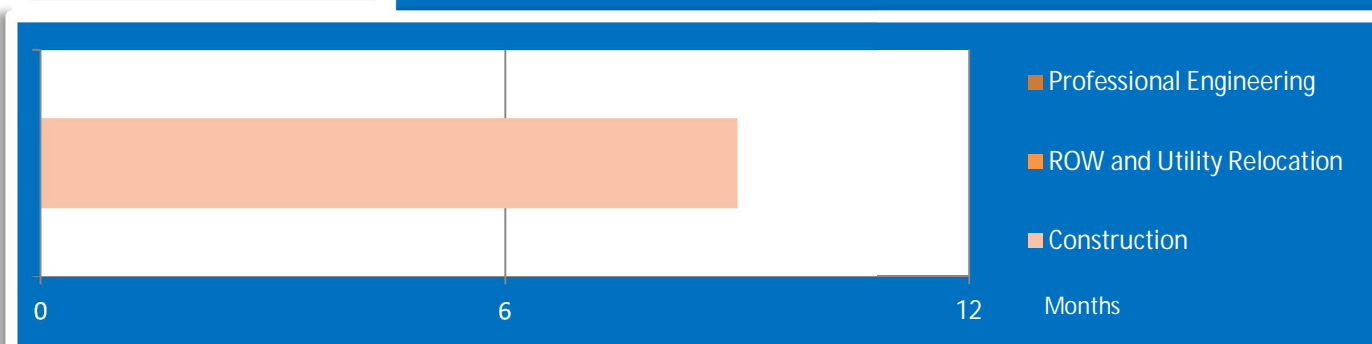


Photograph 3: WB I-64 to NB I-95/SB I-95



Photograph 4: EB I-64 to NB I-95/SB I-195

ANTICIPATED SCHEDULE

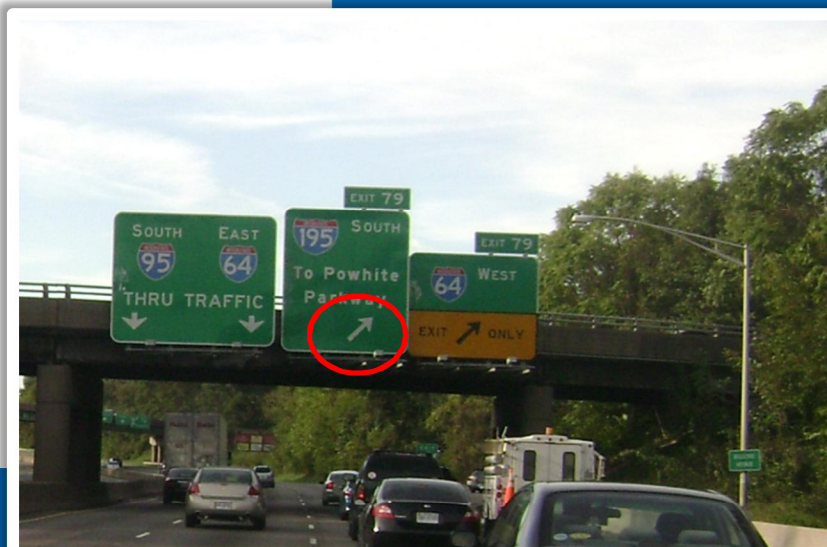


PROJECT BENEFIT

- Guide signs with lane use arrows shown for each lane will provide a clearer message to motorists as to downstream geometry; thereby, improving safety throughout the corridor.

PROJECT DESCRIPTION

- Upgrade the 5 non-standard guide signs with option lane issues to meet the MUTCD Overhead Arrow-per-Lane standard.
- In addition to new guide signs new sign assemblies are assumed including overhead sign bridges, foundations, and sign lighting.



Photograph 5: SB I-95 to WB I-64

I-95/I-64 Corridor – End of Queue Detection Systems

ESTIMATED PROJECT COSTS

Map ID Number	Proposed Location	Preliminary Engineering	ROW and Utility Relocation	Construction	Total
1	SB I-95 North of Bryan Park Interchange	\$250,000	-	\$985,000	\$1,235,000
2	EB I-64 West of Bryan Park Interchange	\$250,000	-	\$985,000	\$1,235,000
3	NB I-95 South of James River	\$250,000	-	\$985,000	\$1,235,000
4	WB I-64 East of Shockoe Bridge	\$250,000	-	\$985,000	\$1,235,000
Total Cost =		\$1,000,000	\$290,000	\$3,940,000	\$4,940,000

EXISTING CONDITIONS

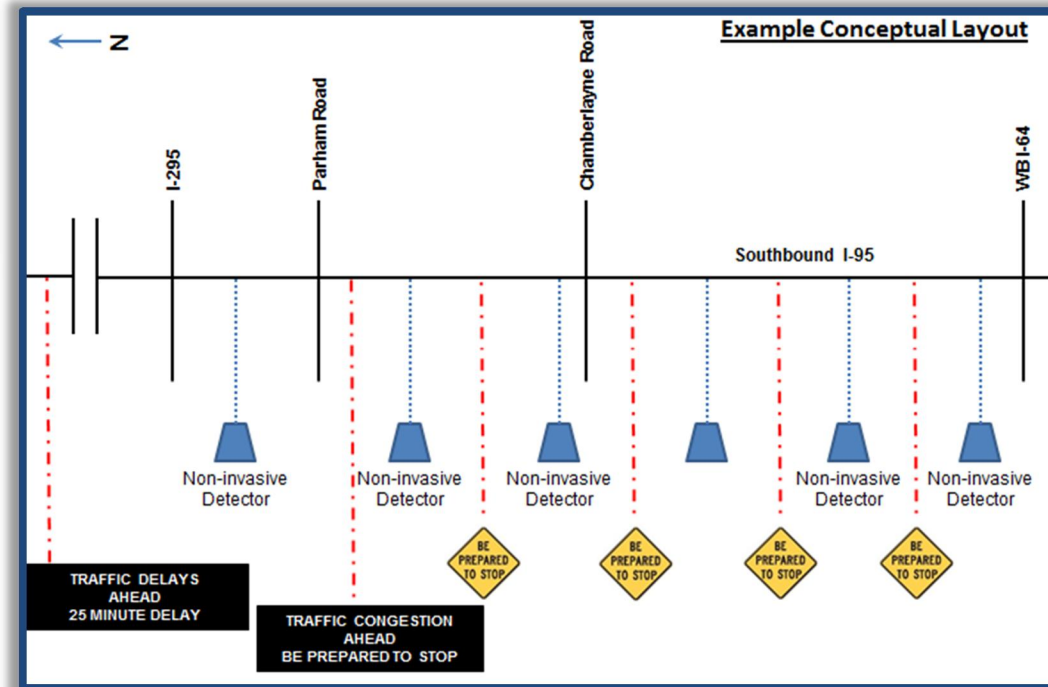
- The predominant crash type from 2007 to 2009 within the study corridor was rear end, which accounted for 58% of total crashes. Sixty-five percent (65%) of the corridor crashes from 2007 to 2009 occurred during the AM and PM Peak hours.
- The corridor currently experiences queues during the peak hours particularly at the interstate-to-interstate junctions; specifically, I-95/I-64/I-195 interchange to the northwest and I-95/I-64 interchange to the southeast.

PROJECT BENEFIT

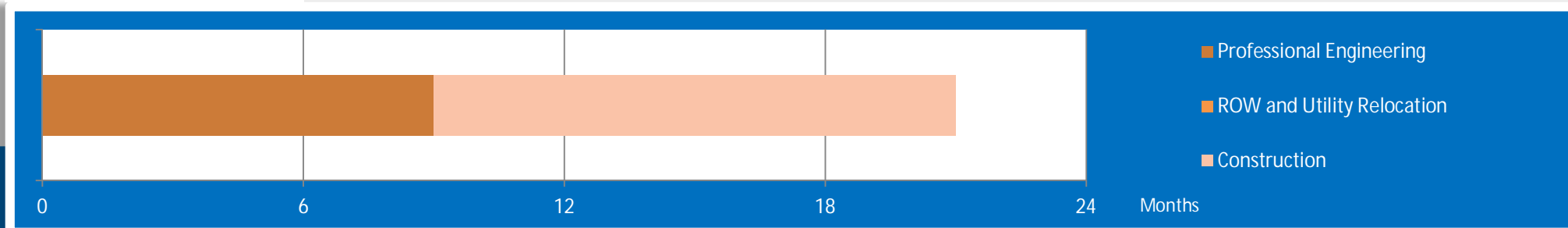
The proposed systems will provide real time information to drivers about upcoming traffic conditions from which they can make a decision to choose an alternate route, if available, or to be aware of downstream queues and/or slow speeds; thereby, improving safety and flow through congested portions of the corridor.

PROJECT DESCRIPTION

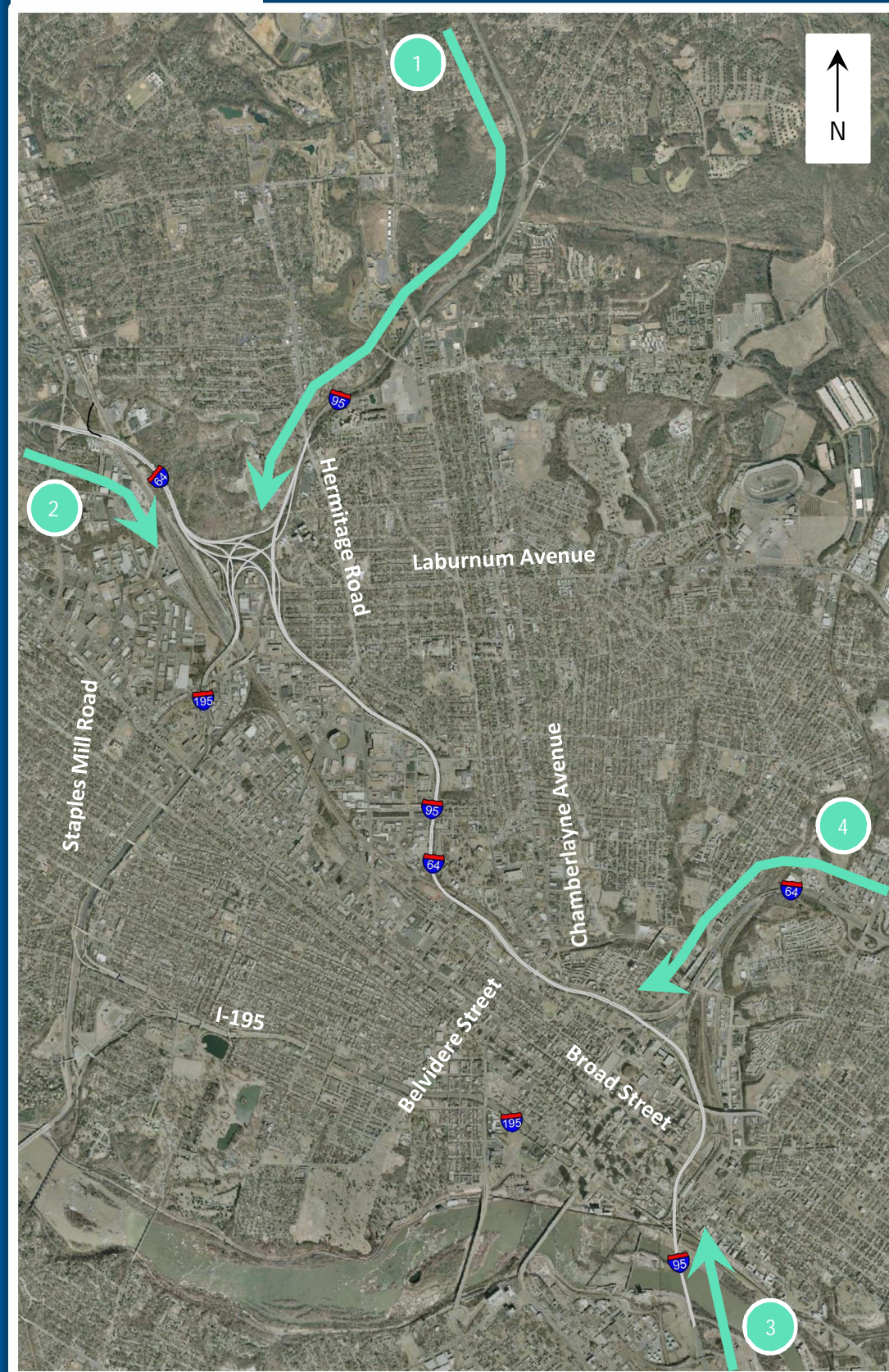
Install end of queue detection systems on the I-95 and I-64 approaches to the overlap section. Each end of queue detection system will consist of detectors at various locations on an approach to act as "trigger points" that activate roadside variable message signs (VMS) once queues reach each point. VMS will alert drivers to the upcoming traffic situation.



ANTICIPATED SCHEDULE

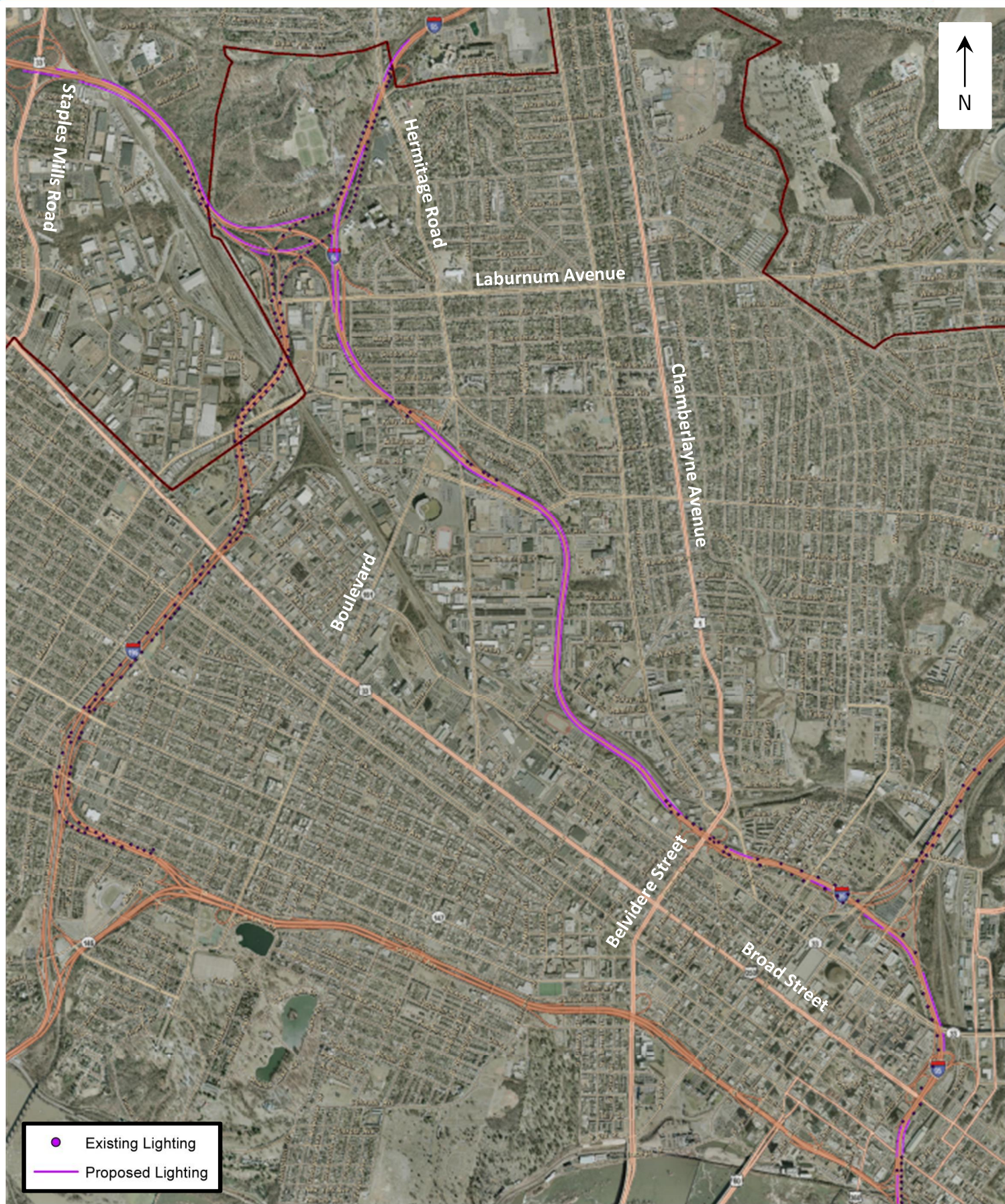


PROJECT GRAPHIC



I-95/I-64 Corridor – Continuous Roadway Lighting

PROJECT GRAPHIC



ESTIMATED PROJECT COSTS

Preliminary Engineering	\$3,110,000
ROW and Utility Relocation	\$0
Construction	\$12,450,000
Total Cost =	\$15,560,000

EXISTING CONDITIONS

- Both high mast and conventional roadway lighting exist along the I-95/I-64 study corridor
- Existing lighting is primarily concentrated around interchanges

PROJECT DESCRIPTION

Remove existing corridor lighting and upgrade to continuous corridor wide high mast lighting.

PROJECT BENEFIT

Improve safety throughout the corridor by reducing night crashes.

ESTIMATED BENEFITS

Safety Measure	# of Related Crashes [^]
Between 2007 - 2009	362
Crash Reduction Factor	0.50
Reduction in Crashes	181

PROJECT PHOTOS

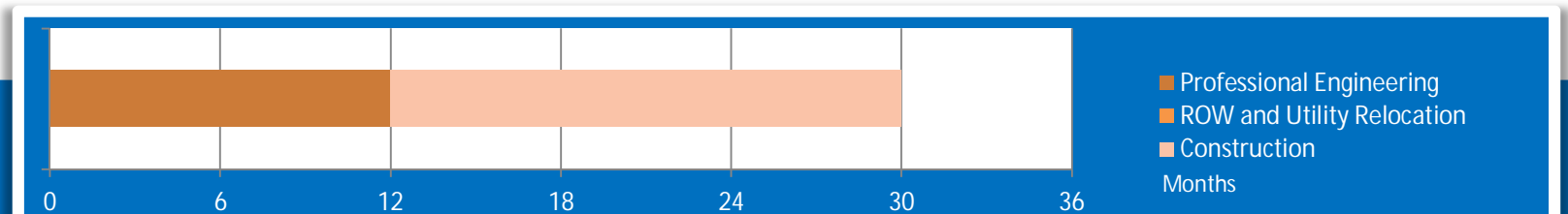


Photograph 1: SB I-95/EB I-64 East Interchange – High Mast Roadway Lighting



Photograph 2: I-64 West of Bryan Park Interchange – Conventional Roadway Lighting

PROJECT BENEFIT



Belvidere Street Interchange - Realignment of Southbound I-95/Eastbound I-64 On-Ramps

ESTIMATED PROJECT COSTS

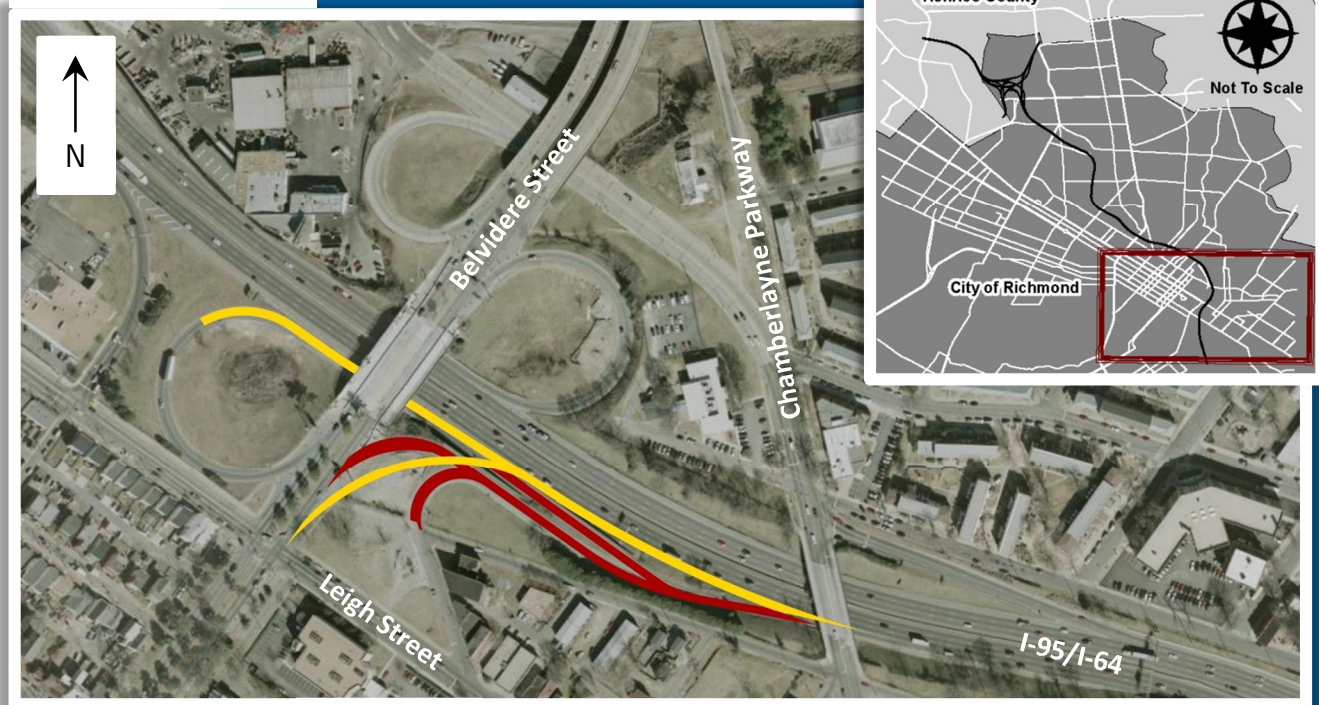
Preliminary Engineering	\$820,000
ROW and Utility Relocation	\$240,000
Construction	\$8,040,000
Total Cost =	\$9,100,000

ESTIMATED BENEFITS

Safety Measure	# of Related Crashes [^]
Between 2007 - 2009	199
Crash Reduction Factor	0.75
Reduction in Crashes	149

[^]Number of crashes on links within influence area of proposed improvement

PROJECT GRAPHIC



PROJECT PHOTOS



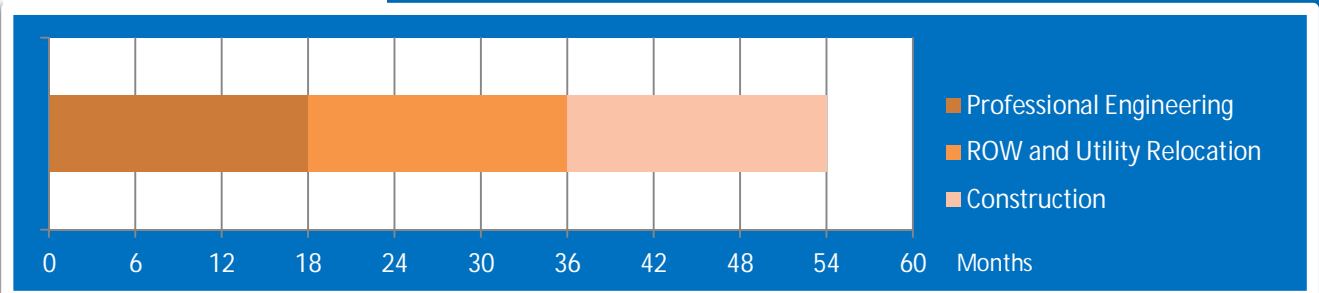
Photograph 1 – Looking East from CD Road from Belvidere Loop On-Ramp

EXISTING CONDITIONS

The following conditions negatively impact operations in the study area:

- Differing geometric grades of the existing 3 on-ramps (from Belvidere Street and Leigh Street) and SB I-95/I-64 mainline, as shown in the photographs; requires two merging points prior to the merge onto SB I-95/EB I-64, which results in lower ramp speeds.
- Peak hour traffic volumes on the ramps (AM = 600 veh/hr, PM = 1,125 veh/hr)
- Downstream weave section between Belvidere Street and Exit 75 to EB I-64
- Located in a high crash location of SB I-95/EB I-64
- There are no shoulders on the on-ramps. This negatively impacts traffic operations when there is an accident or broken down vehicle on the ramps.

ANTICIPATED SCHEDULE



Photograph 2 – Looking East from Slip Ramp from Leigh Street

PROJECT DESCRIPTION

1. The proposed project will eliminate the slip ramp from Leigh Street, which removes one of the merge points.
2. Realign the on-ramps from NB and SB Belvidere Street to merge together at a lower elevation than existing and west of the existing merge location.
3. Create emergency pull-off area in conjunction with the realignment of the on-ramps.

PROJECT BENEFIT

The proposed project will remove a conflict point on the ramps and allow vehicles from Belvidere Street and Leigh Street to reach higher speeds on the on-ramps. Higher speeds will allow for improved merging onto SB I-95/EB I-64.



Photograph 3 – Looking East from Merge Point of Upstream On-Ramps from Belvidere Street

I-195 at Laburnum Interchange - Roundabout and NB Free-Flow Right Turn Lane

ESTIMATED PROJECT COSTS

Preliminary Engineering	\$440,000
ROW and Utility Relocation	\$0
Construction	\$1,770,000
Total Cost =	\$2,210,000

ESTIMATED BENEFITS

Traffic Operations Measures*	AM and PM Peak Hour Intersection Delay* (Seconds)
2022 No-Build	22.2
2022 Build	16.8
Reduction in Delay	5.4
Annual Cost Savings	\$15,000
Benefit-to-Cost Ratio	0.07

*Results reported for both intersections; NB and SB Exit Ramps at Laburnum

	Maximum Queue Length (Feet)	
	SB Exit Ramp	NB Exit Ramp
2022 No-Build	AM = 422, PM = 738	AM = 63, PM = 246
2022 Build	AM = 278, PM = 466	AM = 18, PM = 0

Safety Measure	# of Related Crashes
Between 2007 - 2009	4
Crash Reduction Factor	0.72
Reduction in Crashes	3

EXISTING CONDITIONS

The existing I-195 off-ramps to Laburnum experience queuing during the peak hours, as noted in the table above.

PROJECT BENEFIT

This project proposes to reduce queuing on the northbound and southbound I-195 exit ramps during the peak hours as well as improve the overall safety of the intersections.

PROJECT PHOTOS



Photograph 1 – I-195 SB Exit Ramp to Laburnum – Proposed Roundabout Location

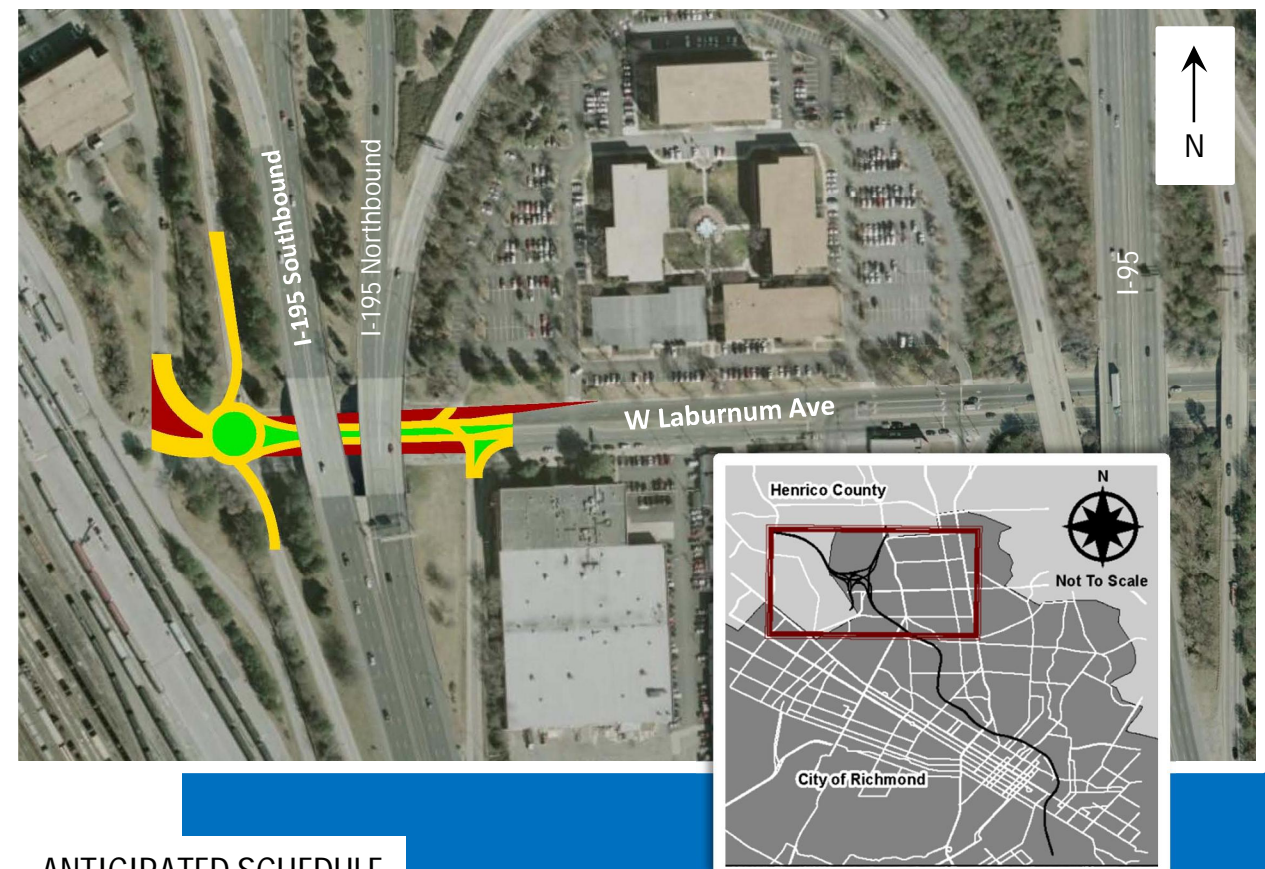


Photograph 2 – Looking East from I-195 Exit Ramp – Sight Distance Impacted by Vegetation

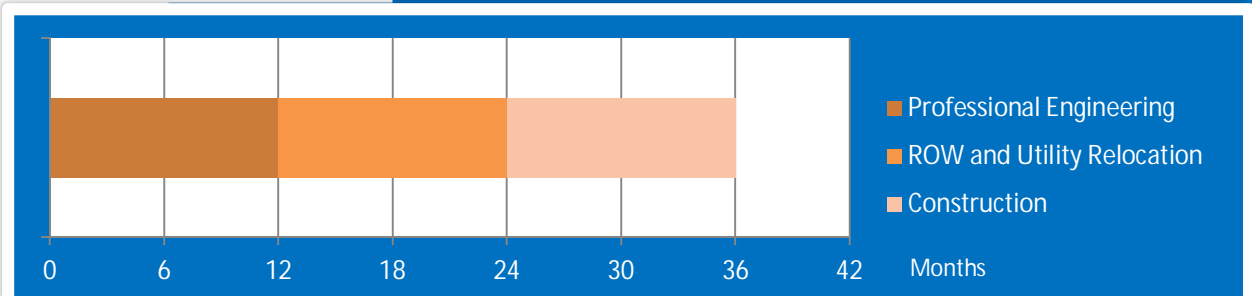


Photograph 3 – I-195 NB Exit Ramp to Laburnum – Proposed Free-Flow Right-Turn Lane

PROJECT GRAPHIC



ANTICIPATED SCHEDULE



PROJECT DESCRIPTION

SB I-195 Off-Ramp at Laburnum Avenue – construct a one lane roundabout to accommodate the heavy conflicting SB left turns (AM = 309, PM = 398) and WB left turns (AM = 281, PM = 323). This improvement will require a lane drop of the rightmost WB through lane prior to the roundabout, which can be done using signing and pavement markings.

NB I-195 Off-Ramp at Laburnum Avenue – drop the rightmost EB through lane, using signing and pavement markings, just west of the off-ramp. Convert the NB right turn movement (AM = 390, PM = 378) to free flow by using the rightmost EB through lane. This improvement can be accomplished using existing pavement since there are minimal NB left turns (AM = 24, PM = 4) and NB throughs (AM = 19, PM = 0) requiring minimal storage. A short left turn lane, approximately 50 to 100 feet, and an exclusive right turn lane can be striped out using the existing pavement. This option will require the restriction of EB left turns and SB left turns to/from the office park on the north side of Laburnum, which could be enforced with some minor median improvements.

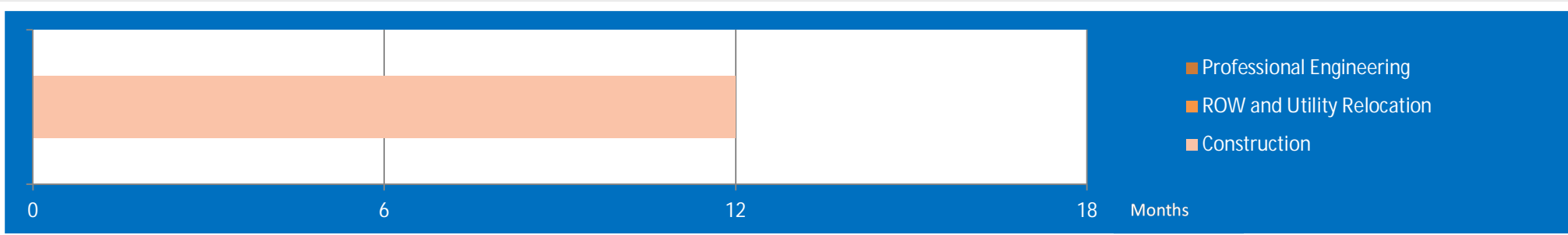
I-95/I-64 – Corridor Wide Signing Upgrades

ESTIMATED PROJECT COSTS

Proposed Improvement	Preliminary Engineering	ROW and Utility Relocation	Construction	Total
Corridor Wide Guide Signs	-	-	\$9,030,000	\$9,030,000
Total Cost =	\$0	\$0	\$9,030,000	\$9,030,000

* Existing guide signs located on bridge structures were not included because they will be replaced as part of a statewide directive to remove all signing from bridge structures.

ANTICIPATED SCHEDULE



EXISTING CONDITIONS

- There are 35 guide signs (ground mounted and overhead) located within the study corridor with varying degrees of degradation and non-compliance to existing retroreflectivity standards.

PROJECT DESCRIPTION

- Perform corridor wide condition assessment of existing guide signs (ground mounted and overhead) and upgrade non-standard guide signs to meet retroreflective sheeting and lighting standards.
- This project would not include overhead guide signs mounted on bridges since they will be replaced as part of a statewide directive to remove all signing from bridge structures.
- This project would not include the 5 guide signs with option lane issues. These signs are being proposed for replacement as a separate SYIP project.
- The Manual on Uniform Traffic Control Devices (MUTCD) requires guide signs meet the following standards by the following timelines:
 - January 2012: Agencies must establish and implement a plan to maintain minimum traffic sign retroreflectivity.
 - January 2015: Retroreflectivity compliance for ground-mounted guide signs.
 - January 2018: Retroreflectivity compliance for overhead guide signs.

PROJECT BENEFIT

- Providing retroreflective delineation and signing improves safety throughout the corridor by reducing nighttime crashes.

PROJECT GRAPHICS

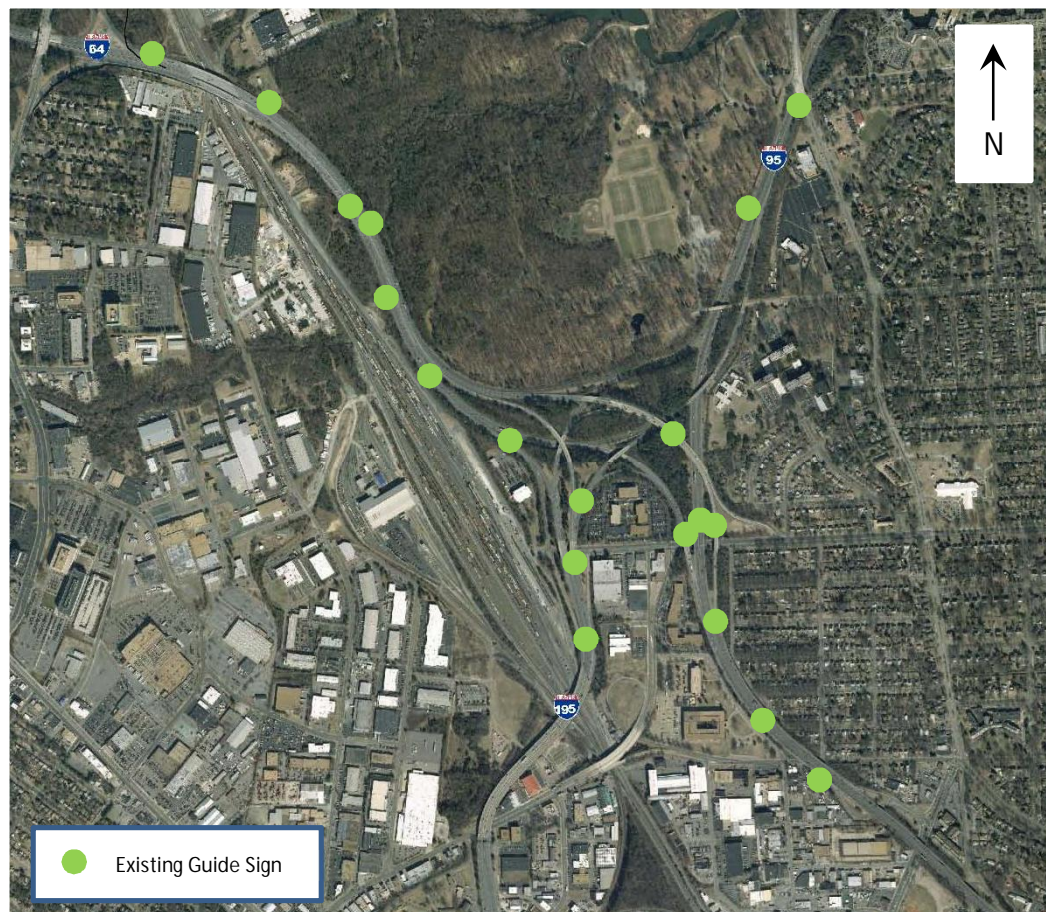
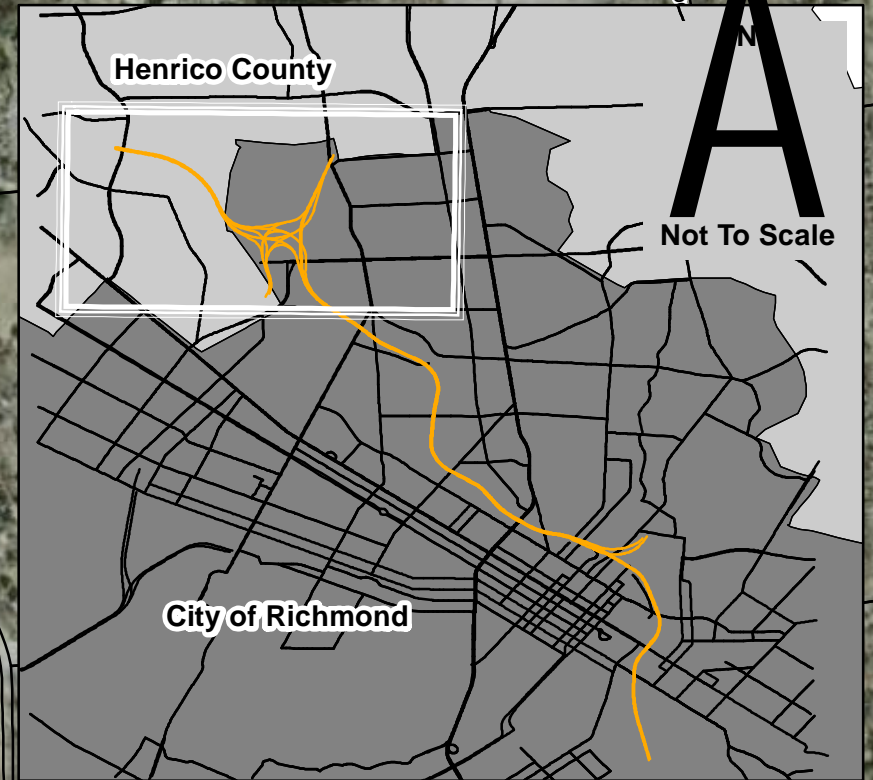


Figure R1
Overhead Sign Inventory
I-95 SB / I-64 EB Overlap Project
City of Richmond and Henrico County, VA



Legend

 Mile Marker

 Overhead Signs

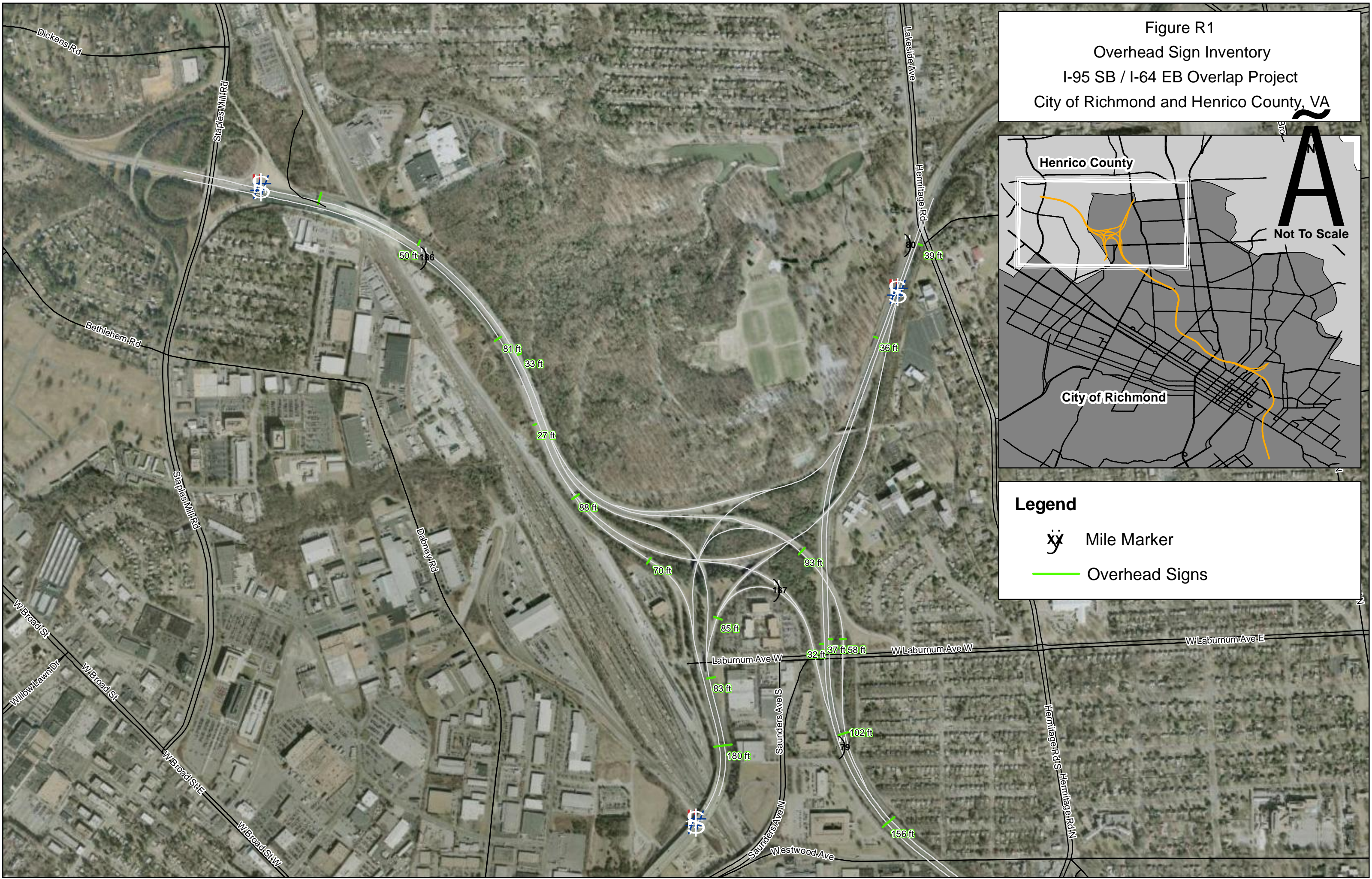




Figure R2
 Overhead Sign Inventory
 I-95 SB / I-64 EB Overlap Project
 City of Richmond and Henrico County, VA



Legend

-  Mile Marker
-  Overhead Signs

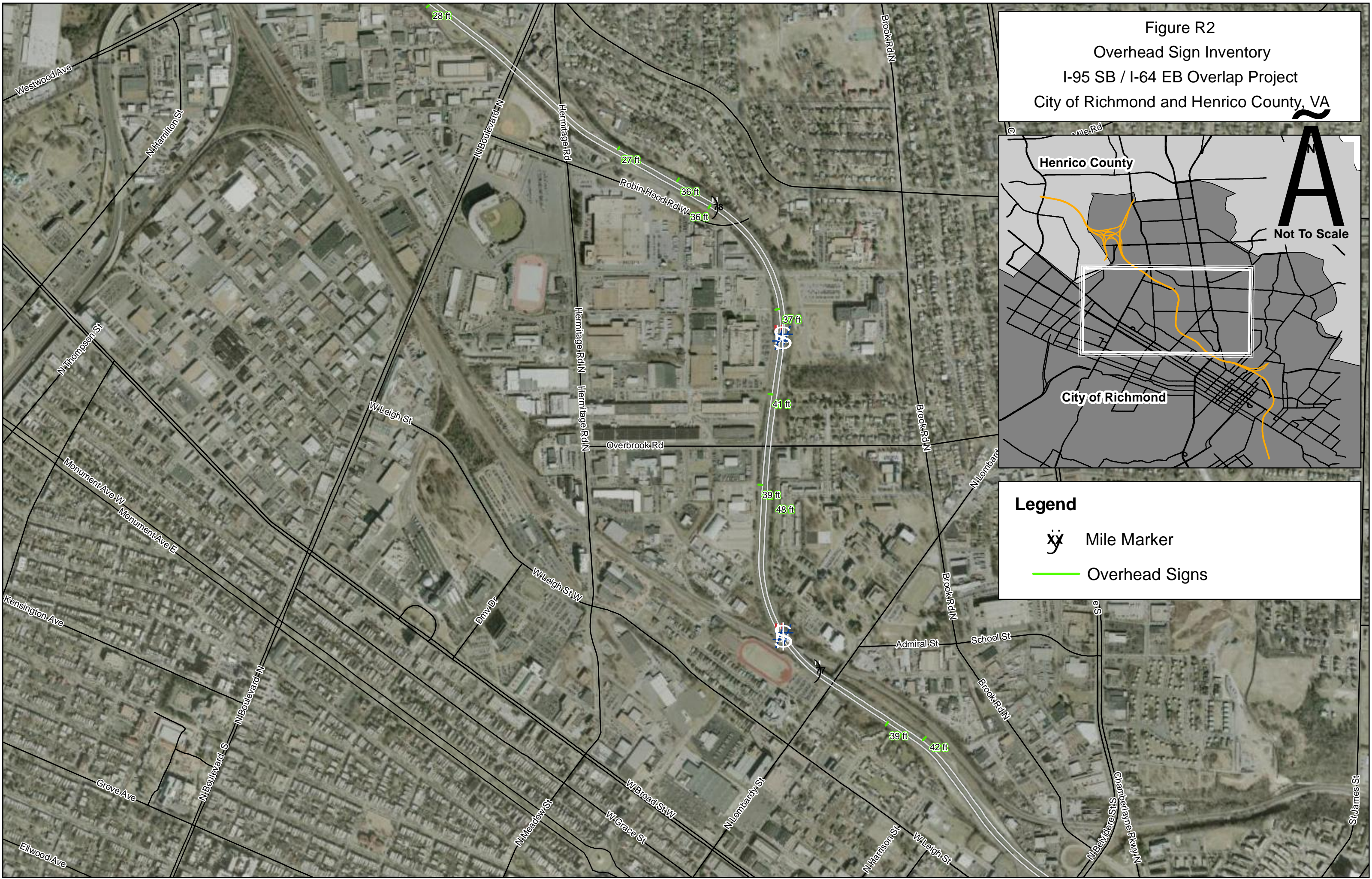
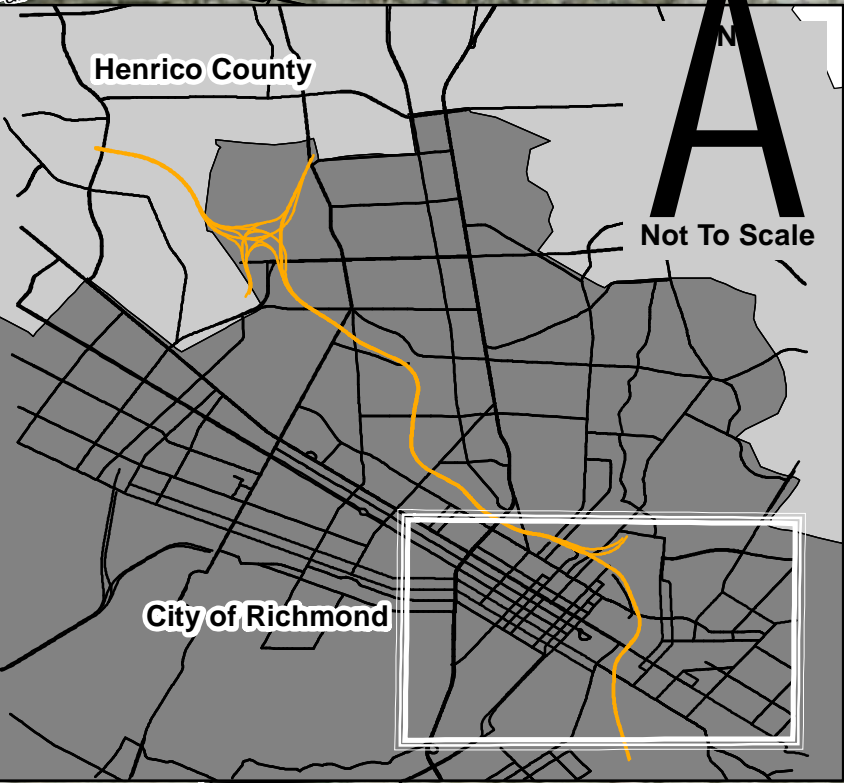


Figure R3
 Overhead Sign Inventory
 I-95 SB / I-64 EB Overlap Project
 City of Richmond and Henrico County, VA



Legend



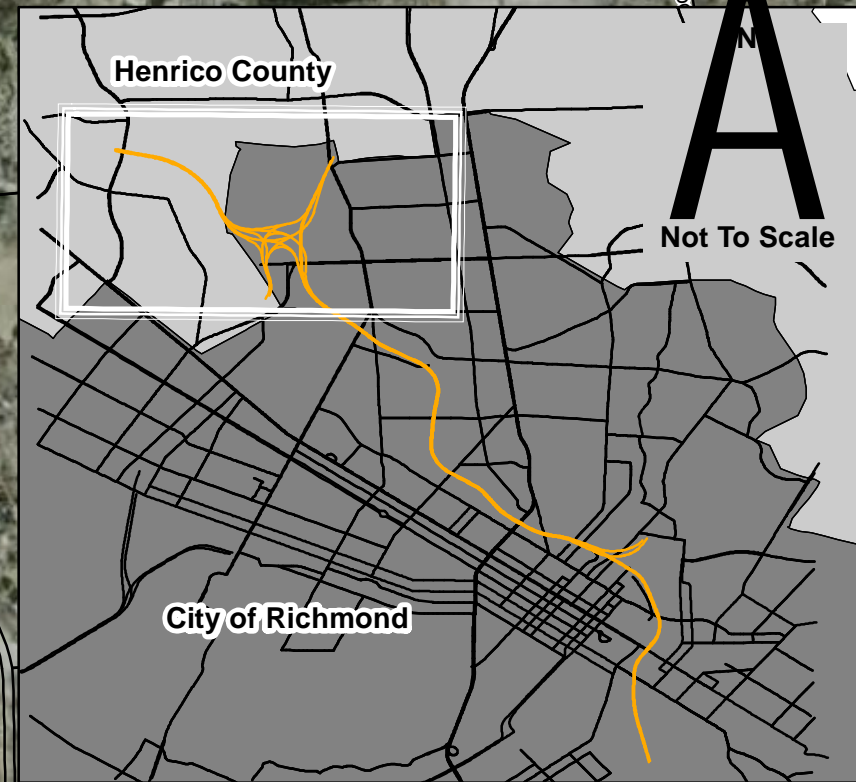


-  Mile Marker
-  Overhead Signs



Figure R4
Proposed Emergency Pull-Offs
I-95 SB / I-64 EB Overlap Project
City of Richmond and Henrico County, VA



Legend

-  Mile Marker
-  Proposed Emergency Pull-Off

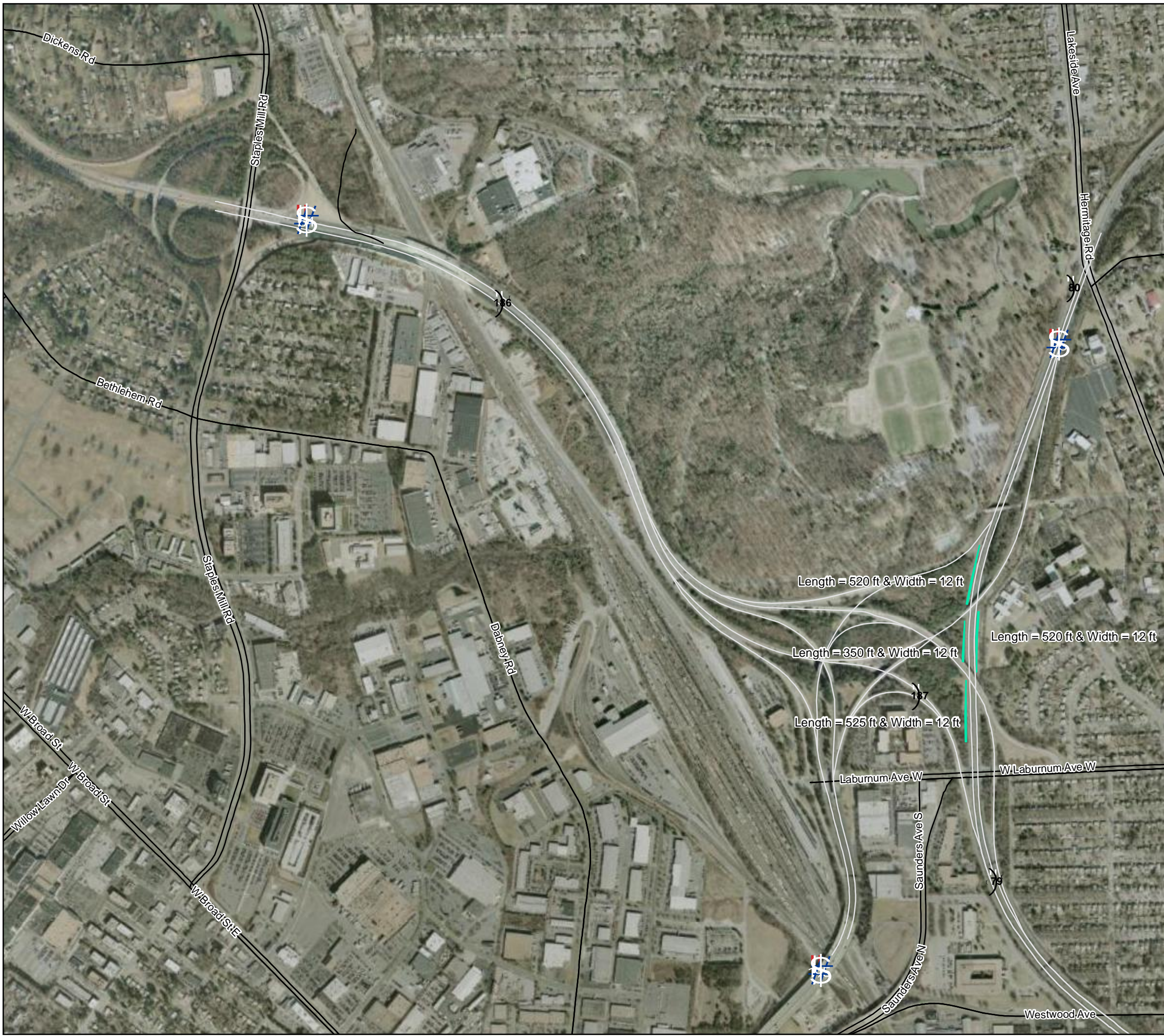




Figure R5
 Proposed Emergency Pull-Offs
 I-95 SB / I-64 EB Overlap Project
 City of Richmond and Henrico County, VA



Legend

-  Mile Marker
-  Proposed Emergency Pull-Off

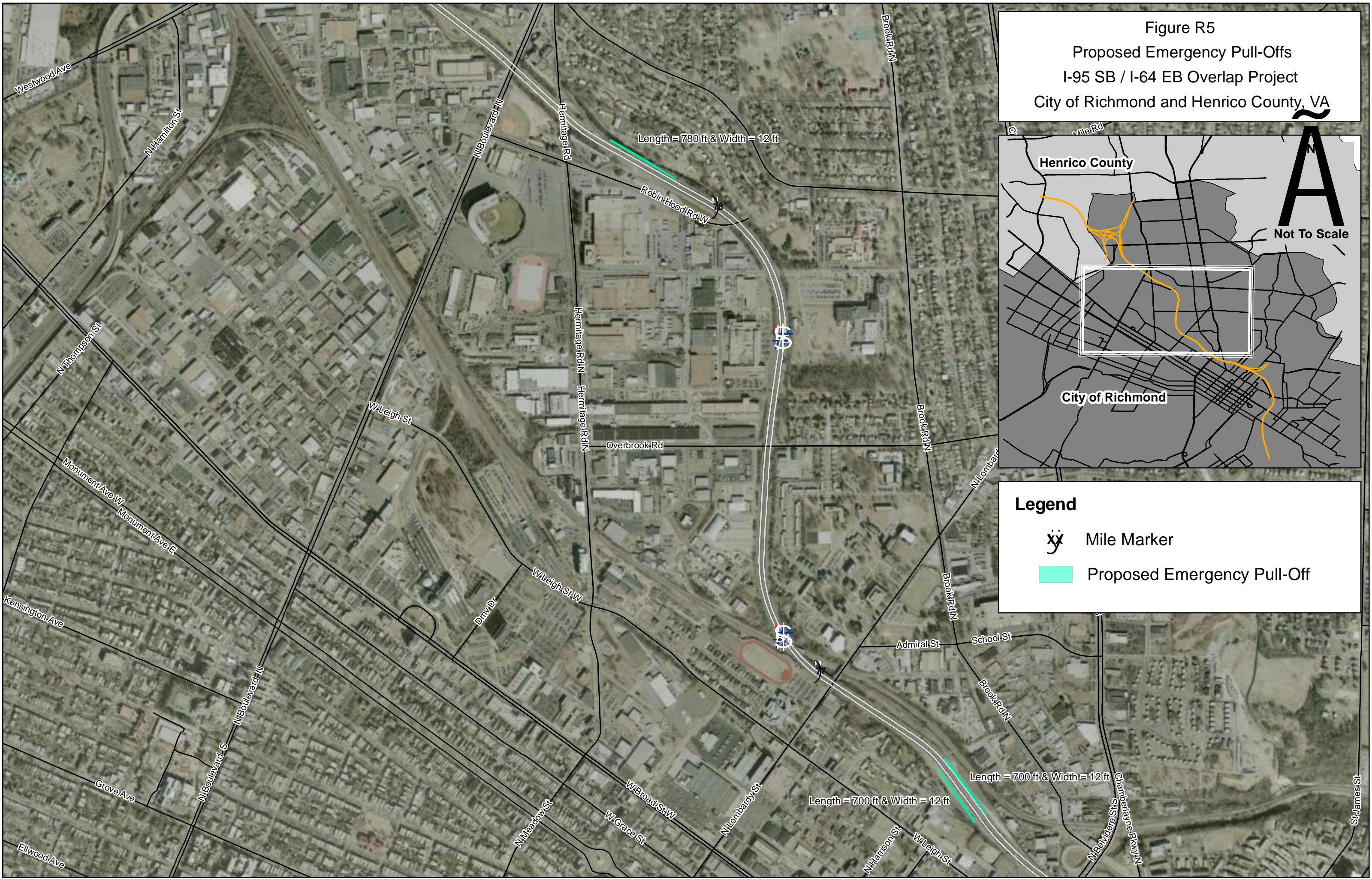
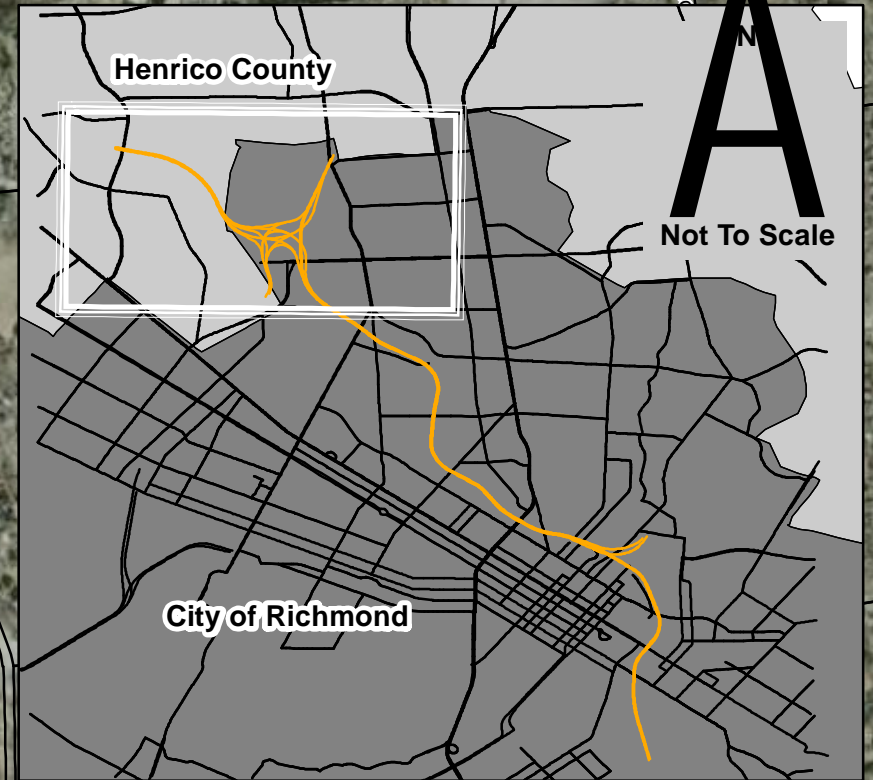






Figure R7
 Existing Lighting and Proposed Lighting
 I-95 SB / I-64 EB Overlap Project
 City of Richmond and Henrico County, VA



Legend

-  Mile Marker
-  Proposed Lighting
-  Existing Conventional Lighting
-  Existing High Mast Lighting

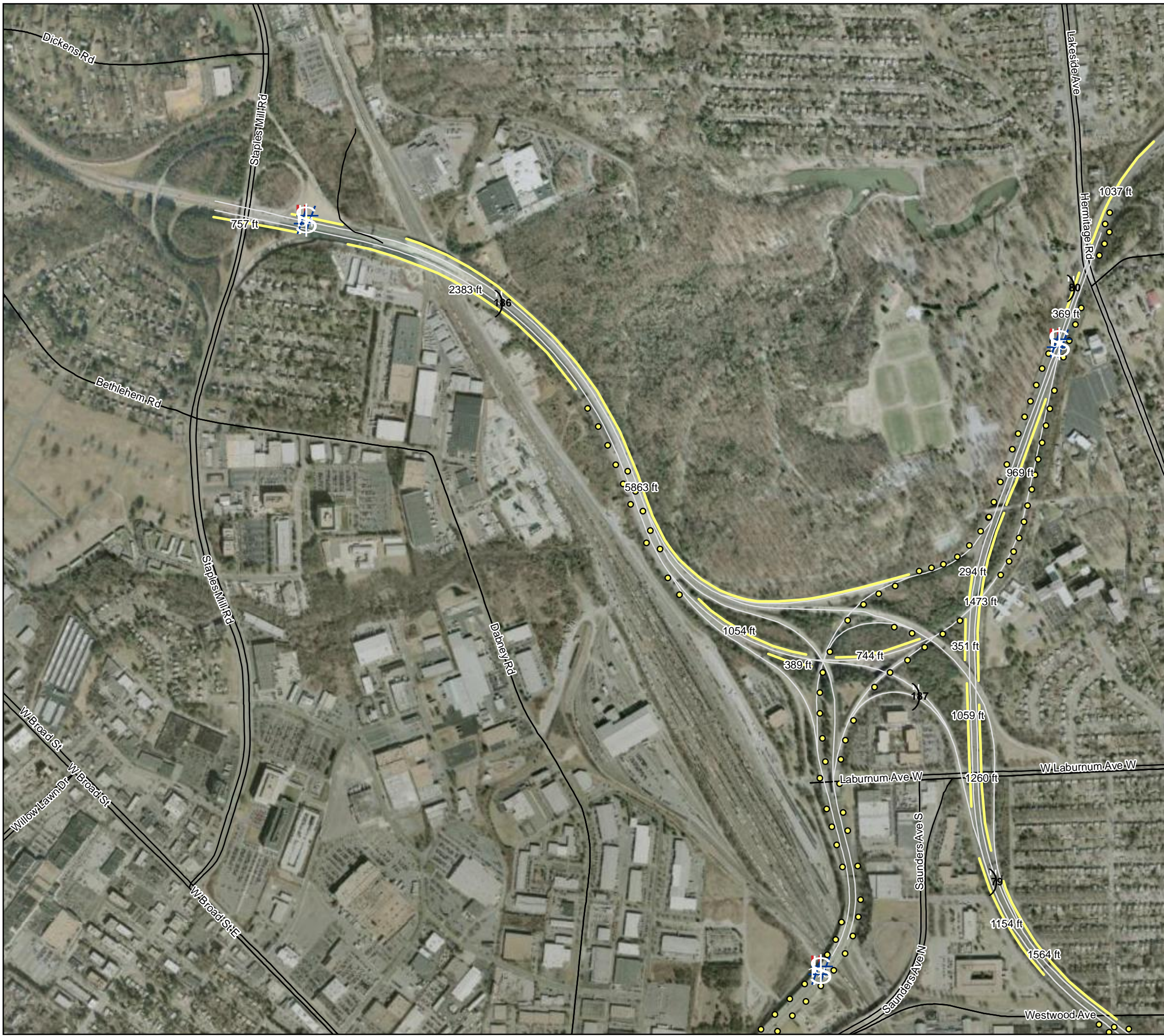






Figure R8
 Existing Lighting and Proposed Lighting
 I-95 SB / I-64 EB Overlap Project
 City of Richmond and Henrico County, VA



Legend

-  Mile Marker
-  Proposed Lighting
-  Existing Conventional Lighting
-  Existing High Mast Lighting

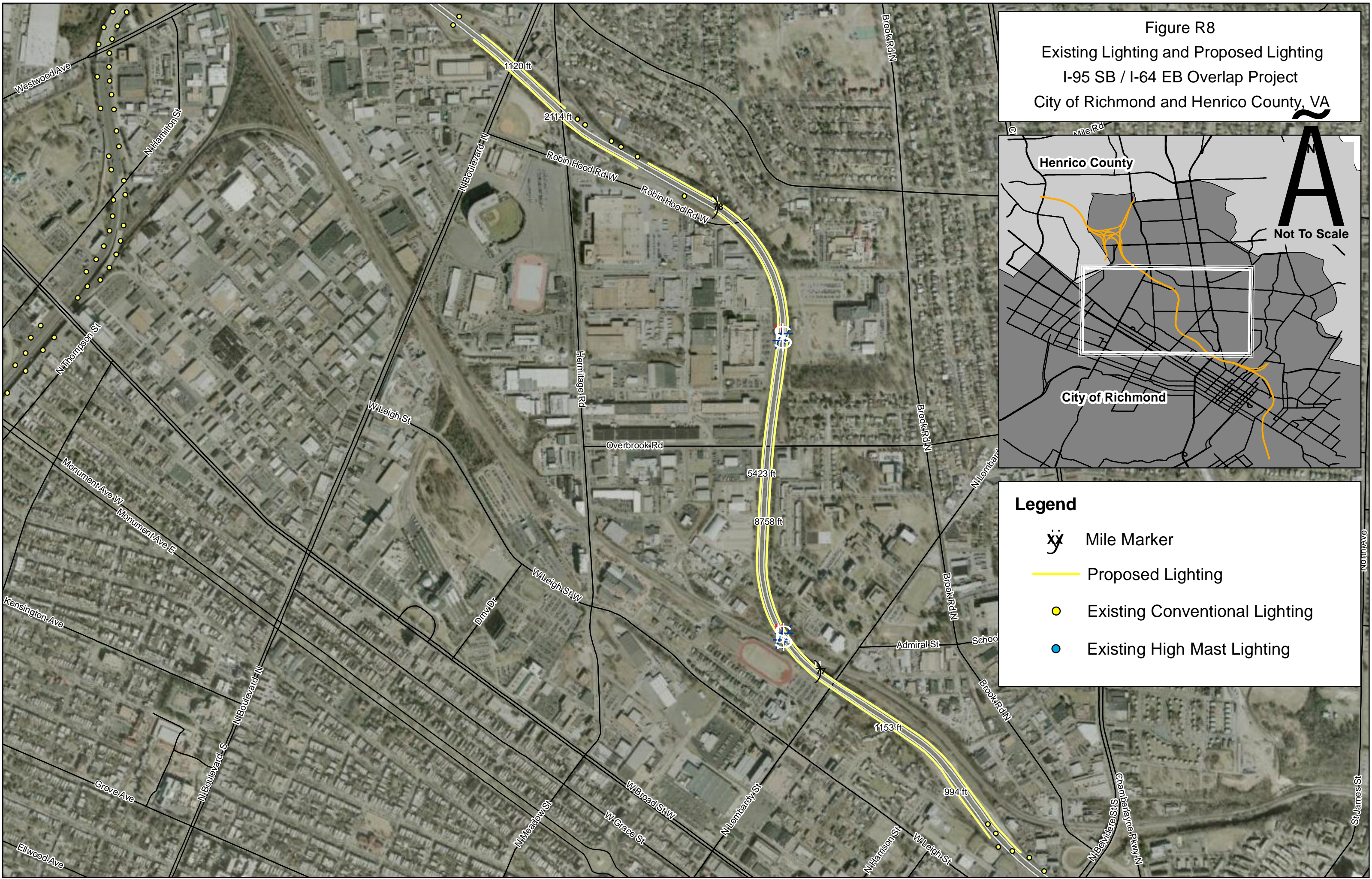




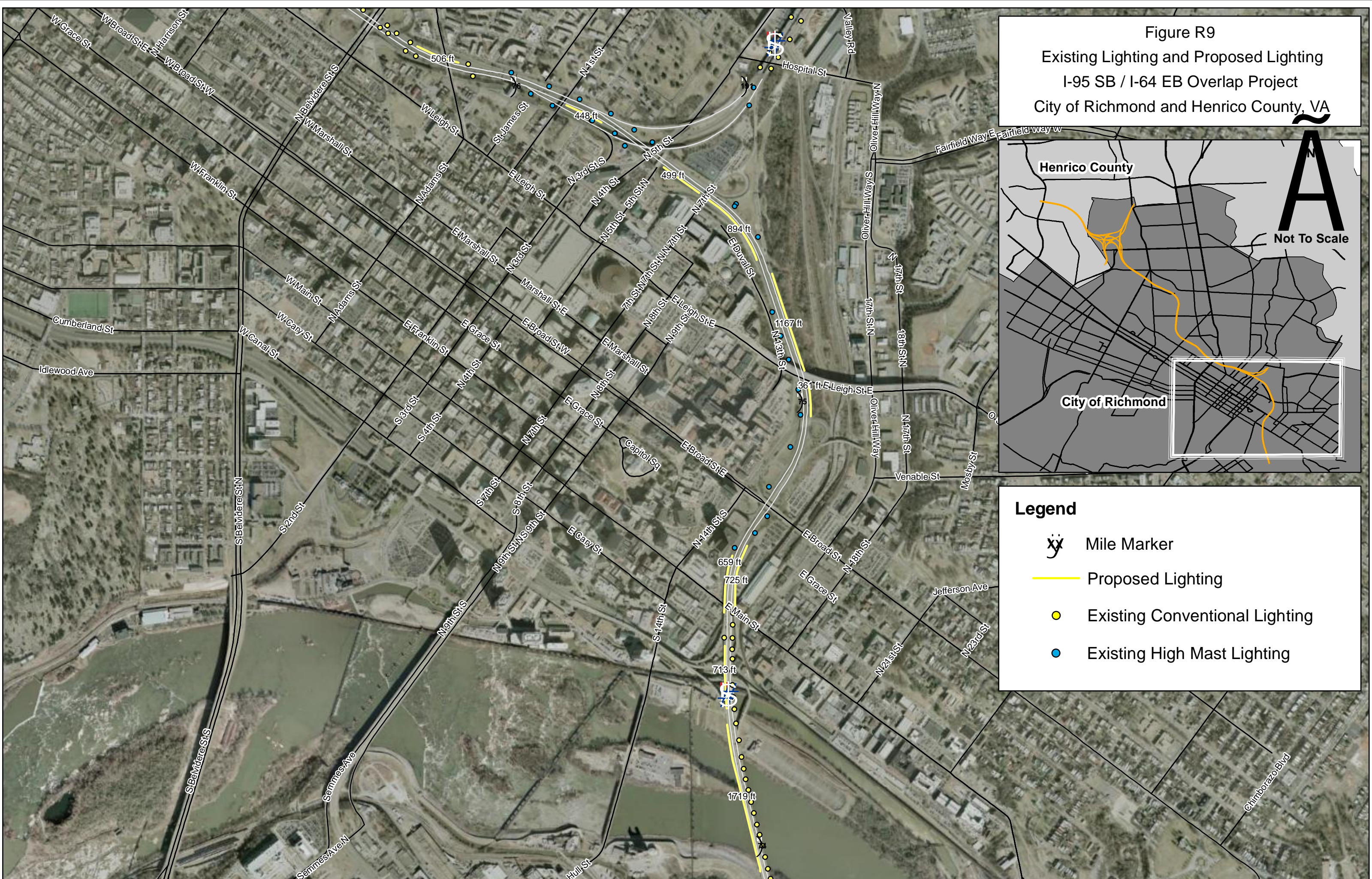


Figure R9
Existing Lighting and Proposed Lighting
I-95 SB / I-64 EB Overlap Project
City of Richmond and Henrico County, VA



Legend

-  Mile Marker
-  Proposed Lighting
-  Existing Conventional Lighting
-  Existing High Mast Lighting



Long-Term #1 - Northbound I-95 at Dumbarton Road Interchange - On- & Off-Ramps

EXISTING CONDITIONS

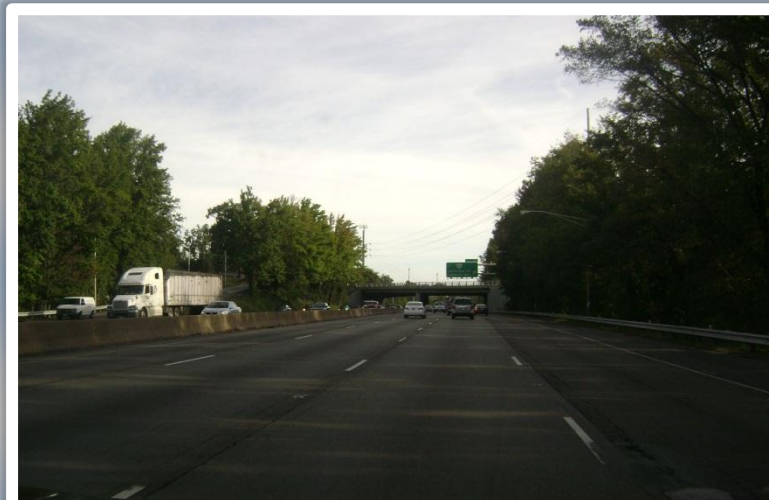
- I-95 between the Bryan Park interchange and Hermitage Road/Lakeside Avenue is one of the most congested areas in the corridor during the AM and PM peak hours due to heavy interstate-to-interstate traffic volumes during the AM and PM peak hours.
- Operational issues targeted by the proposed improvements are:
 - The eastbound I-64/northbound I-195 to northbound I-95 movement; which reduces from a 2-lane ramp to a 1-lane ramp prior to the merge onto northbound I-95.
 - The over capacity on-ramp results in queues that extends upstream on both eastbound I-64 and northbound I-195 (refer to **Photographs 1 - 2**).
 - This issue is compounded by a short merging distance of 500 feet which is limited by the Hermitage Bridge over I-95 (refer to **Photograph 3**).
 - The southbound I-95 to westbound I-64/southbound I-195 movement; which is served by a 2-lane ramp.
 - This movement queues north beyond the on-ramp from Hermitage Road/Lakeside Avenue during the AM peak hour.
 - The short weaving distance between this movement and the on-ramp from Hermitage Road/Lakeside Avenue is 500 feet.



Photograph 1 – Looking South at Eastbound I-64/Northbound I-195 On-Ramp to Northbound I-95 – AM Peak Hour Queue



Photograph 2 – Looking North at Merge from Eastbound I-64/Northbound I-195 On-Ramp to Northbound I-95 – AM Peak Hour Queue



Photograph 3 – Eastbound I-64/Northbound I-195 On-Ramp to Northbound I-95 – AM Peak Hour Queue

PROJECT DESCRIPTION

1. Remove the existing northbound I-95 off-ramp and the southbound on-ramp from Hermitage Road/Lakeside Avenue.
2. Widen the Hermitage Road/Lakeside Avenue bridge over I-95.
3. Construct an additional lane on the eastbound I-64/northbound I-195 on-ramp to provide two lanes entering northbound I-95.
 - a. Continue additional lane from on-ramp as the 4th rightmost lane on northbound I-95 to Dumbarton Road.
 - b. Drop rightmost lane at Dumbarton Road by constructing a northbound I-95 off-ramp and install traffic signal at the ramp termini on Dumbarton Road.
4. Construct an on-ramp from Dumbarton Road to southbound I-95 and install traffic signals at the ramp termini on Dumbarton Road.
 - a. Continue additional lane from on-ramp as the 4th rightmost lane on southbound I-95 from Dumbarton Road and tie into existing 4-lane cross-section south of Hermitage Road/Lakeside Avenue.

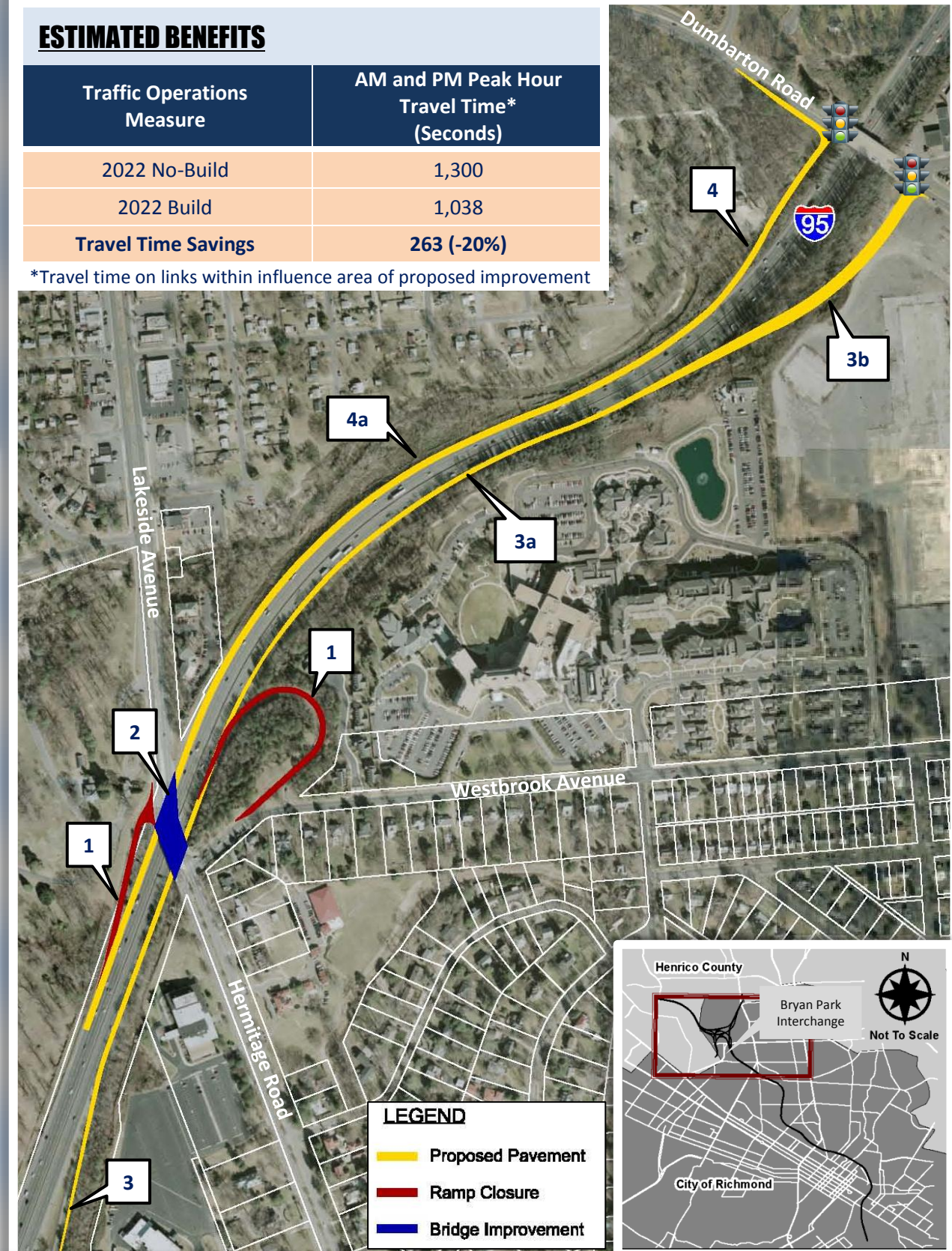
PROJECT BENEFIT

- Reduces peak hour queues on the eastbound I-64, southbound I-95, and northbound I-195 interstate-to-interstate ramps through the Bryan Park interchange.
- Increases interchange spacing from Bryan Park to the first interchange north.
- Improves traffic flow and safety on I-95, I-64, and I-195 by increasing capacity.
- Improves safety by eliminating short weaving movements between Hermitage Road/Lakeside Avenue and the Bryan Park interchange.

ESTIMATED BENEFITS

Traffic Operations Measure	AM and PM Peak Hour Travel Time* (Seconds)
2022 No-Build	1,300
2022 Build	1,038
Travel Time Savings	263 (-20%)

*Travel time on links within influence area of proposed improvement



ESTIMATED PROJECT COST

*Assumes an inflation rate of 2.4%

Existing 2013 Dollars (000's)	Projected 2018 Dollars* (000's)
\$50,900 - \$68,800	\$57,200 - \$77,400

Long-Term #2 - I-95/I-64 Boulevard Interchange (Exit 78) - Braided Ramps

EXISTING CONDITIONS

The Bryan Park interchange area is a high crash, heavily congested area within the I-95/I-64 Overlap corridor.

- Peak hour operational conditions include reduced speeds and queuing on interstate-to-interstate ramps.
- Safety issues related to peak hour congested conditions include a trend of rear-end crashes.
- Roadway deficiencies including closely spaced ramps and short weaving, merging, and diverging distances.
- Peak hour operational and safety issues are primarily due to weaving and merging areas associated with interstate-to-interstate connections.

PROJECT DESCRIPTION

Northbound

- Construct braided ramps to separate movements from northbound I-95/I-64 to westbound I-64 and the on-ramp from Boulevard to northbound I-95/I-64.
- Reduce the number of lanes on northbound I-95/I-64 from 3 to 2 lanes between the off-ramp to westbound I-64/southbound I-195 and the on ramp from eastbound I-64/northbound I-195. This will provide a dedicated lane for the on-ramp from eastbound I-64/northbound I-195 to merge in to.

Southbound

- Construct braided ramps to separate movements from the southbound I-95/I-64 off-ramp to Boulevard and the on-ramp from eastbound I-64/northbound I-195.
- Reduce southbound I-95 from 3 to 2 lanes between the off-ramp to westbound I-64 and the on-ramp from eastbound I-64/northbound I-195. This will provide a dedicated lane for the eastbound I-64/northbound I-195 to merge in to.

PROJECT BENEFIT

- This improvement eliminates the northbound and southbound I-95/I-64 weaving sections between the Bryan Park and Boulevard interchanges.

ESTIMATED PROJECT COST

Existing 2013 Dollars (000's)	Projected 2018 Dollars* (000's)
\$133,700 – \$180,900	\$150,600 – \$203,700

*Assumes an inflation rate of 2.4%

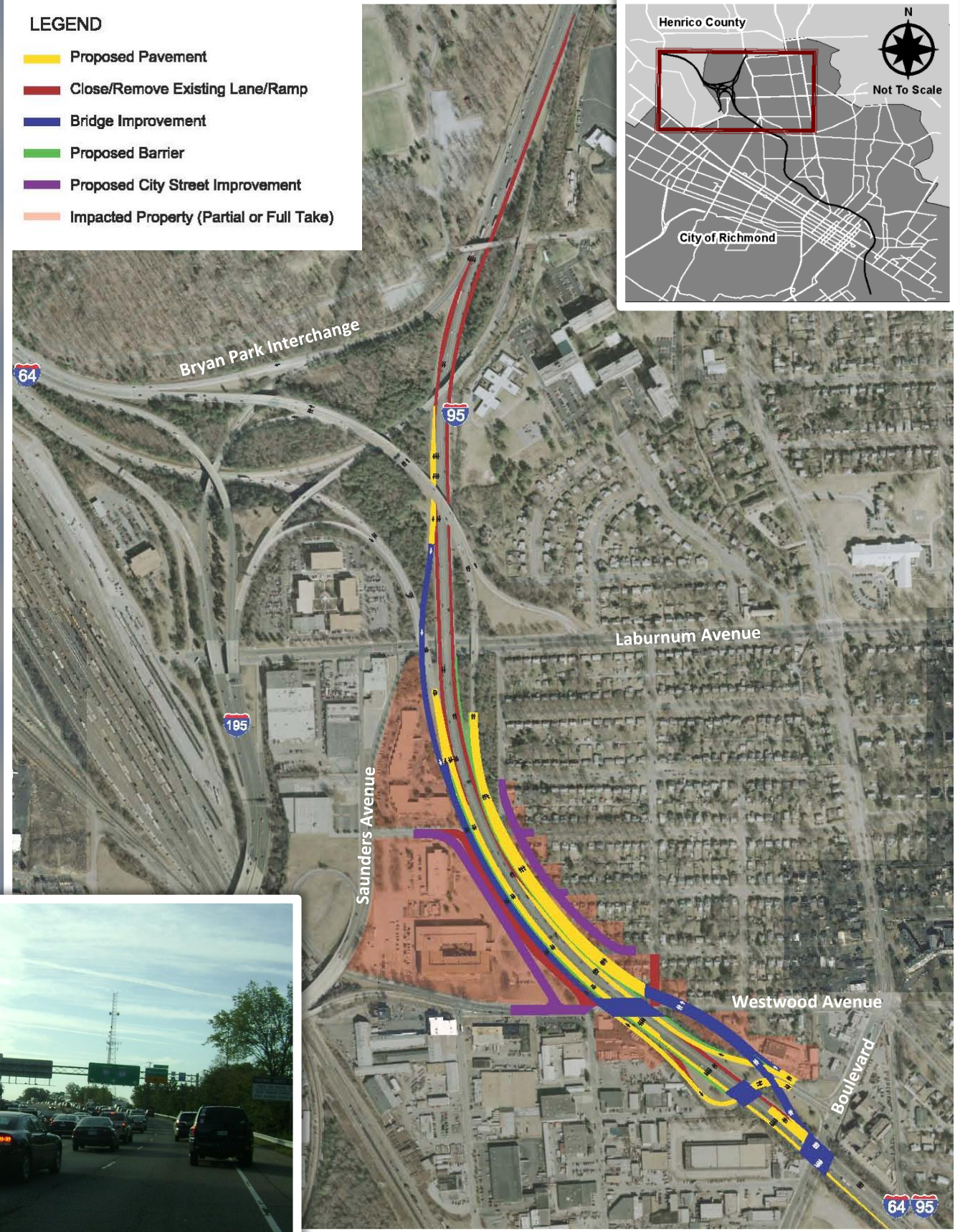
ESTIMATED BENEFITS

Traffic Operations Measure	AM and PM Peak Hour Travel Time* (Seconds)
2022 No-Build	740
2022 Build	651
Travel Time Savings	89 (-12%)

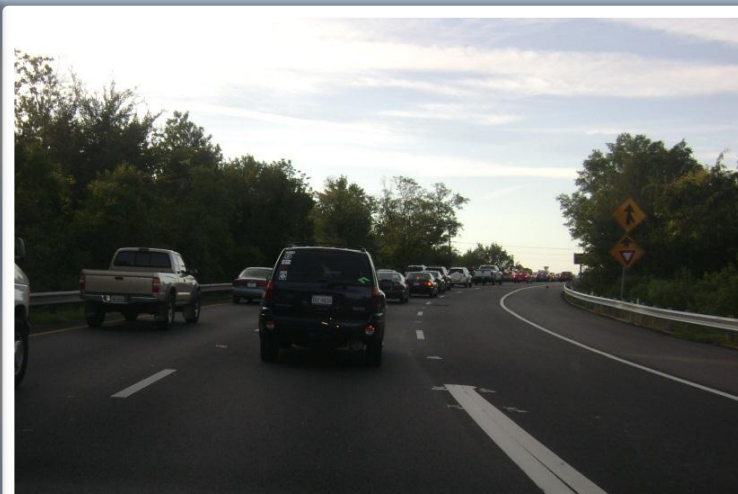
*Travel time on links within influence area of proposed improvement



Photograph 1 – Northbound I-95/I-64 Off-Ramp to Westbound I-64/Southbound I-195 – PM Peak Hour Queue



Photograph 2 – Northbound I-95/I-64 Weave Section between Bryan Park Interchange and Boulevard

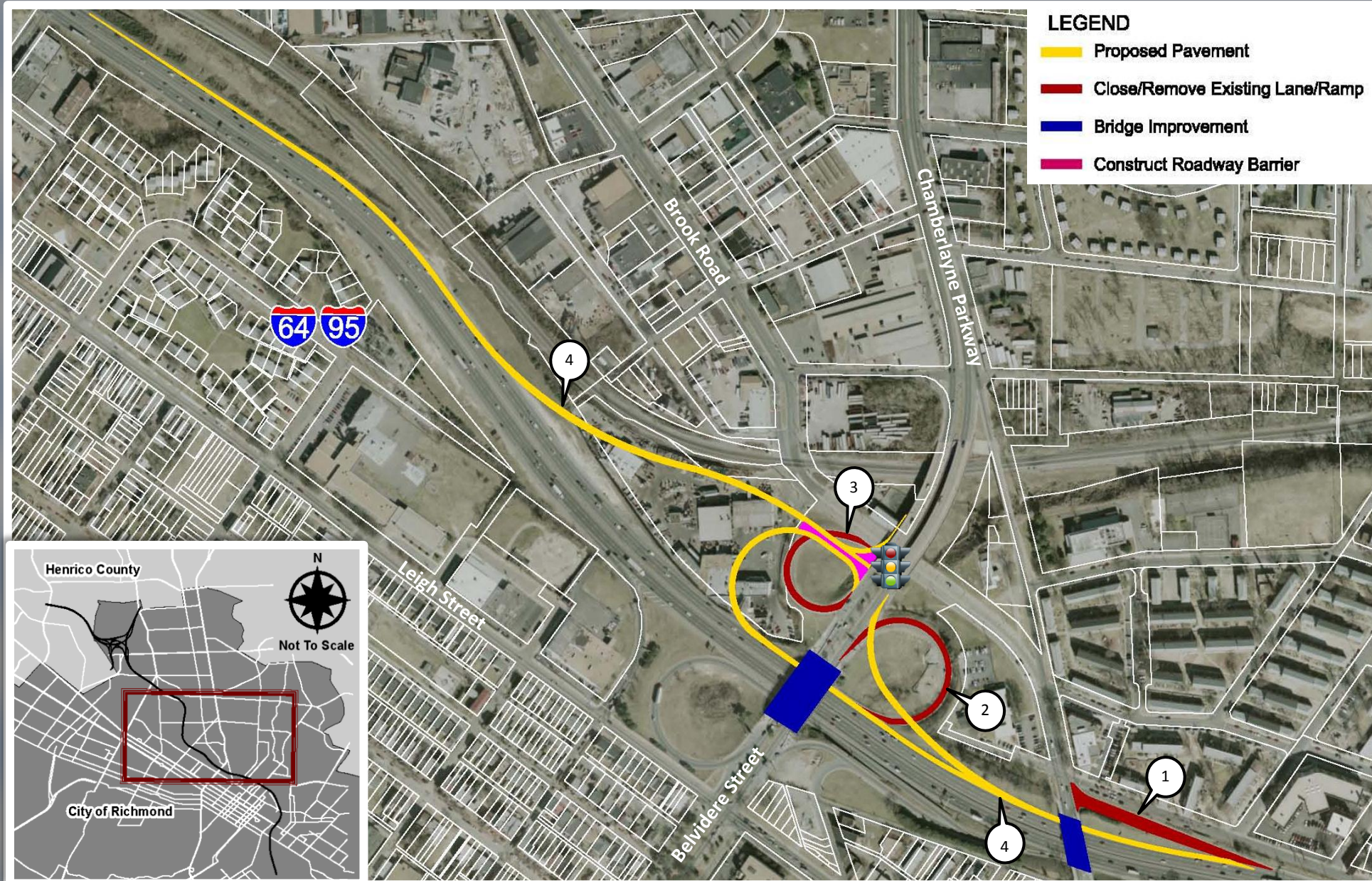


Photograph 3 – Eastbound I-64/Northbound I-195 On-Ramp to Southbound I-95/I-64 – PM Peak Hour Queue



Photograph 4 – Southbound I-95/I-64 Weave Section between Bryan Park Interchange and Boulevard - PM Peak Hour Queue

Long-Term #11 - I-95/I-64 Belvidere Street Interchange - On- & Off-Ramps



EXISTING CONDITIONS

- The existing northbound acceleration lane from the Belvidere Street I-95 on-ramp does not meet current design standards and is a high rear-end crash location.
- The low speed, loop on-ramp from northbound Belvidere Street is over capacity during the PM peak hour.
- The short weave section between the on-ramp from westbound I-64 and the off-ramp to Chamberlayne Parkway results in peak hour queues on northbound I-95/I-64.
- There is no existing access to northbound I-95/I-64 from southbound Belvidere Street.

PROJECT DESCRIPTION

1. Eliminate northbound off-ramp to Chamberlayne Avenue.
2. Eliminate loop ramp from northbound Belvidere Street to northbound I-95/I-64.
3. Eliminate existing loop ramp from southbound Belvidere Street to Brook Road.
4. Construct northbound I-95/I-64 on- and off-ramps to and from Belvidere Street.

PROJECT BENEFIT

- Eliminates the existing deficient acceleration lane from the northbound Belvidere Street to northbound I-95/I-64 loop ramp
- Increases the weave section between the westbound I-64 to northbound I-95/I-64 on-ramp and the off-ramp at Chamberlayne Avenue
- Adds a connection from southbound Belvidere Street to northbound I-95/I-64

ESTIMATED PROJECT COST

Existing 2013 Dollars (000's)	Projected 2018 Dollars* (000's)
\$42,500 – \$57,500	\$47,900 – \$64,800

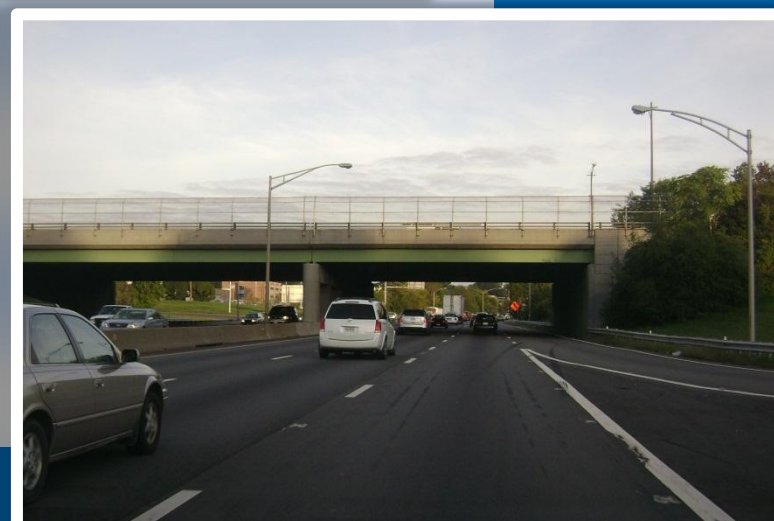
*Assumes an inflation rate of 2.4%



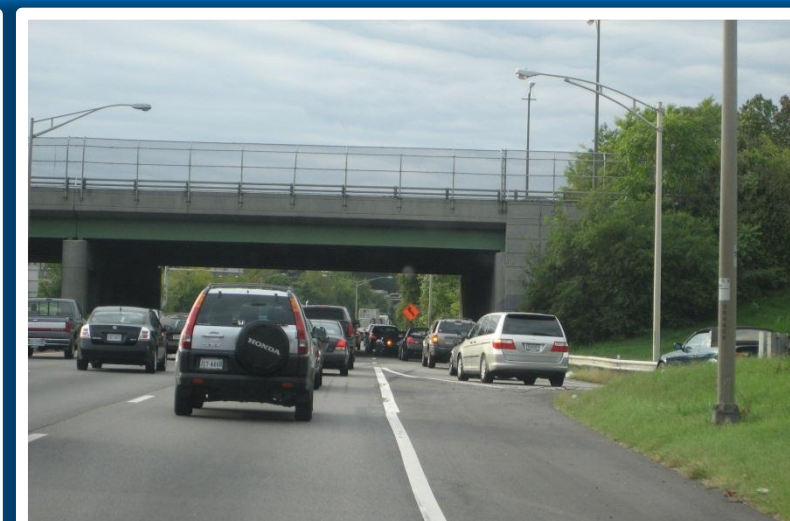
Photograph 1 – Northbound I-95/I-64 Weave Section between Westbound I-64 and Off-Ramp to Chamberlayne Parkway



Photograph 2 – Off-Ramp to Chamberlayne Parkway - To be Removed



Photograph 3 – Belvidere Street On-Ramp to Northbound I-95/I-64 – Deficient Merge Distance



Photograph 4 – Belvidere Street On-Ramp to Northbound I-95/I-64 – PM Peak Hour

Long-Term #12 - I-95 at Broad Street Interchange (Exits 74 & 75) - Long Range Vision

EXISTING CONDITIONS

The Broad Street interchange area is a high crash, heavily congested area within the I-95/I-64 Overlap corridor.

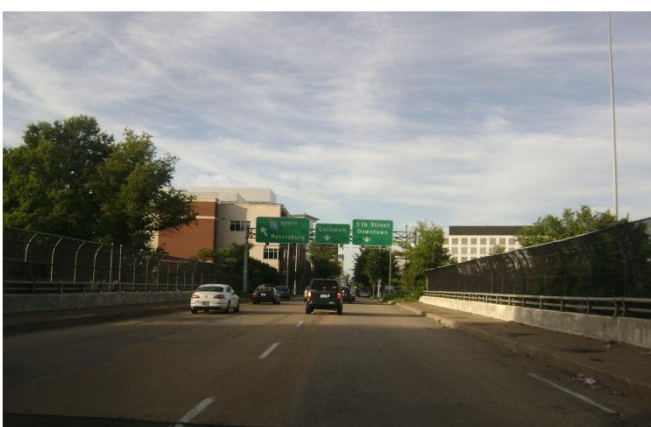
- Peak hour operational conditions include reduced speeds and queuing on ramps.
- Safety issues related to peak hour congested conditions include a trend of rear-end crashes.
- Roadway deficiencies including closely spaced ramps, low-speed, loop on-ramps, and short weaving, merging, and diverging distances.
- Peak hour operational and safety issues are primarily due to weaving and merging areas associated with interstate-to-interstate connections.



Photograph 1 – Interstate-to-Interstate Movement – Southbound I-94/I-64 Off-Ramp to Eastbound I-64



Photograph 2 – Interstate-to-Interstate Movement – Northbound I-95 Off-Ramp to Eastbound I-64



Photograph 3 – Interstate-to-Interstate Movement – Westbound I-64 Off-Ramp to Southbound I-95



Photograph 4 – Broad Street at N. 14th Street Intersection from Southbound I-95 Off-Ramp

PROJECT BENEFIT

- Improves traffic operations and safety on northbound and southbound I-95 by eliminating weave movements.
- Improves safety by closing the southbound I-95 off-ramp to Franklin Street.
- Increases capacity at the intersection of Broad Street and 14th Street.
- Pedestrian conflicts are eliminated at the intersection of Broad Street and 14th Street and at the westbound Broad Street on-ramp to southbound I-95.
- Surface street improvements will improve traffic operations on adjacent streets as a result of changes in traffic pattern changes due to the proposed improvements.

ESTIMATED PROJECT COST

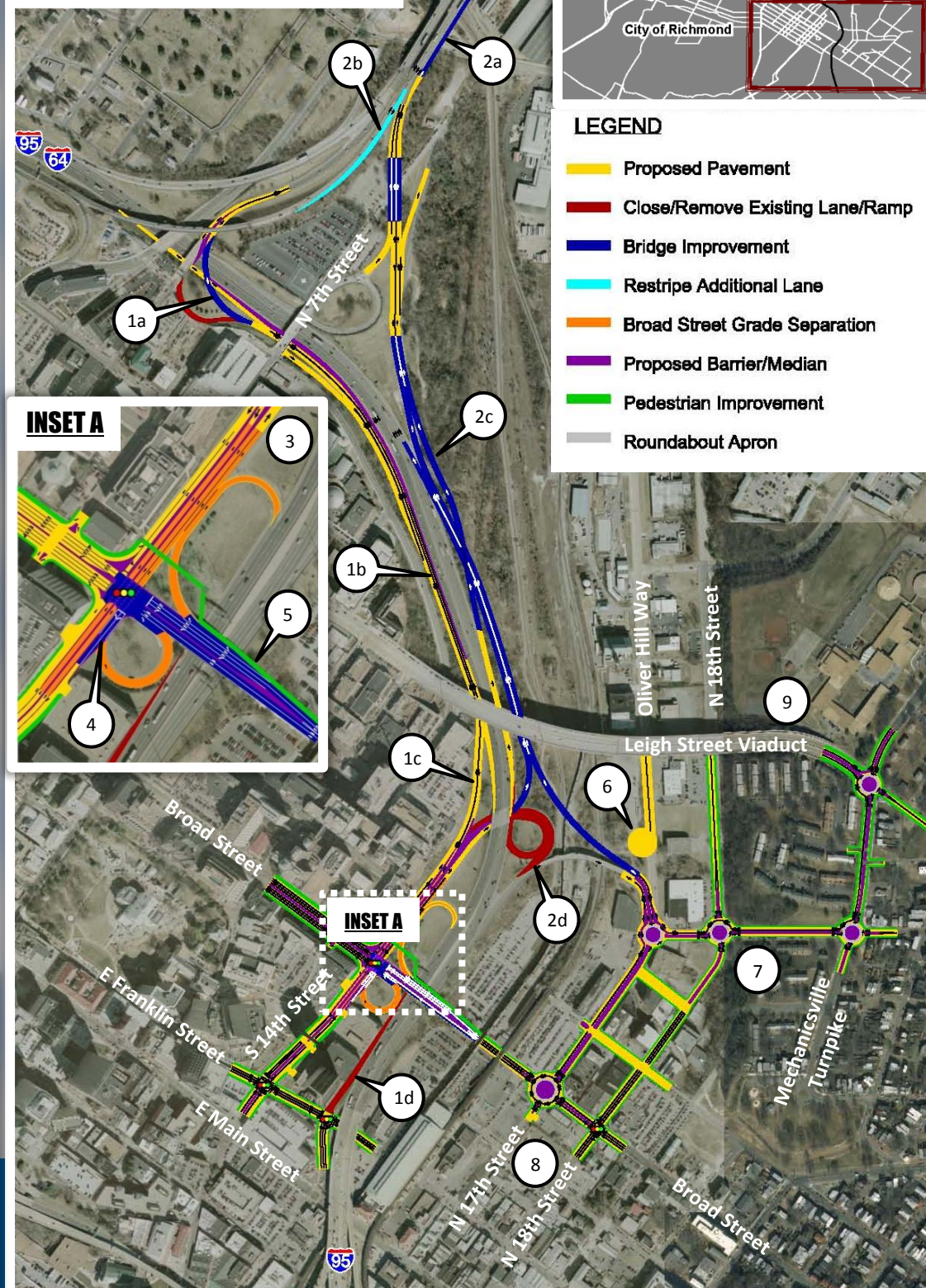
Existing 2013 Dollars (000's)

\$395,700 – \$535,400

Projected 2018 Dollars* (000's)

\$445,400 – \$602,600

*Assumes an inflation rate of 2.4%



PROJECT DESCRIPTION

This concept is a combination of interstate and surface street improvements that would provide a comprehensive set of improvements to the Broad Street interchange area.

Interstate Improvements

1. Southbound I-95
 - a. Construct westbound I-64 to southbound I-95 flyover ramp
 - b. Construct collector-distributor (CD) road between eastbound I-64 to southbound I-95 and Broad Street
 - c. Construct on-ramp from CD road to Broad Street
 - d. Close Franklin Street exit
2. Northbound I-95
 - a. Widen the Shockoe Bottom Bridge in the eastbound direction from four lanes to five lanes
 - b. Increase capacity of southbound I-95/I-64 to eastbound I-64 from one lane to two lanes by restriping and using the existing pavement
 - c. Construct braided ramps
 - d. Close existing loop ramp from Broad Street to northbound I-95/I-64

Intersection Improvements

3. Grade separate the intersection of Broad Street and N. 14th Street
4. Provide slip ramp from northbound 14th Street to provide connection to loop on-ramp to southbound I-95

Pedestrian Improvement

5. Construct pedestrian overpass along the north side of Broad Street from N. 14th Street to east of the westbound on-ramp from Broad Street to southbound I-95

Other Surface Street Improvements

6. Construct a cul-de-sac on Oliver Hill Way to the north of Venable Street
7. Construct roundabouts at five surface street intersections
8. Convert 17th Street and 18th Street from one-way to two-way roadways
9. Convert outer lanes on Leigh Street Viaduct to bike lanes