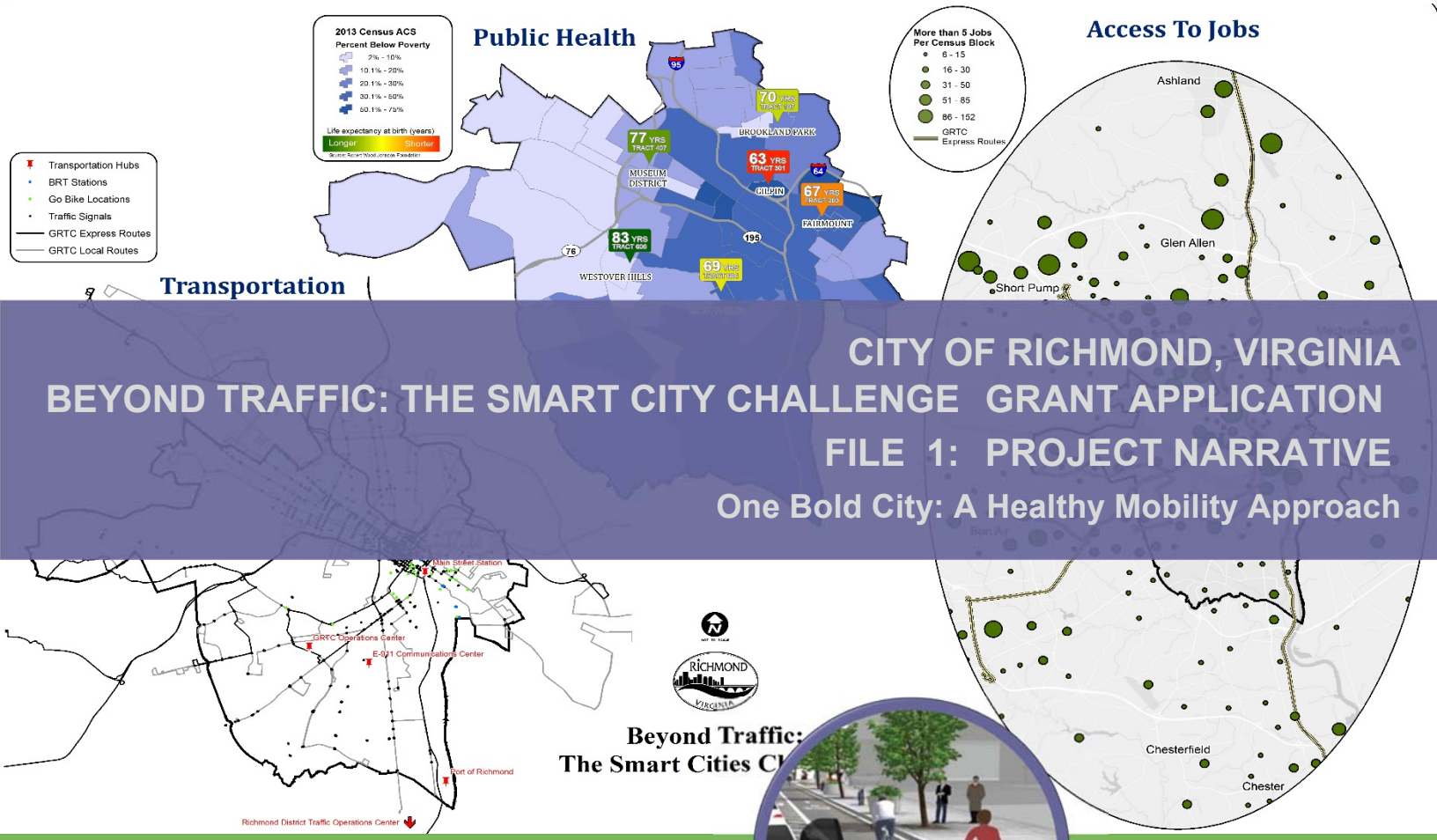

CITY OF RICHMOND, VIRGINIA

BEYOND TRAFFIC: THE SMART CITY CHALLENGE GRANT APPLICATION

FILE 1: PROJECT NARRATIVE

One Bold City: A Healthy Mobility Approach

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INTRODUCTION

The City of Richmond, Virginia, along with a strong coalition of public and private partners, is requesting consideration by the U.S. Department of Transportation (USDOT) to be among the five finalists for Beyond Traffic: The Smart City Challenge. Project partners believe Richmond is uniquely positioned to meet this challenge and exceed all expectations in demonstrating a successful, holistic, and integrated approach to improving transportation in communities of similar size and complexity. Richmond is geographically distinct, not embedded in a complex of metropolitan areas, which better suits it to serve as a model Smart City.

Our proposed approach will deploy cutting edge transportation solutions by integrating emerging transportation data, technologies, and applications with existing systems to address our most pressing social and environmental challenges and demonstrate their efficacy. Equally important is that Richmond's diverse attributes are likely to make Richmond's proposed strategies broadly transferable to other mid-size U.S. cities. With its rich and, in important respects, painful history, Smart City designation will provide an opportunity to demonstrate how innovative techniques can address difficult historical legacies in any city that contends with them.

In the following sections we present our vision of Richmond's Smart City Future, describe key problems and needs of our residents that have resulted from past inequitable transportation and land use decisions, describe the current transportation landscape, and how our proposed Smart City demonstrations will fill the gap between the needs of our residents and the shortcomings of our current systems. In doing so, we will evidence our readiness to conduct and carryout our proposed demonstrations and why Richmond is an excellent location for them. To this end we have a 13th Vision Element called Health Mobility.

Much of the information presented in this proposal is, technical, or descriptive. To provide a more human-level perspective of what the information means for people living in Richmond, a series of short vignettes can be found in various parts of the proposal. The vignettes will present a family that is representative of transportation-disadvantaged families living in Richmond's more challenged neighborhoods. This family, the Smiths, consist of Jan, James, and their 12 year old daughter, Kari. The symbol to the above left represents our 13th vision element, Healthy Mobility, and will accompany each of the Smith vignettes.

1. VISION

In the Smart City, state-of-the-art technology promotes mobility that is safe, conducive to public health, efficient in its use of space and energy, sustainable, and affordable to all. A Smart City is also a livable city, bridging gaps between people and places for economic and social benefits and improving well-being, equity, and health.

Richmond envisions itself as a Smart City in which state-of-the-art mobility technology equitably and noninvasively serves commerce, commuters, and local residents. Our city street network has an excellent grid system, but single occupant vehicle travel is the norm. In our Smart City future, walking and bicycling will be normal mobility modes operating in harmony with powered mobility systems. New technology will be an indispensable means to this end, but will not be mistaken for an end in itself. In its Smart City future, Richmond will continue to value and measure traffic safety and traffic volume, but livability, sustainability, health, and well-being will also continue to be heavily factored into planning decisions as guiding principles.

Although Richmond is currently challenged by the dominance of automobile traffic, our Smart City future will not require residents to own or operate a motor vehicle in order to access job opportunities. As one in four city residents lives below the poverty level, compared to approximately one in ten throughout Virginia,[1] Richmond must offer more reliable, extensive, and affordable transportation to better serve its low-income residents. Indeed, one step out of poverty is relief from the expensive necessity of owning a car. Richmond will use vehicle automation technology to improve multimodal access to jobs and economic development in a way that promotes healthy and safe streets and personal and physical wellbeing.

The Richmond metropolitan area has been ranked as the third most obese "major U.S. community" according to a Gallup poll.[2] Almost 30 percent of metropolitan area residents are obese. In our Smart City future, Richmond will help cut that percentage significantly by creating an environment that is conducive to active transportation.

Finally, new technologies will enable safer, more efficient, and more enjoyable interactions among users of different modes of transportation. Existing and new technologies capture data that, with proper analysis, can yield unexpected opportunities for further improvement of life in the city. Analysis, learning, and innovation based on real data are at the core of a Smart City. Richmond will capture, retain, and disseminate the copious data produced to inform local, state, and national assessments and future program development and strategic planning.

2. POPULATION CHARACTERISTICS

Richmond had a 2010 land area of 59.81 square miles and a population of 204,214, resulting in a population density of 3,414.7 persons per square mile.[3] Richmond represents the densely settled core Census-Designated Place (CDP) of the Richmond Census Urbanized Area (UZA). The Richmond UZA had a 2010 land area of 492.17 square miles and a population of 953,556, resulting in a population density of 1,937.5 persons per square mile.[4] Richmond accounts for 12.2% of the Richmond UZA land area (59.81 square miles divided by 492.17 square miles) and 21.4% of its population (Richmond's population of 2014,214 divided by the UZA population of 953,556). However, in addition to meeting the population attributes of a Smart City, Richmond's Smart City vision has been shaped significantly by past transportation and land use decisions and their role in current socioeconomic realities citywide.

Concentration of poverty within a neighborhood is a strong indicator of lack of employment opportunities and other supports, and, as is evident from the map on page 11, poverty in Richmond is clustered heavily in neighborhoods in the East, North, and South sides of the city. In Richmond, 25.6% of residents live in poverty, more than double that of Virginia (11.3%) and over one-third more than nationally (15.4%). For children it is even more acute: 38.8% for Richmond, 14.9% for Virginia, and 21.6% nationally. The U.S. Department of Housing and Urban Development maintains data estimating the number of people who are identified as low- and moderate-income (LMI), based on incomes that are less than 80% of the area median income. In Richmond's East End, 81.3% of the population is categorized as LMI. This is a higher than the city's overall rate of

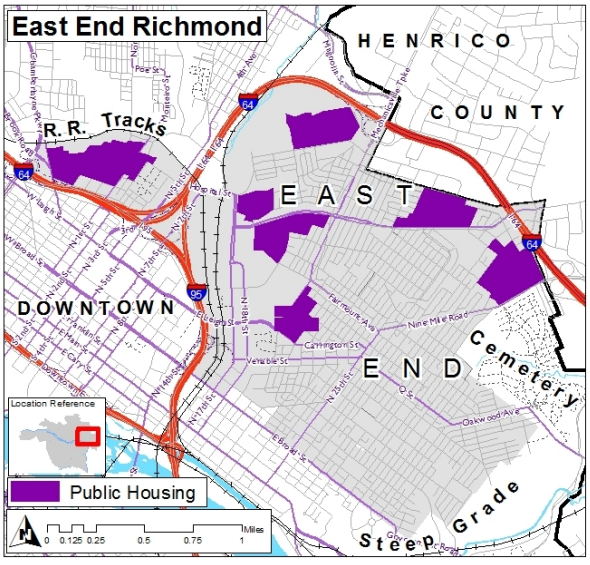
[1] U.S. Census Bureau, 2010-2014 5-Year American Community Survey, Table S1701.
[2] Rifkfkin, Rebecca (2014). *Boulder, Colo., Residents Still Least Likely to Be Obese*. Gallup.
[3] Census Bureau: State and County QuickFacts. Retrieved from: http://quickfacts.census.gov/qfd/states/51/51760.html
[4] Census Bureau: 2010 Census Urban and Rural Classification and Urban Area Criteria, Lists of 2010 Census Urban Areas, retrieved from: https://www.census.gov/geo/reference/ua/urban-rural-2010.html.

61.2%, which places Richmond within the bottom 7% of localities nationwide in terms of having the most disproportionate LMI rates.[5] The working poor, who hover just above the poverty threshold, fall within this category and are at constant risk of falling into poverty.

Quality housing, public safety, and proximity to medical care are also essential to thriving for individuals and communities. One such area in Richmond is its East End, which is characterized by aging public housing facilities as well as extensive abandoned, vacant, and blighted properties that contribute to high crime rates and poor health. In addition, all five Census Tracts within East End are designated as Health Profession Shortage Areas (more than 3,500 people per 1 primary care physician), and three Census Tracts are designated as Medically Underserved Areas. The proposed East End also falls within a USDA-recognized Food Desert, as residents must travel more than one mile in order to reach a grocery store.

The Smiths live in a neighborhood with few parks but with many abandoned buildings and high levels of crime. The majority of neighborhood families have incomes below the federal poverty level, and most adults have not continued education beyond high school. This is the part of town that was historically redlined, resulting in the segregation of African Americans into under resourced, high poverty communities. The Smith family home is a rental unit, modest in size and located two blocks from one of Richmond's public housing communities. There are a few fast food restaurants and liquor stores in their neighborhood, but no full service grocery stores. Among other things, tobacco and alcohol are marketed disproportionately in the community, compared to communities with less poverty and fewer residents of color. In addition, tobacco and alcohol are easier to obtain than fresh fruits and vegetables and low fat foods.

These challenging social, health, and environmental issues are part of a legacy of damaging state- and federally-sponsored public projects and have been exacerbated by poor local land use and planning decisions. Historically, Richmond's East End was part of the Jackson Ward neighborhood, a thriving African-American commercial and residential area after the Civil War and home to many internationally notable citizens and celebrities. Nicknamed both "Black Wall Street" and "the Harlem of the South" by southerners, Jackson Ward was an important cultural destination for African-Americans throughout the early 20th century. The district is also historically significant because it was central to the Civil Rights movement in Richmond. In 1955, prior to the creation of the U.S. Interstate Highway System, the Virginia General Assembly created the Richmond–Petersburg Turnpike Authority as an independent state agency which constructed a new Turnpike of the same name. The Turnpike bisected the Jackson Ward neighborhood, resulting in devastating, irreparable effects on its fabric. Within a month of its opening in 1958, the State Highway Commission designated it as part of Interstate 95.



[5] HUD, FY2015 Low and Moderate Income Summary Data National Data Set. Accessed at: https://www.hudexchange.info/manage-a-program/acs-low-mod-summary-data-block-groups-places/

From the early 1940s through 1970, six public housing communities were constructed in the eastern bisected area, totaling 2,639 housing units within a two square mile area and resulting the highest concentrations of public housing between New York City and Atlanta. In the 1970s, construction of Interstate 64 created a barrier, further isolating geographically the eastern bisected area and Richmond's public housing, now the East End, from the rest of the city and neighboring Henrico County. Exacerbated by poor local land use decisions, these State- and federally-supported public housing and transportation projects reduced Jackson Ward from a nationally-recognized African-American cultural and financial center to separate neighborhoods of poverty, crime, and blight. Today, the city's East End public housing communities represent the greatest geographic concentration of poverty within the entire Richmond Urbanized Area. The population of this area remains geographically isolated and lacks transportation options to connect to job sites and amenities in other parts of the city and surrounding jurisdictions. Given these factors, addressing key problems in Richmond's East End will be a primary focus of our Smart City strategy.

The Smiths always eat breakfast together before going their separate ways for the day. After breakfast, Kari asks her father for help with some finishing touches on a project for school. Mr. Smith helps her gladly, but now he's running late for his bus. He sprints to the bus stop to make up the lost minutes, only to watch the back end of the bus disappear down the road. The next bus doesn't come for another half hour. He paces and waits, knowing he'll lose half an hour of pay and that his lateness will be recorded in his personnel file. Mr. Smith supports his family on his single hourly income, with the additional help of government assistance; there are jobs out in Henrico and Chesterfield counties that pay better, but he would need a car to get to them, and there's no way to save up for a car on the amount of money he makes now. Mr. Smith calls his supervisor and apologizes for missing the bus, leaving out the part where he chose being a present father over being on time – he knows his supervisor is indifferent to this point.

3. OTHER CHARACTERISTICS

Richmond is well aligned with the USDOT's characteristics for a Smart City, including its existing public transportation system, environment, committed leadership, commitment to open data, diverse, sustainable, and healthy mobility, and integrating the sharing economy. Additionally, Richmond has a long history of transportation innovation, a commitment to diverse, sustainable, and healthy mobility, and a commitment to creating wealth and fighting poverty.

Existing Public Transportation System

Greater Richmond Transit Company (GRTC): Founded in 1860, the public transit system known today as GRTC has operated continuously, with one temporary suspension of service during the Civil War, for over 150 years. GRTC's history of being a progressive transit system was established when it was the first public transit agency to implement the system wide use of electric streetcars. That progressive attitude carries forth to today, with service improvements and additions such as expanded services for seniors and individuals with disabilities, welfare-to-work transportation, vanpool and carpool development, regional taxicab oversight, and expanded service to surrounding counties and cities. Jointly owned by the City of Richmond and Chesterfield County, the transit agency was purchased from private owners and incorporated as GRTC Transit System, on April 12, 1973, for the purpose of providing public transportation service in the Greater Richmond area. Today, GRTC primarily serves Richmond and a very small portion of the adjacent counties of Henrico and Chesterfield.

In general, service is concentrated in the City, where many households and residents are characterized as being in need of transit based on demographics. Transit-dependent factors include: living below the poverty line, having a mobility limitation, being aged 65 or older, and having either no, or only one vehicle available. Residents falling into these categories typically have difficulty accessing major destinations, such as medical facilities, government facilities and services, employment centers, as well as grocery and other retail outlets, without adequate public transportation services. On-board surveys of GRTC users reveal that only about half have access to a vehicle; about half do not possess a valid driver's license; 41% of riders have annual household incomes of less than $15,000; over 71% use GRTC services four or more days per week; 86% live within the geographic limits of the city; and 72% self-identify as African-American.[6] Unfortunately, many of Richmond's most transportation- disadvantaged households must rely on transferring from bus to bus multiple times to access job sites, medical offices, and healthy food shopping locations and in many poor neighborhoods buses arriving at stops are infrequent

Mrs. Smith takes the bus to a grocery store five miles from her house twice a month, buying the most groceries at the start of the month when she receives her family's SNAP benefits. It takes her about an hour to get there, as she has to switch bus lines halfway through. She buys as many canned and boxed foods as she can carry and a few pieces of fruit, but only as many as she knows Kari will eat before they go bad and waste money.

Bus Rapid Transit (BRT): The Broad Street BRT, known as the "Pulse," is a 7.6 mile long project that will provide city residents with faster, more convenient access to growth areas in surrounding Henrico County. The Pulse is a regional collaboration between GRTC, the Virginia Department of Rail and Public Transportation (DRPT), City of Richmond and Henrico County. With 14 stations and dedicated BRT lanes, the "Pulse" will improve transit service, increase livability, enhance economic opportunity, revitalize commercial properties, improve environmental sustainability, and stimulate economic development in the city and greater Richmond region. The Pulse has received a $24.9M grant from the USDOT TIGER program. The hallmark of the Pulse is its ability to provide safer, more reliable transportation by having dedicated lanes and transit signal priority (TSP) throughout the corridor. BRT transit service operations and on-time performance are fundamentally dependent on successful implementation of the TSP technology and communication between the BRT vehicle and traffic signals. The Pulse will also have real time next bus arrival information at each station to offer riders accurate minute-by-minute information. The Pulse project is being implemented through a design-build process and is currently in the procurement phase, with anticipated operation by October 2017. As an adjunct to the Pulse project, the City is conducting a study to determine how best to connect East End communities to Pulse stations. This process will become part of the full Smart City proposal should the City be selected as one of the five finalists.

High Speed Rail - DC2RVA: The Federal Railroad Administration (FRA) and the Virginia Department of Rail and Public Transportation (DRPT) are conducting a Tier II Environmental Impact Statement for High Speed Rail between Richmond and Washington D.C. (aka DC2RVA). The Tier II EIS will lead to a decision on advancing the High Speed Rail recommendations for a third track. The City has invested in historic Main Street Station which serves as the City's

[6] Richmond Area Metropolitan Planning Organization (2012, amended 2014). *The Long-Range Transportation Plan for the Richmond Area*. http://www.richmondregional.org/TPO/LRTP/plan2035/plan2035_Chapters.htm.

multimodal transportation hub and will be the City's High Speed Rail station.

Environment Conducive to Demonstrating Proposed Strategies
Richmond's diverse physical environment makes it an ideal candidate as a Smart City. Lying on the fall line of the James River, where Virginia's coastal Tidewater region meets the rolling terrain of the Piedmont, Richmond combines topographical attributes of coastal and floodplain cities and those more typical of the inland. Originally built on seven hills on the north side of the fall line of the James, Richmond now spreads over both banks of the river, encompassing very steep grades to the north and flat terrain to the south, a combination that provides excellent topographical diversity for demonstrating emerging transportation solutions.

A mid-Atlantic city, Richmond has four distinct seasons with wide fluctuations in temperature, humidity, and precipitation through the year. Hence, successful efforts to promote walkability, cycling, and other active mobility must take into account extremes of weather.

Richmond's transportation milieu, a mix of nineteenth-century street grids, urban arterials, and interstate highways, make it typical of mid-sized cities nationwide. However, Richmond is unique in that it owns the Port of Richmond which is the western terminus for commercial navigation on the James River and is Central Virginia's domestic and international multi-modal freight and distribution center, serving waterborne, rail and truck shippers throughout the Mid-Atlantic States.

Richmond has a diverse cultural and economic environment: it embodies attributes of aging industrial cities with those of growing Sunbelt cities; its population is socioeconomically and demographically diverse; its existing transportation infrastructure, including the regional transit systems, is typical of comparable cities; it has areas that are distressed, affluent, and gentrified; has significant and growing peripheral sprawl; and a challenging set of social, health, and environmental issues.

On the off weeks, if the Smiths need groceries, Mrs. Smith walks down to the corner store, where they accept her SNAP card but prices are as much as 50% higher than at a regular grocery store and they almost never carry fresh fruits or vegetables. The coolers at the corner stores are stocked with more alcohol than soft drinks or dairy; Mrs. Smith doesn't drink much, but on her way home with a bag of groceries, she will pass two other places to buy beer and wine and encounter plenty of her neighbors who are out of the workforce and drinking during the day. She heads back into the house and watches television and waits for Kari and James to come home.

Continuity of Committed Leadership and Capacity to Carry Out the Demonstration
Richmond's Smart City Challenge proposal has the full, committed support elected leadership as evidenced by Mayor Dwight C. Jones' strong letter of transmittal. The Richmond City Council has also expressed support and intends to act on a resolution expressing that support, which is being sponsored by both the Mayor and members of the City Council. The resolution was to have been acted upon in time for inclusion in this proposal during January 25, 2016 City Council meeting, but the meeting was canceled due to a major winter storm that paralyzed the city. Richmond's elected leadership understand that Richmond is in a unique transformational period and believe designation as the selected Smart City will help propel the transformation of the community.

In addition, City department heads and other high-level administrators represent a strong cadre of

support for Richmond's Smart City proposal and the cutting edge projects it contains. Many of these non-elected leaders have long tenures with the City which will continue beyond the Smart City Challenge performance period; the committed support of these non-elected leaders will serve to champion Smart City initiatives throughout the performance period.

Finally, the commitment of other Community leaders and project partners, as evidenced by the included letters of support and commitment, reinforce that of elected officials and high-level administrators. The expertise of our partnering organizations and the governance structure proposed to oversee the Smart City Program will also help leverage the City's significant capacity to undertake the demonstration throughout the performance period and bring the associated initiatives and their evaluation to fruition.

When Kari is sick, Mrs. Smith must walk to school to meet her, walk with her to the bus stop, and take two different buses to reach the closest clinic that accepts her health insurance plan. The long, overcrowded bus ride always makes Kari feel sicker, and the ride home, with a third stop at a pharmacy since there is not one within walking distance of their house, feels even longer. Kari's father never takes time off from work to go to the doctor even if he is sick, because an hour of missed work is an hour of missed pay, something the Smiths can't

Commitment to Integrating with the Sharing Economy

The City has committed to integrating with the sharing economy as evidenced in both formal planning documents and ongoing procurement activity. The City unveiled its sustainability plan, RVAgreen, to improve the quality of life for residents, create a healthy environment, and enhance economic opportunity. The RVAgreen Plan was developed under the Mayor's Green Government Order and has been formally adopted by City Council. The RVAgreen Plan includes an initiative to implement a Bike Share program in the City as an important element in reducing its carbon footprint via a reduction of citywide Vehicle-Miles-Traveled (VMT) per capita,[7] as well as a method to increase access to transportation for all residents, including those who are transportation-disadvantaged. Implementation of the Bike Share Project is currently in progress; a vendor has been selected and awarded by the Richmond Department of Procurement Services on February 1, 2016.

Clear Commitment to Making Open, Machine-Readable Data Accessible, Discoverable and Usable by the Public to Fuel Entrepreneurship and Innovation.

On June 30, 2015, the City of Richmond officially launched its Open Data Portal (data.richmondgov.com), which created the first such open data portal in the Commonwealth of Virginia. At its original launch, the Open Data Portal included over 30 machine-readable, open, and accessible datasets. Included in this initial launch were datasets of public value such as property owner lists, GIS shape files, payments to vendors, and police accident incidents. The City of Richmond is committed to making data open and available in a machine-readable format and will provide additional datasets that spur the growth of our innovative, creative community of entrepreneurs and startups. Currently, the City's Department of Information Technology is creating an Open Data Management Team consisting of subject matter experts and database administrators from each department to prepare the release of more government datasets that are both publicly valuable and meet FOIA (Freedom of Information Act) requirements. Richmond's

[7] City of Richmond. RVAgreen: Annual Progress Report 2014: Moving Sustainability Forward, page 18. Available at: http://www.richmondgov.com/Sustainability/index.aspx.

Open Data Portal is hosted by Socrata, the industry leader in making government data readily available and discoverable online. The process for uploading datasets includes the ability to input metadata which further explains the content and meaning of government information and fields. There are built-in tools that reduce the technical capacity required to use and interpret published datasets in the portal. There is also a built-in application program interface, or API, that allows for website and applications to readily access published data and information. The City is committed to expanding the number of datasets available on our Open Data Portal and further promote accessibility, transparency, and accountability of government services and information. The City has a Code for RVA Brigade, a group of passionate citizens with the skills, drive, and ability to transform data on the Open Data Portal into public applications, visualizations, and maps. Brigades across the country are huge catalysts for the consumption of public data as well as proponents for the improvement of data quality and accuracy. Code for RVA Brigade is leading the innovation of open data in Richmond that promotes the entrepreneurial spirit within the community.

Mrs. Smith's ability to work is limited given complications from several years of fighting Type II Diabetes, and she spends hours on the bus every month traveling to see a doctor located on the other side of the city that offers low-cost care for managing her condition, which her insurance doesn't cover. Her condition could probably be controlled, allowing her to work at least part-time, if she could keep up with her regular appointments and medication. However, she often misses her appointments or fails to pick up her medicine when she is feeling too sick to take the multiple bus trips required to reach her provider.

Long History of Transportation Innovation

Richmond has a history of embracing innovative and practical transportation technology for as long as our nation is old. In 1790, the James River Company opened the first commercial canal in the United States. Located along a seven mile route paralleling the river at Richmond, what became the James River and Kanawha Canal (a project first proposed, and then surveyed, by George Washington when he was a young man), connected the navigable waters downstream of Richmond to those upstream. The first stagecoach lines to Richmond were established during the War of 1812, and the first regular steamboat service began on the James River in 1815. Significantly, Richmond had the first successful electrically powered street railway system in the U.S. Designed by electric power pioneer, Frank J. Sprague, the trolley system opened its first line in January 1888 and his design expanded into worldwide use. Richmond's hills, long a transportation obstacle, were considered an ideal proving ground and the new technology soon replaced horse cars and accelerated Richmond's expansion. In 1955, prior to the creation of the U.S. Interstate Highway System, the Virginia General Assembly created the Richmond–Petersburg Turnpike Authority as an independent state agency to administer a new Turnpike of the same name. The new road was planned as an expressway with only 15 exits, most of which were well away from the highly developed commercial areas along parallel U.S. 1-301. Upon opening in 1958, the State Highway Commission designated it as part of Interstate 95, becoming a grandfathered part of the U.S. Interstate Highway System. Finally, as described above, project partner GRTC is in the process of developing a BRT line in Richmond. The "Pulse" will run from Rocketts Landing east of downtown to Henrico County to the west.

Commitment to Diverse, Sustainable, and Healthy Mobility

The City recognizes that there is an important nexus of opportunity between public health, environmental sustainability, and transportation. The City and project partners are committed to

diverse, sustainable, and healthy mobility, as evidenced by policy, investments, and plans. Richmond has adopted policy positons that commit to promoting healthy, sustainable, and diverse mobility. Richmond's Health in All Policies (HiAP) approach is intended to improve the health of all people by incorporating health considerations into decision-making across sectors. HiAP brings together decision-makers from the City, public schools, and City Health District to collaboratively develop policies, programs, and services that promote health for all City residents. In doing so, HiAP creates a framework to discuss how to create policies and programs that will meet community goals while supporting and protecting public health. HiAP ensures that all factors that contribute to health and well-being are considered in all governmental policy decisions that impact where people live, work, learn, and play. HiAP will ensure that healthy mobility considerations are part of all Smart City initiatives.

Additionally, the City adopted Complete Streets Policy in 2014, a transportation policy and design approach that helps make communities healthier, more livable, economically competitive, and safe from. The policy requires streets to be designed and operated in a manner to be safe, comfortable and convenient for all users regardless of age, ability or mode of travel. The goal of the City's Complete Streets Policy is to balance the access, mobility, and safety of all users while creating a stronger and healthier community. The Complete Streets approach was a guiding principle in the Richmond Strategic Multimodal Transportation Plan adopted in 2013,[8] which describes actions and plans that the City will take over the next 20 years to improve transportation.

The James River is four miles from Kari's house. She sees it on the bus every time her mother takes her to the doctor's office, but she's only been there once, on a school field trip. There's an art museum on the other side of town where admission is always free, but her mother says the bus ride would be too long to see it on a Saturday. There are free kids' yoga classes and guided hiking excursions and $1 movies at a theater in the West End of Richmond, but none of these things are on the bus route, so Kari is left out.

An existing facility marked with sharrows.

The City proactively promotes sustainable transportation options, a position made clear in the Richmond Bicycle Master Plan, completed in 2014. The City has invested heavily in pedestrian and bicycling infrastructure in recent years, creating bike lanes, sharrow marking, and bike racks throughout the city, and has created a Pedestrian, Bicycle, and Trails Coordinator position that is involved in all transportation-related planning. The City has begun converting its fleet to CNG fueled vehicles, as GRTC has done with its busses, and is committed to reducing its vehicle-related carbon footprint. Finally, the Richmond Strategic Multimodal Transportation Plan calls for expanding Level 2 charging station availability, particularly at major employer parking facilities and multimodal hubs such as Main Street Station.[9] The City's promotion of diverting travel from personal vehicles to more sustainable transportation, as well as promotion of electric vehicles and fleet conversion to CNG, will have a

[8] Richmond Connects: Richmond Strategic Multimodal Transportation Plan. July 2013.
[9] Ibid, page 80.

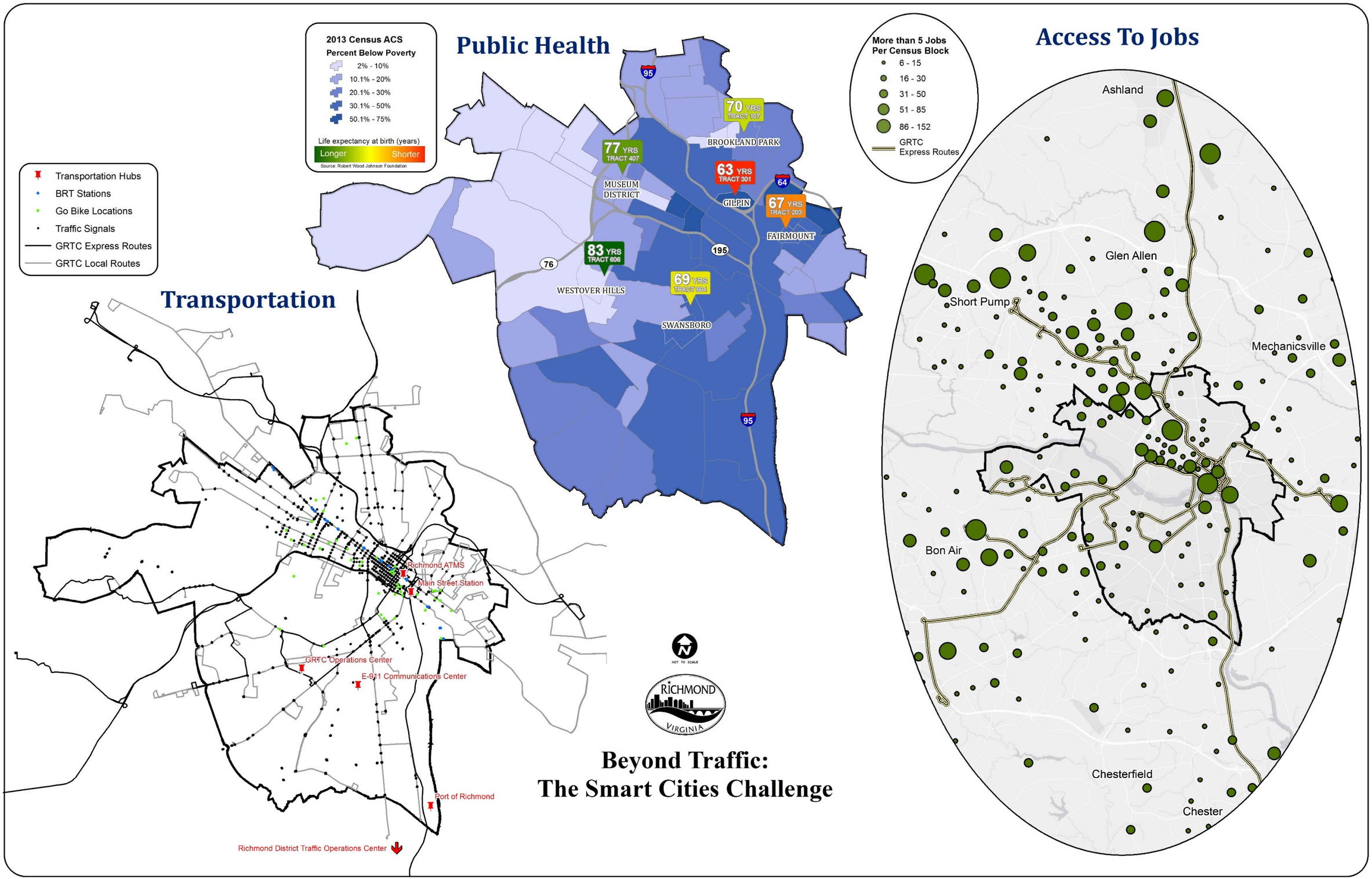
measurable impact on the environment and on long-term sustainability. The diversion of gasoline powered vehicular traffic from highways and streets via individual personal vehicles to walking, biking, transit, rail, and electric vehicles will reduce the greenhouse gas (GHG) emission, which has an associated cost to society in terms of negative health impacts.

Commitment to Building Wealth and Fighting Poverty

The City is in the process of developing important transportation infrastructure and taking unprecedented action to create economic opportunities and empower citizens in our communities of greatest need. A number of exciting initiatives are underway that set Richmond apart from many other mid-size U.S. cities that would be complemented, supported, and brought to fruition through the introduction of Smart City transportation strategies. First, project partner GRTC is about to commence construction of the Pulse BRT line, as described above, connecting Richmond with job centers and growth areas downtown and in Henrico County, ensuring bus service reliability through traffic signal prioritization and dedicated transit lanes. Second, the City established the Office of Community Wealth Building (CWB), the first municipal office of its type in the nation to combat poverty and create wealth. CWB seeks to address the root causes and on-going conditions of poverty in Richmond, a significant one of which is a lack of transportation between areas of concentrated poverty and areas of economic opportunity. Lastly, Richmond has been designated by USDOT as a Ladders of Opportunity Transportation Empowerment Pilot, one of seven U.S. cities to receive that designation. The technical assistance provided by the LadderSTEP program, and the on-going efforts of CWB, will support efforts by public and private partners to improve access to areas of employment opportunities for our transit-dependent residents should Richmond be chosen as the Smart City Challenge recipient.

Too old for the little kids who swarm on the small playground at the edge of the public housing community near Kari's house and too young for the older teenage girls who are practicing to be women, Kari watches a lot of TV, sits on her stoop and talks to her friends, and tries to stay out of the way of older boys who taunt her for being a little too heavy. There is very little Kari can do about being heavy - there isn't anywhere to exercise, or anyone offering to show her how if she wanted to learn

4. PRELIMINARY SITE MAP



5. ALIGNMENT WITH USDOT VISION ELEMENTS

- We envision urban automation will bring unprecedented opportunities in promoting carsharing and automated driving on designated lanes, among others. One of challenges in Richmond, and likely in many other cities, is having unbalanced job and resident locations. We will use urban automation to help address moving those workers without personal vehicles from their residence to work places. In addition to increasing bikeshare and pedestrian access to traditional transit services, low-speed, electric automated shuttles will move people, connecting Ladders of Opportunity and other transportation-disadvantaged communities, college campuses, tourist destinations, the Greater Richmond Convention Center, and other locations, by providing last mile services to other multi-modal transportation opportunities. These flexible-route, flexible-schedule shuttles can serve niche markets for on-demand or fixed route mobility. In addition to increasing connectivity and mobility, these vehicles can also serve as a strategy for decreasing mobile emissions in the Richmond region. Long-haul on-demand mobility services (such as Uber and Lyft) may also be considered in such a system, utilizing an innovative reservation system (via mobile app) to connect travelers and service providers. Researchers at the University of Virginia's Complete Mobility and Center for Transportation Studies have developed agent-based models examining the operations of shared automated vehicles, and plan to adapt this model to Richmond's travel and network patterns. The City will work with researchers and with private firms to identify opportunities for use. Initially, low-speed, electric automated shuttles will function as Limited Self-Driving Automation (Level 3) vehicles.

<u>Vehicle Priority and Pre-Emption CENTRACS</u>

- Richmond will deploy City Fleet (Police, Fire, and School Bus) and Transit Vehicle to Infrastructure for emergency incident response and real-time traffic signal operations with adaptive Transit Vehicle Signal Priority and Emergency Preemption through centralized model connecting E-911 Advanced Vehicle Location (AVL) to the Advanced Transportation Management System (Centracs). Our partner at UVA already developed and demonstrated the performance of transit signal priority under Connected Vehicles environment.[10]

- Richmond's Pulse (BRT) will be a "connected vehicle to infrastructure" system with real-time traffic signal phase selection and sequencing with Centracs integration and real-time AVL technology. BRT vehicles will have an automated docking system to improve travel time and reliability.

- Richmond will use vehicles as mobile probes to identify hazardous winter roads for driver alerting and improved winter maintenance operations (e.g. deicer application, plowing) – Original equipment vehicle onboard sensors are used within a Connected Vehicle Framework to report slippery road conditions. This information can then be used by drivers and road maintenance agencies to improve safety and diminish the environmental costs and infrastructure damage resulting from salt application.

[10] Hu, J., B. B. Park and Y-J Lee, "Coordinated Transit Signal Priority Supporting Transit Progression Under Connected Vehicle Technology," Transportation Research Part C, Vol. 55, 2015, pp. 393-408

- Richmond will use alerts provided to drivers approaching stopped and loading transit and school buses using vehicle-to-vehicle communications - A smart phone or other onboard device is used to alert drivers of school buses stopped ahead thus helping to ensure the safety of students and passengers who are enter or leaving the bus.

Improved infrastructure-based vehicle traffic sensing for load-dependent signal synchronization

- Richmond will have access to Virginia Tech Transportation Institute's (VTTI) Center for Sustainable Mobility (CSM), which conducts research in multimodal transportation network control, traffic signal control, transit signal priority, emergency vehicle preemption, eco-transportation system development and testing, connected vehicle application algorithmic development and field testing, dynamic transit routing and scheduling systems, and automated vehicle application algorithmic development and field testing. Advanced vehicle detection technologies provide information on traffic presence, density, and flow that can improve traffic flow through signal synchronization.

- With sensors in connected and automated vehicles, and with sensors in infrastructure (including loop, video, radar detectors, and mobile phone data), Richmond will monitor traffic congestion and improve traffic operations through techniques such as such as traffic signal synchronization. Research at UVA has demonstrated that gyro sensor measures can estimate road surface roughness. Such techniques may replace periodic scanning by surface detection vehicles.

Ladders of Opportunity - Transportation Disadvantaged Communities

- Richmond bike share will be upgraded to offer pedal-electric assist bicycles (pedelec) to connect Ladders of Opportunity communities in the east end to BRT stations and the GRTC transfer center, offering improved last-mile connections to the BRT system.

- Richmond will use low-speed, electric automated shuttles to connect Ladders of Opportunity and other transportation-disadvantaged communities, college campuses, tourist destinations, and the Greater Richmond Convention Center, among others, for the last mile.

- Richmond will connect pedestrian countdown timer information for visually impaired users to accessible apps and leverage LiDAR 3-D mapping of obstacles to assist visually impaired users (smart white cane concepts).

- Data from these existing systems will be captured and analyzed to identify opportunities for improvements and extensions.

Multimodal Connections

- Richmond will fully automate the Port of Richmond's multimodal connections using Navis software technology.

- Richmond has invested in being the Region's primary multimodal hub at Main Street Station, where it will serve as the primary High Speed Rail station for the Richmond Region, and serve as the focal point for bikeshare, electric vehicle recharging, Bus Rapid Transit, as its front door for multimodal connections.

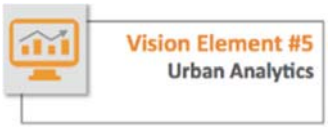
- Richmond will use social media and other user-generated data to monitor changes in usage and of local transportation systems.

Demand-Responsive Transit for Improved Level of Service and Reduction of GHG Production: With assistance from VTTI, Richmond can improve transit service and diminish its environmental impact. With an FTA grant, Blacksburg Transit and VTTI developed an adaptive system in Blacksburg, Virginia, that changes bus schedule and bus size in real time depending on passenger demand. This improves level of service, and decreases fuel consumption and GHG production. The project has three components: passenger demand assessment, fuel consumption modeling, and a dispatch demand decision support system (3DSS). The developers of the system promoted user adaptation through surveys and focus groups. Riders and the transit system can use a smart phone application for real-time travel planning and system adaptation. The mobile application tracks user demand, and reports bus routes, schedules and arrival times to users. A fuel consumption model was developed to measure fuel savings from the more efficient service. The model incorporates engine, GPS, elevation, bus size, passenger load, and other factors. Passenger demand, system status, and fuel consumption models were integrated within the 3DSS to advise dispatchers on schedule, routing, and bus selection modifications that would achieve the goals of increased performance and efficiency.

VTTI's Center for Sustainable Mobility (CSM): Part of the PARC team that was awarded a major DOE project to develop the COPTER system. The system is based on a multi-agent view of trip planning and execution, which takes into account:

1. The traveler's itinerary (the system can search for itineraries that are more energy efficient without reducing QoS), *and*
2. How the traveler executes a trip (this predominantly means real-time driving speed and re-routing suggestions).

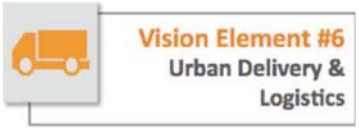
These two strategies are realized by the multi-agent, multi-modal trip planning component of the architecture and the trip execution controller component, respectively. These modules will utilize a meso-abstraction of the system micro model. The planner will consider all transportation alternatives, spanning personal (driving, walking, biking), public (subways, buses), and private (express buses, cabs, ride-sharing services), taking parking availability into account. The planner will use the predicted traffic and public transit conditions as opposed to current or merely typical conditions. These predictions, provided by the Conditions Prediction Module, will be based on real-time data from the respective data sources (Inrix, GTFS-realtime, etc.). Unlike existing planners, this planner will also consider multiple travelers at the same time, clustered by their most likely corridors of travel, and hence enable the dynamic creation of ride-pools, and on-the-fly park-and-ride and ride-share suggestions.



Open Data

- Mobility on Demand: Richmond will integrate shared transportation (bike, vehicle) with transit and parking systems through real time traveler information.
- Richmond will use an open architecture for roadway safety and operations data collection, robust analytics, data management and governance, integration and interoperability.
- Richmond will use crowd-sourcing with an open data infrastructure; citizens can improve apps and populate fundamental data elements (FDE), as outlined in the Model Inventory of Roadway Elements.

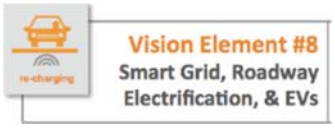
- Richmond will create real-time anonymized pedestrian / bike counts to determine trends and measure use of new facilities, such as transit and bicycle route planning.
- Richmond will create real-time pothole detection by all crowd-sourced vehicles.



- UVA has developed multimodal freight optimization that takes into account economies of scale, goods, vehicle sizes, and distances. With sensor data measuring network congestion and communications, Richmond can use this system for efficient allocation of delivery modes, thereby easing congestion and promoting energy efficiency and sustainability without new infrastructure.

- Richmond will continue to invest in the Port of Richmond. On February 1, 2016, a new $4.2 million 124-ton crane was unveiled with $17 million more in port improvements planned on the 120 acre site. These improvements include rail improvements and cargo-moving equipment. The current barge service eliminates 15,000 tractor trailer trips annually. Richmond is in the center of the supply chain with distribution centers such as online shopping giant Amazon.

Richmond will continue to reach out and engage potential future partners that are willing to demonstrate their technology in an open data platform. If selected, Richmond is prepared to announce several partnerships that are currently in discussion.



- Richmond will expand the number of electric vehicle charging stations and wireless recharge stations for all users, as well as continue to convert its city fleet and transit vehicles to natural gas. Access to electric vehicle charging stations can impact electric vehicle adoption rates, use decisions, electrified mile shares, petroleum demand, and power consumption across times of day. Research has demonstrated that an electric-vehicle-based transport system's overall cost can be reduced by providing more charging infrastructure instead of investing in bigger batteries (with greater range).[11] Researchers at the UVA have examined the planning of electric vehicle charging infrastructure from a behavioral demand perspective,[12] and will integrate these approaches with a time-of-day dimension to apply to the City of Richmond for charging infrastructure planning.
- Richmond bike share will be upgraded to offer pedal-electric assist bicycles (pedelec) to connect Ladders of Opportunity communities in the east end to BRT stations and the GRTC transfer center, offering improved last-mile connections to the BRT system.

Richmond will continue to pursue crowdsourcing through an open data platform to collect key transportation-related data to improve data quality through gamification and other incentives.

[11] Morrow, K., Karner, D. and Francfort, J. (2008) Plug-in hybrid Electric Vehicle Charging Infrastructure. *Final Report Idaho National Laboratory*. INL/EXT-08–15058.
[12] Chen, T. Donna, Kara M. Kockelman, and Moby Khan. "Locating Electric Vehicle Charging Stations: A Parking-Based Assignment Method for Seattle." Transportation Research Record 2385: 28-36, 2013.

Richmond will ensure that only those applications that are technically sound and are institutionally fit to be operated far into the future. Richmond will follow the ITS Systems Engineering process to develop our technical plan that will become the framework for our Smart City. Richmond embraces the open data policy so vital to the adoption of continent-wide connected and autonomous vehicle operations and looks forward to contributing our progress to this effort.

- Richmond will use crowdsourcing that leverages an open data infrastructure and allows citizens to improve apps as well as populate fundamental data elements (FDE) as outlined in the Model Inventory of Roadway Elements.
- Richmond will create real-time anonymized pedestrian / bike counts to determine trends and use of new facilities such as transit and bicycle route planning.
- Richmond will create real-time pothole detection by all crowd-sourced vehicles.

The City of Richmond feels strongly about low-cost, efficient, secure and resilient ICT. The vision and mission of the City's IT department aligns perfectly with the goals of Vision Element #11. It is the vision of the City's information technology department to provide secure, reliable and convenient access to the technology and information needed to support the City's diverse selection of business, cultural, entertainment and recreational needs. Furthermore the mission of the Department of Information Technology is to consistently add value and provide service through the innovative use of information technology. Over the years the City has won many awards (Digital Government Achievement Award, Governor's Technology Award for Innovation in Local Government, Digital Cities Survey Award, and Integrated Justice Information Systems Institute Innovation Award) which further demonstrates their commitment to the vision and mission statements.

In support of a more resilient, efficient and secure ICT a joint effort between the City's Department of Public Works – Transportation Engineering Division, Department of Information Technology and the City's Emergency Operations Center came together to build out a redundant fiber optic network that supported the City when they hosted the 2015 World Road Cycling Championships. Through this coordinated effort several things were accomplished: the traffic signal system utilized the City's redundant and expansive fiber optic network to adjust in real time to accommodate changing traffic patterns around the races; the CCTV cameras connected to the traffic signals used high speed fiber optic communications to give law enforcement and public safety critical surveillance along the race courses; lastly the redundant and secure fiber optic network kept the City's Emergency Operations Center connected to the outside world (including those CCTV cameras) and provided additional communications capacity for the news media that were broadcasting the races live and the Federal Bureau of Investigation and US Department of Homeland Security that were keeping the area safe for participants and visitors alike. The use of City traffic cameras to inform emergency responders is an excellent example of a contribution to one common platform to inform city government decision-making and response. The City supported this combined effort to provide low-cost, efficient, secure and resilient ICT. During the design phase of the City's fiber optic network, redundancy and security were critical requirements. Both of these were implemented to ensure that physical redundancy was maintained in the event of major cuts in physical communication cabling. By installing their own network the City of Richmond has provided for a lower-cost alternative to expensive private leased telecommunication providers. The City of Richmond with the help of a Smart City Challenge grant plans to connect

additional government and educational facilities across the City to further enable users to access, store, transmit, and manipulate information. Furthermore the City's redundant, resilient, low-cost ICT will provide the stable backbone to successfully implement all other Vision Elements of the Smart City Challenge.

Parking and Environment

- Richmond will reduce off-street parking requirements through advanced transit oriented land policies, zoning, and technology, including promoting car-sharing opportunities.
- Richmond will actively manage public parking assets – both off-street and on-street—to better utilize existing parking assets and support the conversion of unneeded spots to other uses like green infrastructure.
- Data from these existing systems will be captured and analyzed to identify opportunities for improvements and extensions.

Multimodal Connections

- Richmond will fully automate the Port of Richmond's multimodal connections using Navis software technology.
- Richmond has invested in being the Region's primary multimodal hub at Main Street Station, where it will serve as the primary High Speed Rail station for the Richmond Region, and serve as the focal point for bikeshare, electric vehicle recharging, Bus Rapid Transit, as its front door for multimodal connections.

Social Media Monitoring of Transportation Systems for Operations and Planning

The data transportation system users generate through social media and other communications is now sufficient to supplement or replace the data transportation system operators actively collect. Public "geosocial" media, such as Twitter, can be used to monitor changes in the use of local transportation systems at specific locations and times. Content analysis can provide information about travel by a wide range of modes, and because social media are updated continuously, changes in behavior and experiences can be monitored over short time frames compared to traditional survey methods. Leveraging location based surveying of users and riders of our transportation system will generate new information and public perceptions about the current status and needs of our transportation system that can create meaningful insights for planning and next steps. Textizen is a tool that has a wide-variety of uses that can support creating new data in a social manner based upon the inputs from riders waiting at bus stops, using bike share, or walking through neighborhoods. Richmond will monitor and analyze a range of publicly available social media inputs to identify short-term system status and longer-term changes in usage and public acceptance of the multimodal transportation system instituted as a part of the Smart City program.

High-quality public transportation provides greater access and freedom for families. Once transportation innovations have been implemented in Richmond, the Smiths make this positive choice. Mr. Smith finds a job at a higher hourly wage and arrives there every day in thirty minutes via the Pulse BRT, using a "next bus" app to know exactly when he needs to leave home, maximizing the time he can spend with his family. Mrs. Smith uses a bike share program to ride a pedelec bicycle to the 17th Street Farmers' Market every week and spends an hour engaged in free taste testing and cooking demonstrations and shopping for local produce using her EBT card, and on warm Saturdays she and Kari take pedelec bikes down to the river to hike and swim. Mrs. Smith uses a community health shuttle for her regular medical appointments and pharmacy visits. On Sundays, Kari and two other girls from her neighborhood take the Pulse BRT to Project Yoga where they are enrolled in a free yoga class – the Smiths learned about the class via a smartphone app which links community events and family programming with GRTC bus routes, inviting them to connect with people and places citywide that had been beyond their reach before better transportation options emerged. Kari's teacher is inspired by the passion of Kari and her friends and is planning to offer a free yoga class in the public housing community in Kari's neighborhood. Transportation is no longer a limiting factor or a source of stress for the Smiths, they are freer to make choices allowing them to pursue the quality of life they desire.

6. TECHNICAL, POLICY, AND INSTITUTIONAL RISKS

Technical Risks

The technical risks associated with this proposal are also a strength of the proposal. The technology deployment environment can be a challenge that will test equipment durability and resiliency. If the proposed technologies can prove their strength, identify weaknesses, and incorporate lessons learned in areas with high concentrations of residents near the poverty level, then the technology should be easier to maintain in any city nationwide.

While the City does have basic ITS knowledge, skills, and abilities, it has strong support from on-call transportation engineering consultants and strong partnerships with VTTI, Virginia Department of Transportation's Research Council (VTRC), and UVA. With data captured, archived, and disseminated by such systems, researchers can identify strengths and weaknesses, and find opportunities for improvements.

Policy Risks

Virginia is open for business regarding automated and connected corridors and so is the City. Through Governor Mcauliffe's proclamation and VTTI's management process, the City can leverage an existing process to expedite approvals. Currently, the General Assembly has taken no action regarding laws restricting automated or connected vehicles. During the performance period, Dr. Noah Goodall, with VDOT's VTRC, will continue his research on the legality of automated vehicles; their certification and licensing; insurance regulations; traffic impacts; litigation and liability; safety; and consistency with other states.

Institutional Risks

The City elects a new mayor in November 2016. The timing of the challenge allows candidates to voice their support for the City's application and further citizen engagement this spring. The City is proactive regarding procurement and has several on-call consultants that have worked with USDOT ready to move forward with Year 1 projects for early successes. The City also plans to leverage existing funding relationships between the USDOT and with VDOT and VTTI to launch the project with trusted partners. The City will utilize UVA-CTS, which has lessons learned from

monitoring new in technology in transportation disadvantaged populations. The City also has many partners to leverage roles, scheduling, and expertise. By working with the TIGER grant to construct the Broad Street BRT on a tight timeline through a design-build process, many of the local partners have firsthand knowledge of each other's capabilities and are willing to work together to achieve a common transportation vision.

7. KEY PARTNERS

Existing Team Partners

The City has engaged several partners directly who are willing to support, implement, and develop outcome-based reports on the demonstration projects as follows:

Commonwealth of Virginia: The Commonwealth will provide support through the Virginia Department of Transportation (VDOT) and Virginia Department of Health, via the Richmond City Richmond Health District (RCHD). VDOT will assist the City in providing available relevant data and collaborate on the selection of appropriate technologies in developing a Smart City Challenge implementation plan and will further assist in the creation of an implementation plan that best meets the City's needs and the needs of the region. RCHD recognizes the relationship between health and transportation and has been working to incorporate health considerations into decision-making across sectors. This is especially true in transportation decision-making and is a key element in its partnership with the City in its Smart City Challenge proposal. As part of Richmond's Smart City Challenge, the Commonwealth will provide support, technical assistance, planning, public engagement, and evaluation Archetecture and Standards and Healthy Mobility elements.

Virginia Transportation Research Council (VTRC): VTRC research scientists have expertise in a variety of transportation areas directly relevant to the Smart Cities Challenge including system operations, traffic engineering, safety, intelligent transportation systems, connected and automated vehicles, public transportation, multi-modal planning, and bike and pedestrian safety and mobility. VTRC also conducts research in advanced materials, pavements, structures, economics, and environmental concerns. VTRC will support all research efforts necessary for technology development and implementation.

Virginia Tech Transportation Institute (VTTI): Conducts research to protect the environment and save lives, time, and money. Researchers and students from multiple fields develop techniques and technologies to solve transportation challenges from vehicular, driver, infrastructure, and environmental perspectives. VTTI is the second largest university-level transportation institute in the US and is designated as one of three Federal Highway Administration/Federal Transit Administration Intelligent Transportation Systems (FHWA/FTA ITS) Research Centers of Excellence. VTTI Institute will lead the data governance and data management portion for all transportation data collected and analyzed in the City's demonstration projects. VTTI will conduct and/or support all research efforts necessary for technology development and implementation, and VTTI will lead efforts to evaluate the success of the integrated solutions in terms of safety, efficiency, reliability, and environmental benefits derived.

University of Virginia Complete Mobility & Center for Transportation Studies (UVA): The Center for Transportation Studies has a long history of conducting high-quality, innovative research that leads to application. UVA has extensive research background in connected vehicles and operations, bringing expertise in planning, demonstration, and implementation of new transportation technologies. UVA has collaborated with VTTI to develop and test past prototypes of connected vehicle corridors. The UVA Complete Mobility team comprises of experts in social

science, urban planning, transport economics, safety, community building, data management, and computer engineering to bring a holistic perspective to Richmond's future as a Smart City. Smart transportation values efficiency and safety yet also prioritizes economic development, livability, sustainability, health, and wellbeing. Beyond traditional transportation engineering and planning, the Complete Mobility Team can provide strategies for Richmond to plan and implement smarter infrastructure with active citizen participation and acceptance.

The Sports Backers: The Sports Backers produce and support nationally recognized quality sporting events and programs that motivate locals and visitors alike to be more active Sports Backers seeks to transform greater Richmond into the most physically active community in the nation by leading the area in embracing and celebrating an active lifestyle. As part of Richmond's Smart City Challenge, Sports Backers will provide support, technical assistance, and public engagement activities as part of Richmond's Healthy Mobility element.

Greater Richmond Transit Company (GRTC): GRTC will serve as the primary public transportation provider for the City of Richmond and they will continue to be collaborative partners as we advance transit signal priority and throughout the implementation of the automated docking system at the BRT stations. As part of Richmond's Smart City Challenge, GRTC will provide support, technical assistance, and public engagement regarding Richmond's Connected Vehicles and user User-Focused Mobility and Services Choices elements.

Bewegen Technologies, Inc.: Bewegen is the selected bike share vendor for the City. Bewegen wants to inject sustainability into the urban transportation mix. To achieve this goal, Bewegen offers the ultimate shared-transportation solution. With its next-generation electric-assisted bicycles, combined with cutting-edge technology, Bewegen is the missing link in urban mobility: a clean-energy, multiuser system of specialized vehicles that provides the most efficient personal transportation experience. As part of Richmond's Smart City Challenge, Bewegen will provide support, technical assistance, planning, design, implementation, management, and public engagement activities as part of Richmond's User-Focused Mobility and Services Choices element.

Richmond Highway Safety Commission (RHSC): RHSC is a City Council appointed board that looks at issues pertaining to traffic safety. It is a multi-disciplinary team of transportation safety experts interested in achieving Vision Zero outcomes by 2030. The RHSC will provide overall support, technical assistance, and public engagement as part of Richmond's Smart City Challenge.

Future Partners

Should Richmond be selected as one of the five finalists, the City plans to engage the following institutions to participate as project partners: Virginia Commonwealth University, Virginia Union University, University of Richmond, Virginia Port Authority, Dominion Power, Evatran, Bosch, General Electric, Uber, Lyft, and Bridg. Several of these organizations have already reached out to the City and are prepared to contribute significant effort and technologies if Richmond is selected.

Organization	Support	Technical Assistance	Management	Planning	Design	Implementation	Data	Evaluation	Public Engagement
City of Richmond	■	■	■	■	■	■	■	■	■
Virginia Tech Transportation Institute	■	■	■	■	■	■	■	■	
VDOT's Virginia Transportation Research Center	■	■	■	■	■	■		■	
UVA Complete Mobility &Center for Transportation Studies	■	■	■	■	■	■		■	
Transportation Sharing (Uber, Lyft, Bridg, WePod)	■	■	■	■	■	■			
Evatran	■	■	■	■	■	■			
Bosch	■	■	■	■	■	■			
General Electric	■	■	■	■	■	■			
Richmond Health District	■	■		■				■	■
Bewegen - Bike Share	■	■	■	■	■	■			■
Virginia Commonwealth University	■	■		■					■
Sports Backers	■	■							■
Richmond Regional Transportation Planning Organization	■	■							■
Richmond Highway Safety Commission	■	■							■
Greater Richmond Transit Company	■	■							■
Dominion Virginia Power	■	■		■					
Virginia Port Authority	■	■		■					
Richmond Public Schools	■								
US Open Data Institute	■	■							

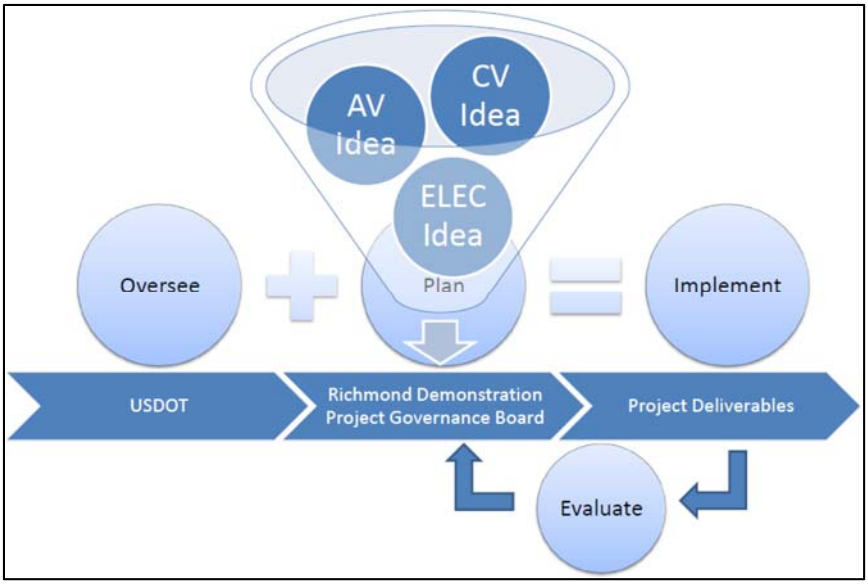
Key Stakeholders

The key stakeholders include the transportation disadvantaged populations (low income, elderly, and disabled) in the City of Richmond and the regional business owners who have entry level jobs. The visitors and residents attending special events as well as those students and faculty on college campuses will also be stakeholders. The ITSVA community of transportation professionals as well as vendors across the country willing to participate in an open data architecture market to test and prove their value to mid-sized cities. The involved local, state, and federal government agencies that are looking to advance the nexus of health, environment, and transportation.

Demonstration Governance Process

If selected as a Smart City Challenge finalist, the City will establish a high level governance structure to vet and approve demonstration projects. A proposed Demonstration Project Governance Board will ensure that each demonstration project have clear, concise objectives, deliverables to promote consistency, productivity, and shared stakeholder expectations. The Board will hold partners accountable to produce quality deliverables on time and on budget using pre-defined PMP practices. The City will empower the Board with baseline procedural review and a

performance evaluation processes. The proposed governance process would be formalized through Memoranda of Agreement with project partners identifying the specific roles and responsibilities of each and define a formalized accountability process. The image to the right provides an illustration of how a formalized governance board will provide oversight, project vetting and on-going evaluation and feedback.



8. EXISTING TRANSPORTATION INFRASTRUCTURE AND SYSTEM FEATURES

Street and Roads: Richmond's mix of nineteenth-century street grids, urban arterials, and interstate highways make it typical of mid-sized cities nationwide. Richmond is a dynamic domestic and international transportation gateway adjacent to I-95 and I-64, with access to inland markets along I-85, I-81, and I-70. Downtown Richmond has a dense population of signal-controlled intersections. Of its 475 intersections, 180 are gridded, signal-controlled, closed-loop intersections in the city's central business district. With Advanced Traffic Management System (ATMS), Richmond connects currently 300 of its 475 intersection sand within three years, 100 percent of the signal-controlled intersections will be connected to the centralized system. The ATMS is connected by fiber optic cable to the E-911 center. By 2017, the ATMS will be connected by fiber to the Greater Richmond Transit Company's Transit Operations Center and the Virginia Department of Transportation's Regional Traffic Operations Center. The City now has 30 signal-controlled intersections with adaptive traffic signal technology, with plans to expand on federal and state routes. The number of arterial and lane miles are as follow:

- Arterial Miles: The city's suburban arterials range from four to six lanes, demonstrating open-loop signal system progression. The City maintains approximately 1,860 moving lane miles within its geographic boundaries, 545 mile of which are arterial.

- Freeway Miles: The Virginia Department of Transportation (VDOT) maintains the roadways at the City border as well as the 49.6 miles of interstate freeway (I-64 and I-95).

Transit Services

The Greater Richmond Transit Company Transit System (GRTC) is the primary public transportation provider for the Richmond region, providing service to Richmond and a very small portion of the adjacent counties of Henrico and Chesterfield. In 2008, GRTC received recognition from the American Public Transportation Association as the Best Transit System in North America for 2008.[13] GRTC is a non-profit public service corporation, owned equally by the City of

[13] *Richmond Connects: Richmond Strategic Multimodal Transportation Plan*. July 2013, page 17.

Richmond and Chesterfield County and governed by a Board of Directors.

GRTC currently has an active fleet of 268 busses, vans, and support vehicles which, as they are retired, are replaced with vehicles fueled by compressed naturel gas (CNG). GRTC currently operates 156 transit vehicles for its fixed route services, including busses and cutaway vans, of which 42 are fueled by CNG. All GRTC busses are equipped with front-mounted bicycle racks. In addition to the fixed route system, GRTC oversees RideFinders, the region's transportation demand management agency, supports the Capital Region Taxicab Advisory Board (CRTAB), contracts with outside agencies to provide Americans with Disabilities Act (ADA) services for the region's elderly and disabled population, and oversees C-VAN, a welfare-to-work transportation service provided in cooperation with local social service agencies.

GRTC's bus route structure can largely be classified as a hub-and-spoke system, where service converges on a central downtown area and then fans out into the surrounding neighborhoods. Additionally, GRTC operates 10 express routes to Henrico and Chesterfield counties. These express routes provide direct service from the surrounding residential areas in the outlying counties to downtown Richmond with few stops in between.

All buses operated by GRTC are equipped with wheelchair lifts, and GRTC is in the process of increasing the number of low-floor buses in its fleet. In combination with drivers specifically trained to help disabled and senior riders, the GRTC system is accessible for mobility impaired customers. For riders who are unable to use fixed-route service, GRTC offers paratransit service through the CARE program. CARE provides curb-to-curb service for eligible riders. Eligibility for the program is dictated by the Americans with Disabilities Act (ADA).

Transit Summary Table[14]

Transit Feature	Quantity
Unlinked Passenger Trips - All Modes	10.01 million
Unlinked Passenger Trips - Bus	9.35 million
Unlinked Passenger Trips – Van Pool	390,600
Passenger Miles – All Modes	68.31 million
Passenger Miles – Bus	37.68 million
Passenger Miles – Van Pool	27.42 million

Port Facilities

The Port of Richmond is Central Virginia's domestic and international multimodal freight and inland distribution gateway on the James River. It serves waterborne, rail and truck shippers throughout the Mid-Atlantic States with major logistics and distribution centers for military and commercial freight. The Port is an excellent distribution and transshipment location, with strong local export/import support; 50% of the nation's consumers and manufacturing establishments are located within 750 miles. More than 100 motor freight companies and brokers serve the area, including specialists in heavy hauling, over-dimensional loads, and liquid and dry bulk. The City owns the Port, currently leasing it to the Virginia Port Authority. The Port is privately operated by PCI of Virginia, LLC, which provides stevedoring services on a full range of supply chain operations, including export packaging and transfer, and warehouse and inland distribution

[14] Dickens, Matthew and Neff, John (May 2014). *2014 Public Transportation Fact Book, Appendix B: Transit Agency and Urbanized Area Operating Statistics*. American Public Transport Association. Washington, DC.

services. The Port offers three, weekly, roundtrip container-on-barge sailings between the Port of Virginia marine terminals at Hampton Roads and the Port of Richmond, a 100-mile journey along the James River, via the 64 Express. This barge traffic removes container traffic from local roads and highways.

Like other world ports, Richmond uses the Navis N-4 cargo handling information system. Navis tracks cargo containers from or to vessels as they move in and out of a terminal through ship, barge, rail, or truck, reporting "in time" information on container location and destination. Terminal operators, stevedores, ship and cargo owners, transportation companies, and U.S. Customs can access the system through codes, yielding a seamless information system. The Navis N-4 cargo handling information system makes Richmond a model port city.

Rail Facilities

The City of Richmond has a long history of working in a collaborative manner with the Class 1 Railroads, with both the Norfolk Southern and CSX railroads located in the heart of the City. Richmond has the only triple crossing in the world where CSX and Norfolk Southern railroads converge at a single point. Richmond's freight rail infrastructure is a critical connection for east/west and north/south rail corridors of the Mid-Atlantic Region. These freight railroads service the Port of Virginia, including the inland Richmond Port, as well as points north of the District of Colombia and Maryland. The City of Richmond will continue to foster the relationship with the railroad industry, as we have a strong belief that shipping freight by rail is the most efficient and beneficial mode for hauling long distances.

Air Facilities

The Richmond International Airport (RIC) is owned and operated by the Capital Region Airport Commission, governed by 14 Commissioners appointed by four Richmond-area jurisdictions – the City, along with the counties of Chesterfield, Hanover, and Henrico. RIC has about 105,000 landings/take-offs and accommodates more than three million visitors annually and is a designated alternative landing site for Washington D.C. air traffic, and is utilized by Air Force One and Two for crew proficiency training and presidents Bush and Obama have visited Richmond onboard Air Force One a combined ten times since 2000.

RIC is one of the busiest air cargo facilities in the nation, averaging more than 100 million pounds of cargo annually. Because of its central location on the Eastern Seaboard, cargo transit via RIC makes sense as goods shipped from RIC area can reach 50% of the U.S. population within 24 hours. RIC has been designated a Foreign-Trade Zone (FTZ) #207, where foreign and domestic merchandise is considered to be in international commerce (not in U.S. Commerce territory), meaning that foreign merchandise may be admitted into the foreign-trade zone without payment of Customs duties or government excise taxes. The Capital Region Airport Commission has applied to the Foreign-Trade Zones Board for reorganization of Foreign-Trade Zone #207 under alternate site framework (ASF) to permit significantly greater flexibility in the designation of new "subzones" or "usage-driven" FTZ sites.[15]

Shared-Use Mobility services

Bewegen is the selected bike share provider. ZipCar is active at VCU and University of Richmond, and the RIC Airport. Uber Richmond is active since 2014. Ridefinders is Richmond's carpool and

[15] Richmond International Airport Website. http://www.flyrichmond.com/.

vanpool provider.

Information and Communication Technology
The Richmond Signal System (RSS) communication network consists of an Ethernet communications over fiber optic cable, 900 MHz wireless communication radios, and twisted pair communications cable. Approximately 50 miles of single mode fiber optic cable, over 15 miles of twisted pair and about two dozen of wireless radios connect 415 signalized intersections.

Intelligent Transportation Systems
- 16 CCTV Transportation Cameras expanding to 30 Cameras, Blank out signs, Video Detection;

Smart Grid Infrastructure:
Dominion Virginia Power is the largest electric utility in the state. Dominion's Powering Virginia Plan began in 2008. The plan provides a jump-start toward meeting the 10% conservation goal enacted by the Virginia General Assembly and the governor. This enables the state to be within one-third of its goal within a five year period. The smart grid would allow energy to be delivered more efficiently, resulting in significant savings, by allowing precise control over its flow. According to an IEE smart meter survey completed in May 2012, Dominion has installed over 100,000 smart meters across Virginia in an effort to demonstrate the technology and customer benefits. The utility industry is in the midst of grid modernization efforts to ensure a more secure, cost effective, environmentally safe power grid. The next generation of metering and data exchange technology or AMI technologies are the basis and most viable elements of the smart grid. Many Virginians may decide to replace their traditional automobile with an electric vehicle. The change will require a reliable, low-cost way to recharge the vehicle at convenient locations at anytime, day and night. Millions of owners will plug in or use wireless technology to charge their electric vehicles. Richmond will take advantage of smart grid technologies and be ready to handle the new demand, seamlessly. A smarter grid can safeguard Richmond's position at the forefront of the world's transition toward a clean energy future. Vehicles-to-grid technology can also be used with BEVs and PHEV plug-ins and provide extra grid capacity.

9. DATA

Existing Data Collection
The City collects data on traffic control devices, pavement conditions, MIRE roadway inventory elements, crash data, driver and vehicle registration data, health outcomes data, and real time information such as work in street permits, emergency vehicle and transit vehicle locations, etc. The City also collects data on the Request for Service from the citizens and uses it to deploy its resources to serve residents.

Proposed Data Collection
We are entering a new era of expectations and the goal for all agencies should be to use up-to-date information for making better decisions. It is acknowledged that 80% of the data has a location context and where you are, where you want to go, what is the real time weather, traffic, what is the demographics etc. cease to be separate streams of data. Mobile apps are not only increasing the consumption of the data but also steering how and what needs to be collected and used. Integrating transportation data with other functional data gives a Common Operational Picture which is key and critical to service providers and responders. Also platform barriers have to addressed and provided for in the dissemination of information. Quality of life index is a derivative

of all factors such as public safety, transit, schools, infrastructure, etc., and therefore all data has great significance in integration. Geographic Information Systems serve as a great integration tool using the location as the key factor. Open architecture allows for programming interfaces to communicate with other systems for porting the data across different information streams.

Proposed Data Analysis

If funding were available, the City would like to collect such transportation data on shorter intervals of three to five years, which would also be in line with FHWA best practices for MIRE and FDE as well as asset condition assessments for maintenance purposes. We are entering a new era of expectations and the goal for all agencies should be to use up-to-date information for making better decisions. It is acknowledged that 80% of the data has a location context and where you are, where you want to go, what is the real time weather, traffic, what is the demographics etc. cease to be separate streams of data. Mobile apps are not only increasing the consumption of the data but also steering how and what needs to be collected and used. Integrating transportation data with other functional data gives a Common Operational Picture which is key and critical to service providers and responders. Also platform barriers have to addressed and provided for in the dissemination of information. Quality of life index is a derivative of all factors such as public safety, transit, schools, infrastructure etc. and therefore all data has great significance in integration. Geographic Information Systems serve as a great integration tool using the location as the key factor. Open architecture of systems allows for programming interfaces to communicate with other systems for porting the data across different streams of information

Proposed Data Interoperability

It is important that an open data architecture be used to seamlessly connect multiple data streams for analysis. The City is also committed to pursuing solutions that are transferrable to other cities across the country. The Open Data Portal is focused on making City data publicly valuable and available. Reducing the technical needs to access and use publicly defined data is an instrumental component to increasing its interoperability. Utilizing open data standards as well as best practices from leading cities in the United States is a crucial element to establish connectivity of our open datasets with other internal sources of information as well as external datasets. A core function of the Open Data Management Team, which will drive and support the sustainability of the Open Data Portal for all City departments and agencies, will be to assure that all available and relevant data is made available and that it is accurate, up-to-date, and accountable. Interoperability is foundational, as the value of open datasets is exponentially increased when disparate datasets are able to be connected, compared, and analyzed to improve the overall quality of the dataset, its public use and value, as well as its ease of use in websites and mobile applications.

Existing Data Policies and Sources

VTTI will lead the data governance and data management portion for all transportation data collected and analyzed in the City's demonstration projects.

<u>VTTI Data Services Center</u>

The Data Services Group handles uploading of collected data, the management and large-scale storage of data, data tracking, data quality control and assurance, database building, optimization, and maintenance. The Data Services back end is housed in two locations and features:

- 40+ high-performance servers
- More than 100 TB of redundant high-speed storage with a full petabyte available for video
- A large-capacity backup system that includes a tape library capable of handling 14.4 gigabytes

of data per minute

- High-speed 10-gigabit Ethernet for all connections

VTTI pioneered the implementation of this technology to every portal. VTTI plans to dedicate a teraflop of computing power toward facial recognition to allow identification of individual drivers within a given study and link them with the real-time data collected during their driving activities, ultimately helping to refine analyses.

Big Data: VTTI has considerable facility with various "big data" systems, with the capability to store several petabytes of structured and unstructured data, integrated into VTTI's High Performance Computing environment. This provides a base infrastructure for subsequent data mining of various systems, to be leveraged for research and operational opportunities. An element of "big data" systems is the wide variety of data sources which can then be correlated to find otherwise unknown relationships. It is proposed that all "smart" subsystems provide operational data feeds and ingested into this environment, where subsequent analysis and research can be performed. These data will be available to researchers beyond Richmond.

10. APPROACH TO ITS STANDARDS, ARCHITECTURES, AND CERTIFICATION

Plan the project – then build the plan: To ensure long lasting, beneficial step-changes for transportation using the convergence of technologies in as organized and effective way as possible, we ensure that only applications that are technically sound and institutionally fit to be operated far into the future. Richmond will follow the ITS Systems Engineering process to develop a technical plan that will become the framework for our Smart City. The current regional ITS architecture was developed using the US National ITS Architecture. The project team will update the architecture and secure the ability for connected and autonomous vehicles to travel city roadways by using the Connected Vehicle Reference Implementation Architecture and SET-IT tools to perform the update. The project team is well-versed in how to create the Richmond CVRIA to help us efficiently reach our Smart City goals.

Richmond embraces the open data policy so vital to the adoption of continent-wide connected and autonomous vehicle operations and looks forward to contributing our progress to this effort. The project team will seek out necessary information from the USDOT's Research Data Exchange (RDE) & Open Source Application Development Portal (OSADP) as the Smart City plan for Richmond's future is developed.

Standards are ever-changing and improving. As part of the Smart City Challenge, Richmond is fully prepared to move toward the cutting edge of standards. We will seek out technologies and applications that utilize the latest approved iteration of standards where available (such as an ATC V6.24 standard versus the 2006-approved ATC V5.2b) and will also rely on our top-notch technical team to support us when moving into the unchartered not-yet-a-standard areas. Our team includes members of the international standards harmonization team, ISO/TC204, and individuals responsible for standardization testing and certifications to help us create our integrated and integral Smart City applications.

Richmond has been keeping up to date with the various USDOT and international ITS and connected vehicle advancements, application suites, pilots, and tests (such as Dynamic Mobile Applications, Safety Pilot, current CV Pilots, and other international pilots) and will assess these state-of-the-practice tools for suitability in achieving our goals.

UVA has a long history of evaluating the effectiveness of new approaches to technology

utilization. Proposed to join UVA as a future partner, the VCU engineering school integrates the City's health goals and is conveniently located in the midst of the Richmond. VCU has an additional impetus for being a project partner as the VCU students will benefit from the Richmond Smart City applications. They represent one of Richmond's body of connected and involved citizens! VCU's engineering school includes undergraduate and graduate programs in electrical and computer, biomedical, mechanical and nuclear, chemical and life science, and computer science engineering fields. The joint UVA/VCU/VT educational and research support team affords the City a dynamic team of partners who are well qualified to support the documentation and evaluation should the City be selected as the Smart City Challenge recipient.

11. MEASUREABLE GOALS AND OBJECTIVES

Below are preliminary goals and objective with measures that can form the basis of evaluation. Should Richmond be selected as one of the five finalists, more robust and specific objectives and measures will be developed as part of a full submission.

Goal 1. Equity and Accessibility: A multimodal system that is more equitable, universally accessible and provide improved access to jobs, sites, and activities

Objective 1: Strengthen transportation linkages between jobs and housing

Measure: Increased % of transportation-disadvantaged population within ¼ mile of a bus stop
Measure: Decreased average bus wait time in transportation-disadvantaged neighborhoods
Measure: Increased number of bus routes to job sited in neighboring counties
Measure: Number of pedelec bikeshare stations in transportation-disadvantaged neighborhoods
Measure: Increased number of system-wide multimodal linkages

Goal 2. Safety and Sustainability: A transportation system that is environmentally compatible and ensures a high quality of life for all the region's citizens.

Objective 2: Resduced reliance on nonrenewable fuels

Measure: Number of available careshare vehicles
Measure: Number of pedelec bikeshare locations
Measure: Increased number of electric vehicle charging stations
Measure: Reduced average daily per capita traffic congestion delay
Measure: Reduced average per capita motor vehicle-mileage in urban-peak conditions

Objective 3: Achieve Vision Zero by 2030.

Measure: Reduced percentage in transportation fatalities
Measure: Reduced percentage in transportation injuries

Goal 3. Healthy Mobility: Transportation opportunities provide choices to walk and bicycle contently and safely throughout the City

Objective 3: **Improve the City's walkability and bikability**

Measure: Number of bikeshare locations
Measure: Increased average number of basic services (schools, shops and government offices) within walking distance of homes
Measure: Increased lane miles of complete streets

Goal 4. Data: Advanced transportation technology and shareable data are part of Richmond's transportation milieu

Objective 4: Improve efficiency through technology

Measure: Number of automated vehicles at Limited Self-Driving Automation (Level 3) level
Measure: Number of vehicles as mobile probes deployed
Measure: Increased number of machine-readable, open, and accessible datasets available through Richmond's Open Data Portal
Measure: Number of vehicles as mobile probes deployed
Measure: Percent of city fleet and transit vehicles fitted with with adaptive Transit Vehicle Signal Priority and Emergency Preemption devices

12. ORGANIZATIONAL CAPACITY

Executive Commitment: The City government is organized under the strong Mayor-City Council form of government with the Mayor setting policies for the administration of the city. The Mayor is elected by popular majority vote every four years and appoints the Chief Administrative Officer who carries out policies, directs daily operations, and appoints administrative department heads as well as other officers and employees of the administration. Richmond Mayor Dwight C. Jones vigorously supports Richmond's Smart City Challenge application. Included as the first item in Appendix A is a letter of transmittal from Mayor Jones providing his strong support and commitment to the proposal and its proposed demonstrations.

Workforce Capacity: The City of Richmond is a municipal corporation of the Commonwealth of Virginia. It is a full service independent city that provides a full range of services including police, fire, and emergency services protection, sanitation services, the construction and maintenance of highways, streets, and infrastructure, human services, recreational activities and cultural events, and many others. In addition to general government activities, the City provides gas, water, and wastewater services to its residents. The City also has financial, budgeting, procurement, human resources, and Information Technology capabilities, supported by an Oracle-Based Enterprise Resource Planning (ERP) system. The City's workforce is capable, possessing the necessary knowledge, skills, and abilities required for its varied responsibilities and is on a par with its peers nationally. The City is fully capable of administering awards the size and complexity of the Small City Challenge and will do so using sound management practices in accordance with Office of Management and Budget (OMB) Circulars, should Richmond be awarded.

Added to the capable workforce and systems of the City, is the exceptional workforce capacity of or key partners. The proposed governance structure includes elite transportation researchers and professionals associated with VTTI, the Virginia Transportation Research Center, and UVA. Transportation experts from these organizations, will vet and approve projects, ensuring that all necessary resources and conditions are met for successful implementation, Finally, VTTI will be responsible for the evaluation of demonstrations and assist in disseminating their results regarding efficacy and transferability to other locations.

Degree of Infrastructure readiness: The City has the basic transportation infrastructure and financial and procurement tools in place to plan, design, implement, and evaluate outcomes at the nexus of health, environment, and transportation. Our partners provide significant capacity to carry our healthy mobility approach via the proposed Demonstration Project Governance Board.

Data and Performance Management Capabilities: The proposed Demonstration Project Governance Board will have an active role to ensure each demonstration project moves forward with clear and concise data management principles and performance management oversight. Since 2013 the City has used a Balanced Scorecard Strategic Management System to guide decisions

within departments and measure effectiveness through a focus on service level performance and industry standards. Additionally, the budget has been developed to target and address service level performance. This approach has made the use of benchmarking and gathering metrics central to being a performance based organization. In July of 2015, the City received the Certificate of Distinction from ICMA Insights for the work of the City's performance management efforts on comparative analysis, and transparency.

13. LEVERAGE OPPORTUNITIES

The opportunities to provide leverage funding are from three primary sources: the City Capital Improvement Plan (Capital Budget), value of in-kind donations composed primarily of City and project partners' staff time and facility use, and private funding associated with transportation, energy, technology, and other industries interested in participating in proof of concept or demonstration projects and willing to bring their own resources to fund Smart City projects.

Cost Share: The adopted/approved City Capital Budget includes $30.3 million in Transportation projects during City fiscal years (FYs) 2016-2018, which is used here as a rough proxy for the Smart City Challenge implementation period. Transportation-related projects included in FY 2016-2018 Capital Budget years include street and sidewalk improvements, route relocations, roundabouts, traffic calming, street lighting, and traffic control installations. In addition to transportation projects, the same FYs include planned economic and community development projects with significant transportation-related elements including funding for GRTC's Pulse BRT, Main Street Station multi-modal facility, commercial corridor improvements, Port/riverfront access, corridor/gateway blight abatement, and public housing transformation projects totaling $19.4 million. Finally, a number of Capital Budget funded Public Safety projects planned for the same period have significant transportation-related elements including 800 MHz radio system expansion and fire station renovations totaling $34.3 million. Funding for many of these projects represent potential leverage opportunities for Smart City Challenge demonstrations. Should the City be selected as a Smart City Finalist, detailed leverage numbers will be included in the proposed budget.

In-kind donations: The City staff that is not assigned to a project will provide in-kind management services and coordinate directly with the appropriate Federal and state DOT contacts, as will staff from Smart City Challenge partner organizations, most notably staff from VTTI, UVA, and the Commonwealth of Virginia. The market rent value of City, State, and other partners' facilities and other resourced proposed to be used will also be included in the calculus. Should the City be selected as a Smart City Finalist, detailed in-kind values will be included in the proposed budget.

Partnering: If selected as a finalist, there are multiple opportunities that will be pursued with private firms that have had discussions with City staff regarding participating in Smart City Demonstrations. Only those organizations willing to provide financial resources for proof of concept or demonstration project purposes and do not pose a potential procurement issue will be able to be included in the quantification of private funding. However, the City reserves the right to announce those partnerships at the right time. Should the City be selected as a Smart City Finalist, detailed private leverage numbers will be included in the proposed budget.