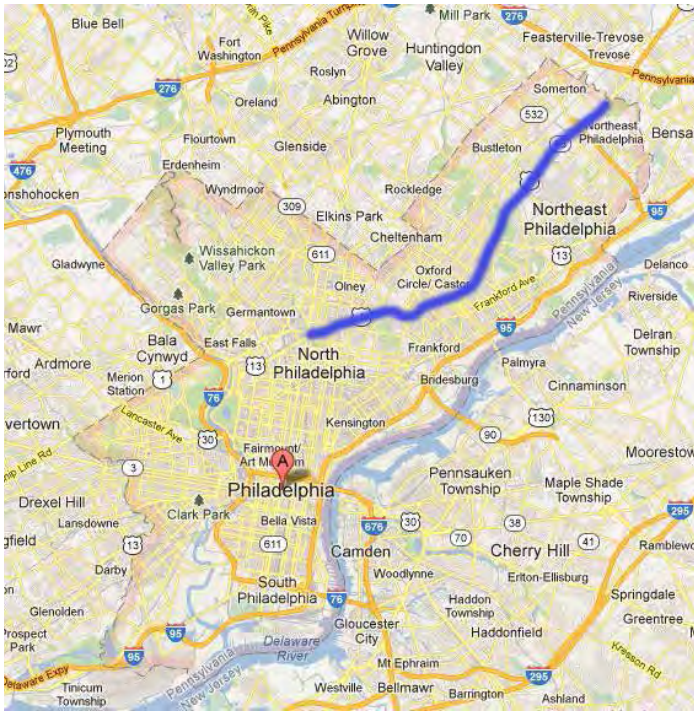
Roosevelt Boulevard Transit Improvement Plan

Executive Summary

Most of the trips in the US, no matter it is for work, errands, or leisure, are made by cars. Nevertheless, public transit is increasingly regarded as an effective alternative mode to transport large number of people quickly over a long distance. Generally, transit services benefit the public in several ways including but not limited to mitigating road congestion, reducing air pollution and cutting down gas consumption. Therefore, in many metropolitan areas, the governments, Metropolitan Planning Organizations, and local transit agencies are making efforts to provide better transit services to people.

Roosevelt Boulevard in Philadelphia is one of the major traffic corridors for commuters in the region. It runs from the northeast border between Philadelphia and Bucks County all the way to the southwest, and ends at Hunting Park near Board Street, as shown with the blue line in the map to the right. From there it extends to the west as Roosevelt Expressway and merges into Schuylkill Expressway in Fairmount Park. This study will not focus on the expressway extension because it is a freeway with no transit stops along it.

This 12-lane highway with 3 medians in between is the spine of northeast Philadelphia, but also physically divided the neighborhoods along it. Currently as many as 75,000 to 90,000 vehicles pass through it every day. The major problems associated with Roosevelt Boulevard include the congestion level during rush hours and pedestrian safety concerns. Transit services should be improved along the Boulevard to encourage more people to take transit instead of driving. Efficient and comfortable transit services would effectively ease the congestion there and guarantee a high level of mobility for commuters. However, the car-dominant environment and pedestrian casualties that happened there could deter people from making walking connections to and from the transit stops. Therefore, walking conditions in areas within 0.25 miles from the Boulevard should also be enhanced to safely and conveniently connect people from transit stops to their final destinations.



Roosevelt Boulevard running from the northeast border down to Hunting Park

Source: Google Map

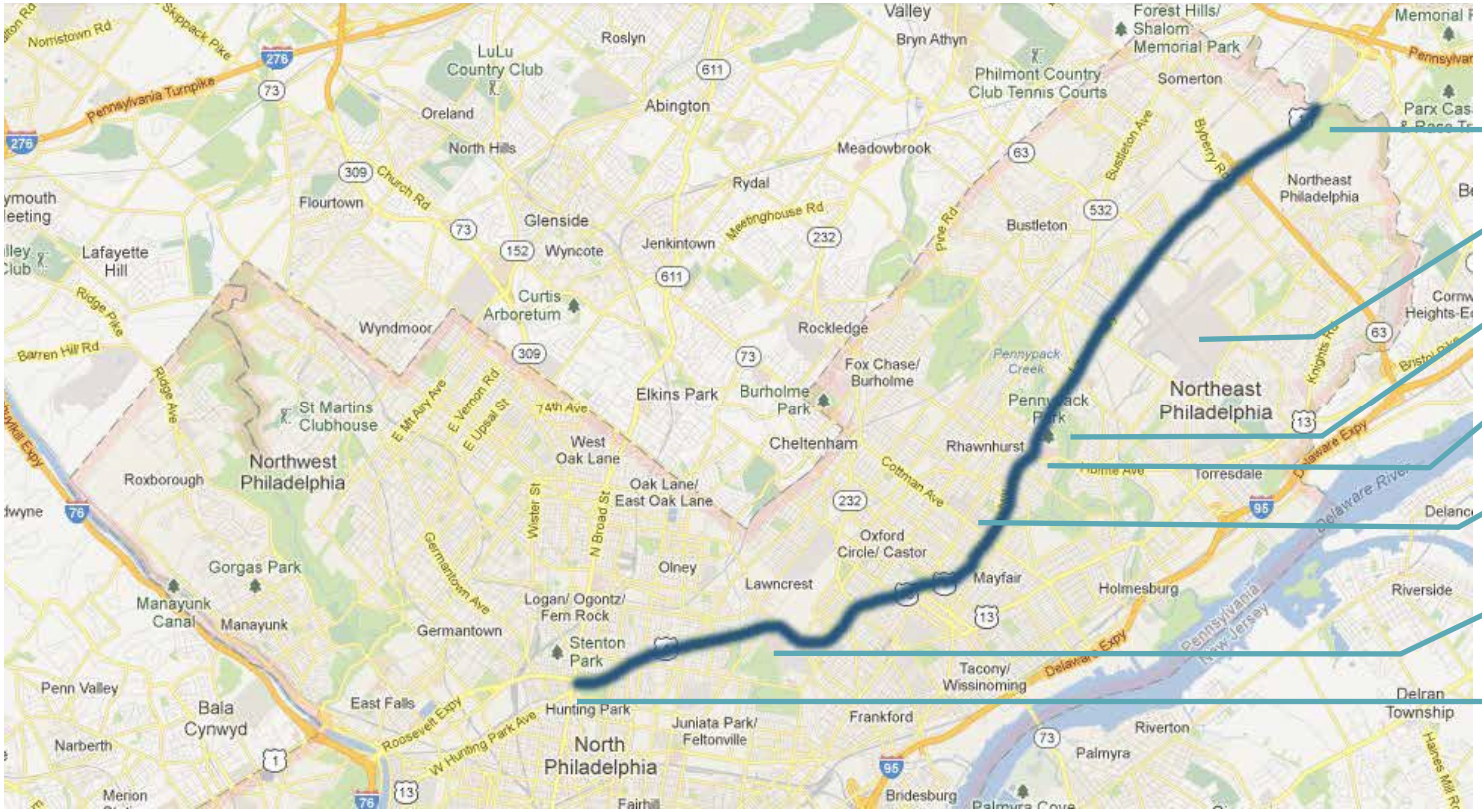
Previous studies including "Roosevelt Boulevard Corridor Transportation Investment Study" in 2003, DVRPC's "2008 Long-Range Vision for Transit" and also "Philadelphia 2035 Comprehensive Plan" all envisioned addition of heavy rail services there either as a extension of Board Street Line or as an elevated rail system. However, the enormous costs of such a implementation could not be afforded by the City and would not be given priority over other more urgent projects under the current situation. Therefore, other more financially feasible alternatives should be examined to improve the existing conditions there in a more cost-effective way. This study will mainly focus on improving the current transit services along the Boulevard without adding extra transit facilities such as bus rapid transit or light rail.

This study will first look into the current situations in Section One. The travel demand associated with the Boulevard will be analyzed, and the existing transit services there will be evaluated. Based on current deficiencies and constraints, several improvement strategies will be recommended in Section Two, including increasing frequency for route J, reducing stop spacing along the northeast segment, improving passenger amenities for the Roosevelt Blvd & Broad St Stop, enhancing sidewalk conditions in certain neighborhoods, and establishing queue jump lanes at congested intersections. In the last section, a cost evaluation will be conducted to examine the cost effectiveness of the proposed improvements and to prioritize the interventions.

Roosevelt Boulevard looking southwest from Devereaux Avenue
Source: Google Street View

Section 1
Existing Conditions

Roosevelt Boulevard is a 12-lane, 300-feet-wide highway stretching across northeast Philadelphia, connecting multiple major destinations along the way, including Hunting Park, Friends Hospital, Naval Support Activities Philadelphia, Frankford Stadium, Roosevelt Mall, Nazareth Hospital, Pennypack Park, Northeast Village Shopping Center, Northeast Philadelphia Airport, and Benjamin Rush State Park. Its north end continues as Lincoln Highway, stretching into Bucks County and all the way to Trenton. Its south end extends as Roosevelt Expressway, continuing to the west and connecting to Schuylkill Expressway. Such geographical location determines that it is one of the most important traffic arteries in the region.



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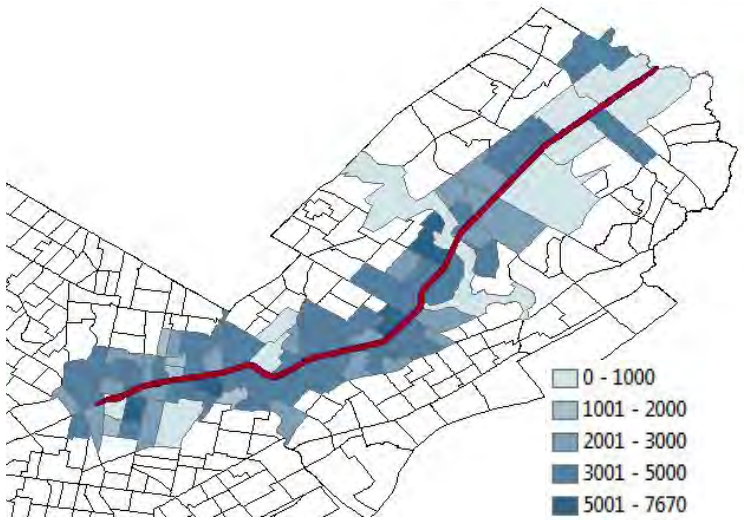
This section will focus on two parts - demand analysis and existing services evaluation. The demand analysis illustrates where the travel demand exists based on demographic data and travel patterns around the study area. The existing services evaluation reveals the quality and efficiency of existing transit services there and helps to identify gaps and problems.

Demand Analysis

Demand for travel can be analyzed based on where people live and where people work. Transit services should be provided near major trip generators such as a large concentration of residential settlements or an anchor institution like a hospitals or an industrial park to guarantee a sufficient level of ridership. Also, households' access to cars is another important determinant of demand for transit services.

Population

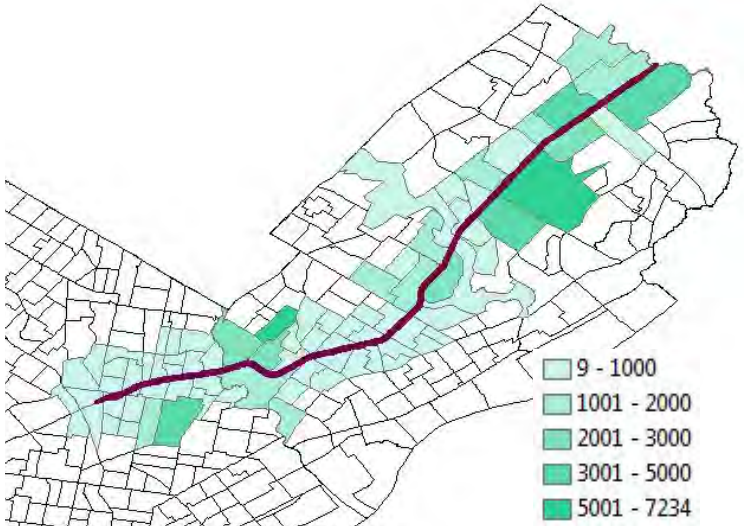
The map to the right shows population by traffic analysis zone (TAZ). The TAZs within 0.5 miles (i.e. 10 minutes walking distance) from the Boulevard were selected for analysis. The total number of people living in these TAZs is 255,286. Generally speaking, the segment to the southwest of Pennypack Park is where a larger number of people live, while along the segment to the northeast of Pennypack Park reside much fewer people. Based on the population map, it is conceivable that more transit services should be provided along the southwest segment.



Population by TAZ, 2010

Employment

As a comparison between the employment map and the population map, most of the dense residential TAZs do not generate a great number of jobs, but the TAZs with small population numbers turn out to be major employment centers. Within 0.5 miles from the bus stops along Roosevelt Boulevard there exist 87,409 jobs. The employers in these TAZs include Northeast Philadelphia Airport, Nazareth Hospital, Naval Support Activities Philadelphia and several shopping centers along the way. Therefore, sufficient transit services during reasonable time periods should also be provided to accommodate the mobility needs of people who work at those destinations.



Employment by TAZ, 2010

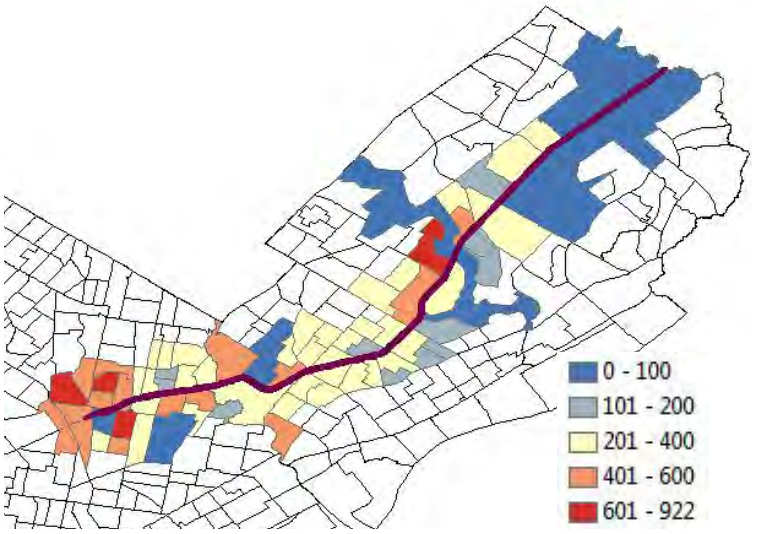
Such concentration of residences and employments along the Boulevard shows that it is a very reasonable route to provide transit services, because several transit customer markets can be combined to generate adequate ridership along the way.

Households with No Vehicle & Household Median Income

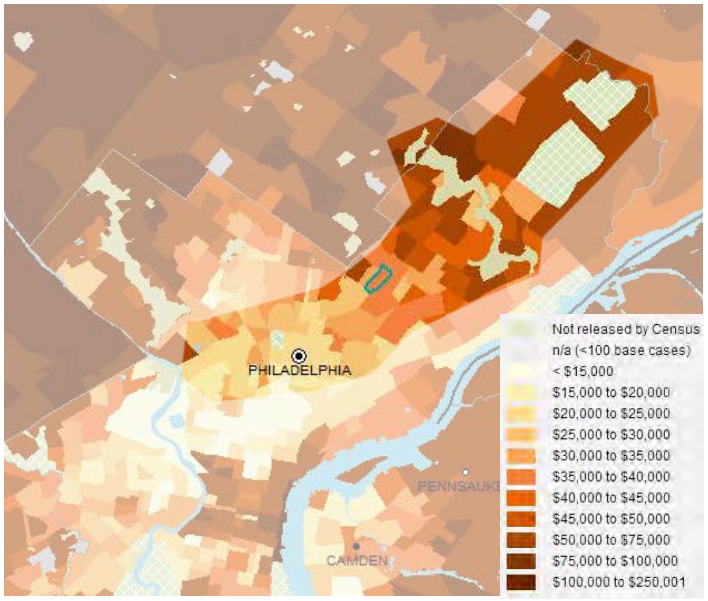
The households which do not have access to a car normally need to rely on public transit to complete long-distance trips. The reason why a household does not have a car could be because of financial difficulty or environmental consciousness. In the case of Roosevelt Boulevard, financial difficulty seems to be the main reason.

Within 0.5 miles from the bus stops along the Boulevard there are 24,400 households without access to a car. The comparison between the households with no vehicle map and the median income map reveals that the households with no vehicle concentrating along the southwest segment of Roosevelt Boulevard happen to also be the households with income lower than $30,000. Meanwhile, as the median household income increases along the northeast segment of the Boulevard, there are fewer households with no access to a car.

In the low-income households, members are more likely to have entry-level jobs. Many of these entry-level jobs are located at suburban areas or require unconventional working hours such as night time or weekend, when transit services are not provided with the normal frequency. These households without access to a car need special attention of transit planners, and federal support such as the Job Access and Reverse Commute program could be a potential funding resource to improve the welfare of this group of people.



Households with No Vehicle by TAZ, 2010



Median Household Income by Census Tract

Source: Social Explorer, ACS 2006-2010

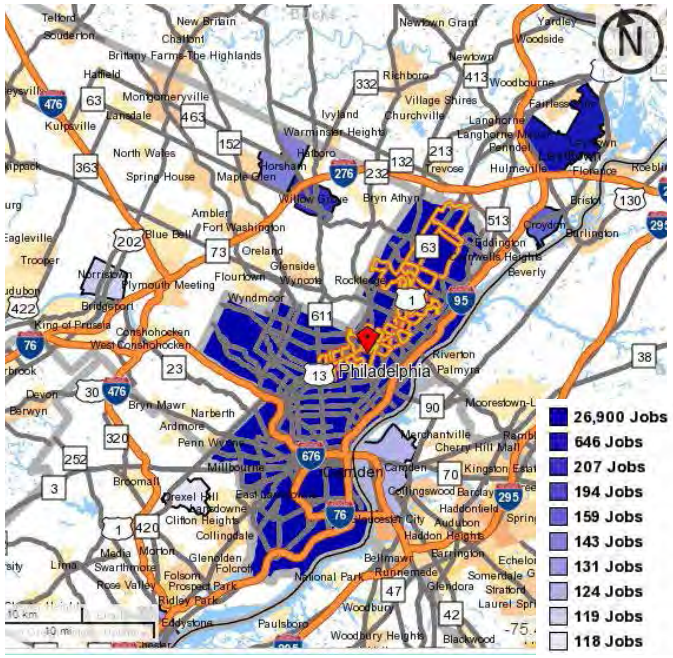
Work Trip Origins and Destinations

Understanding the work trip origins and destinations along the Boulevard would help to discover travel pattern and demand. 37 census tracts along the Boulevard are selected to conduct this analysis with OnTheMap.

In 2010, there are 48,529 jobs in the selected 37 census tracts, among which 5,944 jobs are occupied by people who also live in these census tracts. The rest 42,585 workers come from various places in the region. The largest portion of workers commute daily from other places in Philadelphia, accounting for 55.4%. Others come from places in Pennsylvania such as Levittown and Willow Grove, Camden City in New Jersey, and even New York City.

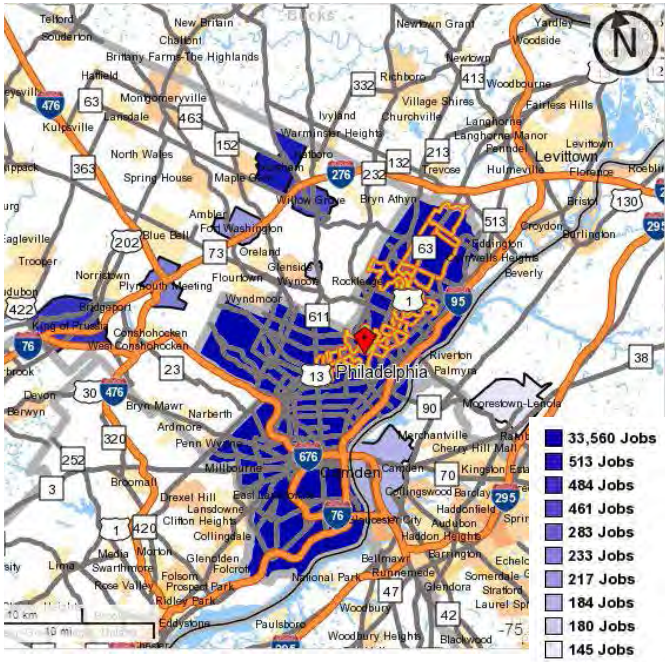
Among people living in the 37 census tracts, 50,450 have jobs outside of the tracts. 59.5% of them commute daily to other places in Philadelphia, and the rest travel to places in Pennsylvania such as Horsham and King of Prussia, Camden City in New Jersey, and New York City.

Origins - Where do workers live?



	2010 Count	Share
All Places (Cities, CDPs, etc.)	48,529	100.0%
Philadelphia city, PA	26,900	55.4%
Levittown CDP, PA	646	1.3%
Willow Grove CDP, PA	207	0.4%
New York city, NY	194	0.4%
Croydon CDP, PA	159	0.3%
Horsham CDP, PA	143	0.3%
Chester city, PA	131	0.3%
Camden city, NJ	124	0.3%
Norristown borough, PA	119	0.2%
Drexel Hill CDP, PA	118	0.2%

Destinations - Where do people go to work?



	2010 Count	Share
All Places (Cities, CDPs, etc.)	56,394	100.0%
Philadelphia city, PA	33,560	59.5%
Horsham CDP, PA	513	0.9%
King of Prussia CDP, PA	484	0.9%
Willow Grove CDP, PA	461	0.8%
New York city, NY	283	0.5%
Plymouth Meeting CDP, PA	233	0.4%
Fort Washington CDP, PA	217	0.4%
Camden city, NJ	184	0.3%
Jenkintown borough, PA	180	0.3%
Moorestown-Lenola CDP, NJ	145	0.3%

Source: OnTheMap

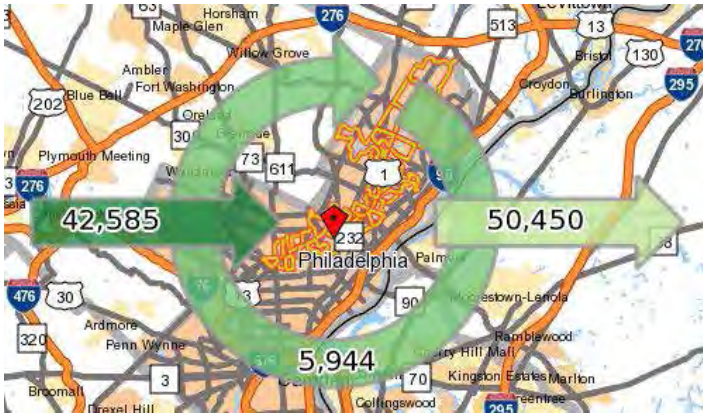
The analysis of work trip origins and destinations reveals that there exist demands for connections between the Boulevard and the rest of Philadelphia as well as certain places in Pennsylvania, New Jersey and New York. As a result, a bus network directly connect those 37 census tracts to other parts of Philadelphia is helpful. Also, connection from the Boulevard to Market-Frankford Line, Board Street Line and the regional rail network is necessary to facilitate those long-distance trips to and from destinations outside of Philadelphia.

Bucks County Travel Demand

A similar analysis is conducted for Bucks County, with an intention to figure out how heavily residents and workers in Bucks County would make use of Roosevelt Boulevard for their daily commute.

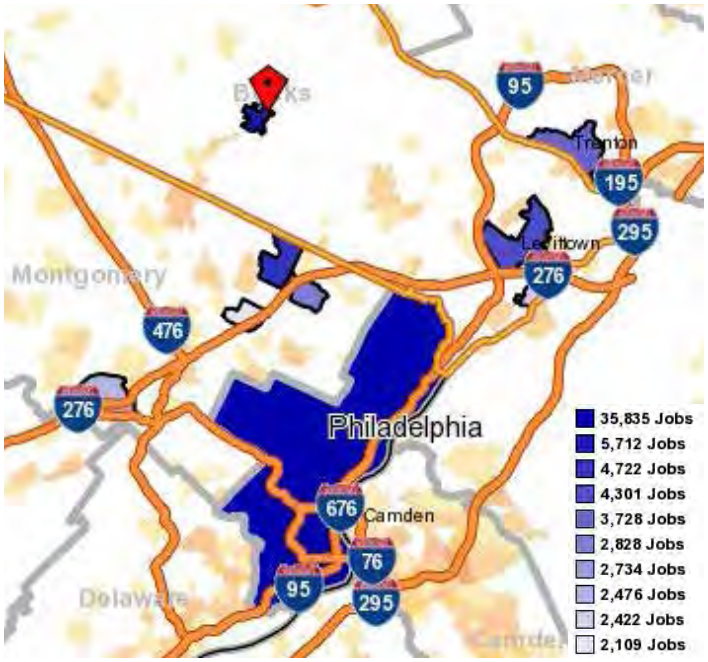
The OnTheMap analysis shows that among the 251,800 jobs in Bucks County, 30,061 (11.9%) of the workers commute from Philadelphia. Similarly, among the 309,808 residents who are employed, 35,835 (11.6%) of them need to commute to their jobs in Philadelphia. The other population work trip destinations and origins for Bucks County also include Horsham, Levittown, King of Prussia, Willow Grove and New York City.

Therefore, improving mobility along the Boulevard to help these people make their way through Northeast Philadelphia is necessary. Also, linkages from the Boulevard to the heavy rail network should be improved to assist these people in making longer-distance trips.



Work Trip Inflow and Outflow to Census Tracts along the Boulevard

Source: OnTheMap



Work Trip Destinations of Residents Living in Bucks County

Source: OnTheMap

Existing Services Evaluation

Currently there are only bus services along Roosevelt Boulevard. The bus routes of which significant segments run along the Boulevard include Routes 1, 14, 20, J and R. Other routes which have two to four stops along the Boulevard include Routes 8, 50, 67, 70, 75, 77 and 88. This study will mainly focus on the quality and efficiency of the existing services of Routes 1, 14, 20, J and R, among which Routes 14 and 20 are categorized as suburban routes by SEPTA, and Routes 1, J and R are urban routes.

Evaluation will be conducted on service frequency, on-time performance, ridership, passenger amenities and operating ratio of these routes. Also, sidewalk conditions along the Boulevard and connections between the bus routes and the regional transit network will be evaluated.

Service Frequency

SEPTA specifies maximum acceptable frequency time period between trips for routes based on mode and service type. Any routes which fail to meet this standard should be improved to bring the performance up to standard.

As indicated in the table to the left, most of the routes follow the SEPTA service frequency standards. Route 14 runs more frequently than the other four routes.

However, Route J, as an urban route serving several parks and large residential areas, fails to meet the frequency standards for late night and weekend, and its weekday AM peak frequency only satisfies the minimum standard. Such service deficiency will show its effect in the operating ratio of this route in a later section.

Route	Service Frequency (in mins)							Service Span
	WKD AM Peak	WKD PM Peak	Early Evening	Late night	Owl	Sat	Sun	
1	5	10	-	-	-	60	-	Wkd: 5am - 1am Sat: 630am - 730pm
14 [suburban]	4	6	10	15	60	10~60	12 ~60	24hr
20 [suburban]	12	10	30	30	60	15~60	20~60	24hr
J	20	15	30	45		60	60	5am - 2am
R	7	10	20	20	30	15~30	20~30	24hr
Urban Standards	20	20	30	30	30	30	30	
Suburban Standards	30	30	60	60	60	60	60	

Data Source: SEPTA Route Statistics Spring 2012

On-Time Performance

SEPTA has minimum percent requirements for on-time services, which is shown in the table below. The on-time service percentages for each route by time period were compared against this table to determine whether each route meets the service standards. Such data for Route 14 are currently not available.

MINIMUM PERCENT OF ON-TIME SERVICE

	SCHEDULE FREQUENCY IN MINUTES	
Time Period	0 to 10	More than 10
Peak Hours	75%	85%
Off-Peak Hours	80%	95%
Weekend	80%	95%

Source: SEPTA Service Standards and Process

STATUS * TIME PERIOD * ROUTE * DAYOFWK Crosstabulation

DAYOFWK	ROUTE				TIME PERIOD					Total
					EARLY AM	AM PEAK	BASE	PM PEAK	EVENING	
WKDY	1	STATUS	EARLY	Count	6	129	149	294	232	810
				% within TIME PERIOD	2.8%	9.7%	15.8%	18.7%	30.6%	16.8%
			ON TIME	Count	197	1065	682	944	449	3337
				% within TIME PERIOD	92.5%	80.3%	**72.5%**	**60.1%**	**59.2%**	**69.4%**
			LATE	Count	10	133	110	332	77	662
				% within TIME PERIOD	4.7%	10.0%	11.7%	21.1%	10.2%	13.8%
		Total		Count	213	1327	941	1570	758	4809
				% within TIME PERIOD	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
SAT	1	STATUS	EARLY	Count		9	30	0	6	45
				% within TIME PERIOD		26.5%	16.0%	.0%	9.7%	11.0%
			ON TIME	Count		24	115	61	53	253
				% within TIME PERIOD		70.6%	61.5%	**48.8%**	85.5%	**62.0%**
			LATE	Count		1	42	64	3	110
				% within TIME PERIOD		2.9%	22.5%	51.2%	4.8%	27.0%
		Total		Count		34	187	125	62	408
				% within TIME PERIOD		100.0%	100.0%	100.0%	100.0%	100.0%

Data Source: SEPTA

Route 1

The overall on-time performance rate for Route 1 is 75% (*SEPTA Route Statistics Spring 2012*). For the weekday am peak when the frequency is 5 minutes, the on-time performance is 80.3%, which is satisfactory, as indicated in green in the table to the left. However, the pm peak performance on both weekdays and weekends is especially undesirable, as indicated in red. In the other time periods on-time performance also needs to be improved for Route 1.

Whether the buses can arrive at each stop on time is influenced by multiple factors such as traffic conditions and vehicle loading speed.

STATUS * TIME PERIOD * ROUTE * DAYOFWK Crosstabulation

DAYOFWK	ROUTE				TIME PERIOD					Total
					EARLY AM	AM PEAK	BASE	PM PEAK	EVENING	
WKDY	20	STATUS	EARLY	Count	33	266	515	539	424	1777
				% within TIME PERIOD	13.5%	11.1%	11.8%	16.9%	9.6%	12.2%
			ON TIME	Count	211	2050	3651	2397	3679	11988
				% within TIME PERIOD	86.1%	85.6%	83.5%	75.2%	83.2%	82.0%
			LATE	Count	1	78	206	252	319	856
				% within TIME PERIOD	.4%	3.3%	4.7%	7.9%	7.2%	5.9%
		Total		Count	245	2394	4372	3188	4422	14621
				% within TIME PERIOD	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
SAT	20	STATUS	EARLY	Count	0	1	12	22	26	61
				% within TIME PERIOD	.0%	1.1%	3.2%	6.3%	2.6%	3.3%
			ON TIME	Count	14	89	343	305	824	1575
				% within TIME PERIOD	100.0%	93.7%	90.7%	86.9%	81.1%	85.0%
			LATE	Count	0	5	23	24	166	218
				% within TIME PERIOD	.0%	5.3%	6.1%	6.8%	16.3%	11.8%
		Total		Count	14	95	378	351	1016	1854
				% within TIME PERIOD	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
SUN	20	STATUS	EARLY	Count	5	11	41	42	62	161
				% within TIME PERIOD	10.2%	9.0%	8.7%	10.4%	6.7%	8.2%
			ON TIME	Count	35	101	404	333	783	1656
				% within TIME PERIOD	71.4%	82.8%	86.0%	82.2%	84.6%	84.0%
			LATE	Count	9	10	25	30	81	155
				% within TIME PERIOD	18.4%	8.2%	5.3%	7.4%	8.7%	7.9%
		Total		Count	49	122	470	405	926	1972
				% within TIME PERIOD	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Data Source: SEPTA

STATUS * TIME PERIOD * ROUTE * DAYOFWK Crosstabulation

DAYOFWK	ROUTE				TIME PERIOD					Total
					EARLY AM	AM PEAK	BASE	PM PEAK	EVENING	
WKDY	706	STATUS	EARLY	Count	9	179	244	198	202	832
				% within TIME PERIOD	5.9%	20.9%	13.5%	11.3%	7.8%	11.6%
			ON TIME	Count	139	631	1402	1392	2009	5573
				% within TIME PERIOD	90.8%	73.8%	77.5%	79.2%	78.0%	78.0%
			LATE	Count	5	45	162	167	365	744
				% within TIME PERIOD	3.3%	5.3%	9.0%	9.5%	14.2%	10.4%
		Total		Count	153	855	1808	1757	2576	7149
				% within TIME PERIOD	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
SAT	706	STATUS	EARLY	Count	2	8	24	15	27	76
				% within TIME PERIOD	22.2%	42.1%	13.0%	16.0%	16.8%	16.2%
			ON TIME	Count	6	10	143	61	125	345
				% within TIME PERIOD	66.7%	52.6%	77.3%	64.9%	77.6%	73.7%
			LATE	Count	1	1	18	18	9	47
				% within TIME PERIOD	11.1%	5.3%	9.7%	19.1%	5.6%	10.0%
		Total		Count	9	19	185	94	161	468
				% within TIME PERIOD	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
SUN	706	STATUS	EARLY	Count	0	0	7	6	56	69
				% within TIME PERIOD	.0%	.0%	5.0%	7.6%	17.0%	11.5%
			ON TIME	Count	7	31	113	61	256	468
				% within TIME PERIOD	63.6%	81.6%	80.7%	77.2%	77.6%	78.3%
			LATE	Count	4	7	20	12	18	61
				% within TIME PERIOD	36.4%	18.4%	14.3%	15.2%	5.5%	10.2%
		Total		Count	11	38	140	79	330	598
				% within TIME PERIOD	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Data Source: SEPTA

Route 20

The overall on-time performance for Route 20 is 78% (*SEPTA Route Statistics Spring 2012*). The peak performances for Route 20 on weekdays and Saturday satisfy the SEPTA standards. Even though the performances for the other time periods do not fully satisfies the standards, the on-time service percentages are pretty close to the minimum requirements, as indicated in yellow. In a word, there exists service deficiency, but not as severe as that for Route 1.

Route J

For all the time periods, Route J fails to meet the SEPTA standards, especially in the early morning, am peak and pm peak.

STATUS * TIME PERIOD * ROUTE * DAYOFWK Crosstabulation

DAYOFWK	ROUTE				TIME PERIOD					Total
					EARLY AM	AM PEAK	BASE	PM PEAK	EVENING	
WKDY	712	STATUS	EARLY	Count	1	89	212	219	303	824
				% within TIME PERIOD	.5%	6.3%	14.1%	12.3%	8.4%	9.7%
			ON TIME	Count	197	1126	1158	1305	3078	6864
				% within TIME PERIOD	98.0%	79.6%	76.9%	73.2%	85.4%	**80.7%**
			LATE	Count	3	199	135	259	224	820
				% within TIME PERIOD	1.5%	14.1%	9.0%	14.5%	6.2%	9.6%
		Total		Count	201	1414	1505	1783	3605	8508
				% within TIME PERIOD	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
SAT	712	STATUS	EARLY	Count		0	18	22	91	131
				% within TIME PERIOD		.0%	4.7%	7.6%	9.5%	8.0%
			ON TIME	Count		6	318	238	786	1348
				% within TIME PERIOD		60.0%	83.0%	82.1%	82.4%	**82.3%**
			LATE	Count		4	47	30	77	158
				% within TIME PERIOD		40.0%	12.3%	10.3%	8.1%	9.7%
		Total		Count		10	383	290	954	1637
				% within TIME PERIOD		100.0%	100.0%	100.0%	100.0%	100.0%
SUN	712	STATUS	EARLY	Count			36	15	94	145
				% within TIME PERIOD			10.2%	4.7%	9.3%	8.6%
			ON TIME	Count			293	265	862	1420
				% within TIME PERIOD			83.0%	83.3%	85.0%	**84.3%**
			LATE	Count			24	38	58	120
				% within TIME PERIOD			6.8%	11.9%	5.7%	7.1%
		Total		Count			353	318	1014	1685
				% within TIME PERIOD			100.0%	100.0%	100.0%	100.0%

Data Source: SEPTA

Route R

Route R meets the service standards for early am and am peak on weekdays, but the am peak performance on Saturday is very unsatisfactory. For the rest of the time periods the on-time performances are very close to the minimum requirements.

Ridership

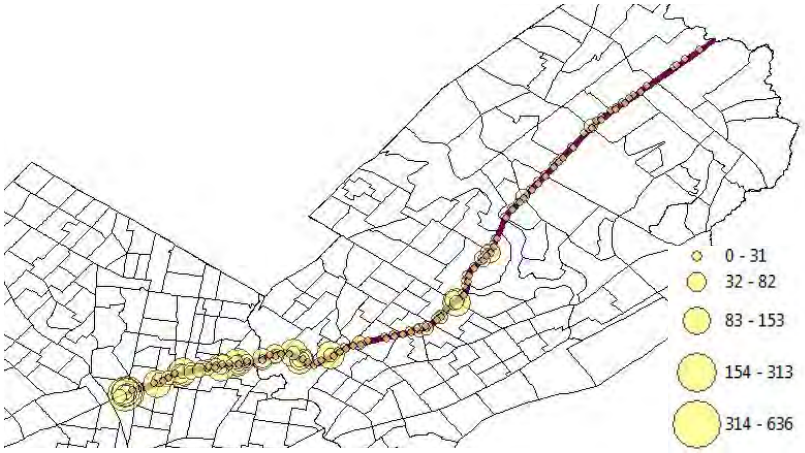
Ridership reflects the utilization of routes and stops. This study analyzes both route ridership and stop-level ridership.

Daily average ridership figures for weekdays of each route are listed in the table below. It shows that Route 14, though designated as a suburban route, is the most heavily used route among all five routes. Meanwhile, Route J is the least used route, with a daily average ridership of only 2,865. The low ridership of this route might be a result of low service frequency and undesirable on-time performance, as discussed previously.

Stop-level ridership is shown on the map to the right. These data are only available for Routes 1, 20, J and R. It is indicated on the maps that there are more passengers boarding and alighting from stops along the southwest segment of the Boulevard. The stops along the northeast segment, even though surrounded by some job centers such as Northeast Philadelphia Airport, are less utilized by people, probably due to the more suburban and car-oriented environment there.

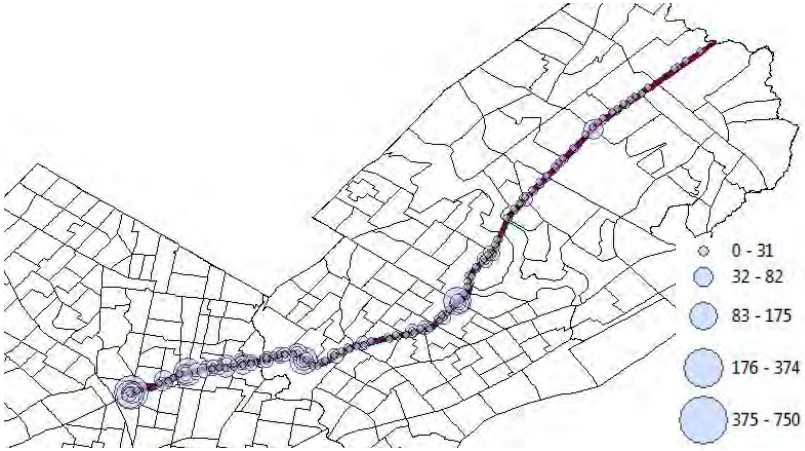
Route	Utilization (Daily Average Ridership)		Weekday Total Trips	Average Ridership Per Trip
	Number	Rank		
1	3866	58th	60	64.43333333
14 [suburban]	11943	18th	299	39.94314381
20 [suburban]	7512	32th	195	38.52307692
J	2865	63rd	97	29.53608247
R	8112	31st	209	38.81339713

Data Source: SEPTA Route Statistics Spring 2012



Stop-Level Average Daily Boardings on Weekday

Data Source: SEPTA



Stop-Level Average Daily Alightings on Weekday

Data Source: SEPTA

Passenger Amenities at Bus Stops

According to SEPTA services standards, passenger amenities which should be provided at all transit stations include identification signage, lighting, trash receptacle and recycling bins. In addition, for stations which have 500 or more boarding or alighting passengers, extra passenger amenities including sheltered waiting area and bench should be provided. This standard only applies to locations owned by SEPTA.

Based on the stop-level average daily ridership data, the stops named "Roosevelt Blvd & Broad St" has 636 boardings eastbound and 750 alightings westbound just for Route R every day. This is probably because they are located near the intersection of these two major arteries, and it is geographically convenient for passengers to transfer from the Hunting Park metro station to the bus stops. These two stops qualify for all the passenger amenities mentioned in *SEPTA Service Standards and Process*. However, in reality they do not meet the standards. The eastbound stop on the picture to the right shows that although there is a sheltered waiting area, there is no bench or trashcan provided for passengers.

However, not every stop that qualifies for such amenities is undersupplied. For instance, the "Roosevelt Blvd & Langdon St" eastbound station in front of the Friends Hospital has a nice sheltered waiting area with bench and space for passengers in wheelchairs.

Roosevelt Blvd & Broad St Stop - Eastbound

Data Source: Google Street View

Roosevelt Blvd & Langdon St Stop - Eastbound

Data Source: Google Street View

Operating Ratio

Operating ratio is a way to measure the economic performance of transit services. As described in *SEPTA Service Standards and Process,* it reveals "a route's success or failure". Routes with operating ratio below the minimum economic standards specified by SEPTA would be handled with "target marketing, restructuring, service adjustments or discontinuance".

The minimum requirement for operating ratio is 60% of the average operating ratio within the operating division. According to SEPTA's *Fiscal Year 2013 Annual Service Plan*, the minimum acceptable operating ratio for the City Transit Division is 22%, and for the Suburban Transit Division it is 18%.

Among the five routes chosen for analysis, only Route J does not meet the minimum requirement with its operating ratio as 20%, which is lower than the standard for the City Transit Division. Such weak economic performance is conceivable based on its poor records in frequency, on-time performance and ridership. Therefore, special attention should be given to Route J in the recommendations of improvement strategies.

Route	Operating Ratio	
	Number	Rank
1	25%	54th
14 [suburban]	24%	60th
20 [suburban]	25%	56th
J	20%	71st
R	34%	32nd

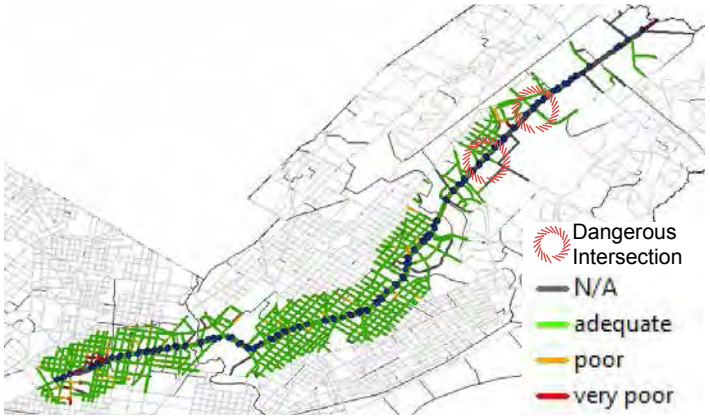
Walkability & Pedestrian Safety

In order to increase the appeal of transit to people, walkability and pedestrian safety around the transit stations should be guaranteed so that the first-mile/last-mile extension from transit stations to the final destinations could be a pleasant and safe journey instead of a scary and dangerous one.

The conditions of the sidewalks within 0.5 miles from Roosevelt Boulevard are analyzed and categorized into adequate, poor and very poor. It is noticeable that the sidewalks to the north of Hunting Park are of very poor conditions, but those bus stops nearby happen to be highly utilized by passengers. This area has an abundance of vacant land. The lack of development there might be the major reason of the poor sidewalk conditions. Along W Courtland Street sidewalks do not exist and pedestrian traffic is blended into car traffic.

Even the residential part of that area is not really walkable. The image of 7th Street illustrates how narrow and chaotic the sidewalks are in the area. In a residential street like this, bad sidewalks would probably deter people from walking to transit stations and encourage them to drive instead if they have a choice. However, households living in this area are mainly from low-income groups and many of them do not have access to a car. If they have no choice but to walk to the bus stops along such sidewalks, they would be put into a dangerous situation without enough protection from the car traffic.

In addition, along the northeast segment of the Boulevard there are remarkably less sidewalks and much bigger blocks. These factors inevitably reduce the walkability in the area. Moreover, as designated by the State Farm Insurance, this segment of the Boulevard has the second and third most dangerous intersections in the country, at Red Lion Road and Grant Avenue respectively. The Boulevard is simply too wide for pedestrians to cross at one time and it can be too daunting for people to want to walk to transit stops there. Therefore, pedestrian circulation between bus stops and their final destinations needs to be carefully coordinated with the vehicle circulation there to avoid conflicts and accidents.



Sidewalk Conditions & Dangerous Intersections

Sidewalks along 7th Street between W Rockland St and W Louden St looking South

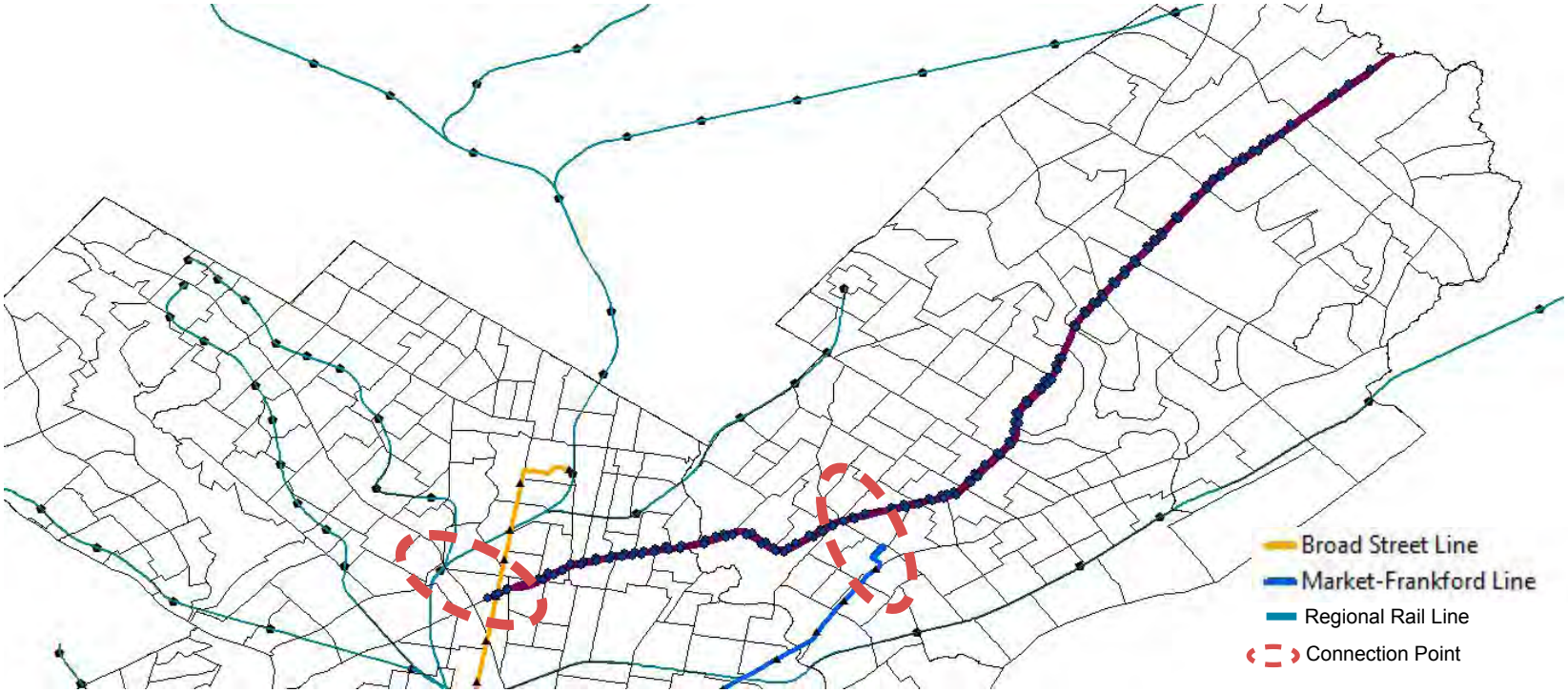
Data Source: Google Street View

Connections to the Regional Transit Network

The existing transit services along the Boulevard are well connected to the Broad Street Line at Hunting Park Station.

It is very close but slightly disconnected from the Market-Frankford Line. Walking distance from Frankford Transportation Center to the closest bus stop along the Boulevard is around 0.73 mile, which takes more than 10 minutes to make the connection by walk. It takes 9 minutes to make a connection from the Boulevard to Frankford Transportation Center by taking the bus R, 14, 20 or 67.

Moreover, the bus services along the Boulevard should also be connected to the regional rail network. The closest regional rail hub to the Boulevard is Wayne Junction. Currently people can get off near Hunting Park and walk to Wayne Junction in 24 minutes, which is beyond the walkable range. Alternatively, people can take bus 75 or R to complete this connection. This process takes around 13 to 19 minutes.



Connections to the Regional Transit Network

Section Two
Improvement Strategies

The analysis in Section One reveals several problems with the existing transit services along Roosevelt Boulevard, including the unsatisfactory economic performance of Route J, weak on-time performance of Route 1 and Route J, small ridership along the northeast segment of the Boulevard, lack of passenger amenities at major bus stops, and poor sidewalk conditions in certain neighborhoods within 0.5 miles from the Boulevard.

This section will deal with these problems identified and recommend five improvement strategies accordingly to ameliorate the current conditions. The improvement strategies include increase frequency for route J, skip or consolidate some stops along the northeast segment, improve passenger amenities for the Roosevelt Blvd & Broad St Stop, and enhance sidewalk conditions in certain neighborhoods. Moreover, to improve the overall efficiency of bus traffic along the Boulevard, queue jump lanes and advanced signal could be established at the most congested intersections to avoid delay and improve on-time performance of the bus routes.

Increase Service Frequency for Route J

According to the existing conditions analysis, the economic performance of Route J does not meet the minimum requirement of SEPTA, and its ridership is among the lowest ones. The major factor that deters people from taking Route J might be its low service frequency.

Route J passes through large area of residential concentrations and connects several major recreational destinations. However, as a city transit route, Route J only meets the minimum service frequency requirement for weekday am peak and pm peak, and at late nights and weekends it even operates with a suburban transit service frequency. In addition to that, while the other routes have a reliable on-time performance at least during am peak, around 20% of the buses on Route J fail to arrive at stops on-time,

Route J
Source: SEPTA Route Statistics Spring 2012

which further subtract the route's appeal to customers. In the morning rush hour, if a person could choose between waiting for 20 minutes (or even longer due to the unaccountability of the schedule) for Route J and waiting for less than 10 minutes for a substitute urban route, he/she would probably choose the latter. Similarly for the weekend, if a person could either wait for 60 minutes for Route J or 30 minutes for another substitute urban route or drive, it is very likely that he/she would drop the Route J option and turn to the other two.

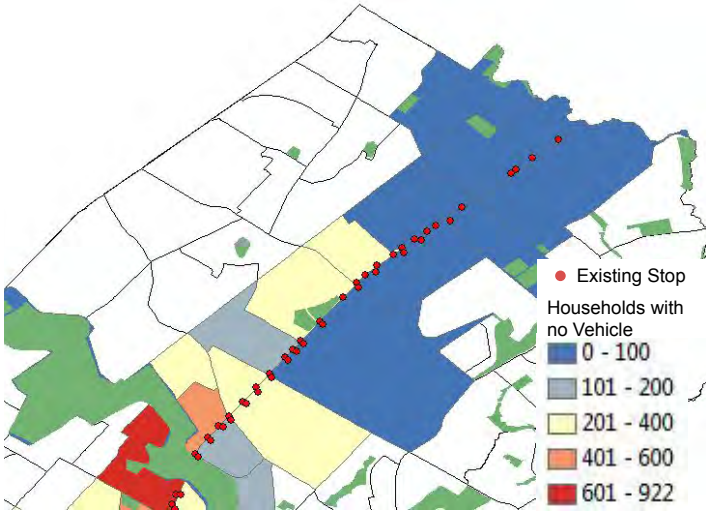
Therefore, new service frequency levels should be established for Route J, as indicated in the table to the right. Increased service frequency for all time periods would help to attract more passengers to take this route for work and leisure activities. Such enhanced frequency, if combined with on-time performance improvement, will increase the appeal of this route to people living and working along it. Improvement of on-time performance will be discussed later in this section.

Route J	Old Service Frequency (in mins)	New Service Frequency (in mins)
WKD AM Peak	20	10
WKD PM Peak	15	10
Early Evening	30	20
Late night	45	30
Owl	-	-
Sat	60	30
Sun	60	30

Change Stop Spacing along the Northeast Segment

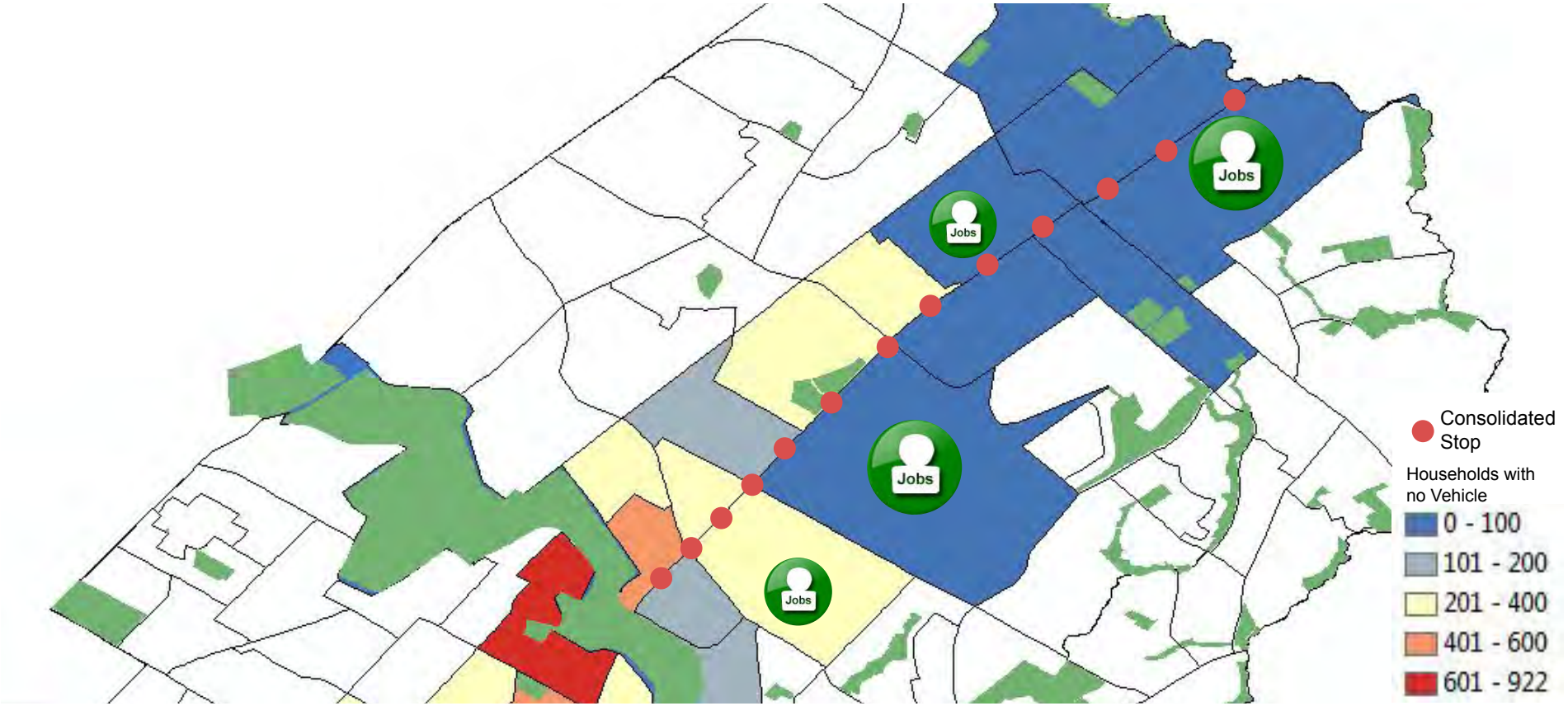
Roosevelt Boulevard changes its character from urban to suburban as it stretches northeast and passes Pennypack Park. Such change of character is also reflected in the ridership number. Many people board or alight at the stops along the southwest segment, but a significantly smaller number of people do so along the northeast segment, despite of the fact that several major employment centers such as Northeast Philadelphia Airport are located there. The low ridership there might be because of the bad or non-existent sidewalks and the car-dominant environment there. Other reasons might be because the household median income level there is higher than the southwest segment and there are fewer households which do not have access to a car.

The routes running along the northeast segment are Route 1 and 14. Currently the buses stop basically for every block, and the many stops are located with a distance of less than 1,000 feet from each other. This stop spacing is unnecessary in such an environment with suburban characteristics. Also, if a bus stops at every block only for a tiny number of passengers, it could be a waste of time and resources for the entire route.



Current Stop Spacing along the Northeast Segment

Therefore, the stop spacing should be enlarged along the segment, while retaining the stops in front of major employment centers and TAZs where more households without vehicle reside, as indicated on the map below. It would be better if such change of stop spacing were made on a temporary basis by skipping the insignificant stops during peak hours. Currently there is no need to permanently take out those stops, because as demographics and employment situation along the segment change, there is a possibility that the area would gradually become denser and more walkable, and generate more ridership to support the stops along the segment.



Proposed Stop Spacing along the Northeast Segment

Improve Passenger Amenities at Bus Stops

As mentioned before, all the bus stops should have identification signage, lighting, trash receptacles and recycling bins. Also, the bus stops which have 500 or more daily boardings or alightings should have a sheltered waiting area and bench.

It is recommended that for the Roosevelt Blvd & Broad St stop where both daily boardings and alightings exceed 500, a bench should be provided while leaving sufficient space for wheelchair users. Also, trashcans and recycle bins should be provided there to keep the waiting area tidy and comfortable. An example for improvement of this bus stop is shown on the image to the right.

For most of the other stops along the Boulevard, what is usually provided is a sign on a light pole. Most of the time there is no trashcan around such stops. While this configuration is enough for small stops with low ridership, other measures could be taken to improve the situation.

A Sheltered Bus Stop with Bench

Source: Electronmedia.in

Although bus stop improvements might not be the prioritized project to be granted with SEPTA funds, strategic partnerships between SEPTA and other businesses could be established. SEPTA could allow other businesses to install advertisements at certain bus stops, and the price those businesses need to pay would be to build a sheltered waiting area with trashcan and bench. Creative bus stop advertisements will not only significantly enhance the waiting experience, and it will also effectively promote the goods and services of the sponsoring businesses to customers. The examples to the right demostrate how a win-win situation such partnership creates.

Quicksilver advertisement, Denmark

Source: Toxel.com

Let people know about how the new Coca-Cola Grip Bottle has a better grip for holding, France

Source: Boredpanda.com

Enhance Sidewalk Conditions

The sidewalks in the neighborhood to the north of Hunting Park should be improved. Currently they are too narrow, uneven and sometimes nonexistent.

Actions should be taken to widen the sidewalks for the residential neighborhoods around N 7th Street. Also the lighting along N 7th Street is very limited in number and brightness. Some pedestrian-scale lighting should be installed in between the existing tall street lights there.

Also, there are buses running along W Wyoming Street but the sidewalks are broken and not continuous. This area is currently vacant but zoned as residential. As new developments come to these parcels, new sidewalks raised above from the traffic lane should be constructed to create safe, continuous and wide enough walking space there.

Moreover, along the segment of the Boulevard next to Northeast Philadelphia Airport, sidewalks do not exist. This might have contributed to the low bus ridership there. If the potential riders working and living nearby are to be served, sidewalks, even as narrow as 5 feet, should be installed there to provide a better walking connection from the bus stops to the final destinations.

Sidewalks along W Wyoming Avenue between 10th and 11th Streets looking east

Source: Google Street View

Establish Queue Jump Lanes

The congestion level along the Boulevard is high during peak hours and it can take a long time for commuters to pass through. Traffic congestion also leads to delay on bus schedules and impairs the on-time performance of the routes there. Freeing buses from traffic congestion could effectively save travel time and increase mobility for riders.

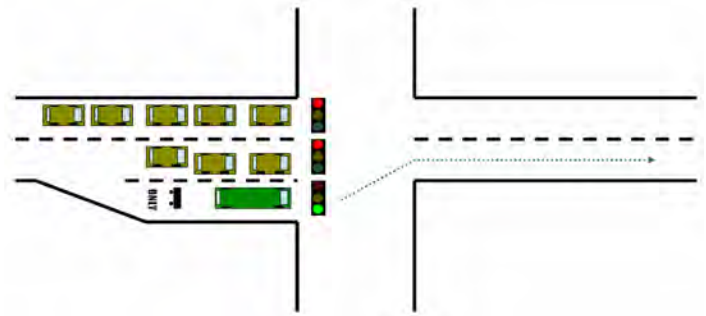
One way to increase mobility of buses is to establish a high-occupancy-vehicle (HOV) lane, which is reserved exclusively for vehicles occupied by more than two persons, including carpools, vanpools and buses. HOV lanes could potentially encourage people to carpool or to take transit. However, HOV lanes could also increase travel time for single-occupant vehicles because the other lanes might become more congested. Normally HOV lanes are suitable for highly congested areas like Los Angeles, but the congestion level along Roosevelt Boulevard is not severe enough to justify establishment of HOV lanes.

A 'lite' version of HOV lanes would be the queue jump lanes. It is an additional lane near an intersection, exclusively dedicated to buses. A queue jump lane should be complemented with an advanced actuated signal, which detects the existence of a bus on the lane, and then gives the bus a "head-start" over vehicles queued in the other lanes, so that the bus can immediately merge into the regular travel lanes after crossing the intersection. Such arrangement will significantly enhance the operational efficiency of the bus services.

However, there exist some challenges. First, most of the bus stops along the Boulevard are near-side bus stops, which poses a challenge to signal actuation. The signal should be configured to not detect the bus until it finishes the loading process. Second, the sidewalks are already very narrow along the Boulevard. Establishing queue jump lane would inevitably encroach even more sidewalk space, which would increase the crossing distance for pedestrians and harm their interests.

HOV Lane in Los Angeles

Source: Thetruthaboutcars.com



Queue Jump Lane with Advanced Signal

Source: Wikipedia.org

Section Three
Evaluation & Prioritization

Despite of all the benefits discussed above, the costs of the recommended improvements should also be evaluated to decide the cost-effectiveness of the interventions. SEPTA's three-part unit cost methodology is used here to evaluate the estimated annual operating cost change for the recommended services.

According to SEPTA's *Financial Year 2013 Annual Service Plan*, the unit costs for bus services in the City Transit Division are as follows:

SEPTA's UNIT COSTS - FISCAL YEAR 2013				
	Average Passenger Fare	Operator $ per v-hour	Maint. & Op. per V-mile	Overhead - per Peak Vehicle - Year Incremental
Bus - City Transit	$0.99	$53.88	$4.18	$38,270

Estimated annual operating cost change, estimated annual passenger revenue change, and the new operating ratio after service improvements will be calculated based on SEPTA's unit costs for 2013. Such estimation will be done for increasing frequency on Route J and reducing stop spacing on Route 1 along the northeast segment of the Boulevard. Due to the limitation in data, the increase in costs for the other three improvement strategies will not be evaluated with this methodology.

Later, all the five improvement strategies will be assessed based on severity of need, cost, and complexity of implementation. Prioritization will be given to interventions that deal with severe needs, show cost-effective prospect, and are less complex to implement.

Cost Evaluation - Increase Frequency for Route J

As shown in the table to the right, increasing frequency for Route J will approximately double its annual vehicle hours and annual vehicle miles. Also, the new services will require additional 9 peak vehicles.

Such improvement is likely to also double the daily ridership, given that the route is running through large residential concentrations and major parks, which provide a substantial market base to absorb the increased services.

As a result, the new operating ratio will increase to 24%, meeting the minimum requirement of SEPTA.

Increase Frequency along Route J				
Costs	Current Vehicle Hours (Annual)	31,013		
	Estimated Increase in V-hour	28,000	Increase in Operator Expenses	$1,508,640
	Current Vehicle Miles (Annual)	282,890		
	Estimated Increase in V-mile	250,000	Increase in Maint. & Op. Expenses	$1,045,000
	Current Peak Vehicles	9		
	Estimated Increase in Peak Vehicles	9	Increase in Peak Vehicle Expenses	$344,430
	Estimated Annual Operating Cost Change			$2,898,070
	Total Annual Operating Cost			$7,263,273
Revenue	Estimated Increase in Daily Ridership	2500		
	Estimated Increase in Annual Passenger Revenue	$903,375	New Operating Ratio	24%
	Total Annual Passenger Revenue	$1,762,281	Current Operating Ratio	20%

Cost Evaluation - Reduce Stop Spacing for Route 1

As shown in the table to the right, reducing stop spacing for Route 1 during rush hour along the northeast segment of the Boulevard will increase the number of trips the route can make each day. This change will add one additional peak vehicle, and slightly increase annual vehicle hours and annual vehicle miles.

Also, this change will not only save time for passengers, especially the long-distance riders, but also attract more people to ride. Therefore, 350 more people are expected to ride this route every day.

This improvement will increase the operating ratio from 25% to 27%.

Reduce Stop Spacing for Route 1 along the Northeast Segment					
Costs	Current Vehicle Hours (Annual)	32,070			
	Estimated Increase in V-hour	1500		Increase in Operator Expenses	$80,820.00
	Current Vehicle Miles (Annual)	425,580			
	Estimated Increase in V-mile	35,000		Increase in Maint. & Op. Expenses	$146,300
	Current Peak Vehicles	11			
	Estimated Increase in Peak Vehicles	1		Increase in Peak Vehicle Expenses	$38,270
	Estimated Annual Operating Cost Change				$265,390
	Total Annual Operating Cost				$4,560,125
Revenue	Estimated Increase in Daily Ridership	350			
	Estimated Increase in Annual Passenger Revenue	$126,472		New Operating Ratio	27%
	Total Annual Passenger Revenue	$1,218,422		Current Operating Ratio	25%

Prioritization

The five improvement strategies are assessed based on severity of need, cost, and complexity of implementation. A table is organized to compare these factors for different strategies. A rating of 1 to 5, with 1 meaning lowest and 5 meaning highest, is given to decide the levels.

	Increasing Service Frequency for Route J	Reducing Stop Spacing for Route 1	Improving Passenger Amenities at Bus Stops	Enhancing Sidewalk Conditions	Establishing Queue Jump Lanes
Severity of Need	4	3	4	5	3
Cost	5	3	2	4	5
Complexity	4	4	2	4	5

Based on the ratings above, **improving passenger amenities at bus stops** are the cheapest and easiest to implement, and will bring cost-effective benefits. Therefore, it should be prioritized. **Reducing stop spacing for Route 1** is less costly, but it can be difficult to implement because the schedule change could cause confusion to riders and potentially discourage them from riding on this route if this change is not communicated in a clear and prompt manner.

Increasing service frequency for Route J and **enhancing sidewalk conditions in certain neighborhoods** could meet severe needs and bring great benefit. However, they are both expensive and complex to implement, as the service change for Route J involves a rearrangement of the whole schedule and inventory, and sidewalk improvements involves private property rights.

Currently, **establishing queue jump lanes** is not immediately necessary because the congestion level along the Boulevard is not severe enough, and also because the high construction costs and logistical complexity associated with it.

References

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