

Network Performance Scenario Modeling

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October 2005

Draft

A research grant was generously provided
by the
Environmental Protection Agency

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Abstract

**“We had better design and build thoughtfully,
sensitively, creatively, as we usher men and women into
the presence of the natural gods...”**

- Stanley William Abbott, architect of the Blue Ridge
Parkway

The purpose of this project was to use scenario modeling to analyze how a parkway and supporting street networks work to support each other in urban or urbanizing areas and provide area-wide performance measures to compare outcomes.

Parkways across the nation have three important common elements; design features that promote a linear park, multi-modal corridor, and a design speed that promotes a 45 mph average speed. A parkway in this analysis was assumed to have 4 lanes total with a capacity of 900 vehicles per hour per lane and a posted speed of 45 mph. This capacity was assumed due to the fact the intersection design was unknown.

Four scenarios were used to test the sensitivity of the parkway with a local street network as well as compare the results against a no-build alternative and highway alternative. The highway was assumed to have a typical capacity of 2000 vehicles per lane per hour.

The measures used to compare these scenarios included the internal vehicle miles traveled within the new city of Damascus, the attractiveness of the area measured by demand for to, from and internal to Damascus, average speed across a cut-line as well as a major facility delay analysis.

The results indicate that when using the corridor only measures a parkway would measure high in delay to the user using a typical level of service analysis. However, the analysis looked at how the network functioned and found that:

- Internal vehicles miles of travel was less for the parkway than other alternatives,
- The level of accessibility and attractiveness of jobs in Damascus were similar in all scenarios and provided increased attractiveness over the no-build,
- Delay experience overall in the pm 2-hour peak of trips attempting to access Damascus (returning home from the region) was better for all scenarios over the no-build but highest in the scenario that combined a highway and an enhanced local street network and
- Regional trips relied less on the assumed major facility to access Damascus in the both the highway and parkway scenarios with an enhanced local street network.

The parkway functions similarly to the highway with the enhanced local street network but the assumed carrying capacity of the parkway in this analysis (900 vphpl) increased the overall delay experienced in the facility itself as well as affecting the overall network. Finding ways to increase the capacity of the facility without increasing the posted speed would involved more research into possible intersection/interchange designs that minimize delay.

Purpose of Project

The purpose of this research project was to use scenario modeling as means to test a wider variety of solutions and performance measures prior to entering an EIS corridor level process for a major roadway facility. **The scenario modeling will analyze how a 45 mph parkway and supporting street networks work to support each other in urban or urbanizing areas.**

Typically, a major road facility is analyzed in a very limited geographic corridor and with performance measures that only measure delay. This has led to many conflicts between stakeholders believing that the process was rigged to a pre-determined outcome. In other words, not all reasonable alternatives may have been considered and not all potential impacts analyzed.

While the State of Oregon has a more sophisticated system of growth management goals than most states, the problem is the similar amongst all the states: how does the required Environmental Impact Study (EIS) quantitative alternatives analysis process limit the ability of communities to discuss the impacts to long-term community quality of life indicators for proposed new roadway facilities?

Some of the barriers that have been identified in the work done by FHWA and national transportation consultants are as follows¹;

- Traditional EIS process does not allow for issues to be placed on the table until the end when it may be too late to take into account the larger system land use and transportation network issues. Natural resources are mitigated instead of avoided in this process.
- There may not be good method to look at a variety of solutions to the transportation issue including “off system” improvements because the EIS process has narrowed it down to one type of improvement to one facility.
- Safety concerns for design of a roadway below 70 mph design speed with wide cross section.

The gap created by focusing on analysis only in the EIS process is that the natural resource avoidance and minimization is not included in long-term area-wide transportation system impacts and has resulted in unsatisfactory, inefficient, ineffective and inequitable project implementations. This in turn leaves state departments of transportation open to lawsuits challenging the legality of the process and end-product. To close the gap between 20-year plans and the EIS process there needs to be a process that takes into account the changes that could be made in the transportation network, land uses and the types of major facilities that are consideration.

In order to effectively use scenario modeling for major roadway facilities, a process needs to be created for determining how a proposed roadway can satisfy travel demand with less impact by designing a local street network to support the lower speed major facility so that higher density employment and residential development are served and local trips use local roads and regional trips use regional roads.

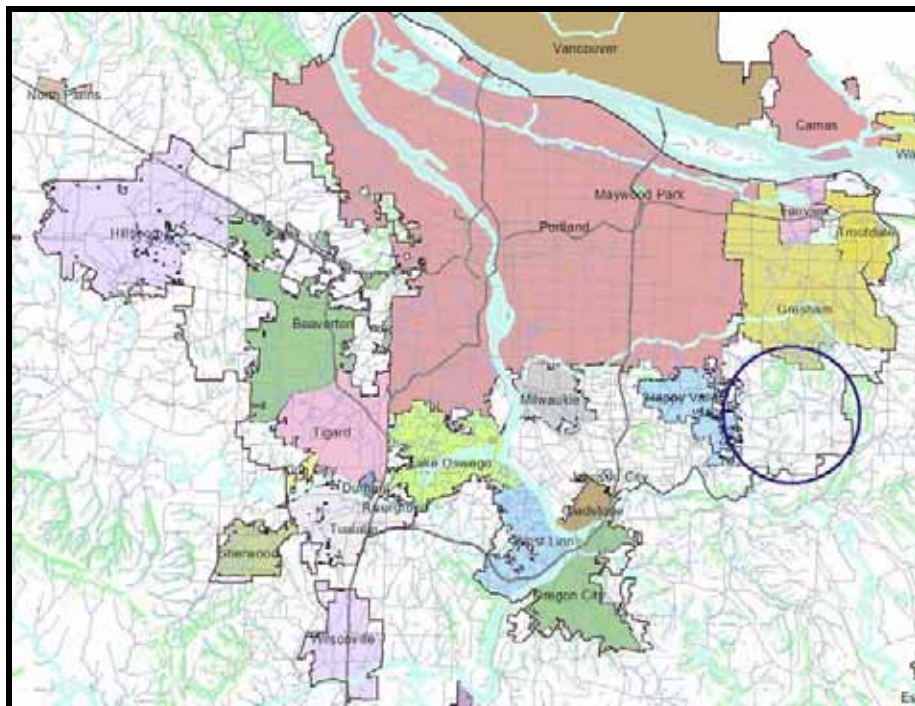
Today, with the advent of neo-traditional development or smart growth, it is time to test whether these type of roads will work as replacements for roads that had been envisioned as highways in the 60s-70s-80s.

¹ CH2MHill presentation by Marcie Schwartz at a Portland State University seminar 2004.

Background

This project uses the area of Damascus, Oregon (a newly incorporated rural area) as a case study to test technical processes and analysis tools that can be used to quantify the performance of 45 mph parkway facility as a part of integrated sub-area transportation networks and land use scenarios. A blue circle indicates the new City of Damascus in Figure 1 below in context to the rest of the region.

Figure 1 – Portland Region-Damascus Location



Background on the Sunrise Corridor

In the mid-1980s the Oregon Department of Transportation proposed a list of new highways as connections from eastern Oregon to western Oregon called Access Oregon Highways. The Sunrise Corridor was one of these projects as a connection outside the newly established Urban Growth Boundary that would connect I-205 on the east side of the region to Hwy 26 and continue the expressway of 212-224 from Milwaukie to Mt. Hood for easier freight movement.

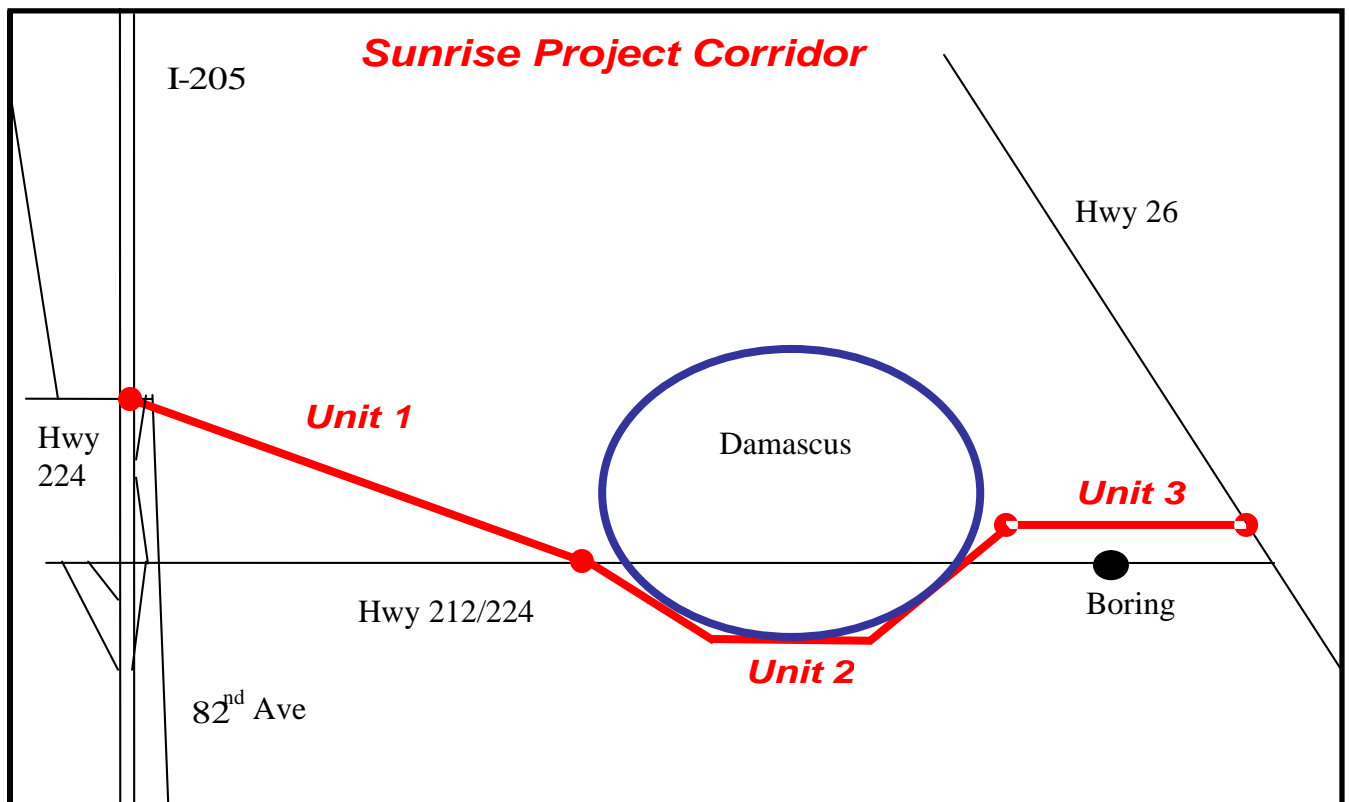
In 1993, Metro increased the buildable residential lands inventory in the region by moving the Urban Growth Boundary to include 18,000 acres. 12,000 of those acres were to be a new city of Damascus that would house approximately 50,000 people and an equal number of employees in 20-30 years.

Currently, the county of Clackamas has been performing Draft Environmental Impact Analysis for Unit 1 from I-205 to Rock Creek Junction, approximately 4 miles, as a 6-lane limited access

expressway with a posted speed of 55-60 mph (See Figure 2 below) and grade separated interchanges. The proposed cross section would typically require a minimum ROW width of

The concept planning for the new city of Damascus has adopted the idea of a 45 mph parkway for Unit 2 and 3.

Figure 2 – Sunrise Project Corridor and Segments



The 4-lane parkway idea is discussed in detail below but would be a linear park with a design speed that promotes a self-enforcing posted speed of 45 mph. This type of roadway has less roadway width in comparison to an expressway or highway cross section of approximately 120 feet but could include additional ROW for off-road pedestrian and bicycle pathways.

Also, in discussion currently is the “Big Park” concept. This proposed park would lie between the UGB and the Clackamas River to the South and protect the Clackamas River Basin from future development as well as provide recreational opportunities for future citizens of the region.

As a result, there are conflicting views of what this road ought to become and who it should serve. Although there is an incredibly amount of information on suburban arterial and highway design for safety for users, there is very little analysis or use of 45 mph suburban and rural parkway designs in the United States. This research attempts to look at how a parkway functions in a complete network of streets.

Many planners, architects and landscape architects use street types such as described above in their community designs and in the urban area they are generally called boulevards in urban or urbanizing areas.

The belief is that a lower speed facility will have the following benefits to the community.

- Supporting compact urban areas
- Balancing mobility with accessibility
- Safety for all the users in an urban area
- Increased Reliability of the system
- Lower decibel noise
- Less ROW needed in terms of runoff area and curves
- Less land use impacts downstream
- Increased continuity of between urban areas

Urban-Suburban-Rural Parkway Designs

These types of facilities were first called Parkways by Olmstead and Vaux in the early process of designing multi-modal, high volume roads for Brooklyn in the early 1860s. “The current Encyclopedia of Urban Planning defines a parkway as a scenic highway for non-commercial traffic with full or partial control of access and usually within a park or ribbon of park-like development.”²

This modern definition only takes into account part of what Olmstead and Vaux were attempting which was to accommodate a mix of traffic on one road in urban, suburban and rural settings.

In 1937, John Nolen, a city planner, wrote a book called Parkways and Land Values. In it he says, “What is a parkway? How does it differ from a boulevard, or an avenue, or a highway with beautified trees? These terms and many others have been loosely applied and have crystallized by custom as the names of such different places, that nothing but specific local knowledge will make it hard to apply to a ‘parkway’ in one town what has been learned about a ‘parkway’ in any other town.”³

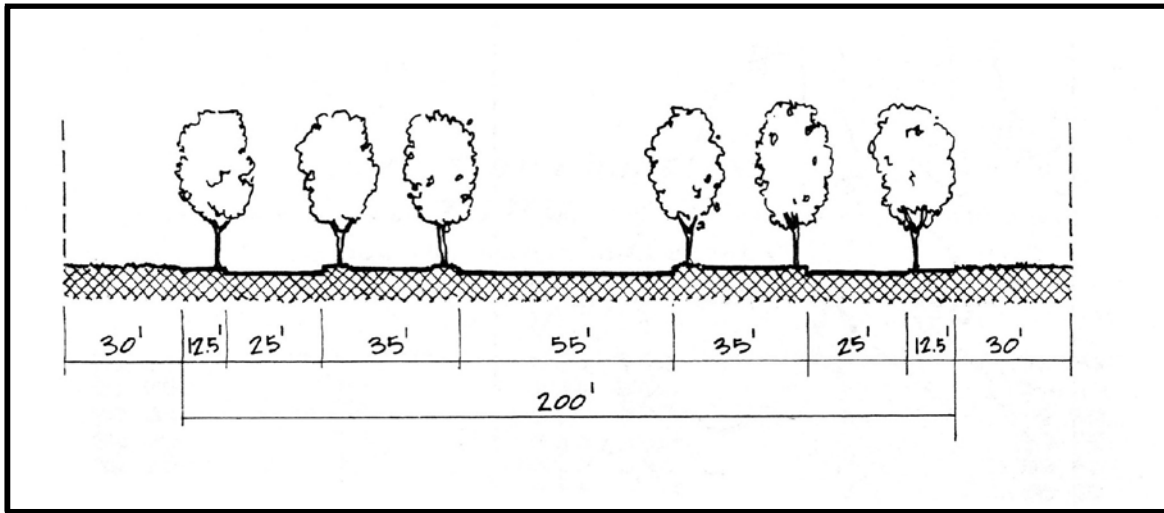
The Olmstead-Vaux vision was a 200-210 foot right-of-way which had a 4-lane main road flanked by local access frontage roads. The main road was separated by the frontage road by a 35-foot “mall” or median with a double row of trees planted. The malls accommodated horse riding, bicycle paths and walking. The sidewalks for local traffic were at the minimum 12.5-feet wide and included another row of trees. Parallel arterials were also envisioned to support the local traffic in the adjoining neighborhoods.

See Figure 2 below for a proposed urban cross section of the Eastern Parkway as originally envisioned by Olmstead and Vaux. They had wanted to make the parkway rolling and curvilinear rather than straight but much of both Brooklyn Parkways was platted into the existing grid system with parallel boulevards to move local traffic.

²MacDonald, E., Enduring Complexity: A History of Brooklyn’s Parkways, The University of California Transportation Center, page 105

³

Figure 3 – Olmstead Eastern Urban Parkway Cross Section



During the 1920s and 1930s the cities of City of Los Angeles, Boston, Chicago, Detroit, New York and San Francisco had created “metropolitan expressway plans” that would have built a dense network of multi-modal, lower speed, less capacity parkway-like roads. The purpose of these roads was inter-regional trip-making, keeping the downtowns connected to the new suburbs and more closely connected to existing or proposed development within the region.

Brian Taylor from the University of California at Los Angeles shows in his dissertation how these plans were never realized due to the funding mechanisms provided by the Federal government to build super-highways for national trip-making⁵. The plans for these parkways were never realized and the parkways have become, over time, more of the modern 55mph expressways that are separate from the community using a combination of large signalized or grade separated intersections.

Rural-Scenic Parkway

The National Park Service picked up on this idea of an aesthetically pleasing roadway with its National Scenic Parkway System in the 1930s and the projects were built with the help of Civilian Conservation Corp.

According to a Park Service pamphlet printed in January 1938 the national parkways were a new type of development in the park system consisting of an elongated park area devoted to recreation, which features a pleasure vehicle road through its entire length and is kept free of commercialism

The parkway was a road constructed in a manner that would protect, yet make available for public enjoyment the outstanding scenic and historic points of interest along the route. A particular aim of the parkways was to prevent the

⁴ MacDonal, E., *Enduring Complexity: A History of Brooklyn’s Parkway*, The University of California Transportation Center, 1999

⁵ Taylor, Brian, *When Finance Leads Planning: The Influence of Public Finance on Transportation Planning and Policy in California*, The University of California, Los Angeles 1992

erection of billboards, signs, and other works that might mar or detract from the natural beauty along the roadway.

In answer to the question of "what is a parkway, and what is the difference between it and an ordinary expressway or highway," the National Park Service formulated a definition of this type of road in 1938. A parkway was defined as a development of the highway that differed from the usual highway in at least eight respects. According to this definition that was articulated to Congress by Assistant Director Arthur E. Demaray in 1938, the parkway

- (1) was designated for noncommercial, recreational use;*
- (2) sought to avoid unsightly buildings and other roadside developments that mar the ordinary highway;*
- (3) was built within a much wider right-of-way to provide an insulating strip of park land between the roadway and the abutting private property;*
- (4) eliminated frontage and access rights and preserved the natural scenic values;*
- (5) preferably took a new location, bypassing built-up communities and avoiding congestion;*
- 6) aimed to make accessible the best scenery in the country it traversed, hence the shortest or most direct route was not necessarily a primary consideration;*
- (7) eliminated major grade crossings; and*
- (8) had entrance and exit points space at distant intervals to reduce interruptions to the main traffic stream.*

The Blue Ridge Parkway is one of the parkways that was built 70 years ago this year. It was the country's first and longest rural scenic parkway. The 469-mile route serves 20 million annual visits and it is estimated that the economic impact for the Virginia and North Carolina counties that the parkway traverses amounts to more than \$2 billion annually.⁶



Figure 4 - BlueRidge Parkway

⁶ <http://www.blueridgeparkway.org/>

While there were many others involved Stanley William Abbott was the lead architect. Abbott was influenced by Frederick Law Olmstead and wanted to create a park-like environment that would blend in with the natural surroundings and showcase not only panoramic views of the mountains, but also agricultural settings, streams and forests.

In a recent publication by Metropolitan Design Center (2003) that researched the different types of parkways within the Minneapolis-St. Paul region they cite three important aspects that differentiate parkways from other roadways by stating that parkways are greener, public spaces that connect important natural features and cultural institutions. While there is much discussion in this study about the look and feel of the parkways, there is little discussion about the design and posted speed, the intersection spacing, the capacity of these roadways and whether they truly in the Olmstead vision of multi-modal, flexible with regard to land use and modal use and high volume.

Here in the Oregon some examples of roads that come close to a 4-lane parkway design are the Bend Parkway in Bend, Kruse Way in Lake Oswego and parts of Terwilliger Boulevard in Portland. All are 45 mph but there are vast differences in length and accommodation of bicyclists and pedestrians as well as transit on each design. Figures 5 and 6a&b below show the cross section of each.

Figure 5 – Bend Parkway Typical Cross Section

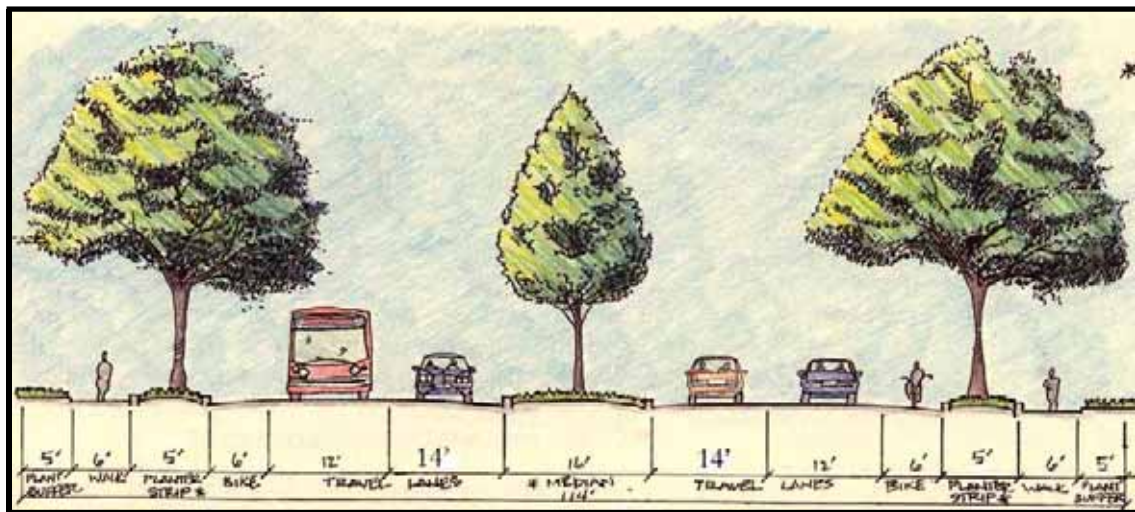


Figure 6a – Kruse Way Cross Section

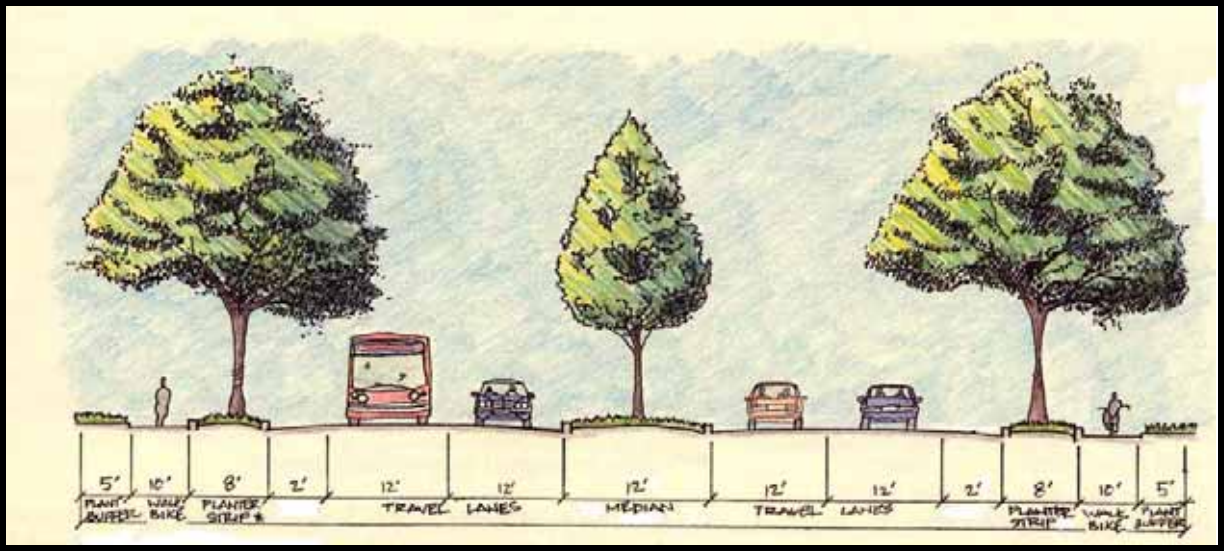


Figure 6b – Intersection on Kruse Way



Terwilliger Boulevard in the Portland region was designed by Olmstead for the City of Portland (from downtown Portland to the Willamette River 12 miles south). The portion along Tryon Creek State Park to the south (from the Lewis and Clark roundabout to Hwy 43), outside of Portland, has some of the features of the Blue Ridge Parkway: 45 mph speed limit, two-lane, parallel off-road paved bicycle path and heavily forested. However, this portion of Terwilliger Boulevard does have a limited number of driveways and at-grade intersections.

This discussion of parkways was to show the varying definitions and cross sections. For the following modeling analysis the exact cross section was not assumed. This project assumed that the road would be designed to keep traffic moving at 45mph and would allow trucks, cars, transit.

Table 1 below compares some of the main design characteristics of roadway types. In this analysis, parkways were assumed to fall above arterials but below expressways **in terms of access control and speed.**

Table 1 – Comparison of Road type characteristics

Roadway Type	Posted Speed	Assumed Model Capacity plph	Typical ROW (feet)	Intersection Type	Access	Green Space	Users
Local-2 lanes with parking	15-25 mph	<700	60	Stop controlled	Driveways – closely spaced	Green strip between parking lane and sidewalk	Multi-modal – no bus or large trucks generally
Collector	25-35 mph	900	60-80	Signal control or roundabouts	Driveways – closely spaced driveways	Green strip between parking lane and sidewalk – possible small median	Multi-modal
Arterial/Boulevard	35-45 mph	1200	120-150	Signal or roundabouts	14-16 local street connections per mile ⁷ with some driveways	Green strip between parking lane and sidewalk – possible median	Multi-modal
Parkway	45 mph	900-1800 ⁸	120-200	Roundabouts possible	Combination of at-grade and grade separated, no driveway access	ROW landscaped on both sides and median with multi-modal paths	Multi-modal – trucks may be allowed
Expressway	50-55 mph	2000	>200	Signals and interchanges	Both possible but a mile or more in spacing	Possible median without landscaping and shoulder and runoff area for errant vehicles	Vehicles only – express bus service only
Highway	55-65 mph	2200	>200	Interchanges	Grade separated – minimum 2 mile interchange spacing ⁹	median and very wide runoff area	Vehicles only

⁷ Metro RTP research

⁸ Metro staff suggested 900 vphpl for this research. Currently Metro staff is using 1800 vphpl as an assumed parkway capacity.

⁹

Scenario Development

A proposed set of scenarios were presented before a committee of regional experts in the field of regional planning, engineering and architecture (see appendix) in June 2004. They suggested that the following five scenarios were determined to be necessary to test the corridor vs. area-wide assumptions for a parkway and a highway.

Each scenario varies either by differences in the grid street system road hierarchy design speed and spacing or land use patterns (density and spatial of development). Scenario 5 is the only one where the land use varies. The density was increased in Scenario 5 to test the flexibility of the parkway road system with changes in density. Table 1 shows the variables that are tested in each scenario.

Table 2 – Scenario Definitions

	Scenario	Parkway	Highway	Enhanced Road Network	Change in Land Use
1	No Build				
2	Highway with existing network - Highway		●		
3	Highway with enhanced network - Highway Plus		●	●	
4	Parkway with enhanced local street network – Parkway Plus	●		●	
5	Parkway with enhanced local street network and increased household and employment density – Parkway-Land Use Plus	●		●	●

Assumptions

Land use assumptions were made for this analysis so they were comparable to other studies taking place at the same time for both land use and the transportation system characteristics. Some of these studies include the Damascus Concept Planning work (currently underway) and the Sunrise Corridor – Unit I Draft Environment Impact Study (currently underway).

Land Use

Forecasts for Scenarios 1-4 are the same as the land use forecast used by the Concept Planning currently underway for the Damascus area using the 2025 RTP. See Table 3 shows that this assumes 26,057 households and 10,043 employees within the Transportation Analysis Zones that define the Damascus area.

The Scenario 5 land use forecast was increased to 40,000 households and 20,000 employees by incorporating housing and employment that had been allocated outside the Urban Growth Boundary in the Carver/Redlands area to the South of Damascus and the Boring area to the east back into Damascus. Due to the Transportation Analysis Zone size outside the UGB where this additional 10 years of growth was allocated in the 2025 RTP allocation, there was not enough information to know how much less land would be consumed in growth. Those zones in total add up to 31,000 acres.

Table 3 - Land Use Assumptions

	Scenario	No. of Households	No. of Employees	Average Density of Households per Gross Acres	Average Density of Employment per Gross Acre
1	No Build	26,057	10,043	2.3	.89
2	Highway				
3	Highway Plus				
4	Parkway Plus	40,000	20,000	3.5	1.8
5	Parkway-Land Use Plus				

Roadways

The transportation base assumptions also needed to be defined in terms of capacity of road types, the capacity and alignment of the parkway, the capacity and alignment of the highway and the location and capacity of a main street.

It was determined that the roadway types would be defined by the Damascus concept planning work currently underway for the Damascus area and those capacities are shown in Table 4 below. There is one difference, the parkway was limited to 900 vphpl in this analysis and was later increased by Metro staff to 1800 vphpl which doubles the capacity.

For this analysis, the exact alignment of the proposed parkway and highway are not necessary to the outcome of the analysis for network analysis. It is more important to remember that the capacity and speed in the general corridor are the important characteristics for modeling.

Table 4 - Damascus Concept Plan Assumptions

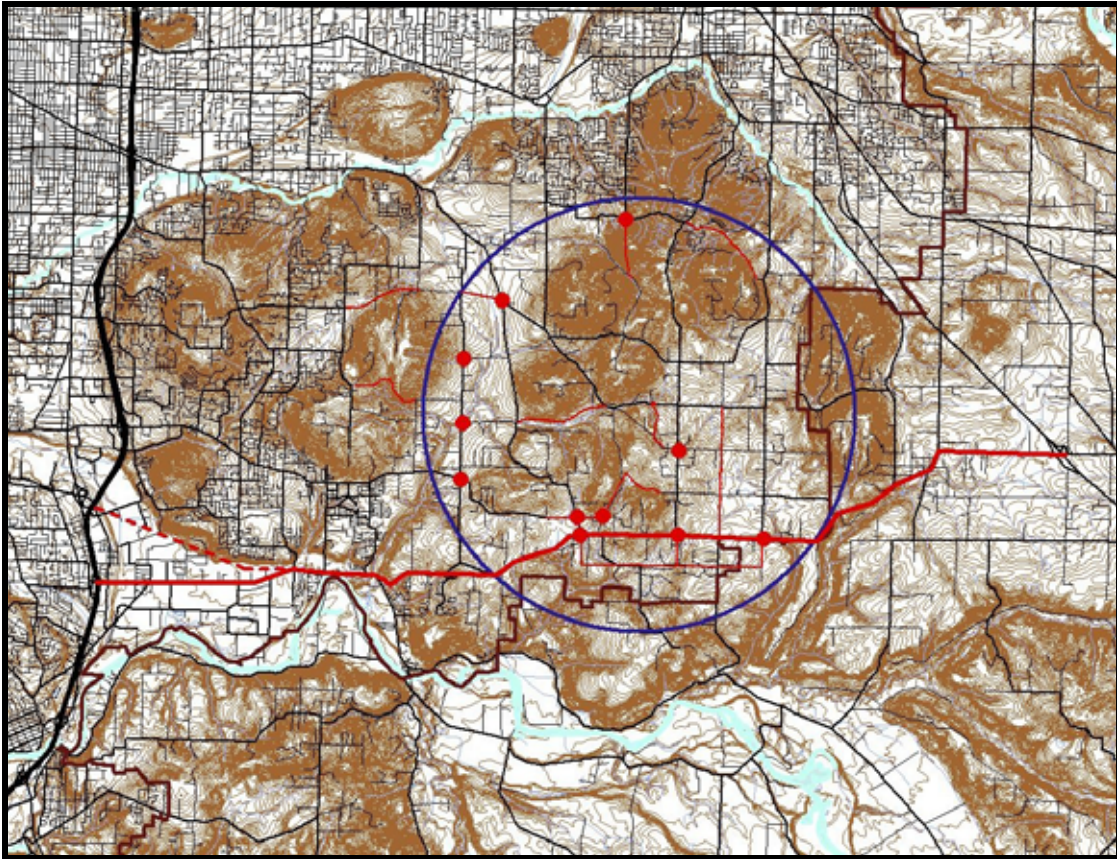
Roadway Type	Total Capacity for one hour per lane	Design Speed (mph)	No. of lanes
Highway	2000	55	4
Parkway	900	45	4
Arterial	900	45	4
Collector	900	35	2
Main Street	1000	25	2

The parkway was assumed to fall within the corridor of the existing 212 with both grade separation and/or roundabouts at intersections (See Figure 7) **from I-205 to Hwy 26**. The parkway also has a support network of local streets that includes an extension of Sunnyside Road through Damascus and enhancement to the grid in Sunshine Valley area.

An important assumption that was made as part of the parkway was that there was no delay at locations where access was provided (Rock Creek, 232nd, 242nd) where roundabouts are located. This was a difficult assumption to make due to the regional model link delay assumptions which define three types of link delay only; no delay, low delay and high delay.

There was no identified way to modify the regional model for roundabout capacity because the capacity of the model depends on an iterative identification of entering and rotating volumes. If the roundabouts are to be included in future work additional analysis would need to be conducted. Instead of delay at the intersections, the capacity was assumed to be conservatively low at 900 vehicles per lane. This is an important assumption that plays out in the performance measures later.

Figure 7 - Scenario 4 with Parkway and additional supporting street network



Local transportation infrastructure assumptions were as follows for all the scenarios with enhanced local transportation infrastructure (Scenarios 3-5):

- An extension of 232nd Avenue north of Hwy 212 as the location for main street.
- Sunnyside Road was extended through to Tillstrom Road to 242nd as an arterial.
- Other collector street connections were made from Happy Valley to Damascus.

The Highway was defined as it appeared in the 1994 Draft Environmental Impact Study due to the fact that this work was done prior to the Damascus Concept Planning work that is currently underway. See Figure 8 below.

Figure 8 – Scenarios 2&3 Highway Location



As a result of these assumptions, there is a difference in the amount of mileage for each road type in the hierarchy. Table 5 below shows that the miles of collector type roads increases from 16 to 22 and the miles of arterial increase from 25-35 from the No Build and Highway alone to the other scenarios. And there are no highway miles in the parkway scenarios.

Table 5 - Transportation Assumptions

	Scenario	Miles of Highway	Miles of Parkway	Miles of Arterial	Miles of Collector
1	No Build	6	0	25	16
2	Highway Alone	5	0	25	16
3	Highway Plus	5	0	35	22
4	Parkway Plus		6	35	22
5	Parkway-Land Use Plus		6	35	22

Transit

In all 5 scenarios, transit service stays a constant. There are frequent bus service (15 minute service all day everyday) routes serving the area along Powell/Foster, 181st and 242nd. No high capacity transit service such as bus rapid transit, streetcar or light rail was assumed in these scenarios.

Output

The purpose of this research project was to use scenario modeling as means to test a wider variety of solutions and performance measures prior to entering an EIS corridor level process for a major roadway facility. **The scenario modeling will analyze how a 45 mph parkway and supporting street networks work to support each other in urban or urbanizing areas.**

The purpose of this research was to look at the lower speed facility as it functions within a network. However a major corridor level analysis was included for comparison purposes to see how conclusions would vary if the analysis was limited to the corridor level only. The following analysis is summarized below.

- Internal Damascus Vehicle Miles Traveled
- Trips to, from and internal to Damascus
- Area-wide accessibility measure - PM 2-Hour Peak Direction Traffic
- Major Corridor Summary
- Environmental

Internal Damascus Vehicle Miles Traveled

Important to all these scenarios are whether they meet regional and state goals to reduce Vehicle Miles Traveled within the area. Of the scenarios where only transportation assumptions changed, the Highway scenarios increased VMT the most over the No Build. When the households and employment numbers were increased for Scenario 5 VMT increased dramatically inside the UGB over the No Build.

Table 5 - Internal VMT

	Scenario	Internal Damascus VMT	Percentage Increase from No Build
1	No Build	108,080	
2	Highway	137,278	27%
3	Highway Plus	144,024	33%
4	Parkway Plus	123,237	14%
5	Parkway-Land Use Plus	148,791	38%

Trip Making patterns

Table 6 shows the trip-making patterns for Damascus in terms of trips from the Region to Damascus (going home from work), from Damascus to the Region (leaving work in Damascus), and Internal to Damascus. This is one measure that can be used to analyze how accessible this area will be to the region.

Internal Trips

Internal trips are the lowest in Scenarios 2-4. While there is a significant increase in internal trips in Scenario 5 which relates back to the higher number of households and employment in the area. The No Build Scenario shows about 33% greater internal trips than Scenarios 2-5. Without the highway or parkway, employment and shopping closer to home are more attractive.

From the Region to Damascus

Generally, these trips are going home from work somewhere in the Region to Damascus where they live. Accessibility of those regional trips can be compared against each other. In terms of demand between origins and the destination of Damascus, there appears to be the same level of demand in all scenarios except number 5. Scenario 5 increases household and employment density in Damascus and therefore has a higher demand to return home from the region.

From Damascus to the Region

The No Build has less regional accessibility for people working in Damascus and returning home to the Region. The Highway, Parkway Plus and Parkway-Land Use Plus scenarios all have similar increases in employment accessibility. An explanation for this is the increase in accessibility from Damascus to the Region is due to the enhanced network. And the same amount of accessibility is basically provided by the Highway and the Parkway. Interestingly, the Highway with the enhanced network does not attract a higher level of trips.

Table 6 – PM 2-Hour Peak Trips

	Scenario	From Region to Damascus	From Damascus to Region	Internal Damascus	From Region to Boring	From Boring to Region
1	No Build	17,803	6,232	3,086	12,775	7,463
2	Highway	18,052	10,068	2,080	12,874	10,229
3	Highway Plus	18,110	6,424	2,026	12,860	7,490
4	Parkway Plus	17,957	9,957	2,135	12,833	10,240
5	Parkway-Land Use Plus	30,198	9,732	7,232	11,923	6,978

From the Region to Boring (Going home from the Region)

All scenarios perform about the same on regional access to jobs in Boring and Sandy. The Transportation Analysis Zone for this part the region outside the Urban Growth Boundary but has a

significant amount of growth in the base land use assumptions. As a result, the only time the attraction is reduced is when a significant amount of the growth of households allocated to that TAZ was brought back into the UGB in the Damascus area in Scenario 5.

From Boring to the Region (Going home from Sandy/Boring)

There is a difference of 3,000 trips between the No Build and Highway Plus and Parkway –Land Use Plus and the other two scenarios. This seems to indicate that the Highway and Parkway Plus offer the most and similar levels of accessibility from the Boring/Sandy TAZ to the region. And again the reason that the Parkway-Land Use Plus (Scenario 5) is reduced even further is that there are less employment options due to moving the allocation back into Damascus.

Area-wide Accessibility Measure

The purpose of this performance measure was to see if the system could accommodate the demand for travel, rather than one corridor attempting to handle all trip type; local, regional and inter-regional.

Eastbound demand

Table 7 summarizes cut line data for eastbound traffic entering Damascus in the peak pm 2-hour time period from the region. The cut line was established on the west side of Damascus to measure trips coming home to Damascus from the region. Some observations for the 30-year planning horizon of this land use and traffic model:

- While all scenarios show a combined V/C ration between 0.8-1.0, the Highway Plus scenario has the lowest and the Parkway-Land Use Plus has the highest (with significantly more households and employment in Damascus).
- Scenarios 2, 3 and 5 have an equally high demand of about 14,000 trips for entering or traveling through Damascus in the peak pm 2-hour. The Parkway Plus (Scenario 4) has the minimum increase over the No-Build in total trips, about 3,000 trips less than the others.
- The average travel speed entering Damascus in the pm peak increases with each scenario over the peak. The highest increase in average travel speed entering Damascus is the Highway Plus with a 36% increase over the No Build. And the smallest increase is the Parkway -Land Use Plus of 10%.
- When the speeds are weighted by volume of road, the average weighted speed is substantially different due the smaller assumed capacity of the Parkways in Scenarios 4&5. In fact, the Parkway-Land Use Plus scenarios has a negative change in average weighted speeds over the no-build scenario.

**Table 7 – PM 2-Hour Peak Traffic
Entering Damascus in Peak Direction (EB) at North-South Cut Line**

	Scenario	Total 2-Hour Volume	2-Hour Capacity	N-S Cut line V/C	Average Travel Speed	Avg. Travel Speed increase over base	Average Weighted Speed (by volume)	Average Weighted Speed increase over base
1	No Build	9,092	8,000	1.1	24.5		30.1	
2	Highway	14,719	16,000	0.9	28.2	15%	35.3	17%
3	Highway Plus	14,193	18,200	0.8	33.2	36%	39.6	32%
4	Parkway Plus	11,962	12,000	1.0	28.7	18%	32.1	7%
5	Parkway-Land Use Plus	14,182	12,000	1.2	27.0	10%	29.3	-3%

Southbound Demand

During the pm peak 2-hour period, there is little variation of demand with the scenarios due to the focus of adding capacity in the east-west direction. Here the base, No Build (Scenario 1), has 200 vehicles less capacity than the other 4 scenarios. Between the scenarios, all are over capacity with the Parkway Plus providing no relief over the No Build. This could be in part that southbound trips are actually going to the higher speed facilities such as I-205 or Hwy 26 and then using the new major east-west facility instead of using internal Damascus arterials and collectors.

The average travel speed fluctuates between 4-5% increase in Scenarios 2 and 5 respectively over the No Build Scenario. And there is a decrease in overall average travel speed for Scenarios 2&3 from the No Build.

**Table 8 – PM 2-Hour Peak Traffic
Entering Damascus in Peak Direction (SB) at the county line**

	Scenario	2-Hour Total Volume	2-Hour Capacity	E-W Cutline V/C	Average Travel Speed	Avg. Travel Speed increase over base	Average Weighted Speed (by volume)	Average Weighted Speed increase over base
1	No Build	3563	2200	1.6	36.6		12.1	
2	Highway	3281	2400	1.4	37.9	4%	14.3	19%
3	Highway Plus	2741	2400	1.1	29.0	-20%	14.8	23%
4	Parkway Plus	3969	2400	1.6	28.4	-22%	14.7	22%
5	Parkway-Land Use Plus	3037	2400	1.3	34.8	5%	14.5	20%

Major East-West Corridor Comparison

The purpose of Table 9 is to look at the major east-west corridor and compare it to the area-wide performance measures. The following observations can be made based on this table alone:

Total Demand

- The Parkway-Land Use Plus scenario has the highest total volume demand. While the No-Build has the smallest demand.
- Scenarios 2, 3 and 4 area all experience similar vehicle demands.

Level of Service

Level of Service in the corridor gives us a much different viewpoint than the area-wide performance measures. In this case, the parkway scenarios do not provide a generally acceptable LOS in the pm peak 2-hour period due to their LOS > 1.0. In addition, there is a significant amount of local traffic relying on the parkway in the Parkway-Land Use Plus scenario. This local/regional split is more evenly split on the Parkway in Scenario 4.

The Highway options have lower LOS and higher average speeds than both the Parkways and No Build Scenarios. The Highway Plus scenario (Scenario 3) experiences the same demand as both the Parkway scenarios, with its higher capacity it serves the corridor at lower Level of Service (V/C ratio).

Through/Regional/Local trip-making

A goal of a major facility working well with its local street network would be that it carries a higher percentage of through trips. This means the local network carries the significant portion of the local trips and regional trips.

In this analysis, any trip with an origin and destination outside of Damascus was considered a through trip and a local trip had either an origin or destination in Damascus. Regional trips have one trip end in the region and one trip end in Damascus.

- All Scenarios have little dependence on the major facility for local trip-making.
- All scenarios have approximately double the demand for travel in the corridor over the No Build and the Parkway Plus has significantly more due to the increased land use assumptions.
- The No-Build and Parkway Plus and Parkway-Land Use Scenarios tend toward an even split of through and regional traffic. However, the Parkway Plus and Parkway-Land Use have almost double the demand in volume.
- The Highway Scenario alone carries the most regional traffic.
- The increased households and employment assumed in Scenario 5 show that the parkway becomes a major route for access into Damascus.

Table 9 - Major Facility Corridor Analysis: PM 2 Hour, EB Peak Direction Only

	Scenario	2-Hour Volume entering	2-Hour capacity	Avg. V/C in peak direction	Avg. Travel Speed (mph)	Through Traffic %	Regional Traffic %	Local traffic %
1	No Build	3,397	1800	1.88	31.4	41%	58%	2%
2	Highway	6,876	8000	0.86	38.4	21%	76%	3%
3	Highway Plus	6,308	8000	0.79	42.6	92%	8%	0%
4	Parkway Plus	6,160	3600	1.71	33.8	53%	45%	1%
5	Parkway-Land Use Plus	7,551	3600	2.10	29.6	28%	69%	2%

Environmental

There were two parts of the environmental performance measures; land consumed and number of stream crossings.

Land Use

As we have seen in the assumptions section of this document, the analysis had to assume land use. It was not an iterative process within 5 year increments to show how increased access promoted increased development overtime. As a result, the Parkway-Land Use Plus (Scenario 5) increased the household density per gross acre within the existing UGB by about 66% and employees per gross acre by 100%. As a result, the amount of land consumed in households and employment was 166% less than in other scenarios. Due to the fact that the Travel Analysis Zones (TAZ) outside the UGB are very large it was difficult to determine exact acres of land consumed in Scenarios 1-4.

Number of Stream Crossings

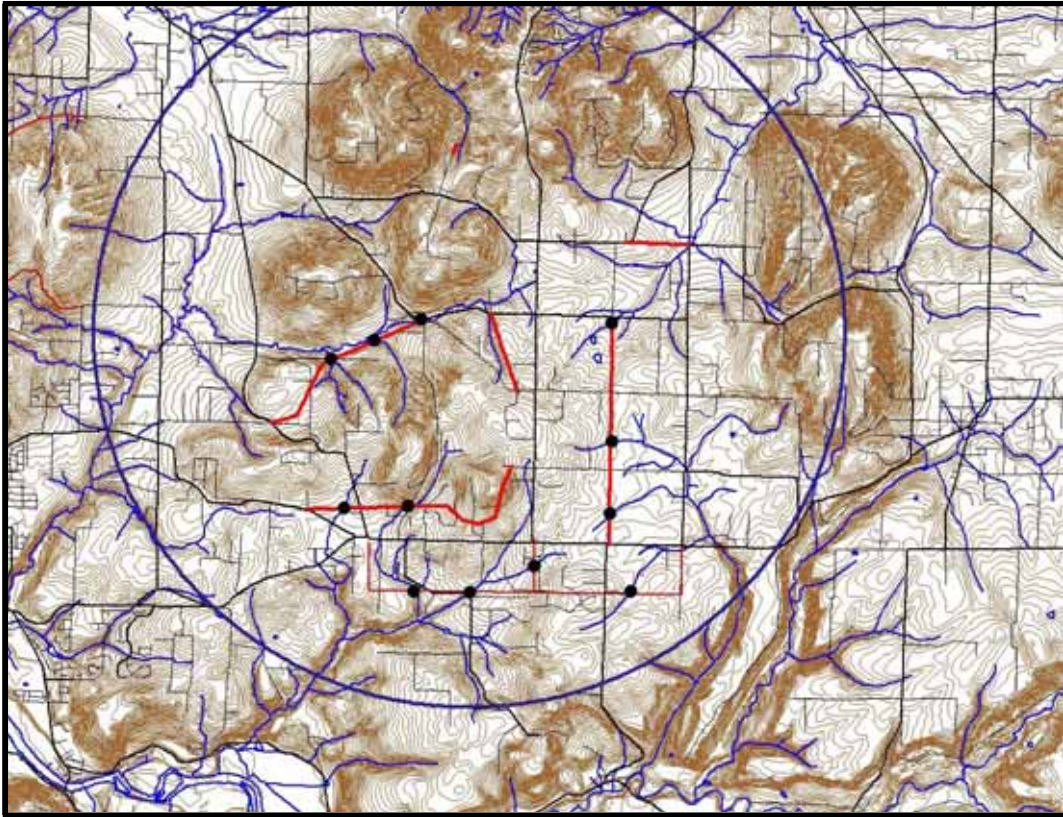
Table 10 below summarizes the number of new stream crossings. Due to the fact that the parkway was assumed to follow the existing Hwy 212 corridor, the only new stream crossings were a direct result of the additional local street network for arterials and collectors which significantly enhanced local street connectivity (See Figure 8). If the parkway were a in a brand new corridor there would be the potential for more stream crossings.

Table 10 - Performance Measures – Stream Crossings

	Scenario	No. of new stream crossings
1	No Build	0
2	Highway	8
3	Highway Plus	20
4	Parkway Plus	12
5	Parkway-Land Use Plus	12

The Highway scenarios assumed the 1991 DEIS corridor and therefore increased the number of stream crossings by 8.

Figure 8 – Stream Crossings from Enhanced Local Street Network



Summary of Findings

The purpose of this project was to use scenario modeling to analyze how a 45 mph parkway and supporting street networks work to support each other in urban or urbanizing areas and provide area-wide performance measures to compare outcomes.

Corridor vs. Area-wide Performance Measures

Generally, the area-wide performance measures showed that the total network was working in the E-W direction with a highway or a parkway. However, due to the increased capacity of the highway, the highway scenarios performed slightly better in the 30 year forecast than the parkway scenarios.

While all the networks performed about the same in the N-S direction, the demand exceeded the capacity. While much attention has been paid to the E-W direction with a major facility, there is a very important issue of how to meet the demand for travel between Gresham and Damascus. A corridor level analysis would not have uncovered this issue. This may have an impact on the corridor by causing out of direction where the capacity is located – the major N-S corridor in each scenario.

There is a significant change in the number of people leaving work in Damascus as well as Boring/Sandy in the pm 2 hour peak period due to the increase in capacity and decrease in travel time as a result of the overall additional capacity in scenarios 2-5. This could indicate two things: 1) that all the alternative scenarios provide the same economic incentive for people to access jobs in Damascus and 2) there is still an issue with both highway or parkway scenarios creating increased access to Boring/Sandy (cities outside the Urban Growth Boundary). A corridor level of analysis generally doesn't account for this change in attractiveness of the area outside the corridor.

Capacity Assumptions for Parkway

Due to the fact that this type of facility was undefined by both the Metro street guidelines and modeling staff at the time this modeling work was completed, the capacity was assumed to be similar to Kruse Way (a 4-lane with median and wide ROW, signalized roadway in the Metro area) with 900 vphpl. The facility was by default the size of an arterial in the network.

The reason that the capacity was kept low for this analysis was that it was assumed that there would be a mixture of grade separated and at-grade intersections on the parkway. To decrease delay, roundabouts were attempted at the at-grade intersections. The Metro model does not have the ability to handle roundabouts so no delay was assumed at the intersections. As a result, the overall capacity was reduced for the segments between the intersections. In the future, Metro should look into creating a methodology to include roundabouts in future work as an analysis tool not only for Damascus but also the region. There about 10 roundabouts in the region on the major road network now.

Due to recent efforts by Metro staff in the Damascus Concept Planning, this assumption was doubled to 1800 vphpl. The resulting travel demand will need to be analyzed but as shown in this analysis, the highway plus scenario had about the same vehicle demand for the facility as the parkway and the increased parkway capacity assumptions would probably improve the LOS.

There also needs to be a more iterative process (this analysis was static) to determine the capacity needs of the parkway versus the total system within Damascus and Happy Valley. While it is costly to reiterate the model, it is imperative so that none of the roadways are oversized.

Next Steps

As part of the next steps for further research, there are some unanswered questions from this research.

- How and when to incorporate Area-wide Performance Measures– Area-wide performance measures helped uncover how the system works. Yet, where in the process of determining the type and size of a specific facility in a corridor should these types of measures be used. The Alternative Analysis would be a place to start but the size of an interchange may be dependent on the availability of corridor facility which would come out in the DEIS process.
- Parkway capacity dependence on intersection type- The research for this project uncovered a lack of research on the intersection types and spacing for a 45 mph limited access facility. There would need to be a summary of facilities across the country that were built or proposed.
- How to build a facility that is designed at 45 mph and posted at 40-45 mph– There would need to be additional information on the design elements used to maintain mobility at 45 mph and minimize delay in the corridor.

Appendix

**Regional Planning, Engineering and Landscape Architecture Committee
June 2004 Meeting**

Dr. Robert Bertini, PSU
Dr. Jennifer Dill, PSU
Ethan Seltzer, PSU
John Fregonese, Fregonese Calthorpe Associates
Paddy Tillet, ZGF Architects
Andy Cotugno, Metro
Jean Alleman, Metro
Bob Cortright, DLCD

Capacity Analysis

N-S Cutline						EB Capacity - 1 Hour				
EB Peak Volumes	EB Average Speeds					No Build	Highway	Highway+	Parkway+	P/Land Use
	No Build	Highway	Highway+	Parkway+	P/Land Use					
Highway		6876	6308				4000	4000		
224 Roadway	3397	2838	3901	6160	7551	900	900	900	1800	1800
Sunnyside	3650	3026	1875	2920	3312	1200	1200	1200	1200	1200
Vogel	410	372	1405	1573	2014	600	600	1200	1200	1200
Troge	523	532	644	683	620	600	600	900	900	900
Hemrick	1112	1075	60	626	685	700	700	900	900	900
	9092	14719	14193	11962	14182	4000	8000	9100	6000	6000

E-W Cutline						SB Capacity				
SB Peak Volumes	SB Average Speeds					No Build	Highway	Highway+	Parkway+	P/Land Use
	No Build	Highway	Highway+	Parkway+	P/Land Use					
172nd	4244	4148	3809	3014	3534	1800	1800	1200	1200	1200
Foster	2239	2112	2188	2292	2259	900	900	1200	1200	1200
181st	2056	1975	1527	1516	1869	900	900	900	900	900
222nd	2563	2440	2286	2056	3953	900	900	1200	1200	1200
242nd	3562	3281	3277	3797	2313	1100	1100	1200	1200	1200
	14664	13956	13087	12675	13928	5600	5600	5700	5700	5700

Speed Analysis

N-S Cutline EB Peak Volumes	EB Average Speeds					EB Weighted Average Speeds				
	No Build	Highway	Highway+	Parkway+	P/Land Use	No Build	Highway	Highway+	Parkway+	P/Land Use
		38.4	42.6				264038.4	268720.8		
Highway 224	31.4	36.3	43.8	33.8	29.6	106665.8	103019.4	170863.8	208208	223509.6
Roadway	36.1	38.7	35	35	34.7	131765	117106.2	65625	102200	114926.4
Sunnyside	20.9	21.3	28	26.3	22.3	8569	7923.6	39340	41369.9	44912.2
Vogel	18.4	18.3	25.6	24.9	26	9623.2	9735.6	16486.4	17006.7	16120
Troge	15.7	15.9	23.9	23.7	22.6	17458.4	17092.5	1434	14836.2	15481
Hemrick	24.5	28.15	33.15	28.74	27.04	30.1	35.3	39.6	32.1	29.3

E-W Cutline SB Peak Volumes	SB Average Speeds					SB Weighted Average Speeds				
	No Build	Highway	Highway+	Parkway+	P/Land Use	No Build	Highway	Highway+	Parkway+	P/Land Use
	14.7	14.7	13.9	14	14	62386.8	60975.6	52945.1	42196	49476
172nd	14	14.1	17	16.5	16.6	31346	29779.2	37196	37818	37499.4
Foster	17.5	17.6	18.6	18.7	17.8	35980	34760	28402.2	28349.2	33268.2
181st	11.6	11.8	12.8	12.7	11.2	29730.8	28792	29260.8	26111.2	44273.6
222nd	5	14	14.1	13.8	16.3	17810	45934	46205.7	52398.6	37701.9
242nd	9.62	9.58333	10.41667	12.34	12.38	12.1	14.3	14.8	14.7	14.5

Select Link Analysis

Existing 224 Alignment	No Build		Highway		Highway Plus		Parkway		Parkway-Land Use	
Internal	63	2%	75	3%	0	0%	82	1%	175	2%
To	1907	56%	2096	74%	494	8%	2734	44%	5162	68%
From	51	2%	67	2%	18	0%	85	1%	67	1%
Through	1377	41%	600	21%	5797	92%	3258	53%	2147	28%
	3398		2838		6309		6159		7551	
Highway										
Internal			0	0%	84	2%				
To			693	10%	2528	65%				
From			0	0%	107	3%				
Through			6183	90%	1182	30%				
			6876		3901					
Sunnyside										
Internal	65	2%	63	2%	0	0%	67	3%	216	7%
To	1796	49%	1706	56%	779	55%	1291	56%	2345	71%
From	95	3%	95	3%	0	0%	63	3%	72	2%
Through	1694	46%	1161	38%	626	45%	880	38%	680	21%
	3650		3025		1405		2301		3313	
Vogel										
Internal	0	0%	0	0%	65	3%	0	0%	0	0%
To	328	67%	281	76%	1305	70%	787	50%	1464	73%
From	82	17%	0	0%	68	4%	0	0%	0	0%
Through	82	17%	90	24%	437	23%	786	50%	550	27%
	492		371		1875		1573		2014	
Total										
	7540		13110		13490		10033		12878	
Internal	128	2%	138	1%	149	1%	149	1%	391	3%
To	2175	29%	2747	21%	4630	34%	2163	22%	3876	30%
From	228	3%	162	1%	193	1%	148	1%	139	1%
Through	3153	42%	8034	61%	8042	60%	4924	49%	3377	26%