



NORTH I-25 EXPRESS LANES EXTENSION CONCEPT

Doing More With Less

Parsons Brinckerhoff

12/22/2010

SUMMARY

PB has performed some concept-level analysis of an extension of the I-25 Express Lanes, and believes it has a viable concept to cost effectively extend priced managed lanes north to 120th Avenue. This white paper provides a state of the practice in managed lanes and outlines PB's preliminary concept; reviewing the project footprint, solutions to integrating the project with existing I-25 lanes and interchanges, project costs, and potential revenues from collecting tolls on the facility. While the plan requires further study, we feel that implementing new managed lanes in this segment will reduce overall congestion in the corridor, improve travel time reliability, and reduce the number of crashes on North I-25.

Features:

- Extend existing I-25 Express Lanes from its current terminus at U.S. 36 to 120th Avenue
- Add one managed lane in each direction (bi-directional facility) keeping the number of general purpose lanes constant
- Leveraging the state of the practice in managed lanes development (Minnesota, Washington), the I-25 Express Lanes Extension would utilize the existing inside shoulder to minimize capital costs
- Pricing options include provisions for HOV-2+ free (current policy), HOV-3+ free (expanding management capabilities of new lanes), all-toll (only buses are provided free access) or peak-period-only use (reverting to shoulder in off-peak periods)
- Capital Cost estimate: \$ 25 Million
- Revenue estimate:
 - Annual Gross: \$2.8m in 2015, growing to \$4.9m in 2035
 - Annual Net: \$1.5m in 2015, growing to \$3.2m in 2035

OVERVIEW

In 2006, the existing I-25 Express Lanes opened to toll-paying customers, providing a congestion-free alternative between downtown Denver and U.S. 36. In the four-and-a-half years since opening, the I-25 Express Lanes have maintained free-flow travel speeds for all customers while generating more than enough revenue to cover the initial cost of conversion and operating and maintenance costs. The Colorado Department of Transportation (CDOT) and the Colorado High Performance Transportation Enterprise (HPTE) have continued to develop new priced managed lanes in the Denver-area, most notably on U.S. 36. However, there is substantial need for similar development in the I-25 corridor north of U.S. 36. The 2009 DRCOG Traffic Bottlenecks Report provides substantial information concerning the segment of North I-25 between U.S. 36 and 120th Avenue. Currently, during the typical peak hour, traffic is flowing at less than half the posted speed (24 mph as compared to 55 mph). Partial contributors to congestion in this segment include the access treatment for the existing I-25 Express Lanes. Additionally, the report indicated that constructing managed lanes in each direction of I-25 in this segment (at least to Thornton Parkway) would mitigate a considerable portion of congestion, and,

yield a possible high reduction in crashes. Furthermore, the North Metro Corridor Draft Environmental Impact Statement indicates that congestion on North I-25 will become severe, with vehicle hours of delay increasing by 67% in 20 years between I-70 and 168th Avenue.

In the short time since the opening of the I-25 Express Lanes, the state of the practice in priced managed lanes has evolved significantly, with new priced managed lanes having been opened in Seattle, Salt Lake City, San Jose, Houston, Miami, and Minneapolis. Although select facilities are continuing to be advanced as a result of concerted planning efforts, many communities are implementing managed lanes in the context of opportunity-based development – implementing managed lanes as opportunities arise. For example, Minnesota is leveraging opportunities for bridge replacement, pavement restoration, and other maintenance to cooperatively develop new priced managed lanes. This allows them to bring new managed lane capacity online at a reduced cost.

Since 2006 and in all cases, the facilities are either buffer separated or continual access, not barrier-separated or reversible, like I-25. Furthermore, some cities (Minneapolis and Seattle) have utilized emerging technologies in Active Traffic Management (ATM) to allow for the safe operation of priced managed lanes in highly constrained corridors. In order to reduce the overall footprint of the new capacity, Minnesota Department of Transportation has developed its managed lanes on I-35W with the use of shoulders. On the northern end of the corridor (approximately 3 miles in length), the right side is permanently used for general purpose traffic; the left side operates as a dynamic shoulder lane (managed lane operations in peak period and shoulder/refuge use in off-peak periods), as shown in Figure 1 and in Figure 2 (left photo). For the rest of the corridor (approximately 12 miles in length), the inside shoulder is used for 24/7 operation of priced managed lanes, while the outside shoulder is maintained in most conditions (Figure 2, right photo). Finally, it should be noted that many communities (Salt Lake City, Minneapolis, Seattle) are incorporating continual access design in priced managed lanes in order to minimize negative impacts of weaving to/from access zones and to optimize potential utilization of the lanes.



Figure 1: Typical Cross Section of I-35W Priced Dynamic Shoulder Lane (Mn/DOT, 2008).



Figure 2: I-35W Priced Dynamic Shoulder Lane (left) and High Occupancy Toll lanes (right).

CONCEPT FOR NORTH I-25

Existing Conditions

I-25 currently consists of three through lanes and various acceleration/deceleration lanes within the area between U.S. 36 / SH-270 and 120th Avenue. Typically, the acceleration / deceleration lanes are associated with interchanges, although at some locations, they are continuous between ramps. Lane widths within this study area are 12 feet wide. The inside median width generally ranges from 28 feet to 30 feet. Providing for a 2-foot concrete barrier, the minimum width for the inside shoulder is 13 feet. The outside shoulder widths vary from 10 feet to 12 feet with a majority of the length being 12 feet.

Proposed Managed Lane Configuration

Leveraging the state of the practice in managed lanes, as described above, this concept for North I-25 would add one new lane of managed capacity to the inside of I-25, in both directions, from U.S. 36 to 120th Avenue. The managed lanes would utilize the width of the existing inside shoulder with minimal impacts to the existing pavement, bridge structures, or the environment.

The complicating factor for the creation of the managed lanes is minimizing conflicts associated with the left-exit from southbound I-25 to eastbound SH-270. Currently, all Express Lane traffic enters on the left side of southbound I-25, after the SH-270 entrance ramp, as shown in Figure 3. If managed lanes were constructed on I-25 north of the existing entrance, then managed lane traffic would be in conflict with the SH-270 entering traffic.

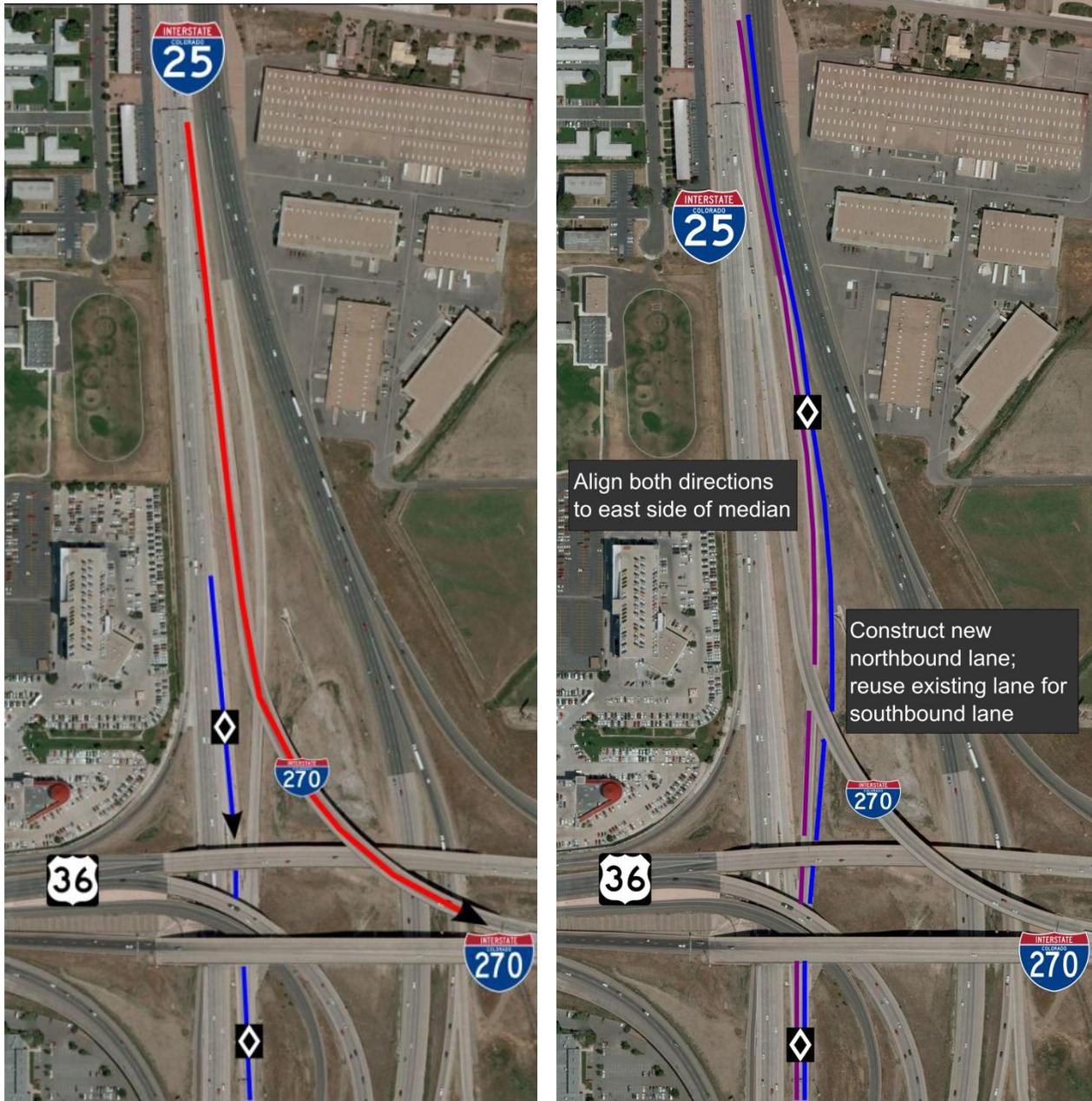


Figure 3: Southbound I-25 Current Configuration (left) and possible New Configuration (right)

In order to resolve this conflict, the southbound managed lane traffic must be routed to the east side of the SH-270 entrance ramp, which can be done within the existing footprint (Figure 3). A new northbound managed lane would be constructed within the I-25 / U.S. 36 / SH-270 interchange immediately to the east of and replacing the existing northbound Express Lane ramp. Additionally, the existing northbound Express Lane would be reconfigured to become the new southbound managed lane. Both northbound and southbound directions would extend from the interchange north, with the southbound ramp realigning with I-25 southbound approximately 1500 feet from the SH-270 entrance ramp gore point.

As a point of interest, this new construction would occur within the limits of the existing I-25 Managed Lane facility. As pursuant to the existing Intergovernmental Agreement (IGA) between CDOT and RTD for the governance of the I-25 Express Lanes, excess revenue above operations and maintenance may be used for reconstruction purposes within the existing facility footprint. The construction identified here would sit within that footprint, which would allow CDOT to use excess funds from the existing I-25 Express Lanes for this project.

Whereas the bulk of construction occurs within this area, only minimal construction is necessary north of 76th Avenue, and may be coordinated with overlay activities in the segment. This can be accomplished by using the inside shoulder, as is currently done on other managed lane facilities such as Minnesota. The outside shoulder would be maintained. Furthermore, as discussed more fully below, the new managed lanes may be operational 24/7 or could revert to shoulder / refuge status outside of peak periods. As is the case for other managed lanes in the U.S., shoulder-converted managed lanes may be designed as a mix of restricted and continual access. A typical cross-section for this segment is shown in Figure 4 below.

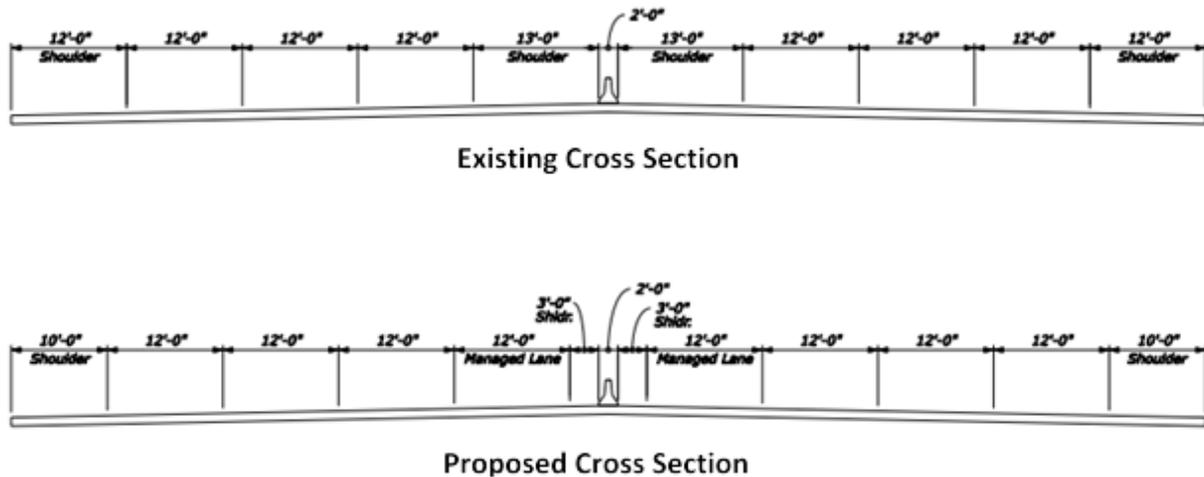


Figure 4: Typical Cross Section for North I-25 Express Lanes Extension

In terms of supportive infrastructure, minimal adjustments would be required to make adequate the existing drainage features within the corridor. The existing inlets in the median would require reconfiguring and may need to be lengthened to maintain the current capture rates. Most sign structures and gantries could remain in place without modification.

Finally, PB has identified two potential treatments for the park-and-ride just south of 88th Avenue (Figure 5). Currently, RTD buses travel in general purpose lanes and exit on right-side ramps, providing online access to bus trips (pedestrians access parking spaces on both sides of I-25 by walking through a pedestrian tunnel underneath I-25). With the North I-25 Express Lanes Extension, two possibilities exist for this park-n-ride:

1. Buses could continue to use the right side ramps to access the park-n-ride, with decision to use or not use the managed lanes determined by RTD operations. There is no additional cost to this option.
2. Dual direction slip ramps could be constructed in the median for buses to access a sub-grade loading platform. All lanes (including managed lanes) would be pushed out in order to accommodate this in-line station. The primary benefit of this treatment would be Bus Rapid Transit (BRT) service, with buses remaining in the managed lane facility to access passengers; however, this option would likely cost approximately \$20 Million to construct.



Figure 5: RTD Thornton Park-n-Ride, South of 88th Avenue Bridge (northbound I-25)

Implementation

As noted, a trend in the development of managed lanes nationally is to conduct the construction in concurrence with pavement preservation and maintenance activities. Initial costs of the implementation of the North I-25 Express Lanes Extension could be reduced by combining the striping efforts with future overlays of the existing pavement. This process would result in a clean and finished look to the new laneage, resulting in less confusion to the driving public while improving driver expectancy. Additionally, a phased implementation plan may reduce the initial investment costs. Initial implementation, prior to overlay, could include the installation of the monitoring system hardware and software, with installation on existing structures with little or no effect to the structures.

Operations

There are some operational considerations for the development of the managed lanes on North I-25.

Various implementers of priced managed lanes are approaching the pricing of users differently. Although priced managed lanes have traditionally permitted all designated HOVs to go free, recent applications have investigated charging lower 2-occupant vehicles, or potentially charge all HOVs a reduced toll. All operational projects allow either 2+ or 3+ HOVs free use, whereas projects in development trend towards only allowing HOV-3+ or none at all with free use, as shown in

Table 1. The decision to toll or not toll HOV-2's or HOV-3+ is not critical to the development of the infrastructure, although it will affect the total revenue collected from the system.

Table 1: Carpool Preference on Priced Managed Lanes, 2010.

Carpool Preference Combinations		HOV 3+				
		Free 24/7	Free Peak Only	Free Off-Peak Only	Discount Peak Only, Pay All Other Times	Pay 24/7
HOV 2	Free 24/7	I-15 (CA), I-110 (CA) *, I-680 (CA), I-25 (CO), I-394 (MN), I-35W (MN), I-15 (UT), SR 167 (WA)				
	Free Peak Periods Only		I-10 (TX)			
	Free Off-Peak Periods Only	I-10 (CA) *, US 290 (TX)				
	Discount Peak Only, Pay All Other Times				I-30 (TX) *, I-635 (TX) *	
	Pay 24/7	SR-91 (CA), I-95 (FL), I-595 (FL) *, I-495 (VA) *, I-95 (VA) *, I-395 (VA) *				TBX (FL), Loop 1 (TX) *

* = Pending managed lane facility as of December 2010.

For the North I-25 Express Lanes Extension, as with the proposed U.S. 36 managed lanes extension, the policy of HOV payment and transponder-carry status are not easily separable, and should be considered in the context of providing the greatest return on investment. The combination of managed lanes traffic from both North I-25 and U.S. 36 extensions could overwhelm the existing mechanism for traffic separation on the existing I-25 Express Lanes (Figure 6). On the existing facility, the toll zone separates toll (paying) from HOV (non-paying) vehicles. Although this works with the current volumes, the volume of traffic anticipated from the two extensions would likely overwhelm the individual capacities of the separated lanes. As a result, the current process for traffic to self-declare occupancy status must change. Leading candidates include:



Figure 6: Toll / HOV Lane Separation on I-25 Express Lanes

- Converting to a “switchable” transponder, where customers declare their occupancy status on the transponder itself (as is currently studied and planned for Los Angeles / San Francisco areas, which use the same transponder technology as Colorado).
- Requiring carpools carry a transponder, pre-registered with the back office as a carpool account (as is done in Miami and planned in Atlanta)
- Eliminating license plate recognition systems for both pay-by-mail and violation enforcement systems, and allowing all traffic to use both lanes. Carpool customers would need to remove their transponders (if they have them) from the windshield and place in a static-free bag (as is done in San Diego and Minneapolis).

Enforcement areas would best be located within interchanges, where CDOT already owns right of way and the ability to accommodate offset enforcement staging can be met within the existing footprint. These locations may include the interchanges for 84th Avenue, 92nd Avenue (Thornton Parkway), and 104th Avenue.

There are multiple options for the operation of the shoulder. One option is to maintain shoulder / refuge status for the shoulder in off-peak periods and open the shoulder to traffic only in peak periods. Another option would be to operate the managed lane throughout the day, as is done on I-35W in Minneapolis. For all options, the outside shoulder would be reduced to an 8 to 10 foot shoulder. If emergency / refuge pull outs of 12 feet width are desired, these can be located at intervals where room allows within the corridor (Figure 7).



Figure 7: Emergency Pull Out Example (I-35W Managed Lane Corridor)

COST AND REVENUE ESTIMATES

Cost Estimates

A scoping level estimate of the probable construction costs was developed for the implementation of the North I-25 Express Lanes Extension. As it initially appears, this project is essentially a “re-striping” effort. However, for the project to tie into the existing HOV/HOT lanes through the US 36 interchange and the addition of the tolling system, additional infrastructure expenses are added to the project. Using 2010 CDOT cost data and quantities associated with this layout, the probable cost for the construction of this project is approximately \$25 million. This estimate includes contingency items, construction engineering, materials testing, tolling equipment, and design engineering fees. No right-of-way takes are anticipated; therefore, no right-of-way costs were included.

It should be noted that capital cost estimates could vary depending upon access policy. For example, if a mandatory transponder policy was enacted (with all non-equipped vehicles subjected to pay-by-mail or violation enforcement by license plate recognition systems), then the additional costs for widening the pavement for enforcement zones may be mitigated. Conversely, if exempted vehicles (such as HOV’s) are permitted to use the lanes without any declaration or transponder, manual enforcement will become more important, and thus require identified locations for pavement widening for enforcement zones (likely in interchanges, so as to minimize cost).

Revenue Estimates

With limited revenues for capital projects in Colorado, projects such as the North I-25 Express Lanes Extension must, at least in part, support themselves. Using DRCOG forecast traffic on I-25 and operating metrics from the existing I-25 Express Lanes annual reports, a sketch-level cash flow analysis suggested that revenues may be sufficient to pay for some of the capital and operating costs associated with the new managed lanes.

The sketch level revenue analysis assumed two tolling points, one at 84th Avenue and one at 104th Avenue. Tolls would be collected in each direction in amounts comparable to those collected on the existing I-25 Express Lanes.

Average Daily Traffic (ADT) at 84th avenue is expected to grow from about 190,000 vehicles in 2015 to 260,000 in 2035. Similarly, ADT at 104th Avenue is projected to grow from 160,000

	Gross Revenue	Operating Expenses	Net Revenue	DSC @ 1.5 X	DCF @ 6%
2015	\$ 2.79	\$ 1.29	\$ 1.50	\$ 1.00	\$ 0.75
2016	\$ 2.87	\$ 1.31	\$ 1.56	\$ 1.04	\$ 0.73
2017	\$ 2.96	\$ 1.33	\$ 1.63	\$ 1.09	\$ 0.72
2018	\$ 3.05	\$ 1.35	\$ 1.70	\$ 1.13	\$ 0.71
2019	\$ 3.14	\$ 1.37	\$ 1.77	\$ 1.18	\$ 0.70
2020	\$ 3.23	\$ 1.39	\$ 1.84	\$ 1.23	\$ 0.68
2021	\$ 3.33	\$ 1.41	\$ 1.91	\$ 1.28	\$ 0.67
2022	\$ 3.42	\$ 1.43	\$ 1.99	\$ 1.33	\$ 0.66
2023	\$ 3.52	\$ 1.46	\$ 2.07	\$ 1.38	\$ 0.65
2024	\$ 3.62	\$ 1.48	\$ 2.14	\$ 1.43	\$ 0.63
2025	\$ 3.73	\$ 1.50	\$ 2.23	\$ 1.48	\$ 0.62
2026	\$ 3.83	\$ 1.52	\$ 2.31	\$ 1.54	\$ 0.61
2027	\$ 3.94	\$ 1.55	\$ 2.39	\$ 1.60	\$ 0.59
2028	\$ 4.05	\$ 1.57	\$ 2.48	\$ 1.65	\$ 0.58
2029	\$ 4.16	\$ 1.59	\$ 2.57	\$ 1.71	\$ 0.57
2030	\$ 4.28	\$ 1.62	\$ 2.66	\$ 1.77	\$ 0.55
2031	\$ 4.40	\$ 1.64	\$ 2.75	\$ 1.84	\$ 0.54
2032	\$ 4.52	\$ 1.67	\$ 2.85	\$ 1.90	\$ 0.53
2033	\$ 4.64	\$ 1.69	\$ 2.95	\$ 1.97	\$ 0.51
2034	\$ 4.76	\$ 1.72	\$ 3.05	\$ 2.03	\$ 0.50
2035	\$ 4.89	\$ 1.74	\$ 3.15	\$ 2.10	\$ 0.49
	Gross Bond Proceeds				\$ 12.99

DSC - Debt Service Coverage
DCF - Discounted Cash Flows

Figure 8: Conceptual Cash Flow Analysis (\$ Millions)

vehicles in 2015 to 205,000 in 2035. The analysis assumes between 5 and 8 percent of this traffic will use the managed lane (growing towards 8% near the end of the forecast period) and about 30% of managed lane traffic will be toll-paying customers (which implies a maintenance of HOV-2+ free use). With this level of patronage, the managed lanes will accommodate over 7,000 users per day, generating annual gross revenues of approximately \$2.8 million in 2015 and \$4.9 million in 2035.

Operating expenses have been estimated at \$1.2 million per year (in current year terms) based on the history of the existing I-25 Express Lanes. This annual cost has been assumed to grow at 1.5% annually. Subtracting this cost, net revenues for use in pay-as-you-go construction funding or a financial package are estimated at about \$1.5 million in 2015, growing to \$3.2 million in 2035. The figure above illustrates the estimated cash flows from the managed lane extension.

The strength of the revenue projections relative to the modest cost of initial improvements proposed for the facility provides some comfort that this extension could be implemented, providing similar traffic relief and trip time reliability as is provided by the existing I-25 Express Lanes, at a minimal additional cost to HPTE and CDOT. If combined with funding sources that could share the construction cost, long-term financing may not be needed at all. Such a circumstance could create excess revenues for other system improvements or provide HPTE the opportunity to adjust toll revenues to better manage traffic flow on the managed lanes.