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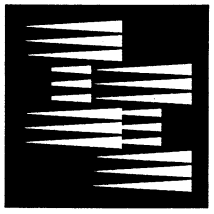
LET THOSE WHO RECEIVE THE BENEFITS PAY THE COSTS:
AN ANALYSIS OF THE COLORADO STATE GOVERNMENT'S FLAWED PLAN FOR I-25

By Stephen R. Mueller, P.E. and Dennis Polhill, P.E.



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INTRODUCTION

I-25 between Broadway Street and Lincoln Avenue is the most congested highway in Colorado. Nearly all of Denver's 2.3 million people are impacted by the traffic on this relatively small 16 mile stretch of freeway. Traveling the highway sometimes takes more than an hour during peak periods. Regular commuters are frustrated, and the "Mile High Salute" is often performed on I-25 with a single finger. Visitors to Denver have flashbacks of their travels on other parking-lot-like freeways in Los Angeles, Atlanta, and New Jersey. Rural residents are afraid to visit simply because of the heavy traffic. Even motorists who try to avoid the freeway are faced with overcrowded arterial streets flooded by like-minded hoards. Everyone who drives in and through Denver knows that something has to be done with I-25.

Exactly what to do with I-25, however, is a political issue of great proportion. This single issue probably decided the campaign for Governor in 1998. Candidate Bill Owens said that more highway lanes must be built. Owens' statement made front-page headlines. It came late in the campaign, when polls indicated an extremely close race. Gail Schoettler, the Democratic candidate, responded that "only light rail" should be built. She wanted people to use mass transit, not automobiles. "No new highways", however, was a message that did not interest the public, and Owens ended up winning by a slim majority. I-25 was the hottest issue of the entire statewide campaign!

The fix, however, had been shaped by governmental regulatory processes for a number of years -- long before it heated up in the public's mind during the 1998 Colorado Governor's race. Coloradoans are pawns in this process. The Western desire for personal freedom is being infringed by federal environmental regulations designed for seaboard urban areas of vastly greater and denser human populations. Current federal legislation has linked automobile travel to air pollution and land use regulation -- despite massive success at cleaning up the internal combustion engine, and making more fuel efficient automobiles. Driving more miles doesn't necessarily mean emitting more pollutants -- but that is exactly the way the environmental laws currently read. One only needs to walk

outside to see the success that the Denver area has achieved in solving its pollution problem. Denver's success was achieved in the midst of a booming population growth, and faster traffic growth.

> ***"The Western desire for personal freedom is being infringed by federal environmental regulations designed for seaboard urban areas of vastly greater and denser human populations."***

This false message, the blanket link equating more driving miles to more air pollution, has been taken up by many so-called environmental organizations that want people to abandon their cars in favor of alternative transportation modes. This is, by definition, a "special interest" position. Most Americans enjoy their personal automobiles, and the mobility they provide, both in earning a living and recreating at locations of their own choice -- locations generally not well served by alternative transportation modes. People in Denver enjoy low-density suburban life and wide-open spaces on the weekends -- both of which are impractical and uneconomical to serve by mass transit. Most Americans, no matter where they live, have no desire to walk away from their car. But the "special interests" are busily continuing their battle to reduce the ability to use privately owned automobiles.

Unfortunately, the special interests have succeeded in manipulating the outcome of the two federally mandated environmental studies related to the I-25 Southeast Corridor project. In 1997, the Major Investment Study (MIS) for the Southeast Corridor recommended that "Light Rail Only" should be built. It went as far as to say that there wasn't room in the corridor for both light rail and additional freeway lanes -- a statement that has since been shown to be completely false. This lie was the result of intense manipulation by the anti-auto special interests. The light-rail-only plan recommended in the MIS was strongly advocated by former Colorado Governor Roy Romer and his entire administration. Bill Vidal, Romer's Executive Director of the Colorado Department of Transportation (and the current Executive Director of the Denver Regional Council of Governments), was taken in by the deceit. At one point, Vidal testified to the Colorado Transportation Commission that the proposed light rail line would replace the capacity of ten to twelve freeway lanes -- a statement directly quoted from the anti-auto lobby, and one that is completely false. When Gail Schoettler espoused the politically correct position, twenty-four years of Democratic administration in Colorado came to an end. Owens campaigned on a promise of more lanes for I-25, and his administration is doing everything possible to fulfill that promise.

But the special interests didn't go away with the election of Governor Owens. They have successfully manipulated the recently released Draft Environmental Impact Statement (DEIS) to include a light rail element in addition to the new highway lanes. The DEIS says that "Additional Lanes and Light Rail" are the best solution for I-25. The research contained in this paper demonstrates that this is incorrect. Even under the watchful eye of the Owens Administration, the special interests have succeeded in convincing several prominent detractors of light rail transit, including Governor Owens himself, that light rail is necessary in order to maintain "conformity" with the EPA approved air quality

plans for the Denver area. Without light rail, so the saying goes, there can be no highway widening. The special interest environmentalists threaten to file lawsuits to stop any highway-only project. In effect light rail becomes an extortion payment to special interests, while the interests of citizens are disregarded.

> ***"...this Issue Paper presents an alternative that will permit future generations the choice to drive their own personal automobiles on I-25 without having to worry about traffic congestion."***

Lawsuit-threat should not be the driving force for transportation policy. Thoughtful environmentalists should more closely and honestly examine all environmental costs and benefits of all possible transportation improvement alternatives. The less-thoughtful ones have concluded that the automobile is the great Satan of society, and will support anything that makes automobile use more difficult or costly, regardless of the adverse environmental and societal impacts. In many areas of the country, environmentalists and fiscal conservatives have worked together to actually lessen the environmental impacts of transportation system improvements AND provide the improvements at far lower costs to the taxpayers than the grandiose plans typically preferred by the special interests. Thus far, there has been no such alliance in Denver. The so-called "environmentalists" in this area have historically refused to give proper consideration to new ideas, such as those presented herein. The special interests' willingness to sacrifice the environment to win the bigger game of power, should cause apprehension for honest environmentalists.

This paper presents a better solution for I-25. This plan will cost taxpayers less than the DEIS plan. It would allow Governor Owen's proposed TRANS Bonds to be used to finance other important projects around the entire state rather than having a large portion of future federal tax dollars being dedicated to this single project. This plan is superior in both cost effectiveness and environmental friendliness to the DEIS plan. More important, this Issue Paper presents an alternative that will permit future generations the choice to drive their own personal automobiles on I-25 without having to worry about traffic congestion. Isn't that really what the public wants?

I. PUBLIC POLICY CONSIDERATIONS AND PROPER TECHNICAL ANALYSIS

If the objective of public policy is to deal with traffic congestion, one would think that many people would agree to an approach that would solve the problem.

The anti-automobile agenda of the special interests is revealed by their initial effort to lay out light rail (LRT) in such a way that the I-25 highway capacity problem could never be corrected. Evidently they operate under the delusion that if traffic congestion can be made bad enough (and closing their eyes to the environmental impacts that their approach would reap) that people will abandon their automobiles and begin to ride trains. To advance their political agenda, certain truths must be ignored:

1. Congested traffic produces more air pollution than does uncongested traffic. It is estimated that emissions are 250% higher under congested conditions.[1]
2. None of the 12 LRT systems constructed in the U.S. has succeeded in reducing traffic congestion or air pollution.[2] [3]
3. The existing I-25 right of way (ROW) is generally sufficient for 6 or more lanes (of something -- highway lanes, light rail, dedicated bus lanes, personal rapid transit, or high occupancy toll (HOT) lanes, or some combination of them) in each direction.[4]
4. Although there may be a set of theoretical condition that might yield a higher LRT passenger count than a lane of traffic, in the real world the opposite is true. Actual LRT ridership represents a fraction of the number of people served by a single highway lane.[5]

The fact is also overlook that new automobiles produce far less pollution than old automobiles. The oldest 10% of Denver's auto fleet generate the majority of auto-related air pollution, and as the older autos are retired air quality has and will continue to improve. In addition, new materials will reduce auto weight by 600 pounds, while greater strength will provide more safety, reducing fuel consumption to about 80 miles per gallon (and emissions proportionally) by 2004[6]. These technological improvements will greatly reduce auto-related air pollution.

The fear that politicians, bureaucrats, and their consultant have for maintaining their credibility in the world of political correctness prevents them from studying problems both comprehensively and creatively. Think tanks, on the other hand, are free from such artificial barriers. A few years ago, when people were less sensitive to political correctness, planners and engineers were bound by the *systems analysis* approach to problem solving. The steps are:

1. Define the problem.[7]
2. Produce alternatives.[8]
3. Evaluate the alternatives.[9]
4. Choose the best alternative.[10]

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[1] "The Air Pollution Transportation Linkage," California Air Resources Board, 1989, page 4.
[2] "Grand Jury Report on Light Rail," Orange County, California, May 27, 1999.
[3] "Reinventing Transit," American Legislative Exchange Council (ALEC), December 1993, page 4. Referencing data from the U.S. Census Bureau and USDOT. In cities where LRT is constructed, mass transit (which includes buses) ridership declines on average by about 18%. This is the product of bus service reductions caused by the high cost of LRT and the increase in trip times caused by the increasing number in transfers imposed on riders.
[4] The ROW width required for LRT is slightly wider but essentially the same width as a traffic lane.
[5] DEIS, August 1999, claims 30,000 daily LRT riders (page 4-4) and 301,000 highway vpd (page 4-10) in 2020. By these numbers (without getting into counting distortions that exaggerate LRT performance), LRT will serve less than half as many people as a single highway lane.
[6] "Guide to 2000 and Beyond," Kiplinger, 1999.
[7] This is the most important step. If the problem is incorrectly stated, then the solution will not yield the desired result. For example, Denver Regional Council of Governments (DRCOG) incorrectly defines the problem as "build LRT." More accurately the problem is, "solve traffic congestion in the SE Corridor."
[8] The list of alternatives should be exhaustive. Illegitimate alternatives fall out in subsequent steps.
[9] Comprehensive factual data is collected for each alternative.

5. Implement the solution.

When the process begins with a preconceived notion, as has happened for both the MIS and DEIS, the problem is defined incorrectly. The subsequent analysis and conclusions are necessarily flawed. When the problem is not correctly defined, the chance that the final solution will actually solve the real problem is no better than random chance (in other words: nearly zero). The fear of not being politically correct appears to be the cause of the poor analysis done in the SE Corridor DEIS. Political correctness threatens to foist upon the public a project that will cost far more than is necessary, will not solve the traffic problem and will do damage to the environment.

The current DEIS recommends a plan that was flawed from its beginning by the desire to include LRT. Truly viable solutions -- such as the one presented below -- were never given thorough consideration because of the preconceived notions about what would be politically correct. Evidently a politically correct DEIS recommendation that will not work is preferable to a politically incorrect solution that will work.

II. SCALE OF THE PROBLEM

I-25 currently has 3 free lanes, sometimes called general purpose (GP) lanes in each direction. Colorado Department of Transportation (CDOT) provided traffic counts show that 3 lanes are capable of moving a little more than 6000 vehicles per hour (vph) or 2000 vph per lane. The capacity of the facility is calculated to be 48,000 vehicles per day (vpd) per lane or 144,000 vpd in each direction or 288,000 vpd in both directions currently. Demand on the facility, as measured by the most recent CDOT traffic count, is 165,431 vpd[11]. The most congested highway in Colorado is being utilized at 57%[12] of capacity. A closer look at the traffic counts[13] also reveals that demand reaches 2000 vph per lane for only one hour per day in each direction.

The DEIS stands in stark contrast to the 1997 MIS. The MIS said there wasn't any room for additional traffic lanes. The DEIS shows that there is adequate right of way (ROW) to add one lane in each direction north of I-225, and two lanes in each direction south of I-225 PLUS thirty feet additional for the LRT line. The thirty feet of reserved ROW for the LRT would be more than adequate space to place one additional lane of traffic in each direction. Therefore, the current plan in the DEIS clearly demonstrates that there is adequate ROW for 5 lanes in each direction north of I-225, and 6 lanes in each direction south of I-225.

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[10] Alternatives that fail to satisfy the intended goal are deleted from the mix. The best alternative is selected.

[11] CDOT provided the most current traffic count which was done in August 1996.

[12] Note that free flow of traffic breaks down at 1500 to 1800 vph/lane. To sustain free flow the demand / capacity ratio must stay close to 50% for GP lanes. Exceeding 50% means that 10,000 to 20,000 vpd in 1996 were moving through the I-25 corridor in less than free flow condition (~10% of gross volume). This is the condition that produces traffic congestion, long travel delays, air pollution, and road rage.

[13] Hourly traffic count data is shown in Table 1. Analytical Tables that relate the text are found in Appendix A.

It should be noted that there are only a few locations north of I-225 that contain the bottlenecks in the right of way which prevent it from being adequate for an additional lane -- for a total of 6 lanes in each direction throughout the entire project length. . Political considerations have prevented questions surrounding the additional costs and benefits of obtaining this essential right of way from being adequately investigated and analyzed. This is a great oversight in the current DEIS, one which will have profound impacts on the operational characteristics of the proposed improvement for this transportation corridor.

III. POLICY PATHS

There are three general public policy paths for transportation:

1. A path based upon *abandonment of the automobile*. This is the path that the anti-auto special interests have successfully inserted into the 1997 MIS for the Southeast Corridor of I-25, the "light rail only solution". The inclusion of light rail in the 1999 DEIS indicates their continuing desire for people to abandon their autos. The theory is that if large numbers of people abandon their cars, then the existing infrastructure may be sufficient to accommodate the remainder. There is no evidence that a significant sector of the population desires or would tolerate life style changes needed to forgo automobile ownership. In fact, most research confirms that most people enjoy their automobiles. This path is opposite of public desire.

2. A path based upon *adding more infrastructure* indefinitely. The DEIS plan yields partially to this path by suggesting the addition of one new GP lane. The addition of lanes is not sufficient to unclog the traffic congestion. If the shape of the traffic demand curve remains unchanged[14] with sharp am and pm peaks, then growth in traffic (at 2.6%[15] compounded annually) would consume all of the additional capacity provided by 3 additional GP lanes by 2023. If only one GP lane is added, growth will consume that additional capacity by 2007, the very year construction will be finished. With the existing ROW consumed and with the possibility of acquiring more ROW unrealistic, the only remaining option in the future will be to double deck I-25 for more capacity -- at a cost of $50 to $100 million per lane mile. The DEIS plan, therefore, imposes a future cost of literally billions of dollars! The DEIS plan evidently intends that when the congestion becomes intolerable again, people will abandon their automobiles. If people do not abandon their automobiles, the DEIS plan fails to account for the substantial future infrastructure cost. The DEIS "preferred alternative" puts the I-25 corridor in a very difficult future situation. The DEIS should be modified to recognize the substantial future costs of additional infrastructure and the associated impacts of this path.

3. A path based upon *using infrastructure more efficiently.* This path is recommended in this report, and is discussed in detail below. It is a path that was inadequately explored in the DEIS process, and should be more thoroughly investigated before any

[14] The data in Table 1 is shown in graphical form in Figure 1, Appendix A, Page 2.
[15] Growth rate estimated by CDOT and conforms with DEIS estimates.

plans for I-25 are allowed to proceed. In addition to getting more people through the existing infrastructure, new infrastructure should be added at expense to those who use and benefit from it and only where it is absolutely necessary to maintain free flow of traffic. Recognition of alternatives that use infrastructure more efficiently depend upon an acknowledgment that certain resources (infrastructure, tax dollars, air quality, ROW, etc.) are limited. Scarce resources must be fairly allocated. Pricing is an accepted method in U.S. society of achieving allocation. The research and analysis presented herein thoroughly demonstrates the superiority of this approach in terms of costs, environmental impact, and the lessening of traffic congestion.

The open-minded investigator is obliged to consider any, all, and combinations of the above policy paths. Various alternatives compete with each other based on their respective cost and benefits. This was not done in either the MIS or the DEIS. This is the general subject of this Issue Paper. The paper is not intended as a substitute for the complete DEIS, or the final EIS. This paper demonstrates that the DEIS proposed "preferred alternative" has not been adequately researched and analyzed as to the future impacts on the traveling public or the environment.

In order to make this research more easily understandable, this Paper limits discussion of potential uses for the existing ROW to three possibilities:

1) General Purpose (GP) lanes. Current users of I-25 are driving in GP lanes. They are open to vehicles of all types: automobiles, motorcycles, pickup trucks, commercial vehicles, etc. They are "free" to all users.

2) High Occupancy Toll (HOT) lanes. HOT lanes are familiar to drivers in southern California. They are being considered in other locations around the U.S., including the North I-25 corridor. Denver drivers are familiar with High Occupancy Vehicle (HOV) lanes, for vehicles with more than one occupant. Unfortunately, the existing HOV lanes are grossly under-utilized at the current time. HOT lane technology will someday allow single occupant vehicles (SOV's) to use the wasted capacity of these HOV lanes. The price of the toll must be variable: the more crowded the HOT lanes, the higher the toll.

3) Light Rail Transit (LRT). Downtown Denver workers and visitors have probably seen LRT, and a few have occasionally ridden the trolley cars. Considering that less than two percent of all trips area are carried by mass transit (buses plus LRT) and only a small fraction of the 2% is LRT use, very few people actually use LRT. In fact, most LRT users are previous bus riders who were forced to use LRT when their bus routes changed.

As noted above, there are other alternatives. Dedicated busways and personal rapid transit (PRT) are often mentioned, then quickly eliminated for some reason in most Environmental Impact Statements (EIS). The authors would suggest that a truly comprehensive EIS would include a complete analysis of all alternatives following the

A list of the configuration possibilities is shown in Table 2, Configuration Possibilities. When the total is less than six (6) lanes for each direction, it simply means that available ROW is not used for transportation purposes at the present time, but that it could be available for future use, if alignments are thoughtfully selected.

The affect of acceleration / deceleration lanes (accel / decel) and appurtenances is not included in cost estimates. It is assumed that their costs will apply to all alternatives equally and, therefore, do not affect the relative result in a competition between configurations.

Several configurations that obviously reduce service from the current levels are not included: such as 2-2-0, 2-2-1, 2-1-0, 2-1-1, and several single or no GP lane alternatives. Transportation improvements should increase service, not reduce it.

A. UNIT COSTS

The unit cost of each mode is calculated by applying the costs provided in the MIS and DEIS.[16] The DEIS costs are as of August 1999 and are in 2007 dollars. Light Rail Transit (LRT) is estimated to cost $883 million to construct 19.7 miles in each direction. (There are two LRT tracks in the 30' ROW.) Thus, the LRT unit cost is $22.4 million per track mile (or per equivalent lane mile). This paper assumes that for ROW purposes, a track mile is essentially the same as a highway lane mile -- in terms of space requirements.

Similarly, the highway cost is estimated at $737 million to construct 50.8 lane miles (two additional lanes from I-225 to C-470 and one additional lane everywhere else in each direction) or $14.5 million per lane mile.[17] Following the DEIS methodology, the existing 3 highway lanes will be mostly unaffected by the construction and are not assigned cost. Because the cost of tolling equipment would add less than 1% to highway construction cost and none of the cost estimates are within 1% precision, the cost of HOT lanes is considered to be the same as GP lanes.

This approach to cost calculation is very simplified, but is adequate for conceptual purposes and to get a view of how all possibilities appear in comparison with each other. These unit costs are used to produce Table 3, Capital Construction Cost for all Configurations.

Table 3A shows the same Capital Construction Cost data sorted from least to most cost.

Considering capital costs alone, the least cost alternative is to do nothing (3-0-0) at $0 and several configurations have the highest cost at $2,025,000,000. That is $2 billion, which translates to about $500 for every person in Colorado or about $1000 for each person in the metro area. The DEIS "preferred alternative" (4-0-1) is $1.454 billion.

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[16] By Carter and Burgess, Inc. under CDOT contract.

[17] CPTC constructed 40 lane miles of HOT lanes on the California 91 Freeway for $126 million in 1993 dollars (i.e. $3.2 million per lane mile).

B. OPERATING COSTS

The MIS set LRT net operating losses after accounting for fares[18] at $21 million per year in 1997 dollars. The DEIS questionably lowered the operating loss (20%) to $17 million and then inflated it to $23 million in 2007 dollars. The huge net operating losses for LRT have a significant impact on the financial viability of all alternative configuration that includes LRT. The authors suspect that the LRT costs are understated and that the highway costs are overstated in the DEIS, but have used DEIS cost figures throughout.

Highway operating costs (especially for new construction) are insignificant in comparison to the other costs included in this project, and generally equal between the alternative configurations. Pot hole patching, crack sealing, stripping, and litter pickup are less than $10,000 per lane mile per year.

Electronic toll collection (ETC) equipment virtually eliminates toll collection safety concerns and simultaneously reduces toll collection costs by over 90%.[19] The best source of data on ETC operating costs is SR-91 Freeway Express lanes in southern California. The 91 Freeway connects Orange County and Riverside / San Bernardino. The preexisting ten-mile long, 4 lanes in each direction, highway was congested to a virtual standstill with a six hour daily peak period. In 1989 the state legislature invited proposals from private firms. A team of firms formed California Private Transportation Company (CPTC). CPTC constructed 2 additional lanes in each direction and opened for operation in December 1995.

Operating costs on the SR-91 toll lanes increase proportionally with the number of customers served. The formula for estimating HOT lane operating costs is computed from CPTC annual report data and is shown in a subsequent footnote. CPTC's operating costs are total costs, meaning that maintenance and police enforcement (contracted to the State of California) are included in the total. Showing these costs for HOT lanes and not for GP lanes, will tilt the following analysis somewhat in favor of GP lanes. Therefore, the HOT lane operating cost data comparisons are overstated, which helps to insure that net revenue estimates are understated.

C. REVENUE PROJECTION METHODOLOGY

LRT and GP lanes generate no revenue and are completely dependent upon tax dollars to cover both capital construction and operational costs. HOT lanes generate their own revenue and can, like the SR-91 freeway example, cover all (or most) of their costs, allocating those costs through tolls to those who use and benefit from the expanded facility.

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[18]Because the majority of LRT users are transfers from buses and transfers produce no additional net revenue, it is unknown how these fares are accounted by RTD. In other words, this may be an opportunity for RTD to misstate the true farebox performance of LRT.

[19] "The Pikepass Story," video, Oklahoma Turnpike Authority, 1993.

Revenue projections for toll roads are subject to many variables that are difficult to account for. Few consulting firms provide the service of making Traffic and Revenue estimates for the toll road industry. All use proprietary (secret) methodologies. In April of 1998 the Texas Transportation Institute (TTI) released "Procedures and Criteria Used to Evaluate the Financial Viability of Private Toll Road Projects." Fourteen toll road projects were compared based on forecasted versus actual traffic and revenue figures. In all cases both traffic and revenues were overstated. Evidently the proprietary models used by these firms need to be improved.

The problem of estimating traffic and revenue is further complicated when toll rates vary with demand and a competing free facility is parallel and contiguous. All 14 projects evaluated by TTI are fixed toll facilities, in which all users always pay the same toll. Toll lanes that vary the toll rate with demand are referred to as congestion pricing, HOT (high occupancy toll), managed HOV (high occupancy vehicle), special use, value pricing, FARE (fast, affordable, reliable, efficient), or choice lanes. The term "HOT lane" is chosen to describe these types of facilities throughout this paper.

The California Department of Transportation (CALTRANS) and US DOT funded a 4 year study performed by California Polytechnic State University (CalPoly) of the 91 Express lanes. The final report was released in May 1998. Table 4, "91 Freeway -- Traffic and Revenue Analysis" extends CalPoly fifteen (15) minute increment traffic counts for all lanes and HOT lanes[20] and toll rates from February 1997 eastbound lanes. Careful analysis of CalPoly data reveals some interesting findings:

1. When free flow exists in free lanes, few consumers are willing to pay a toll.
2. When free lane volume exceeds 1500 vph / lane,[21] market capture rate in the toll lanes exceeds 10%.
3. As traffic volume grows in the HOT lanes and toll rates are increased to insure free flow, there is a compounding affect on the amount of gross revenues collected.
4. In the eastbound lanes, the six hour peak from 2pm to 8pm accounts for 80% of HOT lane traffic volume and 94% of gross revenues.

Based on these findings, toll revenues for each of the 22 configurations for the I-25 Southeast Corridor are estimated in Appendices B & C. Appendix B is based on 2006 traffic volumes. Appendix C is based on 2011 traffic volumes.

[20] "Evaluating the Impacts of the SR 91 Variable-Toll Express Lane Facility," CalPoly investigative team lead by Prof. Edward Sullivan, May 1998, pages 26 & 27.

[21] The fact that free flow of traffic begins to break down at 1500 to 1800 vph / lane is corroborated by the "Toll Lane System Feasibility Study" conducted for the Minnesota DOT, January 1998.

V. I-25 TRAFFIC GROWTH

Colorado's population has grown at 2% per year consistently over the long term. Traffic volumes grow faster than population. Traffic volumes are expected to grow at 2.6% compounded annually.[22] Table 5, "Traffic Growth Projections" shows the hourly distribution of NB I-25 traffic 5, 10, 15, 20, & 25 years in the future. The growth factors are computed to be 14%, 29%, 47%, 67%, and 90% respectively.

Adding one additional GP lane to the existing 3 lanes increases the highway capacity by 33%. Growth would consume this additional capacity by 2006 or 2007, the year construction is due to be completed. This means that simply widening I-25 by one additional GP traffic lane in each direction as suggested in the DEIS would doom Denverites to endure congested traffic conditions before, during and after completion of the proposed project. Since current traffic conditions show there are 2000 vehicles per hour (vph) per lane in the peak congested condition, Table 5 illustrates that a similar congested condition would exist for several hours per day in 2006.

Adding two additional GP lanes increases current capacity by 67% and the breakdown of free flow of traffic is delayed -- but traffic flow breakdown will occur before the proposed bond financing for the construction is paid back. Even under this scenario, the I-25 freeway south of I-225 will be doomed to traffic congestion a few years after it is opened -- based on the normal growth rates alone. Other traffic considerations mentioned below reinforce the view that the facility will be congested as soon as it opens and a more innovative approach to the problem is needed.

A. INDUCED TRAFFIC / LATENT DEMAND

When a transportation system ceases to move people efficiently, people adjust. They make trips on parallel facilities or forego some trips completely. Experts refer to this as induced traffic or latent demand. When new capacity is available people go back to the facility they previously avoided. Simply stated, this is merely the movement of users from less efficient to more efficient routes. In reality, the entire transportation system benefits because people who were previously driving on overcrowded arterial streets have been attracted back onto the freeway. The arterial streets, therefore, will operate better as a result of the additional freeway capacity and will simultaneously generate less air pollution. Unfortunately for the freeway lane, however, latent demand jumps the traffic counts ahead of historic growth rates. Latent demand is the reason many new highways soon become crowded.

In a sense, greater latent demand is a measure of the extent to which a new facility aids the efficient operation of other parts of the transportation system. This benefit to the efficient operation of the greater transportation system is not insignificant. On the other hand, the authors are unaware of there ever being a discussion of LRT latent demand.

[22] Growth rate estimated by CDOT.

This is likely due to the tiny LRT ridership that would be minuscule in any potential positive effect on other parts of the transportation system.

The size of the traffic jump is difficult to estimate. Studies have found induced traffic to range from 7% to 28%, but CDOT's SE Corridor consultant states that the project, "is unlikely to bring on much induced traffic."[23] It is dangerous to make potentially large assumptions. If the magnitude of induced traffic is not small, then induced traffic may have an enormous affect on the corridor, on the performance of various alternatives, and on the alternative that might be selected. Understating latent demand, understates the amount of traffic congestion and air pollution that the DEIS "preferred alternative" would produce.

The authors respectfully disagree with the exclusion of latent demand estimates, and request that a more comprehensive analysis be conducted prior to approval of the DEIS. Traffic count data and the levels of service should be more thoroughly analyzed. When level of service falls on adjacent arterial streets, drivers will move to more efficient routes, particularly new freeway capacity -- and particularly GP lanes until they become congested again. Latent demand will negatively impact the operation of the improved I-25 under the scenario presented in the DEIS.

This phenomenon also underscores how difficult it will be for Colorado to recover from the anti-transportation policies of previous decades. The failure to add capacity when population and traffic was increasing has created system-wide problems that will not be easily solved. Because of the lack of a specific number for induced traffic and to again overstate in favor of GP versus HOT lane alternatives, subsequent analysis assigns nothing to induced traffic.

B. IMPULSE TRIPS

Impulse trips are a subgroup of induced traffic. A congested highway provides a disincentive to not take a special trip for an ice cream cone -- most drivers will avoid the hassle. Similarly, LRT is not conducive to impulse trips and denies people mobility. People who want immediate gratification are unlikely to wait around for LRT.

Relatively uncongested free lanes, however, provide no such disincentive for making frivolous trips. Drivers will jump onto the freeway for short distances in order to fulfill their immediate desires in the quickest possible manner. Ramp metering theoretically[24] reduces impulse trips on I-25, but there still isn't a Dairy Queen on every corner. Lots of drivers are still willing to wait at the ramp meter as long as using the freeway can reduce their total trip time. The problem is that each new vehicle entering the highway creates a small delay for vehicles already traveling on the system. There is no feedback mechanism that helps newcomers perceive the cost in diminished service quality that their presence

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[23] "More Lanes, More Traffic?", Ricky Young, Denver Post, June 28, 1999.

[24] The theory of ramp metering is that free flow is sustained on the most major transportation links by throttling traffic at the access points and forcing congestion onto other roads. The injury to users of adjacent facilities is offset by the greater good of more service to more users on the major facility.

impose on others: that is, the internalization of external costs. As the number of vehicles on the highway reaches a critical point, the free flow of traffic ceases, stop and go traffic results, and the throughput of the entire system plummets. The artificial throttling of impulse trips via traffic congestion, ramp metering, and mass transit have proven ineffective with the adverse affect of decreasing societal mobility. HOT lanes increase societal mobility and provide the proper disincentive for reducing frivolous impulse trips.

Variable priced HOT lanes provide an incentive to minimize impulse trips. The price of a cheap hamburger or an ice cream cone is not nearly as attractive when trip price is recognized as part of the total price.

C. TRAFFIC COUNTING METHODOLOGIES

The impulse trip discussion underscores another flaw in the DEIS. The DEIS shows that I-25 will serve 301,000 vehicles per day in 2020. Many drivers enter and exit I-25 without driving its entire length. If an average trip length in I-25 is five miles, then over a million vehicles per day are served by this facility -- not 301,000 as shown in the DEIS. This, in fact, is the method of counting used by LRT advocates to produce the 30,000 rider claim. Every person who enters the LRT system is counted.

It should also be pointed out that the 301,000 is *vehicles* per day and that average vehicle occupancy is 1.1 *people*. Thus, there are more people served, but not counted, by the highway in 2020 as there are claimed in the exaggerated LRT service claim. Therefore, the inconsistent service comparisons between LRT and highways are misleading and are incorrect in the DEIS. The benefits of the highway are clearly understated and the benefits of LRT are overstated, because of the different counting methodologies. A more accurate measure would be "passenger-miles served." At a minimum the counting method for both should be consistent.

D. LONGER, BUT FEWER, TRIP-CHAINS

Combined trips are referred to as trip chaining. For example: a stop at the dry cleaner is combined with picking up little Johnny after school. Many impulse trips can be delayed or combined. Historically, the only incentive to trip-chain is an individual's personal time management. HOT lanes provide an additional incentive. Customers save both time and money when they can avoid unnecessary trips. Everyone benefits with fewer trips on the system by more efficient free flow of traffic. Congestion will be reduced because the facility will not be as attractive to impulse drivers just running short errands. HOT lanes, therefore, also help to motivate fewer, but longer trips by highway users. Longer trips at higher speeds result in more efficient operation of the internal combustion engines and the additional benefit of less automobile-related air pollution.

Trip-chaining is good for the transportation system, is unreliable with congested GP lanes, and is nearly impossible with LRT. HOT lanes increase mobility.

E. OTHER TRAFFIC DEMAND FACTORS

Worker independence is increasing because of new technologies and more family-friendly corporate policies designed for higher levels of employee productivity and retention. Telecommuting, flexible work hours, and more jobs in the suburbs are the result. The suburbs are where the growth is happening, and where the people and jobs are located. Trips from suburb to central city are under one-third (1/3) of all commuters and declining. Public transit use (declining in spite of unbelievably high taxpayers subsidies) now accounts for fewer commuters than does telecommuting.[25] What impact might there be on traffic demand if subsidies similar to those to LRT were offered for telecommuting? Or if zoning codes that make people criminals for working at home were liberalized. All of these changes in society will have an impact on future transportation policies. However, immediate action is needed on the too-long ignored I-25 corridor.

VI. LRT SERVICE POTENTIAL COMPARED TO ALTERNATIVES

Will LRT be the savior of the SE Corridor? If so, things may not be so bleak. LRT advocates boldly claim, "Yes!" But documents like the MIS and DEIS need to be read with a degree of skepticism. Truth is clouded by statements like, LRT "provides almost as much peak hour directional capacity as five highway lanes."[26] Whether this is even theoretically possible (with no stops, no headways, no empty seats, no space between trains, and high-ball speed,) is not relevant. The slow trip times[27] of mass transit combined with the time consumed in additional transfers for LRT users causes more people to stop, rather than start, using mass transit.[28]

What LRT *does* carry is far more relevant than what LRT *might* carry. As discussed in the section on Traffic Counting Methodology, the DEIS miscounts both the system throughputs and vehicles versus people, distorting the potential service that LRT would provide. Accounting for these factors, it is unlikely that LRT would carry much more than 3% of all the people traveling the corridor.

But ridership is further exaggerated by double counting bus riders that are forced to ride LRT. By counting "boardings" each passenger who exists a bus and boards LRT is counted as two. Forced boardings means that a much smaller number of people is served by LRT than the numbers suggest. Accounting for the large proportion of the LRT riders

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[25] "Commuting to Work," USA Today, August 6, 1999, April Umminger and Genevieve Lynn.
[26] "Final Report SE Corridor Major Investment Study," by Carter & Burgess, Inc., July 1997, page ES-3.
[27] "Daily Jams Don't Keep Commuters From Cars," USA Today, Scott Bowles, April 14, 1999, Commuter trip times in 1995 were 42 and 20 minutes and trip speeds were 19 and 35 mph for mass transit and private vehicles users respectively.
[28] "Reinventing Transit," ALEC, December 1993, page 4. Referencing U.S. Census Bureau and USDOT data.

who are current bus riders,[29] there will certainly be far less than 3% daily users of LRT in the SE Corridor in 2020. If the State Auditor's 10% figure holds, then automobiles removed from the highway would be no more than 10% of 3% or 0.3%.

> ***"NO LRT construction has caused an increase in mass transit ridership. RTD and industry boosters hope, but offer no evidence or rational basis, for their highly optimistic opinion that Denver will be the first ever LRT success."***

Three percent of the one direction 108,530 daily trips in 2006 is only 3,256. In 2011 it will be 3710 and in 2020 it will be 4515. The DEIS, however, predicts that only 30% of the passengers on LRT will have been bus riders. Thirty percent is an enormous increase over actual LRT performance in Denver and other cities. Such an extreme claim merits substantiation and justification in the DEIS.

Another way to test the reasonableness of a 3% LRT market share is to compare it to current market share. To achieve 3%, LRT is obliged to increase mass transit market share by at least 50% from the current declining Denver mass transit market share of under 2%. Such an achievement would be revolutionary,[30] since *NO* LRT construction has caused an increase in mass transit ridership. RTD and industry boosters hope, but offer no evidence or rational basis, for their highly optimistic opinion that Denver will be the first ever LRT success. Of the 9 cities that constructed LRT in the 1980s, it was found that average ridership was 66% to 85% lower than forecasts.[31] Add to this the fact that average construction costs are 13% to 50% higher and it is discovered that average cost per rider is 5.4 times greater than the original estimates.[32]

Distortions by rail advocates are becoming increasingly exposed. On May 27, 1999, a Grand Jury in Orange County, California released its report investigating the Orange County Transportation Authority. The decision to build LRT, "should not be based on public relations fluff. It should not be a 'done deal' followed by a search for a justification."[33] The scathing report claimed that the OCTA was spending more time "promoting than studying" LRT and was purposefully withholding information from the public. "Jurors studied 12 LRT systems built in various parts of the country over the last two decades. None, they said, can be called a success."[34] In short the Grand Jury found

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[29] "Regional Transportation District Performance Audit," Colorado State Auditor, January 1995, Page 47. "... according to RTD's estimates, about 90 percent of the (LRT) ridership is composed of riders transferring from buses ..."

[30] "Increasing the Productivity of the Nation's Urban Transportation Infrastructure," U.S. Department of Transportation, January 1992, page 14-7. "LRT seems to us to be nothing more than a slow and expensive bus that cannot pass and is unable to operate off of its guideway, virtually all LRT users must transfer from feeder buses and private automobiles, with predictably adverse effects on ridership."

[31] "Urban Rail Transit Projects: Forecasts Versus Actual Ridership and Costs," Don H. Pickerell, USDOT National Transportation Systems Center Economist, 1989.

[32] "Stop That Train," by Stephen Mueller and Dennis Polhill, Independence Institute, March 8, 1994.

[33] "Grand Jury Hits OCTA on Plan for Urban Rail," Megan Garvey, Los Angeles Times, May 28, 1999.

[34] "Grand Jury Hits OCTA on Plan for Urban Rail," Megan Garvey, Los Angeles Times, May 28, 1999.

that LRT would not improve commuter travel times, energy conservation, safety, traffic congestion, cost-effectiveness, development, population density, or air pollution.

Some honest representations by the experts, and an effort to really explain all of these numbers in a straightforward, easily understandable manner, would do wonders for their credibility, and for the EIS process itself.

In the final analysis it is equally (if not more) likely that LRT will force more people onto highways than it will remove. Whichever direction ridership goes, the numbers are not likely to be substantial. Therefore, in estimating traffic distribution between GP and HOT lanes, the full traffic volume of the corridor is assumed to be carried by the highway.

A. THE 2006 CONDITION

GP lanes and LRT do not generate revenue. Only HOT lanes generate revenue. Therefore, there are no revenue projections to make for Configurations 1 through 7 (3-0-0, 4-0-0, 5-0-0, 6-0-0, 3-0-1, 4-0-1, and 5-0-1). Also, because the distribution of traffic loading on GP lanes affects potential HOT lane revenue, but LRT does not, several others will yield an identical result:

- (8) 3-1-0 = (11) 3-1-1
- (9) 4-1-0 = (12) 4-1-1
- (13) 3-2-0 = (15) 3-2-1
- (17) 2-3-0 = (19) 2-3-1
- (20) 1-4-0 = (21) 1-4-1

To cover every possible configuration in 2006 (the 10 year condition), ten separate spread sheets are calculated. They are Tables A-10 through J-10 in Appendix B. The rational basis for calculating the spread sheets is what was learned from the CalPoly study of the SR-91 Expressway:

- Few customers will choose to pay a toll when free flow of traffic exists in GP lanes.
- When GP lanes reach 1500 vph per lane, the excess flow spills to the HOT lanes.
- Toll rates are applied by the same function[35] used by CPTC in February 1997 to avoid any variations in driver behavior. This fails to account for reasonable inflation of fees (probably at 2% to 3% per year to keep pace with the consumer price index). Thus, toll revenues in 2006 are likely to be understated by at least 20%.

For spreadsheet expediency, the CPTC step function is converted to a straight line continuous function.[36] The use of a continuous function also seems more appropriate to reflecting actual market demand on the HOT lane facility. As with the step function a

[35] CPTC toll rate step function in use February 1997 was: less than 100 vph = $.50; 100 to 200 vph = $1.00; 200 to 600 vph = $1.50; more than 600 vph = $2.75.

[36] The straight line continuous function is: toll rate = .003125 * vph per lane + .35.

user pays the toll as of the moment the HOT lane is entered. But with the continuous function, the toll rate can vary in increments as small as $.01.

B. THE 2011 CONDITION

The year 2011 (the 15 year condition) is similarly analyzed in a set of spreadsheets (Tables A-15 through J-15) in Appendix C. Thus, year-10 and year-15 data points are available in order to estimate the gradient slope of revenue growth. All of the Tables in Appendices B and C are summarized in Table 6, Summary of Variable Toll Gross Revenue Estimates. Two additional service measurement parameters are generated in the 2006 and 2011 Tables:

- *Number of Customers Refused Service* -- The number of *customers refused service* represents the number of users that the facility is not sized to accommodate. Customers are not actually denied service from socialized institutions, such as highways. Just as Adam Smith discussed with his "tragedy of the commons" example, service level is degraded for all by the actions of just a few. Service will not degrade in the HOT lanes, because tolls are adjusted to always insure free flow of traffic. A few might choose to use LRT, but the vast majority will force themselves into the GP lanes. By choking down speed, about 2000 vph / lane can be moved through the system at a slow speed. At greater than 2000 vph / lane, throughput of the system degrades quickly for all users as speeds decline to a standstill. Just as with the "tragedy of the commons" everyone, not just the offending individual, is injured. This is exactly the condition that existed on I-25 in 1996. The number of "customers refused service" in 1996 was 9,900. The number of "customers refused service" in 2006 under the 4-0-1 DEIS recommendation is 10,782 (see Table 6, Page A-8). Obviously similar numbers in the future reveal a similar condition. Future driver discontent with the system can be confidently predicted.

- *Number of Full Flow in All Lanes* (in hours per day) -- This is the number of hours per day that all lanes are at full free flow of 1500 vph or greater. In 1996 this condition occurred for 12 hours out of 24. The Tables in Appendices B and C actually understate this parameter, because no assumptions are made as to how or when the surplus customers would be moved through the system. The "Preferred Alternative," as recommended in the DEIS, will reach full free flow capacity in all lanes for 10 hours per day in 2006 and for 13 hours per day in 2011. It seems likely that taxpayers would expect better service in return for such a large capital outlay and years of construction delays.

C. HOT LANE REVENUE

The purpose of Table 6 is to focus on the revenue generating potential of HOT lane facilities. Variable price tolling thrives on traffic congestion. The most revenue is generated when the number of free lanes is fewest (1-4-1, 1-4-0, and 1-5-0). Since these configurations actually reduce the level of service, they are not recommended.

In addition the greatest pressure on the system occurs when the greatest number of customers is being refused free flow service. Where HOT lanes are available, the free flow condition motivates more people to use the toll facility, raising toll rates above those estimated in Table 6. To avoid overstating toll revenues, it is assumed that $5.04 is the peak toll and it is sufficient to sustain HOT lane free flow. To the extent that this is not true, then toll revenues will be larger than estimated. This same traffic and pricing pressure will cause the shape of the traffic distribution curve (Figure 1) to change. That is, when customers learn that the cost is less to drive to work at 6am or 9am than at 8am, some will flex their schedules accordingly, moderating the natural peaks in traffic demand. Such change in demand on the system increases the number of customers served by both the GP lanes and the HOT lanes. This causes the 50% demand / capacity limitation to increase, resulting in more expedient, free flow service to more people. The 3-1-0 and 3-1-1 configurations produce the highest toll rates and the highest number of toll customers. With these two configurations, however, the service level of the facility is no better on opening day, than it was in 1996. Since there is no improvement in service, these configurations are not recommended.

E-470 is the only currently operating toll facility in Colorado. E-470 tolls are fixed at $.15 per mile. Thus, for this HOT lane proposal, $5.04 for a 20 mile ($.25/mile) free flow trip when the GP lanes are choked does not seem excessive. The minimum toll rate is $.35 or $.02/mile. The concept of variable pricing should be more thoroughly investigated by the E-470 Authority, because it appears likely that by lowering prices during non-peak periods more users would be attracted to their facility and a stronger revenues stream might result.

Similar configurations (4-0-0 & 4-0-1) that do not offer the HOT lane option put customers in a bind. Customers have no choice but to sit in traffic or abandon their automobile and ride LRT. Many people claim to support LRT because it offers drivers a choice. It seems clear that the HOT lanes proposed in this research report offer far more choices for congestion free travel using: buses, taxis, vanpools, carpools, and private automobiles. Worse yet, while these configurations, deny these choices, <u>all</u> highway users are forced to sit in traffic jams: a punishment for not conforming to the "special interest's" view those people should live their lives. 4-0-1 is the DEIS "preferred alternative."

The configurations that provide three GP lanes and two or more HOT lanes look very attractive. Although reducing the number of free lanes below three produces more revenue, the political backlash because of the appearance of reducing the level of service and generating revenue from facilities already paid for with general taxation is not likely to be acceptable. When more than three free lanes are provided, the ability of the facility to generate revenue through tolls to pay for itself is injured. For example, the 5-1-0 configuration generates so little revenue that it can not cover its cost of operation.

E. HOT LANE OPERATING COSTS

The experience base for determining the operating costs of ETC facilities is limited. E-470 uses ETC, but only as a convenience to those users who choose to not stop and fish for coins. Toll booths are a safety hazard and are labor intensive. The Oklahoma Turnpike Authority found that ETC reduced toll collection costs by 91% and accidents by 100%.[37]

CPTC (91 Expressway in California) anticipated that gross revenues would grow over time and structured their debt retirement schedule accordingly. Since opening in 1995, three annual reports have been released to the public. Operating costs tend to be directly proportional to the number of customers served. Since CPTC is a private company, not subject to public audit, some observers have speculated that operating costs are exaggerated by the payment of obligations not related to the annual operations. For fiscal and calendar years 1996, 1997, and 1998, the annual operating cost was $6.3 million, $9.1 million, and $8.7 million, and customers served was 5.7 million, 8.6 million, and 9.3 million, respectively.[38] [39] CPTC operating costs include the cost of contracting with the state for maintenance and police services.

F. SUMMARY TABLES: REVENUES AND EXPENSES

The findings from the tables in Appendices B & C are used as the basis for Tables 7 and 8, Annual Gross Revenue and Operating Costs in 2006 and 2011, respectively. Revenues, use, and operating costs are computed in annual terms for all 22 configurations.

Appendix B (revenue estimates for 2006) exercises the revenue estimating methodology evolved by studying traffic and revenue performance of the California SR-91 Freeway. Because traffic characteristics necessarily vary when the configuration changes, the analysis exercise was repeated for each varying configuration. These are the calculations found in Appendix B. Table 7 lists the bottom line gross daily unidirectional revenue estimates from the Appendix B Tables and annualizes them based on 260 toll revenue days per year. Table 7 also computes annual toll customers served (in millions per year) and computes annual toll operating expenses. Table 8 does the same things to summarize the information from Appendix C (2011) estimates.

Table 9 is 2006 Toll Debt Retirement Capacity. This is the calculation of the amount of capital debt that can be paid off by the revenues from tolls. When expense is subtracted from revenue, a "net" figure results. If there is no debt, this appears on a profit and loss statement as profit. If there is debt, the net figure is referred to by bankers and accountants as "Net Operating Income" (NOI) and is available to pay down the debt. When the cost of capital (interest rate) and the length of the debt retirement schedule are

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[37] "The Pikepass Story," video, Oklahoma Turnpike Authority, 1993.

[38] CPTC Annual Reports for 1996, 1997, & 1998.

[39] For use in subsequent spread sheets the following relationship is used: annual operating costs = .657 * annual trips + 2,600,000. Both costs and trips are in millions.

known, the amount of debt that can be supported by a revenue stream can be calculated. In other words, the capital value or present worth is known.

Table 9 extends gross revenues and operating expenses from Table 7 to yield NOI for each configuration. With tax exempt government bonds currently at 4% and amortized over 30 years, the amount of debt that can be retired with the toll revenue is computed in the last column of Table 9. Recall that toll revenue grows annually on a gradient and that this computation is done based on 2006 revenue potential. Toll revenues grow at an average of 7.2% per year averaged over all configurations. So, again, using 2006 estimates causes the financial potential of the HOT lane options to be understated. Table 10 is the same calculations, but for 2011.

G. TABLES 11 and 11A: NET COST TO THE TAXPAYER SUMMARY TABLES

Table 11, Net Cost to Taxpayers using 2006 Toll Revenues, combines all costs and revenues for 2006 in one spread sheet. The $23,000,000 annual operating loss for LRT is accounted for and using the same amortization parameters[40] is brought to a present value of $398,000,000. That is, if a sum of money was deposited in an account at 4% interest (the current rate for government bonds) and installments of $23,000,000 are withdrawn every year, the account will be a zero balance in 30 years. Otherwise stated: the decision to commit to a project that requires $23,000,000 per year in taxpayers subsidies is the same as spending $398,000,000 today. The purpose is to account for all costs in common terms so that the various configurations can be observed in apples-to-apples terms. Note: in the "Net Cost to Taxpayers" column that a negative cost is a revenue surplus or *taxpayer profit*. The 3-1-0 and 2-3-0 configurations produce taxpayer profits of $74,000,000 and $436,000,000, respectively. The 1-4-1 configuration produces so much money that the full cost of constructing and operating LRT is covered with only $19,000,000 from taxpayers. The similar configuration, 1-4-0, which omits LRT, produces a taxpayer profit of $1,261,000,000!! The more practical 2-4-0 configuration costs taxpayers only $554,000,000 and produces less future air pollution and traffic congestion than either 1-4-0 or 1-4-1. The Table 11 data is sorted by increasing cost in Table 11A.

H. TABLE 12: MULTIPLE BENEFIT SUMMARY TABLE

The discussion of benefits cannot be limited to costs. A project of the scale of I-25 should provide many benefits for many years into the future. Table 12, "Costs and Benefits to Taxpayers in 2006," shows some. For convenience the Net Cost to Taxpayers column is repeated from Table 11. All figures (except for Total Cost, which is shown in net present worth terms) are annualized.

- One of the more important benefits is "Demand / Capacity Ratio." From the 1996 traffic count data it is known that free flow begins to break down at 50%.

[40] 4% and 30 years.

Configurations 3-0-0[41] and 3-0-1[42] which were in failed condition in 1996 are much more seriously failed in 2006 at 64.4%. Several (4-0-0, 4-0-1, 3-1-0, and 3-1-1) are dangerously close to the 1996 condition when the facility is first opened to traffic. At 32.2%, several 6 lane configurations provide enough capacity to avoid reaching the 1996 congested condition for quite some time. This point applies specifically to GP lanes, because HOT lanes have the ability to reshape demand and exceed the 50% demand / capacity ratio limit.

- The 3-3-0 configuration looks especially attractive. Each of the 3 HOT lanes very likely can move 1/3[43] more vehicles than a GP lane after 2024. Therefore, from a traffic management perspective, constructing 3 HOT lanes would be functionally the same as constructing 4 GP lanes. The extra throughput capacity of 3 HOT lanes is the consideration that outweighs, the superior short term financial performance of the 3-2-0 alternative.

- "Full flow in all lanes (in hours per day)" is defined as any hour where traffic flow exceeds 1500 vph / lane in all lanes. The 1996 condition was 12 hours per day. Thus, anything close to 12 is not a substantial improvement over the 1996 condition. Configurations 4-0-0, 4-0-1[44], 3-1-0 and 3-1-1 would prove to be an embarrassment to Colorado, if constructed, and probably should be deleted from further consideration.

- The term "Customers Refused Service" is somewhat misleading. No customers are actually refused service. The term simply refers to the number of customers that exceed the system's capacity to serve efficiently. As with most socialized institutions, all users are equally entitled to use the facility and forced collectivized use imposes delay costs on all other users. Each additional user beyond the system capacity chokes down both flow and speeds. The lack of free flow imposes costs on everyone and severe costs on society when medical, fire, or public safety emergencies are hampered. In a sense this is the same parameter as the previous one: full flow hours. When more people use a facility that is already loaded, more full flow hours result. The 1996 condition was 5.1 M-VPY refused, which caused there to be 12 hours per day of full flow in all lanes.

- The "Customers Refused Service" parameter also provides a measure of air pollution contribution by the various configurations. Because it is known that automobiles sitting in stalled traffic produce more in air pollution than free flowing traffic, the configurations with the highest number of "Customers Refused Service" add the most air pollution. The converse is equally true; the configurations with the smallest "Customers Refused Service" produce the least air pollution.

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[41] 3-0-0 is the "do nothing" alternative (i.e. the 1996 condition).
[42] 3-0-1 is the MIS Recommendation.
[43] It seems reasonable that variable toll pricing would be capable of raising the demand / capacity ratio from 50% to 67%.
[44] 4-0-1 is the "preferred alternative" recommended in the DEIS.

I. TABLE 13: A NEW MEASURE OF COST EFFECTIVENESS FOR TAXPAYERS

To measure the efficiency of a financial outlay, some unit of "effectiveness" must be defined. Sometimes it is more efficient to spend additional money up front. Spending a little more might yield more than a little in benefits. Thus, marginal benefits might exceed marginal costs and it would be foolish to forgo capturing the benefits. Not only is it important to know the total being spent, but it is equally important to know how much is being gained by the outlay. This is just as when King Soopers gives away a free bag of potato chips when a shopper buys two. Grocery shoppers are very astute at balancing costs and benefits. The State of Colorado has a moral and fiscal responsibility to be equally astute.

The best measure is the amount of money that each person using the transportation system will cost taxpayers. It is in the taxpayers interest to minimize this amount. Table 13, "Cost Effectiveness -- Cost to Taxpayers Per Person Served" computes the cost-effectiveness of the three mode alternatives (GP lanes, toll lanes, and LRT) for all 22 configurations. The three modes cannot be combined for each configuration into a single parameter, because such a calculation would yield the same result (the numbers would change, but the relationship between the configurations would be identical) as Net Cost to Taxpayers in Table 12. Thus, Table 13 is a comparison of modes, not a comparison of configurations.

Table 13 shows that LRT, which moves relatively few people at a high cost, has a cost-effectiveness of $915 per person served. This is 1/184th as cost effective as GP lanes that on average cost taxpayer $4.97 per person. If the previously discussed LRT counting inconsistencies are adjusted out, the cost-effectiveness of LRT would be worse by 3 to 10 times.

Taxpayers get a lot more bang for their buck by investing in GP lanes than LRT. Seven of the 15 HOT lane configurations produce a *taxpayer profit* on opening day. All of the remaining 8 configurations will do the same in a few years. So with a little creativity in structuring a graduated debt retirement schedule, even the worst HOT lane alternative will produce a *taxpayer profit*.

Table 13 is computed using the 2006 (opening day) values. The HOT lane options are far more favorable in 2011 or 2016 when growth causes the toll rates to increase.

J. TABLE 14: ENVIRONMENTAL EFFECTIVENESS

Because LRT is touted as environmentally beneficial, this claim deserves a closer look. Would LRT in the SE Corridor help or hurt the environment? A measure similar to cost-effectiveness is needed. Because the goal should be to reduce the corridor's contribution to Denver's air pollution, units of "equivalent vehicles" is used. It is known that a traffic-stalled vehicle produces 250% as much air pollution as a free flowing vehicle. Therefore,

a stalled vehicle counts for 2 ½ free flowing vehicles in the amount contributed to air pollution. The air pollution contribution of all modes can be combined so that the 22 configurations are easily comparable to each other. These calculations appear in Table 14.

The configurations that produce the least air pollution in 2006 are all six-lane alternatives: 5-1-0, 4-2-0, 3-3-0, 2-4-0, & 1-5-0. The two alternatives that produce the most air pollution, twice as much as they move traffic, are the 3-0-0 (the "do nothing" scenario) and 3-0-1 (the configuration recommended in the 1997 MIS). Not only are the 6 lane configurations the most environmentally friendly in 2006, but they will also perform better in 2011 and 2016 than other configurations.

The DEIS recommended configuration, 4-0-1, produces nearly twice as much air pollution as any of the 6 lane configurations and does it at substantially more cost. This observation defies the notion of trade-offs, when more benefit come at the cost of more money (or something else of value). Even the 6-0-0 configuration which produces no revenues to offset costs is less expensive to taxpayers and produces nearly half as much air pollution as the DEIS recommended "preferred alternative."

VII. DO YOU WANT SOME "FREE MONEY", KIDS?

Some politicians lose their senses when it comes to "free money." They quickly abandon the fiduciary trust of the taxpayers in favor of getting a handout from Washington. It's like offering some candy to a child. A prominent politician in Denver was overheard to say, "Light rail won't cost us anything. It is all federal money." Of course, it is not all "federal money", or RTD wouldn't be presenting a ballot issue to the local taxpayers in November. Federal money is not free in too many ways to discuss in this paper.

In 1965 the U.S. Congress defied the U.S. Constitution when it Federalized mass transit systems and raided the Highway Trust Fund. The trust fund is the bank account set aside for gasoline taxes, which was created exclusively for highway purposes. Congress designated a portion of the fund to be used to support mass transit and an associated federal bureaucracy. As with other programs run from Washington, the disconnection between Washington perceptions and local needs has fostered enormous waste. Since then, more than $350 billion in federal tax dollars (in constant 1995 dollars) have been spent to subsidize mass transit systems in the United States, according to a Reason Foundation report.

In 1997 the construction cost for the light rail on I-25 was estimated to be only $444 million in the MIS. Colorado politicians, especially Governor Romer and his staff, yielded to the Sirens' lure. The "free money" was at hand. Colorado needed only $90 million (20%) to receive $360 million (80%) free money from the Federal Transit Agency (FTA) to build LRT along I-25.

Since 1997, many more millions of dollars have been added to the estimated cost, and the cost projections keep rising. The DEIS currently places the cost at $883 million, not

including operating losses.[45] But, alas, the FTA is reluctant to honor their 80:20 formula when it means sending $706 million to Denver, not even on the FTA's list of "recommended" projects.

So, to win the "free money," Denver has the newfound burden of "sweetening the pot." Instead of Colorado's share growing to a mere $177 million (20% of $883 million), it is now being suggested that a 40% Colorado match would motivate the FTA to modify its "recommended" list to include Denver. What was to originally cost Colorado taxpayers $90 million has quickly escalated to $353 million. This is more than $150 for every man, woman, and child in the Denver-Metropolitan area, or about $600 for a family of four, just for construction. It does not account for the $23 million per year operating losses anticipated for this single LRT line, which adds about another $40.00 per year to every Denver family's tax burden. These are only the current local taxpayer costs, do not including our share of the federal tax burden. The experience of other LRT projects suggests that cost escalation has not ended.

These price increases should outrage voters. It is rather like going to a used car dealer and being quoted a price of $900 on a used car. When you come back a day later, the same car is now $3,530. Would you buy that car? Or would you be outraged at the used car dealer? And then, after the papers have been signed, it is disclosed that you have to pay the car dealer another $230 every year forever or $3,980 now, whichever you prefer. Suddenly, you realize that your $900 car deal has really cost you $7,510. Are you sure you don't want some of that "free money", kid?

All of this ignores the relevant discussion of value, utility, and more beneficial alternatives. But that is what "free money" is intended to do. "Free money" blinds non-market based political leaders. Rationality is the casualty. In the end the victim is the taxpayer, both in service and in cost.

A. TABLE 15: COMPARATIVE RANKING OF CONFIGURATIONS

Table 15 is the last Analytical Table. Considering that many readers will be in data overload by this time, Table 15 is largely non-analytical. It follows the methodology typically used in public presentations by transit agencies trying to gain public support for their LRT system. It assumes that most people don't really understand the relationship between numbers -- like the difference between $900 and $7500 in the used car example. It is the "Ma and pa simplified-to-the-point-of-being-oversimplified summary."

Table 15 ignores the relative magnitudes of various parameters and ranks them from 1 to 22, best to worst. The parameters ranked are: Total Capital Cost, Total Cost (capital + operating), Revenue generation Potential, Net Cost to Taxpayers, Traffic Congestion, Air Pollution, Reserve Capacity, and a Summation Ranking.

[45] Operating losses are estimated at $23 million per year which is calculated to have a present value of $398 million.

The Summation Ranking (last column) gives equal weight and adds four rankings: Net Cost to Taxpayers, Traffic Congestion, Air Pollution, and Reserve Capacity. Those who place heavier weight to costs or to air pollution can recalculate by their personal value system.

However, by this simple method a few observations follow. The 3-0-1 (MIS recommendation) is worse than 3-0-0 (do nothing) and 4-0-1 (DEIS recommendation) is not much better. These 3 rank dead last of the 22 alternatives considered.

Any 6 highway lane alternative is best for air quality, traffic congestion, and reserve capacity. The 5 lane alternatives compromise air, traffic, and capacity for better financial performance generally. The 6 highway lane alternative with 3 GP lanes and 2 or 3 HOT lanes produce the most value at the least cost.

B. COST OF CONGESTION

The cost of traffic congestion greatly exceeds the cost of eliminating it. Enormous amounts of money can be cost justified by multiplying a trivial value of times the number of people stalled in traffic. This is why people choose to pay tolls for HOT lanes. When congestion gets bad enough I-25 will be double decked, even at the high cost it will take to achieve it. Therefore, the injustice included in the potential misallocation of ROW on I-25 with the DEIS "preferred alternative" is that Coloradans will have to pay again later. The cost to double deck will be several billion dollars,[46] but will become cost-tolerable at some point. Policy makers have an obligation to use the existing ROW efficiently and defer traffic congestion and expense as long as possible. The failure to use resources wisely today imposes a very high cost in the future.

C. THE 3-2-X ALTERNATIVE

It seems clear by studying the data herein that the configuration that produces the least environmental impact, the fewest disruptions, and the most service to the most people for the least cost over the long term is the 3-3-0 configuration. The 3-2-0 and 2-3-0 configurations are also very attractive. 3-3-0 actually provides so much capacity that it injures the corridor's ability to generate revenue to pay for itself. But this report opens the "paying for itself" discussion for the first time. The counterbalancing view argues in favor of 3-3-0 for more capacity for the future and for moderation in short term toll rates.

There is another alternative that deserves mention. One not included in the 22 analyzed herein. But one that the analysis reveals as potentially viable. It is one that avoids foreclosing any future options. RTD and the special interests have stridently advocated approaches that forecloses all other options. RTD has pushed for LRT for over a decade and spent hundreds of millions of dollars without authorization. RTD steadfastly refuses to perform analysis of LRT performance. There has never been an RTD study on the cost effectiveness of the existing 5.3 mile LRT demonstration line, and the DEIS is being

[46] It is very difficult to estimate the cost of double decking I-25: maybe $5 to $10 billion, depending upon how much and when.

pushed through before opening day on the Southwest Corridor line. Will LRT live up to the claims of its proponents? There would be numerous reports trumpeting its effectiveness if that were the case. RTD and CDOT are trying to lock down the future having never studied the past in this premature submittal of a DEIS.

The foreclosure avoiding alternative allows everyone to observe how well various systems perform: in short a "3-2-X" configuration. The "3-2-X" is 3 GP lanes, 2 HOT lanes, and a "reserve lane." The reserve lane could be kept in unfinished ROW. It is available for LRT, if mass transit ridership should ever reach a sufficient level to justify the expense of installing rails. Deferring construction until ridership is proven may even negate the need for taxpayer subsidies. On the other hand, if ridership proves not to materialize, then the "reserve lane" can be reassigned as an additional GP or HOT lane.

In the short term, the highest and best use of the "reserve lane," would likely be as a dedicated busway[47] to encourage growth in mass transit ridership. As the first in a phased mass transit development, the cost to RTD and FTA would decline to $571 million, a savings to the two agencies of $675 million. Surely there are many other demands on the two agencies that would appreciate funding.

Compared to the DEIS recommended 4-0-1, the 3-2-X configuration at $280,000,000 (which would become no cost to taxpayers with a graduated debt retirement schedule covered by growth in toll revenues) saves taxpayers over $1 ½ billion, produces 29.5% less air pollution, and provides more societal mobility by moving more people faster.

Most importantly, 3-2-X defers the most costly and irreversible public policy decisions on the use of the Southeast Corridor ROW until more information on the true viability of LRT in Denver is available through a proper analysis of the Southwest Corridor and Central Corridor lines.

Everyone wins!!

CONCLUSIONS AND RECOMMENDATIONS

The history surrounding the planning and analysis of transportation improvements for I-25 in Denver is a dismal embarrassment. Plans have been created not as a result of technical analysis, but as a result of preconceived politically correct notions. The planning process has been manipulated by special interests, even to the point that blatant mistruths were included in early versions of "official" documents. These falsehoods were repeated at official public meetings and in numerous media accounts of those meetings. The MIS and DEIS are hardly more than propaganda pieces intended to rationalize view favoring LRT. Revised plans have corrected some of the previous errors, but not all of them. The process has still been unduly influenced by anti-auto special interests. The fear

[47] "Increasing the Productivity of the Nation's Urban Transportation Infrastructure," U.S. Department of Transportation, January 1992, page 15-1, "... busways will generally be a more cost-effective way of providing high-performance rapid transit services than light or heavy rail in nearly all cities in North America... This is particularly true for low-density, Sunbelt and western cities such as ... Denver ..."

of potential delays because of special interest legal actions is hindering the process to the point of extortion.

For Traffic and Revenue analysis, this report presents an entirely new analysis methodology. The proprietary analysis tools used by private consultants have never been opened to public scrutiny. It is known that conventional methodologies are inadequate. The methodology contained herein in addition to estimating toll revenue from a variable toll facility goes further to identify the most efficient use for a given ROW. The methodology is completely open for review, and an adequate level of detail has been provided to allow this sort of review. For the first time, estimates of costs, traffic congestion, and environmental benefits can be analyzed and debated in an open format. Like any analysis tool and modeling procedure, there are limitations, and the tool could be modified over time to improve its performance. In fact, it is expected that others will soon improve upon the ideas revealed herein.

This report has shown that in order to achieve congestion free driving on I-25, a pricing mechanism must be implemented. The DEIS recommended "preferred alternative," which does not involve user pricing, would result in zero improvement in traffic congestion over the 1996 condition the on the very day it opens. Motorists who have survived the construction process will not be pleased. Implementation of the DEIS will only lead to further mistrust of government's ability to meet the people's needs. The goal must be to create a transportation system that offers congestion free driving, better environmental outcomes, and lower taxpayer costs.

A number of flaws in the DEIS for the I-25 southeast corridor are presented in the report. First and foremost was the failure to adequately scope and analyze the available alternatives. The entire DEIS document is centered around a predisposition to LRT being placed in the corridor. This report has provided an analysis tool that should be included in all reviews of future LRT proposals in the nation. The placement of the LRT precludes adequate analysis in the DEIS, and will result in tremendous unaccounted-for future costs to upgrade I-25.

The failure of the DEIS to adequately address the costs and benefits of the various configurations for potential use of the ROW was discussed at length. Traffic growth projections in the DEIS are limited and weakly analyzed. Latent Demand has not been adequately addressed in the document. Impulse driving impacts on congestion were not considered due to limitations in the scoping process. The counting methodology for vehicles versus LRT boardings is inherently flawed. There was inadequate discussion of the potential costs of obtaining additional ROW or providing an alternative engineering solution in several bottleneck areas north of I-225.

HOT lanes, given no mention in the DEIS, have been shown to be a substantially superior solution in this report. Most people are familiar with variable pricing based on demand. People pay more for phone calls, airline tickets, water, gasoline, and electricity during peak periods. It makes sense to begin the process of bringing transportation financing into the real world -- especially when the demand for a freeway is exceptionally high, and

there is a limited amount of space available to build new lanes. There is a lot of value in the space next to the existing freeway, and just like beach front property, people will be willing to pay to use it.

The report recommends that the existing freeway be widened from three "free" lanes in each direction to three "free" lanes PLUS three "HOT lanes" in each direction. This plan adequately addresses the cost and environmental concerns that surround this project, but most importantly, it will guarantee future generations the ability to drive in congestion free conditions whenever they choose to pay to access the HOT lane facility. The HOT lane facility would be available to buses, taxis, vanpools, company carpools, and all other forms of rubber-tired mass transit vehicles, in addition to private automobiles. HOT lanes offer far more choices to people than fixed-guideway mass transit systems.

Other configurations may have the ability to achieve higher user revenues, but the argument that the taxpayers have already paid for three GP lanes is a viable argument. By adding HOT lanes and allowing those who benefit to pay their own costs, the cost to "free" lane users is unchanged. Only users who choose to pay the toll will finance the HOT lanes. As proposed by Governor Owens, debt financing is used, but with HOT lanes users who benefit produce the bond payback revenue streams. Thus general highway revenues currently envisioned as payment for I-25 construction may be reassigned to accelerate other projects throughout Colorado. This can be done irrespective of whether the TRANS bonds package passes or fails. Because I-25 is Colorado's most congested highway, it is also the best opportunity for HOT lanes to be financially viable, and the financial estimated contained in this report indicate that the HOT lane application would be very viable.

It is clear from this report that the plans to place LRT in the SE Corridor must be stopped. The ROW is needed in order to achieve the socially optimal usage for this transportation facility. RTD should instead plan to invest in additional buses which can use the congestion free HOT lanes, and operate at higher speeds than can be achieved by LRT. LRT will doom the Denver metro area to subsidies and future tax increases, and a decreasing proportion of people riding mass transit. The increases in the local costs already presented the LRT's ever changing cost estimates should outrage voters. The greatest cost, however, will be the future need to double-deck I-25 -- wasting literally billions of tax dollars that can be saved by using the ROW now. LRT is not financially, environmentally, or functionally justifiable for the I-25 Southeast Corridor. HOT lanes fulfill all the criteria, and those who receive the benefits will pay the costs.

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