I-70 Express Lanes Technical Memorandum

September 2018

MoDOT

ENVISION I-70

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I-70 Express Lanes Evaluation

1.0 Purpose

The purpose of this technical memorandum is to outline short-term and long-term options for the I-70 "median" express lanes in downtown St. Louis. This memorandum is being prepared in conjunction with the I-70 Planning and Environmental Linkages (PEL) Study. The PEL is a strategic plan outlining a long-term vision for the Interstate 70 Corridor in the St. Louis metropolitan area. The PEL assesses the current state of the corridor, including land use and development patterns; identifies transportation needs; regional and community goals; evaluates improvement strategies; and addresses transportation needs with recommended strategies and concepts to meet I-70 goals at the regional and community levels. The reader should reference the PEL for a more comprehensive view of the corridor. PEL recommendations for the I-70 corridor are broken down into five segments. The barrier separated median lanes are in Segment 5, the far eastern segment being evaluated. The express lanes were identified in the PEL as being underutilized.

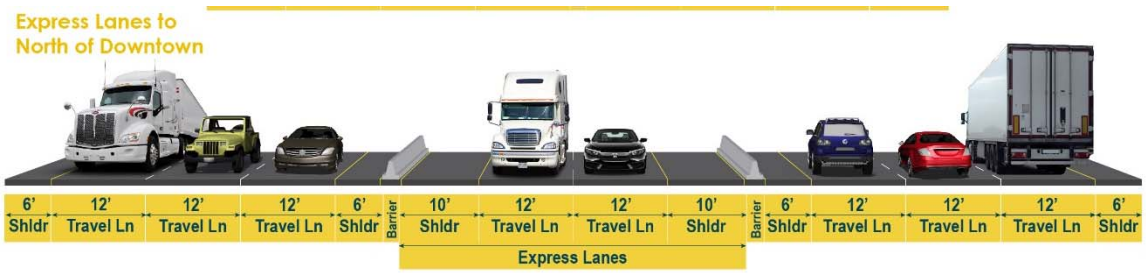
The Missouri Department of Transportation (MoDOT) currently owns and maintains the I-70 express lanes. The I-70 median lanes, which are approximately six miles in length and two lanes wide, had previously been used as reversible lanes from the 1960s until the early to mid-2000s. When the reversible lanes were implemented they were viewed as an innovative way to create additional vehicular capacity through the I-70 corridor to get people to the downtown St. Louis job center in the morning and back to the residential parts of the region at the end of the day. The median lanes extend from Union Boulevard on the west to Broadway on the east. Over subsequent decades many of the employment centers started spreading to other parts of the region reducing the significant directional split along the I-70 corridor. Several factors caused MoDOT to reevaluate their use and function. As the outdated technology and costly maintenance of the gates and restraining barriers, changes in travel patterns, and anticipated changes to the traffic patterns that would result from the Stan Musial Veterans Memorial Bridge carrying I-70 over the Mississippi River, MoDOT made the decision to maintain traffic flow only in the eastbound direction.

2.0 I-70 Travel Patterns

The primary reasoning for the reversible lanes is the fluctuation in directional flow of traffic. When MoDOT constructed the reversible lanes, St. Louis had high directional flows. Over the past five decades, directional travel through the I-70 corridor no longer has as significant of a directional split. In 2016, the Average Daily Travel (ADT) ranged from 136,828 vehicles per day (vpd) east of I-170 to 127,939 vpd. Despite some of the directional balancing, the PEL documented several bottlenecks that occur in both the eastbound and westbound directions in the morning and afternoon peak periods.

3.0 Existing Conditions

I-70 is predominantly an eight-lane facility with three lanes in each direction in the outside lanes and two median eastbound express lanes in the City of St. Louis. Both the outside lanes and the median express lanes have a posted speed of 55 MPH. The cross section of the median lanes consists of two 12′ lanes and two 10′ outside shoulders. The outside shoulders vary in width from 8′-12′, but typically are 10′ wide. Shoulders narrow to accommodate foundations for overpasses and overhead sign structures and widen around some horizontal curves.



3.1 Issues Influencing I-70 Median Lane Operation

Aside from the balance of motorists traveling the corridor, there are other factors that could impact design of the median lanes or the operational characteristics of the corridor.

3.1.1 Operational Limitations

Current limitations exist with the westbound entrance to the express lanes at the easternmost limit. The zipper barriers that were originally installed at this location have been removed due to mechanical failure and replaced with permanent jersey barriers. At this time, the express lanes cannot be opened for westbound traffic operations. In addition to the mechanical issues at the eastern entrance, geometric challenges also exist due to the close proximity of the entrance ramp from the Martin Luther King Bridge ramp. The distance from the end of the ramp to the eastern express lane entrance causes safety concerns for vehicles traveling across three lanes of traffic to access the express lanes.

3.1.2 I-70 Overpasses

When I-70 was constructed, the overpasses were designed with piers placed on either side of the median lanes, thereby locking in the three-two-three lane configuration without a major bridge reconstruction effort. As investments in reconstruction and rehabilitation of the bridges over I-70 have been made over the last 15-18 years, the existing cross section was maintained.

The PEL has identified several bridges that have substandard vertical clearances limiting some freight movements. Despite substandard

clearances and limitations on corridor design, the existing bridges have several years of useful life remaining and replacement could cost tens of millions of dollars and have significant impact to travelers and the adjacent communities. Despite the limitations, the existing bridges should be maintained for a majority of their remaining useful life, thus all short to medium design options are based on maintaining the bridges. Longer term options have a blank slate of design options to match the operational strategies outlined in the PEL.

3.1.3 Northside/Southside Light Rail Extension

A study evaluating light rail options connecting the north and south sides of the city, appropriately named Northside-Southside Light Rail Extension for the St. Louis Region, is in its final stages. The goal of the Northside-Southside Light Rail is to better connect neighborhoods to jobs and opportunities. The Northside-Southside study team recommended alternatives north and west of the City near the proposed National GeoSpatial Intelligence Agency. The impact of the Northside-Southside Rail is being discussed as part of the study. While the new light rail may not pull motorists off I-70, it may have an indirect benefit that could have a longer-term impact on regional travel patterns. For example, transit may trigger new developments adjacent to light rail. Over time employment centers downtown may draw more on employees coming from these light rail neighborhoods and fewer from communities to the west, thus lowering the work trips utilizing I-70. However, these new developments may attract a generation that prefers to live near light rail for entertainment options, yet still work along the I-270 and I-170 business parks and drive to work. This would add to the reverse commute patterns.

Based on the current study, light rail could be operating by 2028. As the I-70 PEL and subsequent studies are prepared in parallel, a key element would be to create I-70 access points away from transit stations in order to create a pedestrian friendly environment around the stations.

3.1.4 Impact of Stan Musial Veterans Memorial Bridge

In February 2014, a new river crossing over the Mississippi River was constructed for I-70 north of its current location on the Poplar Street Bridge. Formally named the Stan Musial Veterans Memorial Bridge, this bridge provided a standalone river crossing for I-70. Previously I-70 shared a river crossing with Interstates 64 and 55 on the Poplar Street Bridge resulting in a bottleneck into and out of Missouri from the east. The Stan Musial Veterans Memorial Bridge now carries over 54,000 vehicles per day between Illinois and Missouri and clears up a congestion

point on a key interstate route for freight mobility in the United States. While the Stan Musial Veterans Memorial Bridge relieved traffic between Missouri and Illinois, it also had an impact on the traffic operations on the I-70 corridor and the median lanes on I-70. The current design does not offer a direct connection from the median lanes to the Stan Musial Veterans Memorial Bridge. The direct access limitation restricts the benefits of some of the design options outlined in the next section.

3.1.5 Special Events/Destinations

Downtown St. Louis has several special events and regional destinations including Cardinal baseball games, Blues hockey games, Soulard Mardi Gras, the Gateway Arch, and events at The Dome at America's Center. These events draw a large number of persons to downtown. The I-70 corridor is utilized heavily for these events, but depending on the location of the event, the impact on traffic can be different. For example, Busch Stadium and the Enterprise Center impact traffic flows on I-44 and I-64 to a greater extent than I-70, while events at the Dome at America's Center impact I-70 to a greater extent. As planning continues for the I-70 corridor, access and interchange design considerations should revisit special events north of downtown should the City of St. Louis attract another NFL team, construct a new stadium, or other major event center.

3.1.6 Freight

I-70 through the study area is a major freight route experiencing high volume commercial truck movements. There are six Class I railroads and several Mississippi River ports within the project limits of the I-70 PEL. Freight continues to be a key element in the economic vitality of the region, and the operation of I-70 plays a key role in the region's ability to safely and efficiently accommodate freight movements.

There are several on-going and completed studies which have documented the need for improvements to better serve freight including the East West Gateway (EWG) commissioned report, *St. Louis Regional Freight Study* (EWG 2013), to evaluate freight infrastructure capacity and usage in the St. Louis Metropolitan area. A summary of freight operations and related freight studies is outlined in greater detail in the PEL Study.

As it relates to the freight, I-70 median lanes play a limited role in freight mobility, primarily due to limited access points. The median lanes could play a role in improving freight movements in the region, but access points at key locations that serve freight movements would need to be incorporated into the design. As an example, a freight bottleneck was identified at the east end of the corridor in the PEL report. Providing

access to and from the Stan Musial Veterans Memorial Bridge would allow for more options for regional freight movements. Additionally, providing an exit at O'Fallon Park, which leads to North Broadway and Carrie Drive serving key intermodal and trucking centers, would eliminate trucks needing to go into downtown and back tracking north on Broadway.

3.1.7 Environmental Justice

When I-70 was widened, the neighborhoods immediately adjacent to the corridor were impacted disproportionately. Impacts included loss of connectivity across the corridor and higher volumes near interchanges creating poor pedestrian accommodations. While I-70 connected downtown to the airport, St. Charles County, and Kansas City, it divided the neighborhoods of Walnut Park, Penrose, and Mark Twain. As part of longer term options for the corridor, all long-term solutions should evaluate how to better connect neighborhoods to either side of the corridor and evaluate points of access to ensure that access is not restricted.

4.0 Outreach

The project team identified members of the community who may provide opinions and insights about the express lanes, including the future use of these lanes. These stakeholders included staff from MoDOT, East-West Gateway Council of Governments, and Downtown STL, Inc., as well as comments received from the Senior Advisory Group, Technical Advisory Groups, and the public during the outreach of the I-70 PEL Study. Themes that emerged from these discussions included the following:

- Operational and maintenance issues need to be addressed
- If removal is an option, consideration needs to be made of the overall benefit to the region versus the cost, which may be used elsewhere with a better return on investment
- Access needs to be provided to/from the Stan Musial Veterans Memorial Bridge
- Access needs to be provided to trucks accessing the industrial area to the east of I-70
- The express lanes feel "old" and do not seem to be used much
- The express lanes, and overall I-70, needs to be more aesthetically pleasing

5.0 Proposed Alternatives

Four alternatives for the existing median lanes were developed to help shape a discussion on potential options for I-70. Alternatives were evaluated based on how well they met the goals outlined in the I-70 PEL. Alternatives were categorized based on their applicability to serve as 'short-term' and 'long term' alternatives or both. Short-term alternatives are those that would not require modifications to existing bridges, the

need for additional right-of-way, or a full Environmental Impact Statement. Long-term alternatives are defined as any alternative that would be considered as part of a blank slate for the corridor, including bridge replacements, new interchanges, and, potentially, right-of-way modifications.

The focus of this memorandum is on the short- to mid-term options that are based on the assumption that the existing three-two-three lane cross section will be maintained. If the I-70 corridor is overhauled, there will be additional long-term alternatives and considerations that will be considered as part of that study.

In addition to the four alternatives, several operational concepts are discussed. An operational concept are strategies that can be deployed to better managed traffic flow. Examples of operational strategies would include additional ITS or managed lane operations. Operational strategies are alternative neutral and can be used under both short-term and long-term strategies. Operational strategies follow the discussion of alternatives.

The four alternatives developed include:

- Maintaining eastbound traffic flow (existing condition),
- Re-implementing the reversible lanes,
- Converting median lanes to one-lane in each direction, and
- Closure of the lanes.

Sub-options for each alternative were developed for some of alternatives listed above.

5.1 Alternative 1 - Maintain Eastbound Flow (Short Term/Long Term)

Alternative 1 would maintain the current condition of the inbound (eastbound) flow through the median lanes, but on a permanent or semi-permanent basis. Inbound flow has worked because the eastbound traffic flows have been concentrated around the morning peak period, while increased westbound flows are spread out over several hours in the afternoon and early evening. Motorists in the St. Louis area have adapted to the eastbound-only flow and may have adjusted travel patterns accordingly. Keeping I-70 as eastbound flow would have little to no costs and may allow the removal of the swing arm, restraining barriers, westbound dynamic message signs, and guide signs eliminating maintenance costs associated with each of these items. The disadvantage of Alternative 1 is the limitation to accommodate periods of high westbound traffic flows. A sub-option to consider with Alternative 1 would be maintaining some sort of manual reversal of lanes for special events or to accommodate an emergency evacuation plan for downtown. This would require that the

crashworthy barrier at either end of the median lanes has the ability to be moved by MoDOT maintenance personnel or emergency equipment.

5.2 Alternative 2 - Re-establish the Reversible Lane Operation (Short Term/Long Term)

Re-establishing median lanes
As part of re-establishing reversible lane operation, revising the operational plans should be evaluated. This plan should discuss if MODOT wishes to operate remotely, manually or a combination of the two. Because the concern of a head-on collision is so great, remote operations would require full and overlapping camera coverages. In-operable cameras will need to be serviced immediately.

Re-establishing reversible lanes operation would give MoDOT the flexibility to provide additional capacity based on current travel conditions. Operation could be based on recurring congestion, or in response to special events or incidents that occur on the local freeway network. Re-establishing the reversible lane option would require replacement of the existing jersey barriers and replace with a movable gate system and confirm that the signage for the westbound lanes remains and is current. Unit prices from a recent repair costs for the repair of the 7.8-mile reversible lane system on I-90/94 in northeastern Illinois were used to approximate the costs to rehabilitate the I-70 reversible lanes. Based on this related cost the I-70 repairs is approximated to be $6M. This estimate includes swing gate replacement/rehabilitation, barrier wall repairs, restraining barrier repair, replacement of the programmable logic controllers (PLC), installation of additional CCTV surveillance and six (6) new dynamic message signs. The cameras and sensors would allow MoDOT to operate the system remotely; however, the current plan is to have at least two maintenance personnel drive the corridor for each reversal of the lanes. Full remote operation would require a higher degree of maintenance and testing of the sensors to ensure that the lanes are clear before reopening in the opposite direction. This alternative would assume eight cameras (one per mile plus one at each entry point) and six new DMS signs including foundations and supports. Future detailed design may determine that some of the signs could be on the same supports as the current signs.

5.3 Alternative 3 - Create One Express Lane in Each Direction (Short-Term Only)

A third alternative would be to create one (1) express lane in each direction. Providing an express lane in each direction would equalize the balance of lanes between eastbound and westbound I-70. Eastbound capacity would be decreased slightly, but westbound capacity would be increased. Alternative 3 would require the installation of a median barrier wall down centerline and the remaining space on either side of the wall would be reconfigured to accommodate one traveled lane with inside and outside shoulders. While two-way operation would match existing travel patterns, Alternative 3 results in some geometric challenges requiring design exceptions, a reduction in the posted speed limit, or both.

Geometric challenges also include providing adequate shoulder width to pass a stalled vehicle, shy distance, and stopping site distance. The existing median lanes include 40’ to 44’ of traveled way consisting of two 12-foot lanes and a variable outside shoulders ranging from 8 to 12 feet. If a two-foot-wide double

Establishing One Express Lane in Each Direction
Establishing an express lane in each direction would match travel current patterns, but would result in geometric challenges to implement. Geometric challenges include shoulder width, shy distance, and sight stopping distance.

faced median wall down the centerline would result in 19′ to 22′ of available space in each direction to accommodate a traveled lane, an inside shoulder or wall offset, and outside shoulder. Within 19′ there is not sufficient space to accommodate a full outside shoulder to accommodate a stalled vehicle, thus a combination of both the inside and outside shoulder would be used to pass a stalled vehicle. Accommodations could be made to provide removable barriers at intervals along the express lanes in the case of an incident in order to allow emergency vehicles to gain access.

The design of the inside shoulder would be based on the shy distance. Shy distance is important because it allows drivers the ability to see an object or stopped vehicle with sufficient time to stop. The width of the inside shoulder is determined based on the recommended shy distance and sight stopping distance.

The AASHTO design guidelines are shown below:

Design Speed	Shy-Line Offset
70 MPH	9′
60 MPH	8′
55 MPH	7′
50 MPH	6.5′
45 MPH	6′

Using a 60 MPH design speed the inside shy-line offset would be 8′. With an 8′ offset there would be not be any available space on the outside shoulder. Even if this was deemed acceptable from a lateral offset perspective it would lead to concerns with vehicles driving over the drainage inlets.

Allowing a narrower inside shoulder is a common design exception when trucks and other larger vehicles are prohibited from the inside lane; however, a narrowing of the inside shoulder impacts the sight stopping distance (SSD) or the ability for a motorist to see a stopped vehicle or object in the roadway with sufficient time to react and break. Of the four horizontal curves along I-70, two of the curves would not have sufficient SSD at a 45 MPH posted speed limit. MoDOT may consider the use of lanes less than 12 feet, which could allow a slight increase in the posted speed.

The suggested cross section for Alternative 3 would include a 2′ median wall, 4′ of shy distance separation and a 12′ lane. The resulting outside shoulder would result in a variable shoulder of 3′ to 5′. The posted speed in the express lane should be posted at 45 MPH. Because the posted speed would be less than the

mainline, it would be suggested that the express lane only be open during certain times of the day.

The cost of installing a median barrier wall would vary based on the design of the barrier. A semi-permanent barrier wall consisting of a pinned jersey barrier and glare screens would cost approximately $2.5M. A permanent wall and foundation would increase the cost to approximately $4.4M.

5.4 Alternative 4 – Close/Repurpose the Median Lanes (Short Term/Long Term)

Alternative 4 would close the median lanes to general traffic. Four sub options were developed ranging from consideration for alternate transportation methods to full closure. While traffic volumes on I-70 have decreased over the last several years, capacity issues remain a challenge through the corridor during peak periods and during special events. The PEL report identified several congested areas in Segment 5 which includes the section of median lanes. The debate related to Alternative 4 is not whether or not the median lanes provide additional eastbound capacity, but rather if the operational benefit to general purpose lanes outweigh the operation and maintenance costs of maintaining lanes and the benefits that could be provided to other regional initiatives. Westbound traffic would not be impacted by Alternative 4.

Sub-options include:

- Transit/busway,
- Truck only lanes,
- Connected vehicle pilot, and
- Full closure.

5.4.1 Transit/Busway

Installing Bus Rapid Transit through the I-70 corridor was previously reviewed by the East-West Gateway and dismissed to focus transit efforts on other high priority corridors. This corridor between downtown and St. Louis Lambert International Airport is well served by the Metro Red Line. For a transit/busway to be a vital alternative for the median lanes, transit routes serving a unit of the regional population in the vicinity of I-70 would need to be identified.

5.4.2 Truck-Only Lanes

Improving freight and intermodal operations is an initiative of East-West Gateway and the greater St. Louis region. Providing truck-only facilities access could provide an uncongested connection to locations through the region and remove a significant amount of truck traffic from the general-purpose lanes. Per the East-West Gateway Freight Study, I-70 median

lanes could provide better connections between the industrial areas of St. Louis Lambert International Airport, Kingshighway-70, and the East Industrial Gateway.

One-way or two-way operation options could both be considered based on truck flow patterns; however, the narrow cross section with a median barrier and single lane operation would not be advisable for freight operations. Trucks would need to travel through the median lanes similarly as they do on a two-lane rural roadway with passing restricted. Even with truck-only access to the median lanes, the current limitation of access points near freight connections, and concern of issues during an incident may reduce the benefits of this option. For truck-only operation to be effective, additional access points to regional connections and additional regional facilities would need to be added.

An additional study would need to occur in order to determine the extent of how the express lanes could accommodate truck-only traffic, as well as the benefits to the region.

5.4.3 Connected Vehicle Pilot

The emergence of connected and autonomous vehicles is reshaping the transportation industry. Agencies, private industry, and academics are continuously looking for testing areas to refine the design. Since the median lanes are not required for capacity outside of the morning peak, this paved area could be used as a test bed for connected and autonomous vehicles. An added benefit of allowing testing, whether it be public or private, would be the potential for an outside funding source being made available for infrastructure. Connected vehicle infrastructure generally includes a robust communications system and intelligent transportation systems. MoDOT could negotiate to utilize this added communications infrastructure for general operation of the corridor. A disadvantage of a Connected Vehicle Pilot would be the high degree of visibility of all testing activities. This option could be implemented now as it is a minimal disruption for the express lanes to be closed for periods of time.

5.4.4 Full Closure

Full closure would create a blank space that could be used for additional greenspace through the corridor, require less pavement, smaller bridges, fewer drainage structures, fewer sign structures, and create less of a footprint for plowing operations and less drainage run off. The cost savings in this corridor could be invested on other areas of the MoDOT transportation network. A disadvantage would be the loss of the additional capacity to general traffic and for multi-modal options. The

loss of eastbound capacity could be offset with operational strategies that could increase throughout with fewer lanes. Several operational strategies are discussed in the section that could be applied to both the eastbound and westbound directions, negating the need for the median lanes.

Full closure options could be temporary, semi-permanent, or permanent. For example, the median lanes could be used for a connected vehicle pilot for several years as the median lanes have useful life remaining but could be closed as pavement and rehabilitation needs are required.

If full closure would occur, rough order of magnitude estimates from a recent Chicago-area reversible lane project and MoDOT bid tabulations assume up to $5 million per bridge for the replacement of 12 bridges ($60 million) plus pavement improvements for six miles at $2.7 million per mile ($16.2 million) for a total construction cost of approximately $76 million. Maintenance cost savings associated with snow removal, sewer cleaning, sign inspections, patching, and street sweeping could be as much as $50,000 per year.6.0 Traffic Operations Strategies

6.0 Traffic Operations Strategies

Traffic Operation Strategies use a combination of regulation, technology, and small infrastructure improvements to create additional capacity within existing roadway configurations. Potential traffic operations strategies that could be effective on I-70 include:

- Intelligent Transportation Systems
- Managed Lanes
- Active Traffic Management
- Resilient Power and Communications

6.1 Intelligent Transportation Systems

ITS uses advanced applications of electronics and communications, such as enhanced traveler information and variable message signs, to improve traffic operations and increase roadway effectiveness. The installation and maintenance costs of an ITS program tend to be lower than traditional infrastructure improvements, such as adding lanes. MoDOT currently uses ITS along I-70 to help support incident management, monitor traffic conditions, and distribute traveler information using a fiber optic communications network, closed-circuit television (CCTV) cameras, DMS/variable message signs (VMS), microwave vehicle detection systems (MVDSs), and road weather information stations (RWIS).

The I-70 ITS network is part of a region-wide system consisting of hundreds of cameras, dynamic message signs, and vehicle sensors. ITS improves the operations by providing motorists more information on their trip, better responding to incidents. When the Gateway Guide system detects an incident, an operator at the MoDOT Transportation Management Center can notify Motorist Assist or emergency personnel. The use of intelligent transportation systems should continue in all proposed short-term and long-term options.

6.2 Managed Lanes

An operational strategy used in corridor management includes the use of managed or flexible "flex" lanes to be incorporated into corridors. As defined by the FHWA, managed lanes are defined as a highway facility or set of lanes where operational strategies are proactively maintained in response to changing conditions. Examples include high occupancy vehicles, truck restrictions, or as previously utilized on I-70, reversible flow lanes. Some agencies are experimenting with using the inside or outside lanes, including the inside or outside shoulder, to be used as a managed lane. Managed lanes can be actively managed (e.g. opening the shoulder for transit use when mainline speeds are reduced below a certain point) or passively managed (e.g. Metro Transit buses permitted to use the shoulder from 7:00-9:00 AM).

VDOT I-495 Express Lanes
Due to past successes, the Virginia Department of Transportation is extending their managed lane network on I-95 and I-295. VDOT managed lanes consist of HOT lanes and reversible flow lanes.

In the future, managed lanes could include lane restrictions for electric vehicles, high occupancy toll lanes, or connected/autonomous vehicles. Some managed lane operations require or benefit from physical separation (e.g. revisable lanes and toll lanes adjacent to general purpose free lanes), but most operational strategies would not. When evaluating short- and near-term options for median lanes, managed lane strategies should be considered.

6.3 Active Traffic Management/Lane Control

Active Traffic Management (ATM) is an operational tool added onto managed lane options. ATM consists of lane control signs placed over the lanes every half mile or mile (full ATM) or the use of frequently spaced dynamic message signs to warn of the travel conditions immediately ahead.

During non-peak operation, the lane control signs only provide information on incidents; however, during peak times the lane control signs are used to open the left shoulder for transit use or utilize the shoulder as an additional general-purpose lane. Tolling or transit use is not required for a managed lane to be effective. The use of the left shoulder and

Illinois Tollway I-90 Smart Road
The IL Tollway has deployed ATM on a 16-mile section of I-90 consisting of lane control systems, additional DMS, and vehicle sensors. Due to the operational and safety successes of the ATM strategies with lane control, signs are being added to the I-294 Corridor.

ATM strategies essentially creates a fifth lane of traffic on a four-lane cross-section allowing an agency to provide added capacity with less pavement. The use of the shoulder lane requires some additional operations effort to visually sweep the lane for debris before it is put into operation and to actively monitor the lane during operation to detect a stalled vehicle. Coordination with the state police is required to educate them on moving all enforcement activities to the outside shoulder.

6.4 Resilient Power and Communications

As the corridor begins to include more technology, the importance of reliable power and communications greatly increases within the corridor. Typically, MoDOT has relied on the local power utility to supply power to its systems. While the recommendation will not be for MoDOT to get into power generation, there are several steps to greatly improve the electrical reliability along the corridor.

A design alternative that incorporates the use of Intermediate Power Distribution and Communication Shelters (IPDC) could be considered. IPDC facilities would provide backup power service for critical ITS assets, serve as a hub for lighting controllers, and be a central resource for communications networking hardware. IPDC facilities would be deployed every 1.5 miles to provide the coverage necessary to operate roadway lighting from a controller placed in the shelter. An IPDC could be equipped with battery backup systems, connected to two electrical substations, or connected together to provide redundant service. Connecting to multiple substations with an automatic fail over switch allows for corridor power to be maintained should power be lost to one of the substations. In lieu of or in addition localized generation could be used. Localized generation could consist of either a four-hour battery backup system or a permanent natural gas generator. Multiple power options greatly reduce the occurrence that corridor facilities would be without power.

As critical as power is to a corridor, so is communications. The amount of data being transmitted is continually increasing. These increases are expected to continue as connected and autonomous vehicles become more common. The best communications media is the use of fiber optic cables. Spare fibers are recommended. Fibers should be broken into condo (long distance) and distribution. The cost of a fiber optic network is with the installation of the conduit and cable itself, not with the number of fibers. Suggested fiber counts include one (1) 144 strand backbone singlemode fiber optic cable for distribution and one (1) 432 strand “Condo” singlemode fiber optic cable in duct bank. The communications network should have redundant and drivers paths to protect the network from an accidental cable cut. To maintain a redundant network,

MoDOT should use Layer 3 switches for ITS access and distribution switches to create an Ethernet mesh solution.

7.0 Other Long-Term Considerations

7.1 Limits and Access Points of the Median Lanes

Assuming long term options consider maintaining median lanes in one direction, bi-directional, or reversible operations consideration should be made to extend the lanes westward, at a minimum to I-170. Extension further west, possibly into St. Charles County, should be considered as a means of reducing congestion. Access into and out of the median lanes should also be considered along the corridor. On I-70, access should be considered at I-270 and I-170. Optional freight connections could be added at Bircher, Carrie, Adelaide, or Branch. Connections should also be provided to the Stan Musial Veterans Memorial Bridge so that through motorists on I-70 can utilize the express lanes.

Access can be provided through median weaving areas or direct ramp access. Direct ramp access is preferred if the median lanes are managed or part of a managed lane network.