



Transportation Management Center **2018 Performance Evaluation**

City of Austin

Kimley»Horn

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Performance Evaluation for City of Austin

Mobility Management Center, 2018
Austin, Texas

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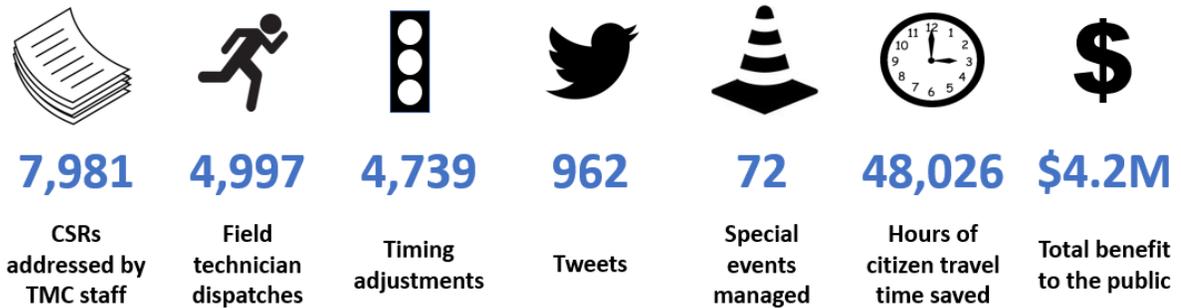
LIST OF ABBREVIATIONS

BBU	Battery Backup Unit
CCTV	Closed-Circuit Television
CSR	Citizen Service Request
DMS	Dynamic Message Sign
TMC	Mobility Management Center
TxDOT	Texas Department of Transportation



2018 IMPACT AT-A-GLANCE

The graphic below summarizes the information discussed throughout this report, representing totals for 2018:



EXECUTIVE SUMMARY

The City of Austin Mobility Management Center's (TMC's) goal is to reduce private & commercial vehicle occupant delay, goods inventory delay, cost of crashes, fuel cost, and environmental cost of fuel emissions. TMC staff provide a variety of services to the City of Austin and traveling public. It is staffed 7 days a week, and TMC personnel perform a wide range of duties. These duties include addressing citizen requests, deploying resources to address equipment issues, providing incident management, assisting emergency service providers, assisting with traffic management during special events, monitoring day-to-day traffic operations, providing travel information, and developing signal timing plans.

In performing these services, TMC staff provide distinct benefits that are quantified in this report. These benefits are analyzed and documented annually to evaluate the benefit-cost ratio of the TMC. Only a portion of the total benefits are quantifiable, so the remaining benefits are discussed qualitatively.

Sources of quantitative benefits provided by TMC staff include timing adjustments for lane closures related to incidents & special events, signal outage responses, and remote responses to citizen requests. These benefits are quantified using data reported by TMC staff throughout 2018 and produced by traffic simulation software. Signal timing adjustments help service the additional turning demand at upstream signals and change in traffic patterns during lane closures and effectively reduces delays and queues. The added benefits from TMC staff proactively implementing timing adjustments include saving the public time, reducing vehicle emissions, and lowering the chance of secondary collisions.



Additionally, TMC staff identified approximately 57% of the signal outages between 6 am and 8 pm before the issue was reported as a citizen service request (CSR). In each of these instances, the operators reduced the response time for a technician to resolve the issue, which translates to several hours of delay saved for vehicles traveling through the intersection. In addition to reducing lengthy delays associated with traffic signal outages, outages can increase likelihood of collisions at the intersection which is also mitigated from a faster response time. Before the TMC was operational, technicians were dispatched throughout the city to address all CSRs regardless of the issue reported. In the current operations, TMC operators now manage CSRs by investigating all the complaints and efficiently dispatching technicians if need be, ultimately increasing output of resolved CSRs and improving utilization of signal technicians and city resources. There are other qualitative benefits, including distribution of traveler information and coordination with other agencies that is handled by the TMC and outlined further in this report.

This report estimates that the benefits the TMC staff provides to the City of Austin and the traveling public outweighs the cost of operating the TMC. The benefit-cost analysis conducted showed a total benefit of more than **\$4.3 million**, and an operating cost of approximately **\$1.8 million**. This resulted in a benefit-cost ratio of **2.4** for 2018. This is an increase from the \$1.7 million of benefits reported in 2017.



I. INTRODUCTION

The City of Austin Mobility Management Center (TMC) staff perform many duties that improve the movement of vehicles and goods throughout the City of Austin providing an added benefit to the people and businesses traveling along the roadway network. The TMC staff address citizen requests, deploy resources to address equipment issues, provide incident management, assist emergency service providers, aid in special event management, monitor day-to-day traffic operations, provide travel information, develop signal timing plans and more.

Several years ago, the operation and staffing of the TMC were expanded to provide additional benefit to the traveling public and to mitigate increasing congestion on City of Austin roadways. The TMC's goal is to reduce private & commercial vehicle occupant delay, goods inventory delay, cost of crashes, fuel cost, and environmental cost of fuel emissions.

This report serves as an internal summary of services and benefits provided by TMC staff as part of the TMC operations contract in 2018. This report assesses the impacts of the TMC for the year 2018, provides information to the City of the TMC's performance, and outlines specific benefits in a benefit-cost analysis. Only a portion of the total benefits are quantifiable. For benefits to be included, the performance measure must be understandable to technical and nontechnical audiences, calculated easily, and estimated accurately. The benefits are largely reported in terms of monetary cost savings from reduction in vehicle occupancy delay. This report is the third of an annual series that documents the performance of the TMC expansion. The methodology in this report is repeated from the 2017 report.



II. MOBILITY MANAGEMENT CENTER OVERVIEW

A. Capabilities, Services and Goals

The TMC's goal is to reduce private & commercial vehicle occupant delay, goods inventory delay, cost of crashes, fuel cost, and environmental cost of fuel emissions. The capabilities and services provided to meet these goals include:

- **Monitor traffic conditions and signal operations** using City's network of communications and CCTV coverage
- **Investigate CSRs**
- **Dispatch technicians** and provide support for technicians in the field
- **Interface with citizens** to investigate CSRs and communicate results
- **Make timing adjustments** in response to lane closures and incidents
- **Coordinate with other City departments and contractors** on construction activities and special events
- **Coordinate closely with TxDOT and Mobility35** on major construction projects along state roads and highways, and manage signal operations during construction
 - **Provide on-call support** for contractors in the field during construction events
- **Develop specific timing plans for special events**
- **Send out DMS messages** to advise public of special events and abnormal road conditions, which may require coordination with TxDOT for significant road closures
- **Adjust detection** as necessary to maintain optimal system operation

The TMC is actively staffed seven days a week, from 6 am to 8 pm during weekdays and 10 am to 6 pm on weekends (opening at 9 am on Saturdays) by operators and managers with expanded hours during special events.

B. Qualitative Benefits

Many of the TMC staff's daily activities provide qualitative benefits to the traveling public and City of Austin staff. These benefits, although cannot be included in the benefit-cost ratio, are important to improve the operations of the TMC and the coordination between agencies. These activities are listed below.

- **Provide TMC tours** to a variety of groups ranging from UT students, other municipal agencies, 311 operators, and other guests. This gives a chance to display the City's capabilities and infrastructure and showcase the City as a traffic management leader in the area.
- **Represent City at meetings for AIM High (Austin area Incident Management for Highways)**. The AIM high meetings are held every other



month at CTECC and are attended by TxDOT, the Austin Police Department (APD), the Austin Fire Department, the Sheriff's office, TxDOT Toll Division, the Central Texas Regional Mobility Authority (CTRMA), the City of Round Rock, the City of San Marcos, and various towing companies. Austin TMC presence at these meetings has allowed for the development and strengthening of relationships with APD and highway patrol. Now, during a major incident on the highways, law enforcement does not override signal timings, and instead the responsibility falls to the TMC. This allows for the TMC to maximize the signal output and relieve officers to attend other needs.

- **Attend TMC Agencies Meetings** every other month (just before the AIM High meeting). These meetings are attended by agencies that operate a TMC, including TxDOT, CTRMA, the City of Round Rock, and the City of San Marcos. Involvement in these meetings has improved communication and coordination between these agencies, which is critical during a major event and for timing corridors that fall under multiple jurisdictions.
- **Attend ROW Closure meetings**, which are a newer initiative in the City of Austin, intended to address all lane closures in the city and centralize lane closure notifications. TMC staff attendance at these meetings helps the TMC prepare the timing adjustments and traveler information that may be necessary during the closures. This coordination also helps TMC staff track and identify lane closure issues for inspectors.
- **Support Capital Metro TSP Reporting** by providing background information and TSP data to the Texas A&M Transportation Institute (TTI), who was retained by Capital Metro.
- **Enhance Weekend Retiming Efforts** by supporting field work done by signal engineers. Signal engineers can now call the TMC to make offset changes while they are fine-tuning, instead of pulling over to manually make changes at each traffic signal controller.
- **Staff the Combined Transportation and Emergency Communication Center (CTECC)** as necessary when Emergency Operations Center is activated. In 2018, TMC staff helped coordinate bottled water pick-up points around the city during the water boil notice and monitored rising water during various flooding events.
- **Review Traffic Control Plans** for special events. TMC staff can provide suggestions to make sure special event operations will be successful. This is especially valuable as TMC staff can provide input from previous occurrences of the event and supplement the designated route with signal timing adjustments.

Furthermore, there are additional benefits that cannot currently be quantified, including actions resulting from other supporting tasks of the TMC operations contract (e.g. software and other initiatives). These qualitative benefits include:

- Dissemination of traveler information



- Assist in deployment and maintenance of video detection
- Coordination with schools to deploy and maintain school zone flashers
- Identification and integration of enhancements to various transportation software, including Advanced Transportation Management System
- Deployment of Automated Traffic Signal Performance Measures software for advanced signal operations
- Coordination to procure fiber management software and develop Citywide Communication Plan RFQ
- Development Video Management Software RFI
- Analysis of retiming benefits using probe data
- Support for grant applications
- Monthly analysis of citywide performance measures on critical corridors

The expanded TMC operations ultimately allows for many additional tasks to be completed for the City of Austin; translating into both time saving for the public and improved safety of the Austin roadway network.

III. ASSESSMENT OF BENEFITS

A. Performance Measurement Methodology

Much of the data for the benefit assessment presented herein is from the City of Austin's data tracker (**Figure 1**). This online system was developed in-house at the City of Austin and is fully integrated with the City of Austin's 3-1-1 service. This service is the primary process by which citizens can submit requests, known as Citizen Service Requests (CSRs), directly to the TMC. It is also the tool TMC operators use to manage and record day-to-day operations. Examples of recorded information within the data tracker include:

- Signal outages and signals in flash mode
- Signals with malfunctioning equipment or detectors
- Lane blockages near signal locations
- Signal retiming information and needs
- Citizen Service Requests (CSRs)
- Dynamic message sign updates
- Social media messages
- Dispatched technicians
- Special event operations

Using the data tracker, TMC operators track the actions taken to investigate and resolve CSRs. The data tracker also reports information in regard to response time for signal outages and dispatched technician. Signal timing adjustments are recorded in the data tracker which can be used to quantify the benefit of those adjustments during lane closure incidents, planned events, and other traffic congestion issues.

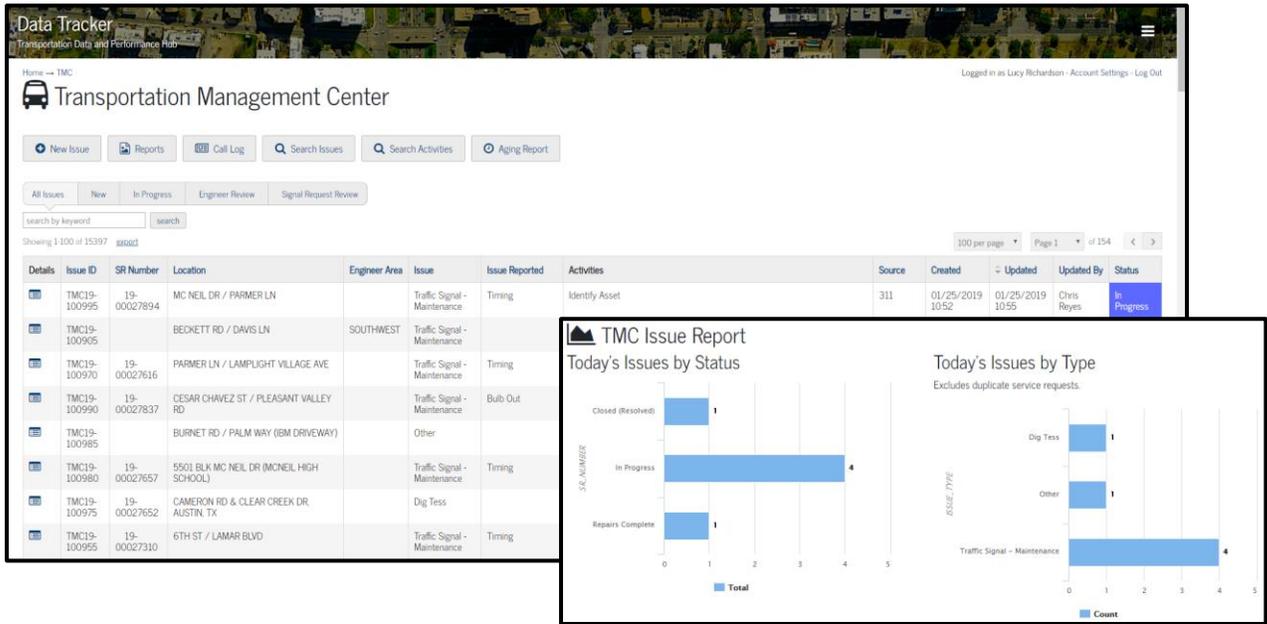


Figure 1: Data tracker interface

The data tracker is the primary source of information used to calculate the benefits from the TMC. In select cases, this data is paired with data from traffic modeling software to analyze a specific type of incident.

B. Planned Events

Austin is home to hundreds of special events each year, ranging from small local events to international events attracting thousands of attendees. Large events flood the transportation network with vehicles during ingress and egress periods, causing lengthy delays. Events often come with street closures, further disrupting typical traffic patterns. In addition to special events, Austin has planned street closures from construction projects adversely affecting traffic flow. TMC staff coordinate signal timing plans proactively and reactively to mitigate traffic delays due to the influx in traffic volumes or reduced roadway capacity from street closures. The customized signal plans increase capacity at adjacent traffic signals, reduce the length of queues, and appropriately service the unique traffic volumes. These actions performed by TMC staff can equate to thousands of hours saved in road user delay.

To evaluate time savings provided by TMC staff during special events, sample events at the Frank Erwin Special Events Center were analyzed. One of the events had a special egress timing plan, and the other event did not. Data was gathered from INRIX Analytics to evaluate how many minutes an egress timing plan saved per vehicle, compared to the event with no signal timing adjustments. The results equated to a reduction of 14% in travel time on the egress roadway in the event area.



These findings were then applied to the following large-scale events in Austin: UT football games, Austin City Limits, South by Southwest (SXSW), Formula 1 COTA, and Trail of Lights. When applied to these events, the road user cost savings are estimated to be **\$1.4 million**. TMC actively service more than 70 events in Austin each year, therefore this calculation is a conservative estimate of the total road user delay cost savings. The table below shows the assumptions and calculations for special event road user cost savings. The assumptions include a vehicle occupancy rate of 2.5 persons per vehicle and a 20% multimodal reduction.

Table 1: Special Event Road User Cost Savings

Special Event Management							
Event	Dates	Total Attendance	Multimodal Reduction	Corridor Average Travel Time	Travel Time Savings (min) per Vehicle	Event Benefit	
Austin City Limits	Weekend 1	10/5-10/7	225,000	20%	18.72	2.621	\$ 150,397.91
	Weekend 2	10/12-10/14	225,000	20%	19.00	2.660	\$ 152,607.04
SXSW		3/9-3/18	432,500	20%	18.67	2.614	\$ 288,315.04
UT Football	vs. Tulsa	9/8	90,563	20%	17.91	2.508	\$ 57,919.74
	vs. USC	9/15	103,507	20%	17.97	2.516	\$ 66,425.81
	vs. TCU	9/22	95,124	20%	18.84	2.638	\$ 64,001.07
	vs. Baylor	10/13	93,882	20%	19.24	2.694	\$ 64,491.52
	vs. WVU	11/3	100,703	20%	19.56	2.739	\$ 70,339.00
	vs. ISU	11/17	102,498	20%	18.19	2.546	\$ 66,549.26
F1 COTA		10/19-10/21	263,160	20%	19.69	2.757	\$ 185,033.53
Trail of Lights		12/10-12/23	400,000	20%	19.01	2.661	\$ 271,456.16
Total Benefit:							\$ 1,437,536.07
Assumptions							
Assumed TT Improvement:	14%	from Frank Erwin Special Events Center Analysis					
TxDOT Road User Cost per vehicle:	\$28.69	from TxDOT Road User Costs					
TxDOT Road User Cost Vehicle Occupancy:	1.5	from TxDOT Road User Costs					
TxDOT Road User Cost per person:	\$19.13	from TxDOT Road User Costs					
Vehicle Occupancy for Special Events:	2.5	from FHWA publication <i>Managing Travel from Planned Special Events</i>					
Special Event MultiModal Reduction:	20%						

Furthermore, TMC staff share real-time information via dynamic message signs (DMS) and Twitter (**Figure 2**). This information minimizes congestion-related impacts by alerting drivers of impacts and suggesting routes to efficiently utilize the roadway network capacity. The management of event traffic adds to the prosperity of the event and benefits the people traveling to the event, or providing services in support of the event, and to the normal traffic using the adjoining roadways. Coordination with other involved agencies provides additional benefit by helping events operate more smoothly. Although the benefits are apparent, quantifying the value is difficult and therefore remains unreported in this report. A list of all events managed can be found in **Appendix A**.



ATX Transportation @austinmobility · 10 Dec 2018

'Tis the season for Trail of Lights! Check the map for road closures, bike/scooter parking and passenger pickups/drop-offs inside the park! Through traffic for bicyclists and pedestrians is allowed during the closure. ow.ly/WSKI30mTWUP
@ATXLights #ATXTraffic

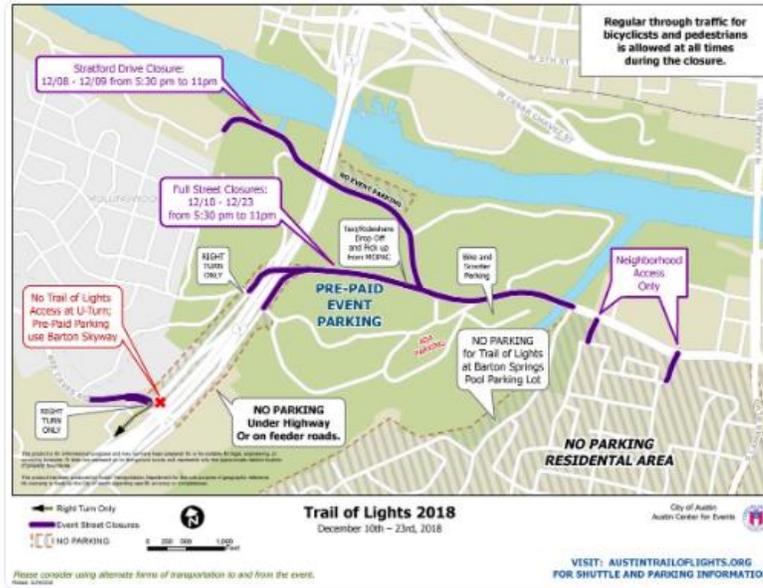


Figure 2: Trail of Lights street closure information

C. Traffic Signal Adjustments due to Lane Closures

Lane closures happen on Austin roadways each day. Some closures are due to planned events, but others are unexpected, for example when a traffic collision occurs or when a tree has fallen into the roadway. TMC staff identify the incident by locating the closure or congestion within view of one of the closed-circuit television (CCTV) cameras located at traffic signals throughout the City of Austin. TMC staff respond by alerting the public through Twitter or, if available, at permanent DMS. **Figure 3** shows a tweet from the TMC alerting drivers of a lane closure and advising to use an alternative route, accompanied with a photo of the incident on Loop 360.



ATX Transportation @austinmobility · 26 Dec 2018
#ATXtraffic Incident on Loop 360 south of West Gate Blvd. has Loop 360 south bound down to one lane. Drive with caution.



Figure 3: Traffic collision on Loop 360 identified by TMC

The benefit from alerting the public is currently unquantifiable, however the time savings from TMC operators' signal adjustments that improve traffic flow are calculated in this report. TMC staff implement signal timing adjustments at adjacent signals to accommodate the changes in traffic flow due to lane closures. Often, this new traffic pattern is very different than the expected daily traffic movements that are addressed in routine annual signal timing efforts. The new traffic pattern demands a custom signal plan to help clear long queues due to the reduced capacity of the roadway. The volume of turning movements upstream from the lane closure often increases, because through traffic becomes very congested from the lane closure and drivers take alternative routes. Signal timing adjustments help service the additional turning demand at upstream signals and effectively results in shorter delays and queues. The added benefits from a reactive TMC implementing timing adjustments include saving the public time, reducing vehicle emissions, and lowering the chance of secondary collisions.

The delay savings is quantified in **Table 2** below for both arterial and highway lane closures. The delay hours saved is estimated within traffic modeling software by modeling a typical intersection where 10 seconds of green traffic was added to the effected approach, alleviating delays. Assumptions are reported in the technical addendum.



Table 2: Lane Closure Responses

Lane Closure Response	# of Incidents	Delay (hrs)
Arterial lane closures - major-major	216	53.33
Arterial lane closures - major-minor	216	40
Total annual delay (hrs)	20159.28	
Value of time (Source: TxDOT) (\$)	\$28.69	
Annual delay savings (\$)	\$ 578,369.74	
Highway Lane Closure Response	# of Incidents	Delay (hrs)
Highway lane closures	36	281
Total annual delay (hrs)	10116	
Value of time (Source: TxDOT) (\$)	\$28.69	
Annual delay savings (\$)	\$ 290,228.04	
Grand Total	\$	868,597.78

D. Signal Outages

TMC staff actively identify and respond to signal outages across the City of Austin (**Figure 4**). During most signal outages, the signal is in a flashing red state; rarely do the signal outages result in a dark signal. Even when signals lose power, the majority of signals have a battery backup unit (BBU) that allows the signal to go into the flashing red state. A signal outage can be caused by one of many reasons, including adverse weather such as lightning or high winds, power outages, vehicle collisions with signal equipment, or malfunctioning equipment. The City of Austin responded to 1,253 outages during TMC operating hours in 2018, an average of three to four times a day. A signal outage can wreak havoc on normal intersection traffic flow causing immense delays, especially if the outage takes place during the morning or afternoon peak hours.

In addition to lengthy delays associated with traffic signal outages, outages can increase likelihood of collisions at the intersection. Safety is a top priority for the City of Austin and the TMC, therefore, response time for a technician to be dispatched to the location is critical.



Figure 4: Real-time tweet alerting of signal outage and technician dispatch

Most signal outages are identified by 3-1-1 CSRs, the Austin Police Department, or TMC staff. The TMC, actively staffed for 14 hours of the day, identifies signal outages through cameras or



the Advanced Transportation Management System (KITS). TMC staff identified approximately 57% of the signal outages between 6 am and 8 pm before the issue was reported as a CSR. In each of these instances, the operators reduced the response time for a technician to resolve the issue, which translates to several hours of delay saved for vehicles traveling through the intersection. The remaining 43% of signal outages most likely occurred at locations without communication, or the CSR came in while staff were dispatching a technician and had not yet logged the outage.

To measure delays associated with signal outages, traffic simulation software was used to estimate vehicle travel delays at intersections when in flash. A signal outage was modeled at a Major-Major intersection, Major-Minor intersection, and Minor-Minor intersection during the AM peak, PM peak and off-peak hours. The delay at these intersections over time was subtracted from the typical delays to get additional travel delay for each intersection due to the signal outage. To calculate the cost savings, the TxDOT value of passenger vehicle time was used and applied to the time saved at an intersection from identifying the issue more quickly. **Table 3** shows the cost savings from TMC staff improved response time for each month.

Table 3: Monthly Signal Outages and Associated Cost Savings

	Total Signal Outages	Outages Identified by TMC	Vehicle Delay Saved (hrs)	Cost Savings by TMC
January	67	28	837	\$ 24,022.48
February	74	44	1316	\$ 37,749.61
March	92	41	1226	\$ 35,175.78
April	70	36	1077	\$ 30,886.05
May	167	107	3200	\$ 91,800.20
June	126	91	2721	\$ 78,073.06
July	141	89	2661	\$ 76,357.17
August	127	85	2542	\$ 72,925.39
September	115	64	1914	\$ 54,908.53
October	118	63	1884	\$ 54,050.58
November	68	22	658	\$ 18,874.81
December	88	47	1405	\$ 40,323.45
2018 Total	1253	717	21441	\$ 615,147.11

E. Remote Investigation and Response

One of the major benefits provided by TMC staff is the ability to remotely investigate and respond to Citizen Service Requests (CSRs). CSRs can be submitted through the Austin 3-1-1 service and can be classified into the following categories:

- Traffic signal maintenance
- Traffic signal new/change
- School zone flasher



- Emergency vehicle preemption device

CSRs are assigned to appropriate personnel at the TMC. Addressing a CSR may include activities such as monitoring on CCTV, dispatching a technician, updating signal timing plans, and contacting the citizen to follow up.

Before the expansion of the TMC, technicians were dispatched throughout the city to address CSRs regardless of the issue reported. Now TMC staff can remotely investigate the cause of various issues and determine whether dispatching a technician is truly necessary. Many CSRs can be resolved by remote investigation, using tools such as KITS and CCTV (**Figure 5**). If the issue can be resolved and closed remotely, a technician does not need to be dispatched to the field. This saves valuable time and enables them to work on the next available task.

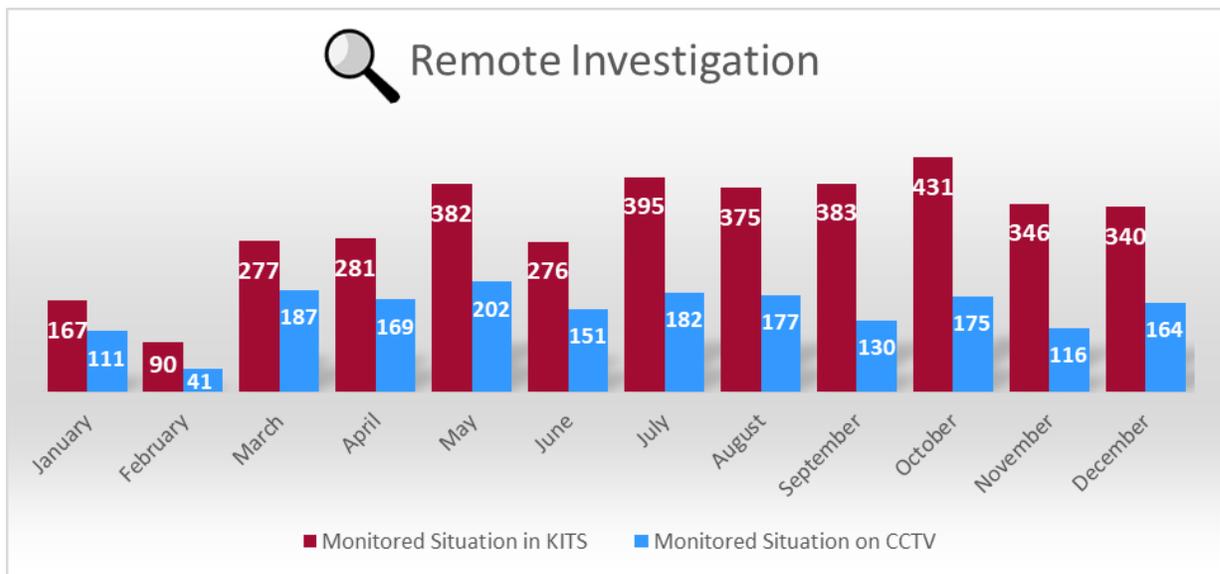


Figure 5: 2018 Monitored Situations by Month

Additionally, the expansion of the TMC gave operators the responsibilities of responding to CSRs, relieving the City's signal engineers of that duty. This provides an additional benefit to the City and the public, as signal engineers can now focus their time on signal timing and construction.

When a dispatch is necessary, TMC operators can investigate the CSR in a similar manner and identify specific actions for the technician to take after arriving at the field location. This saves valuable time troubleshooting in the field.

The resulting calculations of benefits of remote investigation and response are shown in **Table 4**. The calculations are based on time saved for technicians and engineers. The total CSRs and CSRs resulting in a dispatch were determined from the actual CSR records from 2018.



Overall, the remote investigation and response capabilities of TMC staff provided more than \$1.3 million in cost savings.

Table 4: Remote Response and Investigation Capabilities

Remote Response Capabilities	
Total CSRs handled by TMC	7981
Total CSRs that result in a dispatch	4997
Avg time spent by signal tech dispatch (incl. travel) (hr)	1.5
Total time savings for signal tech (hrs)	4476
Loaded cost for signal tech (\$/hr)	\$ 100.00
Annual Technician Cost Savings (\$)	\$ 447,600.00
Avg time spent by signal eng to evaluate a request (hr)	0.5
Total time savings for signal eng (hrs)	5482.5
Loaded cost for signal eng (\$/hr)	\$ 125.00
Annual Engineer Cost Savings (\$)	\$ 685,312.50
Response Cost Savings Subtotal (\$)	\$ 1,132,912.50
Remote Investigation Capabilities	
Total CSRs that result in a dispatch	4997
Average time spent by signal tech troubleshooting (hrs)	0.5
Total time savings for signal tech (hrs)	2498.5
Loaded cost for signal tech (\$/hr)	\$ 100.00
Investigation Cost Savings Subtotal (\$)	\$ 249,850.00
Grand Total	\$ 1,382,762.50

F. Traveler Information

TMC staff provide traveler information in a variety of formats to the traveling public. This includes information about travel time, road closures, incidents affecting roadways, signals on flash, and special events. TMC staff disseminate this information through channels including Twitter, DMS boards around the city, and local media. In 2018, personnel in the TMC tweeted 962 times (example in **Figure 6**, summary in **Figure 7**). These tweets made additional impact as they were retweeted by local media and other neighboring agencies.



ATX Transportation @austinmobility · 11 Dec 2018
#ATXTraffic reminder: Full closure on Barton Springs Road 5:30-11 p.m. through Dec. 23 for Trail of Lights (@ATXLights). Be sure to plan ahead for alternate routes. (Sign messages don't flicker in real life, just on camera.)



Figure 6: Tweet alerting of a full closure with an image of the changeable message sign

When information about lane closures or signal outages is shared with the public, travelers can make the choice of taking an alternate route. By redistributing traffic throughout the network, there are fewer vehicles traveling on the route impacted by the incident. This decreases delay for all affected vehicles.

Benefits from sharing traveler information were not quantified for this analysis due to the difficulty of equating social media impact to a dollar amount.

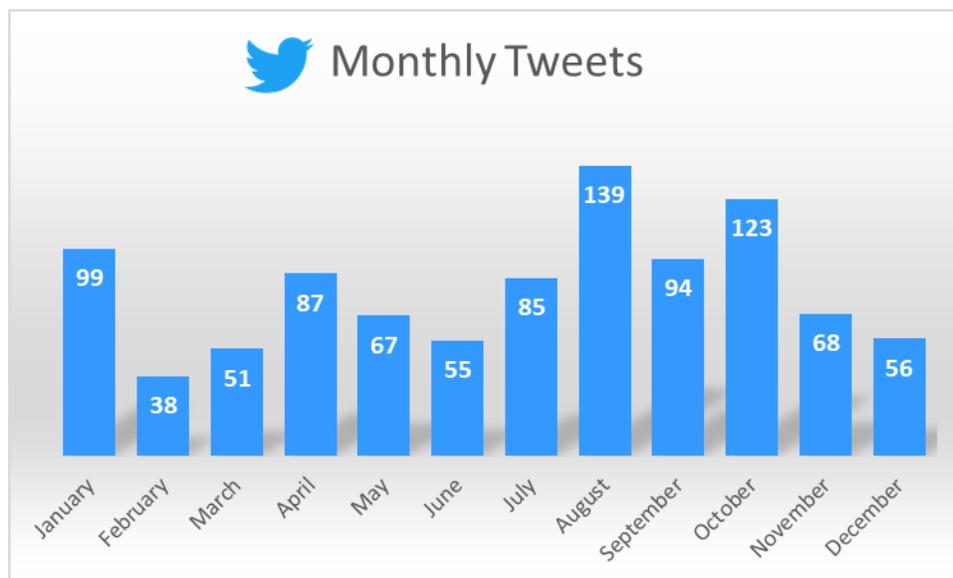


Figure 7: 2018 Tweets by Month



G. Benefit-Cost Analysis

To summarize the analyses presented above, **Table 5** shows the benefits from each activity against the total cost. The overall benefit-cost ratio is 2.4. This is a conservative estimate, because there are many other actions that TMC staff take that cannot be easily quantified in this way. TMC staff have also identified ways to further improve procedures and operations, including additional operator training, more cross-agency coordination during special events, and further use of data reporting tools to investigate CSRs. This will have an even more positive impact on the City of Austin in the future.

Table 5: Overall Benefit-Cost Analysis

Overall Benefit-Cost	
Activity	Benefit to Public
Signal Timing - Arterial Lane Closure	\$ 578,390.40
Signal Timing - Highway Lane Closure	\$ 290,228.04
Signal Outage Response	\$ 615,147.11
Remote Response	\$ 1,132,912.50
Remote Investigation	\$ 249,850.00
Special Event Management	\$ 1,437,536.07
Total Benefit	\$ 4,304,064.12
Total Cost	\$ 1,796,176.18
Benefit-Cost Ratio	2.40



IV. CONCLUSION

The TMC provides benefit to the City of Austin and the traveling public that outweighs the cost of operating the TMC. The benefit-cost analysis conducted showed a total benefit of more than \$4.3 million, and an operating cost of approximately \$1.8 million. This resulted in a benefit-cost ratio of 2.4 for 2018. These benefits were an increase from the benefits of \$1.7 million reported in 2017.

TMC staff monitor current traffic conditions to detect incidents and lane closures, allowing operators to make critical timing adjustments reducing delay for affected traffic and traveling public. TMC operators remotely monitor the status of signals, and dispatch technicians efficiently when a signal outage occurs. By detecting signal outages prior to receiving citizen calls about the outage, technicians can respond to signal outages more quickly reducing the amount of time a signal is in flash. This results in a significant decrease in delay for traffic in that area. Remotely investigating CSRs also provides benefit to the public. TMC staff can diagnose malfunctioning equipment, dispatch technicians as needed, and provide guidance to technicians repairing equipment in the field.

Further integrating the TMC into the City of Austin's operations and continued partnership with other agencies such as the City of Austin Police Department will increase the impact it has on the city. Additional initiatives to enhance the TMC's effectiveness will provide additional benefit to the public.



V. REFERENCES

City of Austin Data and Performance Hub.

<http://transportation.austintexas.io/>

TxDOT Road User Costs.

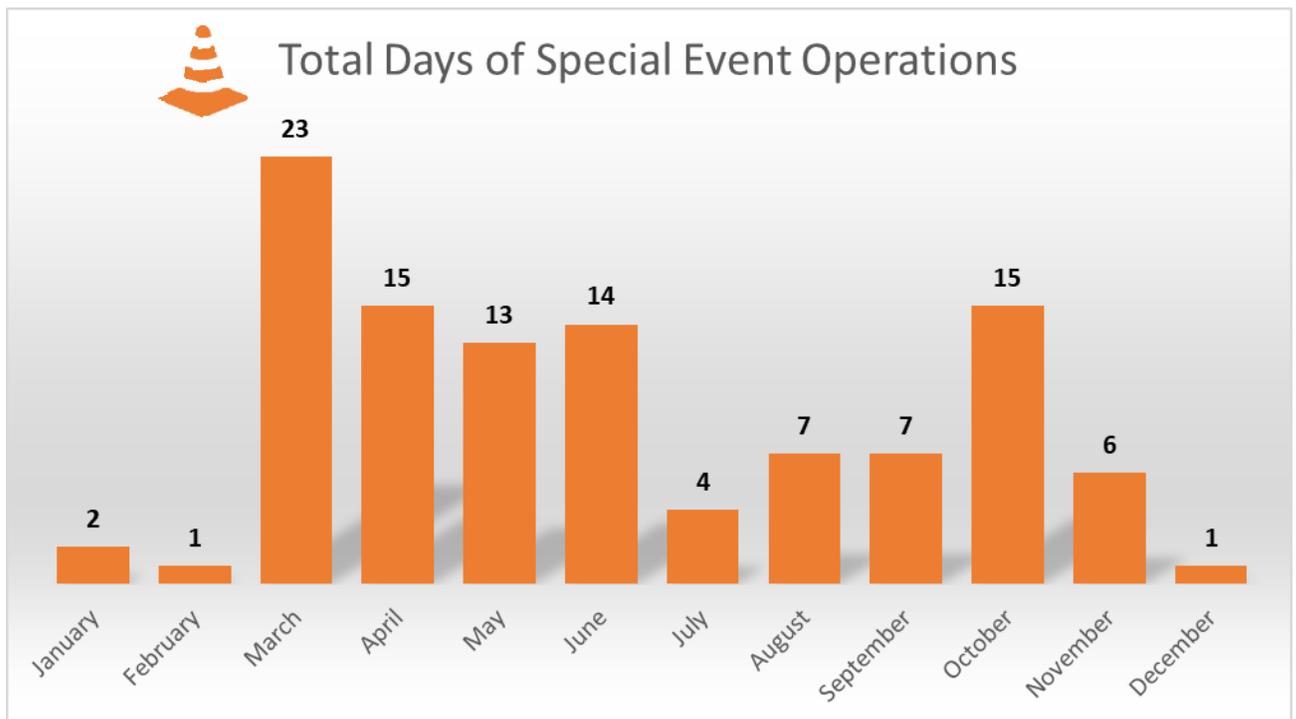
<https://www.txdot.gov/inside-txdot/division/construction/road-user-costs.html>

FHWA Managing Travel for Planned Special Events

https://ops.fhwa.dot.gov/program_areas/sp-events-mgmt/handbook/handbook.pdf

VI. APPENDIX

A. Special Events for 2018





Special Cultural and Sporting Events in 2018	
Martin Luther King Jr. March	Mon, Jan 15
Women's March	Sat, Jan 20
Austin Marathon	Sun, Feb 18
Texas Independence Day Parade	Sat, Mar 3
Kite Festival	Sun, Mar 4
South by Southwest Festival	Fri, Mar 9 to Sun, Mar 18
World Golf Championships	Mon, Mar 19 to Sun, Mar 25
St. James Mission 5K	Sat, Mar 24
Head for the Cure 5K	Sun, Mar 25
Urban Music Festival	Fri, Mar 30 to Sat, Mar 31
Statesman Capitol 10K	Sun, Apr 8
Longhorn Run	Sat, Apr 14
The Foo Fighters Concert	Wed, Apr 18
Austin Reggae Festival	Fri, Apr 20 to Sun, Apr 22
MotoGP Red Bull Grand Prix	Fri, Apr 20 to Sun, Apr 22
Austin Food + Wine Festival	Thu, Apr 26 to Sun, Apr 29
Eeyores Birthday	Sat, Apr 28
Eric Church Concert	Sat, Apr 22
Pecan Street Festival	Sat, May 5 to Sun, May 6
JMBLYA Music Festival	Sat, May 5
Ride for the Fallen	Sat, May 5
Silicone Labs Sunshine 5K/10K	Sun, May 6
Texas Peace Officer's Memorial Ceremony	Mon, May 7
CelebrASIA Event	Sat, May 12
TCEQ Conference	Tue, May 15 to Wed, May 16
Kendrick Lamar Concert	Fri, May 18
UT Spring Commencement	Sat, May 19
Blues on the Green	Wed, May 23
Life Time Tri CapTex	Mon, May 28
Queerbomb March	Sat, Jun 2
ROT Rally	Thu, Jun 7 to Sun, Jun 10
Moonlight Margarita Run	Thu, Jun 7
ROT Rally Parade	Fri, Jun 8
Cristo Rey Jamaica	Sun, Jun 10
Blues on the Green	Wed, Jun 13
Families Belong Together March	Thu, Jun 14
...continued on next page	



Special Cultural and Sporting Events in 2018 - Continued	
Central Texas Juneteenth	Sat, Jun 16
Post Malone Concert	Sat, Jun 16
Slayer Concert	Wed, Jun 20
Fun Stop 5K and Fest	Sat, Jun 23
4th of July Concert & Fireworks	Wed, Jul 4
Willie Nelson's 4th of July Picnic	Wed, Jul 4
BOG DMS	Mon, Jul 16
Blue on the Green	Wed, Jul 18
Imagine Dragons	Thu, Aug 2
Austin Duck Derby	Sat, Aug 4
White Linen Night	Sat, Aug 4
BOG DMS	Mon, Aug 6
Blues on the Green	Wed, Aug 8
Austin Pride Parade	Sat, Aug 11
Bat Fest	Sat, Aug 18
UT Football vs. Tulsa	Sat, Sep 8
UT Football vs. USC	Sat, Sep 15
UT Football vs. TCU	Sat, Sep 22
FIA World Rallycross Championship	Sat, Sep 29 to Sun, Sep 30
Pecan Street Festival (fall)	Sat, Sep 29 to Sun, Sep 30
ACL Weekend 1	Fri, Oct 5 to Sun, Oct 7
ACL Weekend 2	Fri, Oct 12 to Sun, Oct 14
UT Football vs. Baylor	Sat, Oct 13
Formula 1 United States Grand Prix	Fri, Oct 19 to Sun, Oct 21
Austin Heart & Stroke Walk	Sat, Oct 20
CTECC Staffed 8am-Midnight	Sat, Oct 20
CTECC Staffed 7am-9pm	Sun, Oct 21
Livestrong Challenge	Sun, Oct 21
CTECC Staffed 6am-10am	Mon, Oct 22
UT Football vs. WVU	Sat, Nov 3
Run for the Water	Sun, Nov 4
Veterans Day Parade	Sun, Nov 11
UT Football vs. Iowa State	Sat, Nov 17
Turkey Trot	Thu, Nov 22
Chuy's Children Giving to Children Parade	Sat, Nov 24
Austin Jingle Bell 5K	Sun, Dec 9



B. Technical Notes and Methodologies

This appendix contains further details on the calculations performed for each category of benefits discussed in the main body of the report. The calculations were based on entries from the data tracker, including TMC operator notes, TMC manager notes, and logs from CSRs.

1. Planned Event Road User Cost Savings

To calculate benefits from ingress and egress traffic signal timing plans for planned events in Austin, travel time data was collected during events at the Frank Erwin Special Event Center. An event with no egress timing plan was compared with a similar-sized event that did have an egress plan. The resulting time savings equated to 14% along the main egress roadway. The 14% time savings were then applied to large scale events that always have custom ingress and egress timing plans implemented. The events included in the analysis were Austin City Limits, UT Austin football games, South by Southwest, and Trail of Lights. A 14% travel time reduction equated to 2.5 to 2.8 minutes in time savings for each vehicle traveling to and from the events.

The vehicle time savings were multiplied by the total number of vehicles traveling to the event. This vehicular volume was calculated by dividing the event attendance by the expected vehicle occupancy of 2.5 persons per vehicle, with a 20% multimodal reduction. This total delay reduction was multiplied by TxDOT Road User Cost to determine the total road user cost savings for each event. The large events are only a fraction of the total events in Austin, with most events not included in this analysis. Consequently, this estimation is a conservative value of the total delay savings during special events. A table summarizing the assumptions and calculations is shown below.

Special Event Management							
Event		Dates	Total Attendance	Multimodal Reduction	Corridor Average Travel Time	Travel Time Savings (min) per Vehicle	Event Benefit
Austin City Limits	Weekend 1	10/5-10/7	225,000	20%	18.72	2.621	\$ 150,397.91
	Weekend 2	10/12-10/14	225,000	20%	19.00	2.660	\$ 152,607.04
SXSW		3/9-3/18	432,500	20%	18.67	2.614	\$ 288,315.04
UT Football	vs. Tulsa	9/8	90,563	20%	17.91	2.508	\$ 57,919.74
	vs. USC	9/15	103,507	20%	17.97	2.516	\$ 66,425.81
	vs. TCU	9/22	95,124	20%	18.84	2.638	\$ 64,001.07
	vs. Baylor	10/13	93,882	20%	19.24	2.694	\$ 64,491.52
	vs. WVU	11/3	100,703	20%	19.56	2.739	\$ 70,339.00
	vs. ISU	11/17	102,498	20%	18.19	2.546	\$ 66,549.26
F1 COTA		10/19-10/21	263,160	20%	19.69	2.757	\$ 185,033.53
Trail of Lights		12/10-12/23	400,000	20%	19.01	2.661	\$ 271,456.16
Total Benefit:							\$ 1,437,536.07
Assumptions							
Assumed TT Improvement:	14%	from Frank Erwin Special Events Center Analysis					
TxDOT Road User Cost per vehicle:	\$28.69	from TxDOT Road User Costs					
TxDOT Road User Cost Vehicle Occupancy:	1.5	from TxDOT Road User Costs					
TxDOT Road User Cost per person:	\$19.13	from TxDOT Road User Costs					
Vehicle Occupancy for Special Events:	2.5	from FHWA publication <i>Managing Travel from Planned Special Events</i>					
Special Event MultiModal Reduction:	20%						



2. Traffic Signal Adjustments due to Lane Closures

To calculate benefits from traffic signal adjustments due to lane closures, lane closure incidents logged in the data tracker were used. TMC staff make notes of lane closures and subsequent timing adjustments at affected signals. These incidents were classified into major-major intersections and major-minor intersections and assumed to happen equally at both types of intersections. The number of highway lane closures logged in the data tracker was artificially low, possibly because many highway lane closures were due to construction events and traffic signal adjustments were developed in advance. Therefore, the assumption of 36 closures per month was repeated from previous reports. The delay per incident was also assumed to be the same as previous CTR reports. The table below shows the calculations for arterial lane closure responses.

Off-Signal Retiming for Lane Blocking Incidents	Major-Major	Major-Minor
Normal Intersection Delays (sec/veh)	46.1	
Intersection Delays from closure (sec/veh)	77.6	
Intersection delays with signal adjustments (sec/veh)	65.6	
Delay savings (sec/veh)	12	
Intersection Volume (veh/hr)	4000	3000
Total delay savings overall per hr (hrs)	13.3	10
Assumed lane closure time (hrs)	4	4
Total delay savings during lane closure (hrs)	53.3	40
Value of Vehicle Travel Time (source: TxDOT)	\$28.69	\$28.69
Delay Savings Per incident	\$1,530.13	\$1,147.60
Average # of monthly timing adjustments	18	18
Delay savings per month	\$27,542.40	\$20,656.80
Total Delay Savings in 2018	\$330,508.80	\$247,881.60
	\$ 578,390.40	

3. Signal Outages

In order to calculate the time saved from TMC staff identifying signal outages, information was obtained from the data tracker and signal modeling software. In 2018, a total of 1,253 signals went into flash mode during 6 am and 8 pm. Of those, approximately 57% (717 incidents) were identified by TMC staff before the issue was reported as a CSR. It is conservatively assumed that the TMC detects signal outages 15 minutes before a 311 call or another method.

That 15 minutes is critical in reducing the delay and queues that vehicles experience at the intersection. An analysis was performed to determine the delay incurred during a signal outage, using signal modeling. Total delay saved by TMC staff detecting a signal outage in 15 minutes was determined in this way.



Of the total recorded signal outage incidents in the City, the proportion of major-major, major-minor, and minor-minor was calculated from the data tracker. It was also assumed that signal outages occur evenly across the time-of-day periods analyzed (AM, Off-Peak, PM). The incident occurrence of the 717 signal outages is shown in table below.

Outage Frequency per Intersection Type and Time of Day			
	Major-Major	Major-Minor	Minor-Minor
AM Peak	6	50	46
Off Peak	31	251	230
PM Peak	6	50	46
Total	43	351	323
Grand Total			717

Those categories were then modeled in VISSIM traffic software to estimate the extra vehicular delay caused by a 15-minute delay in detecting a signal outage. The delay for each of these signal outage scenarios is shown in table below. The location of the outage is important as more vehicles are affected at larger intersections and therefore more delay is incurred. This delay was also dependent on time of day. Delays during the AM and PM peak have a bigger impact on the total vehicular delay due to higher volumes.

Delay per Intersection Type and Time of Day (Hrs)			
	Major-Major	Major-Minor	Minor-Minor
AM Peak	172	32	29
Off Peak	218	5	6
PM Peak	289	74	56

The typical delay for each of these occurrences was multiplied by the frequency to get a sum product of the total delay for 2018 signal outage incidents.

4. Remote Investigation and Response

To calculate cost savings from TMC staff remotely investigating and responding to citizen complaints, CSR records from 2018 were obtained from the data tracker. CSRs that were closed without dispatching a technician represented cost savings. The methodology assumed that 1.5 hours of technicians' time was spent per dispatch, including travel. Cost savings for signal engineers were also calculated, assuming they previously spent 0.5 hours investigating each CSR.

The savings from remote investigation were also calculated. This assumed that remote investigation saves technicians 0.5 hours troubleshooting in the field for every CSR resulting in a dispatch.



Remote Response Capabilities	
Total CSRs handled by TMC	7981
Total CSRs that result in a dispatch	4997
Avg time spent by signal tech dispatch (incl. travel) (hr)	1.5
Total time savings for signal tech (hrs)	4476
Loaded cost for signal tech (\$/hr)	\$ 100.00
Annual Technician Cost Savings (\$)	\$ 447,600.00
Avg time spent by signal eng to evaluate a request (hr)	0.5
Total time savings for signal eng (hrs)	5482.5
Loaded cost for signal eng (\$/hr)	\$ 125.00
Annual Engineer Cost Savings (\$)	\$ 685,312.50
Response Cost Savings Subtotal (\$)	\$ 1,132,912.50
Remote Investigation Capabilities	
Total CSRs that result in a dispatch	4997
Average time spent by signal tech troubleshooting (hrs)	0.5
Total time savings for signal tech (hrs)	2498.5
Loaded cost for signal tech (\$/hr)	\$ 100.00
Investigation Cost Savings Subtotal (\$)	\$ 249,850.00
Grand Total	\$ 1,382,762.50