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Good afternoon my name is Dan and I will be your conference operator today. At this time I would like to welcome everyone to the leveraging traffic management center resources for work stone management webinar. Always have been placed on mute to prevent any background noise. After the speaker's remarks there will be a question and answer session. If you would like Russian during this time simply press star than the number one. On keypad. If you would like to withdraw your questions you may pass the pram -- prompt key. Call you may begin your covers.

Good afternoon or good morning any number you are welcome to the 14th webinar in the smarter webinar series leveraging traffic management center resources for works on management. My name is Nicole [Indiscernible] in my Marguerite taste webinar. Before I go any further, to mention that we've have been expressing connectivity issues with Adobe connect. The team is working to resolve these issues however permanent fix is not yet in place. If you begin to expense Paul webinar the best solution is to call the teleconference line. Please bear with us if we need to pause to address audio issues. Will try to do them as quickly as possible. If you call a teleconference line for audio you will be to mute your computer speakers. Today we have three presenters Todd Peterson federal highway office of operations. Gerald Ullman of the Texas A&M transportation Institute. Eric Rasband of the Utah Department of Transportation and Brian Kary of the Minnesota Department of [Indiscernible] as a member of the smarter works on implementation team for FHWA everyday Initiative Todd Peterson promote adoption of works on intelligence transportation system solutions and actions to better cornet highway construction projects to accelerate project delivery reduce cost and reduce public exposure to work some congestion or go Todd is a licensed PE and a certified PTO we and received his Masters degree in civil engineering from Virginia Tech. Gerald Ullman is a[Indiscernible] into two and leads the works of its mimic message sign research team at TTI. Joining TTI 1984 he has been the principal investigator for numerous studies pertaining to work stone safety mobility traffic control device effectiveness for operations and travel information systems. Was the primary author of the FHWA publication works on ATS implementation guide and is a member of the FHWA everyday counts smarter work stone implementation team. Eric Rasband at the Utah Department of transportation has 20 years of experience in traffic operations with none of those years and local government with an emphasis in operations in the design and construction of traffic signal systems. He is involved in signal timing traffic operations analysis and travel demand modeling for the Utah Department of trust petition. Eric is in the process of finishing up eight to an half year assignment on the I 15 core project in Utah County as the traffic MOT manager and is looking forward to his new assignment as a statewide signal manager. He is under certification and signal operations from the international municipal signal Association. Brian Kary has worked with the Minnesota Department of hesitation since 1990 tide and has a bachelors degree in civil engineering from University of Minnesota. His work includes working in freeway operation traffic analysis and instant management. Brain oversees the daily operations of the regional transportation management Center which includes the [Indiscernible] the first program ramp metering in the freeway operation group. To a seminar will less 90 minutes with

60 minutes allocated for speakers and the final 30 minutes for audience question-and-answer. Turned the presentation you think of a question you can type into the chat area. Please make sure you send your question to everyone and indicate which percent to your question is for. Presenters will be unable to answer your question during the presentation but we will pause halfway through the presentation to answer questions typed into the checkbox to participate in some polling activities. Will answer questions again at the end of the presentation. In addition if time allows Google open up the phone lines for questions and comments. If we run out of time and are unable to address options will attempt to get written responses to the presenters for answered. Power presentation is available from demo from the file demo box in the lower right corner of your screen. Presentation also be available online with a long transfer of title 10 is once online. Everyday counts three smarter works on nurseries program does not offer PDA [Indiscernible] resubmit individual confirmation request to Rachel Klein at KL in the eye and or and [Indiscernible] you will receive this patient emails in 5 to 7 business days. There's no careless agent PDH consideration measures work stone eligibility presence of licensing agency numbers some nurseries program. No going to turn it over to Todd Peterson to get us started Todd? , Nicole Desmet thinking, Nicole. This is a 14th in the series of webinars federal highway works on management team is conducted the smarter works own initiative that we are conducting through federal highways everyday counts program. We've covered a number of topics on the subject of smarter works owns which we will talk about what that means a little bit more here coming up. We've covered a number of topics as you can see listed here based on both the guidance we published on both the technology application side project coronation side and some of the specific applications of each of these techniques and strategies that we are hoping to promote through the smarter works own initiative. So today Eric focus is going to be on traffic management centers. The next webinar coming up is going to be works on impacts and strategies estimator the WISE tool so stay tuned for that if you're interested.

So today's webinar and like I said we're going to cover discussion of traffic management centers and how those can be utilized in achieving smarter works on goals and leveraging technology to improved management of work zone traffic operations. So want to discuss a little bit how that relates to our smarter work zone technology initiative, related also to the guns of his guns on TMC management and also we are going to have some great examples provided in the world applications of smarter works own applications for traffic management centers. So little bit about what is smarter work zones? On the top level. Smarter work zones is sort of a collection of strategies designed to optimize work stone safety and mobility so we are trying to promote through smarter works owns policies and practices to improve works own operations both the context of improved safety and improved mobility. So pure crashes, less delays, and utilizing some innovative tools and innovative strategies to make that happen. So we are doing that through there's two different aspects to smarter work zone one is part of coronation when is technology application. The project coronation side is focus a little bit more on the planning of work zone in order to reduce the collective impact of multiple work work zone or multiple activities within a region or on a cord or within an agency. Technology application is more focused on the application of data collection strategies, roadside hardware, basically roll up everything intelligent transportation system and that's all included in the technology application strategy. So what we are talking about today on traffic management enters could [Indiscernible] in technology application side but we're going to focus on technology application which is because the data centric nature is what was also. Solo LG publication really trying to? With

works own idea Desmet IPS is to understand what is happening as part returned to understand what's happening with works on traffic and relate that upstream to drive better decisions on how to prepare for the work so completely to adjust their speed and what to more than just putting you know work ahead alert we want to provide better guidance you may call it actual guidance to drivers telling them specifically what they can expect where they can expect it and provide as much guidance as we can to help them make better decisions about how to prepare for. So there are several components of this collecting data from the field, having understood by system having that conveyed to the people doing the construction the traffic managers, the TMC and having the process into a message that can be related to drivers so they can make the decisions to adjust their behavior accordingly. Or for the traffic managers or the folks at the TMC to adjust their activities and their management the works own to better economic changes in traffic. So from a program standpoint we have a couple goals associated technology application. One side of this is for agencies to develop policies and processes standards and so forth to institutionalize the adaptation of works own IT is technologies in their program activities. The second part that goal is to actually implement them, to actually put the hardware out there, to do something with it, to actually implement and improve works on traffic operations function through the implantation of works own IKEA. And we are well on our way to achieving those goals for the smarter works own initiative. So at this point I'm going to turn it over to Jerry. He's what he tells little bit more from the guidance on using TMC management guide.

Angst, Todd. Greetings from Texas. I'm going to spend just a few minutes going over recently published document on this particular topic here, the website is listed here. It's on the FHWA operation works on management website and the intent of it as you can tell here is to illustrate ways in which transportation management centers can and have been used to support works own management efforts to mitigate safety mobility impacts. Threat the project from process and that the keeping here. Ethically think about TMC support of works so management think we think of commonly think in terms of know what you can do during the actual work itself and in terms of managing traffic and that certainly is a key aspect of the guidance document, but there are also opportunities to make use of TMC resources actually throughout the project developing process. When you think about resources in terms of the equipment that is out there, the staff that TMC may have available, the data obviously as well as the procedures and operations in that kind of thing. So we're going to cover here in just a queue sizes the actual guidance that can mail that went into putting this together. Quite a bit discussions with various TMC throughout the country , gathering lessons learned in that kind of thing. And what we're going to percent here we will call it strategies and some strategies that we -- were identified ways in very steps in the project developing process with TMC resources were found to be effective and helpful. Beginning the earlier stages during maybe scoping planning and design very earlier process, work zone or TMC resources can be very, very useful it may be good to keep track of as we will see on the left here is a project coordination tool several TMC the TMC is where plans for project as far as what's coming up will be held. Certainly in some cases TMC restocking are the folks that are responsible for ensuring when enclosures are going to occur in multiple locations in the region that aren't complex that they aren't [Indiscernible] going on to adjacent parallel routes such that any diversion from one you to congestion is going to land rate limit on the other one and thus doubled the negative impacts of those two projects. So certainly that coordination aspect comes of it as well. TMC resources can also be useful in the early stages of impact assessment. Just in terms of being able to essentially what are the general volumes and capacities we have out here?

But what is our normal traffic operational activities from the TMC committee useful for going into a point of developing her transportation management plan assessing those in being able to get the information in as well. And it certainly the data at this point from a preliminary impact assessment might be what is used and helpful for setting you know some innovative contracting you know Lane rental rates or incentive disintegrates in those kinds of things. Soberly early on these TMC resources can be very, very helpful. Another area still within the project development of a bit further into design is when you are actually doing the transportation management plan development both from an impact assessment standpoint and from the development of an identification and assessment of the potential mitigation strategies that might be utilized. Certainly when you are doing impact assessments, the traditional traffic data that you can get from a TMC and a very fine level can be very helpful. You know, you may have standard particular time of day distributions of ADT that you could use but have very specific in one hour earlier even parts of an hour for a 24 hour cycle that's available from TMC as well as the normal chewing patterns and Steve -- speeds in those kind of things that exist prior to the start of the project would be very helpful in the TMP developing process. Another thing that some states have found useful in addition to the traffic data is the event logs that most TMC collect . Incidents and things like stalls and certainly crashes, some agencies it still takes a bit of time to even get crash information for a segment of road and lag several months behind. Instant blogs made be better get this on of a kind of expected crash rates were kind of expected stall rates, which one you are deciding whether or not what the impacts are the things like closing shoulders or reducing lanes. Recognizing better assessing the number of times that you're going to have kind of events further reducing [Indiscernible] is very useful set of data to have. And at the same time, another aspect is the special events and the records of what's coming up, which typically happens every year it, those types of things all can come from a T -- TMC in the TMP help process. And to then certainly when you were assessing the mitigation strategy themselves, one of the key things at this point is recognizing here's what I have is a permanent TMC in terms of equipment communication in that kind of thing and to what extent it works own -- work zone may disrupt that is important to have seat can make plans to keep the TMC resources operating than the project is underway whether [Indiscernible] temporary devices you know alternative communication mechanisms in those kind of things. Then we get into where we think of most commonly with TMC support or work zone activities the actual things that occurred during the operation itself. You can read these for yourselves. For pre-work information coming link closures for road closures that kind of thing disseminated in a variety of ways that's why TMC are establishing one of the primary functions is to get that information into really good job very very critical support role for management or management strategy as well as the supporting of the information during construction. Both in terms of the hear the safety aspects putting out warnings of downstream cueing that's developed because of the strategy that kind of thing here, and or incident support or incident response ticking sure the backup occur because of a crash in a work zone three responded to and mitigated as quickly as possible. And certainly the mobility side of things as well. Try to get up the information during the work operation about travel times the congestion, delays involved that kind of thing so drivers can make better route choice decisions and those kinds of things. And in some cases some TMC have additional management tools like rent metering active [Indiscernible] in a few locations for the been deployed, these are all tools and resources that can be employed as needed to mitigate the mobility impacts of a particular work zone or set of work zone. And then finally, the evaluation or assessment of the impacts of it works own -- work zone or series of work zone can be well supported by TMC

resources. The archived traffic data of course as well as the logs about what happened in terms of incidents and other things that together can be used very usefully to assess the impacts and develop works own performance metrics that will aid in agency in assessing or coming up with better ways to further [Indiscernible] into better job. Typically is not received a lot of attention by FHWA has been working for several years to encourage increased use of performance metrics for work zone measuring purposes and we are seeing more more states are looking at this in coming up with ways to do this for them -- for themselves so I think this is important aspect of how TMC can support activity. Let's go quickly that guidance report is about. I would encourage you all to download it take a look at it if you are -- at your convenience. If you have any question Dean and Tina's contact information is there if you wanted to e-mail them with him to contact me if you have any questions. I can see what I can do to either answer them for get Tina to help me with that as well. That concludes my presentation I'm going to turn it over to Eric now to give you an idea of what Utah DOT does and how it uses its TMC to support work zone measuring. Eric ?

Inc.'s commentary. Were going to go through an example here of how we used this process. On a design project in Utah County which is more central part of Utah and we will kind of cover the relationship to mean that TMC our local government partners are public involvement team and then ultimately our consecutive leadership team that supported us through this project. So just from an MOT overview, we've really felt strongly that as we were going into this project that nobody really had a higher expectation of we could accomplish and how we could manage traffic than we do. We had recently come off another design build project in advance of the 2002 Winter Olympics where a lot of this functionality was turned over to design builder and we made a conscious effort on this project to maintain this functionality program management standpoint. As part of the contract, we develop some goals to address MOT and their outline their and really the big thing was minimizing convenience to the public as we were moving through. So when we are putting together our contract documents come at these were the principles that helped us develop our plans and specifications as moviegoers. Suggest some background, this corridor, the recent pharmacy that covered 43 miles from Draper and Salt Lake County to [Indiscernible] seven Utah County and the scope of this reconstruction project was 24 miles from just north of Utah Lake in the central part to the south end of Utah Lake. A little bit more about the scope, $1.7 billion budget 24 mile freeway to new lanes and a whole lot of field that approaches and those bridges you are going to see a correlation to the bridges and a number of closures that we allowed on I 15 for that bridgework. So as we are moving forward into the project, we had a challenge. This corridor and red is the quarter we did the reconstruction on. Quarter in green is the alternative travel route that is really the only file -- Bible travel route in this county. We are limited with the lake on the west end of the screen area here is the mountains and so it's a fairly narrow character with not a lot of alternatives. As we are moving forward we had several local governments that we needed to partner with and we brought them in in the planning process is well. Now Jerry talked about a bit about the data that we had available to us. We have a lot of data and so we went and looked at the hourly distribution of our traffic patterns and looked at the variations that we would expect to see and using that information we then established hours of operation of when we would allow the contractor to close lanes. For a significant portion of this project the contractor maintained a number of lanes which was a huge part of the success of the project, but there were times when they had to just to get the construction completed they had to close lanes down that the peak period and that caused some congestion and diversion onto the

alternative routes. So as we continue to move forward we had -- we developed the traffic management plan from contract of a document element standpoint and then returned a lot of that traffic management plan over to the design builder is still -- as far as the cone barrel in signing requirements and if they developed a specific plan for the traffic management plan that included incident management plans of their crushes how we would do with that how do we communicate with each other? Emergency access to the quarter as well as local properties is Mrs. and residents. A big component of this was that whenever they wanted to close lanes they had to submit a request and the department had the ability to either reject or accept that request based on that information. We required a 14 day advance notification in the primary purpose was for our public involvement team to be able to disseminate the information to the public and for our traffic management team to be able to finalize and fine-tune any last minute plans that would be needed for those specific closures. So during the procurement process we asked ourselves to we have all of the infrastructure that we need? We knew that we were short in some areas. We had some lacking signal interconnect in the north and central part of this corridor on the arterial roads. We have limited camera coverage to help with those diversion routes and so we went on a windshield survey with several groups from the traffic management center here in Salt Lake intro through the core door looked at the eternity of routes and identified areas where improvements made sense. And then we wanted to make sure that our 511 and our traffic website was up and running. At the tail end of this project are [Indiscernible] traffic app was published and started to get used to help the public manage the system as we move forward. So some of the ideas and things that we came up with through the windshield survey is we needed to add some left turn phasing at several critical intersections and the project had a limited budget. Seems like $1.7 billion there's a lot of money but there was really tied to pavement work in bridgework and so we partnered with other groups within the organization to find additional funding to get some cleft turns installed some right turn overlaps as we move forward and then in addition some cameras and some interconnect that we needed to help manage those alternative routes. We were very fortunate in we had some very good proposals come through. The procurement on this was just after the 2008 downturn in the economy and there was a very competitive bidding environment that we had and design builder's really wanted the job. The teams with large groups and a lot of the team members there were on those design build teams understood the benefits of advanced traffic management so they came to us with additional proposals that were outside of the requirements and this is a photograph of a sign that the design builder proposed and installed for us that give us travel times. This is on the arterial feeding into the quarter corridor and give travel time to the north and in south end of the corridor or go that was installed prior to major construction and all the devices on mainline were maintained threat the life of the project which was a big -- attribute it to the sport we have from his active leadership team. Really helped us enforce contract documents and make sure that the devices that we expected to stay online did stay online. In addition to these[Indiscernible] on other projects outside of this one, we've installed due to the readers up and down the corridors to use as an incentive or disk assented that the contractor then is able to monitor the cues in the travel times using this Bluetooth data and they can adjust their motive accordingly. It's not the way worked on this project. We had very defined hours but it's an option that we've used on subsequent projects that has provided a lot of success. So as he moved into the project, there was a engineering work that we needed to do. I'm going to bring up a green arrow right there at the Grove area is an area we can have access to sing -- signal interconnect. We had nukes medications in the area in no cameras or cut again the design builders saw the benefit of managing traffic using signal timing and part of the winning

proposal they proposed interconnect for us using [Indiscernible] that they put in at their cost. As part of the project and advance of major labor work on a 15 which was nice for us to manage diversion routes. And also in advance of this we installed some to connect on the north end of the county and then there was a project prior to the reconstruction to install ramp meters and a lot of conversation going into that ramp during project we're going to be tearing up by 15 in the near future to we really want to install ramp meters now? In it a conscious decision to install the meter's up and down the court work because we knew they would be a critical component in managing construction. That proved to be a true condition as he moved forward. So our approach, we are responsible for all of the signal operations. We are religious possible for state routes in Utah County the local governments responsible for the local routes. We men are TMC 24 seven and like I said, we had some experience with design build in the past. Coming into this project we have three distinct operations systems and we work with our local governments to come up with a unified system and control. It wasn't easy as there was a lot of ownership and pride in this existing systems as there should have been but we worked closely with our local governments and develop some agreements on who had the jurisdiction the operating procedures and the partnerships for future upgrades and expansion. This partnership is -- was really strengthened during the construction project that is been maintained long-term which is been a huge advantage to the citizen of the state of Utah as we moved forward. To some of the key component that we post a lot of our success with Ms. we made commitments to Those commitments. Everybody had to make from compromised with -- it really was a strong professional working environment moving forward Erica and probably the biggest reason were so successful as we had several large special events firework shows football events best broadband where we work together. We would actually go to the traffic management center from these local governments and manage these large events at their facility in a partnership and that developed a synergy between the state DOT and the local government as we move forward. Some of the benefits working with [Indiscernible] it was fun we extended the coverage of signal operations here at the main traffic management center and that is continued long-term and so we see better coverage throughout the day and throughout the week based on the successes we saw during this construction. As everybody's working together toward a common goal the public ones that benefit and as with everything more heads of the table we think we get a better outcome. So this is a photo of miniature control center that we set up our project offices. It was basically for CCT monitors with one computer. The computer was directly linked into the main traffic management center and had all of the functionality that her main traffic management center has. We are limited in our scope because of four cameras but it was enough for us to manage the day-to-day. This was used heavily for instant management throughout the project and then larger construction management only close the freeway down we went to some from this facility but typically would go to the archer TMC with more camera images or partner with our local government partners and run those events at their facility. It's fortunate now that the entire state all of the local governments now are on one system for signal operations. Have great interoperable relationships. We basically don't have jurisdictional boundaries when it comes to signal operations throughout the entire state and there was a lot of success in this project. Some of the specifics on closure, how many traffic engineers get to close the freeway down on a regular basis? During the life of the project we were able to shut the freeway down for 6 to 2 times and learned a lot personal time as we had two different freeway traffic over onto the local government. Typically in the middle the night when we did these closures but varied by the time of day when disclosures would take lace and how long they would go. There were some

extended closures that went through Sunday for major bridgework that they needed that additional time just to get the work completed and overall, high level of success on those alternative routes. Those routes were really covered with instant management plans that we pre-engineered going into the project. We did a lot of engineering work with [Indiscernible] being these routes and are signal system has functionality called action plans where we can hit a code and an inter-button and a plan is sent out to 20, 50 signals and we get different timing plans help us run the signals during that time. During the project we ran in the first year 520 manual assignments and the last part of the project, 1330 manual assignments so use the signal system quite a bit to manage traffic. So some of the success that we had like I mentioned, we had some large sporting events that we were managing and went to appoint where we observed the 50% reduction. The condition prior to this was having officers at each intersection running the intersection manually in the center of the intersection with whistles and his hand signals and we didn't want the officers to continue that one. Is not safe and two, it's not efficient and it really to be focused on other issues public sale on operations so we worked closely with our public safety partners and help them understand all three of the end of the day saw significant benefits in loading times for these events. During one of our football events with Wyoming in 2010 at BYU, there was link closure on I 15 that was tied to paving's we were closing on a fine need for a detour and communicated with our [Indiscernible] team and were able to get a 15% change in behavior. For the fans to stay late or do some shopping after the game and it really helps with getting people away from the venue and the clearance times benefited and really not any significant congestion on the way even though we had lost a lane during that time period. And then this was a full reconstruction project. Had found the life of the payment as far as we could and during December of and during December 2010, the pavement started to fall apart and significant pothole started to develop we had to make a decision to close the freeway. It was in the winter and we need the warmest time of the day so we had to shut down the freeway down to a single lane in the middle the day to allow us for some pavement repair. It was two days before Christmas so we were fortunate in that the workforce was in place. We had to bring our team in off of holiday you know, their holiday plans which wasn't fun for our team but they had a professional attitude and came forward and took it over. During this event we partnered closely with the main traffic management center. The signal [Indiscernible] on the arterial free maintain from a project standpoint. At the project office. Or central office will be monitoring the traffic monitoring the back of Q in addition to that we had to members joining of a dumb corridor on I 15 as well as the alternative routes giving travel times back to the TMC that they were reporting to the media and to the overhead travel time signs which helped to get some diversion and you can see in the red, we saw kind of our peak congestion or diversion basically in the middle the day when really needed it the most. That worked well and then two weeks later the temporary repair worked but other parts of the quarter started to fall apart and this time we had a little more time using our public involvement team and they did a great job. When it was fresh in people's mind on the public's mind what it was two weeks before and our public involvement team had a very defined message them out to the media and for the second period same plan we monitored monitoring stations we monitored back of the [Indiscernible] ran floating car travel times through the quarter and posted those and we were able to see 50% diversion on the second time closure. So big success showing the ability to handle an unplanned event. So in summary, as we estimate messages as early project planning helped us have equipment in the field and contract documents in place. Our design builder was really good at understanding the importance of a TMS and they brought things to the table as part of their proposal that helped us manage traffic

throughout the project. We had great cooperation in respect with her local partners and the cold there is as long as we are successful or as long as they are successful, we are successful and that was kind of the relationship that all of us had as we are working for the success of her counterpart. More so than our own success. Interpublic [Indiscernible] we can't understate the benefit of the shaping the behavior of the public based on information that we were able to give them in managing the system. So that's the end of my presentation. Certainly welcome to contact me. I would be glad to answer any questions moving forward and I will turn it back over to Nicole.

Thank you, Eric. We are now going to pause to conduct some polling questions here come --. Will bring up each question and read aloud. Two of the questions are short answer. Please note that you were limited to 250 characters and the only answer the question once. If you answer the question a second time it will overwrite your first response. The first question, does your agency local county or state to analyze traffic management center resources and/or tools to support work zone management ? Yes or no. Question 1B. If you answered yes to the first question, please provide a brief summary how your agency utilizes traffic management center resources to support work zone management. And then the final question , is there any information that could help your agency and utilizing traffic management center resources to support works on -- work zone management? And while people are answering that we would like to remind anyone if you have any questions for the presenters please feel free to check type them into the chat area or if you'd like to meet a question or comment over the phone, will pose a people are answering an open for mind if you press*one and your phone keypad that will open up your telephone line to speak. So we won't fit for second while everybody is answering the polling questions.

It looks like we're getting a lot of good responses. I'm going to go ahead and leave the polls (one more minute and we did get a question from Tracy. Did you do anything to[Indiscernible] the contractor to care about traffic flow management such as contract provision? Eric?

Yes, we have a policy from the department standpoint for user costs on every project. So we put out some calculations determining what the impacts are to the traveling public and develop some cost and then put some disincentives or liquidated damages to every contract project that we go through. On this I 15 core project we had liquidated damages with the most expensive being $50,000 per lane of I 15 per hour if they close that freeway down or a lane down on the freeway during unapproved times. So it was a big stick and the contractor work with that guideline knowing that it would cost them a lot of money if they took a lane and overall it worked well with incentivizing them to keep lines -- lanes open through life the project.

Thank you, Eric. They're going to go ahead and and the pole mount. And move on to our final presentation which is given by Brian Kary. Brine if you would like to go head?

Okay. Thank you . First opera to provide you look bit of background on [Indiscernible] management center we are a shared operation facility including traffic operations [Indiscernible] and state patrol and we pretty much have covered within the freeway system through the[Indiscernible] and so we sort of utilize this area for a lot of work sensitive been occurring in the Twin Cities. Kind of touch on some of the best practices that we've done over the last few years. I don't necessarily talk about one project multiple different projects that we have been doing here

in Minnesota. Background under software system or intelligent roadway sister raised [Indiscernible] Iris controlling all of our field devices our DMS meters etc. meters etc. Also click over traffic data and is a software system that we developed in-house and about five years ago we opened it up open source software such -- system in Mexico other state duties are able to use as well as other local news apologies. Tell trends using his mother centers. Wyoming in Nebraska are currently deploying in city of Wilmington here in the Twin Cities is also deploying it using some signs on their archery or network. So it's been utilized by some other folks as well as well as Mende but provide a bit of background just so you have a better understanding as I start getting into the construction projects that's what I'm referring to with our Iris and existing tears the center. So starting off with some of the construction projects, we've kind of made it a goal for incident management to have cameras within our work stone to help detect and verify incidents we utilize existing cameras were there available and where communication lines are still maintained to them. But where we either don't have camera coverage or we of loss camera coverage through the construction will work with our contractors to get temporary cameras when needed. To be there done that as part of a contract for the contractors provided those clever in the last year we've actually purchased a couple of trailers that have cameras so if we had more short term duration construction projects there may be some maintenance activities adding significant traffic impact, we can deploy those as needed cute. For the longer projects retentive with contractor provided devices. The example in the picture here is on interstate with contractor provided devices. The example in the picture here is on Interstate 494 in a Northwest Metro. The court orders to link each direction being widened to three lanes in each direction. During the construction we cannot accommodate two lanes in [Indiscernible] so we utilized a barrier we can provide two lanes and then switch it around for the other peak period. The picture shown here is a crash that occurred in that one lane section. (Maybe in the image you can see multiple vehicles kind of piled up there in that single lane. In this case we were able to utilize the cameras to verify the location of the incident recognize that the Bradley was completely about locked in be able to get the appropriate [Indiscernible] and if you can kind of makeup of vehicle on the left is a straight trooper that responded the runway since he knew that from his dispatch that there was no traffic able to get through so was able to do that. And we coordinate any kind of response in the opposite direction as well and having to recover the barrier. So really provides a lot of information on only for traveler information before her emergency measurement incident management and state patrol has access to the same cameras we do since we had a shared center and facility. Little background service for your patrol we have our incident response team first there are MnDOT vehicles and staff driving three-quarter ton pickup trucks legacy in the picture . We will typically utilize those in our work stone. We have them throughout the metro covering just over 200 miles of freeway system in the Metro but where we've had either construction zones that are just outside of our first coverage or where we've had some very severe restrictions, have done some tow truck service patrols that are contracted to help supplement the first program and provide that to truck service since we don't actually have to trucks. So we've actually done this on three projects. We did a couple about 10 years ago and we've got one coming up this summer so it's been a while since we've done one. The project we had this summer is kind of similar to that [Indiscernible] example we have a single lane with not much access and not much refuge area we wanted to avatar truck on site at all times to be able to move in and remove those vehicles as quickly as possible. So they will help supplement the first program and our first trucks are dispatched through the MnDOT personnel through the[Indiscernible] so we require that the toy truck would basically act as an extension of that and be

dispatch by the same folks that dispatch first so they will act really in tandem with them and being dispatched by the same folks in working with our state patrol. One example we had of how we've utilized TMC data to be able to justify the need for a toy truck service patrol or other kind of enhancements to work zone is a 30 5E project we had an unwritten Metro North of St. Paul. A few years ago now and this was a court or that was undergoing a concrete rehab project actually concrete overlay where they had to rip up one direction of travel at each time and this quarter is only allowing court or so we actually took the traffic down to a single lane in each direction for several months and overall we track delays that were occurring the travel times are shown here in the graph. This is a travel time about a week period. Fleet -- free float travel time [Indiscernible] we're probably peeking out at about 20 minutes about double the free float travel time. Swifter like we were doing fairly well overall in helping manage the congestion with the networks own. You will see some very extreme [Indiscernible] which a couple them being pointed out with the B where delays went from 10 minute travel time to 50 minute travel time or in one case a 60 minute travel time. And those are both as a result of crashes that occurred within the works on. So we utilize this information to help kind of justified as to what we feel it is necessary to spend the extra money of getting until truck service patrol over just doing our standard first program. How we've gotten some of it travel time data, we've really utilize the temporary detection to provide the travel time and work sounds not only providing that real-time information to the public being able to provide that post analysis information linkages shoji their. Can sterile that data in Québec to at a later date. So our detection systems that we have our permanent systems are a mix of loop [Indiscernible] so we tend to lose those systems during the projects and they're usually the first things to go and one of the last things to come back so we've relied on temporary detection travelers during that time but the one that's pictured so always have a traffic sensor will have a camera on the same trailer if needed and then wireless modem. We've deployed this construction projects to have major traffic impacts. Either they're going temperament when closures that are going be up 24 seven during the project so such as midday but even go to repeat period or errors that are already very restrictive or already heavily congested where we have a very high final court or even if we don't have permanently closures maybe the work zone is very restrictive and that is that some tight curves or some narrow lanes that can restrict flow and so we will supplement to make sure we have travel times for those type of projects. And we've done this a couple of different ways preferably done stand-alone systems where we ask the contractor to provide everything from a traffic sensors to the portable message sign to the system that's going to actually Tekelec travel time. Done that more on the upstate where we don't have existing systems but in the Metro in the Twin Cities will try to integrate that with our testing [Indiscernible] systems. And so to expand on the [Indiscernible] we will integrate those temporary sensors directly into the existing Iris software so the contractor will just provide a link from the traffic sensor into Iris so will talk to that just that we would to a permanent detector of their. That we we can just incorporate that into her existing system to connect with the travel times. Iris Re: has connectivity tour 511 network 30 Collectivity to existing data tools so that when we're not having to reinvent the wheel as much for all these different projects we can just utilize some of those existing connections. Also helps reduce cost. We don't have a bunch of purple message sign for temperate signs to deploy the travel times. Just utilize their existing network of tangible method signs of the havoc in the Metro. If they are also taken up because of congestion and will supplement the portable usually those work zone leading into the work zone we can still utilize those as people make their determination whether or not they want to reroute. And the same thing with the detection to. If you stand-alone system a lot of

our backups are really leading into the work zone.Messerli in the work zone itself to start having those raindrops at the start of the project area. Usually all that detection still runs and is still active so we can utilize that dress if the contractor had provided everything you would have to tap into our centers are provided own detection to capture those delays that occur leading into the works on -- trend work zone. So who was responsible for the data? Register munchers all the traffic sensors to make sure they are fully functional at all times. Get a lot of connectivity issues with the wireless modems power issues with the solar and batteries, tractor-trailers that might get hit by vehicles get blown over highest so all that contractor response bulleted mixer that everything is up and running at any time. Data sent to Brian Kary [Indiscernible] and then we will store that data within MnDOT for personals is. All her existing data we have data going back 20 years we just pray that Emperor sensors in the same database. Hardly assessed quality? Contractor ensures that the sensors are working to provide some high-level property check. Some of the contractors are better at providing more detailed checks than others but we basically want to ensure that the data MnDOT more rigorous testing. We've done some travel time and we done some simple comparisons which is nice because a child time runs can be pretty labor-intensive so maybe will do that for the first couple days and we can't spotcheck it using some of the information and well into more in-depth testing. Doesn't seem like they are getting incorrect. Different contracting methods that we've used, we've done intelligent works owns temporary cameras and detection provided by a subcontractor. Is usually easy because we're already doing prime contractor with the prime who's doing the work zone during the pavement resurfacing or whatever the project may be inevitable higher a subcontractors by the trailers. We've had some issues with that in the past we have had difficult in getting devices out in a timely manner where the prime contractor wants to hit the ground running in Britpop payment and starts making his link closures and at the same time the subcontractor feverishly is trying to set up the trailers and get them integrated into the [Indiscernible] network which could take a few days and so there are several instances where we missed may be the first three days or first week of construction project when the link closures started happening and we weren't able to get travel time posted and usually the first week is kind of the most critical because people are stunned to learn what delays are going to be like with their attorney of routes are in traffic patterns happily settled out yet what sort of a critical time and we see is kind of a failure not getting those travel times up during that time period. And we also had issues where sometimes the subcontractor was not notified well enough about prime that a tropics which was happening. Also and they move traffic from them down to supper and so now we have a bunch of detectors that are looking at and two roads and so we have to go out and contractor has to recalibrate those we point those the lanes now carrying traffic so that can sometimes cause delays where after major tropics which may have a day or two where we are not providing travel times again. So we try to look for ways to improve that. Putting things in our specifications making the requirement that is not just about putting the trailers out there. Bring them on a timely manner and making sure that they get adjusted SDB during the life of the project. And so we've changed our specifications that we've also done some things we've done independent contractor separate from the prime which helps us to separate the intelligent work zone mentor work with them directly as opposed to through the prime contractor. We had one project that I will get into a little bit more here in a little bit worried the contractor provides intelligent work zone for major projects throughout the Metro so we had kind of -- we went through a standard process for rehire the [Indiscernible] through [Indiscernible] told them they were going to be providing detection for four other projects had to Courtney with these other contractors and was also written in those projects that those

contractors had to Courtney [Indiscernible] and we had something like I think that the trailers as part of that large scope project. We were provided those trailers during those major projects that were going on. Look to the future, long-term project they're going to years. We tend to subdued a subcontractor to the kind of had that working relationship and lasting for an extended period of time making it more specific and having those specifications that show that we require this equipment to be deployed in a timely manner in maintained in a timely manner so that we don't end up with the issues that we had in the past. And then the short-term projects will probably do something similar where we have multiple projects in a year that are all expected to last within the construction season to be doing independent contractor where they would provide those trailers for multiple work -- work zone or even we looked at utilizing an on-call contractor that maybe we had the intelligent work zone under contract for two or three years and as we need them we can deploy them were need be . That's what we are still kind of investigating and not actively done yet. This couple case studies here this is one on I 94 St. Cloud or near St. Paul really connecting [Indiscernible] was on the outer reaches of the [Indiscernible] network so we get kind of a couple different things here in the westbound direction as head of the city we're still within our [Indiscernible] coverage area. We had a mixture of MnDOT devices MnDOT signed which would be the red area and then the yellow area within the work zone was a combination of some MnDOT devices that were still active provided by the contractor. So in this case in the westbound we had our TMC providing the travel times and utilizing [Indiscernible] and supplementing pretty be with the contractor. In the eastbound direction we had nothing. Just happened the work some was pre-much at the end of our coverage area so there we decided kind of a little bit of a test to compare approaches we have a contractor provide everything and so the blue area they provide[Indiscernible] signs they provide static signs with dynamic answers the provided travel time in the provided detection throughout the area so you had pretty much standalone system eastbound and integrated system westbound. And we were able to kind of compare and contrast how well each performed overall datebook performed pretty well. They both had their riches that need to be overcome but for the most part think your pre-successful. And we exited an evaluation with the public as to have a valued it. 23 of response valued this [Indiscernible] in alternate[Indiscernible] we also provided stop traffic ahead into some 9% responded both of the travel information posted helped enhance safety and 80% of them really liked the usefulness of the stop traffic ahead warning messages. Overall driver of reporters less stress and delays in the work zone because of the system deployed. During into some of the data tools and how we have utilize their existing tools, to help monitor work zone and also plan for work zone we have a couple of different tools. One is [Indiscernible] which the web-based system provided by [Indiscernible] version developed by UC Berkeley for Caltrans we adopted about 34 years ago now and with access to all of our [Indiscernible] data instead reporting within that [Indiscernible] software. We also have another difficulty Which is developed the loop campus can provide some specific measures on throughput and travel times so we will utilize both these tools which optional couple of examples of to help plan as well as monitor work zone. Some of the challenges we've had is working with both of these tools work well with permanent detection and so we staying in the same place and some of these temporary detention and with traffic switches where traffic is on the northbound side for a couple months and maybe on the southbound side for couple months it becomes a little comforted to try and track the location of both devices and have the reporting tools be able to recognize those differences. That may occur during the work sound in during the construction. Some do have a couple projects experimented where the contractors providing some reporting since they are monitoring[

Indiscernible] of the data anyway the temper sensors they can provide some performance reports showing travel time information in volume. So we kind of have done a little bit of multiple approaches. Is an example from [Indiscernible] were used calculate travel times. Is was for work zone buyer maintenance crews that had to do some repair work on the shoulder but had to also close the left lane. They waited until after 9 PM after the main rush hour but it probably still wasn't within our link closure manual that would allow for the enclosure as early as on a clock. As of the travel times which normally be five minutes during that time period shut up quite rapidly to about 41 minutes. In the works are lasted for about two hours and then you're around 11 PM and you can see dissipate rather rapidly but still some very extensive delays during that time. So this is how we were able to kind of show this was probably not a good thing maybe should've waited until the weekend or overnight work when traffic volumes were lower. And this was just kind of more of another way of showing our [Indiscernible] software has more visual representation. This connection be an animation. Image of it but the blue icon on the left there little triangle shows were the works on was and then you can see all the traffic act up that's about a distance of about 5 miles so we can actually show it is kind of an animation of traffic building and how quickly build. It provides a nice visual tools for some phone that will maybe the big we do that [Indiscernible] and Leslie on the sample data here this is an example a contractor for [Indiscernible] travel time information 95thtravel time information 95th percentile buffer index the compulsive incident reports. They are actually scrubbing the data from a 501 system and they just develop tools and grab at 511 data input in a report for us in listing all the incidents that occurred within the work sound during whatever time period we specified. So they can provide daily reports or month or weekly reports whatever we ask for. With a project with University of Minnesota. The main project is wrapped up in we're looking at doing a phase 2 but we're trying to utilize some of our existing [Indiscernible] data to get a better expectation of diversion rates and delays due to work some prior to actually implementing our work sounds more in the planning stages to develop this will that looked at multiple different projects looked at the historical data and trying to come up with something that would allow us to predict those diversion rates and delays on a future project are called right now it's only established for a two-lane roadway, two lanes in each direction I should say. On the freeway system and you can plug in what your volumes are like, what kind of restrictions were planning on having with your attorney different looks like and it will do some different iterations to come up with what those diversion rates will be. Right now the tool is not very user-friendly. There was a lot of experimentation and analysis the thundering resource [Indiscernible] emphasis was put into making into use a primary tool. So really only the principal investigator as well as some of his [Indiscernible] have utilize it so that's where we're looking at probably doing a phase 2 to make it more user-friendly tool that some of our design engineers can use. And so there's more information on the link there if you are interested in more on that report. Wrapping a. Much is kind of looking ahead to the next construction season I noted for project we mentioned are going to have a touch of service patrol. We're also doing something new in terms of our wording messages for stop traffic ahead. Of resurfacing project in St. Paul's going to be over the next two summers the project is already underway and we don't have the major restrictions in place quite yet so will be in 2016 and 2017. We have detection element quarter we had loop detectors on the quarter which we knew were going to basically be obsolete soon as work started so we actually got out there and head of time [Indiscernible] on permanent polls and integrated those into iris so they are the permanent tension that will last after the project but is providing temporary detection during the works on so those early integrated in iris. The contractor than is providing

portable message signs with every mile within a works owner think the total of seven personal message signs providing an advisory[Indiscernible] wind speeds are less than 45 miles an hour the speed morning the pop-up and look like the one picture there will say something like 5 miles an hour half-mile ahead of the 25 miles an hour after mile had. It speeds drop below 40 miles an hour threshold will exit justice blank stop traffic warning of just a stop traffic ahead which is something we've done before but typically in past projects we have either said no traffic ahead or stop traffic ahead and we feel that slow category wanted to give them more accurate representation of what traffic was doing ahead. Accumulative of crash we had on Monday for sink on project where we had a sign that said slow traffic ahead and SMA still hit the queue and I think two things a command that when the semi driver said I didn't think you meant that slow so wanted to provide some true indication with the speeds were, but also being able more specific on the head so that half-mile can actually change. It could set a quarter mile had given him a little bit more indication as to how soon ahead is really going to be. And with that able rapid up here and provide my contact information and thank you for the opportunity to talk about what MnDOT is doing.

Thank you, Brian. At the time I would like to remind everybody if you have any questions please type them into the chat pod or go ahead and press start one telephone keypad to be placed in the queue. While we wait for people to queue up questions I'm going to turn it over to Todd Peterson to go ahead and provide wrapup slides are called Todd?

Ray, Inc., Nicole and also to convey my thanks to Brian and Eric.'s is really some great examples there that really show the potential of how the smarter work sounds philosophy can be extended to provide an improved work sound management experience so thanks for that. At this time I just want to go over some of the resources that the federal highway can provide as you look to intimate some of these things in your own agency. The national works on safety information clearinghouse site we provided as a sort of an archive and warehouse of all the information we've developed on smarter work zone to date . That includes recordings and links to the presentation materials to be provided for the webinar series in addition to information on case studies relevant guidelines any other documentation associated with both the project coronation in technology application initiatives. So it's a good one-stop shop for everything we've developed under smarter work zone and if there's anything that catches your IQ would like more information, go free to reach out to myself or anybody on the team and we can have to get pointed in the right direction. There's a couple other links here. Both the guidance document that Jerry talked about earlier up at the top, there's a number of other documents here the work tone by TS implication guide Jerry also had a hand in that as well. Of these links pertain to the items we discussed today. And with that, I just want to make everybody aware of the upcoming webinar number 15 which will focus on the WISE tool we are looking to schedule that sometime in early September . If you are staying into the clearinghouse website will have updates on that webinar is actually going to be scheduled for so either keep an eye on the website or if you are on our mailing list, keep an eye out for an invitation sometime in Midshipman August on that. And final leg as we will wrap up. We have [Indiscernible] program manager and initiative leave for the work zone initiative so reach out to him if you have any questions and engage you pointed in the right direction. So Nicole, without it looks like we may have some comments questions coming over the chat pod here so I will turn it over back to you to address some of those.

Yes, we do have one question from Kyle. Do you think using the 511 app encourages people to use cell phones while driving? Is there be any impact on people using Apple driving?

Yes, I can try and talk about this this is Brian Kary. We developed our app about three years ago we had a lot of conversations about that and we decided to go forward with the app anyway. We felt there was a lot of third-party apps out there so we are not going to really be able to prevent it anyway. We do encourage our motors and her users to not use the apps we have a warning message message that pops up on it to tell them to use this note when driving. And as far as any impacts of people using the app, we haven't heard any negative feedback since we deployed at.

Thank you. Those are all the questions we haven't chat right this moment. We will go head impulse for woman minute to give anyone a chance to type. In addition, we can take questions over the loan by pressing*one on your telephone keypad. So will give it one more minute and that we will wrap up.

Okay. I don't see anyone typing and we do not have any questions over the phone. Some going to go ahead and close things out. Thank you again to our presenters today. Recording will be available online in the next week or two. & E-mail to everyone who was registered once it is available like Todd said the next weather will be held in September and the topic is work zone estimator tool pilot series of sent out invitation to the smarter work phones distribution was once the date is set and registration is available. Thank you again and I hope everybody has a great day.

This concludes today's webinar. To me now disconnect.