

Reconstructing the Michigan State Police (MSP) Test Tracks to Enable Evaluation of Advanced Traffic and Pavement Engineering Concepts

Final Report

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16. Abstract Current conditions at the Michigan State Police (MSP) Test Track Facility were examined for the purpose of evaluating the feasibility of reconstructing, improving, and adding other functionalities to the facility. Issues related to pavement, drainage, widening of tracks, adding traffic control equipment, lighting of tracks, adding a gravel road section, and adding other road features that are typically encountered in urban areas. The study determined what should be done to maximize the benefits of the track to MSP and to MDOT. MDOT could use the track for evaluation and testing of some traffic control and/or detection technologies. Drainage appears to be a serious issue. Its remediation is necessary before proceeding to other issues. Estimates of costs for most of the necessary work has been attempted but the cost estimate for the most pressing issue, drainage, could not be completed as many of the necessary pieces of information for cost assessment can only be collected as part of a detailed and more comprehensive study on drainage problems and an elevation survey of different points, especially those for the water outlets.			
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TABLE OF CONTENTS

Executive Summary.....	4
Introduction	5
Project Description:	6
Drainage: Assessment of problems and proposed improvements	6
Proposed Solutions	6
Challenges and Necessary Work	7
Sprinkler System for the Skid Pad.....	9
Construction/installation of Signals, Conduits, and Foundations for Traffic Control.....	9
MSP Needs	9
MDOT Needs.....	11
Geometric Issues.....	11
Crowning of the outer tracks:	11
Provision of compatible friction and pavement slopes at points of transition:.....	12
Third lane addition:.....	12
Construction of a gravel road section:	12
Paving and Related Work	14
Edge-line and lane markings	14
Rumble strips	15
Construction of a gravel road section with rail road crossings.....	16
In-pavement pedestrian crossing lights	16
Training with Loaded Fire Trucks.....	17
Use of Warm Asphalt Mix.....	17
Lighting.....	17
Cost estimates	18
Drainage Work.....	19
Signals.....	19
Sprinkler System for the Skid Pad.....	19
Lighting System.....	19
Paving	20
Conclusions and Closing Remarks	20
Appendices	I
Appendix I: Sprinkler System	II
Appendix II: Lighting.....	III
Appendix III: Lane Switching Signals	IV

EXECUTIVE SUMMARY

Current conditions at the Michigan State Police (MSP) Test Track facility (hence forth the *test track*, or the *track*) were examined for the purpose of evaluating the feasibility of reconstructing and adding other functionalities to the facility. Issues related to pavement distress, drainage, widening of tracks, adding traffic control equipment, lighting of tracks, adding a gravel road section, and adding other road features that are typically encountered in urban areas. The objective of the study was to determine what should be done and at what stage to maximize the benefits of the test track to MSP and to other agencies that could use the track for other activities. It was determined that there are currently serious issues with drainage that a comprehensive study and subsequent drainage improvements be instituted prior to all other improvements and additions. Estimates of cost for most of the necessary work has been attempted but the cost estimate for the most pressing issue, drainage, could not be completed as many of the vital pieces of information for cost assessment can only be collected as part of a detailed and more comprehensive study on drainage problems and an elevation survey of different points, especially those for the water outlets. Sources of information (and, in some cases, costs) on other improvements/additions were identified.

INTRODUCTION

The Michigan State Police (MSP) training facility for precision, located in Eaton County southwest of I-96 and shown in Figure 1, is used to train MSP troops for high speed maneuvers, exposure to different roadway conditions, and recovery techniques. The pavements of the track, precision/skills and skid pads currently show signs of surface distress and possible subsurface structural failure. It is unlikely that simple surface treatment such as repaving will be sufficient to address the roots of the pavement distress issues. Michigan State University was retained to evaluate the need for necessary improvements and to examine the feasibility of incorporating additional features to enable both enhance training atmosphere for MSP and future evaluation and testing of advanced traffic operations/technologies and concepts as well as new pavement and materials in support of the Michigan Department of Transportation (MDOT) operations. Specific new components to consider included: 1) innovative roadway and traffic control technologies/concepts to enhance operations and safety in general as well as for specific users such as elderly drivers/pedestrians, and 2) geometric and roadside features necessary for evaluation of the human/vehicle/roadway interactions.

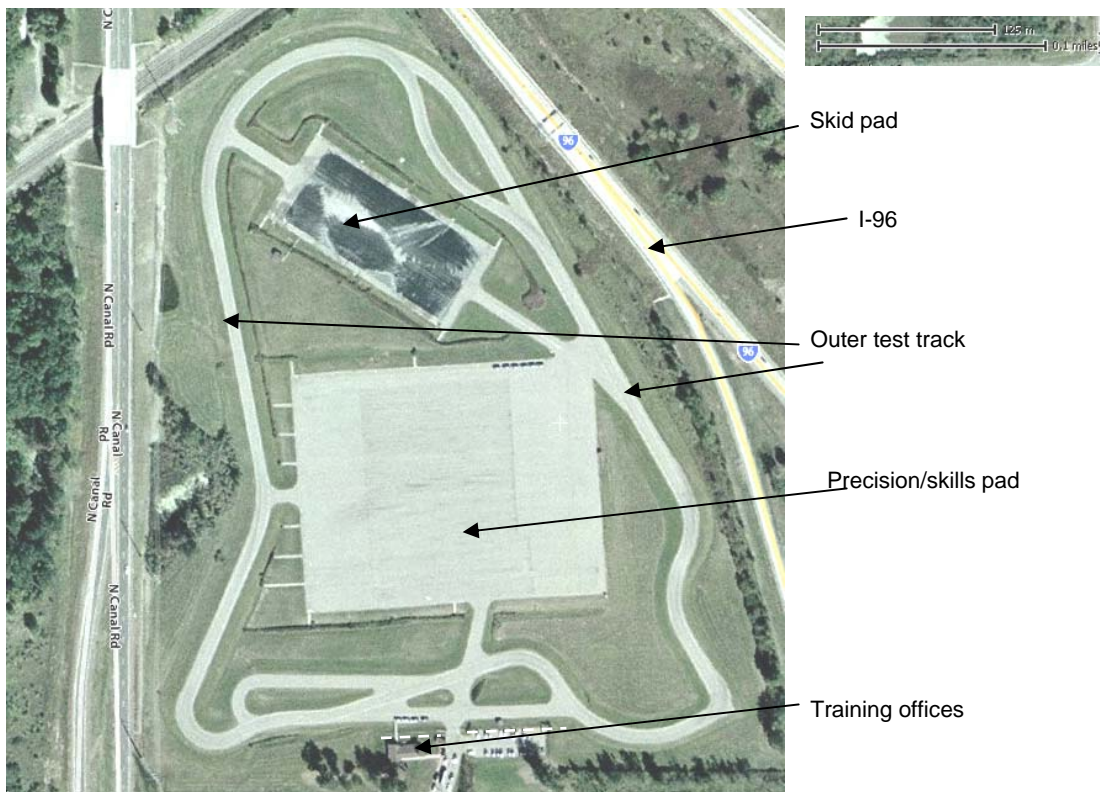


Figure 1: Components of the test track facility, and surrounding areas

The objective of this study is to determine the necessary improvements and additions to fulfill the needs of MSP, and to evaluate the feasibility of complementing the redesigned test track with instrumentation and necessary features to enable testing and demonstration of advanced traffic, geometric, and pavement concepts and technologies in a safe and controlled environment. Initially the study was to address the feasibility of a diverse use of the track by MSP, MDOT, and other MDOT's partners, only MDOT and MSP's needs where considered.

Project Description:

The primary goal of this project was to determine a range of advanced traffic operational and safety concepts, diverse geometric conditions, and pavement surface and subsurface testing section that would be desirable to include as part of the redesigned and resurfaced MSP test tracks. This report includes an evaluation of the feasibility of the above-mentioned traffic, geometric, and pavement facilities. Three points are more specifically addressed: 1) can all such facilities eventually be part of the test tracks and what are the limitations of their use, 2) can they all be constructed simultaneously or should they be completed in different phases, and 3) how would a fully redesigned, instrumented, and reengineered facility meet the needs of MSP and MDOT.

DRAINAGE: ASSESSMENT OF PROBLEMS AND PROPOSED IMPROVEMENTS

Drainage in the test track facility is currently achieved using a network of roadside ditches that are connected with culverts. The current drainage is both inadequate and poses safety issues for trainees. Inadequate drainage is apparent in many sections along the tracks and at the peripheries of the skid and precision pads. Soil erosion seems to have led to serious surface problems (e.g., settlement and pavement cracks around drain inlets). In other spots around the pads, concrete spillways have been compromised and/or damaged due to water backups. Many of those issues have likely been accentuated by the fact that the entire area of the test track was a swamp area.

Ditches are a safety hazard. They are constructed along most of the track sections, and hence vehicles running off the tracks, especially at curves during high speed maneuvers, often end up driving into or across the ditches. To date most incidents involving vehicles running into and across ditches have been property damage only; however, these accidents are frequent enough to warrant attention.

Solving the drainage-related problems is a necessary first step to addressing most pavement distress problems and to prepare the ground for further expansion of the functionality of the test track (e.g., installation of traffic control devices, widening of specific sections of the tracks to enable specific vehicle maneuvers and to enable training for specific urban roadway geometric and signage conditions.)

The following section discusses, conceptually, the different components to the drainage work that will be necessary.

Proposed Solutions

The solution that will remedy both the lack of adequate drainage and safety consists of constructing a series of catch-basins and connecting them to a network of drainage pipes that would carry the water to a detention pond (or ponds) outside but near the facility. The collected water will eventually have to drain into the county drainage system. The location(s) of the detention ponds cannot be pinpointed at this time; there will have to be a closer examination and a survey of the facility to determine critical elevations, especially those of potential outlet points. Provision of the detention pond on the premises is not an option; however there are a couple or three possible locations either immediately outside the facility or across the Canal street Bridge to the southwest, as shown in Figure 2.

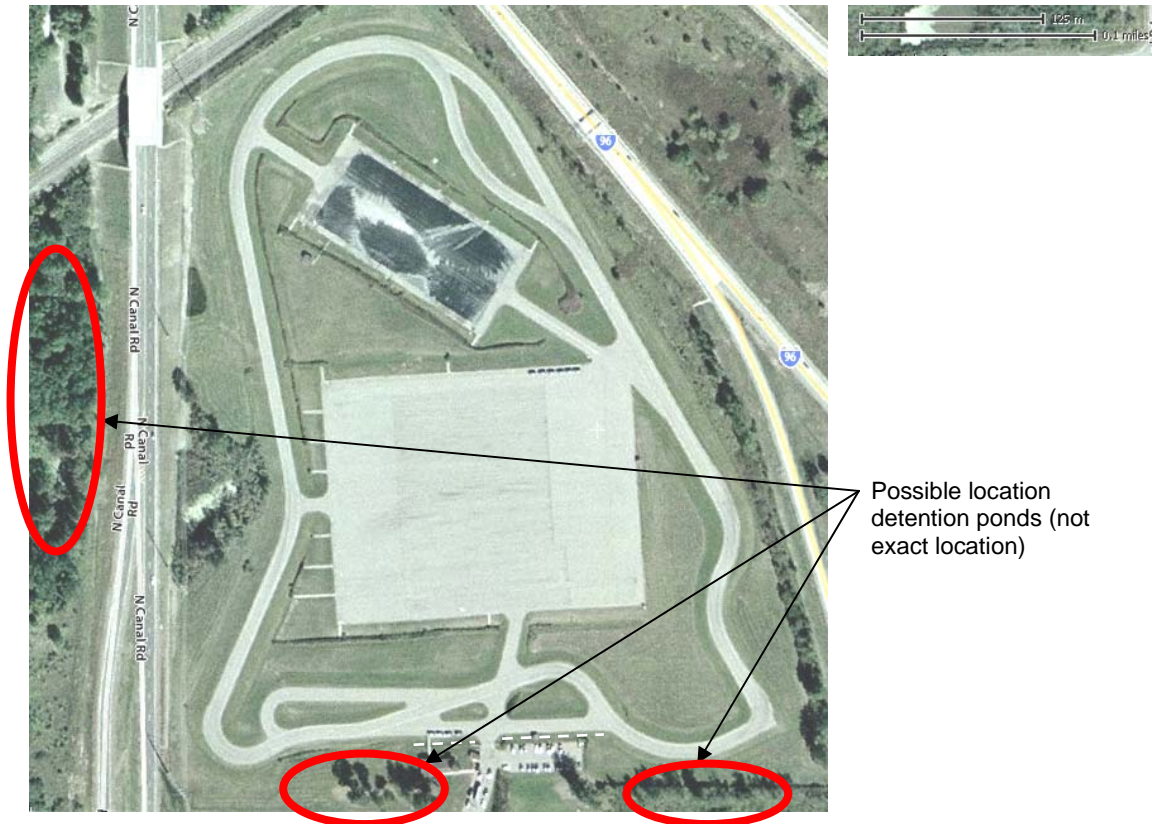


Figure 2: Potential locations of proposed detention ponds

The volumes of fill for the existing ditches and wetlands on the facility will have to be determined along with the areas of necessary detention areas. The sizes and designs of these elements significantly impact the costs of construction. Hence these costs cannot be estimated without the design (as-constructed) plans of the ditches and culverts and not without a survey of the facility (especially determination of elevation of potential outlets of the facility).

The distances that the drainage pipes will have to run must be determined before a cost estimate can be prepared. Hence determination of the location and areas of the detention ponds and the location of the inlet points into the country drainage system will also have a significant bearing on the cost estimate of the drainage improvement at the facility. At this stage, this information is not available but can be determined once a design study is undertaken.

Another option to address the drainage problems is to use ordinary ditches a way from the tracks using necessary pipes and catch-basins. However, limitation of the area will likely render this option infeasible.

Challenges and Necessary Work

A survey is needed to determine elevations of different critical points. Of particular importance is the elevation of the potential water outlet points from the facility. This will in turn influence both the sizes and layout of the drainage pipes carrying water out of the facility.

Sizing of the drainage pipes to install will be necessary. The size of pipes to install will depend, among other things, on the distances to carry the water, the elevations of the outlet points, and the design year (10-year, 20-year design, etc.). This, again, underscores the importance and necessity of conducting a survey for the site.

Based on information available to the study team, the detention ponds will have to drain into county drainage systems. As such, the choice of the design event (10 year design event, etc.) will have to be governed by the County regulations. Presence of the sub-base under-drains will have to be considered when filling the ditches and designing the catch basins.

Drainage from the nearby section of I-96 is likely contributing to water detention in the ditches on the northeast side of the facility (see Figure 3). If these ditches are to be filled then proper pipe sizes should be installed to adequately capture drainage from I-96 and the close-by ramp.

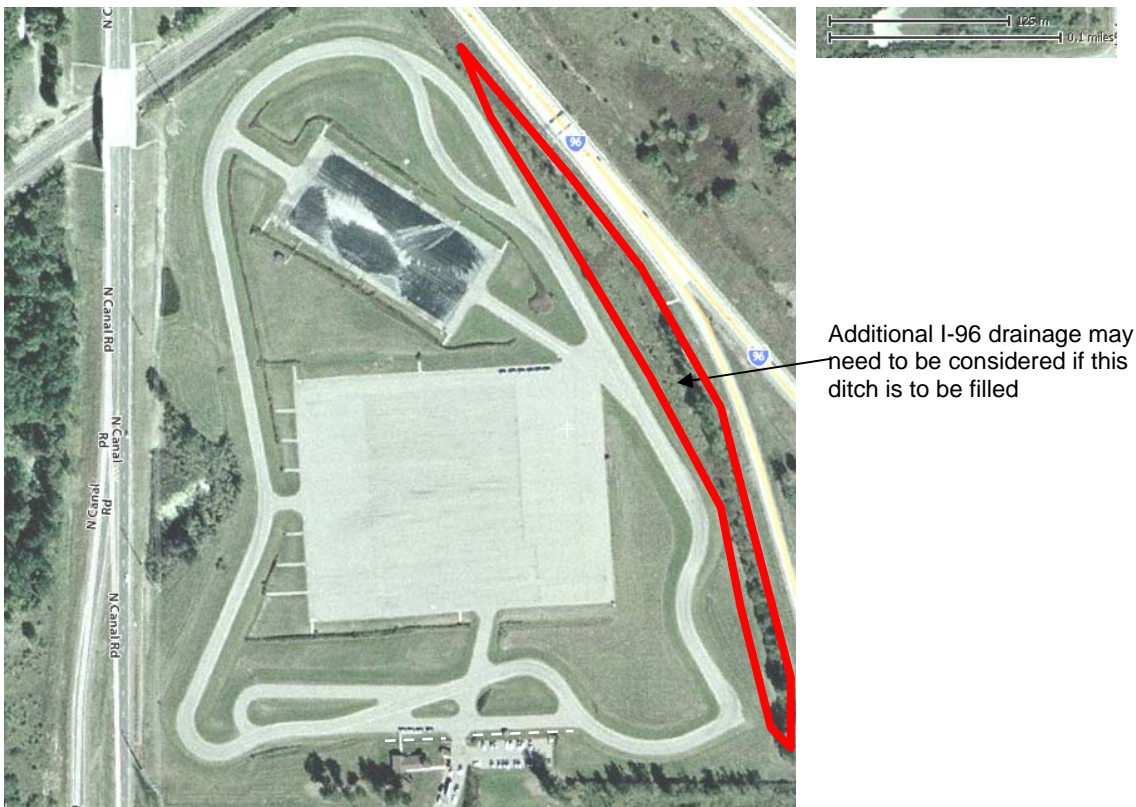


Figure 3: Shown ditch might be part of I-96 drainage system

Irrespective of the final design and slope of the surface of the tracks MSP would like, it will be necessary to slope the surface of the tracks and shoulders enough to drain the water. Proper inlet covers will have to be used (i.e., ones designed for the volume of traffic in the facility).

Sprinkler System for the Skid Pad

Although this is not a drainage issue per se, it is closely related. Water seepage from the pipes appears to have contributed to severe soil erosion at several points around the periphery of the skid pad. The erosion at several points is severe enough that it has caused structural failure in the surface of the pad. MSP is looking to replace the existing sprinkler system with one that will ensure long-term integrity of the pipes and eliminate seepage. The components of the proposed sprinkler system are described, along with necessary specifications in Appendix I. Although such system is meant primarily for ordinary irrigation purposes, its functionality is such that it can be used for the special purpose (such has been verified with the supplier of the system). The sprinkler system will have to first be designed for the MSPS' special use before a final price for the system can be estimated. The design of the system is an additional cost to the equipments that will be used. There are two companies in Michigan that both supply the system components and do the necessary design¹. One thing should be noted though: in ordinary irrigation uses soil erosion is not an issue perhaps due to the fact that there are no traffic loadings on the surface.

For the surface of the skid pad, the MSP would like the following two options be considered: first is to use the same material that is currently used (called Jennite)². The version of this sealant used at the Skid Pad is without sand (sand is normally used in regular use sealant mixes). The second option is to use polished concrete. In this case concrete slabs will have to be installed with appropriate joints. Polishing will likely take place in- situ. This type of skid pad is used in other states. Further information may be obtained on its feasibility and advantages if this is deemed a viable option.

CONSTRUCTION/INSTALLATION OF SIGNALS, CONDUITS, AND FOUNDATIONS FOR TRAFFIC CONTROL

MSP Needs

As part of the training of officers, MSP would like traffic signals to be installed at two points (see Figure 4). In the first location (Signal 1), the signal will simulate a regular signalized intersection situation. This signal is to be installed near the training offices as this location offers multiple vehicle pathways, or approaches, that can be used to closely simulate the crossing of signalized intersection approaches. At this location, it is preferred that the signal heads be mounted on a mast/arm support, with the support located outside the fenced area to minimize crash risks. However, because the length of the span to cover will likely exceed 50 ft, it is expected that a standard mast/arm assembly cannot be used for the installation of this signal. A span wire arrangement might be more appropriate.

¹ The two companies are: Hydrologic, 1-810-220-2040, and John Deere, 1-810-225-7800, both based in the Brighton-Ann Arbor area. Hydrologic is the same company that designed the sprinkler system for the GM Proving Ground using the RainBird system presented in the Appendix

² This is a sealer manufactured by a company called NEYRA. They are located in Cincinnati, Ohio. More on Jennite at <http://www.jenniteusa.com/index2.html>. More on NEYRA at <http://www.neyra.com/products.htm>. Phone: 800-543-7077

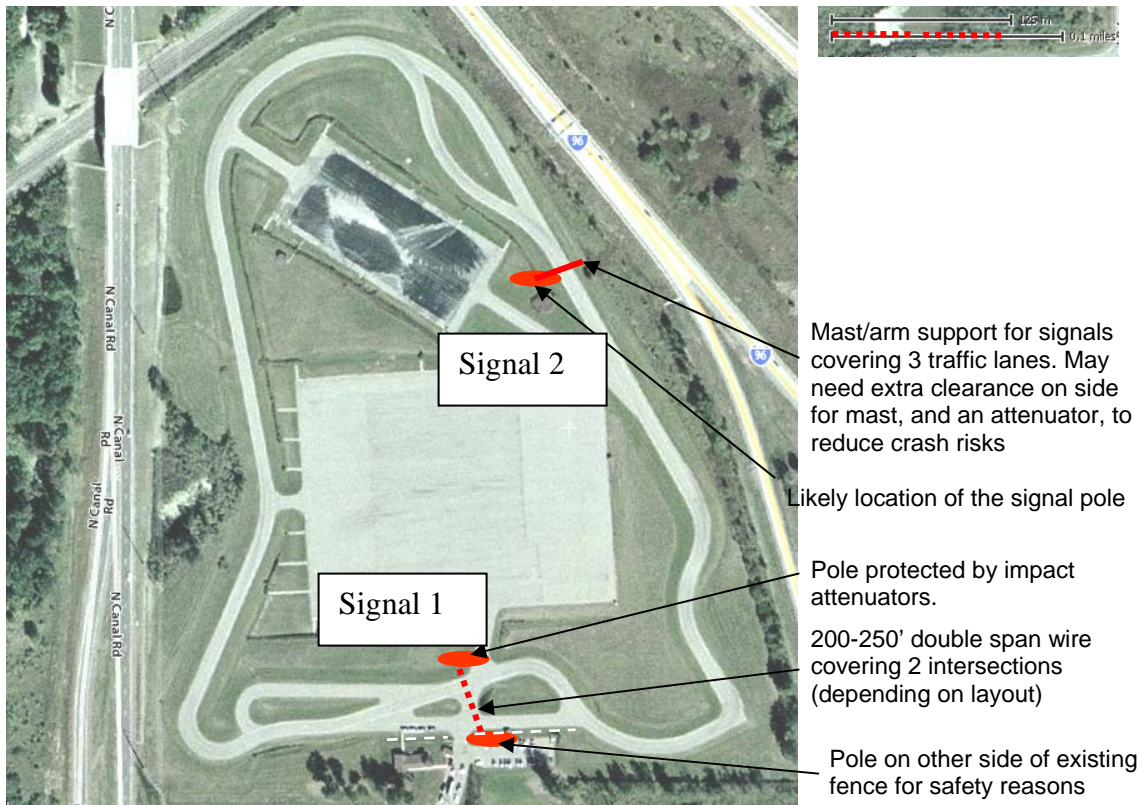


Figure 4: Locations of signal

A first option for the installation of the above signal was to use a special mast/arm design. However, initial assessments by MDOT personnel indicated that this may not be possible because of the fatigue stress involved. A suggested alternative is to mount the signals on a truss similar to those used on freeways for mounting signs above the roadway. Such a truss could have a span of up to 100 ft. However, this would have the disadvantage of creating a need for the installation of at least one of the truss bases somewhere inside the testing area, which is a safety hazard. A third alternative is to mount the signal on a set of span wires. Similar to the truss option, this alternative creates a need to add a pole within the testing area but would allow for potentially longer spans to be deployed. If a pole should be installed inside the testing area, its location will have to be carefully selected to be on the “inside” of any nearby horizontal curves so as to minimize the risk of collision in case vehicles drift or ran of the tracks. Attenuators will also have to be used to minimize the impact of potential vehicle impacts. Based on survey of the site and the limitations on the locations of the poles and the available space around them, the option of the span wire appears the most feasible.

The second set of signals (Signal 2) is to be used for lane use assignment during high speed maneuvers. As shown in Figure 4, this signal is to be located over the straight roadway segment in the eastern side of the facility, where a third traffic lane is proposed. These signals will be equipped with a detection system and a switching mechanism to assign which lane a vehicle should use. It is likely that the signal heads at this location will be mounted on a mast/arm with a pole located in the “inside” areas of the curve as far away from the track as possible. Use of a mast/arm assembly at this location is possible because of the need to cover a span extending only three traffic lanes. Because of the addition of a pole within the testing area, attenuators should be used to minimize crash risks. Also, because of

drainage issues, installing the signal pole may be feasible only on the southwest side of the track (see Figure 4). Installing foundation for the pole on the northeast side of the track may not be feasible due to the presence of the drainage ditch.

MDOT Needs

As part of any reconstruction/improvement plans for the site, MDOT would like to eventually have traffic signals installed at two locations on the test track along with necessary conduits and controller infrastructure. The signals are to be used for testing of either control hardware-related and/or related software. MDOT also has an interest in having sufficient conduits for power and data cables to be installed along the test track to facilitate future equipment deployment on the site.

The proposed locations for the installation of traffic signals are the same as the locations suggested by MSP for their training needs. The main difference between MDOT and MSP needs is in the fact that MDOT is primarily interested in using the signals for testing new hardware. There is no plan at this point for using the signals to test traffic control methods/logics and/or signal coordination.

For the power and data cable conduits, it is recommended to install two 4-inch conduits around the entire facility. One of the conduits will be used for power cables and the other for data communication cables. Such a layout will give MDOT the flexibility to do a variety of signal related hardware and software experimentation in the future. Installation of these conduits will require handholes/manholes (more likely manholes that need to be appropriately placed). At the design stage, more specific information will have to be provided by MDOT (ITS Program) on the preferred and necessary locations of the manholes.

Although MDOT initially expressed interest in testing weather applications at the test track, it has been determined that doing so may provide an unacceptable hazard to the MSP vehicles using the track.

In summary, MDOT is interested in installing two signals and conduits for power and data communication cables along the test track. Installation of these devices is not likely to pose much difficulty, and is not likely to cause much change to any reconstruction/rehabilitant plans for the facility. A primary concern will be the need to attenuate crash risks posed by the potential installation of new poles on the facilities. Proper foundations for the signal poles (mast arms or span-wire) will also have to be constructed to account for the specific drainage conditions on the facility.

GEOMETRIC ISSUES

There are multiple issues in this category. They are addressed separately in the following sections.

Crowning of the outer tracks:

When the tracks are to be reconstructed, MSP would like to maintain the current pavement surface slopes (currently the pavement surface has only 0.015%). Although this may not be per AASHTO standards, it is suitable for MSP's special needs.

possible locations for the gravel section as noted in Figure 7. The first location is the preferred one. It is recommended that this option be adopted. If for any reason the construction of the gravel section is to be delayed, the ramps to the section should be completed as part of the track reconstruction/improvement.

The preferred location of the gravel section will encroach on, and possibly disturb the wet land area in the western part of the site (see Figure 7). As such, necessary mitigation will have to be done.

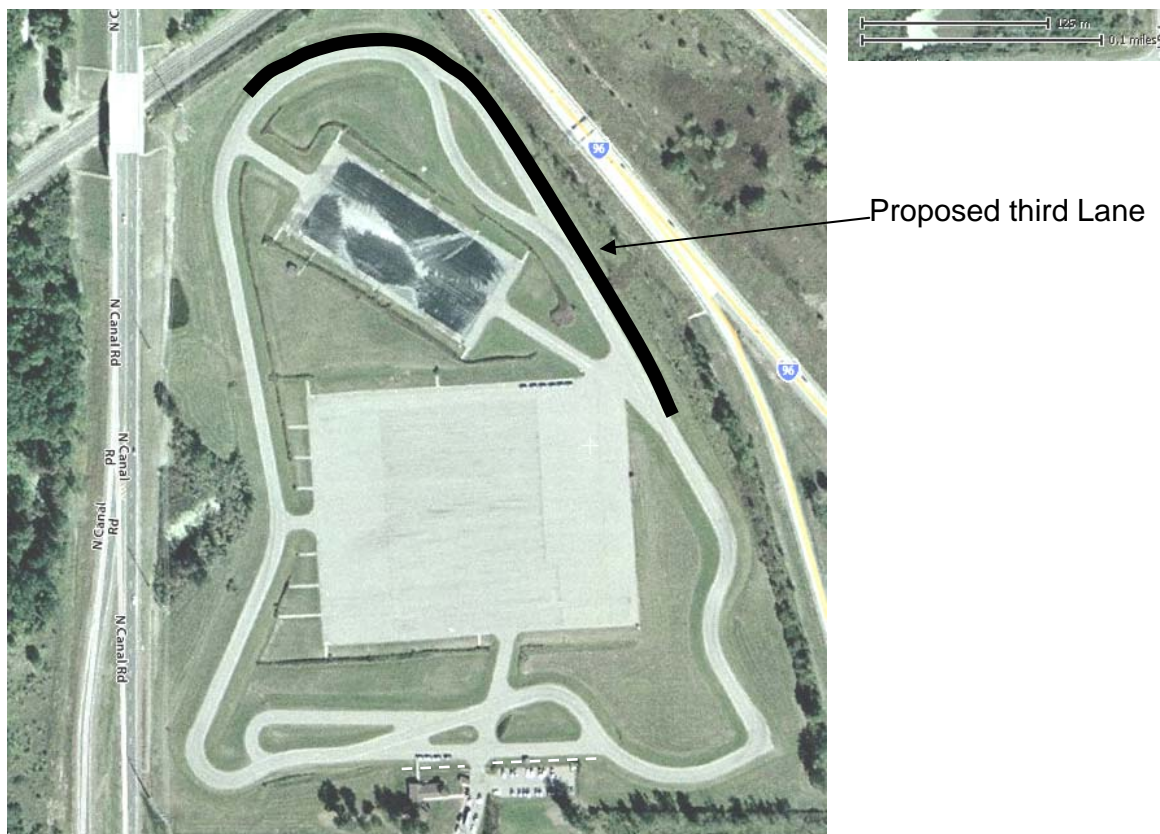


Figure 6: Location of the proposed third lane.

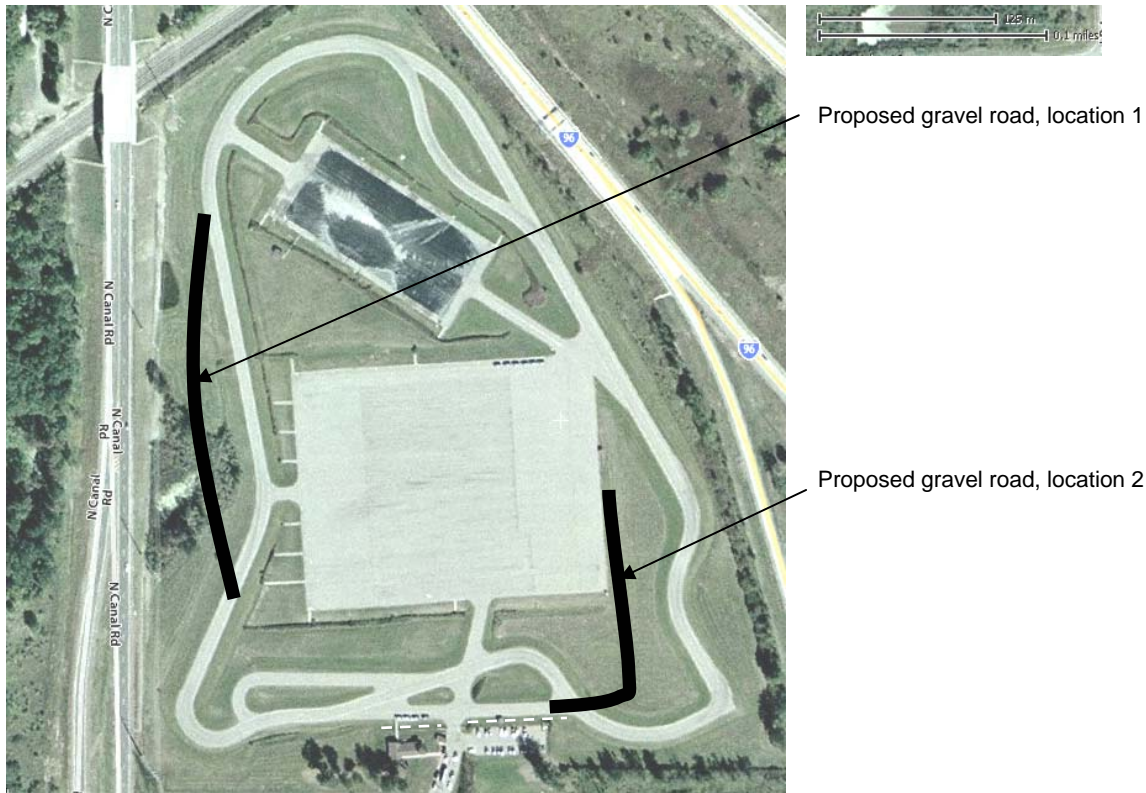


Figure 7: Possible locations of the gravel road section. Location 1 is preferred.

PAVING AND RELATED WORK

Edge-line and lane markings

MSP would like raised edge line pavement markers installed. This will help in training related to maintaining position within lanes. These markers are both easier to see, especially in inclement weather, and they are somewhat protected from snow plowing. MSP would like to have the entire track fitted with these markers if possible. At minimum two sections of the outer tracks should be fitted with those lane markers: the sections shown in Figure 8. There are currently different designs for these markers. The specific design to be used will have to be decided (in consultation with MSP) at the design stage of this project. For the middle lane lines MSP would like to use regular paint markings. The water-based paint that is currently used in the facility would be sufficient.

Construction of a gravel road section with rail road crossings

A simulated railroad crossing is proposed for the gravel road section (not the paved track). The location of the rail road tracks within the gravel road section should be about midway. MDOT standards for tracks installation should be used. In addition, MSP would like to the rail road crossing to be elevated slightly above the road level. The slight elevation in the level of the tracks is intended to create less than ideal conditions that trainees may encounter in the real world. It is the preference of MSP to have the space between the rails is filled with concrete.

Flashing lights (but no gate) are recommended in conjunction with the rail road crossing to create conditions similar to those encountered in the real world. The crossing flashing lights would be operated remotely (i.e., they would NOT be activated by devices in the immediate vicinity of the crossing. In normal conditions the lights would be activated by the passage of a train). The light posts should be designed with forgiving frangible base to lessen the impact of crashes.

In-pavement pedestrian crossing lights

MSP would like to have in-pavement pedestrian crossing lights installed across the lane in front of the walkway to the training office. The in-pavement crossing lights at this location would simulate a mid-block pedestrian crossing situation. Since the use of these lights at the test track is atypical one (i.e., there will be no pedestrians to activate the lights), they will have to be specially designed so that they can be remotely activated. The proposed location is shown in Figure 9. These lights are typically not installed at intersections.



Proposed location for in-pavement pedestrian crossing lights

Figure 9: Locations for in-pavement pedestrian crossing lights

Training with Loaded Fire Trucks

The redesign and construction of the pavement should take into account the likelihood that loaded fire trucks may be used for training. In the past MSP was approached to using the facility for training with loaded fire trucks. However, the current pavement conditions and design do not permit such usage. Preliminary analysis indicates that the use of such heavy trucks on the current structure (1.75 in asphalt layer over a 4 in base and a 24 in subbase) is not warranted. A preliminary AASHTO design calculation suggests a maximum allowable number of fully loaded fire trucks (27,000 lb steer axle with either a 31,000 lb rear single axle or a 53,000 lb rear tandem axle) to be about 10,000 to 15,000. This number is alarmingly low, suggesting that there is a high potential for premature base/subbase or subgrade failure, which would probably lead to severe rutting due to shear failure. It is therefore recommended that more detailed testing of the existing layers be conducted for a better assessment of the structural capacity of the current pavement structure. The presence of a high water table and poor drainage conditions will further aggravate the problem. Furthermore, the operation of these trucks under severe maneuvering along curved trajectories would lead to very high traction forces which would require specially designed mixes to withstand high lateral shear stresses. Therefore, it is anticipated that the use of such heavy trucks would require significant strengthening of the pavement structure including a high stability asphalt mixture.

Use of Warm Asphalt Mix

The concept behind warm mix technologies is reduction in asphalt binder viscosity, allowing for the asphalt to attain suitable viscosity for coating of the aggregate and compaction of the mix at lower temperatures. Currently there are two commonly used types of warm mix additives in the market, wax-based additives that are added to the asphalt binder through low shear mixing, and hydrated mineral compounds that are added to the pugmill during normal batching operations. Both of these additives achieve reduced binder viscosity by different mechanisms. The implementation of warm mix technology as a viable option for paving operations is a promising concept as far as cost and environmental considerations. However further investigation of the effects of the aforementioned additives on the constituent materials of asphalt mixtures and pavement performance must be undertaken. Specifically, the impact of the additives on mixture workability must be quantified, and the field performance of pavements placed using warm mix technologies should be evaluated and compared to conventional HMA mixes. Rutting, moisture damage, and mix design are some key issues that have yet to be fully resolved. This part of the research is scheduled to be investigated in a subsequent project, if the implementation of the test track reconstruction is approved.

LIGHTING

MSP would like to increase the hours the test track may be utilized. Providing suitable lighting during night hours can achieve that. Using stadium lighting is probably the best choice. However, this might be a costly option. Use of Texas Lights (see Appendix II) might be a suitable compromise. Using regular street lights is not a suitable option.

Given the layout of the facility and the limited space, it appears inevitable that some of the high mast arms will have to be installed within the facility thus making them a potential hazard during high speed runs especially at curves. Installing the masts at the peripheries may not be an option in part because of drainage problems (this is especially true in the area close to I-96). Placing the masts at the peripheries in less drainage-prone areas might render them ineffective as they might be too far from the areas

intended for lighting. Given that MSP does high speed runs in both directions, there are no “safe” inside-curve areas. As such the masts or high masts may have to be placed in areas within the facility that are not totally collision-safe. Proper attenuator must be used in this case. Figure 10 shows suggested locations of the high masts. These locations were identified with the MSP trainers based on their knowledge of the areas that are most prone to running off the road. Not all masts shown will be needed; that will depend on the exact types of lights used (there are different options that fulfill the MSP needs but that vary based on other considerations such as the exact type of lighting fixtures. See Appendix II for further information). A lighting design will have to be conducted before the final locations of masts are decided. That is an additional cost to the actual lighting hardware. As can be seen from Figure 10, the eastern-northeastern side of the facility has fewer feasible places for masts. This is due to the close proximity of I-96, and the drainage ditch which will likely complicate the construction of foundations for the masts.

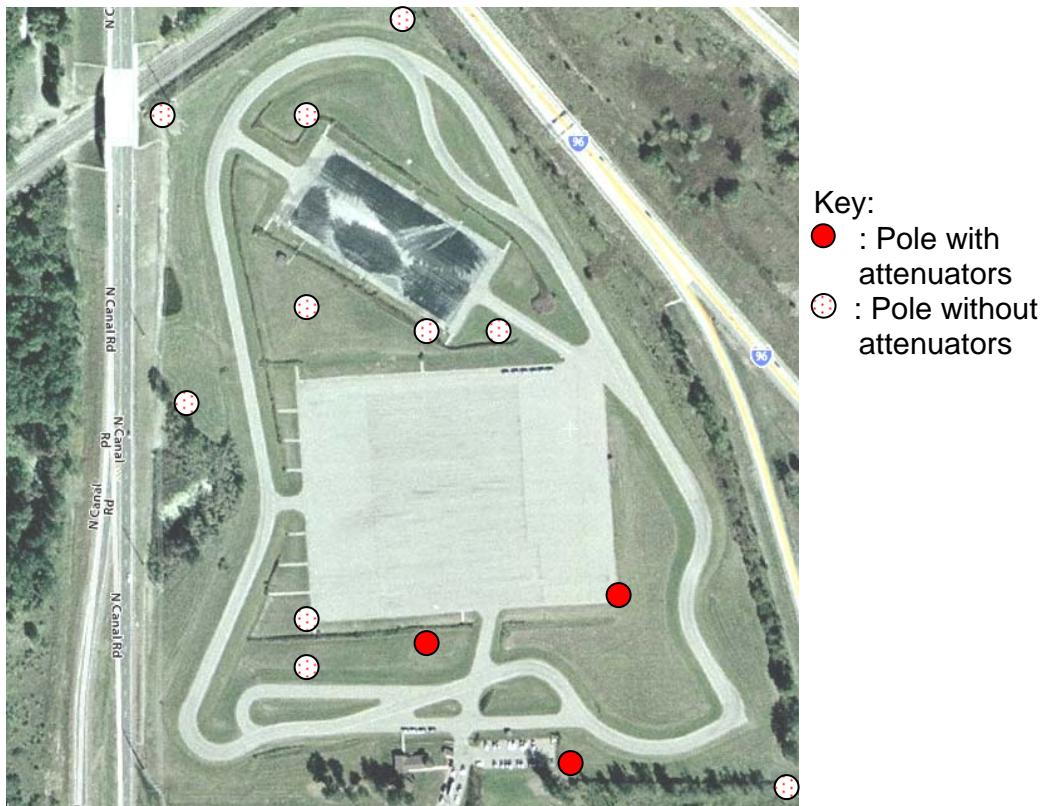


Figure 10: Potential locations of lighting poles. Not all shown locations will have to be used. Locations are approximate. Some of the poles may have dual lighting and signals use

COST ESTIMATES

A cost estimate for the all the work elements proposed in this report could not be completed at this stage. The major cost element will be that of the drainage work. Without design (or as constructed) plans and a survey of the area (to determine heights of critical points, especially those of possible outlet points), a cost cannot even be guessed. Costs of several other components could not be easily determined because the uses at the MSP facility are not typical ones. For example, installing the rail road tracks across the proposed gravel section is not a typical one and hence its cost is not readily available.

Drainage Work

Cost estimate for the major drainage work could not be obtained at this point of the study. As noted earlier, a survey will be necessary for the site, and as-built plans will be necessary to determine the different feasible options to address the drainage issues and determine the associated costs.

Signals

Regular Signal

Signal heads: 8 signal heads @\$1000/head	\$8000
Span wires: assume 4 wires will be used. Exact arrangement may be different	\$3,000
Poles with foundation: assume 4 poles@\$3,500 each	\$14,000
Controller with cabinet	\$14,000
Signal design	\$6,000

Mast Arm option: assuming this is the option to be used, the cost per mast arm arrangement is \$32,500 to \$37,500. For four of these the cost is between \$130,000 to \$150,000. However, the proposed signals are not typical; one mast arm with heads may be all that is needed. A mast arm with a span greater than 50 ft may not be possible due to fatigue considerations. If type C trusses are used instead, the cost is about \$100,000 per truss. As noted earlier, use of span wire arrangement might be more feasible.

Lane Designation Signal and Switching Mechanism

Cost of the system (not including installation. A breakdown of this sum is included in Appendix III)
\$57,300

Sprinkler System for the Skid Pad

Costs of the sprinkler system can be obtained but the vendor will need more information on the layout and locations of the different system components (existing pipes and water lines). Since the sprinkler system for the skid pad is not a typical one, special designs and provisions may have to be included. These two cannot be determined without detailed plans. The vendors identified in this report can prepare detailed plans at additional cost.

Lighting System

Cost for the lighting system could not be obtained at this point. A lighting plan will have to be prepared first. The plan will outline the number of the poles and the types and arrangements of those poles and the lighting fixtures. Appendix II shows different options for high poles and light fixtures.

Paving

Cost for paving work could not be estimated at this stage of the project.

CONCLUSIONS AND CLOSING REMARKS

This report summarizes different issues at the Michigan State Police test track (also known as the precision driving training facility). The report identifies problems that needs attention, identifies new features that can be added to the facility to enhance and/or widen its functionality, and identifies additions that will be used by other agencies, most notable the Michigan Department of Transportation.

- 1- Drainage is the most pressing problem. Many other problems have been identified and are believed to be caused by the lack of sufficient drainage in the facility. Suitable solution to the drainage problem will have to be implement before any other improvements are undertaken
- 2- Increasing the hours the facility can be used for training is possible if sufficient lighting is provided. Different options for lighting are available, however use of high masts (poles) within the facility will be necessary but such fixed objects can be hazardous. Potential locations for lighting masts have been identified in collaboration with the MSP trainer so that risk of collision with the masts is minimized. A lighting design plan will have to be done first before final location of masts is determined. Attenuators will have to be provided for at least some of the masts.
- 3- The sprinkler system for the Skid Pad will have to be reconstructed. More durable pipes, joints and pumps will have to be used. A design for the system, given the specifics of the location and dimensions of the Pad, will have to be done first. Two companies that can do the design and the installation of the system have been identified and pertinent information given somewhere else in this report.
- 4- It will be possible to construct a third lane in the eastern portion of the facility. The third lane should be constructed on the outside of the existing two-lane section.
- 5- A gravel road section is proposed in the western part of the facility between the existing track and Canal road. This section should be connected to the existing paved section using paved ramps. Appropriate transitioning from the existing track to the ramps (of the gravel section) should be consistent with necessary geometric standards. Adding this lane will likely disturb existing wetlands and hence necessary mitigation are warranted.
- 6- A rail road crossing is proposed at the gravel road section. Necessary flashing lights should be installed, with necessary crash protection, to simulate conditions in the real world. No gate is to be installed.
- 7- A lane switching system should be installed help randomly assign lanes in the 3-lane section of the facility. The system should be capable of randomly assigning lanes once an approaching vehicle is detected. The system should be capable of operating automatically without human interference. Besides the signals heads, detection and switching components will have to be installed. This is not a standard system and has to be custom-built for MSP. Information on the components of the system is provided in Appendix III.
- 8- One standard traffic signal should be installed at the intersection area near the entrance of the facility.
- 9- Two conduits should be constructed around the entire facility. The conduits are for MDOT's future needs. One of the conduits is to supply power, the other if for information lines.
- 10- In-pavement crossing lights are recommend across the road section in front of the walkway from the training office.

11- Use of the existing track for training with loaded fire trucks is NOT an option given the current pavement structural conditions. The pavement, pavement base, and sub-base structural designs do not support the expected axel loadings of the fire trucks. In addition, maneuvering of fire trucks will create significant lateral traction forces that will cause further surface damage.

APPENDICES

Appendix I: Sprinkler System

Appendix II: Lighting

Appendix III: Lane Switching Signals

Appendix I: Sprinkler System

The system components described are have been verified to be useable for the Test Track facility. One of the companies (Hydrologic) that supplies the system components described here has installed a sprinkler system at the GM Proving Grounds. The system is similar in many respects to the one used by the MSP. Contact information are: Hydrologic, 1-810-220-2040, contact person: Jim Koziatock (phone: 248-640-1280)

(Material for this Appendix appears only the hard copies of the Report)

Appendix II: Lighting

There are different options to meet the requirement of MSP that the tracks be useable during the night hours. A lighting plan has to be produced first. The plan can look at different options. The following web sites provide information on high masts (poles) and lighting fixtures that can be used. It is clear that there are tradeoffs that should be weighed carefully. The web sites provided here are meant to be a source of information only. The listings here do not constitute a recommendation or endorsement of any of the companies/products. More results were obtained by searching under “sports lighting”.

Web site for high masts: <http://www.cuphosco.co.uk/HighMasts.html>

Web site for sports lighting (UK Company) (most applicable to the MSP facility):
<http://www.cuphosco.co.uk/SportsLighting.html>

Web site for Musco lighting (USA): <http://www.musco.com/>
http://www.venturelighting.com/LampsHTMLDocuments/sports_lamps_selection.html

Poles and lights:
<http://www.uslnet.com/?page=products>

Poles and lights:
<http://www.sportslighting.com/>

Appendix III: Lane Switching Signals

The cost estimate provided in this appendix is approximate and it is based on information from only one supplier. The cost estimate is based on the description of the functionalities that the MSP would like to have and not on examination of the facility where the system will physically be installed. Cost of the actual system may change upon its design. The cost estimate provided here does NOT include installation.



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QUOTATION

Sales Quote Number **9050**

Sales Quote Date: 07/11/07

Expires On:

Page: 1

Sell To: MICHIGAN STATE POLICE
714 W. SAGINAW
LANSING, MI 48917

Ship To: MICHIGAN STATE POLICE
714 W. SAGINAW
LANSING, MI 48917

Quote/Bid Ref:
Shipment Within
Shipping Terms
Terms

NET 30 DAYS

Customer ID 1275
Salesperson Brad Case

Item No.	Description	Cross-Ref. No.	Qty.	Unit Price	Total Price
	IN-PAVEMENT LIGHTING				
58-NS003511	IN-PAVEMENT LIGHTING SYSTEM 10 LIGHTS		1	14,500.00	14,500.00
58-NS003511	IN-PAVEMENT LIGHTING SYSTEM 14 LIGHTS		1	11,850.00	11,850.00
	ADD \$ 2,000 FOR SOLAR POWER SYSTEM				
	OVERHEAD LANE CONTROL				
101AC24M30W/R	CONTRLER ASSY,EPAC M30 MDOT W/R		1	7,438.00	7,438.00
101-2327	CABINET ACT M30 4PH WR MI PGW		1		
101-2319	CONTROLLER EPAC3608M30 W/FSK		1		
160-2001	MONITOR, 6 CH. ENHANCE SSM-6LE SSM-6LE		1		
149-1004	FLASHER, NEMA 2 CKT CUBE 304-15		1		
149-1000	LOAD SWITCH, CUBE MODEL 300-01		8		
178-1000	FLASH TRANSFER RELAY MGCRFT W21ACPX-2		2		
103-3127	CABINET BRACKET, ALUMINUM		2		
207-2410	HARDWARE, CAB POLE MOUNT -2/SET		1		
	***** END of KIT *****				
103TS12A4LED	1-WAY 2-COLOR 12" SW A4 LED		3	361.00	1,083.00
101-4835	SIGNAL POLY 12" R G LED MDOT		3		
103-7011	SPAN WIRE CLAMP ASSEMBLY		3		
103-7014	BRACKET, WIRE ENTRANCE		3		
103-7401	PINNACLE, SIGNAL CLOSURE POLY YELLOW		3		
	***** END of KIT *****				
187-1000	40' (12190mm) POLE MDOT 18" BC		2	4,318.00	8,636.00



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LANSING, MI 48917

Ship To: MICHIGAN STATE POLICE
714 W. SAGINAW
LANSING, MI 48917

Quote/Bid Ref:
Shipment Within
Shipping Terms
Terms

NET 30 DAYS

Customer ID 1275
Salesperson Brad Case

Item No.	Description	Cross-Ref. No.	Qty.	Unit Price	Total Price
157-1023	ANCHOR BOLT 2" X 114" X 6" MDOT		8	179.00	1,432.00
	OR				
187-1050	STANDARD, 30' CAT III HH @ 21'		1	2,808.00	2,808.00
187-3050	MAST ARM, 50' CAT III		1	3,736.00	3,736.00
100-1000	C&G TECH SERVICES SET-UP		1	750.00	750.00
ITEM	VEHICLE DETECTION		1	5,000.00	5,000.00
	THESE ARE BALLPARK COSTS NOT INCLUDING INSTALLATION				

Amt Subject to Sales Tax	Amt Exmt from Sales Tax	Subtotal:	57,233.00
0.00	57,233.00	Total Sales Tax:	0.00
		Total:	57,233.00