NEW ENGLAND TRANSPORTATION CONSORTIUM
QUARTERLY PROJECT PROGRESS REPORT

A. PROJECT NUMBER AND TITLE: NETC 15-3

B. PRINCIPAL INVESTIGATOR(s) & UNIVERSITY(s): Eshan V. Dave, University of New Hampshire

C. WEB SITE ADDRESS (*If one exists***):**

D. START DATE (*Per NETC Agreement***): 8/1/2016**

E. END DATE (*Per NETC Agreement***): 7/31/2018**

F. **ANTICIPATED COMPLETION DATE: 7/31/2018**

G. PROJECT OBJECTIVES:

1. Evaluate good and poor performing asphalt mixtures in New England and determine mechanisms responsible for poor performing mixtures
2. Determine impacts of remedial measures (anti-stripping additives and hydrated lime) in reducing moisture susceptibility of poor performing mixtures
3. Assess impacts of moisture induced-damage on pavement performance and service life
4. Recommend an evaluation framework consisting of appropriate test procedure(s), specification, analysis procedure verified with field performance data that is reliable and suitable for moisture susceptibility testing of asphalt mixtures used in New England

H. REPORT PERIOD: 4/1/2018 – 6/30/2018

I. ACCOMPLISHMENTS THIS PERIOD:

The majority of the work performed this quarter was focused on the finalization of the laboratory testing, data analysis, and the final deliverables for the project. As of the writing of this report, all of the laboratory testing and analysis outlined in the proposal has been completed and will be presented in the final project report. In addition to finishing the laboratory testing, significant progress has been made with regards to the final recommendations outlined in Task 4 of the project. Preliminary versions of these recommendations, as well as the majority of the laboratory testing and analysis, was presented during the project closeout meeting on June 14th. A copy of presentation from this close-out meeting is attached with this quarterly report.

One of the newest additions to the laboratory testing and analysis is the completion of the mechanistic-empirical pavement performance analysis using AASHTOWare PavementME. PavementME analysis was used to determine the potential effects of moisture damage on pavement performance and service life. These simulations, which were compared to an undamaged baseline case, were conducted in a worst-case scenario where the material properties of the asphalt layers were moisture damaged at the time of construction (moisture damaged material properties taken from dynamic modulus results on MiST conditioned materials). A typical New England arterial highway cross section and traffic levels were chosen for the simulations.

Figure 1 shows the predicted rut depth of the pavement structure for the three Vermont mixtures, where VTG1 is a good performer, and both VTP1 and VTP2 are poor performers. Looking at Figure 1, it can be

seen that all three mixtures are predicted to have higher rut depths with conditioned properties, which is not surprising considering their reduction in stiffness. This increase is more pronounced for the two poor performing mixtures, especially as the service life of the pavement increases. In the first few months of service, there is little distinction between any of the mixtures. The two poor performers are predicted to accumulate an additional 0.2 inches of rut depth compared to the baseline condition. This is much larger compared to the good performing mixture, which only experiences and additional 0.08 inches of rutting.

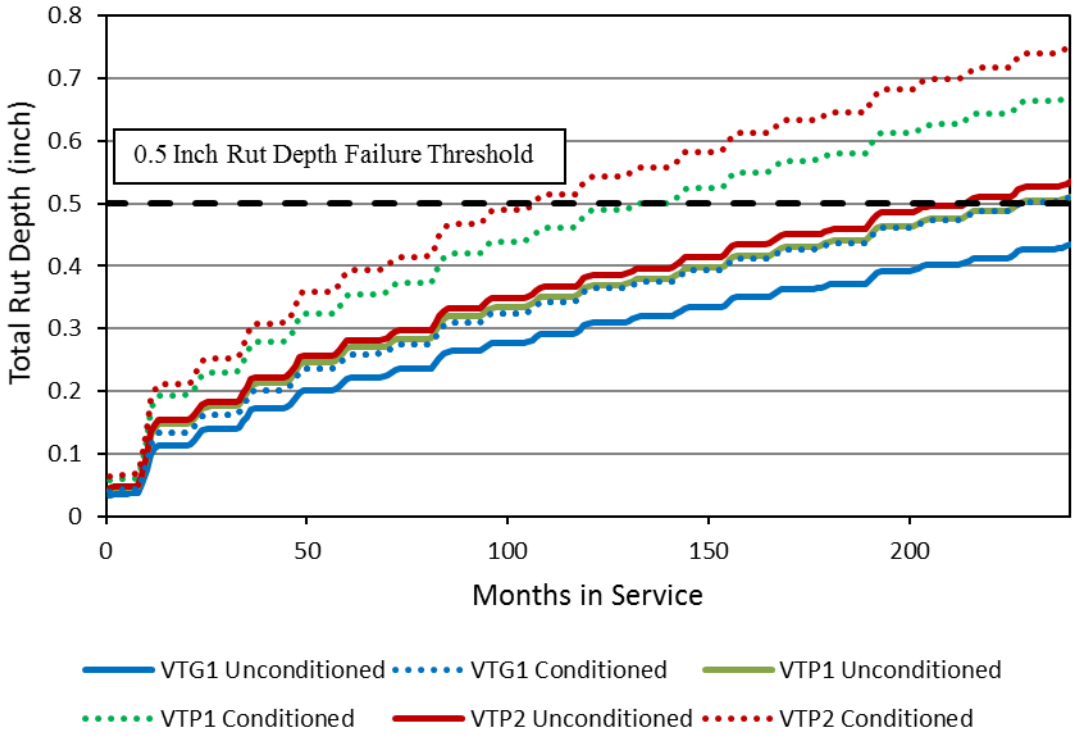

Figure 1: PavementME Predicted Rut Depth for VT Mixtures

A common failure threshold, which is the default threshold in Pavement ME, of 0.5 inches of rut depth is also shown on the plot. Pavement life in terms of rutting can be defined as when the predicted rutting crosses this threshold. Looking at Figure 1, it is apparent that all of the moisture conditioned material reach the failure point earlier than their unconditioned counterparts. When comparing the two poor performing mixtures to the good, significant differences in loss of pavement life can be seen. For example, VTP2 passes the rutting threshold at 214 and 107 months in the unconditioned and conditioned state respectively. This difference represents a significant loss of life of 107 months, almost 11 years, compared to the 20 year design life of this pavement section. Compared to the good performing mixture VTG1, which loses approximately half as much life at a loss of 50 months, this is a substantial difference in expected pavement life.

Another significant accomplishment of this quarter was the development of preliminary recommendations based off of the findings from the project. The findings, at this point, are based off of the laboratory testing results presented in previous quarterly reports as well as the project close out meeting. In summary, the preliminary recommendations are as follows:

- As a mixture design/screening test for routine usage to ensure adequate resistance to moisture damage in the field, the Hamburg Wheel tracker shows the most promise. Results from the Hamburg consistently showed the clear distinction between good and poor materials as well as materials with and without moisture treatments. In addition to this, the equipment required to conduct the Hamburg test is affordable, simple to understand and operate, and more readily available

for agencies in New England. Both the traditional stripping inflection point based analysis and the Texas Transportation Institute analysis methods were successful in distinguishing good and poor materials.

- If a performance-based design/specifications type approach is desired, it is recommended that the dynamic modulus paired with MiST conditioning approach is used. The main advantage of this approach compared to Hamburg is that dynamic modulus is a fundamental material property that can be used to predict pavement responses, and subsequently pavement performance, in pavement analysis tools such as PavementME. This type of approach allows life predictions and life cycle cost analysis to be conducted to gain a more complete understanding of the implications of material choice in the context of moisture damage.
- If a non-destructive approach is desired, the UPV is recommended. This approach allows designers to quickly and simple determine the reduction in stiffness (through seismic modulus measurements) due to moisture damage. Non-destructive approaches such as UPV do not require extensive amounts of materials and specimen preparation as well as any expensive lab equipment to perform. Design modulus for elastic analysis can also be obtained using this approach.

It is worth noting that above are preliminary recommendations. These will likely be refined in the coming month to reflect discussion made at the close out meeting. The final recommendation, with more specific information in terms of testing logistics, will be provided with the final report.

J. PROBLEMS ENCOUNTERED (If any):

No significant problems were encountered during this quarter.

K. TECHNOLOGY TRANSFER ACTIVITIES:

No activity to report.

L. STATUS BY TASK:

Task 1: State of the Practice and Literature Review: All work for Task 1 has been completed. A report for this task was submitted with a previous quarterly report.

Task 2: Identify and Inspect Moisture Susceptible Mixes and Develop Testing Plan: All of the work for Task 2 has been completed.

Task 3: Laboratory Testing: All of the work for Task 3 outlined in the proposal has been completed. More laboratory testing, which is an extension of the project, is being finished within the next two weeks.

Task 4: Final Report and Recommendations: Preliminary recommendations were developed and presented at the project close out meeting. Small progress has been made in compiling the final report**.** This quarterly report also serves as the deliverable for the reported calendar quarter.

M. PERCENT COMPLETION OF TOTAL PROJECT: ____95_____%

N. ACTIVITIES PLANNED FOR NEXT QUARTER:

- Refine and finalize recommendations for the lab procedure to be used by New England DOTs for screening of moisture susceptible asphalt mixtures.
- Prepare final report and deliverables for NETC Technical committee by the end of July.
    - This will include supplemental information such as specifications and data analysis tools for the testing and analysis methods recommended by the research team.

O. FINANCIAL STATUS:

As of: *3/31/2018*

Total Project Budget: $ 150,000

Total Estimated Expenditures: $ 136,000

Note: This report should not require more than 2-3 pages & should be e-mailed to the NETC Coordinator so as to arrive no later than three (3) working days after the end of each calendar quarter.