# TRANSPORTATION POOLED FUND PROGRAM
# QUARTERLY PROGRESS REPORT

Date: __9/30/2016

Lead Agency (FHWA or State DOT): __Vermont Agency of Transportation_____

**INSTRUCTIONS:**
*Project Managers and/or research project investigators should complete a quarterly progress report for each calendar quarter during which the projects are active. Please provide a project schedule status of the research activities tied to each task that is defined in the proposal; a percentage completion of each task; a concise discussion (2 or 3 sentences) of the current status, including accomplishments and problems encountered, if any. List all tasks, even if no work was done during this period.*

| **Transportation Pooled Fund Program Project #** *(i.e, SPR-2(XXX), SPR-3(XXX) or TPF-5(XXX)* TPF-5(222) | **Transportation Pooled Fund Program - Report Period:** ☐Quarter 1 (January 1 – March 31) ☐Quarter 2 (April 1 – June 30) ☑Quarter 3 (July 1 – September 30) ☐Quarter 4 (October 1 – December 31) |
|---|---|

**Project Title:** New England Transportation Consortium (VI)

| **Name of Project Manager(s):** | **Phone Number:** | **E-Mail** |
|---|---|---|
| Joe Segale | 802-828-2561 | Joe.Segale@vermont.gov |

| **Lead Agency Project ID:** | **Other Project ID (i.e., contract #):** | **Project Start Date:** |
|---|---|---|
| CA0306 | NETC 06-4 | 9/16/13 |
| | NETC 07-1 | 7/1/13 |
| | NETC 09-2 | 9/1/13 |
| | NETC 09-3 | 9/1/13 |
| | NETC 10-3 | 9/16/13 |
| | NETC 13-1 | 9/1/14 |
| | NETC 13-2 | 6/1/14 |
| | NETC 13-3 | 12/1/14 |
| | NETC 14-1 | 3/1/15 |
| | NETC 14-2 | 2/1/15 |
| | NETC 14-4 | 7/06/15 |

| **Original Project End Date:** | **Current Project End Date:** | **Number of Extensions:** |
|---|---|---|
| NETC 06-4 9/15/15 | 9/15/15, NCE to 9/15/16 | 1 |
| NETC 07-1 3/31/16 | 3/31/16 | 0 |
| NETC 09-2 2/28/16 | 2/28/16 | 0 |
| NETC 09-3 8/31/15 | 8/31/15, NCE to 12/31/15 | 1 |
| NETC 10-3 9/15/15 | 9/15/15, NCE to 5/31/2017 | 2 (for NETC) |
| NETC 13-1 8/31/16 | 4/2/16, NCE to 1/14/2017* | 2 (for NETC) |
| NETC 13-2 5/31/16 | 4/2/16, NCE to 12/1/2017 | 1 (for NETC) |
| NETC 13-3 11/30/15 | 3/31/16, NCE to 4/2/2017 | 2 (for NETC) |
| NETC 14-1 4/2/16 | 4/2/16, NCE to 12/31/2016* | 2 (for NETC) |
| NETC 14-2 4/2/16 | 4/2/16, NCE to 5/31/17** | 1 (for NETC) |
| NETC 14-4 7/05/17 | 7/05/17 | 0 |

* NCE in process between UVM and Partner University **NCE requested

Project schedule status:

☐ On schedule ☑ On revised schedule ☐ Ahead of schedule ☐ Behind schedule

Overall Project Statistics:

| Total Project Budget | Total Cost to Date for Project | Percentage of Work Completed to Date |
|---|---|---|
| NETC 06-4 $242,909 | $214,777.87 | 90% |
| NETC 07-1 $198,154 | $190,421.37 | 93% |
| NETC 09-2 $80,000 | $80,000.00 | 100% |
| NETC 09-3 $165,000 | $149,695.39 | 90% |
| NETC 10-3 $150,158 | $65,317.38 | 75% |
| NETC 13-1 $174,923 | $128,864.46 | 65% |
| NETC 13-2 $249,785 | $55,042.07 | 40% |
| NETC 13-3 $100,000 | $70,810.41 | 80% |
| NETC 14-1 $100,000 | $22,521.32 | 30% |
| NETC 14-2 $205,554 | $114,284.14 | 85% |
| NETC 14-4 $200,000 | $42,198.12 | 35% |

***Quarterly*** Project Statistics:

| Total Project Expenses and Percentage This Quarter | Total Amount of Funds Expended This Quarter | Total Percentage of Time Used to Date |
|---|---|---|
| NETC 06-4 $137,494.64 56.6% | $137,494.64 | 150% (based on 24 months) |
| NETC 07-1 $0.0 0% | $0.00 | 118% (based on 33 months) |
| NETC 09-2 $0.0 0% | $0.00 | 123% (based on 30 months) |
| NETC 09-3 $0.00 0% | $0.00 | 146% (based on 28 months) |
| NETC 10-3 $0.00 0% | $0.00 | 150% (based on 24 months) |
| NETC 13-1 $5,873.86 5.9% | $5873.86 | 104% (based on 24 months) |
| NETC 13-2 $2,509.83 1.1% | $2,509.83 | 116% (based on 24 months) |
| NETC 13-3 $29,756.68 29.8% | $29,756.68 | 183% (based on 12 months) |
| NETC 14-1 $1,718.50 1.7% | $1,718.50 | 127% (based on 22 months) |
| NETC 14-2 $25,422.63 12.4% | $25,422.63 | 123% (based on 26 months) |
| NETC 14-4 $7,930.97 4.0% | $7,930.97 | 58% (based on 24 months) |

**Project Description**:

06-4 Preventative Maintenance and Timing of Applications
07-1 In-Place Response Mechanisms of Recycled Layers Due to Temperature and Moisture Variations
09-2 Effective Establishment of Native Grasses on Roadsides
09-3 Advanced Composite Materials: Prototype Development and Demonstration
10-3 Low Temperature and Moisture Susceptibility of RAP Mixtures with Warm Mix Technology
13-1 Development of High-Early Strength Concrete for Accelerated Bridge Construction Closure Pour Connections
13-2 HMA Mixtures Containing Recycled Asphalt Shingles (RAS): Low Temperature and Fatigue Performance of Plant-Produced Mixtures
13-3 Improved Regionalization of Quality Assurance (QA) Functions
14-1 Measuring the Effectiveness of Competency Models for Job-Specific Professional Development of Engineers & Engineering Technicians
14-2 Investigation of Northern Long Eared Bat Roosting Sites on Bridges
14-4 Optimizing Future Work Zones in New England for Safety and Mobility

**Progress this Quarter (includes meetings, work plan status, contract status, significant progress, etc.):**

NETC 06-4, A draft copy of the final report was emailed to the technical committee for review and comments. At the request of the technical committee chair, UMass Dartmouth is organizing a meeting to discuss the comments with the entire technical committee.

NETC 07-1, In this quarter, the research team completed the draft of the final report and provided it to the technical committee for review and comment. The research team revised the draft of the final report based on comments from the technical committee.

NETC 09-2, In this quarter, research team revised the draft final report and began to develop technical transfer material.

NETC 09-3, In this quarter the research team provided the draft final report to the technical committee for review and comment.

NETC 10-3,
UMass Dartmouth received the following plant produced mixture from the second contractor (Palmer Paving, Springfield MA) this quarter:

- SSC 12.5mm 75 Gyration WMA with 48% RAP (2.5% Binder Replacement) Evotherm WMA

This mixture, along with the two previous mixtures noted below, was tested this quarter.

- SSC 12.5mm 75 Gyration WMA with 29% RAP (1.5% Binder Replacement) Evotherm WMA
- SSC 12.5mm 75 Gyration WMA with 39% RAP (2.0% Binder Replacement) Evotherm WMA

The following tests were completed on each mixture using multiple replicates:

1. Binder content verification using the ignition oven.
2. JMF verification by wet wash sieve analysis
3. Volumetric verification (density, VMA. VFA, etc.)
4. Moisture susceptibility testing using the Hamburg wheel tracking device (HWTD) in accordance with AASHTO T324 at 45°C
5. Low temperature cracking using the disk-shaped compact tension (DCT) test at -18°C
6. Constructed performance space diagram (HWTD vs. DCT) for each mixture
7. Moisture susceptibility (TSR) in accordance with AASHTO T283
8. Low temperature cracking using the thermal stress restrained specimen test (TSRST)
9. Mixture dynamic modulus and subsequent construction of mixture master curve
10. Dynamic modulus (E*) ratio evaluation of moisture susceptibility
11. Mixture workability in the asphalt workability device.

Summary sheets of results were constructed and data was analyzed.

NETC 13-1,
Task 1: Literature Search
• Performed literature review as necessary to obtain research reports and technical papers to assist in further development of mix design trial batches.
Task 3: Develop Mix Design
• Running ring shrinkage tests to understand behavior of mix designs; will modify based on results
• The volume of paste to volume of voids ratio was adjusted to improve the consistency of trial batches
• A pilot study was performed to understand the effects of high range water reducer addition rates
• Aggregate sizes were blended at specified ratios to reduce the gap grading of the coarse and fine aggregates
• The curing temperature was increased, and the compressive strength was measured to quantify the effects
Task 4: Test Mixture
• The slump test (AASHTO T119 / ASTM C143) or the spread test (ASTM C1611) was performed on each trial batch depending on the workability of the concrete mixture.
• The air content test, pressure method (AASHTO T152 / ASTM C231), was performed on concrete mixtures developed through trial batches.

NETC 13-2,
1. UMass Dartmouth finished reducing and compiling the survey results obtained for Task 2.
2. UMass Dartmouth has consistently contacted and met with the contractor during the last quarter to discuss production of the mixtures for this study. The contractor stated they would attempt to produce the mixtures as soon their schedule permits.

NETC 13-3,
During this quarter primary research effort was spent on developing two spreadsheets that provide recommendations for QA practices to be adopted by state agencies for precast and prestressed concrete elements. The spreadsheets provide recommendations for (1) plant certification; (2) sampling and testing as part of QA inspection. Each spreadsheet is set-up with four tabs. First tab provides definitions and descriptions. The other three tabs are organized to provide recommendations for following categories of the elements:

(1) Prestressed elements
(2) Structural precast elements
(3) Non-structural precast elements

A detailed report to accompany these recommendations is currently being prepared and is expected to be delivered to Technical Committee by end of October.

NETC 14-1, No progress reported this quarter.

NETC 14-2
• Concluded the field work component of the project
• Completed early, mid and late season 2016 field monitoring of bridges
• Completed rapid inspections of all 15 bridges during both 2016 summer monitoring
• Completed emergence studies at all bridges
• Documented all collected data
• Collected guano samples
• Completed call analysis running collected call data through SonoBat and EchoClass for Summer 2016 data.
• Continued acoustic monitoring program comparison analyses
• Presentation at Northeastern Transportation and Wildlife Conference at Lake Placid, NY
• Contacted guano testing labs for project samples
• Updating of final project report draft
•Sonobat and EchoClass programs provide a fairly wide variation in results for species classification and number of calls. Research team has begun working with Alyssa Bennett and Sarah Boyden, along with contacting Sonobat developers to verify that these results are accurate.
• Full paper submitted to TRB 2017 Annual Meeting in Washington D.C.
• Abstract submitted/accepted for presentation at North American Society for Bat Research
Annual Meeting, San Antonio, TX, October 2016.

NETC 14-4 Work on Task 1 (Literature Review) and Task 2 (Development of TTCP Metrics) complete.
Task 3 – Development of Methodology for Testing and Analyzing TTCPs
Naturalistic Driving Study Data
Received the Naturalistic Driving Study (NDS) data at the end of August 2016 in two batches. The first batch contains vehicle front-view videos and the second one consists of driver and vehicle data. In the past few weeks, we have been reviewing and analyzing the received data. The video data covers a variety of conditions (e.g., daytime, nighttime, rain) and provides useful information for understanding driver behavior, especially speed changes in work zones. The results will be shared at the upcoming project meeting. A limitation of this initial data set is that it does not include work zones with only one lane open. The road segments selected have multiple lanes in each direction with the right shoulder closed.

For this initial data request, we only asked for a subset of the data we budgeted for. This is to ensure that if any unexpected situations happen, we still have chances to make it up. We are currently working on submitting our second data request to the Virginia Tech Transportation Institute (VTTI). For this data request, we will make sure that scenarios with lane closure and one lane open will be covered.

Smart Work Zone (SWZ) Data
The team has been working on analyzing the data obtained from two SWZs in Massachusetts. The two SWZs have been recreated in both VISSIM and Aimsun and preliminary simulation results have been generated and will be shared at the upcoming project meeting.

Driving Simulation Study
The team further looked into the possibility of using virtual reality technology to establish a low-cost and high-fidelity driving simulator. The main challenge is to create different work zone scenarios and TTCPs in a virtual reality environment. The team has spent a lot of time on this subject and has made significant progresses. Based on our

investigation results, we have concluded that it is feasible to develop a virtual reality driving simulator for this study. We have created a right lane closure scenario for a two-lane highway. We are able to create various speed and merge control strategies/devices such as radar speed sign, traffic drum, concrete barrier and variable message sign. Once the proposed speed and merge control strategies are approved by the project technical committee, we will be able to code them in the virtual reality environment and conduct simulations.

Task 4 – Development of New TTCPs
The team has reviewed about 60 literatures on work zone temporary traffic control strategies. Most of them are on work zone speed and merge control. Merge control strategies mainly include: (1) late merge for moderate to heavy traffic; (2) early merge for low to moderate traffic; (3) dynamic merge (dynamically switching between early and early merge strategies); and (4) signalized merge for extremely heavy traffic. Many studies have been conducted to evaluate these merge control strategies by either microscopic simulation or field test. However, no detailed guidelines have been established to determine when to apply each merge strategy. From the SWZs in Massachusetts, traffic volume, speed and occupancy data is available at a 1-minute interval for individual lanes. It seems that such data was not being effectively utilized. The variable messages signs in these two SWZs were only used to share travel time information with travelers. The team is working on developing dynamic merge control algorithms/procedures based on the detailed traffic data for individual lanes. This will be one of the major contributions of this research and will be completed by the end of this year. There are many work zone speed control strategies that have been developed, including variable speed limit control, speed photo-radar enforcement, variable message sign, radar speed sign, temporary removable rumble strips, narrow lane and tubular marker. In this research, we plan to focus on evaluating some combinations of existing speed control strategies. Also, we plan to integrate speed and merge control using variable message signs. In previous studies, these two types of control were considered separately. In our opinion, it would make more sense to integrate them in some cases.

We attempted to identify innovative traffic control strategies from the NDS data but were unsuccessful. We also checked the SWZ data. It seems that the two SWZs used the MassDOT Standard Traffic Control Plans for work zones. Currently, we are in the process of documenting the reviewed traffic control strategies and will present them at the upcoming project meeting.

Task 5 – Evaluation of New TTCPs
For this task, we initially proposed to use either VISSIM or Aimsun to evaluate the proposed temporary traffic control strategies. We have now tentatively decided to use VISSIM, since an ongoing FHWA sponsored project is working on developing a new car-following model specifically for work zones. This FHWA project also plans to implement this work zone car-following model as a VISSIM extension. If this extension is successfully implemented before May 2017, we will adopt in our TTCP evaluation.

Our TTCP evaluation will focus on the dynamic merge control strategy under development. Two work zones have been coded in VISSIM and the team is ready to implement additional TTCPs. The team plans to finish developing the dynamic merge control strategy by the end of this year. The driving simulator and VISSIM evaluations of this strategy will be concluded before May 2017.

Task 6 – Project Meetings
The team held the 3rd quarterly meeting on July 8, 2016. We plan to have the 4th quarterly meeting within the next 10 days depending on the schedules of the project technical committee members. We will also coordinate with the project technical committee to set up the schedule for the 1st annual meeting.

**Anticipated work next quarter**:

NETC 06-4, Continue final report.

NETC 07-1, No work projected at this time.

NETC 09-2, The research team will submit technical transfer material to the technical committee.

NETC 09-3, No work projected at this time.

NETC 10-3, UMass Dartmouth will continue testing the plant produce mixtures.

NETC 13-1,

Task 1: Literature Search
• Continue literature search as required.
Task 2: Develop Mixture Design Specification
• Adjust existing concrete mix design specifications based on feedback from the NETC Project Technical Committee, trial batch results, and feedback from the PCI Bridge Tech Committee.
Task 3: Develop Mix Design
• Adjust concrete mix design and perform select short and long-term tests on additional trial batches as required by results of further testing.
Task 4: Test Mixture
• Complete design and fabrication of bar pullout test (ASTM A944) setup.
• Begin the full-scale mockup test setup design to be used for the large-scale specimen representing a longitudinal concrete bridge deck joint.
• Perform bar pullout test (ASTM A944) on concrete mixtures developed through trial batches and compare to results.
• Perform the bar pullout test (ASTM A944) and the ring shrinkage test (AASHTO PP 34-99) on normal strength concrete to compare with test results of high-early strength concrete mix designs
• Fabricate freeze-thaw specimens using concrete from trial batches to be sent to DOT lab to be tested (ASTM C666)

NETC 13-2, Meet with contractor to discuss production.

NETC 13-3,
- A report with details on common acceptance standard as well as some insight on selection proposed by researchers is under development and will be submitted for review to technical panel by end of October
- Revision of the common acceptance standards on basis of agency feedback
- Selection of agencies and manufacturers for pilot implementation of common acceptance standards

NETC 14-1,
Task 2: Determine Gaps in Existing CM's
Task 3: Develop a Transportation CM Framework for Each NETC Member State
Task 4: Run a Pilot Program in at Least One State

NETC 14-2
• Send guano samples to external laboratories for species identification
• Obtain hand vetting (by Sarah Boyden of MaineDOT) of all Northern Long-Eared Bat calls identified by call identification software.
• Further evaluation of collected data (acoustic, visual, thermal, etc.)
• Compile all field inspection data/reporting into report format
• Continue call analysis comparison between programs
• Obtain quotes to hire a consultant to run data through other call identification software programs and hire if within budget.
• Continue working on final report draft
• Present at North American Society for Bat Research conference at San Antonio, TX
• Submit abstract to International Conference on Ecology and Transportation (ICOET) conference
• Submit abstract to Northeast Bat Working Group (NEBWG) conference
• Coordinate with Technical Committee to schedule late winter/early spring meetings to disseminate results through workshop meetings

NETC 14-4
The project team will continue working on tasks 3) development of methodology for testing and analyzing TTCPs; 4) development of new TTCPs; 5) evaluation of new TTCPs through simulation; 6) project meetings; and 7) reporting.

**Significant Results:**

None as of this reporting period.

**Circumstance affecting project or budget. (Please describe any challenges encountered or anticipated that**

**might affect the completion of the project within the time, scope and fiscal constraints set forth in the agreement, along with recommended solutions to those problems).**

NETC 06-4, None during the current period.

NETC 07-1, None during the current period.

NETC 09-2, None during the current period.

NETC 09-3, None during the current period.

NETC 10-3, The research team has been consistently making arrangements with contractors to provide plant produced mixtures as stated in the scope of work. However, only recently has a second contractor begun producing the needed mixtures. UMass Dartmouth is following up with the second contractor to produce more of the mixtures noted in the test matrix.

NETC 13-1, None during the current period.

NETC 13-2,
1. The contractor assisting producing the mixtures for this study only utilizes one source of RAS which is manufacturers shingle waste (MSW). The contractor does not utilize post-consumer asphalt shingles (PCAS) or a blend of MSW and PCAS.
2. The project PI has continued efforts to find another contractor willing to produce mixtures for this study, preferably one that utilizes other RAS sources. To date, the PI has only been able to get commitment from one local contactor which has not produced the mixtures yet.

NETC 13-3, The no-cost extension process took substantial amount of time and prevented researchers from spending effort on this project during a portion of this quarter.

NETC 14-1, Waiting on approval of contract extension.

NETC 14-2,
• Sonobat and EchoClass programs provide a fairly wide variation in results for species classification and number of calls. Research team has begun working with Alyssa Bennett and Sarah Boyden, along with contacting Sonobat developers to verify that these results are accurate.
• Requested extension to project end date to allow presentation at 2017 International Conference on Ecology and Transportation, Salt Lake City, UT, May 2017.

NETC 14-4,
A limitation of this initial data set is that it does not include work zones with only one lane open. The road segments selected have multiple lanes in each direction with the right shoulder closed. For this initial data request, we only asked for a subset of the data we budgeted for. This is to ensure that if any unexpected situations happen, we still have chances to make it up. We are currently working on submitting our second data request to the Virginia Tech Transportation Institute (VTTI). For this data request, we will make sure that scenarios with lane closure and one lane open will be covered.

**Potential Implementation:**

The seven of the 11 research projects listed above are still in progress. Implementations of the results of those projects are not anticipated in the near future. Four research projects (NETC 06-4, 07-1, 09-2 and 09 -3) are in the process of completing their final report and technical transfer process. During this process, the technical committees and researchers will work to identify strategies for implementing the results of this research.