RUTGERS

Quarterly Progress Report

Project Title:	Highway Repair Consolidation Feasibility
NJDOT PROJECT NUMBER: 2012-08	NJDOT RESEARCH PROJECT MANAGER: Smmamunar Rashid
TASK ORDER NUMBER: 283	PRINCIPAL INVESTIGATOR: Dr. Hao Wang
Project Starting Date: 9/17/2012 Project Ending Date: 9/17/2014 Modified Ending Date: 03/31/2015	Period Starting Date: 10/01/2014 Period Ending Date: 12/31/2014

1. Project Progress Summary

Task No.	Task Description	Percent of Total Project Budget	Cost of Task	% of task this quarter	Cost this quarter	% of task to date	Total Cost to date
1	Conduct a Review of Existing Resources	5.24%	$ 16,848.84	0%	$0.00	100%	$16,848.84
2	Determine the Current NJDOT Work Zone Practice	10.47%	$ 33,697.68	0%	$0.00	100%	$33,697.68
3	Develop a Benefit Cost Analysis Process	10.24%	$ 32,939.80	15%	$4,940.97	100%	$32,939.80
4	Develop a Framework for Managing and Coordinating Workzone Projects	27.38%	$ 88,121.32	5%	$4,406.07	90%	$79,309.18
5	Develop an Interface for Work Zone Coordination and Management	29.76%	$ 95,787.85	10%	$9,578.79	85%	$81,419.67
6	Training and Technology Transfer	9.53%	$ 30,666.14	30%	$9,199.84	30%	$9,199.84
7	Project Management, Final and Quarterly Reports	7.38%	$ 23,757.49	10%	$2,375.75	80%	$19,005.99
Total		**100%**	**$321,819.12**	**9.48%**	**$30,501.41**	**84.65%**	**$272,421.01**

2. Project Overview

Project Abstract

New Jersey's aging highway transportation infrastructure constantly requires reconstruction, maintenance and expansion to meet the ever-increasing demand for travel. As travel demand increases with little growth in roadway capacity, a large number of work zones are expected in order to keep the existing highway system operable. The increasing number of work zones adversely affects the mobility and safety of travelers on the already congested roadways. Drivers are constantly faced unfavorable road conditions and unexpected delays due to work zones.

Faced with the growing number of work zones, the challenge for transportation agencies is to effectively manage the impacts of work zones to alleviate congestion and maintain the safety of motorists without disrupting project schedules.

The NJDOT wants to minimize the negative impacts of work zones through successful project coordination. The major goal of this research is the development of an understanding of the types of work zones that can be coordinated, in terms of construction compatibility, design completion, and construction schedules. The goal also includes a quantitative analysis of the effectiveness of coordinating short- and, when possible, long-term projects to measure the efficiency of various combinations of projects relative to each other and the status quo.

Project Objectives

The objectives of this research are:

1. To develop a documented and vetted process, within the NJDOT, which delineates the appropriate stakeholders who will determine and prioritize which projects and/or problem statements can be coordinated for a consolidated work zone approach.
2. To develop and/or refine a data management process / interface, with current inter- and intra-agency data resources, that can be incorporated into the existing NJDOT's in-house automated data management system.

Various tasks have to be completed to achieve these objectives. The most important steps are:

- Conduct brief interviews with representatives from other state DOTs who have been practicing the coordination of various types of work zones.
- Assemble a panel comprised of representatives from the NJDOT who are involved in the work zone decision making process to identify various types of projects put forth by the NJDOT that require short-term or long-term work zones.
- Work closely with the NJDOT contacts to utilize TRANSCOM and its existing regional structure to improve the communication and collaboration in terms of coordinating various repair activities in the region.
- Through one-on-one and/or panel interviews with the identified key personnel, understand the organizational flow within the NJDOT for communicating, collaborating, and scheduling of various types of work zones.
- Determine, through expert interviews with the NJDOT engineers and staff, what type of projects can be coordinated, the anticipated challenges for coordinating various combinations of these projects, and the appropriate steps to eliminate such challenges.
- Collaborate closely with the assembled panel and develop a framework for managing and coordinating work zone projects.
- Develop a user-friendly interface or modify / refine an existing one that will be used to estimate the effectiveness of various combinations of short-term and long-term work zones based on the developed work zone management and coordination framework.
- Explore the use of emerging web-based communication and collaboration technologies that are inexpensive and easy to deploy and maintain. This can be a solution to maintain a contact list of the identified decision makers from the NJDOT and other agencies with the goal of timely sharing information and plans for work zone activities in the region.

3. Description of Work Completed by Task over This Period

PHASE I— Literature Review

This task is completed.

PHASE II

Task 1 — Conduct a Review of Existing Resources

This task is completed.

Task 2 — Determine the Current NJDOT Work Zone Practice

This task is completed.

Task 3 — Develop a Benefit Cost Analysis Process

This task is completed.

Task 4 — Develop a Framework for Managing and Coordinating Work Zone Projects

This task is near completion. Its completion will be upon the completion of Task 5.

The proposed two-stage coordination framework is: 1) Stage 1: long-term coordination that coordinates maintenance engineering projects with CPM projects; 2) Stage 2: short-term coordination that coordinates all other work zones.

The research team has completed a historical analysis of completed projects. This approach involves looking back in the past and determines if there were any opportunities for work zone coordination, and determines the benefit and costs of coordination accordingly. To that end, the research team has obtained the list of maintenance and CPM projects between 2012 and 2013. Also, the research team has also obtained the historical OpenReach database. This database contains all events including information on historical work zones such as the time and date of work zone, how many lanes were closed, work zone description, type of project, etc. It was proposed that by combining the list of historical maintenance and CPM projects and the historical OpenReach database, the research team could pinpoint cases where coordination could have been beneficial for road users and the NJDOT.

However, it was determined that matching the maintenance projects in the CPM tool is not a straightforward task. The research team found many maintenance projects in the OpenReach database that do not appear in the list, and there are many cases where the maintenance projects included in the list do not appear in the OpenReach database. The research team has tried computer coding to do this automatically; however, it was not satisfactory. This process took longer time than expected.

Therefore, it was decided to conduct this analysis manually. To that end the research team identified conflicting projects using the OpenReach database only. We identified about 100 conflicts on 10 different roadways by manually checking the database. **Error! Reference source not found.** shows the potential conflicting work zones identified on Route 1 using the historical OpenReach database.

WCS tool is being used to estimate the benefits and costs of coordinating or consolidating these conflicting projects.

US 1

Workzone1	Workzone2	Hours Overlapped	Mile Difference	Description1	Description2	Wz1 Create Time	Wz1 Close Time	Wz2 Create Time	Wz2 Close Time	Lane Information for WZ1	Lane Information for WZ2
48963301	48964401	5	2.9	'NJ DOT - TOC South: Construction steel repair	'NJ DOT - TOC South: Construction tree trimming c	'2013-04-04 09:00'	'2013-04-04 15:19'	'2013-04-04 09:00'	'2013-04-04 14:30'	right shoulder closed	right shoulder closed
50410701	50410901	8	4.7	'NJ DOT - STMC: Construction guard rail repair	'NJ DOT - STMC: Construction bridge construction	'2013-04-25 21:00'	'2013-04-26 06:03'	'2013-04-25 21:00'	'2013-04-26 05:01'	ramp closed	1 to 2 lanes closed
50891401	50893201	8	4.8	'NJ DOT - STMC: Construction construction on	'NJ DOT - STMC: Construction bridge work on US 1	'2013-05-02 21:00'	'2013-05-03 06:02'	'2013-05-02 21:00'	'2013-05-03 05:02'	ramp closed	left lane closed
52261301	52263001	5	8.1	'NJ DOT - TOC South: Construction roadwork o	'NJ DOT - TOC South: Roadwork roadwork on US 1	'2013-05-22 09:00'	'2013-05-22 15:00'	'2013-05-22 09:13'	'2013-05-22 15:43'	N/A	left lane closed
57716401	57716501	5	4.5	'NJ DOT - TOC South: Construction guard rail re	'NJ DOT - TOC South: Construction guard rail repai	'2013-08-14 09:01'	'2013-08-14 15:00'	'2013-08-14 09:01'	'2013-08-14 15:00'	left lane closed	right shoulder closed
57716401	57716501	5	4.5	'NJ DOT - TOC South: Construction guard rail re	'NJ DOT - TOC South: Construction guard rail repai	'2013-08-14 09:01'	'2013-08-14 15:00'	'2013-08-14 09:01'	'2013-08-14 15:00'	left lane closed	right shoulder closed
58720001	58730501	6	8.1	'NJ DOT - STMC: Construction utility work on U	'NJ DOT - STMC: Construction bridge work on US 1	'2013-08-29 08:00'	'2013-08-29 15:02'	'2013-08-29 09:00'	'2013-08-29 15:02'	right shoulder closed	1 lane may be closed
58720001	58730501	6	8.1	'NJ DOT - STMC: Construction utility work on U	'NJ DOT - STMC: Construction bridge work on US 1	'2013-08-29 08:00'	'2013-08-29 15:02'	'2013-08-29 09:00'	'2013-08-29 15:02'	right shoulder closed	1 lane may be closed
59075101	59097801	5	3	'NJ DOT - TOC South: Construction crack sealin	'NJ DOT - TOC South: Emergency construction and	'2013-09-05 09:00'	'2013-09-06 14:03'	'2013-09-05 17:07'	'2013-09-05 22:46'	left lane closed	right lane closed
59645001	59673501	22	0.2	'NJ DOT - STMC: Construction intersection imp	'NJ DOT - STMC: Construction construction on US 1	'2013-09-13 16:23'	'2013-09-25 14:16'	'2013-09-14 00:00'	'2013-09-14 22:45'	partial ramp closed	right shoulder closed
61733601	61733901	8	9.6	'NJ DOT - TOC South: Construction constructio	'NJ DOT - STMC: Construction drainage improvem	'2013-10-15 20:01'	'2013-10-16 05:00'	'2013-10-15 20:01'	'2013-10-16 06:01'	2 right lanes closed	right and center lanes closed
61831301	61831501	9	9.6	'NJ DOT - TOC South: Construction constructio	'NJ DOT - STMC: Construction drainage improvem	'2013-10-16 20:00'	'2013-10-17 05:01'	'2013-10-16 20:00'	'2013-10-17 06:02'	2 right lanes closed	right and center lanes closed
62566301	62584801	6	2.5	'NJ DOT - STMC: Construction construction on	'NJ DOT - STMC: Construction construction on US 1	'2013-10-28 07:00'	'2013-10-28 15:32'	'2013-10-28 09:01'	'2013-10-28 15:01'	right shoulder closed	right lane closed
67163501	67179601	0	0.2	'NJ DOT - TOC South: Construction guard rail re	'NJ DOT - STMC: Unanticipated Construction Delay	'2014-01-20 09:00'	'2014-01-20 15:00'	'2014-01-20 14:57'	'2014-01-20 15:24'	right lane closed	right lane closed
70566601	70566901	2	3.3	'NJ DOT - STMC: Construction moving operatio	'NJ DOT - TOC South: Construction construction or	'2014-03-24 21:00'	'2014-03-25 02:01'	'2014-03-24 21:00'	'2014-03-24 23:00'	1 to 2 lanes closed	right lane closed
71135901	71136101	0	1.5	'NJ DOT - STMC: Construction moving operatio	'NJ DOT - STMC: Construction moving operation o	'2014-04-02 21:00'	'2014-04-02 21:05'	'2014-04-02 21:00'	'2014-04-03 05:01'	1 to 2 lanes closed	1 to 2 lanes closed
71136101	71142101	6	2.8	'NJ DOT - STMC: Construction moving operatio	'NJ DOT - STMC: Construction moving operation o	'2014-04-02 21:00'	'2014-04-03 05:01'	'2014-04-02 23:00'	'2014-04-03 05:03'	1 to 2 lanes closed	right shoulder closed
72324701	72329801	4	6.7	'NJ DOT - STMC: Construction moving operatio	'NJ DOT - TOC South: Construction traffic signal re	'2014-04-22 09:01'	'2014-04-22 15:01'	'2014-04-22 10:00'	'2014-04-22 14:01'	1 lane closed	N/A
73875701	73875801	0	0	'NJ DOT - STMC: Construction construction on	'NJ DOT - STMC: Construction bridge maintenance	'2014-05-14 20:00'	'2014-05-14 20:28'	'2014-05-14 20:00'	'2014-05-15 06:02'	2 right lanes closed	right and center lanes of 3 lanes closed

Figure 1. Potential conflicting work zones identified in the historical OpenReach database

Task 5 — Develop an Interface for Work Zone Coordination and Management

This task is near completion.

In this quarter the research team added the benefit cost analysis module in the WCS tool. This module is based on the proposed benefit cost analysis framework designed in Task 3.

When users login in the WCS tool, they can see a list of active projects (either CPM or Maintenance Engineering projects). When users click on the project, they can find the detailed information on that project at the bottom of the screen, and its location on the map to the right of the screen.

Users can compute a lane closure analysis on a project simply by clicking on the Compute Lane Closure link. For example, if a project is selected and Compute Lane Closure button is clicked, users will see a pop-up window with various input parameters. They can simply select the start and end hour of lane closure and the number of lanes closed, and other necessary parameters to find out the vehicle queue, queue length, total delay, etc.

Additionally, when users select a project from the list, they can see the project timeline simply by clicking on the View Project Timeline.

The essential use of the WCS tool is to find out if the selected work zone is in conflict with any other project in its vicinity. Users can find out conflicting projects by selecting a radius (the default is 10 mile radius) and the number of days overlapping (5 days default) by clicking on the Analyze button. When users find conflicting projects with a given project, they can simply select a conflicting project from the list (as shown in Figure 2).

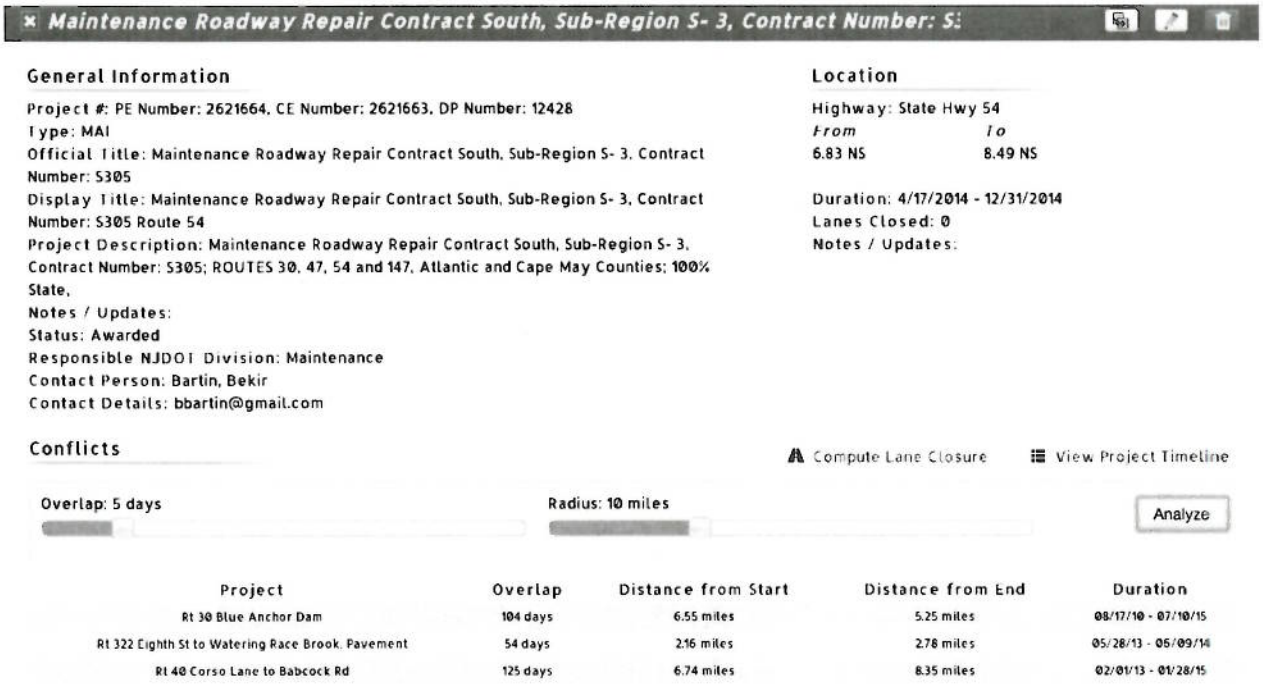

Figure 2. List of Conflicting Projects

Once selected, users can view the project timeline in a Gantt chart. In the Gantt chart, there is a link to conduct benefit cost analysis for coordination / consolidation of these two projects (See Figure 3).

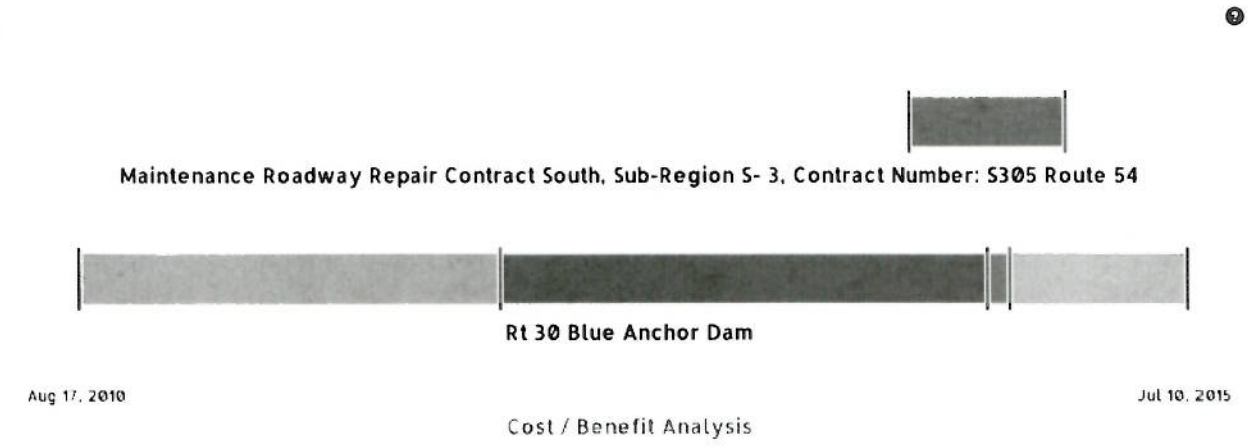

Figure 3. Benefit Cost Analysis Link in a Gantt Chart

When the Analyze button is clicked, it brings up an input box with all parameters needed to conduct benefit cost analysis, as shown in Figure .

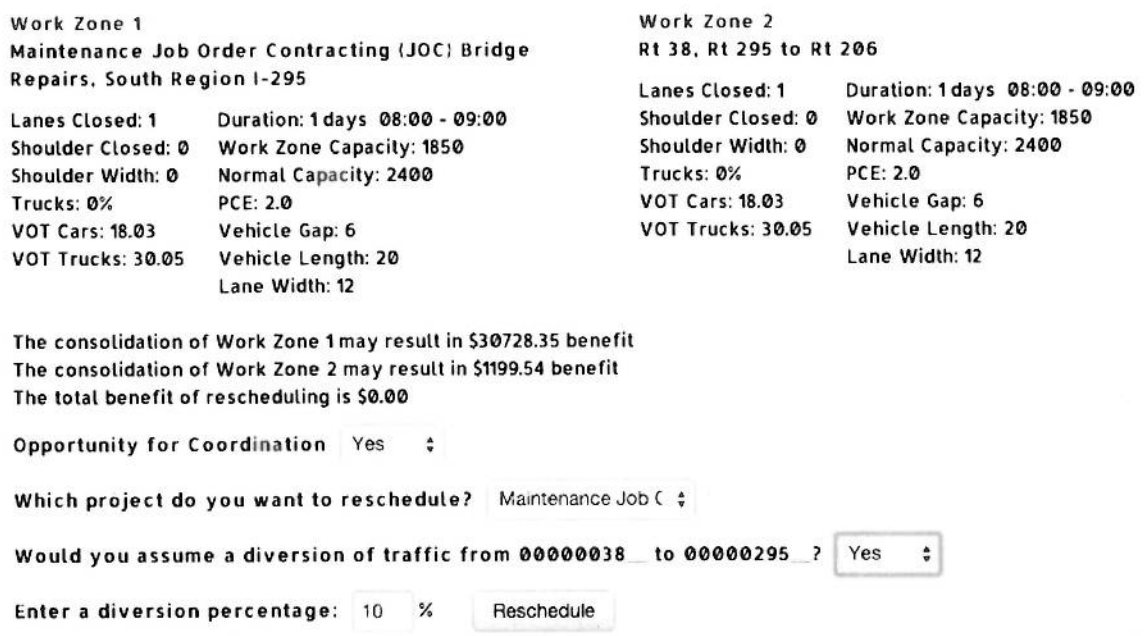

Figure 4. Cost Benefit Analysis Module in WCS Tool

For example, if users select Maintenance JOC Bridge Repairs, South Region I-295 from the list, and click on the Analyze button with the default Overlap and Radius values, they will see three conflicting projects. Once users click on any of these conflicting projects, they will see a pop-up screen with overlapping Gantt charts of project timelines. For example, if users click on the second conflicting project, which is the Rt 38, Rt. 295 to Rt. 206, they can see the overlapping Gantt charts.

In this Gantt chart there is a Cost / Benefit Analysis link. When users click on this, it provides a tool to calculate the benefit of rescheduling of either project. First screen is the input for JOC Bridge Repairs - here users can input the number of lanes closed, hours of closure, and how many days it will be closed with other necessary parameters. For the sake of illustration, suppose users select one lane closed between 8 am and 9 am for Duration of one day. When clicked on the Next button, users input values for Rt. 38, Rt. 295, and Rt. 206 project. Suppose users select again one lane closed between 8 am and 9 am for one day as well and click on the Next button. Here the third window shows the assumptions and the benefit of removing either project. If consolidation of a project is not feasible then it asks if there is any opportunity for coordination, meaning "can users move one of the projects to another time period?"

Suppose that users can reschedule the JOC Bridge Repairs project. Then from the drop down menu users can select "Yes" to the Opportunity for Coordination and select JOC Bridge Repairs project from the drop down menu of "Which project do users want to reschedule?" Then users can assume a traffic diversion to the roadway of this project from the Rt. 38, Rt. 295 to Rt. 206 project (since there won't be a lane closure at the same time period, vehicles that are queued up can easily divert). Let's assume that there won't be a diversion and Say "No". Then users click on the Reschedule button and change the time period of JOC Bridge Repairs project to, say 2 am to 3 am, and click Reschedule in the new window. Then users will see in the final window the Total benefit of rescheduling as $30,728 for one day.

By the end of the quarter, the research team will incorporate the Report module in the WCS tool, where users can select prepare a report of the analyses conducted and present them in a PDF format.

In the next quarter, once the modifications to the WCS tool are completed, the research team will input the conflicting projects identified in Task 3 and estimate the benefits of coordinating / consolidating the conflicting projects using the benefit cost analysis module.

Task 6— Training and Technology Transfer

The research team shared the trial version of the WCS tool to Ahsan Ali at Traffic Operation unit of the NJDOT for his feedback.

Task 7 — Project Management, Final and Quarterly Reports

- 1st quarter report was compiled and submitted in December 2012
- 2nd quarter report was compiled and submitted in March 2013.
- 3rd quarter report was compiled and submitted in June 2013.
- 4th quarter report was compiled and submitted in September 2013.
- 5th quarter report was compiled and submitted in January 2014.
- 6th quarter report was compiled and submitted in April 2014.
- 7th quarter report was compiled and submitted in June 2014.
- 8th quarter report was compiled and submitted in September 2014.
- 9th quarter report was compiled and submitted in January 2015.

4. Proposed activities for next quarter by task:

Task 1 — Conduct a Review of Existing Resources

- N/A

Task 2 — Determine the Current NJDOT Work Zone Practice

- N/A

Task 3 — Develop a Benefit Cost Analysis Process

- N/A

Task 4 — Develop a Framework for Managing and Coordinating Work Zone Projects

- The research team will finalize the developed framework based on the feedback from the NJDOT customers.

Task 5 — Develop an Interface for Work Zone Coordination and Management

- The research team will improve the WCS tool based on the feedback from the NJDOT customers.

Task 6— Training and Technology Transfer

- The research team will communicate with the NJDOT customers from Division of Capital Program Support, Maintenance, and Traffic Operation to obtain their comments on the WCS tool.

Task 7 —Project Management, Final and Quarterly Reports

- The research team will submit a quarterly report for the March meeting.

5. List of deliverables provided in this quarter by task:

A preliminary full version of the WCS tool will be submitted.

6. Progress on Implementation and Training Activities:

The research team shared the trial version of the WCS tool to Ahsan Ali at Traffic Operation unit of the NJDOT and will communicate with the personnel from other divisions for the evaluation of the tool.

7. Problems/Proposed Solutions:

We had a few implementation problems basically related to historical and network data obtained from the NJDOT but these problems are resolved now.

The invoices from the subcontractor were delayed due to the merge of Polytechnic Institute of NY to New York University. The invoices problem was just resolved at the beginning of January.

The research team is still waiting for the comments from the NJDOT customers on the analysis framework and interface of the WCS tool. This has caused some delays in the project progress. The research team will discuss with the NJDOT in the quarterly meeting in January to decide if a no-cost extension is needed to allow for the improvement of tool based on the feedback received from the customers.

8. Project Summary:

Authorized Project Budget (Year 1)	$168,488.40
Total Project Budget (Years 1&2)	$321,819.12
Total Project Expenditure to date	$272,421.01
% of Total Project Budget Expended	84.65%

NJDOT Research Project Manager Concurrence: _____ Date: 02/03/2015