STATEMENT OF WORK

Research, Analysis and Program Support for the New York State Department of Transportation

February 2017

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Prepared for
New York State Department of Transportation (NYSDOT)
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Department of Energy (DOE) Proposal Number NFE-16-06390

Prepared Under DOE Contract Number DE-AC05-00OR22725
Between the
U.S. Department of Energy and
UT-Battelle, LLC
INTRODUCTION

The New York State (NYS) transportation network encompasses nearly 114,600 highway miles and over 17,400 bridges, serving more than 19 million New Yorkers and handling over 130 billion vehicle miles per year. There are more than 130 public transit operators serving over 7.5 million passengers each day. An extensive 3,400 plus mile rail network moves more than 67 million tons of equipment, raw materials, manufactured goods and products each year. Five major ports handle almost 80 million tons of freight annually. Additionally, New York City (NYC) is the most populated city in the United States with a population of 8.5 million, which is more than twice the size of the second largest city, Los Angeles.

The responsibilities of the New York State Department of Transportation (NYSDOT) include:

- coordinating and developing a comprehensive transportation policy for the State;
- coordinating and assisting in the development and operation of transportation facilities and services for highways, railroads, mass transit systems, ports, waterways and aviation facilities; and
- formulating and keeping current a long range, comprehensive statewide master plan for the balanced development of public and private commuter and general transportation facilities.

To effectively manage, coordinate, and plan for this complex transportation system and to better serve the over 19 million residents, NYSDOT relies on information generated from surveys and research that are very data and analysis intensive. The NYSDOT requires data from high-quality data programs, up-to-date information technology, as well as advance data analytic and modeling capabilities to make its planning, policy, and program decisions, as well as to address numerous diverse issues encountered. Based on these demands, a continuing availability of current, high quality and consistent data is crucial to NYSDOT.

Data of interest to NYSDOT include, but are not limited to, highway performance, travel behavior, highway users (passenger and freight), transportation safety, fuel usage and emission, land-use and economic growth, and movements of commodities (including transport of energy commodities). Equally important to NYSDOT is an analytic competency capable of converting data into information that is usable in supporting the program planning and policy development, execution, and evaluation.
WHY ORNL

The Center for Transportation Analysis (CTA) at Oak Ridge National Laboratory (ORNL) has extensive experience in analyzing survey data and developing estimation models/tools for the U.S. Department of Transportation’s (DOT), Federal Highway Administration (FHWA). This experience includes the examination of travel patterns on passenger/goods movements, the estimation of highway usage of motor fuels by state, and the development of decision-support tools for visualizing critical transportation infrastructure.

One of the major data products developed by CTA for FHWA is the Freight Analysis Framework (FAF) database, which was used by the U.S. Department of Energy (DOE), Office of Energy Policy & Systems Analysis (EPSA), to prepare the first Quadrennial Energy Review (QER) Report: *Energy Transmission, Storage, and Distribution Infrastructure*, which was released April 2015. Due to CTA’s encompassing knowledge in analyzing and modeling freight data, EPSA solicited CTA’s expertise in performing a Shared Freight Transportation study that generates county-level freight flows for several DOE-selected energy commodities to support EPSA’s mission and needs.

In addition, CTA has conducted studies and developed decision support tools to assist policy-making and planning activities for many other U.S. Federal agencies, including DOT’s Bureau of Transportation Statistics (BTS) and the Federal Motor Carrier Safety Administration (FMCSA), and the Transportation Security Administration (TSA) of the U.S. Department of Homeland Security (DHS). Nearly all decision support systems and tools developed by ORNL’s CTA were built by integrating a geospatial information system (GIS) with state-of-the-art visual analytic technologies to provide enhanced features for stakeholders to visualize and conduct spatial data analyses. These ORNL-developed GIS-based visual analytic tools will form a strong foundation for the proposed NYSDOT tasks (e.g., Tasks B3, C1, & C2) described in this SOW, with resulting benefits in cost reductions and timesavings no others can achieve.

The CTA’s extensive one-of-a-kind experience in developing these decision support tools and models were proven in projects conducted for both DOE and other federal agencies (e.g., DOT). Along with CTA’s uniquely diverse knowledge of critical issues involving passenger and freight transportation systems, CTA has compiled a unique and highly skilled team that can perform analysis, develop mathematical modeling, and design policy-making tools to support NYSDOT. During the 2015 National Academies of Sciences’ Transportation Research Board Annual Meeting, a study based on CTA’s innovative method was recognized as a unique and highly specialized approach for environmental and social justice applications, and was regarded as highly preferred over the traditional methods applied by other modelers. Specifically for this proposed research analysis (e.g., Tasks A1, A5, B3, and C2), CTA will utilize the ORNL-developed LandScan day-time-population data with a GIS tool to derive service indices that reflect transportation services coverages (e.g., transit stops, park and ride locations) within NYS
neighborhoods. These indices can be used as performance measures to aid NYSDOT in evaluating the effectiveness of their transportation programs.

CTA’s highly specialized experience and analytical techniques coupled with their knowledge of implementing innovative data science into practice were further demonstrated when CTA was tasked by the FHWA’s Office of Planning to develop a statistical model that allows local planners to evaluate factors influencing the “walkability” of their regions. The purpose of this study was aimed at promoting non-motorized travel so that traffic congestion and the associated air pollution can be reduced in the nation (i.e., FHWA requires a general model that can be applied to any community in the country). In this type of modeling, researchers commonly consider factors such as regional demographic characteristics, population and roadway densities, travel statistics, and regionally collected land-use patterns, where possible or available. The land-use data (with details suited for planning needs) is not available at the national level, and such detailed national information is cost prohibitive to collect. With the comprehensive knowledge of data and prior experience gained from the TSA work, CTA was able to employ a national data set from the Federal Emergency Management Agency (FEMA) to derive a land-use entropy measure (an index) and integrated that measure into the model development process to overcome this data challenge. Such an unconventional use of data from a seemingly unrelated field was a first in transportation planning and policy-making applications. With the success of this model development, FHWA tasked CTA to implement that resulting model into a GIS-based demonstration tool, which allows planners to conduct a what-if scenario analysis to identify areas for improvement in walkability.

The NYSDOT recognizes CTA’s unique expertise, particularly CTA’s comprehensive and multidisciplinary-based research proficiency in transportation network systems and its ample analysis capabilities for applying passenger and freight data in national and regional policies and planning practices. As the result, the NYSDOT has identified CTA as the agency with the skill set not found elsewhere to assist with their transportation planning challenges and analyzing their complex transportation data.

The research proposed in this SOW relates to five of ORNL’s core competencies:

- Decision science and analysis,
- Advanced computer science, visualization, and data,
- Computational science,
- Applied mathematics, and
- Cyber and information science.
VALUE TO DOE MISSION

As a nation on the move, nearly 30% of the U.S. energy consumption goes to the transportation sector, mainly for transporting people and goods from one location to another. Understanding how passengers and goods move, accurately estimating the volume of travel at the national, state, and local levels, and producing measures that allow proper evaluation of transportation system performance and efficiency, are issues not only important to the DOT but also to the DOE. After realizing the importance of this information/data and their implications, in May 2016 DOE announced a joint effort with the DOT to advance the research, demonstration, development, and deployment of smart transportation and alternative fuel technologies. One of DOE’s goals is to complement DOT’s efforts in “support of cities by offering tools and capabilities in future mobility system modeling and simulation, data management and analytics, and access to National Laboratory technologies” as stated in a news article released by the Office of Energy Efficiency and Renewable Energy (EERE) of the DOE.

Specifically, the research described in this proposal supports three of the four major missions of DOE: Energy, Science and Innovation, and Management Operation Excellence.

Energy
The results of this proposed research are consistent and complementary to DOE’s mission to promote efficient movement of people and goods, and advance knowledge of energy use in the transportation sector, with the goal to make transportation cleaner. Additionally, the work and capabilities created from this research can be leveraged with efforts from DOE’s Systems and Modeling for Accelerated Research in Transportation (SMART) Mobility consortium. This multi-laboratory consortium provides an integrated framework to analyze the complex landscape of future transportation energy.

Furthermore, potential advances in visual analytic techniques and data science methodologies will support DOE’s goals toward sustainable transportation and sustainable communities (e.g., smart cities).

Science and Innovation
ORNL has developed data products, data analytic techniques, statistical analysis methodologies, models, and visualization tools that are valuable and unique in supporting policymaking and program planning for agencies in the DOT, DHS, and DOE. The proposed research described in this SOW will put forth these valuable DOE assets to improve the development of transportation and energy programs, evaluation of economic impacts on projects, prioritization of investments, and execution of transportation policies and strategies. The refinement of methodologies and GIS-based visualization tools, or the creation of any new tools resulting from researches supporting the NYSDOT will in turn further DOE’s work in science and innovation. In addition,

data fusion skills and techniques spawned from studies undertaken for this proposed research could help to advance the ORNL team in performing similar data science activities for DOE applications and/or projects.

**Management Operation Excellence**

Over the last two decades, CTA has provided data analysis, developed data products, and created GIS-based visualization tools to support policymakers at Federal and state levels in managing programs, improving situational awareness in identifying potential vulnerabilities in transportation system operations, as well as disseminating research data to the transportation community at large, including both public and private users. The overall impact of this proposed research will further promote awareness in the relationships between transportation and energy, provide up-to-date qualifying measurements to evaluate any impacts, and encourage the movement toward sustainable communities.

**PURPOSE/OBJECTIVE**

The main objectives of this agreement are for the CTA to provide technical assistance and research support to NYSDOT in conducting statistical data analysis, program assessment and performance evaluation, visualization systems and tools development, and other modeling support needed to fulfill strategic planning requirements for NYSDOT—at both state and regional levels. As a part of this research effort, CTA’s expertise will be utilized to gather and analyze various transportation datasets, including survey-based data from the FHWA and the U.S. Census Bureau (Census), to look for opportunities to integrate multiple data sources with visualization tools developed by CTA, when applicable, and to enhance the analysis products. Research findings and results will be summarized in technical reports, executive summaries, web-based documentation, and data products for dissemination to all stakeholders.

**SCOPE**

Tasks to be performed under this agreement will include a number of research areas, data analyses, program evaluations and support, simulation and planning tool developments, as well as modeling and other technical assistance activities in support of planning and policy-making at national, state, and regional levels. These activities may include,

- development of technical approaches, models, and tools to foster innovation, increase efficiency, and meet transportation needs of tomorrow;
- conducting analyses and reviews of issues related to transportation policy and planning programs;
• identification of research needs as called for under Federal requirements and/or mandates;
• compilation of transportation statistical reports in support of state and local travel demand modes;
• development of methods and tools for timely dissemination of information to stakeholders, planners, and policy-decision makers;
• development of data standards and quality assurance procedures;
• evaluation of state-of-the-art information technologies or programs;
• design and development of GIS-based visualization and other big-data visual analytic tools for planning applications at various government levels; and
• design and provision of technical support to transportation surveys or data collections.

TASKS

In order to accomplish the objectives of this program, the work to be performed is framed within three major research task areas. The following describes the nature of the activities planned under each of the areas.

Task A: Research Activities for Better Planning and Policy-Making

ORNL will conduct research studies involving modeling, statistical analysis, development and testing of concepts, feasibility studies, cost-benefit analyses, evaluations, forecasting, and design, as well as management aspects of various issues in transportation planning and policy development for NYSDOT’s data and analysis programs. Specific research activities in this area include the following.

Subtask A.1 Assessing The Trend Towards A Sustainable Community – Use of Shared-Ride, Car-Sharing, and Park & Ride

As a participant of the Add-on Program for the 2016 NHTS, NYS was given the opportunity to add survey questions to collect data elements pertinent to state specific needs. Several of the questions added by NYSDOT were designed to allow NYS to gather information about the use of shared-ride services (e.g., Uber, local ride matching), car-sharing services (e.g., Zip cars), park and ride facilities, and their associated access and egress modes utilized by survey participants in NYS.

Under this task, ORNL will assist NYSDOT in analyzing these new data elements and exploring ways to develop quantified measures to evaluate the effectiveness and/or impacts of these programs. Results from this task will enable NYSDOT in
quantifying implications of statewide mobility systems associated with travel demand, energy, environment, and congestion.

Deliverable: A final report detailing data analysis and findings from the evaluation will be compiled and delivered to NYSDOT at the completion of this task.

**Subtask A.2 Comprehensive Comparison Study of Travel Behavior and Patterns**

ORNL will examine travel behavior and patterns by analyzing the latest NHTS data (2016) and compare those results to data from prior years to establish trends, when applicable. In this study, travel behaviors of NYS residents will be compared to those of the rest of the nation as well as detailed geospatial analyses for regions within NYS (e.g., Metropolitan Planning Organization, or MPO) to allow local planners and policymakers to conduct peer-comparisons. In addition, the Census American Community Survey (ACS) data series will be explored and integrated for benchmarking, especially for work-related commuting travel (i.e., Journey to Work, or JTW). Specifically, ORNL will conduct statistical comparisons by several geographic regions, including:

- NYS resident travel versus those of the rest of the U.S.,
- NYC resident travel versus those of the rest of NYS,
- Major NYS MPOs travel versus that in other metro areas of similar population density,
- Rural travel in NYS versus that of outside NYS, and
- NYS MPOs by Census-defined metropolitan statistical area (MSA) size.

Deliverable: A comprehensive report that summarizes data analyses results, documents data fusion method/techniques applied, and presents comparison results on travel behaviors/patterns found among the above-specified geographical regions will be delivered to the NYSDOT at the conclusion of this task.

**Subtask A.3 Investigation of Trip Chaining and Auto Choice**

ORNL will conduct a study to use the FHWA-created trip chaining data files, for the 2009 and 2016 NHTS datasets, to examine issues that are germane to travel behavior and trip-making decisions for and within NYS. Specifically, this research will examine travel behaviors from a tour-based approach, rather than typical trip-based studies conducted using the NHTS trip data. In addition, differences in mode choice for work-based or home-based tours, including certain intermodal passenger travel, will be investigated.
Findings from this task will empower NYSDOT analysts and planners to have a better overall understanding on travel behaviors (e.g., associations and/or correlations among travel activities and inter-modal travels), especially in areas not covered well by typical trip-segment-based data. This information will allow planners and policymakers to make better-informed decisions so that NYS residents’ needs in transportation facilities and services can be well addressed.

Note that this research will be conducted in two phases, with the first phase focused on using 2009 NHTS data to explore the potential benefits of applying tour-based data on regional planning practices. Phase two of this research will be performed using the latest 2016 NHTS data, which will address any shortcomings or lessons-learned from phase one research, and include trend analysis to examine changes over time.

Deliverables:
Phase I: A final report summarizing study results and findings based on 2009 NHTS data.
Phase II: A final report summarizing study results and findings based on 2016 NHTS data, including trend comparisons over time.

Subtask A.4 Examination of Alternative Fuel Vehicle Usage and Transportation Technology in NYS

In addition to collecting the types of motor fuels used in vehicles, the 2016 NHTS expanded its questions to include a detailed list of alternative fuel-vehicle types: biodiesel, plug-in hybrid, electric, hybrid, and other fuel. ORNL will (1) develop analytical methods to examine and quantify the extent of alternative fuel vehicle usage in NYS; (2) determine the characteristics and travel behaviors of the users; and (3) estimate the market share of this transportation technology in NYS. As a part of this research, a literature review of relevant data from other agencies (e.g., DOE, USDOT) will be conducted to identify data items with potential benefits toward enhancing the research findings. Furthermore, comparisons with the rest of the nation and among major geographic regions within the NYS (e.g., NYC and larger MPOs) will be performed to the extent possible based on availability of data.

Deliverable: A final report describing data sources, estimation methods, and summarized study results will be compiled and delivered to NYSDOT at the end of this task.
Subtask A.5  Analysis of Travel Behavior by Special Populations in NYS

To provide transportation systems that serve all residents’ needs equally well, it is essential for NYSDOT to understand what special transportation facilities and services are required, as well as how the mobility status of those special populations are, especially when comparing to others. In this task, ORNL will identify differences, if any, in travel behaviors and patterns that are attributable to demographic characteristics, household characteristics, geographic location, and other aspects. Focus will be given to trip rates, travel time (e.g., time of the day, weekday vs. weekend), trip distance, purpose, and mode of choice. This effort will employ data fusion method(s) to integrate data from multiple sources such as NHTS and ACS (including JTW and data from the Census Transportation Planning Package, or CTPP), as well as other sources if available. Data will be analyzed as appropriate to study mobility, examine trends, and evaluate changes overtime, if any.

Special populations of interests for NYSDOT could include the elderly population (age 65 and older), transit users or other non-motorized transportation users, low-income or other disadvantaged residents, foreign-born residents, etc. Under this task, ORNL will examine up to five special population groups. The prioritization of these special population groups will be determined by NYSDOT and ORNL before the task begins.

Deliverable: One final report will be generated for each individual special-population examined in this task. At the completion of all (up to five) individual population-specific studies, ORNL will produce a combined executive summary report that includes key findings from all individual studies.

Subtask A.6  Compilation of NYS Area-Specific Transportation Statistics Reports

To support regional travel demand modeling and transportation planning activities, ORNL will analyze the latest 2016 NYS NHTS data to produce detailed area-specific summary transportation statistics and generate performance measure estimates that are important to regional travel demand modeling and planning uses. These region-specific summary statistics will be compiled individually for each major MPO as defined by NYSDOT, with additional sets of summaries provided for a consolidated rural area, a consolidated urban area, and a combined statewide region. Twenty area-specific statistical reports will be produced under this task, including:
(Optional task) Furthermore, the need to understand nonurban and address transportation planning challenges in a more geospatially-disaggregated level (such as county or sub-county) is crucial for NYSDOT. Therefore, an optional component of this subtask could expand the analysis to a more geospatially-detailed level for a selected set of larger MPOs (up to 3 sites). The selection of specific MPOs for further disaggregated analysis will be determined and agreed between NYSDOT and ORNL later.

**Deliverable:** Twenty sets of area-specific transportation statistics reports will be compiled and delivered to NYSDOT, including spreadsheets for each report.

**Deliverable (optional task):** For the optional analysis report, the deliverable will include similar statistics as those of the MPO-level reports, but in a more detailed geographic level (county or sub-county as appropriate). Areas of selection will be determined prior to the start of this optional task.

**Subtask A.7 Mode Choice and Utilization of Transportation Infrastructure by NYS Residents**

ORNL will evaluate how NYS residents utilize different mode-specific transportation systems (e.g., transit line) and facilities (e.g., airport) within the state for conducting their daily activities. Particularly, by analyzing information obtained from responses to the new questions included in the 2016 NYS NHTS Add-on data, ORNL will investigate how the availability of certain transportation services, or any specific traveler characteristics, might have impacts on travelers’ mode choices and/or facility choices (e.g., selecting a specific airport).

**Deliverable:** A final report describing the data, analysis techniques or estimation methods, and summarized study findings will be compiled at conclusion of this task and delivered to NYSDOT.
Task B: Mission Critical Program Support
In the area of program support, ORNL will assist NYSDOT in developing and identifying research and program needs in fulfilling NYSDOT’s mission, including examinations of current programs and identification of areas for improvements or updates. This task area may consist of the following specific activities.

Subtask B.1 Examination of Quality of Transportation Services
ORNL will evaluate how NYS residents view the transportation services being provided and compare the views of NYS residents to those from the rest of the nation. Data from the 2016 NHTS will be examined and compared to similar data from prior survey years to identify common views or changes over time. When possible, other surveys (e.g., Gallup public opinion surveys) from comparable periods will be investigated as a part of this research.

Deliverable: A final report describing the data sources and analysis techniques, as well as summarized research findings will be produced and delivered to NYSDOT at the completion of this task.

Subtask B.2 Development of Emission Factors (EMFAC) Profile for Air Quality Modeling
Under this task, ORNL will assist NYSDOT in analyzing the 2016 NHTS data to generate the EMFAC profiles for each of the major urban areas, as well as other specific geographic regions in NYS (25 areas in total). Statistical confidence intervals for these estimated factors will be included to fulfill NYSDOT’s needs in their air quality modeling exercise.

Deliverable: At the completion of this task, twenty-five sets of EMFAC profiles as specified by NYSDOT will be produced and delivered to NYSDOT at the end of this task.

Subtask B.3 Building a Visualization Decision Support Tool for Corridor Analysis
ORNL will assist NYSDOT in designing and building a GIS-based decision-support tool that integrates transportation network systems, attributes of facilities that serve passengers and/or freight, passengers and goods flows, and other critical data (e.g., safety and operational statistics). Data fusion techniques will be developed under this task to integrate data from flows of passengers (e.g., NHTS), freight (e.g., FAF), and information from other performance measures, such as Highway Performance Management System (HPMS), National Performance Management Research Data Set (NPMRDS), and other geospatial datasets. In addition, state-of-the-art visual analytic capabilities will be incorporated as user-
friendly tools (functions) to enable policymakers and planners in NYSDOT to conduct what-if scenario analysis on a user-specified transportation corridor.

Deliverable: An operational prototype tool will be demonstrated to NYSDOT during the mid-term of this research task. Comments and feedback from NYSDOT will then be incorporated into the final tool and implemented as a web-based visualization application for NYSDOT users.

**Task C: Modeling and Database Development**

This task area includes the development of mathematical models, computer software tools, or new databases, as required to fulfill the research and program support for NYSDOT. This may consist of tasks to address issues such as:

**Subtask C.1 Investigating the Use of Big-Data for Planning Applications**

The FHWA has acquired a national data set, entitled NPMRDS, which has been made available to states and MPOs for their use in performance measurement activities. The NPMRDS was compiled using actual observed probe data (i.e., data obtained from Global Positioning System, or GPS), and includes data collected for both passenger and freight. The data is available on a monthly basis at 5-minute intervals, 24 hours a day, and 7 days a week, covering the entire country (i.e., big data). The information contained in the NPMRDS, thus, provides a unique opportunity for conducting “big data” research.

Under this task, NYSDOT will make the NPMRDS data accessible to ORNL for exploring and evaluating the potential uses of NPMRDS in NYS’s transportation planning and data-quality validation analyses. Specifically, ORNL will examine how and when NPMRDS can be utilized, in conjunction with or supplemental to, traditional data collected through surveys or other means (e.g., NHTS, Commodity Flow Survey (CFS), HPMS, FAF, and Census’s data) to improve NYS’s statewide transportation planning and policy making practices.

Deliverable: ORNL will prepare a final report that documents findings and recommendations from this research and deliver to NYSDOT at the conclusion of this task.

**Subtask C.2 Determining Factors Influencing Non-Motorized Travel in NYS**

The idea of livable communities suggests that people should have the option to utilize non-motorized travel (NMT), specifically walking and bicycling, to conduct their daily tasks. Forecasting personal travel by walk and bike is necessary as part of regional transportation planning, and requires fine detail not
only about individual travel, but also on transportation and neighborhood infrastructure. Under this task, ORNL will assist NYSDOT in identifying factors that influence communities to walk and bike and to examine why or why not travelers walk and bike in their communities. In addition to the NHTS data, ORNL will pull information from other data sources (e.g., ACS, Walk Scores, etc.) and conduct statistical screening process as well as modeling effort to identify factors that impacting the NMT travels by NYS residents.

**Deliverable:** At the completion of this task, ORNL will prepare a final report documenting data sources and methods used in the study, as well as detailing results and recommendations from this research, and submit to NYSDOT.

**MILESTONES/DELIVERABLES**

**Reports and Technical Summaries**

1. ORNL will prepare draft final reports that document the findings and recommendations of activities undertaken in Tasks A through C. These reports will describe how each study was conducted, the conclusions and the recommendations of the research conducted.
2. ORNL will also prepare a draft executive summary report for tasks undertaken in the Tasks A through C, when applicable. Each draft summary report will describe the principle findings and conclusions in clear and concise language. The summary will allow executives and administrators to assess the developments and impacts of the research findings without the necessity of reviewing the entire technical report.
3. Based on the comments provided by NYSDOT, ORNL will revise each draft final report and summary. A reproducible copy will be furnished to NYSDOT on or before the scheduled completion date.

**Reporting Requirements**

ORNL will provide NYSDOT with three copies of a bi-monthly progress report on the 25th of every other month. Each report will include the following:

1. A clear and complete description of the work performed in each task.
2. An outline of work to be performed during the next reporting period.
3. A description of any problems encountered or anticipated that will affect the completion of work within the time and budget as proposed in the statement of work, and a description of recommended solutions.
4. A tabulation showing the planned, actual, and cumulative expenditures.
**Deliverables**

ORNL will deliver to NYSDOT on the planned completion date the following:

1. Task reports for each subtask performed under each program area.
2. The source code and documentation for any prototype software (or tool) developed.
   Source codes will be provided on media specified by NYSDOT. Documentation will include user's manuals and programmer's manuals. In general, all deliverables will be in electronic formats.

NYSDOT shall have 30 days to review and approve each final report as delivered under each performed task.

**ESTIMATED BUDGET**

The cost estimates for the tasks in this Agreement are based on actual ORNL operating costs. This rate structure reflects the standard accounting method used by ORNL. The cost rate includes average research-staff salary, staff and secretary fringe benefits, and normal materials and supplies. Note that the cost and subcontract rates are average rates, provided for estimation purposes only. The actual rates vary from month to month and are determined from the standard accounting method used by ORNL.

The following funding profile is intended to establish the upper programmatic bound. These numbers represent reasonable estimates for potential tasks to be performed under this agreement.

**Note:** The budget table below represents five project years but spans six fiscal years.

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# BUDGET SUMMARY

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<th>TASK B</th>
<th>TASK C</th>
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<td><strong>Subtask A.7</strong> Mode Choice and Use of Transportation Infrastructures</td>
<td>Labor: $95</td>
<td>Computer, software, materials: $4</td>
<td>Travel: $0</td>
</tr>
<tr>
<td><strong>Subtask B.1</strong> Quality of Transportation Services</td>
<td>Labor: $217</td>
<td>Computer, software, materials: $6</td>
<td>Travel: $0</td>
</tr>
<tr>
<td><strong>Subtask B.2</strong> EMFAC Profile for Air Quality Modeling</td>
<td>Labor: $63</td>
<td>Computer, software, materials: $2</td>
<td>Travel: $0</td>
</tr>
<tr>
<td><strong>Subtask B.3</strong> Visualization Decision Support Tool for Corridor Analysis</td>
<td>Labor: $246</td>
<td>Computer, software, materials: $10</td>
<td>Travel: $6</td>
</tr>
<tr>
<td><strong>Subtask C.1</strong> Development of Performance Measures with Big-Data for Statewide Planning</td>
<td>Labor: $108</td>
<td>Computer, software, materials: $3</td>
<td>Travel: $2</td>
</tr>
<tr>
<td><strong>Subtask C.2</strong> Factors Influencing Non-motorized Travel</td>
<td>Labor: $107</td>
<td>Computer, software, materials: $3</td>
<td>Travel: $2</td>
</tr>
<tr>
<td><strong>TOTAL ESTIMATES</strong></td>
<td>Labor: $2,735</td>
<td>Computer, software, materials: $75</td>
<td>Travel: $20</td>
</tr>
</tbody>
</table>