

North Carolina Department of Transportation
Transportation Mobility & Safety (M&S) Division
Spot Mobility Program Guidelines

The Spot Mobility Program systematically and objectively allocates Spot Mobility Funds to projects or programs that reduce congestion across the state. In 2017 the Spot Mobility Program was codified in [Session Law 2017-57 Senate Bill 257 Section 34.7](#). The text of this law is included at the end of these Guidelines.

The primary audience for this document is the NCDOT Transportation Mobility and Safety Division (TMSD) and the NCDOT Transportation Divisions. These guidelines document the processes used by Regional Traffic Engineers (RTE), Division Traffic Engineers (DTE), the Spot Mobility Selection Committee, the Spot Mobility Team, and the Safety Evaluation Group to identify, analyze, prioritize and select projects for the Spot Mobility Program and to evaluate the effectiveness of these projects once complete.

Roles & Responsibilities

- The RTE is the main M&S point of contact for these projects and works with the Divisions on the project.
- The Division Project Manager keeps the database of Spot Mobility projects.
- The Congestion Management Section does before and after modelling of the project.
- The Traffic Safety Systems Unit evaluates Spot Mobility projects.

All project related data should be entered into the Safety Database by the RTE. Document all estimates, projections, calculations, methodology and assumptions for projects and submit these with the project package. Spot Mobility projects are selected quarterly.

Submitters are encouraged to consider innovative solutions to mobility problems. The Spot Mobility Business Plan contains more general information on the Spot Mobility Program.

The Spot Mobility Program is currently funded at \$20M per year. Spot Mobility Projects are currently capped at a \$750,000 cost. The State Traffic Engineer may approve Spot Mobility project requests above this cost on a case by case basis. As the program matures this cap will be revisited to ensure that the most competitive projects are funded.

Spot Mobility Program Process

Step 1: Identify Location and Mobility Problem

Potential projects may be identified by means such as: field observations, citizens' complaints, bottleneck rankings, analytical methods, etc.

Write a clear statement of the mobility problem that needs to be solved, such as "reduce average daily queue length on westbound approach to Sweeten Creek Road at Mills Gap Road in Buncombe County". Also state what the likely cause of the mobility problem is, such as the "during the AM peak the right turning traffic queues up at signal up to 500' west of Jones Street" This is an important step and will be necessary to develop a project to address the mobility problem as well as to calculate the benefits of the improvement from the constructed project.

Once a location having a mobility problem has been identified, compile background data including, but not limited to, the following:

- What is the origin of the request (i.e. citizen, elected official, internal)?
- What is the nature of the request (congestion, peak hour operations, etc.)?
- Collect or acquire pertinent data for the site, including:
 - Existing conditions, including:
 - Aerial photography
 - Utility information (overhead and underground)
 - Detailed field investigations
 - Existing traffic control devices
 - Physical Constraints
 - Traffic count data (AADT, turning movement counts, growth rates, etc. related to problem statement)
 - Other traffic data (including probe speed data from <https://vpp.ritis.org/suite/>)
 - Signal plans (if applicable)
 - Safety data
 - Previously applied treatments
 - Potential impacts from proposed developments: inquire with District and Division Traffic offices.
 - Future projects (TIP, Division, Municipal, etc.); Determine if these will address the problem
 - Other data as required

Review the data and field investigations to identify the underlying cause(s) of the mobility problem. This may differ from what has been identified as the problem by the person or group submitting the request.

Step 2: Analyze No-Build Conditions

The Congestion Management Section (CMS) will analyze the no-build conditions to validate the problem and provide a basis for comparison. CMS will determine the appropriate analysis tool, ensuring that consistency between projects is maintained.

Step 3: Develop Alternatives

In conjunction with the RTE staff and Division staff, the CMS will develop alternatives to be analyzed. As part of this process, any design concepts and discarded concepts should be forwarded to the CMS for evaluation to identify non-practical alternatives and to prevent duplication. The CMS would appreciate any comments on the concepts that have been vetted and discarded. (ie. If a roundabout will not geometrically fit as a solution, note this so CMS knows it was considered.) In many cases, concepts will be identified when the project is submitted, however CMS will review the location to identify other potential alternatives and discuss these alternatives with the RTE to determine feasibility and practicality of alternatives.

Identify a Project Influence Area (analysis network) to ensure that the analysis of alternatives includes all impacts from the proposed concept. The analysis network should cover the same physical area as the no-build conditions.

Step 4: Analyze Alternatives

The CMS will perform traffic analysis for identified alternatives. The analysis methodology should match the no-build analysis process.

Measures of Effectiveness (MOE) will be identified in order to provide benefit values for comparison. The most common MOE will be travel time savings; however other MOEs may be used, such as number of stops, queue lengths, travel distance, average speed, and fuel and emission savings. The 2017 Spot Mobility Program legislation requires that travel time savings and reduction in motor vehicle queues be considered in evaluating Spot Mobility projects.

Initially this will be done from scratch for each project. Over time NCDOT will create travel time savings factors for different improvement types.

At this step a cost estimate for each feasible alternative should be developed. The RTE should request this data from the appropriate source.

Part of the analysis process should include identifying when the proposed improvement reaches the end of its effectiveness. This "Service Life" will be used for determining project benefits and annualized costs. The Service Life of a project will be the lesser of the effective life and the life span of the physical improvements proposed. Considering the Service Life of the project is required by the 2017 Spot Mobility Program legislation.

A proposed project may not provide a long-term resolution to the identified problem. Interim improvements may be considered as part of this process. Care must be taken to identify the appropriate service life of the improvement, in particular if a more elaborate, long-term solution has been proposed and/or scheduled.

Step 5: Select Recommended Alternative

Calculate a Mobility Benefit Cost Ratio for each alternative submitted for funding consideration. Considering the Benefit Cost Ratio of the project is required by the 2017 Spot Mobility Program legislation.

Ideally a project would be developed from the alternative that best meets the project's purpose and need as demonstrated by having the best Mobility Benefit/Cost Ratio. However, other factors may make this alternative infeasible for a Spot Mobility project.

Include documentation of the project's scope, description, MOE's and service life for each alternative submitted for funding consideration.

Submit the project for inclusion in the Safety database for prioritization.

Step 6: Prioritize Projects (Spot Mobility Program Index)

A key component of the Spot Mobility Program is the program index decision support tool. This Tool is modeled after NCDOT's Spot Safety Program Index Tool that has been in use since 2005. The Spot Mobility Program Index is information based evidence driven quantified formula that includes a subjective but knowledge based local priority component.

Spot Mobility Index $MI = 0.35MBC + 0.30LP + 0.20TTR + .05PI + 0.10 SAP$

35 % Mobility Benefit Cost (MBC) Factor

30 % Local (Division/Region) Priority (LP) Factor

20 % Travel Time Reliability (TTR) Factor

5 % Programmatic Identification (PI) Factor (Meets multiple needs)

10 % School Access Preference (SAP) Factor

Mobility Benefit Cost (MBC) = 35%

To calculate the Mobility Benefit Cost Ratio

- Benefits
 - The 2017 Spot Mobility Program legislation requires that travel time savings and reduction in motor vehicle queues be considered in evaluating Spot Mobility projects. These factors should be included in calculating the Mobility Benefit Cost Ratio.

- Calculate delay by subtracting the sum of the expected after treatment delays from the determined baseline delays. Be specific and use the appropriate values that match the stated purpose and need of the project: peak hour, 24 hour, seasonal, etc.
- Average delay values can be calculated for a specific traffic movement (for example "Southbound Left Turn"). If the benefit is calculated for a specific movement, use the specific volume for that movement. Please provide sufficient data so that analysis may be done for both one specific movement and the overall intersection.
- Projects with average vehicle delay savings of less than 30 seconds per vehicle through an intersection or corridor will not be eligible for funding under the Spot Mobility Program. For projects intended to reduce delay on a specific movement, these projects must reduce delay per vehicle by 1 minute for the targeted movement while not adding more than 20 seconds of delay per vehicle to the mainline.
- Use a uniform statewide value of time of \$22.00 per hour for all delay calculations. This value will be re-evaluated when on-going NCDOT research on this topic is complete
- Costs
 - Spot Mobility Project costs may include PE, Construction, Utilities, Right of Way, and Operations.
 - Leveraging other funding sources in Spot Mobility Projects is encouraged. Include only Spot Mobility Program funded to calculate the cost of the project. Do not include other leveraged funds in the cost of the project in the MBC calculation. [This is consistent with how companion funds are encouraged (and can leverage additional investments in safety) in the Spot Safety Program]. If safety funds are leveraged, additional documentation will be required for safety benefits calculations.

Document all estimates, projections, calculations, methodology and assumptions for projects and submit these with the project package. Once enough information and knowledge has been gained on the performance of mobility improvement treatment types NCDOT will then uniformly apply Standardized Statewide Mobility Improvement Factors for project development. Once available there will not be alternate approaches for deriving the Mobility Benefit Cost ratio for project development and comparison.

Initially the Mobility Benefit Cost Ratio scoring values will be categorized into four (4) equally distributed bins. These bins assign the number of points a project can score in the MBC term of the Spot Mobility Program Index. Point values will be assigned to each project by the Spot Mobility Program team once all projects have been evaluated.

Percentile	Points
100 – 76 %	40
51 – 75%	30
26 – 50%	20
0 – 25%	10

Once sufficient data is available re-calibration of the ranges may allow additional bins and associated ranges and points.

Local Priority (LP) - Division and Regional 30%

In each Division the Division Engineer (or delegate/designee) shall prioritize candidate Spot Mobility projects from 1 to N (N = number of candidate SM projects from that Division) with 1 (one) being the highest priority candidate project. Priority numbers cannot be duplicated (you cannot have two “Number One” priorities). The highest priority project will receive 15 points, with each successive priority receiving one less point.

Priority	Points
1	15
2	14
3	13
4	12
5	11
6	10
7	9
8	8
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15	1
16 +	0

The RTE will follow the same procedure as the Division Engineer (outlined above). Division and Regional Priorities do not have to align or have the same values.

All candidate Spot Mobility Projects (On Hold plus any new submissions) will be re-prioritized each quarter by the Spot Mobility Selection Committee.

Travel Time Reliability Factor (TTR) 20%

TTR is based on the change in the demand to capacity (v/c) ratio from the existing conditions to the proposed conditions. The v/c for the existing and proposed conditions can be calculated from traffic simulation, a macroscopic model like the Highway

Capacity Manual/Software, or even a simple critical lane volume method. It is important that the calculation of the v/c be made with the same method for the existing and proposed conditions, keeping as many input values constant as possible. Once the existing and proposed v/c values have been computed, the TTR is determined in four steps as follows.

Step 1) If the proposed project will have a significant effect on reliability due to its handling of incidents, weather, work zones, and/or special events, conduct a special analysis of the proposal and assign a TTR in conjunction with management. Otherwise advance to Step 2.

Step 2) If existing v/c < 0.7, TTR = 0. Move to Step 3 if existing v/c > 0.7.

Step 3) If proposed v/c > 0.7,
Interim Score = (((existing v/c-0.7)*10)^2) - (((proposed v/c-0.7)*10)^2),
then move to Step 4.

If proposed v/c ≤ 0.7,
Interim Score = (((existing v/c-0.7)*10)^2), then move to Step 4.

Step 4) For existing v/c > 0.7, TTR = MIN (20, Interim Score).

- Step 1 is to allow for the rare and special proposed projects that affect reliability other than through day-to-day traffic variations.
- Step 2 is to insure that all proposed projects with existing v/c values below 0.7 result in a score of 0 as those sites are uncongested and are providing reliable travel times.
- In Step 3 the formula for existing v/c values over 0.7 works by first subtracting the minimum level at which reliability begins to matter, 0.7, from the v/c values. Then we multiply the remainder by 10 to get the score into a 0 to 20 range. Next we square the revised scores to mimic the effect of the delay function and thereby reward projects that impact projects with higher v/c values and greater variability. After that, for projects with proposed v/c values over 0.7, we subtract the score for the proposed project from the score for the existing project so that the final score is based on the change in capacity and reliability.
- In Step 4 we set a cap of 20 points on the TTR to fit in the overall formula and insure that this dimension does not get too much weight in the overall selection process.

The steps are easy to code in Excel. As an example of the calculation, suppose that we were evaluating a proposed project with no apparent effects on incidents, weather, work zones, or special events. The proposal would move the v/c at the site from 1.2 to 0.8. In step 2, the existing v/c at 1.2 is above 0.7, so we move on to step 3. In step 3, we perform the computation as:

$$\text{Interim Score} = (((1.2 - 0.7)*10)^2) - (((0.8 - 0.7)*10)^2)$$

$$\text{Interim Score} = ((0.5 \cdot 10)^2) - ((0.1 \cdot 10)^2)$$

$$\text{Interim Score} = (5^2) - (1^2) = 25 - 1 = 24$$

In step 4, we note that the interim score is greater than 20 so we assign TTR to be 20.

School Access Preference (SAP) 10%

Session Law 2017-57 Senate Bill 257 Section 34.7 states “In selecting projects to receive funding from the Spot Mobility Program, the Department shall give preference to projects that will improve access from the State highway system to a school. For purposes of this section, the term "school" means any facility engaged in the educational instruction of children in any grade or combination of grades from kindergarten through the twelfth grade at which attendance satisfies the compulsory attendance law and includes charter schools as authorized under G.S. 115C-218.5.”

To comply with this legislation NCDOT shall grant 10 points in the Spot Mobility Program Index for projects that will improve access from the State highway system to a school. To qualify for these 10 points the project submission must demonstrate that the school generated traffic is the driving force for the improvement.

Spot Mobility projects and the associated School Access Preference is limited to existing schools. Existing schools are those that are currently open and educating students. Projects that address access to new schools should be pursued under the Strategic Transportation Investments (STI) program.

Programmatic Identification (PI) 5%

Programmatic boost to the Spot Mobility Index Score will be given if a candidate project location (intersection, road approach, road segment, corridor, etc.) has been identified by one or more established NCDOT Programs. The added value will be determined based on the following scale:

Identified By # of Programs or Lists	Points
4	5
2-3	4
1	3
0	0

Programs and Lists that can be considered for this PI value:

- Highway Safety Improvement Program Listing
- Spot Safety Candidate Project List (On-Hold Projects)

- Most Congested Locations Listings by Division (Development by Division and TM&SD) **
- Top 20 Bottleneck, from VPP Bottleneck Ranking
- STI Candidate TIP Project Spreadsheet
- Division Listing Based on Complaints (Maintained by Division and Submitted Updated Quarterly/Project turn in Cycle) **
- NC Transportation Network Corridors (includes intersecting routes also (NCTN))
- City or MPO Project Listing **

** The State Traffic Engineer (STE) should receive routine updates of any prioritized list that wants to be considered for the Programmatic boost scoring. Additional Programs and Lists require advance approval of the STE.

Step 7: Approve Funding

Spot Mobility projects will be prioritized and selected by the Spot Mobility Selection Committee and funded by the Board of Transportation.

Step 8: Design, Let and Construct Project

The Divisions will be responsible for developing, managing, and delivering Spot Mobility projects. The goal, as with Spot Safety, is to deliver these projects within 18 months of funding approval.

Step 9: Evaluate Projects:

Work Plan

A spot mobility evaluation work plan shall be established during project development well in advance of a project being implemented. This plan should consider the type of mobility countermeasure, measures of effectiveness, data needs, and a timeline of planned work. At this stage, all parties involved in the project development, implementation and evaluation should identify and document any potential issues impacting the project evaluation. The Mobility and Safety Field Operations Section, the Congestion Management Section, and the Traffic Safety Systems Section should be a part of the work plan development and the project evaluation process.

Countermeasure Types

Spot mobility projects can be implemented at new or existing locations, and can be used to improve mobility for all classes of roadways. Projects can improve operations on a corridor, or at a specific intersection, ramp, or driveway. Countermeasure types can vary based on the location type and what mobility problem is being addressed. To evaluate a project, we need to know specific location and countermeasure information. Project countermeasures may include (and are not limited to): new traffic signal

installation, traffic signal revisions, adding or revising left turn lanes, adding or revising right turn lanes, ramp merge revisions, changes to existing lane assignments, and/or alternative designs.

Measures of Effectiveness

The measures of effectiveness (MOEs) are variable and depend on the countermeasure type and the anticipated results. The underlying purpose of the program is to develop projects that reduce traffic congestion and vehicular delay times. Specifically, projects are selected for the program based on their travel-time savings and reductions to motor vehicle queues. The MOEs may include changes in: volume, delay, annual travel time savings, average corridor speeds, average corridor travel times, queue lengths, and/or saturation flow rate. Some of this information is modeled, some is obtained from vehicle probe data, and some is collected in the field.

Data Needs

Data must to be collected in the before period and the after period for countermeasure evaluation. We need to know what data items need to be collected and measured to showcase the anticipated project results. Data collection must include turning movement counts for intersections and volume counts for sections. The data must also include one or more of the following: delay (modeled or field collected), travel times (VPP data or field collected), queues, compliance, and/or saturation flow rate. For un-signalized locations, we need to know the current geometry, and the planned revisions. For signalized locations, we need to know the current signal timing and phasing, the current geometry, and the planned revisions.

If turning movement or volume counts have already been obtained for project development, we must review this information for the evaluation work plan so we can identify the target days and times for data collection. The target time is typically during the weekday peak hours, but may include other time periods based on the site specifics.

We must know the extent of the mobility problem in the before period so we can collect the right type of data and we can be collect it in the right spot. Is there a queuing problem or not? For example, if there is a queueing problem, does the end of queue typically extend a 1/2 mile or 2 miles from an intersection in the AM or PM peak hour? If there is not a queuing problem, do some vehicles typically have to wait 5 minutes to enter an intersection from the minor road in the AM or PM peak hour?

Timeline of Planned Work

The spot mobility evaluation plan should specify the evaluation timeline. We need to collect traffic data both before and after the project is implemented to measure the countermeasure's effectiveness. The timeline of project implementation and specific

feedback on when traffic data should be collected are important to a successful evaluation. For example, we would need to know if the improvements are intended to address beach traffic because we would wait to collect the data during the summer months. The before period data should ideally be collected at least several weeks prior to the project being let, and at most a year prior to the project being let, so the information is current and relevant. The after period data should be collected at least a month after the project is complete, and at most six months after the project is complete.

Evaluation Report

The final product of the evaluation is a brief technical report summarizing the project information, location information, before and after data analysis, and items for discussion. The primary audience for the report is engineering staff within the NCDOT Transportation Mobility and Safety Division and Division field staff. The reports may also be used in discussions with policy makers and public officials.

USE OF FUNDS IN MOBILITY/MODERNIZATION FUND

SECTION 34.7.(a) Spot Mobility Program. – Of the funds appropriated in this act to the Mobility/Modernization Fund in the Highway Fund, forty percent (40%) of the funds shall be used for a Spot Mobility Program that shall be managed by the State Traffic Engineer of the Department of Transportation. The purpose of the Spot Mobility Program is to provide funding for small projects that will reduce traffic congestion and vehicular delay times. The Department shall develop a quantitative, evidence-based formula to use in selecting projects to receive funding from the Spot Mobility Program. At a minimum, the Department shall consider all of the following in developing the formula required by this subsection:

- (1) The travel-time savings resulting from the proposed project.
- (2) Reductions to motor vehicle queues resulting from the proposed project.
- (3) The service life of the proposed project.
- (4) The benefit-cost ratio of the proposed project.

In selecting projects to receive funding from the Spot Mobility Program, the Department shall give preference to projects that will improve access from the State highway system to a school. For purposes of this section, the term "school" means any facility engaged in the educational instruction of children in any grade or combination of grades from kindergarten through the twelfth grade at which attendance satisfies the compulsory attendance law and includes charter schools as authorized under G.S. 115C-218.5.

SECTION 34.7.(d) Report. – The Department shall develop a report detailing (i) the formulas developed under subsections (a) and (c) of this section, (ii) the types of projects funded under this section, and (iii) the total amount of funding allocated to each project funded under this section. The Department shall submit the report required under this subsection to the Joint Legislative Transportation Oversight Committee by March 1, 2018.