

**Virginia Transportation Research Council
Research Needs Statement**

RNS 26-6: Development of a User-Friendly Traffic Responsive Signal Control Methodology for Incident Management and Daily Operations

Suggested Timeline: 18-24 months

Maximum Budget: \$250,000

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Background

Traffic Responsive Plan Selection (TRPS) has been established as an improvement over traditional Time of Day (TOD) signal operation, but its adoption in practice has been limited by the complexity of selecting the appropriate TRPS parameters. For a corridor, system detectors must be defined that are used to calculate and then measure the volume and occupancy thresholds to activate pre-defined timing plans. VDOT has access to TRPS functionality in the KITS statewide central signal software Congestion Manager module, but it is not being fully utilized due to the difficulty of defining the appropriate parameters – the system detectors, appropriate volume/occupancy thresholds, and associated timing plans. Many VDOT districts operate signalized corridors that are official detour routes for interstates, where TRPS could provide an automated response to an influx of diverted traffic. Advances in technology open the opportunity to use probe data speeds or travel times as another trigger for TRPS, which could be advantageous in oversaturated conditions or where vehicle detection is minimal.

A 2009 VTRC-funded study entitled *Evaluation of Traffic Responsive Control on the Reston Parkway Arterial Network*, detailed a methodology for defining TRPS parameters, but the results of the project were ultimately not implemented by VDOT due, in part, to the complexity of the methodology. Wider implementation by VDOT necessitates a robust tool that signal engineers can use to define TRPS parameters without advanced statistical expertise or excessive time investment. This project will create a robust, user-friendly tool that can generate the parameters necessary to run TRPS using existing sources of data.

The main focus of this project is using TRPS as a replacement for the static time-of-day schedule, but special event activation (i.e., incident detours) is also within the scope of effort. While VDOT currently uses Kimley-Horn KITS products, the developed tool should be vendor-agnostic to maximize its utility. It is anticipated that the tool would be run offline and would use manual data exports from KITS or other possible future central traffic signal systems.

Project Objectives and Scope

The primary objective of this project is to remove barriers to TRPS adoption by VDOT with a tool that can optimize the input parameters for any given corridor. This tool should:

1. Use input data available to VDOT for a user-defined corridor (e.g., detector volume and/or occupancy, Automated Traffic Signal Performance Measures, INRIX XD segment data, coordinated timing plans, queue presence and length).
2. Identify key system detectors and recommend volume/occupancy (or other) thresholds for each detector, identify key INRIX XD segments and recommend travel time thresholds, and assign corresponding timing plans or identify where new plans are needed.
3. Not require advanced statistical or coding knowledge to operate.

Potential Tasks

This project should include the development of the tool and testing on at least two corridors with differing characteristics using simulation (preferably VISSIM) using actual VDOT corridors. The testing should demonstrate both the use of the tool from corridor definition to creation of defined TRPS plan, as well as document any delay improvements due to the resultant plan change. Hardware- or software-in-the-loop testing could also be part of the evaluation, and it is recommended that the team plan to visit the corridors to observe congestion patterns and field operating conditions as part of simulation construction. If the results are satisfactory, then field piloting and implementation may occur in a future project. These test corridors are expected to contain at least 5-10 signals, and corridors will be selected in consultation with the TRP.

Each research team should develop a methodology that best satisfies the project objectives. The research team should describe their approach to tool development, as well as how the quality of the parameter estimates generated by the tool will be demonstrated via simulation. The Expression of Interest (EOI) should clearly state expected data needs for the tool and indicate the source of the data. The tool developed in this project should be designed in a way to comply with any relevant Information Technology Division (ITD) or Operations Technology Division (OTD) requirements. The TRP will work with the selected research team so that they are aware of relevant requirements that may impact the proposed design. Related to this, respondents should note that while artificial intelligence may be used in the development of the tool, solutions including AI techniques may be subject to review by ITD/OTD before implementation.

Successful projects will involve VDOT traffic signal engineers as the end users of the product to inform the tool's development and usability. Researchers should plan on consulting with stakeholders at multiple points throughout the project, in addition to regular TRP meetings.

Researchers should include an implementation plan that would describe how the tool may be put into practice at VDOT. While piloting and full implementation are being reserved for future efforts, this project should lay the groundwork for field implementation and must be undertaken with an eye towards use in the field.

Resources:

- 2009 TRPS Study: <https://vtrc.virginia.gov/reports/all-reports/09-cr6/>

Special Notes

1. In preparing the EOI, each responding university must indicate the number of hours to be spent by key personnel on the project by task in their budget submission. This requirement also applies to any subcontractors.
2. The EOI should include virtual meeting updates with the Technical Review Panel on at least a quarterly basis.
3. Researchers should explicitly indicate in the EOI if they are expecting VDOT to provide any data, materials, or services to complete the project.