4.0 Performance Measures and Evaluation Methodologies

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The evaluation goals and objectives presented in the previous section provide the framework for the evaluation. This section presents the particular measures of effectiveness that will be evaluated during the study. These evaluation measures build on the evaluation objectives and are designed to provide for a comprehensive analysis of the evaluation goals. This section also presents an overview of the methodologies that will be employed to collect and analyze data for the study.

4.1 Evaluation Measures

For each of the evaluation objectives identified in Section 3.0, one or more measures of effectiveness have been identified to provide an assessment of the objective. Where possible, these evaluation measures are expressed in quantitative terms; however, many of the measures are more appropriately expressed in qualitative terms.

The evaluation measures selected for each evaluation objective are presented in Table 4.1. The measures of effectiveness are focused on the incremental change observed between the two evaluation scenarios – "with" (meters on) and "without" (meters off). By focusing on the change occurring between the two scenarios, the evaluation team will be better able to isolate the particular benefit/impact. The measures of effectiveness are not mutually exclusive and in some cases the same measure is used to test several objectives. The evaluation measures are also designed to be "neutral" and not presuppose any outcome of the ramp meter test. In all cases, the outcome of the particular measure may be either positive or negative depending on the impacts observed during the two scenarios. Outcomes may also be *both* positive and negative in that results may vary geographically across the selected corridors, market segments, or timeframes.

Appropriate data will be collected related to each of these measures to provide the opportunity for assessment against the evaluation objectives and goals. Section 4.2 presents an overview of the methodology that will be employed in evaluating these measures. The remaining sections of this document provide greater detail on the data collection and analysis methodologies.

Table 4.1 Evaluation Measures

Evaluation Objective	Measures of Effectiveness
1. Quantify ramp metering safety impacts for selected corridors.	• Change in the number of crashes occurring in selected corridors. • Change in the severity of crashes occurring in selected corridors. • Change in the number of traffic conflicts (non-crashes) occurring at specific corridor locations (ramp merge and adjacent intersections). • Change in HOV lane violations. • Perceived change in safety of travel in selected corridors.
2. Quantify ramp metering traffic flow and travel time impacts for selected corridors.	• Change in travel time for primary travel route in selected corridors. • Change in travel time for alternative travel routes in selected corridors. • Change in travel speed for primary travel route in selected corridors. • Change in travel speed for alternative travel routes in selected corridors. • Change in traffic volume for primary travel route in selected corridors. • Change in traffic volume for alternative routes in selected corridors. • Change in travel time reliability for selected corridors. • Change in traffic volume, travel time, travel speed, and travel time reliability for on-ramps in selected corridors. • Perceived change in travel time for selected corridors. • Perceived change in travel time reliability for selected corridors.
3. Extrapolate ramp metering safety impacts to the entire system.	• Change in the number of crashes occurring systemwide. • Change in the severity of crashes occurring systemwide. • Estimated change in the regional crash rate for different facility types. • Estimated regional change in vehicle miles traveled for different facility types. • Estimated change in regional volume to capacity (v/c) ratios. • Perceived change in systemwide safety of travel.
4. Estimate ramp metering impacts/ benefits (positive and negative) on energy consumption and the environment.	• Estimated regional change in emissions by pollutant and by facility type. • Estimated regional change in fuel consumption by facility type.

Table 4.1 Evaluation Measures (continued)

Evaluation Objective	Measures of Effectiveness
5. Extrapolate ramp metering traffic flow impacts/benefits (positive and negative) for the entire system.	• Estimated regional change in travel time. • Estimated regional change in vehicle miles traveled for different facility types. • Estimated regional change in travel speed for different facility types. • Estimated regional change in travel time reliability. • Perceived regional change in travel time. • Perceived regional change in travel time reliability.
6. Compare the systemwide ramp metering benefits with the associated impacts and costs.	• Change in the number and severity of crashes occurring systemwide. • Change in systemwide travel times. • Change in the total number of trips. • Change in travel time reliability. • Change in fuel use and other user paid costs. • Change in vehicle emissions levels. • Estimated change in DOT operating costs. • Estimated change in operating costs of other agencies (e.g., State Patrol, transit agencies, local jurisdictions, etc.) • Capital cost of ramp metering system.
7. Identify ramp metering impacts on local streets.	• Change in traffic volumes on local streets in selected corridors. • Change in the length and severity of ramp queue spillover onto adjacent intersections in selected corridors.
8. Identify ramp metering impacts on transit operations.	• Change in transit travel times for selected corridors. • Change in transit ridership levels for selected corridors. • Estimated change in operating costs for transit providers.
9. Document additional ramp metering benefits/impacts observed during the study.	• Documentation only.
10. Identify similarities and differences between the Twin Cities' ramp metering system and other metropolitan areas in terms of ramp meter operation strategy employed and ramp configuration strategy.	• Documentation only.
11. Identify national and international trends regarding the use of ramp metering as a traffic management strategy.	• Documentation only.
12. Identify benefits/impacts of ramp metering systems documented in other national and international studies.	• Documentation only.

4.2 Overview of Evaluation Methodologies

Data related to the measures of effectiveness will be collected during two periods during the fall of 2000. The first data collection period will be used to assess the baseline or "with ramp meters" scenario. In this scenario, the ramp meters will be operated according to established operating practices. These data will be used to establish a baseline for the purpose of identifying the incremental change occurring in the "without ramp meters" scenario.

A second data collection period will be conducted to evaluate the "without ramp meters" scenario. In this scenario, *all ramp meters will be deactivated systemwide*. The deactivated ramp meters will be set to "flashing yellow" mode – consistent with their normal operation during off-peak periods. Although all ramp meters throughout the system will be deactivated during the test, the data collection effort will be focused on four selected corridors. These corridors were selected as representative of other corridors throughout the metropolitan region. Section 5.0 identifies the selected corridors and provides additional detail on the criteria used to select the corridors. Other systemwide data will be collected during this period to allow for the normalization of data collected in the selected corridors.

In parallel with the field traffic data collection, a series of market research tasks will be conducted. This effort will include both focus groups and surveys conducted during both the "with" and "without" scenarios.

Data collection will occur over a four- to six-week period during both the "with" and "without" scenarios. "With ramp meter" data collection will occur between September 11th (following the Labor Day holiday and the return of normal fall business and school activity) and October 15th, 2000. The public will be informed on October 9th that the ramp meters will be deactivated the following Monday, October 16th. Most of the public knows that this will be occurring sometime in the fall. The goals of the schedule are: 1) to provide adequate time for the collection of the "before deactivation" data; 2) to provide the public with adequate notice of the impending change in traffic operations such that they have time to plan changes in their travel routines should they be interested in doing so; and 3) to not provide so much advance notice that the resulting induced behavioral change would in some way taint the "before deactivation" data collection. It is the intention of the plan to collect the vast majority of data prior to the October 9th public notification, using the final week primarily for contingency purposes. It should be noted that the public will not be formally notified of the selected test corridors; however, it is likely that many travelers will observe the data collection activities in progress on these corridors.

The ramp meters will remain deactivated from October 16th through November 17th, thereby concluding prior to the Thanksgiving Holiday and the onset of the Christmas shopping season. This five-week test period will also enable the evaluation to assess changes over time in travel behavior as travelers adjust to new operating conditions and congestion patterns.

Following the conclusion of the "without" scenario test, the ramp meters will most likely be turned on to operate in their pre-test mode absent a policy decision by Mn/DOT to the contrary. Data analysis will be conducted to isolate the incremental impact observed between the two scenarios during this time. These incremental impacts will then be extrapolated and combined with other data to support the regionwide analysis of ramp meter effectiveness.

To support the evaluation, several individual test plans have been developed to guide the collection and analysis of different types of data. Each test plan provides detailed instructions for conducting a specific aspect of the study. Yet, all the individual test plans have been carefully linked to provide coordination between the different analysis efforts. The individual test plans developed for this study include:

- **Field Data Collection Plan for Selected Corridors –** Defines corridor selection criteria, selected corridors, and the field data to be collected and analyzed for the selected corridors (Section 5.0);

- **Market Research Test Plan –** Defines the focus group and survey data collection tasks to be performed and presents the methodology to be used (Section 6.0);

- **Benefit/Cost Analysis Test Plan –** Identifies how the data collected for the selected corridors will be extrapolated to develop estimates of regionwide impacts and presents candidate methodologies for performing the methodology (Section 7.0); and

- **Secondary Research Test Plan –** Identifies the secondary research to be performed to compare and contrast the ramp metering system in the Twin Cities with systems in other national and international locations (Section 8.0).

The following sections present the various individual test plans that provide specifics on the conduct of the various evaluation tasks.