Performance Measures Report
for the Montana Rest Area Usage: Data Acquisition and Usage Estimation Research Project

The Montana DOT (MDT) research project "Montana Rest Area Usage: Data Acquisition and Usage Estimation" resulted in data collection and analysis to support various aspects of future rest area planning, design, and operations in the state of Montana. Usage data from rest areas throughout the state was used in the research to develop guidance, related to various aspects of rest areas including parking, patron visitation, water usage, and wastewater generation. A key piece of guidance recommends a water usage value of 2.0 gallons per patron, which correlated to the same value per patron for wastewater generation. This is a significant departure from the existing guidance provided by AASHTO's "Guide for Development of Rest Areas on Major Arterials and Freeways", which recommends the use of 3.5 gallons per patron. This 1.5 gallon difference has significant implications on the sizing and associated cost of each system and advanced wastewater treatment component, the land area necessary for a drainfield, and resulting operations and maintenance of the constructed system. The application of this finding in designs for new and renovated rest areas was the most immediate outcome from the short-term implementation of the research.

In just the next two years, there are six rest areas scheduled for wastewater system rehabilitation. The savings realized at these sites is over $1.3 million. When applied in the design calculations of systems at thirty additional Montana rest areas requiring wastewater system rehabilitation over the next twenty years[1] (through 2032), the reduced wastewater figure is expected to produce savings of between $65,445 and $513,750 per site. The collective savings generated by this revised guidance will total $6,308,060 in present value (2013). The present cost of the research (2013) is $206,031. These savings and the research cost were used when calculating the benefit-cost ratio of the research and the return on investment.

Assumptions:

1.) Without research, the AASHTO wastewater guideline of 3.5 gallons per patron would continue to be used.
2.) With research, the wastewater generation is 2.0 gallons per patron.
3.) Even though discussions to decrease the overall cost of rest area rehabilitation, including the construction of wastewater systems, have taken place, there was no basis to use a gallon per patron usage estimate other than that which is recommended in the AASHTO guidance. Therefore, all wastewater system design savings can be attributed to the research.
4.) The design life of wastewater systems is 20 years.
5.) A discount rate of 5% is used to determine the present value of the research cost.
6.) The cost of advanced wastewater treatment systems is $105 per gallon.

[1] The expected life of a rest area wastewater system and mandated system review period via state regulation is 20 years.

7.) Annual traffic growth at each site is 1.5 percent.
8.) No change in Department of Environmental Quality treatment regulations will occur requiring more stringent (costly) systems.
9.) For one site (Dena Mora) only 50 percent of the calculated savings were attributed to the research, as a reduced overall site design also contributed to cost savings.
10.) Total 2013 savings (benefits) from using revised guidance for rest area rehabilitation $6,308,060.

Calculations:

While the research was initiated in 2009 at a cost of $150,601, the estimation of the collective design savings from all thirty six rest area sites were estimated in 2013 dollars. First, the 2009 research cost was updated to a present value, using the following equation:

$$A = \mathrm{P} * (1 + \mathrm{i})^t * (1 + \mathrm{r})^t$$

Where:

A = value of the payment (2013)

P = present value of money (value of the cost of research)

i = inflation rate

r = discount rate

t = number of years (four) since research initiation

Based on this equation, the present value of the research cost in 2013 was computed as:

$A = 150{,}601 * (1 + 0.03)^4 * (1 + 0.05)^4$= $206,031 in 2013 dollars

To bring the value of expected benefits to a present (2013) value, the following equation was used:

$$Ben = \frac{E}{(1 + \mathrm{r})^t}$$

Where:

Ben = present value of the benefit (2013)

E = estimated value of the benefit accrued in the future

r = discount rate

t = number of years until the benefit is achieved

Individual calculations for each rest area project were made to convert the future expected savings into present values. The total present value of all expected savings for rest area projects over the next 20 years was calculated to be $6,308,060.

After the research cost was converted to present values the benefit/cost ratio was determined. To compute the benefit-cost ratio, the savings were divided by the research cost:

$B/C = \frac{\$6{,}308{,}060}{\$206{,}031}$ = 30.62:1

This figure indicates that \$30.62 in savings was produced for every \$1.00 spent on the research. All estimated benefits (dollar savings) for rehabilitation are in present value (2013) and were discounted to the year in which the cost savings should be realized.

The return on investment was calculated as the future value of the benefits minus the future value of the research cost, which was then divided by the future value of the research cost.

$$ROI = \frac{FVbenefits - PVcost}{PVcost}$$

Where:

ROI = Return on investment

FVbenefits = Future value of the benefits accrued

PVcosts = Future value of the cost of the research (2013 dollars)

Using the equation above, the return on investment was computed as:

$$ROI = \frac{(\$6{,}308{,}060 - \$206{,}031)}{\$206{,}031} = 29.62$$