

Executive Summary, Research Readiness Level Assessment, and Technology Transfer

Characterization of Sediment Loads and Size Distribution in Nebraska Roadway Runoff

Research Objectives

The overarching goal of this project is to establish reasonable estimates of particle size distributions and concentrations of sediment washed from roadways into storm sewers in Nebraska MS4 municipalities. These data are needed for proper sizing and maintenance scheduling of SAFL Baffles. To meet this goal, the following objectives have been identified:

1. Develop a thorough understanding of existing roadway sediment runoff data including concentrations and sediment distributions.
2. Establish a rigorous and defensible methodology for collecting roadway runoff sediment data that is representative of MS4 communities in Nebraska.
3. Collect a complete set of roadway sediment runoff data for a two-year period that includes multiple seasons.
4. Produce a model and guidelines for extending the data to represent MS4 communities throughout Nebraska.

Research Benefits

This research is straight forward, and the results will be directly utilized by NDOT in its MS4 program. The research will allow for inlet and manhole sump structure designs that are tailored specifically to Nebraska data. The data may also be utilized in design of other MS4 treatment methods by using the sediment concentration and particle size distributions to calculate expected sediment loads, potential settlement timing, and clogging potential on filtering systems.

Principal Investigator

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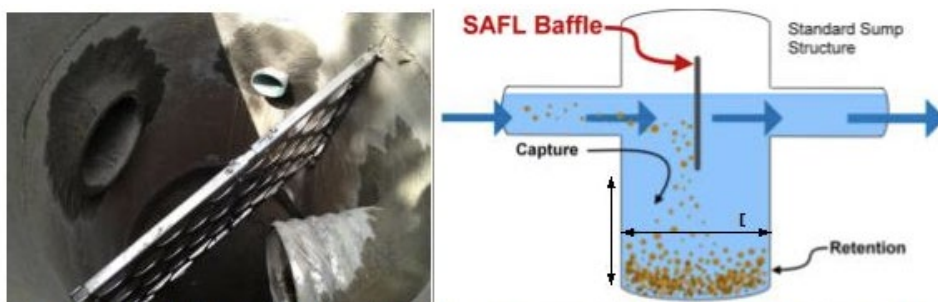
Julie Ramirez, PE, Hydraulic Engineer

Background

NDOT would like to implement SAFL Baffles and possibly other mechanical sediment trapping devices in future projects to address MS4 regulations. These devices require preliminary determination of runoff sediment characteristics including particle size distributions and concentrations. The required data are available in some other states but not in Nebraska. Using data obtained in other states will be inaccurate and will likely result in over- or under-design of the sediment trapping devices. Proper design of the trapping devices will optimize cost and efficiency of the devices. Measuring sediment size distributions and concentrations at multiple drainage sites in Nebraska municipalities is needed to provide defensible characterization of runoff sediment. Modeling of the sediment size distributions and concentrations is needed to extend measured results to similar drainages.

Conclusion

The Nebraska Department of Transportation (NDOT) must manage sediment, and pollutant loads from roadway runoff to meet stormwater regulations. The SAFL Baffle, a hydrodynamic separator used by NDOT, depends on reliable estimates of total suspended solids (TSS) and particle size distribution (PSD). However, limited data exists for Nebraska roadways. In this study stormwater runoff was monitored at four NDOT-maintained sites, two in Lincoln and two in Beatrice, over 1.5 years to characterize TSS and PSD and to evaluate SAFL Baffle performance using the SHSAM model. Results showed large variability across sites and seasons. Median TSS ranged from 158 to 580 mg/L, and median particle size (d_{50}) from 16 to 322 μm . Finer particles dominated at most sites, likely due to runoff from gravel or exposed soils off the roadway and especially outside of the NDOT right of way. Higher TSS in spring was observed and reflected low vegetation cover and winter sediment buildup. SHSAM modeling showed that the SAFL Baffle alone may not achieve 80 percent TSS removal, as it is less effective for fine particles. However, if off-site sediment loads are credited toward compliance, performance goals could be met. The study highlights the need for local sediment data and for accounting for off-site sources in NDOT stormwater design.



SAFL Baffle installed within a sump manhole (left) and schematic view of the operation of the SAFL Baffle (right)

Source: Adapted from Upstream Technologies

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Final report is available:
[HERE](#)

NDOT Recommendations Based Off Research Project – 2026 – RRL3

The research provided a model for properly sizing SAFL baffles and other mechanical sediment trapping devices used to address Municipal Separate Storm Sewer System (MS4) regulations; however, the four selected sampling sites do not represent the breadth of site characteristics in Nebraska, with project results indicating that gathering data from additional sites would be beneficial. In Phase II of this project, [FY26\(053\)](#) Characterization of Sediment Loads and Size Distributions in Nebraska Roadway Runoff – Phase II, four additional sites are selected to capture the variability of Nebraska's MS4 communities in terms of soil types, storm drainage systems, and traffic flow. This will be used to update the Phase I model and guidelines to better represent MS4 communities in Nebraska.

- As provided by Julie Ramirez, Lead TAC Member

Research Readiness Level (RRL) Assessment

Level 3: Development

Follow up after completion of Phase II, FY26(052), in 2027.

RRL 3

Technology Transfer

Webinars/Presentations

- Dvorak, B.I, Admiraal, D.AP, and Shrestha, P. (2025) "Characterizing Sediment and Identifying Sources in Nebraska Roadway Runoff: Implications for BMPs", *IEAC Great Rivers Conference*, Lincoln, NE, Sept 23, 2025, Presentation.

**This brief summarizes Project SPR-FY24(031)
"Characterization of Sediment Loads and Size Distribution in Nebraska Roadway Runoff"
Nebraska Department of Transportation Research Program**