

DIVISION OF RESEARCH, INNOVATION & SYSTEM INFORMATION
Research Initial Scope of Work
SUBMITTAL FORM - FY 15/16

I. Project Number: P986

Project Title: Safety of Earthen Stormwater Infiltration Best Management Practices (BMP) adjacent to Highways

II. Task Number: 2896

Task Title: Research Design Parameter for Stormwater Treatment BMPs that Optimize Infiltration and Maintain Traffic Safety.

III. Project Problem Statement:

Caltrans is required to comply with the National Pollution Discharge Elimination (NPDES) permit planning and design requirements for the treatment of storm water runoff. The design requirements include maximizing the infiltration of 85th percentile 24 hour storm event volume from the highway and to prioritize the use of soil based BMPs. Some of the Caltrans right of way available to meet this requirement is the clear recovery zone (CRZ), which include embankments and slopes that must be traversable and recoverable to meet traffic safety requirements. Caltrans needs research on how to balance two objectives: increasing water infiltration and providing traffic safety. Currently there is no report or study that studies how changes in roadside embankment soil to improve infiltration may effect roadside traffic safety. There are studies that suggest that adding amendments and organic materials to roadside embankments may cause CRZ, traversability, soft shoulder, or rutting issues for vehicles. But there are no studies directly linking traffic safety issues with soil based BMPs. Without reports or data to reference, it is difficult for highway engineers to determine if there are traffic safety risks, when applying methods to help increase infiltration capabilities of highway embankments to construct stormwater BMPs.

IV. Objective:

Research the methods, guidance, and specifications used to construct soil based stormwater BMP and determine an acceptable range of values that highway engineers can use to design and construct BMPs to infiltrate the storm water, while maintaining traffic safety. The objective is to have a scientific based set of design parameters that can be referenced by designers that will address traffic safety questions and concerns. A panel of Caltrans members from Design, Traffic Safety, Construction, Maintenance, Environmental, and Geotechnical areas will work collaboratively with researchers to determine an acceptable test project to meet these objectives. Design Guidance will be ultimately be expanded to include traffic safety considerations for soil based BMPs.

The objective is to determine if these BMPs currently cause soft shoulders, CRZ issues, traversability issues, or rutting to a degree that they are traffic safety issues (such as roll overs) or if design parameters can be modified to allow these BMPs to eliminate the traffic safety concerns. As part of the effort, it will be determined if

there is an acceptable setback from the edge of pavement to which this type of soil modification can be implemented.

V. Task Description of Work and Expected Deliverables:

- Define Soft Shoulders and identify soil properties that may lead to soft shoulders (rutting), including within the embankment area.
- Review current design guidance for soil based BMPs, specifications for road side embankments, and traffic safety standards for road side BMPs.
- Review the design parameters that effect infiltration, bulk density, and void space, then determine ranges acceptable for highway roadsides.
- Evaluate USCS soil classification (gradation and clay type and content), relative compaction, depth of amendments, percent organic materials (or percent amendment to soil)(application rate), and soil bearing strength ranges.
- Identify geometry constraints for the design of soil based BMPs within the roadside to maintain traffic safety; 1. Depth of incorporation, 2. Maximum slope, 3. Minimum setback from the edge of pavement or edge of travelled way for BMP placement.
- Evaluate the impact of varying the existing standard Caltrans embankment specifications to improve infiltration and as it pertains to the traffic safety performance of soils.
- Test vehicles on a variety of soil conditions for the potential for soft shoulders, rutting, and rollovers or test a variety of soil based BMPs with computer models to determine the range of acceptable geotechnical properties of soil based BMPs.
- Develop a report that will include a finding of the effects of soil based BMPs on traffic safety and technical information that will give ranges of values that can be used to update design guidance for Caltrans for soil based treatment BMPs. The data may also be used for editing or creating specifications for Stormwater BMPs.
- Determine siting design criteria for soil based BMPs, that is feasible for the highway environment
- Develop technical information that can be used for design and construction. The identified soil modification techniques, methods and parameters used for design calculations also need to consider how they will be developed into specifications that are biddable and buildable. The amended material construction methods, must be reasonable and not require excessive costs.

VI. Background:

Caltrans is required to design and construct soil based BMPs to comply with the NPDES permit and also required to follow the highway design manual for the construction of stormwater BMPs. The district have begun designing these BMPs and are trying to maximize the stormwater infiltrated in the Caltrans right of way. In many areas this area is limited and designers are having trouble finding areas to infiltrate the required volume of stormwater. To increase infiltration and void space, soil amendments are being added and tilled into the soil at a variety of

depths and rates. This varies from the Caltrans standard soil embankment specifications and has raised concerns with a number of traffic safety engineers on the potential to cause soft shoulders, rutting, or the potential for roll overs. HQ Design is not aware of any data or reports that address these questions, so it is unclear if this is truly an issue or not. Other studies would suggest that it may be an issue, but the feasibility and acceptable siting criteria ranges for soil based BMPs within the roadside has not been investigated. Amending slopes with organic materials also could be an issue for maintenance to sustain these types of BMPs long term and so operation and maintenance needs to be analyzed for settling and potential drop offs. A preliminary investigation found related studies, but none that directly addressed this issue and the findings concluded that further research was needed to answer the questions.

VII. Estimate of Duration: Two Years

VIII. Related Research:

Caltrans and other agencies have conducted studies that show that soil based BMPs are effective for infiltrating stormwater volume. FHWA has in the past conducted studies on traffic safety and roll overs. There does not seem to be a study that investigates the feasibility of soil based BMPs effectiveness along with roadside soil properties, as they relate to traffic safety.

IX. Deployment Potential:

This study is part of a greater Caltrans goal of updating its design guidance, tools, and specifications for the stormwater BMPs to comply with the new NPDES permit and comply with the highway design manual goals of traffic safety.

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