Sediment Transport Prototypes

Novel Methods to Disconnect Roads from Streams

Erica Kemp

M.S. Candidate

Water Resources Engineering

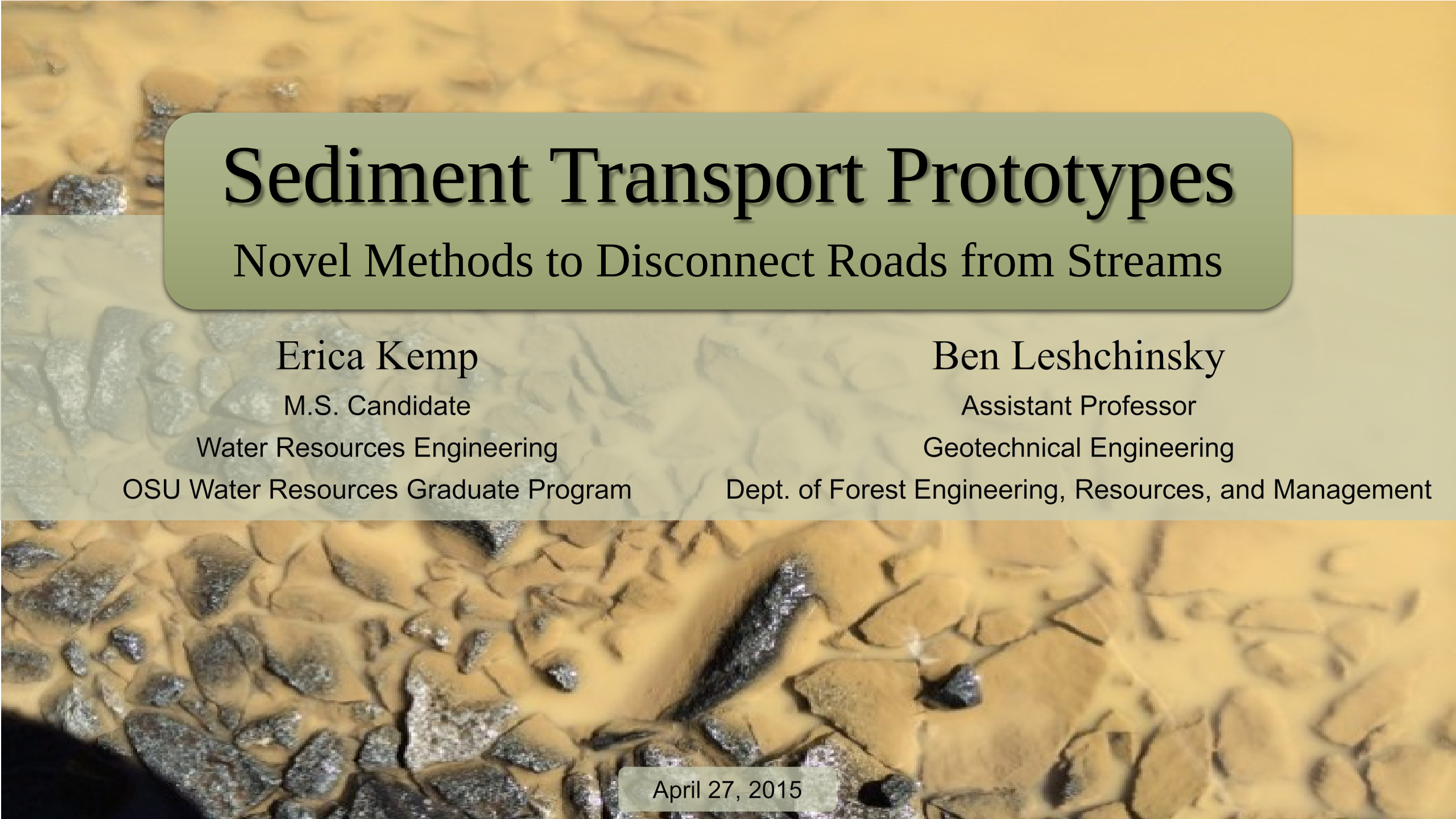
OSU Water Resources Graduate Program

Ben Leshchinsky

Assistant Professor

Geotechnical Engineering

Dept. of Forest Engineering, Resources, and Management



April 27, 2015

Overview

Introduction

- Problem statement
- Research objective
- Hypothesis

Methods

- Site description
- Field methods
- Analytical methods

Results

- Turbidity/SSC
- Aggregate degradation
- Subgrade pressure
- Rutting

Conclusion

- Agreement with existing knowledge
- Next steps

Sediment Originating from Unpaved Forest Roads

Why is it important?

Sediment from forest roads leaches into nearby streams and degrades aquatic habitat

Endangered Species Act

Threatened salmonid species in Willamette and Lower Columbia Basins (NMFS 2015)

- Chinook Salmon
- Chum Salmon
- Coho Salmon
- Steelhead

Photo: Ken Hammond, USDA

Photo: Ben Leshchinsky

Research Objective

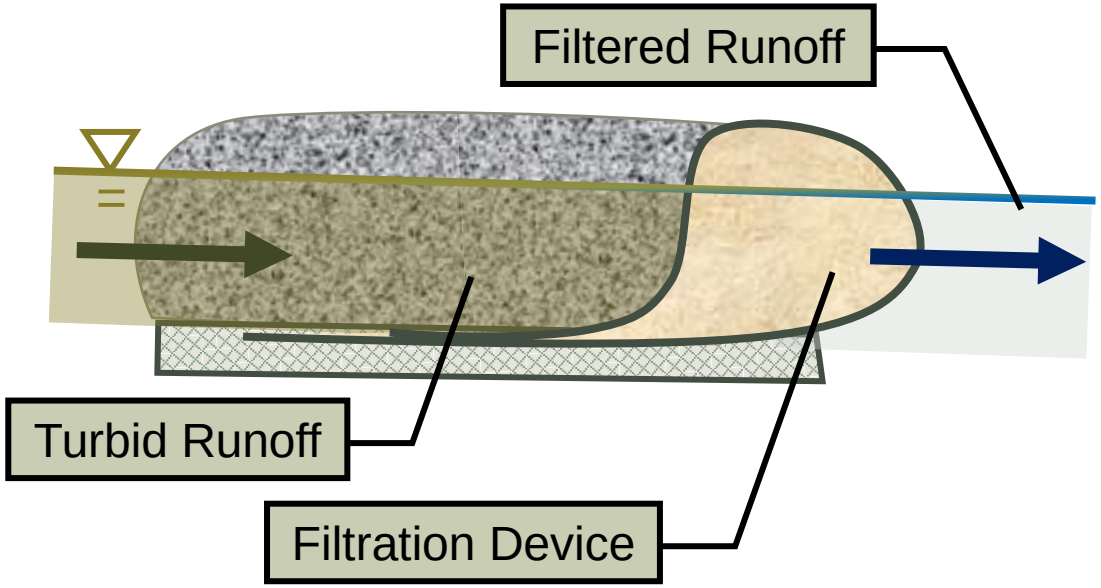
For a small, field scale, test track with sediment control treatments

Observe and Quantify

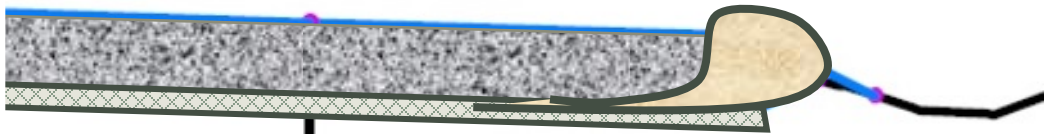
1) Sediment transport leaving surface aggregate
2) Physics of sediment generation in surface aggregate
3) Treatment efficacy – benefit, service life, construction

During wet-weather hauling conditions

Hypotheses

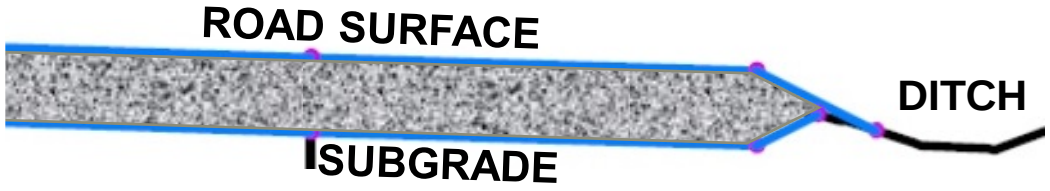


- Filtration devices will provide a sediment sequestration benefit
- Geogrid reinforcement will improve aggregate performance (reduce rutting)



Geotextile wrap-face berm with filtration sand and geogrid reinforcement

Douglas Fir biomass filtration bale



Control – Aggregate only

Justification of Approach

Past Efforts

- Use of geotextile to segregate aggregate
- Use of geogrid to prevent rutting

Methods to manage sediment:

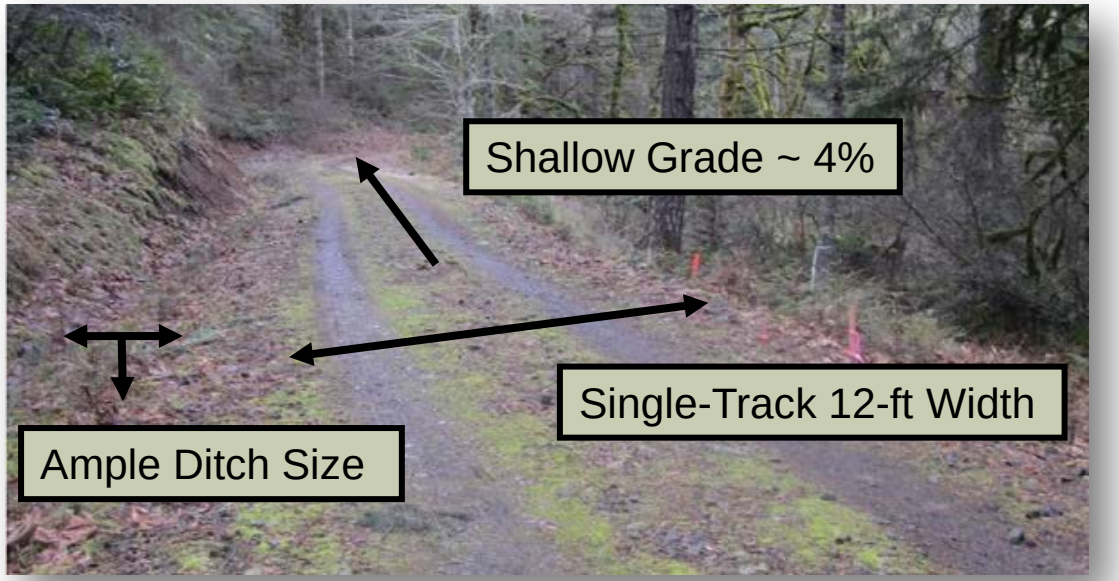
- Geogrid reinforcement
- Use of poorly graded surface aggregate
- Confining materials to provide filtration of runoff

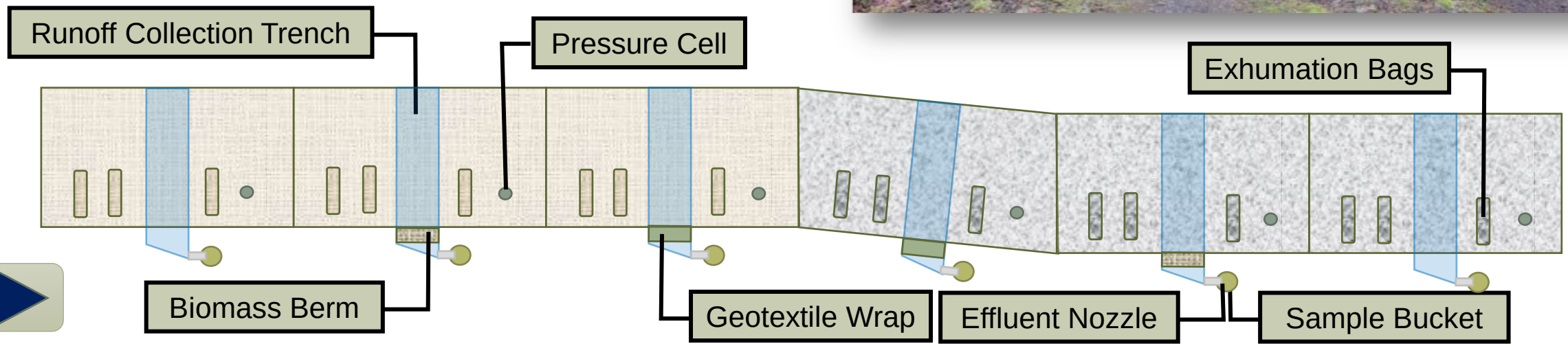
Photo: Ben Leshchinsky

Dunn Research Forest

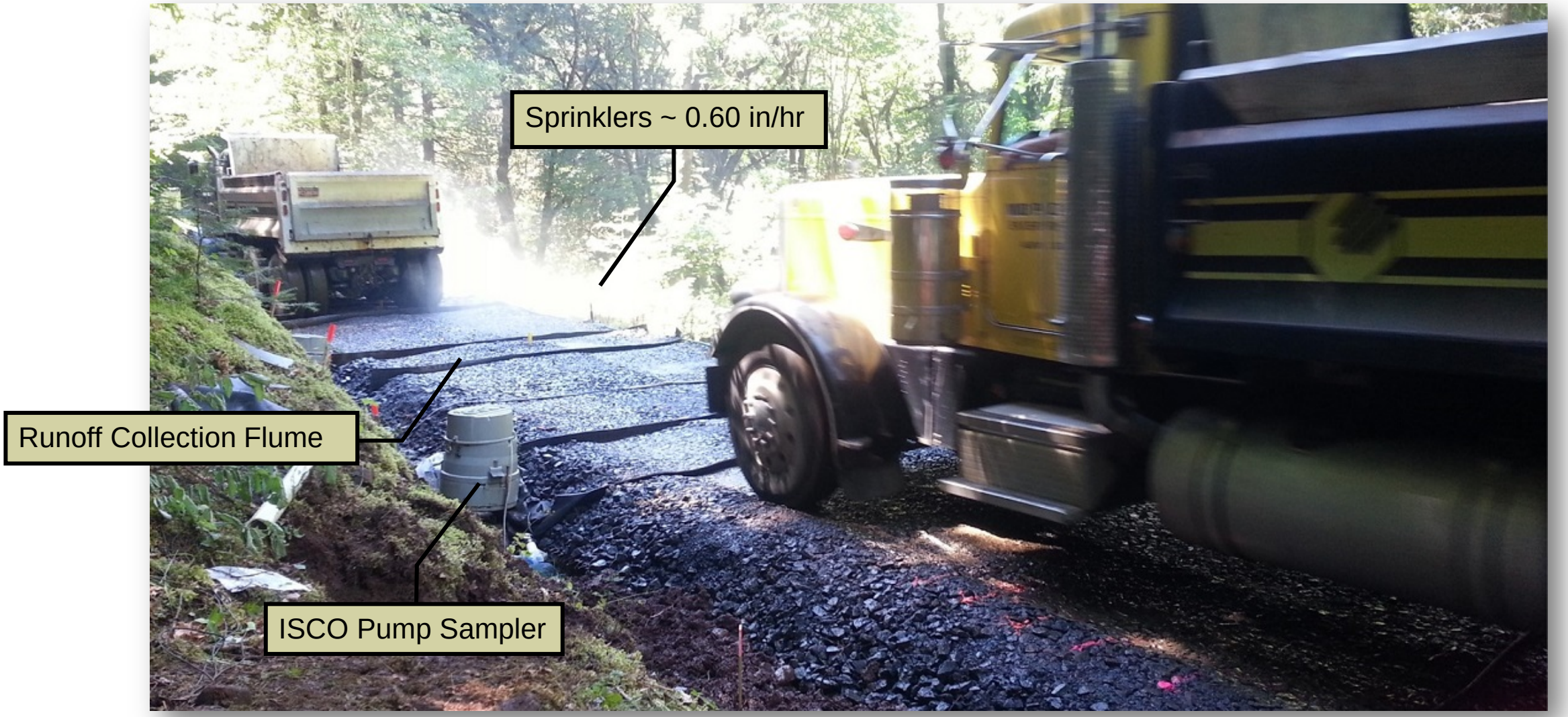
Reconstructed 120 ft section of road

- 6 treatments
- 12 ft x 20 ft sections
- Insloped towards ditch
- 2 aggregate varieties

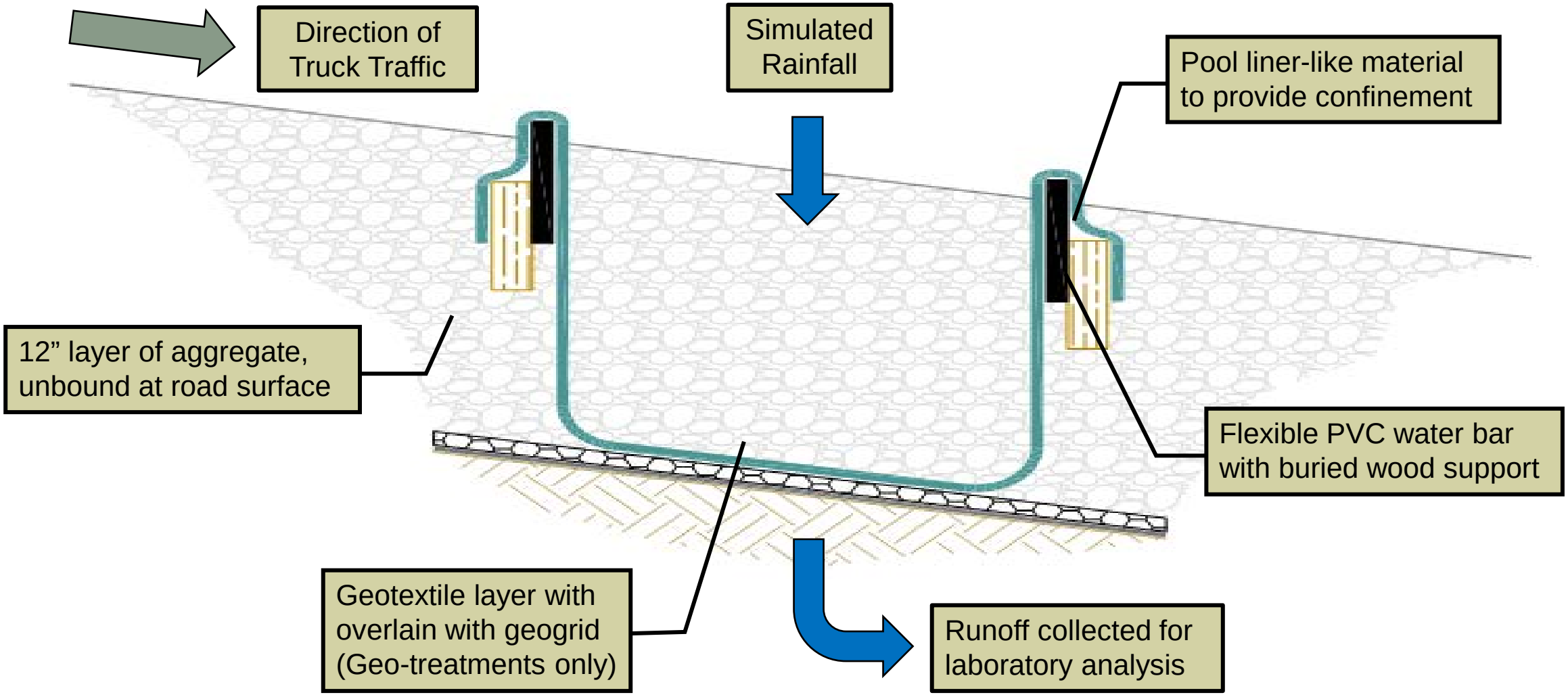




Field Testing



Runoff Collection Trench



Construction

Photos: Ben Leshchinsky

Analytical Methods

Turbidity

Suspended Solids

Screening/Sieving

Data Logger

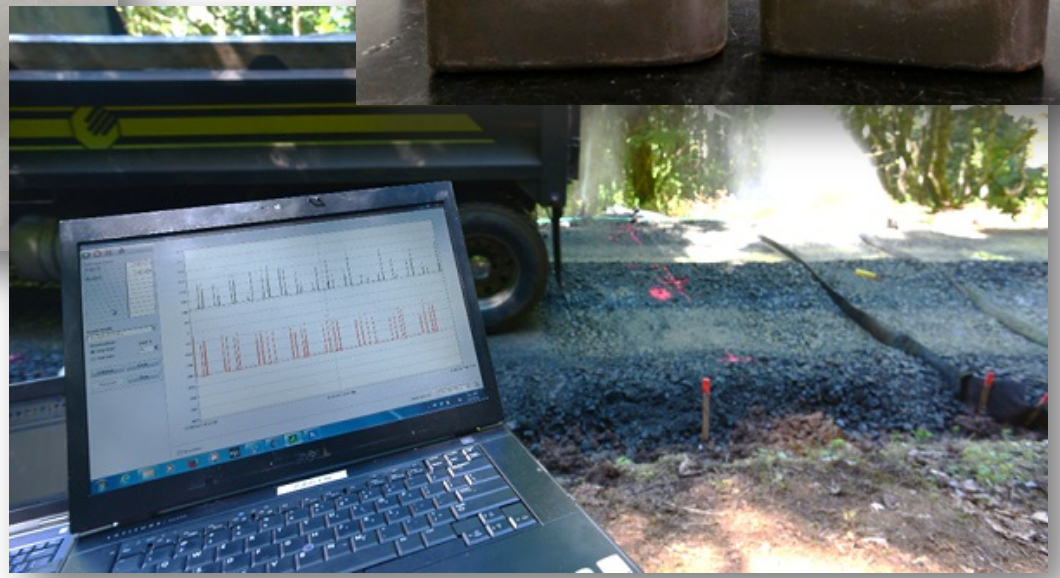


Photo: Ben Leshchinsky

Permeability

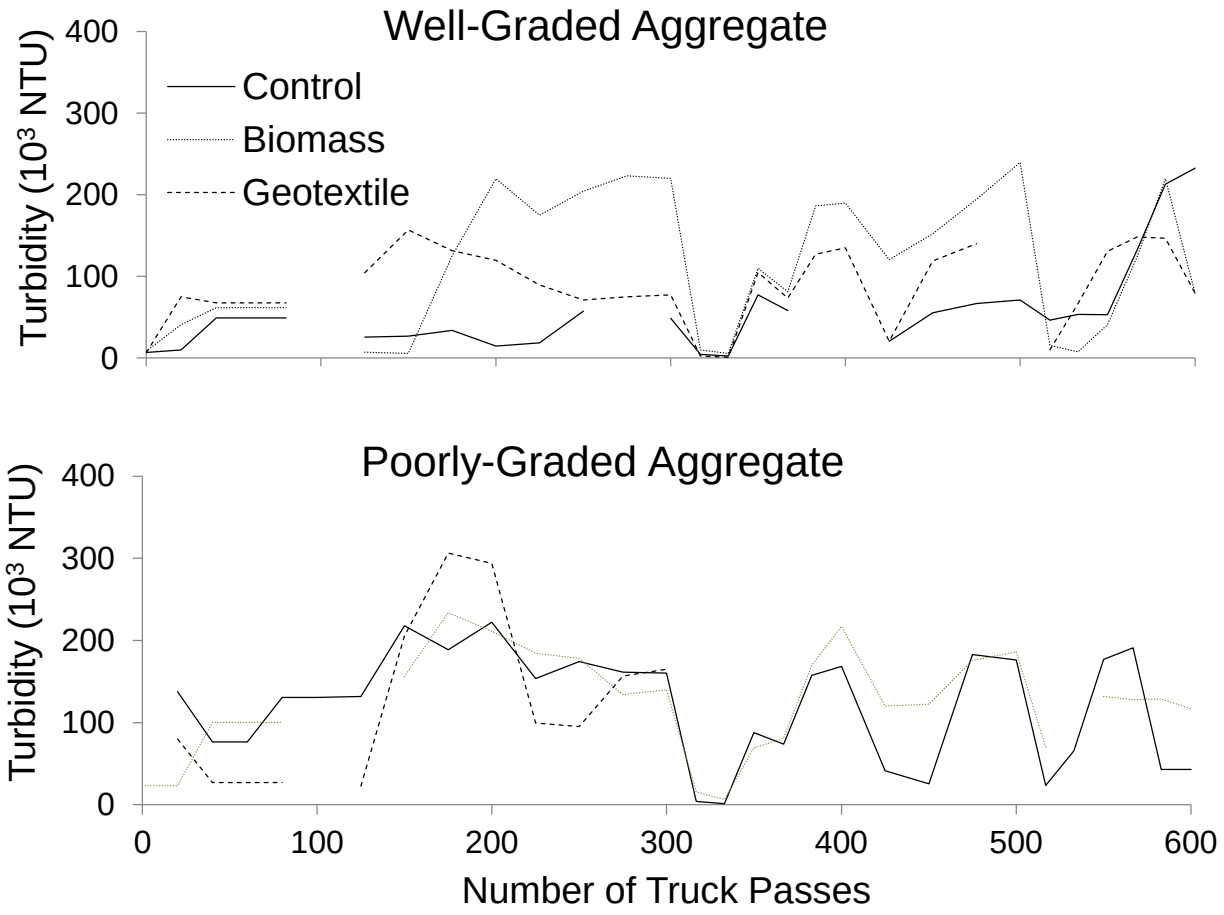
Test Track After 600 Truck Passes

Photo: Ben Leshchinsky

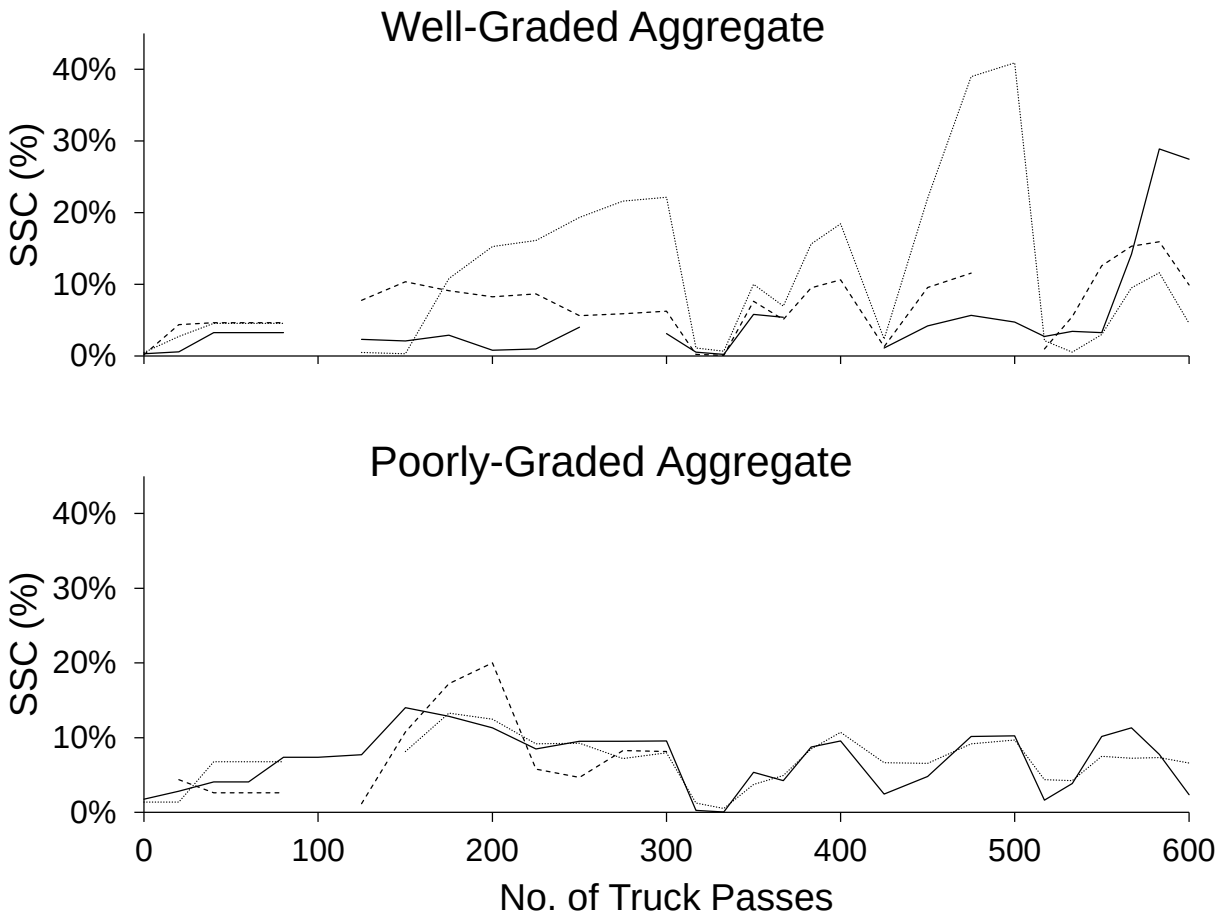
Turbidity and Suspended Solids Concentration (SSC)

Turbidity and SSC Time Series

Turbidity



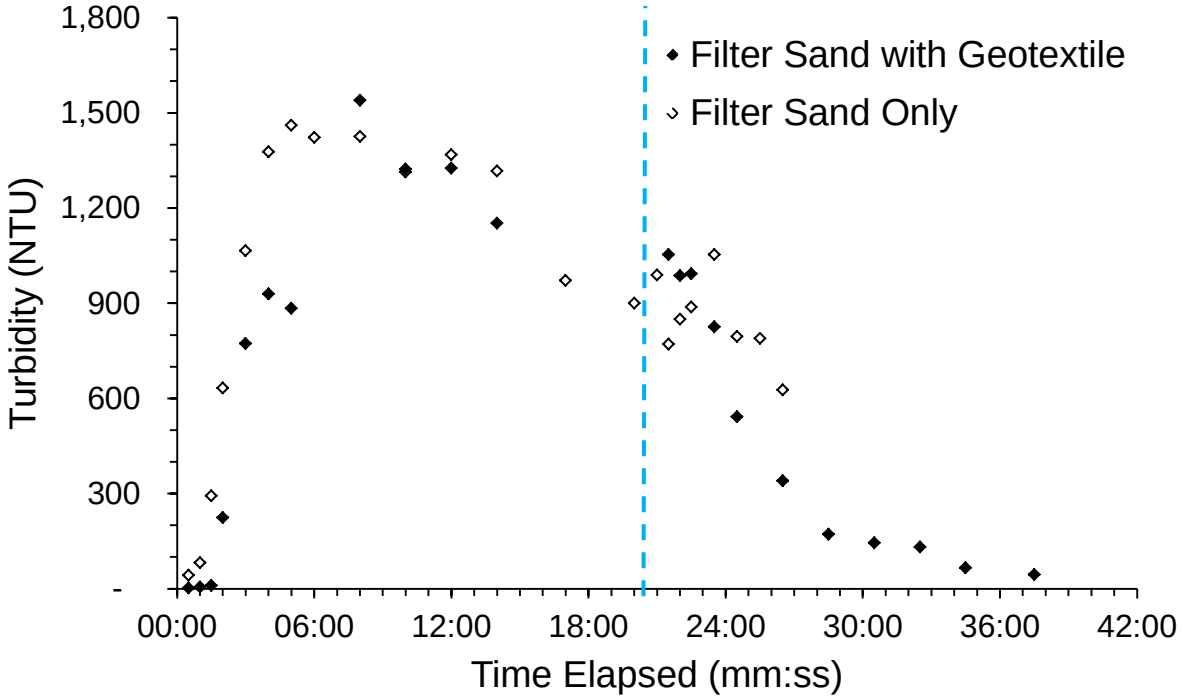
Suspended Solids Concentration

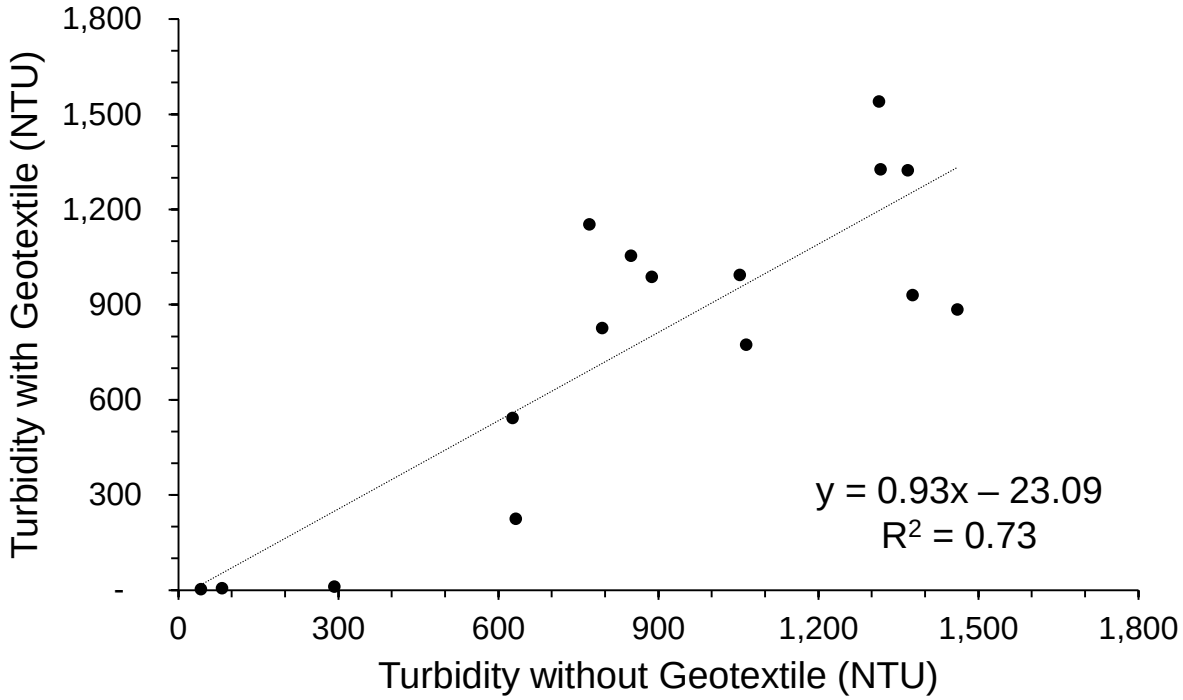


Permeability Testing

Influent
- 1% fines by mass
- Approx. 5,500 NTU

Effluent
- Max 1,500 NTU at peak
- 900 NTU prior to flushing



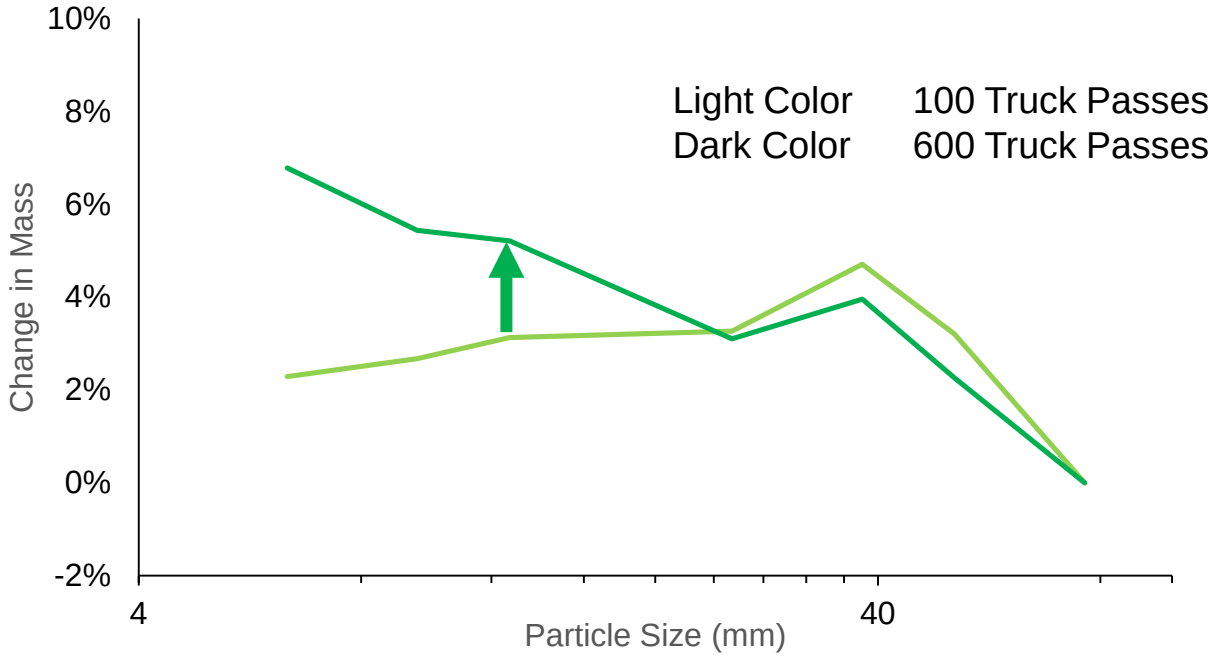


<u>What does a geotextile cost</u>
Fabric $1.25 per sq. yrd
Geogrid $1:50 per sq yrd

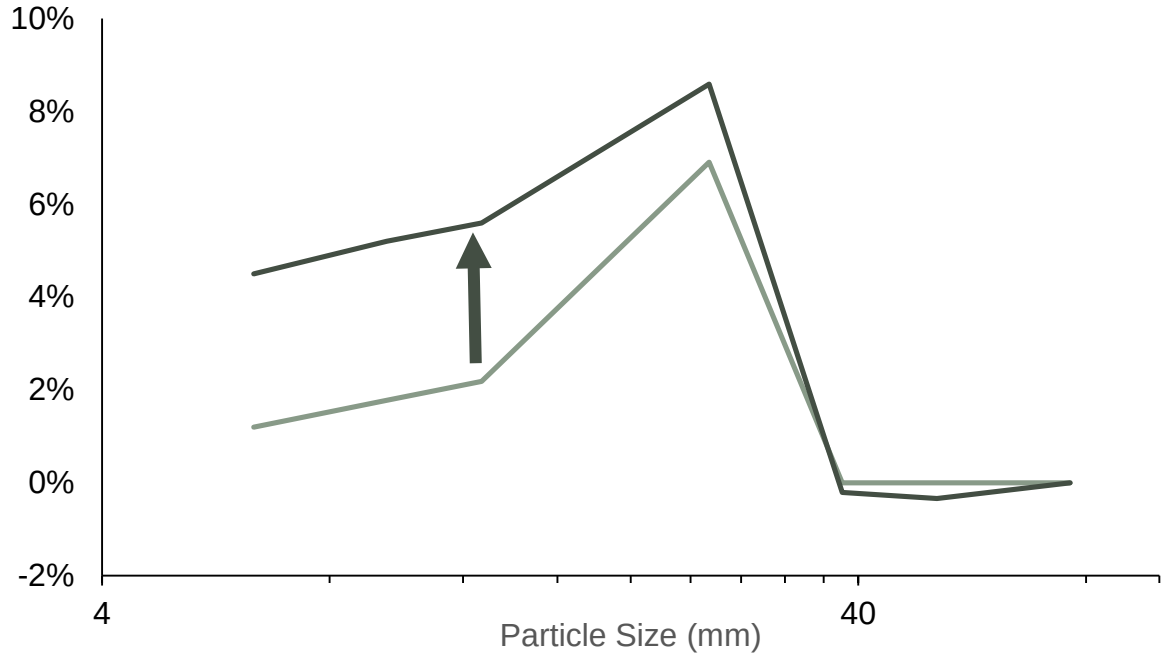
Aggregate Degradation

- Aggregate degradation = Function of truck traffic
- % increase of fines > % increase of coarse grains

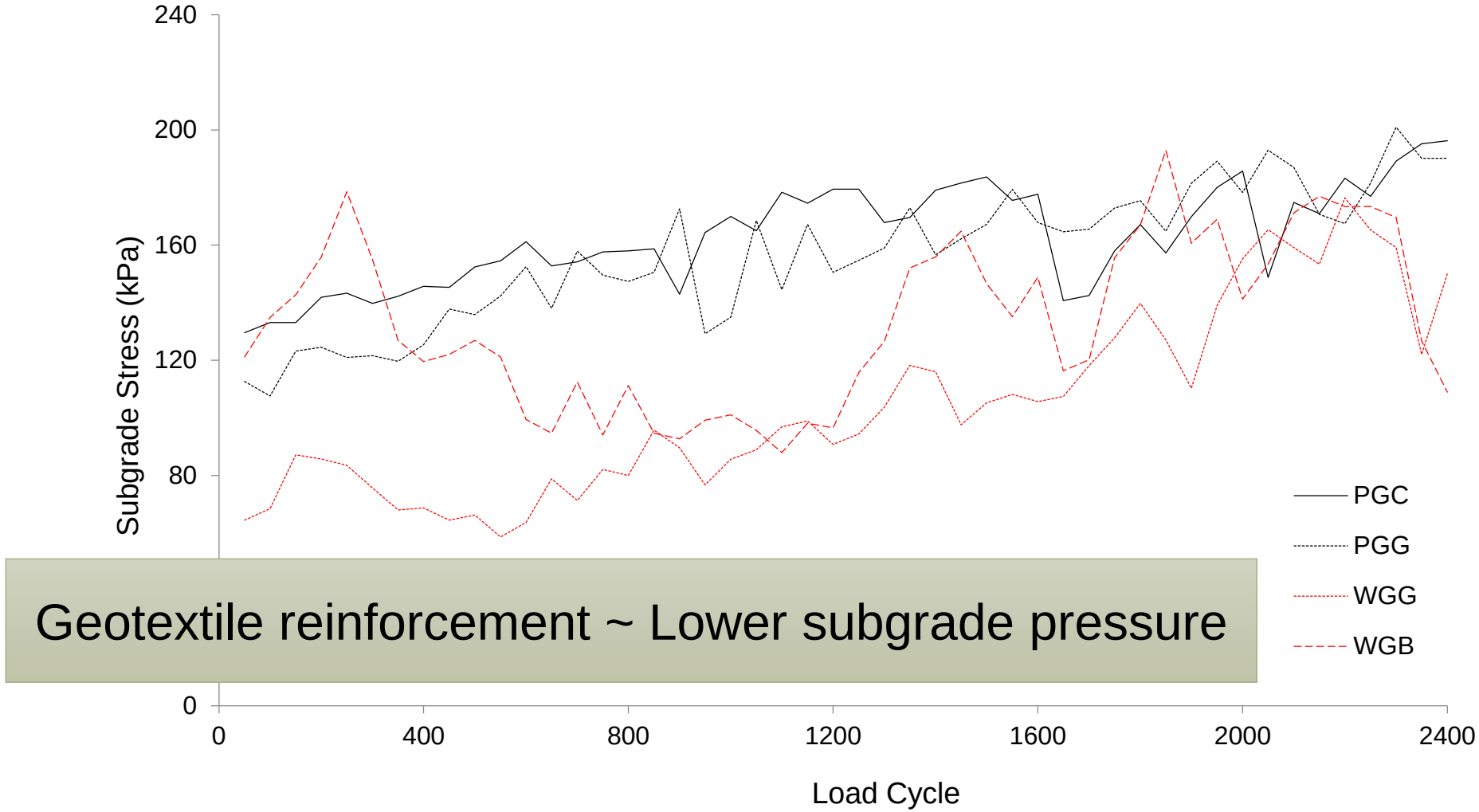
Well-graded Aggregate



Poorly-graded aggregate



Subgrade Pressure



Geotextile reinforcement ~ Lower subgrade pressure

Findings

- Sand filter berm (if implemented correctly) can provide a substantial reduction in turbidity > 70 % reduction in turbidity
- Geogrid reinforcement improved load distribution for well-graded rock
- Geogrid reinforcement improved rutting for well-graded rock
- Aggregate degraded in proportion to truck traffic.

Questions?

References

Leshchinsky, Ben, and Hoe Ling. "Effects of Geocell Confinement on Strength and Deformation Behavior of Gravel." *Journal of Geotechnical and Geoenvironmental Engineering* 139, no. 2 (2013): 340-352.

Miller, Rebecca H., and Arne E. Skaugset. "Influence of Log Truck Traffic and Road Hydrology on Sediment Yield in Western Oregon." Master's thesis, Oregon State University, 2014.

Toman, E. M., and A. E. Skaugset. "Reducing Sediment Production from Forest Roads During Wet-Weather Hauling." *Transportation Research Record: Journal of the Transportation Research Board*, 2011: 13-19.