Informational Bulletin

Real-time Dust Monitoring

2/2016

Center for Dirt and Gravel Road Studies

PROBLEM

The generation, transport, and fate of airborne particulates generated from unpaved road is an area of growing interest and concern across Pennsylvania and the US. The loss of road fines to dust can have negative impacts to road longevity, the surrounding environment, and human health. Within Pennsylvania there are over 20,000 miles of public unpaved roads and approximately 1/3 of the road miles fall within 150 feet of a stream. Due to the close proximity of unpaved roads to streams, there exists the potential for road dust to impact water quality.

DUST MONITORING SETUP

Dust production from unpaved roads is being measured using a vehicle-mounted particulate monitoring system built and designed by the Center for Dirt and Gravel Road Studies (Center) with support from the DCNR Bureau of Forestry and the State Conservation Comission. The primary monitoring instruments consist of two TSI DustTrak 8530 aerosol monitors that measure particulate matter (Figure 1, Photos 1 & 2). One monitor is mounted on the front of the vehicle to capture ambient dust concentrations and the other is rear mounted to monitor the dust generated by the vehicle.

TSI – DustTrak 8530

- Real-time mass concentration readings
- Light scattering laser photometer
- Measures aerosol concentrations PM_1, $PM_{2.5}$, Respirable, PM_{10}
- Concentration range 0.001 to 400 mg/m^3
- Logging interval 1 to 60 seconds

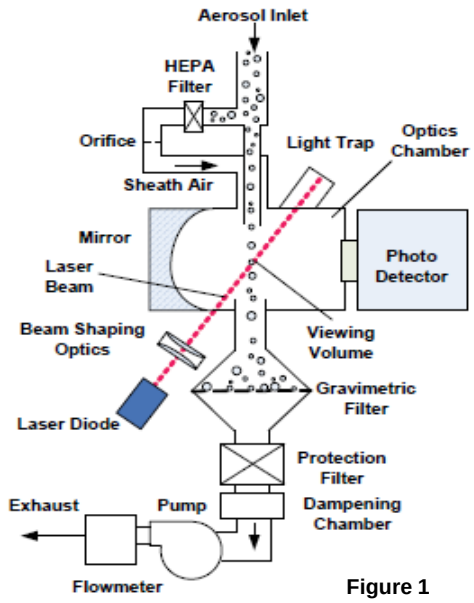


Figure 1

USES

Comparing Road Surfaces: The primary use of the monitoring vehicle is to quantify relative dust production from different aggregate wearing courses.

Testing DSA: Test the relative dust suppression effectiveness of various engineered road materials such as Driving Surface Aggregate (DSA) developed by the Penn State Center for Dirt and Gravel Road Studies.
http://www.dirtandgravel.psu.edu/general-resources/driving-surface-aggregate-dsa

Testing Dust Palliatives: Test the relative dust suppression effectiveness of various commonly used dust palliatives.

The publishers of this publication gratefully acknowledge the financial support of the PA Department of Conservation and Natural Resources Bureau of Forestry and the PA State Conservation Commission. For additional information contact: Eric Chase at the Center for Dirt & Gravel Roads Studies, Penn State University, 201 Transportation Research Building, University Park, PA 16802 (Phone: (814) 865-3967, Email: ehc111@psu.edu).

pennsylvania DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES

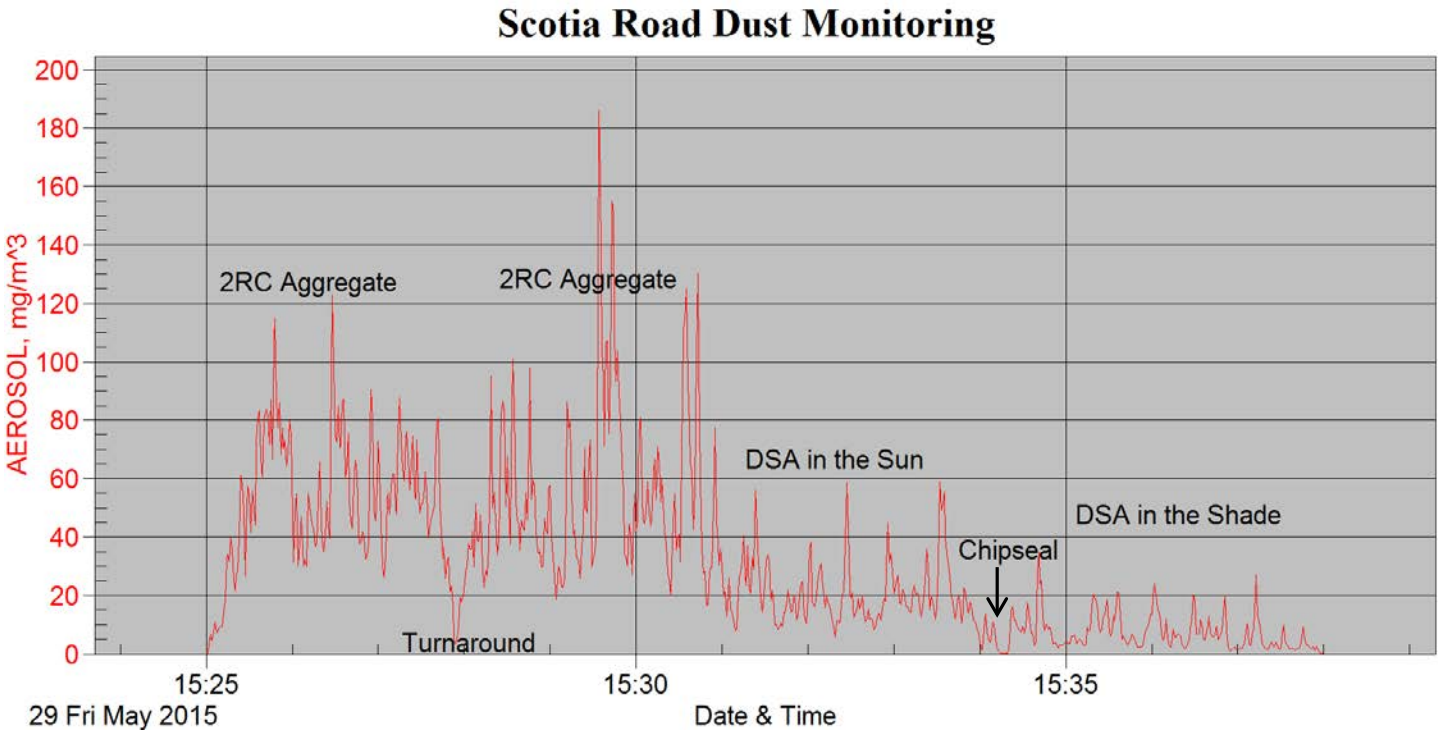
Center for Dirt and Gravel Road Studies

INITITAL DUST MONITORING RESULTS

In May of 2015 the Center began testing the vehicle-mounted dust monitoring system. Initial testing was conducted on Scotia Road in State Game Lands 176 comparing a 3 year old placement of the Center's DSA to a more commonly used road surface aggregate mix (2RC) that typically contains clay and silt fines. Monitoring started on a 2 mile long 2RC loop with a halfway turnaround. After completion of the loop the vehicle was driven immediately onto a 3 mile stretch of DSA surfaced road with both open and shaded sections. The results showed that the DSA section in the sun produced 2/3 less dust than the comparable 2RC road in the sun. The DSA section shaded by the tree canopy produced less than 1/7 of the dust as the 2RC section of road and approximately ½ the dust of the DSA in the sun. All testing has been completed at a constant speed of 25 mph.

Mean dust production by wearing course

2RC in the sun – 53.3 mg/m^3
DSA in the sun – 17.5 mg/m^3
DSA in the shade – 7.0 mg/m^3



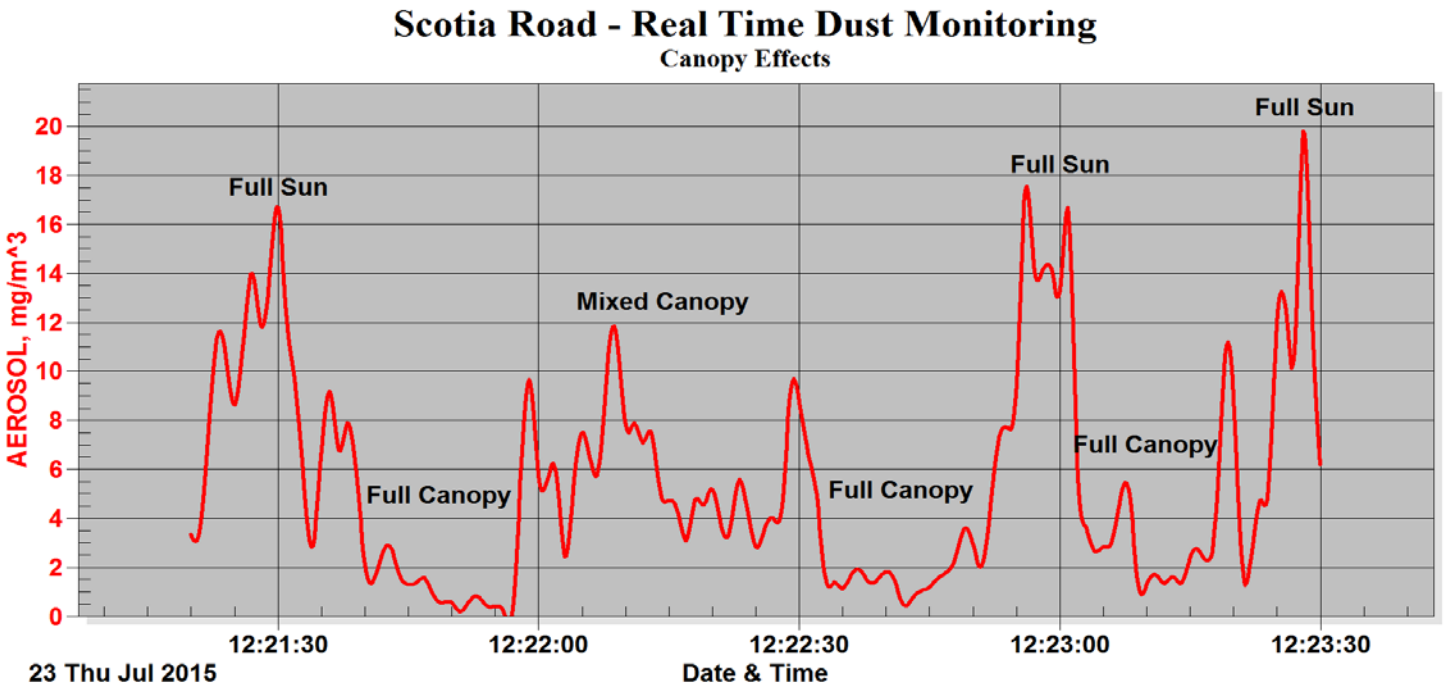
Additional testing was conducted throughout the summer in Rothrock State Forest and similar results were obtained when comparing DSA to 2A, another commonly used road surface aggregate mix. Using Laural Run Road for testing, dust production from the 2A section of road was compared to a 2012 and a 2015 DSA placement. Monitoring started on the 2012 DSA placement which consisted of material sourced from Naginey quarry. The monitoring immediately continued onto a 2015 DSA placement sourced from Oak Hall Quarry and then on to the 2A section of the road. Similar canopy cover conditions were noted for all three sections monitored. The results showed that the 2012 DSA section produced approximately 50% less dust than the 2A section and the 2015 DSA placement produced less than 25% of the dust of the 2A section. Additional dust monitoring will continue in summer 2016.

Laural Run Road Rothrock State Forest 9/2/2015
all values in mg/m^3

	Run #1	Run #2
DSA - 2012 Naginey quarry	17.9	27.8
DSA - 2015 Oak Hall quarry	6.2	12.5
2A	53.8	54.7

INFLUENCE OF CANOPY ON DUST GENERATION

As noted in the monitoring results from May, there was a strong effect of canopy cover on dust generation. To explore this effect further, testing was repeated in State Game Land 176 in July of 2015. During this test relative canopy cover was noted for a test section of DSA. Monitoring was kept to a short stretch of road in order to accurately verify which canopy conditions were present. As shown in the graph below, dust production was clearly correlated with canopy cover. The variables driving this correlation will be explored further in summer 2016.



Dust generated by a triaxle dump truck on Laural Run. Note the denser dust cloud generated in the canopy opening in the distance.

UPCOMING WORK

The Center will use its mobile aerosol sampling technology to continue to monitor relative dust loads from unpaved roads on Bureau of Forestry lands and other DSA, 2A and 2RC roads. In addition, the Center will begin studying the effects of canopy cover on dust production in order to support management objectives such as canopy connectivity. Using the data collected through these studies, the Center ultimately plans to create a spatially explicit predictive model to assist road managers in selecting best management practices to reduce road dust and protect water quality.