Research Summary

Center for Dirt and Gravel Road Studies

Sediment Production from Shallow Oil & Gas Access Roads in the Allegheny National Forest

3/2012

Research Overview:

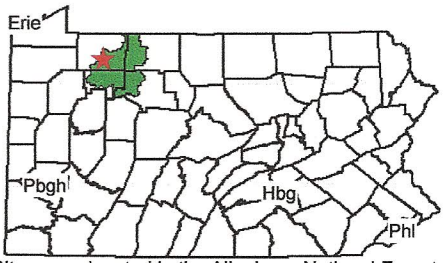
This project quantified sediment production from 14 sections of road used by the shallow oil and gas industry within the Allegheny National Forest. In addition to these 14 "existing condition" road tests, four of the sites then had a new surface applied, after which testing was repeated. The purpose of this research was to quantify and compare sediment production rates from existing roadways, and to determine any change in sediment runoff after placement of new aggregate surfaces on the road.

This document is a summary only, full report is available at "www.dirtandgravelroads.org" under "research."

funding: U.S. Department of Energy, National Energy Technology Laboratory; and U.S. Department of Agriculture, Northern Research Station

Study Details:

Shallow oil and gas development has been occurring in the Allegheny National Forest (ANF) for most of the last century. As of 2010, there were an estimated total of 9,800 wells throughout the ANF. Many wells are still in production today and are serviced by a network of over 3,000 miles of roadway (1,300 ANF and 1,700 oil/gas). New wells are still being drilled and current estimates are that this network of roads will be expanded to over 3,550 miles by 2020. Erosion and sedimentation from this extensive and increasing network of roads has become a growing environmental concern.



Sites were located in the Allegheny National Forest just southwest of Warren, PA

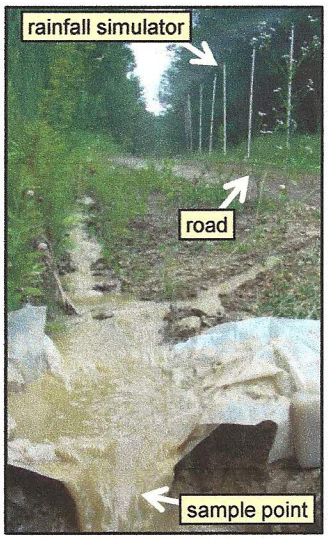
Phase I: 14 sections of roadway were chosen for testing in cooperation with personnel from the Allegheny National Forest (ANF). The road sections were chosen to cover a wide variety of traffic levels, slopes, and widths typical of the road network. Testing was completed on these 14 existing road segments in 2010. The purpose of this testing was to determine sediment productions for these roads and attempt to identify site characteristics affecting sediment production.

Phase II: Four of the 14 road sections above had new aggregate placed on them in early 2011. These four sites were tested again in late 2011 in order to determine any differences in sediment production compared to the 2010 tests. Two of the sites were covered with "pit-run" material. **Pit-run** is a locally excavated material of varying quality that is available at a relatively low cost. Two of the sites were covered with "Driving Surface Aggregate (DSA)." **DSA** is a PENNDOT aggregate specification designed to achieve maximum density for use as an unbound wearing course for unpaved roads.

Rainfall Simulator:

A rainfall simulator, or "Rainmaker," was used in this study in order to create a controlled and repeatable rain event. This makes it possible to compare sediment production between sites, or to compare sediment production "before" and "after" practices are implemented on a section of road. The Rainmaker, developed by the Center for Dirt and Gravel Road Studies, creates a 0.6" rainfall event in 30 minutes over a 100' length of road (nearly equivalent to a 2-month return interval for a 30 minute storm for most of Pennsylvania).

The Rainmaker was used on each of the 100' long road test segments in this study. Each site test consisted of three 30-minute runs of the rainmaker, with 60 minutes of drying time and 20 light-duty vehicle passes between runs to simulate traffic stresses. Flow and sediment samples were taken at regular intervals to determine the total sediment loss for each section of road. The three runs were combined for each section of road to determine the average sediment loss for one 30 minute event. For various reasons, sediment productions from the Rainmaker can be considered conservative in comparison to equivalent natural storms.



Rainfall simulator running on site C in the Allegheny National Forest.

The publishers of this publication gratefully acknowledge the financial support of the US Department of Energy and the US Forest Service. For additional information, contact: Center for Dirt & Gravel Roads Studies, Penn State University, 215 Transportation Research Building, University Park, PA 16802 (Toll-Free Phone: 1-866-668-6683, Fax: 814-863-6787, Email: dirtandgravel@psu.edu). Additional copies available on our website at: www.dirtandgravelroads.org

Center for Dirt and Gravel Road Studies

3/2012 Newsletter Insert – page 2/2

Results

Special Note: *This study provides a valuable look at sediment production from roads in the Allegheny National Forest. Great care should be taken, however, in expanding or extrapolating these results. The results outlined here only represent a "snapshot" of sediment production at a certain point in time on a small number of roads. In addition, site-specific conditions such as soils and hydrology mean that the "existing road" sediment production rates found here will not be consistent with other locations.*

Part I: Sediment Production from Existing Roads

Sediment production was measured on 14 existing oil and gas access roads in the Allegheny National Forest. The table to the right highlights the important site characteristics and sediment production rates of all 14 sites in order of increasing average sediment production.

The average sediment production from the 1,400 feet of road tested in this study was 25 pounds for a single 30 minute rain event of 0.6". **This equates to 1,300 pounds of sediment production per mile of roadway for a single equivalent rain event.**

Site ID	Slope %	Road width (ft)	rd + berm width (ft)	Strength (CBR)	traffic level	Lbs Sediment per 30 min. event Run 1	Run 2	Run 3	Avg	Site ID
A*	14.7	na	13	31	v. low	1.0	2.1	6.4	3.2	A*
T	3.3	12	16	141	high	7.1	7	8	7.4	T
S	7.6	11	11	91	med	4.2	10.1	9.4	7.9	S
R	9	11.5	11.5	99	med	9.3	9.8	14.3	11.1	R
K	4.4	12	13	67	med	7.9	15.4	14.9	12.7	K
G	16.2	12.5	12.5	126	high	15.1	14.0	10.0	13.0	G
I	20.5	13	17	81	low	14.0	16.5	13.7	14.7	I
C	7.2	10	14	na	low	11.9	14.6	18.0	14.9	C
L	13.8	12	15	71	low	12.0	35.7	37.5	28.4	L
N	5.6	13	15	103	high	14.3	40.5	34.4	29.7	N
E	9.2	13	13	65	low	7.8	36.9	62.8	35.9	E
F	13.3	15	15	76	high	47.1	42.2	38.8	42.7	F
M	19.2	10	15	133	low	23.6	50.5	55.2**	43.1	M
B	12.7	11	16	na	med	31.7	67.0	81.7	60.1	B
					Avg	15.8	27.7	28.6	24.7	pounds
					Avg	836	1,463	1,511	1,306	lbs/mile

* Site A on grass road: not used in averages.
* Site M, run 3 extrapolated

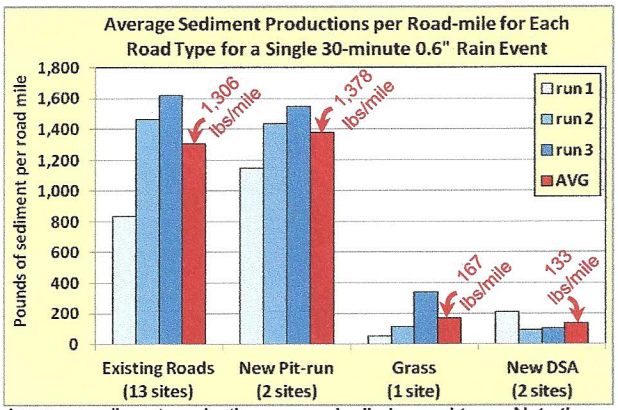
Run 1	Run 2	Run 3	Average
Lbs Sediment per 30 min. event			

Data Trends and Observations:

- Site A, partially covered by grass, had least amount of sediment production.
- A significant "first flush" effect was seen on all sites where most of the sediment left during the first 5-10 minutes of runoff.
- Without traffic stress (run 1), the best indicators of sediment production from the roads tested were road slope combined with road width, although the correlation was not as strong as expected. After traffic stresses (runs 2&3), the amount sediment increases becomes more dependent on road strength as measured by the California Bearing Ratio (CBR).

Part 2: Sediment Production After Use of New Aggregate

Four of the sites detailed above had a new aggregate surface placed on them in 2011 (sites B & F with "pit-run aggregate," and sites G & C with Driving "Surface Aggregate"). The newly placed pit-run material reduced sediment production by 39% and 64% (note that these two sites happened to have a higher "before" sediment production). The newly placed Driving Surface Aggregate material showed sediment reductions of 67% and 95%. **A direct comparison shows that the two pit-run sites produced 10 times the amount of sediment of the two DSA sites (average 26.1 lbs and 2.5 lbs respectively).** The sediment reductions found here from DSA placement were comparable to previous studies conducted by the Center. Previous research conducted in 2007 showed sediment reductions from DSA placement of 75% after one month and 90%+ after one year compared to existing roads in a similar study. DSA was also unaffected by traffic stress, as illustrated in the graph below (sediment decreases from run 1 to run 3 for DSA, increases for all other sites).



Average sediment production per road-mile by road type. Note the number of test sites available for use in averages varies from 1 to 13.

The runoff collection point from site "C" is show here for both the "existing" road in 2010, and after DSA placement in 2011 showing a 95% sediment reduction.

This is a summary only, full report available at www.dirtandgravelroads.org under "research."