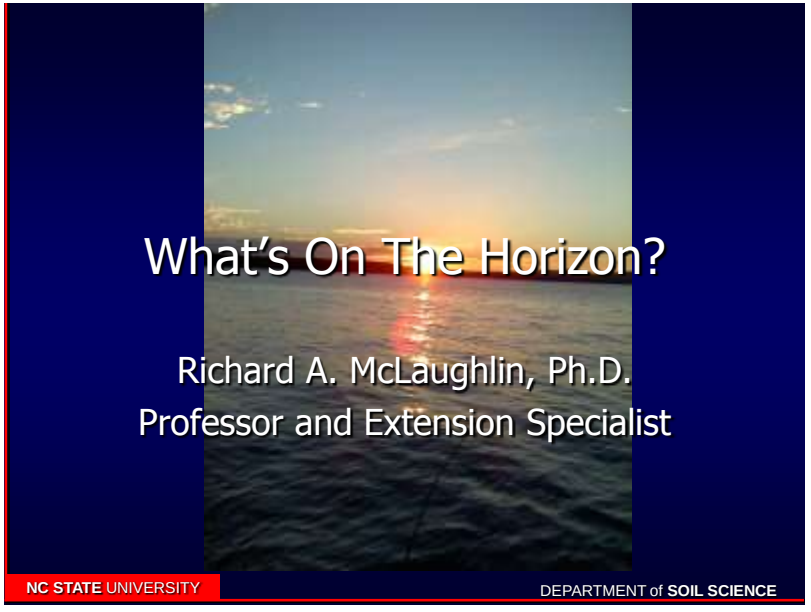
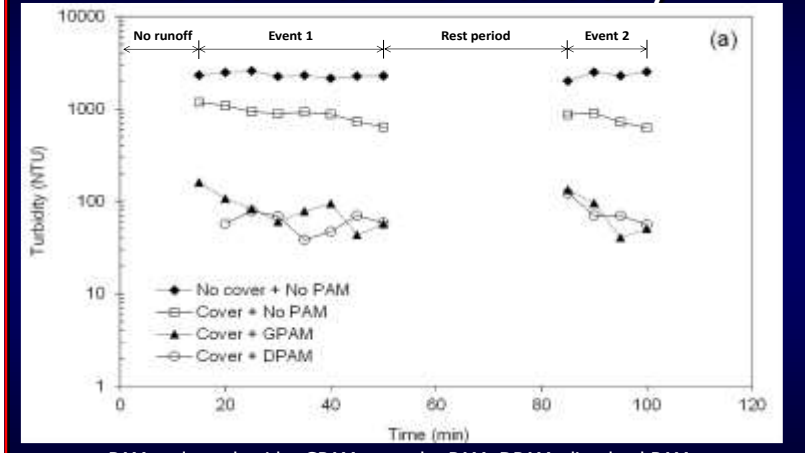

What's On The Horizon?
Richard A. McLaughlin, Ph.D.
Professor and Extension Specialist
NC STATE UNIVERSITY
DEPARTMENT of SOIL SCIENCE

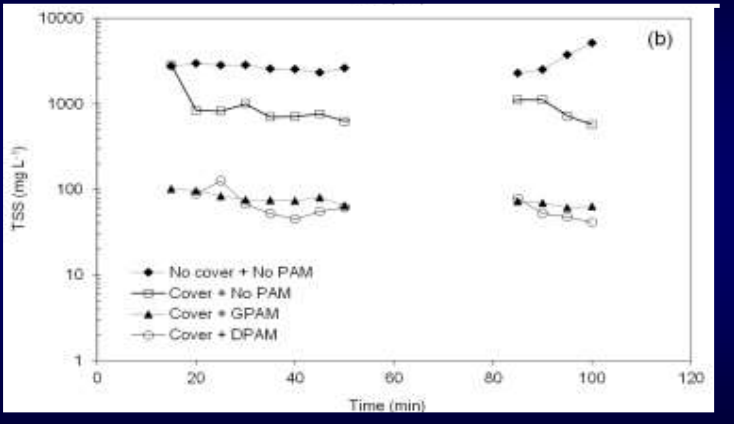

Excelsior Blanket Plus
Granular vs. Dissolved PAM
NC STATE UNIVERSITY
DEPARTMENT of SOIL SCIENCE

Runoff Results: Turbidity



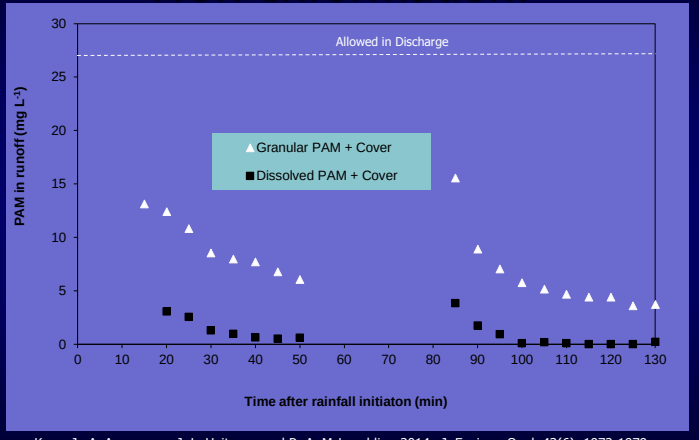
PAM: polyacrylamide; GPAM: granular PAM; DPAM: dissolved PAM

Runoff Results: Solids (TSS)



PAM: polyacrylamide; GPAM: granular PAM; DPAM: dissolved PAM

PAM Concentration in Runoff New Information!



Kang, J., A. Amoozegar, J. L. Heitman, and R. A. McLaughlin. 2014. J. Environ. Qual. 43(6): 1972-1979 doi:10.2134/jeq2014.01.0022.

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Structure Effects

(blanket removed)

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Erosion Conclusions

- Adding PAM to the blanket substantially reduced erosion and turbidity
- Both granular and dissolved PAM worked well, with some advantage to the dissolved
- Less PAM is lost in runoff when it is applied dissolved
- PAM in runoff remains well below aquatic toxicity levels, even in first flush

Weather Factors in Grass Establishment

- Average rainfall per day
- Max intensity 1st event (negative)
- Amount of 1st event (negative)
- Max intensity of 2nd event (negative)
- Time between seeding and rain (negative)

Babcock and McLaughlin, 2011. J. Soil Water Cons. 66*(2)*:132-141.
Babcock and McLaughlin. 2013. J. Soil Water Cons. 68(3):221-227

Might be worth watering during dry spells…

Careful About Plastic Netting!

Soil Compaction: Poor vegetation establishment, high runoff rate




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Tillage for Infiltration

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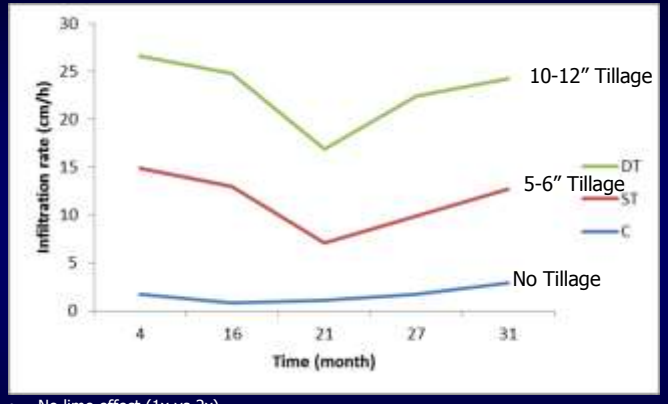
Piedmont #1 Infiltration Rate Over Time



- No lime effect (1x vs 2x)
- No mower traffic effect except at one location.
- Compost had no effect but appeared to improve resistance to re-compaction from mower.

What About Drones?

Current Study at Auburn

Courtesy Mike Perez
PhD Candidate
Department of Civil Engineering

DJI PHANTOM 2 VISION

- UAV Quadcopter
  - 13.8 in. length / 2.6 lb. weight
  - 25 min. / 984 ft. flight range
  - 34 mph max. flight speed
- Sensor
  - 14 MP photographs / 1080/30P video
  - 0-60 deg. gimbal tilt
- Operation
  - First person real-time view
  - GPS flight control enabled
  - Autonomous flight plan application

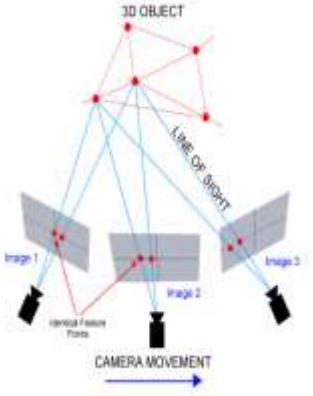
US HWY 27 / SR1 WIDENING RANDOLPH COUNTY, GA

US HWY 27 / SR1 WIDENING RANDOLPH COUNTY, GA

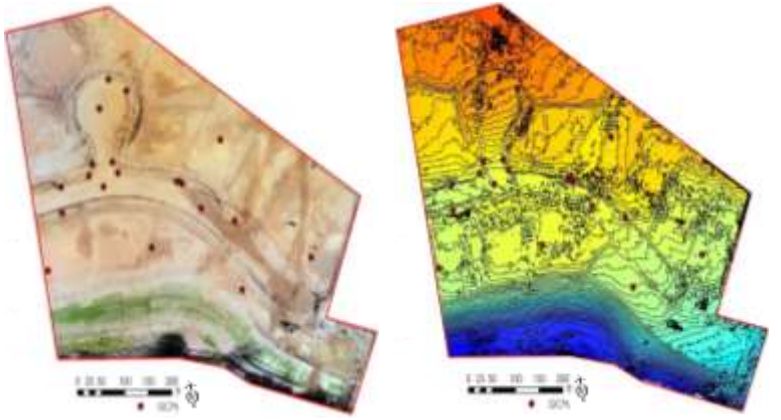
CORRECTIVE ACTION (5/1/14)

PHOTOGRAMMETRY

- Obtaining reliable measurements from overlapping photographs
- Scaled three-dimensional reconstruction through triangulation
- Common applications
  - Large-scale topographic surveys, land-use maps, forestry covers
- Image resolution
  - Airplane / satellite: 7.9 to 19.7 in./pixel
  - Low altitude UAV: 0.40 in./pixel



PHOTOGRAMMETRIC DEM GENERATION



VOLUME ESTIMATION

STOCKPILES

- Haul & transport estimation
- Efficient material storage / handling

SEDIMENT BASINS

- Available storage volume
- Identification of dredging / maintenance needs

Point Cloud of Basin

3.7 million points from 30 images

CONSTRUCTION DOCUMENTATION

- Construction industry is burdened with legal disputes
- Assessment of pre-development conditions
  - Identification of natural resources
- Project progression
  - Evaluation of progress
  - Contractor claims / disputes
- Material management
  - Pavement sub-base thickness
  - Stock-pile volumes
- Project communication
  - Public meetings
  - Design engineers / contractors

Alabama DOT Constructed Wetland

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INITIAL ROADWAY GRADING: MARCH 8, 2014

FOLLOWING HEAVY RAINFALL EVENTS: MARCH 30, 2014

ROADWAY BASE LAYER PLACEMENT: MAY 1, 2014

ROADWAY & VERTICAL CONSTRUCTION:
JUNE 30, 2014

UAVs are fun, but…

National - Federal Aviation Administration

- In 2012, Congress mandated the FAA to determine how to integrate UAS into commercial airspace by September 2015.
  - *Integration will be incremental*
    - proposed rule for small UAS (< 55lbs)
  - *Certificate of Authorization (COA)*
    - permits public agencies and organizations to operate a particular UA, for a particular purpose, in a particular area.
  - *Airworthiness Certificate*

The State of the State: North Carolina UAS Legislation

SECTION 7.16.(e) Until July 1, 2015, no State or local governmental entity or officer may procure or operate an unmanned aircraft system or disclose personal information about any person acquired through the operation of an unmanned aircraft system unless the State CIO approves an exception specifically granting disclosure, use, or purchase. Any exceptions to the prohibitions in this subsection shall be reported immediately to the Joint Legislative Oversight Committee on Information Technology and the Fiscal Research Division. The following definitions apply in this section:

(1) "Unmanned aircraft" means an aircraft that is operated without the possibility of human intervention from within or on the aircraft.

(2) "Unmanned aircraft system" means an unmanned aircraft and associated elements, including communication links and components that control the unmanned aircraft that are required for the pilot in command to operate safely and efficiently in the national airspace system.

SECTION 7.16.(f) If the State Chief Information Officer determines that there is a requirement for unmanned aircraft systems for use by State or local agencies, planning may begin for the possible development, implementation, and operation of an unmanned aircraft system program within the State of North Carolina. This planning effort shall be accomplished in coordination with the Chief Information Officer for the Department of Transportation and the DOT Aviation Division Director. If the State CIO decides to plan for an unmanned aircraft system program, a proposal for the implementation of the program shall be provided by March 1, 2014, to the Joint Legislative Oversight Committee on Information Technology, the Joint Transportation Legislative Oversight Committee, and the Fiscal Research Division. At a minimum, the proposal shall include the following:

(1) Governance structure to include the appropriate use at each level of government.

(2) Guidelines for program implementation to include limitations on unmanned aircraft system use.

(3) Potential participants.

(4) Costs associated with establishing a program.

(5) Potential sources of funding.

(6) Issues associated with establishing a program to include limitations on entities that may already have purchased unmanned aircraft systems.

(7) Recommendations for legislative proposals.

In Short…

1) No State or Local agency can procure or operate a UAS without approval from the CIO
2) CIO and NCDOT Aviation will collaborate to develop a plan for statewide integration

(funding, participants, data management, issues, governance of use)

North Carolina
NextGen Air Transportation (NGAT) Center

- Primary Responsibility: coordinate all Unmanned Aircraft Systems (UAS) activities in the state
  - Institute for Transportation Research and Education at North Carolina State University *(non-profit, university-research center)*
  - Chartered by NCDOT Aviation (2012-relaunch)
  - Provides structure, process, and coordination for all UAS activities in North Carolina
    - university research, public safety, emergency management, and product

The State of the State:
North Carolina UAS Governance Board

- Special 13 member Panel *(first in country)*
  - Regulate and Govern UAS in North Carolina
  - Create standards and policies for their use and operations
  - Approve or deny drone use requests (COA's)
  - Certification, registration, and licensing
- $1.6 million initial investment (2014-2015 fiscal year)
  - $215,000 executive director and data analysis
  - $130,000 for data storage and management
  - $435,000 a year to operate and maintain UAS
  - $850,000 in initial set-up costs

Small UAS Notice of Proposed Rulemaking (NPRM)

- Framework of regulations that would allow routine use of certain small unmanned aircraft systems (UAS) in today's aviation system.
  - Finalized by June 2016

Operational Limitations

Weight less than 55 lbs. (25 kg)
Visual line-of-sight (VLOS) only
Daylight-only operations
Maximum airspeed of 100 mph
Maximum altitude of 500 feet AGL
Operations in Class G airspace are allowed without ATC permission
May not operate over any persons not directly involved in the operation
Proposes a microUAS option

Aircraft Requirements

FAA airworthiness certification not required
Aircraft markings required

Small NPRM HIGHLIGHTS

Operator Certification

Operators would be required to pass an initial aeronautical knowledge test
Operators vetted by the Transportation Security Administration
Obtain an unmanned aircraft operator certificate with a smallUAS rating
Pass aeronautical knowledge test every 24 months
Be at least 17 years old.
Report an accident to the FAA within 10 days

The 333 Exemption

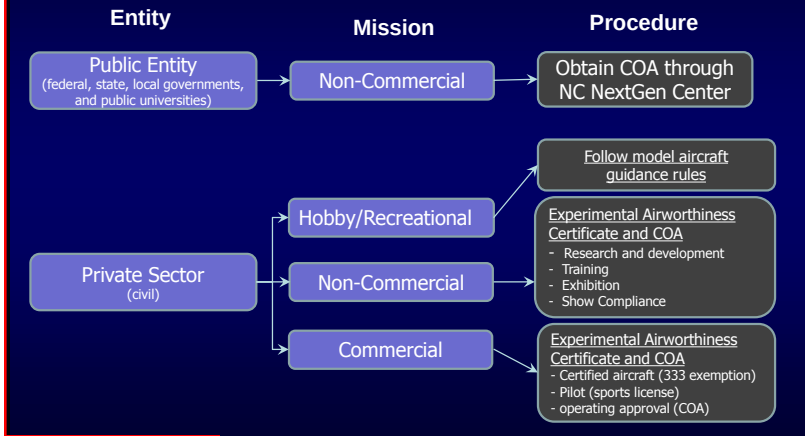
2420 Petitions Granted as of 11/25/2015

- By law, any aircraft operation in the national airspace requires
  - A certificated and registered aircraft
  - A licensed pilot *(sport pilots license or better)*
  - Operational approval *(COA)*
- Section 333 of the FAA Modernization and Reform Act of 2012 (FMRA)
  - determine whether an airworthiness certificate is required for a UAS to operate safely
  - case-by-case authorization for certain commercial operations before Small UAS Rule
  - provides operators a legal, competitive advantage in the UAS marketplace
- Certificate of Authorization (COA)
  - permits public agencies and organizations to operate a particular UA, for a particular purpose, in a particular area.

Recreational Use

- < 4.4 pounds
- Operations below 400 feet
- Line-of Sight
- during daylight conditions
- Inside uncontrolled airspace (Class G)
- > 5 miles from airport or aviation activities
- Away from gatherings – stadiums, concerts, etc.

So... You want to fly a UAV in NC



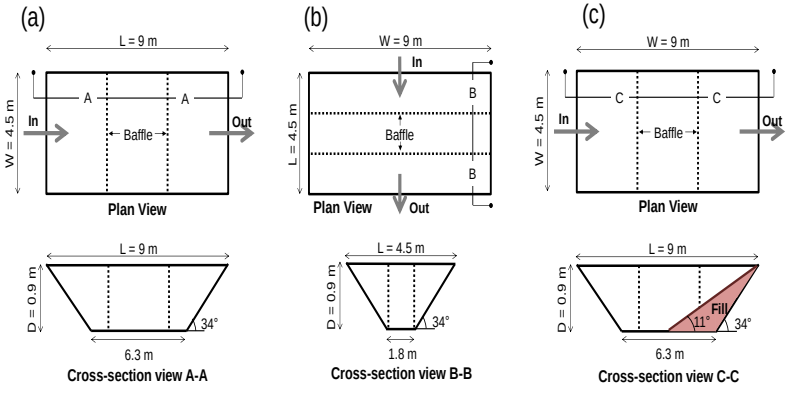
Spray-On Ditch Liner?

Next, Optimizing Basin

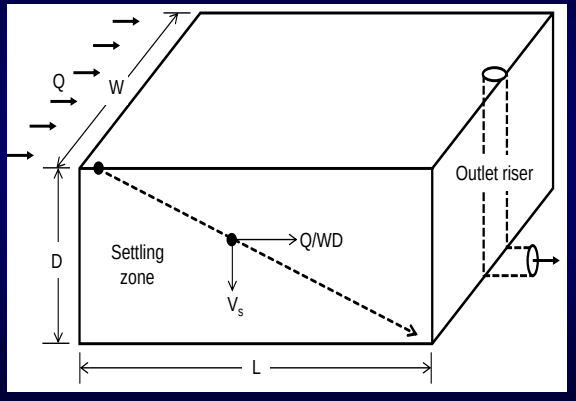
- Standard Basin: 2:1 length:width, sized to NC standards
  - 325 sq ft/1 cu ft sec; 1,800 cu ft/acre
- Standard + sloped outlet
- "Sideways" : 1:2 length:width
- All with porous baffles, surface outlet

Flow in a Porous Baffle

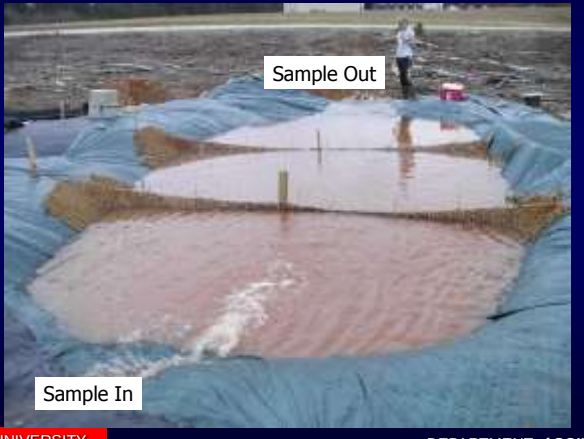
Basin Designs



Idealized Settling

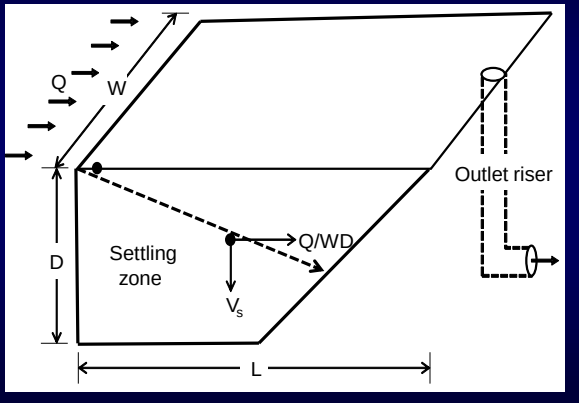


Normal 2:1 Basin



2:1 With "Ramp"

Settling With Ramp



"Sideways" 1:2 Basin

Basin Configuration Effects No Flocculation

		Turbidity (NTU)		TSS (mg L^{-1})	
PAM	Basin	Ditch exit	Basin exit	Ditch exit	Basin exit
None	Horizontal	268 ± 25 a	197 ± 27 a	995 ± 79 a	125 ± 3 b
None	Ramp	262 ± 24 a	162 ± 19 a	1,121 ± 122 a	195 ± 14 a
None	Standard	271 ± 21 a	234 ± 22 a	1,258 ± 107 a	239 ± 30 a

Basin Configuration Effects With Flocculation

		Turbidity (NTU)	
PAM	Basin	Ditch exit	Basin exit
None	Horizontal	268 ± 25 a	197 ± 27 a
None	Ramp	262 ± 24 a	162 ± 19 a
None	Standard	271 ± 21 a	234 ± 22 a
PAM	Horizontal	96 ± 20 b	30 ± 5 b
PAM	Ramp	98 ± 14 b	23 ± 4 b
PAM	Standard	78 ± 18 b	34 ± 5 b

Basin Size: Flocculation Effect

Based on Equation: Area = 1.2 Q/V, where Q = flow, V = settling velocity

Parameter	Unflocculated sediment	Flocculated sediment
Settling velocity (m s^{-1})	0.0017	0.004
Particle diameter (D_{56}, μm)[a]	46	74
Surface area requirement (m^2 per m^3 s^{-1})	700	300
Required basin surface area (m^2)	40	17

Kang, J., S. E. King, and R. A. McLaughlin. 2015. Journal of Environmental Management 166: 450-456. doi:10.1016/j.jenvman.2015.10.049.

Basin Design Conclusions

- For unflocculated sediment, the sideways basin configuration (w/ baffles & surface outlet) had a slight advantage.
- For flocculated sediment, configuration made no difference.
- To achieve high sediment retention, flocculated sediment requires much smaller basins. (how to guarantee it is flocculated?)

Upcoming Training Opps

- IECA Environmental Connection – San Antonio Feb. 13-19.
- Southeast Chapter IECA – EPA MS4 Conference, Nashville May 16-18
- All through 2016: www.soil.ncsu.edu (NCDOT certification, turbidity, general workshops)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