Evaluation of Erosion and Sediment Control Practices for Land Disturbance Activities Using RUSLE2

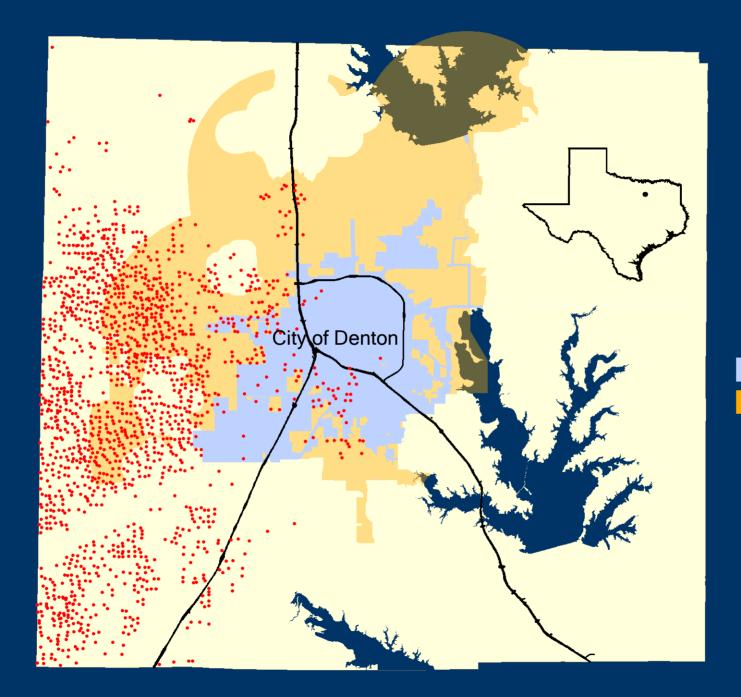
> David J. Wachal City of Denton Water Utilities Kenneth E. Banks City of Denton Division of Environmental Quality

Erosion from Land Disturbance

- Sediments are the single most widespread pollutant affecting the water quality in rivers and streams (USEPA, 2000)
- Physical, chemical, and biological damage from erosion and sedimentation in North America may exceed \$16 billion annually (Osterkamp et al., 1998)
- In developing urban areas, construction activities are responsible for 50 to 90% of sediment entering surface waters (Burton and Pitt, 2002; Canning, 1998)
- Sediment yields from construction activities range from a few tons to over 500 tons per acre per year (USEPA, 2002a)

Research Objective

- The objective of this research was to evaluate the relative effectiveness of BMP alternatives for natural gas well sites
 - Modeling approach using the Revised Universal Soil Loss Equation (RUSLE, Version 2)
 - Three slope profiles
 - Three soil erodibility factors
- Short-term goal understand how slope and soil might effect various BMP efficiencies
- Long-term goal use quantitative results to improve storm water component of existing ordinance



Study Area

Gas Well
City Limits
ETJ

Site Characteristics

- Construction activities from natural gas well sites disturb a substantial amount of the ground surface (2-5 acres)
- Completed sites may have moderate to steep cut and fill slopes that are unprotected from erosion
- Pad sites are semi-permeable
- Construction activities and field operations for oil and gas exploration and production are exempt from NPDES permitting

Site Grading

Bird's Eye View of Site Development

Drilling in Process

5 40 0 Th

Natural Gas Well Site

Methodology

- Average annual sediment yields were modeled using RUSLE2
- For each slope and soil combination sediment yields were modeled with and without BMPs
- BMP Efficiencies were calculated accordingly:

 $ER = (SY_{without BMP} - SY_{withBMP}) / SY_{without BMP}$

ER = (50 tons - 10 tons) / 50 tons = 80% efficiency

Modeled BMPs

- Seeding
- Mulching
- Erosion Blanket
- Silt Fence
- Filter Strip
- Sediment basin

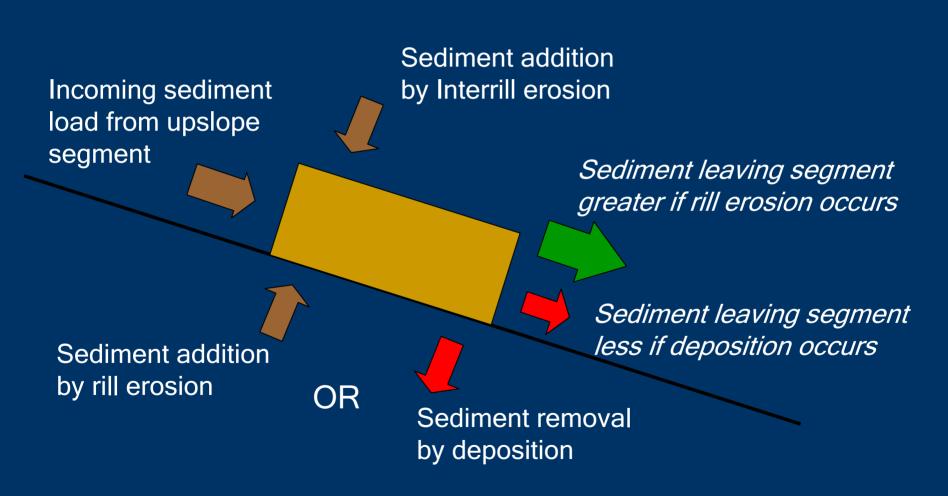
Erosion Control

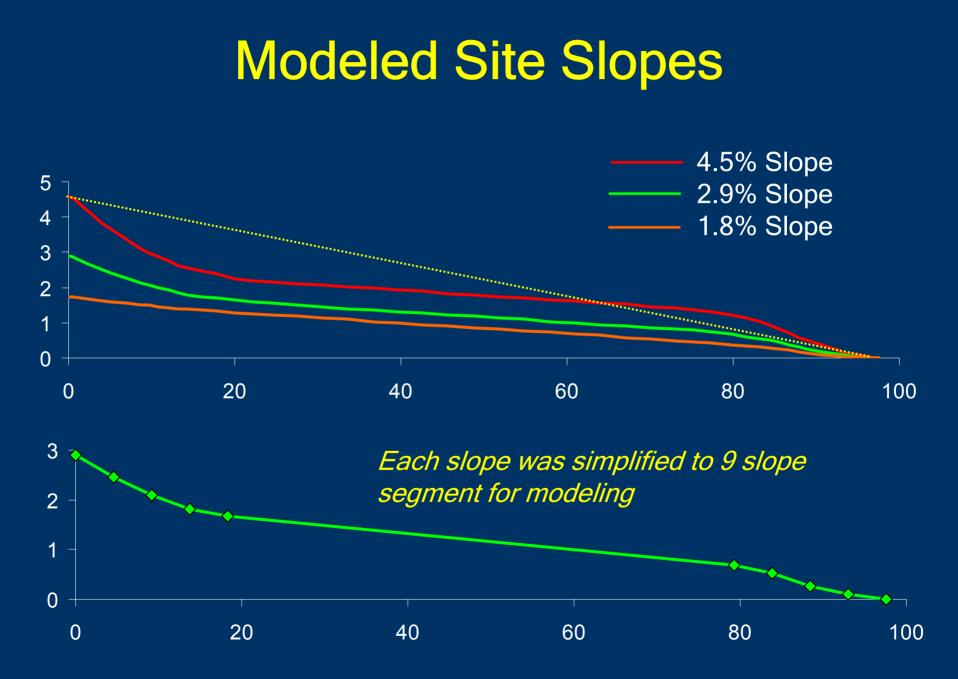
Sediment Control

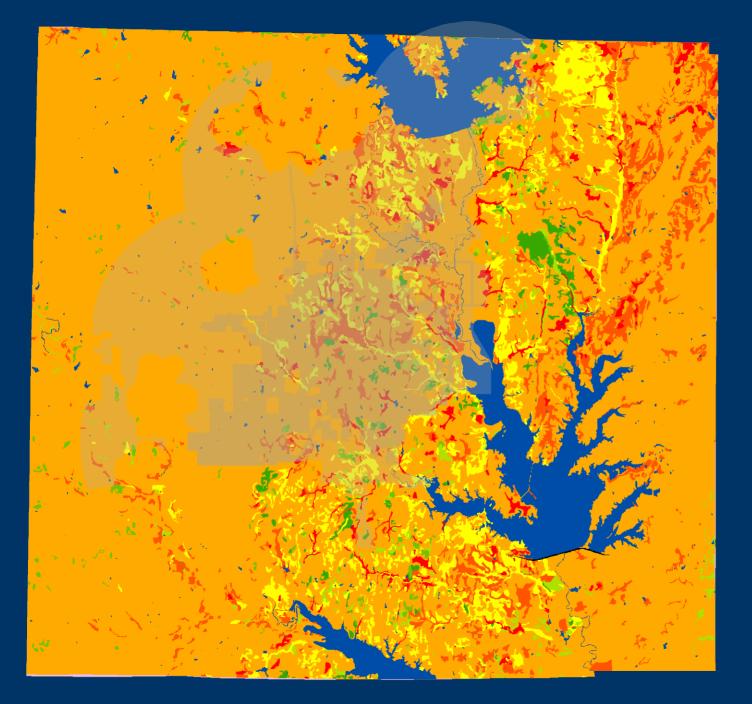
About the RUSLE2

- Public domain model developed and maintained by USDA - Agricultural Research Service - *Model Documentation (Foster, 2003)*
- Specifically designed as a conservation management tool for a variety of different land uses
- Intended to be used uncalibrated
- Estimates average annual sediment yields
- Easily customizable to specific site characteristics and geographical regions

How RUSLE2 Works







Area Soils

> NRCS Soils K-factor .17 .20 .24 .28 .28 .32 .32 .37 .43 .43 Dam Water

(NRCS, 2006)

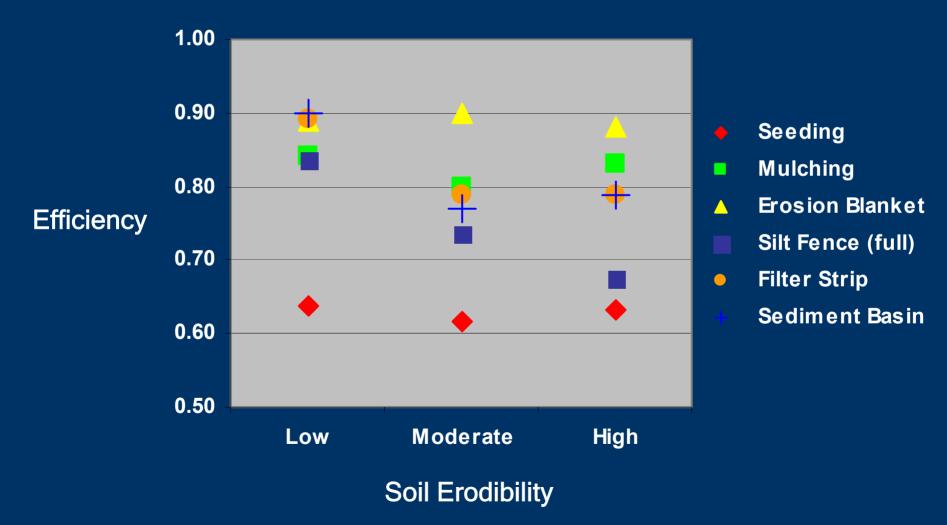
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Results

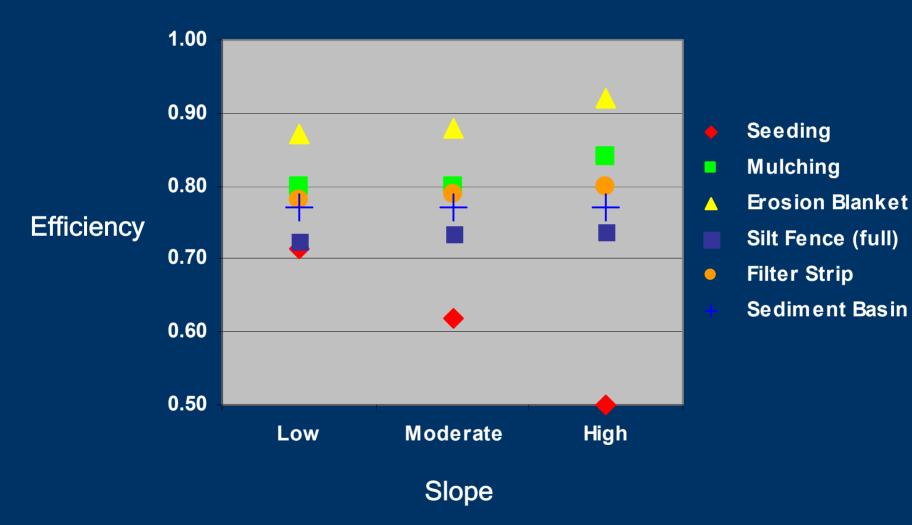
Sediment Yield without BMPs (tons/acre/yr)

| | K-factor | K-factor | K-factor | |
|---------------|---------------|----------------------|--------------------|--|
| | 0.17 | 0.32 | 0.43 | |
| | Sandy Loam | <i>Clay Loam</i> | Silty Clay Loam | |
| 1.8% slope | 5.4 | 8.7 | 13.0 | |
| 2.9% slope | 11.0 | 17.0 | 27.0 | |
| 4.5% slope | 25.0 | 38.0 | 60.0 | |

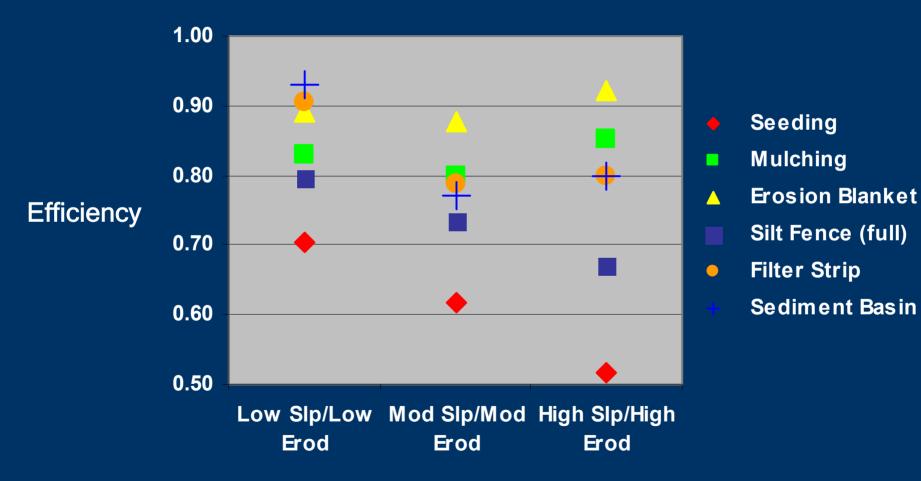
Results BMP Efficiencies for 2.9% Slope



Results BMP Efficiencies for 0.32 k-factor



Results BMP Efficiencies for Combined Factors



Conclusion

- Without BMPs, modeled sediment yields ranged from 5 to 60 tons per acre per year
- With BMPs, sediment yields were reduced by 50 to over 90 percent
- Soils and slope can both influence BMP efficiency
- Methodology can be used to assist in the selection of BMPs according to various site factors

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Thank you

David Wachal City of Denton david.wachal@cityofdenton.com (940) 349-7107