Caliche Soil Attributes Pertinent to On-Site Wastewater Treatment in Central Texas

Larry P. Wilding
Professor Emeritus, Texas A&M University
Wilding Professional Services, College Station, TX

TOWTRC March 4, 2008

Final Report

"Study of Hydrological Attributes and Treatment Capabilities of 'Caliche and Related Soils' Pertinent to On-Site Sewage Facilities"

Larry P. Wilding, Principle Investigator
(Grant Contract No. 582-3-55760)

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Project Tasks

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- Tasks (h)- Propose refinements in guidelines
- Proposed new activities

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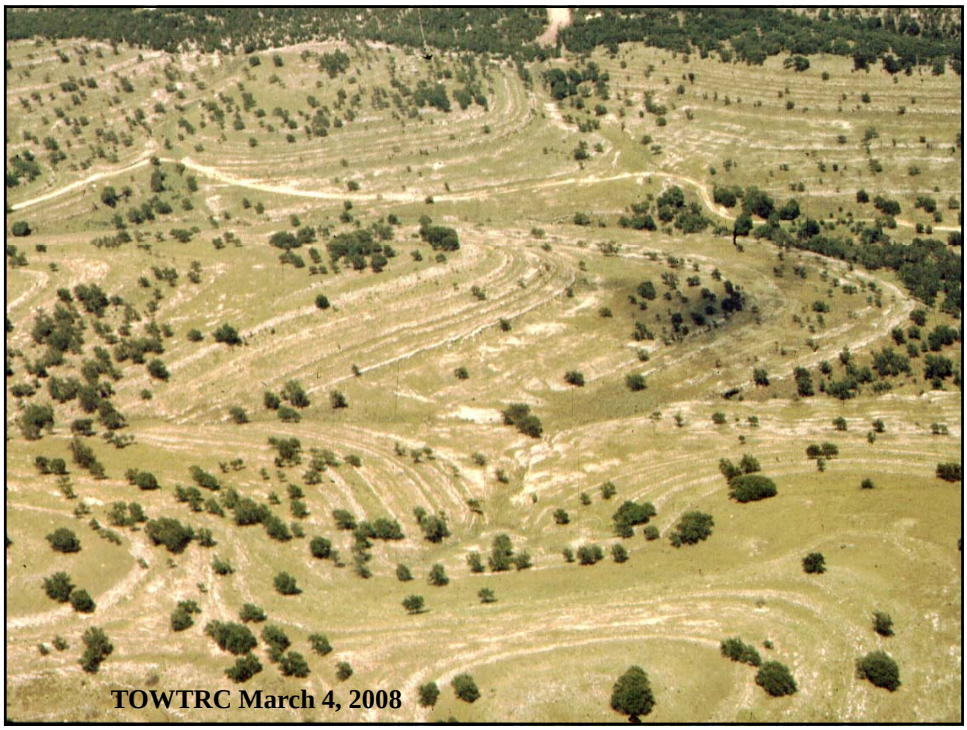
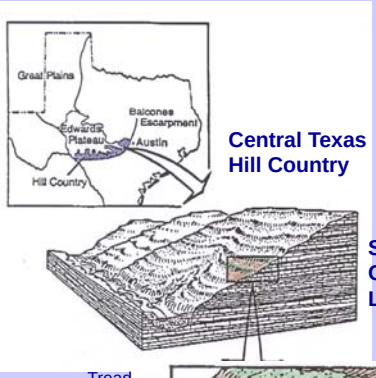


Central Texas Hill Country Microtopographical Elements [Modified from Woodruff (1992)]



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Backhoe Trenches Normal to Stepped Landform

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Wedge-shaped Soils in Stepped Landforms

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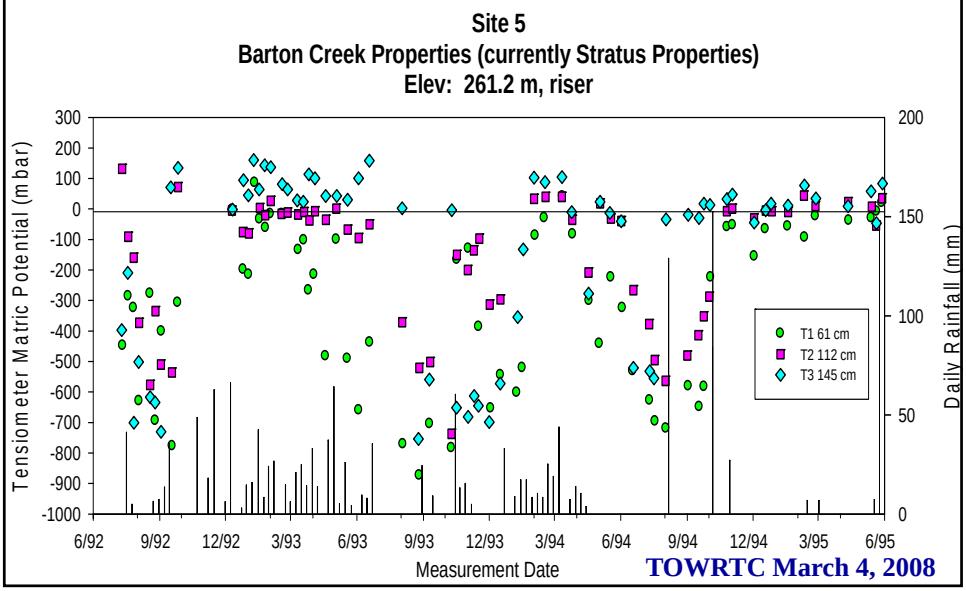
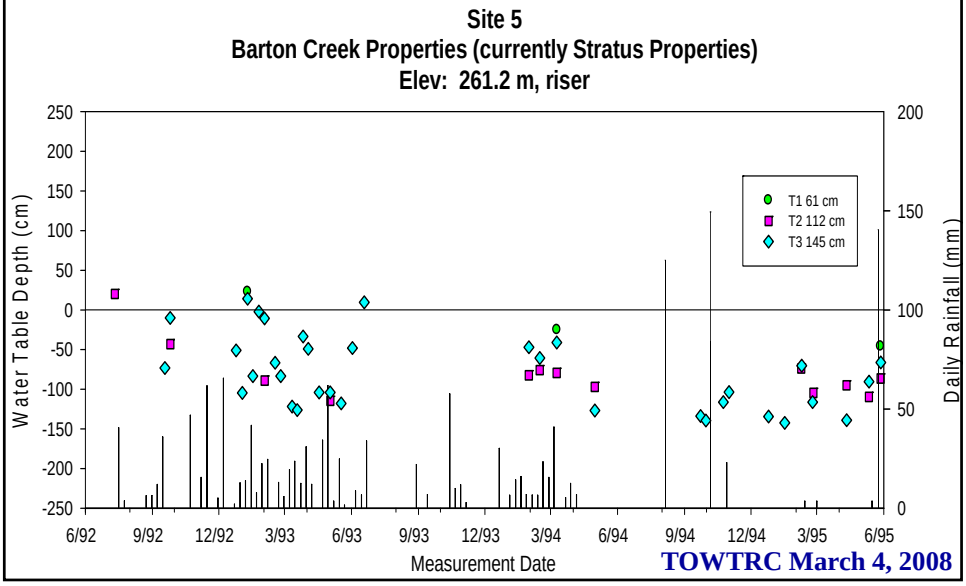
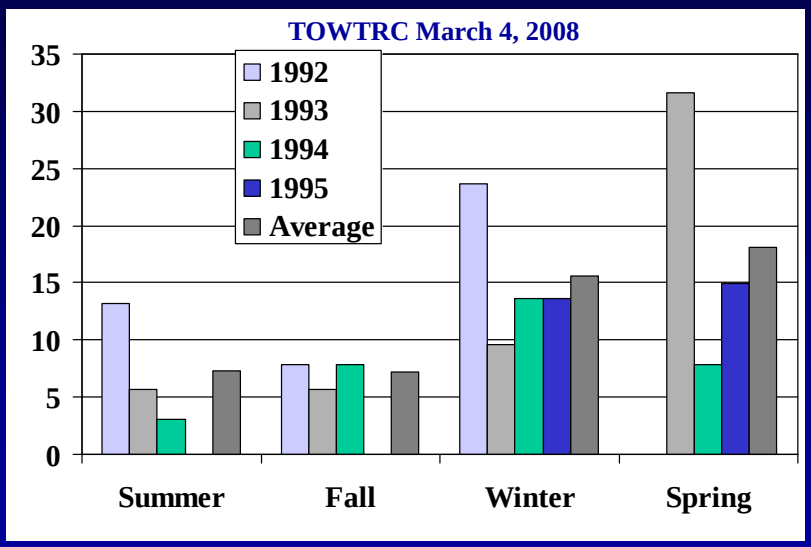
Tensiometer Time Series



Perched Water Tables



Percentage Seasonal Saturation



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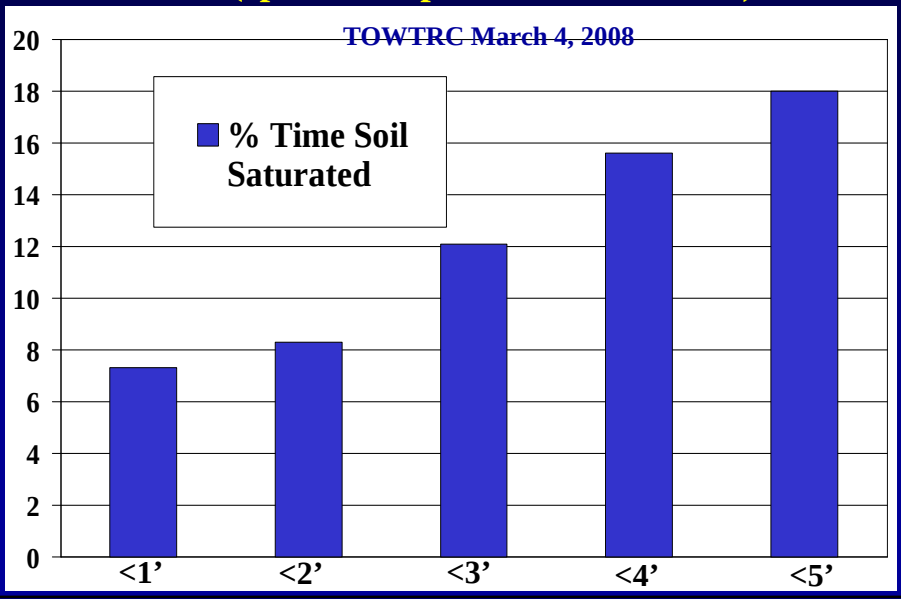
Percentage time soil saturated

(ephemeral perched watertables)



Summary of Hydrological Studies

- Seasonal perched water tables occur at variable depths in risers
- Little connectivity of perched water tables from riser to riser
- No systematic increase in soil wetness from upslope to downslope risers
- Rapid movement of infiltrating waters through macropores

Summary of Hydrological Studies (Cont.)

- Some watertables confined with weak artesian or hydrostatic head
- Perched water tables may pose constraints to conventional on-site wastewater treatment systems
- They promote reduction of effluent NO_3^-
- Risers would be ideally suited to spray and drip irrigation wastewater treatment

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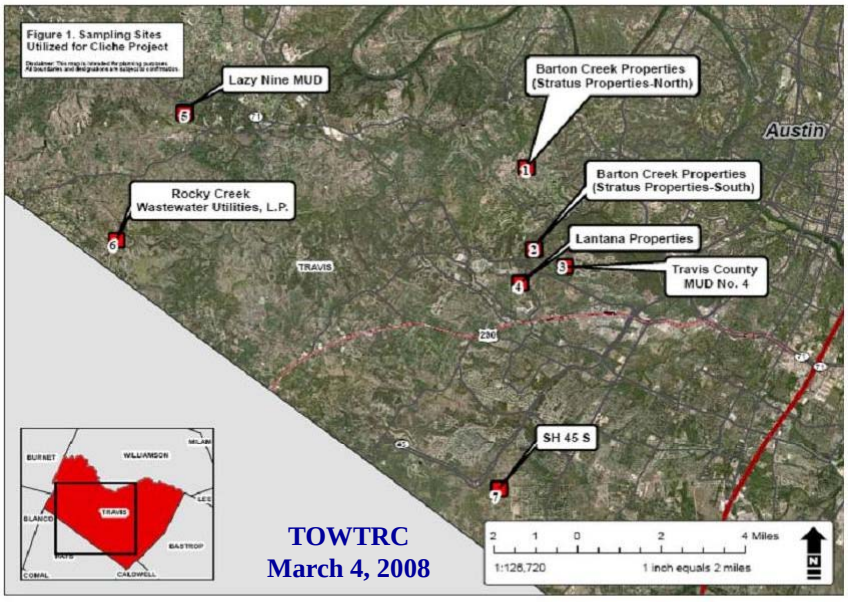

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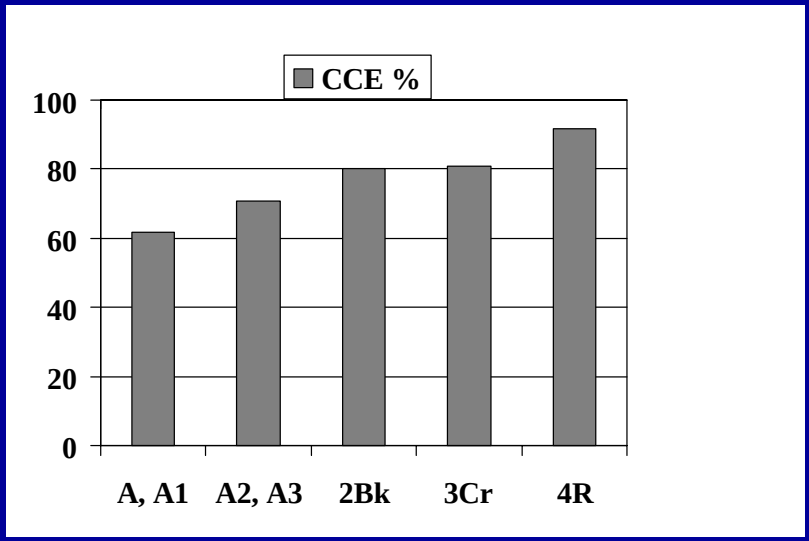
Calcium Carbonate Equivalent



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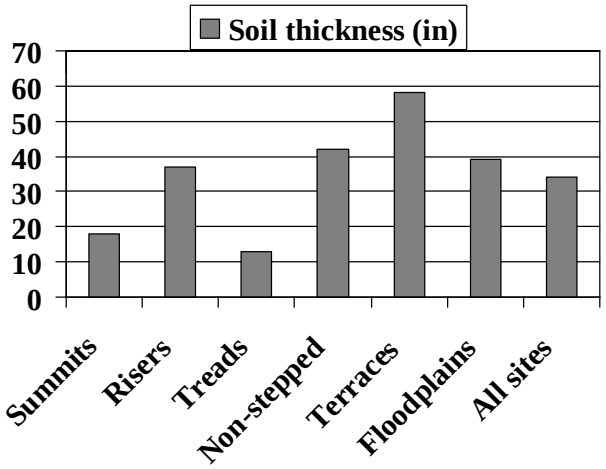
Soil Thickness



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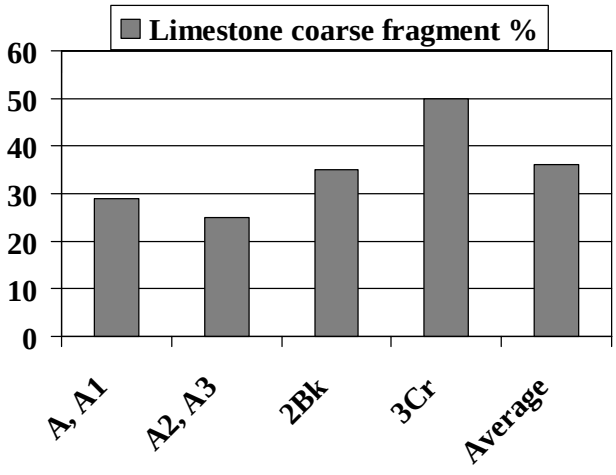
Limestone gravel content



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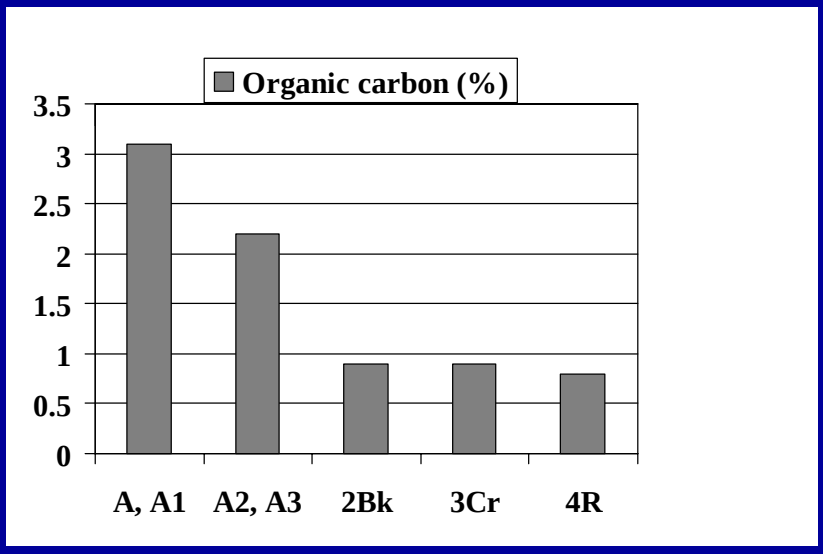
Organic carbon content



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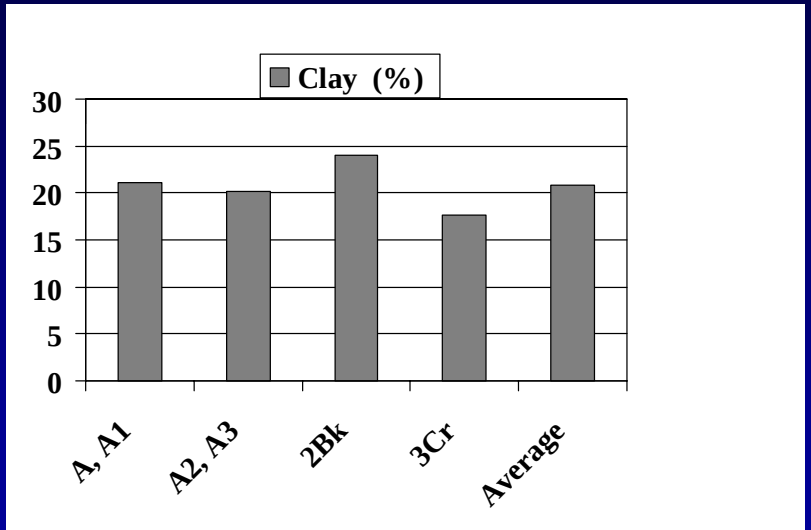
Clay percentage



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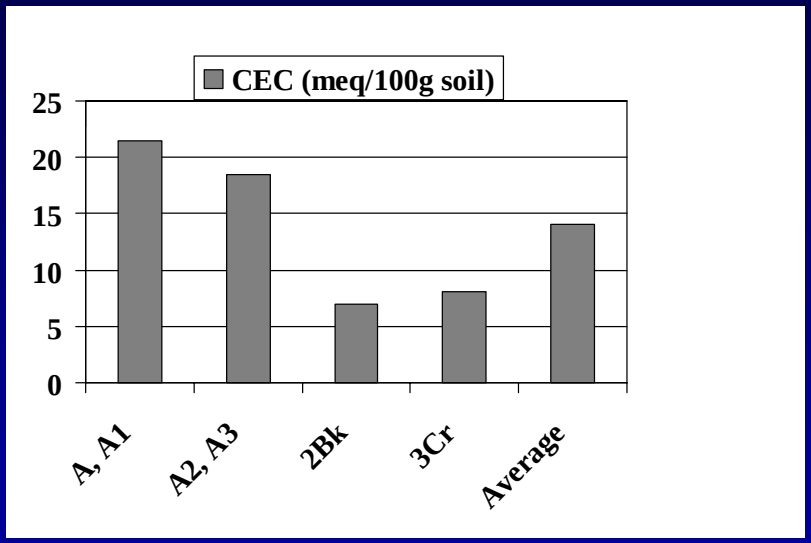
Cation Exchange Capacity



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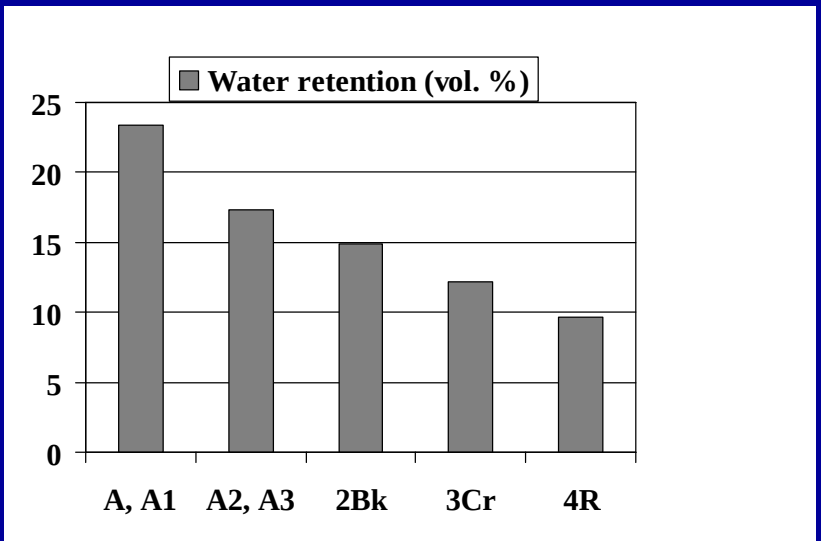
Water holding capacity



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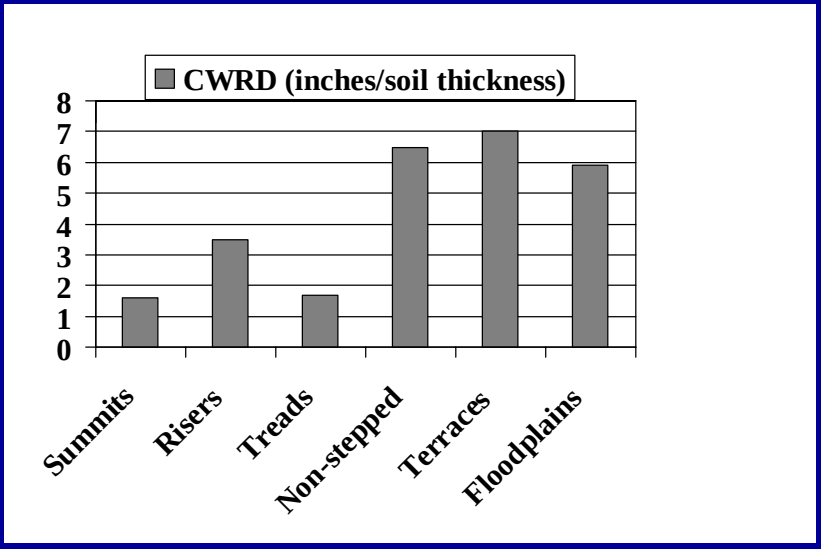
Plant available water content



TOWTRC September 13, 2007

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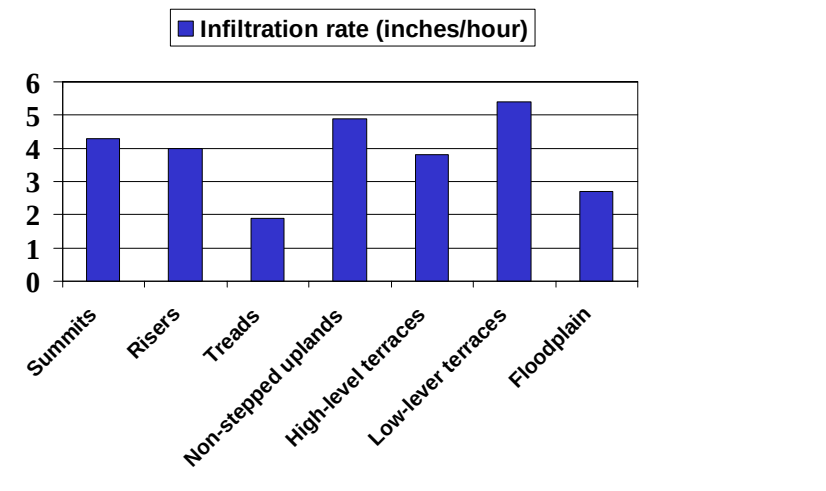
Terminal infiltration rates



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BBD Dye Tracer

(Speck Clayey Soil)

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Comparison of Dye Tracers on Brackett Soil (Site TX-2A)

BBD Dye

Br^- Dye

Comparison of dye tracers on riser soil of Brackett series mapping unit (Site TX-2A)

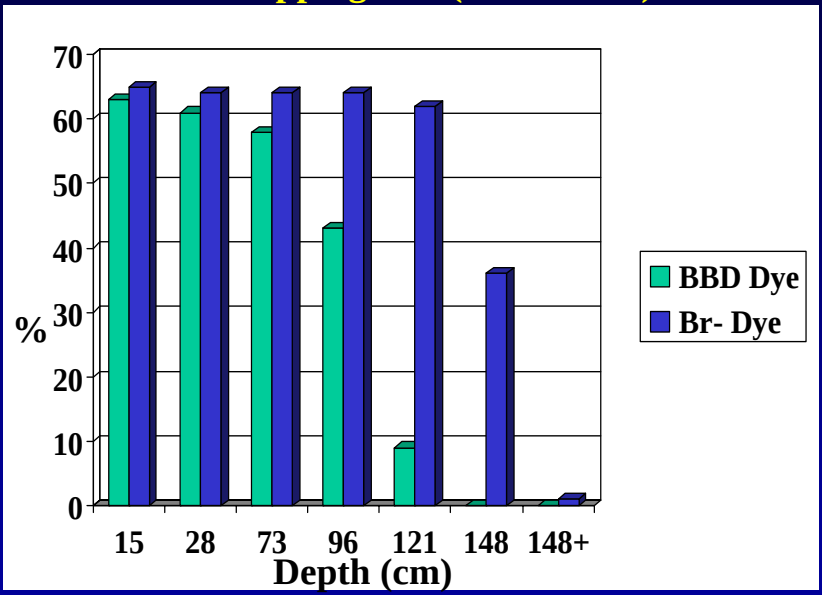

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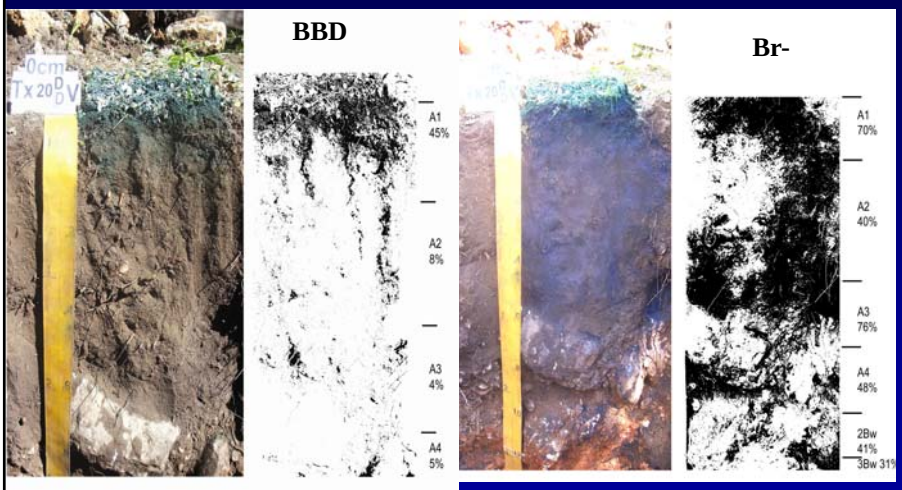
Figure G3. Comparison of BBD and Br- dyes at Site 20, Bear Creek Alluvium



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BBD Dye **Br^- Dye**

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Dye Methodology Results

- Significant differences between BBD and Br^-
- Tested clayey, loamy, and sandy soils
- BBD tracer indicated higher preferential flow
- Br^- tracer indicated all surface flow
- Br^- best to monitor water movement without chemical retardation
- Possible to use Br- in field with new visible chemical detection methods
- Both dyes can be imaged quantitatively

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Br^- Dye-Tracer

- Riser position
- Weakly weathered recessive ls beds
- Preferential flow pathways

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Riser showing "all surface" flow pattern. Many soft and hard gravels (see arrow) stained by Br^-

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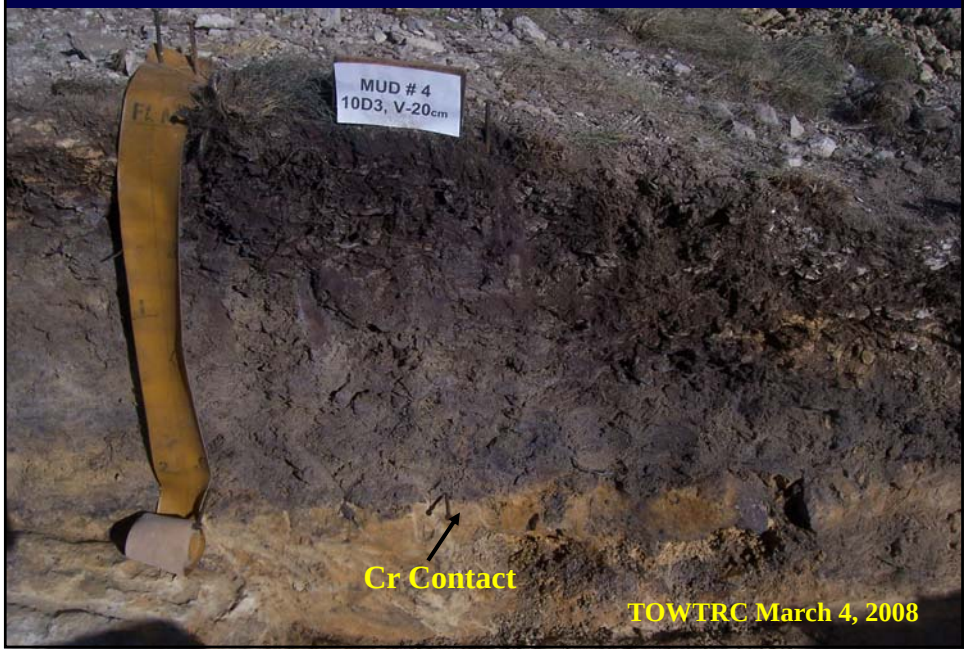
Br- Dye-Tracer Tread position Aquitard Cr interface



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Br^- dye tracer on tread.

- Dye did not penetrate into bedrock
- Most limestone gravels completely stained.

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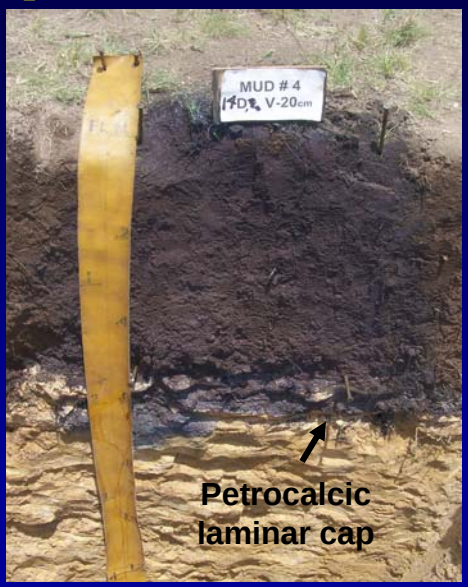
Restrictive petrocalcic horizons that limit dye penetration below laminar cap (arrow).



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Summary of Br^- Dye-Tracer Studies

- Preferential flow limited, hence most of soil volume participates in chemical interactions
- Lateral water movement extensive in risers
- Hard and soft limestone fragments absorb water & enhance water storage capacity of soils
- Lower Bk, Bkm, Cr, and R horizons are aquitards and pollutant buffers

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Revise Guidelines for Caliche Materials (D285:30-31)

- Develop separate caliche guidelines
- Add Certified or Professional Soil Scientists
- Use only backhoe exposures for caliche obs.
- Gravel contents of >30% not restrictive
- Class IV textures (>40% clay) not restrictive
- Soil surveys NOT for on-site information
- Risers are preferred sites for OSSF's
- Slopes up to 40% suitable for on-site treat.
- Strongly cemented caliche restrictive

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(5) Table V. Criteria for Standard Subsurface Absorption Systems.

FACTORS	SUITABLE (S)	UNSUITABLE (U)
Topography	Slopes 0-30%	Slopes greater than 30% Complex slopes.
Subsoil Texture	Soil Class Ib, II, or III soils along the sidewall and two feet below the bottom of the excavation	Soil Class Ia soils along the sidewall or within two feet below the bottom of the excavation (Except for lined ET) Soil Class IV along the sidewall or within two feet below the bottom of the excavation (Except for pumped effluent and ET)
Restrictive Horizon	No restrictive horizon intersects the sidewall or is within 24 inches below the bottom of the proposed excavation.	A restrictive horizon intersects the sidewall or is within 24 inches below the bottom of the proposed excavation. (Except as indicated in §285.33(b)(1)(A)(vi))
Gravel analysis	In Class II or III soils, only; Gravel portion less than 30% and gravel greater than 2.0 mm; or If greater than 30% gravel, 80% of the gravel portion must be less than 5.0 mm	All other Class II and III soils, which contain gravel in excess of what is described as suitable All other soils with greater than 30% gravel
Groundwater	No indication of seasonal groundwater anywhere within 24 inches of the bottom of the proposed excavation.	Indications of seasonal groundwater or drainage mottles anywhere within 24 inches of the bottom of the proposed excavation. (Except for lined ET)
Flood Hazard	No flooding potential.	Areas located in the floodplain and regulatory floodway unless system designed according to §285.31(c)(2) Depressional areas without adequate drainage
Other		Fill material.

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Tips for More Accurate Evaluations

- Identification of caliche materials
- Pit exposures essential for evaluations
- Identify degrees caliche cementation
- Evidence of perched watertables
- Root distribution patterns
- Don’t use amended fill over caliche

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Follow Up Activities

- Multidisciplinary committee should be developed to evaluate proposed revisions in guidelines for on-site suitability criteria
- Proposal should be solicited to offer on-site evaluators field and office training workshops to identify caliche and appropriate suitability criteria.

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Acknowledgements

- Contractual support through TOWTRC grant
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- Consultancies from several MUD and Stratus Properties, Austin, TX