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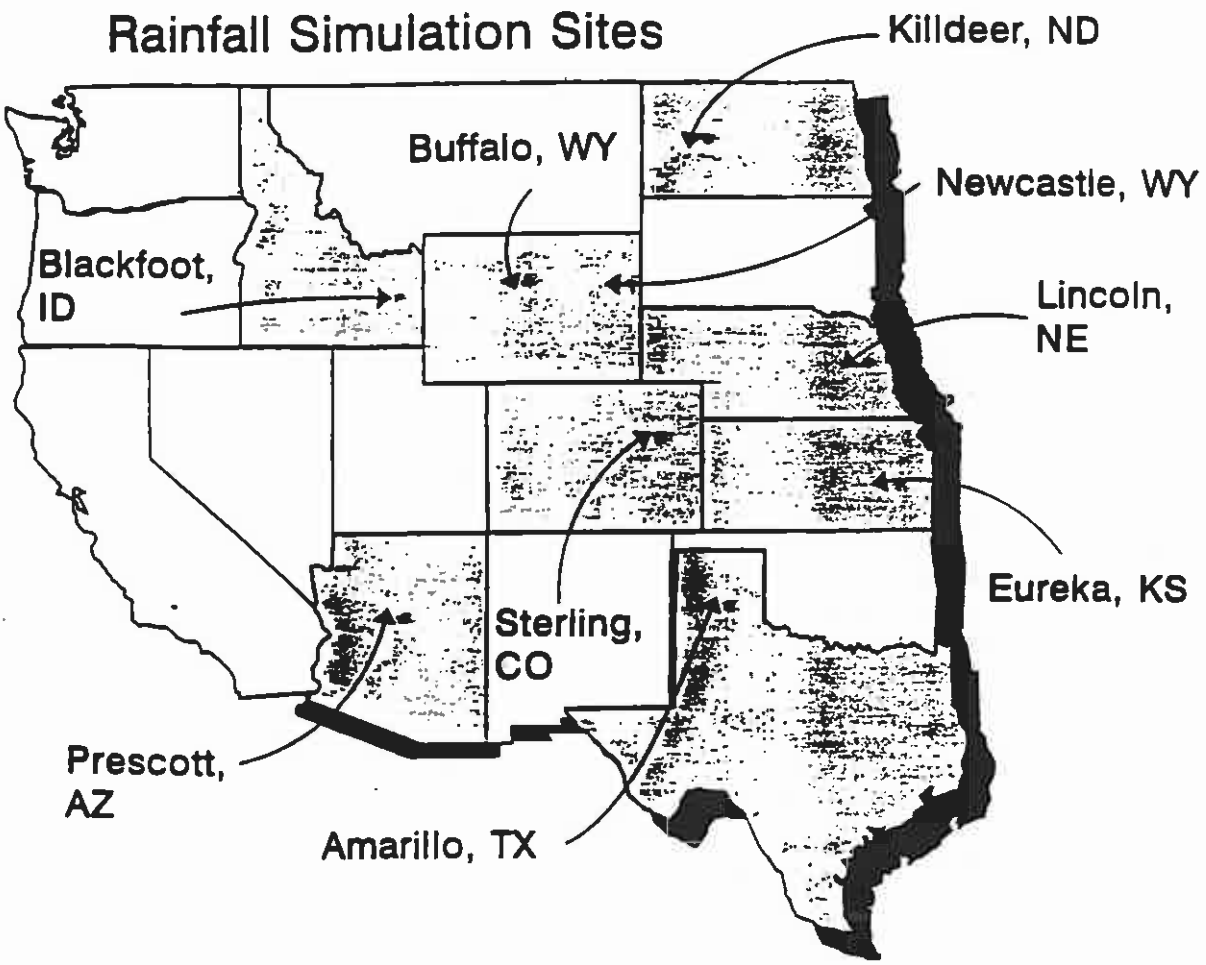
Annual Progress Report
Interagency Rangeland Water Erosion Project

National Range Study Team (NRST)

Interagency Rangeland Water Erosion Team (IRWET)



Introduction

The increasing importance of water has produced new demands from rangelands and the concept of multiple use. In the Southwestern and Western United States, rangeland watersheds are important sources of surface water and ground water. The primary source of rangeland and surface water pollution is sediment produced from natural processes and management activities. Since rangelands comprise vast watershed areas in the United States (401.6 million acres of non-federal lands, about 28.5% of the total), it is of prime importance that policies and activities are implemented to update United States Department of Agriculture-Soil Conservation Service (USDA-SCS) technology for hydrology and erosion prediction.

Traditional and State of the Art Perspectives

Society requires that the SCS maintain technical credibility by using "state of the art" methods to predict erosion rates and water yields on rangelands. The SCS is currently using the Hydrologic Curve Number method and the Universal Soil Loss Equation (USLE) for runoff and erosion predictions. The Hydrologic Curve Number method came into use in the mid-1950's; the USLE was developed from cropland research and was implemented in the mid 1960's. Both the Hydrologic Curve Number method and the USLE have limited applicability to rangelands, pasturelands, and forestlands.

Hydrology and erosion processes on rangelands are influenced by complex interactions of soil and vegetation factors. Rangelands are not homogeneous, even within seemingly continuous, unbroken expanses of grass. The kind of vegetation as well as the quantity of vegetation influences many hydrologic processes including: interception, infiltration, percolation, surface runoff, soil erosion, deposition of sediment, soil water storage, evaporation, and transpiration. Also, the spatial distribution of vegetation and temporal cycles of plant growth strongly influence rangeland hydrology and erosion.

In 1987, the USDA-Agricultural Research Service, Soil Conservation Service, USDA- Forest Service, and USDI-Bureau of Land Management organized to develop a new generation water erosion prediction technology called the Water Erosion Prediction Project (WEPP). Because rangelands are unique and diverse, model components of WEPP have been specifically developed for rangelands. Rangeland field data were collected during the early phases of the WEPP project; however, it became apparent that additional data, model enhancement, and validation were needed if WEPP was to be applied over a wide spectrum of rangeland sites.

This document summarizes the SCS, National Range Study Team (NRST) and ARS/SCS Interagency Rangeland Water Erosion Team (IRWET) activities—all in the context of supporting the WEPP effort by enhancing and validating the rangeland components of the WEPP model.

Project Structure and Objectives

The NRST and IRWET are composed of SCS and ARS personnel. These two teams work in concert, but have different roles with respect to the project.

- The National Range Study Team was organized in 1990 to collect and develop quantitative data sets on soils, vegetation, hydrology, and erosion in two to four rangeland plant communities on approximately 15 different soils in 12 Midwest and Western States. This information will be used for WEPP model enhancement and validation purposes by the Interagency Rangeland Water Erosion Team. The data will also provide SCS with a national archive data base that can be used in resource planning and in development of hydrologic guides in range site descriptions.

- The Interagency Rangeland Water Erosion Team was established in April of 1991 to enhance the rangeland components of the WEPP model through: (1) improving the plant and soil relationships within the model to address vegetation induced spatial variability; (2) validating and testing the model on rangelands; (3) supporting technology transfer between SCS and ARS by

- Four cooperative projects are underway with university researchers related to meeting IRWET objectives.

- Parameter data sets for validating the WEPP model on rangelands have been developed for all 1990 and 1991 NRST sites and all 1986-1988 SCS/ARS WEPP rangeland sites.

- IRWET has been involved in numerous activities aimed at transferring information and technology to SCS, BLM, university and international personnel.

- 32 journal articles, symposium proceedings, technical bulletins, and 9 presentations were authored or co-authored by IRWET members during 1991 and 1992.

- Sponsored and coordinated Soil Science Society of America and Society for Range Management symposia.

NEBRASKA Data Summary

Table 1. Nebraska Site Characteristics.

Variable	B1 Nebraska Heavy Grazing Use	B2 Nebraska Native Hayland
Range Site	Clay loam	Clay loam
Avg. Annual Precip. (in)	25 to 34	25 to 34
Slope (%)	10	11
Elevation (ft)	1500	1400
Aspect	West	East
Potential Climax Vegetation	Big bluestem/little bluestem	Big bluestem/little bluestem
Range Condition	Poor	High Good
Dominant Plants	Kentucky bluegrass Western ragweed Dandelion Horseweed	Big Bluestem Indiangrass Porcupine-grass Sideoats grama
Primary Use	Cow/calf operation; pasture is used as a drylot calving area spring through summer	Native hayland harvested in mid July
Management History	No fertilizer, brush control, or burning	No fertilizer, brush control, or burning

N A R R A T I V E P E D O N D E S C R I P T I O N

NSSL Pedon Number: 90P0693
Print Date: 01/13/92

Pedon: Burchard
Soil Survey Number 890-NE-155-061
Location: Saunders County, Nebraska
2360' S and 2000' W of the NE corner of Section 32, T.13N., R.5E.

Longitude: 096-52-37-W

Latitude: 41-03-14-N
Physiography: Hillside or mountainside in glaciated uplands
Geomorphic Position: backslope sideslope
Microrelief: on middle third of component

Elevation: 435 m MSL

Slope: 13% convex east facing
Precipitation: 71 cm - Udic Moisture Regime.
MLRA: 106 Nebraska and Kansas Loess-Drift Hills
Air Temperature: Ann: 11 Summ: Win:
Soil Temperature: Ann: 10 Summ: Win:

Land Use: Pasture land and native pasture
Runoff: Moderate

Drainage: Well drained
Stoniness: Erosion or Deposition: None
Particle Size Control Section: 41 to 91 cm
Parent Material: glacial drift from mixed-calcareous material
Classification: fine-loamy, mixed, mesic Typic Argiudoll
Diagnostic Horizons: 0 to 20 cm Mollic, 41 to 102 cm Argillic, 53 to 102 cm Calcic
Sample Date: 6/90
Described By: Steve Scheinost and Steve Hartung.
Tall grass pasture -- mowed for hay, seldom grazed. Associated soils are Judson and Fawnee.

A1 -- 0 to 5 cm; black (10YR 2/1) crushed moist loam; weak fine crumb structure; friable; many fine and medium roots throughout and fine to coarse roots throughout; 5 percent pebbles; abrupt smooth boundary.
24% clay
90P4079

A2 -- 5 to 15 cm; very dark gray (10YR 3/1) crushed moist loam; weak fine granular structure; friable; many very fine and fine roots throughout and medium and coarse roots throughout; 5 percent pebbles; clear smooth boundary.
27% clay
90P4080

A3 -- 15 to 20 cm; very dark grayish brown (10YR 3/2) crushed moist clay loam; weak fine prismatic structure parting to moderate fine subangular blocky; friable; many very fine and fine roots throughout and medium and coarse roots throughout; 5 percent pebbles; clear wavy boundary.
30% clay
90P4081

AB -- 20 to 41 cm; dark grayish brown (10YR 4/2) crushed moist clay loam; weak medium prismatic structure parting to moderate medium subangular blocky; friable; common fine and medium roots throughout and medium roots throughout; discontinuous faint organic coats on faces of peds; 5 percent pebbles; clear wavy boundary.
31% clay
90P4082

Bt -- 41 to 53 cm; olive brown (2.5Y 4/4) crushed moist clay loam; few fine distinct and common medium faint mottles; weak medium prismatic structure parting to moderate medium subangular blocky; firm; common fine and medium roots throughout; patchy clay films on faces of peds; common fine irregular soft masses of iron-manganese; strongly effervescent continuous; 5 percent pebbles; clear wavy boundary.
35% clay
90P4083

Btk1 -- 53 to 69 cm; brown to dark brown (10YR 4/3) exterior and dark brown (10YR 3/3) crushed moist clay loam; few fine distinct, few fine prominent and common fine distinct mottles; weak coarse prismatic structure parting to moderate medium angular blocky; firm; common very fine and fine roots throughout; very fine and fine tubular pores; patchy clay films on faces of peds; common fine irregular soft masses of iron-manganese; strongly effervescent continuous; 5 percent pebbles; gradual wavy boundary.
36% clay
90P4084

Btk2 -- 69 to 86 cm; 40% brown to dark brown (10YR 4/3) [illegible] tior, 60% grayish brown (2.5Y 5/2) exterior and dark yellowish brown (10YR 4/4) crushed moist clay loam; few medium prominent [illegible] w coarse prominent and common coarse prominent mottles; [illegible] [redacted]

N A R R A T I V E P E D O N D E S C R I P T I O N

Pedon: Burchard
Soil Survey Number 590-NE-155-060
Location: Saunders County, Nebraska
2050' N and 235' E of the SW corner of Section 29, T.13N., R.5E.
Latitude: 41-03-50-N
Physiography: Hillside or mountainside in glaciated uplands
Geomorphic Position: backslope sideslope
Microrelief: on middle third of component
Slope: 10% convex northwest facing
Precipitation: 71 cm - Udic Moisture Regime.
MLRA: 106 Nebraska and Kansas Loess-Drift Hills
Air Temperature: Ann: 11 Summ: Win:
Soil Temperature: Ann: 10 Summ: Win:
Drainage: Well drained
Stoniness: Erosion or Deposition: None
Particle Size Control Section: 30 to 81 cm
Parent Material: glacial drift from mixed-calcareous material
Classification: fine-loamy, mixed, mesic Typic Argiudoll
Diagnostic Horizons: 0 to 30 cm Mollic, 30 to 109 cm Argillic
Described By: Steve Schainost and Lester Brockman.
Over grazed pasture - heavy continuous use. Associated soils are Judson and Pawnee.

NSSL Pedon Number: 90P0608
Print Date: 01/15/92

Longitude: 096-53-18-W

Elevation: 448 m MSL

Land Use: Pasture land and native pasture
Runoff: Moderate

Sample Date: 6/90

A1 -- 0 to 3 cm; very dark brown (10YR 2/2) crushed moist silt loam; moderate fine granular structure; very friable; many very fine and fine roots throughout; abrupt smooth boundary.
90P4051

A2 -- 3 to 5 cm; black (10YR 2/1) crushed moist clay loam; moderate fine platy structure parting to moderate fine granular; friable; common very fine and fine roots throughout and many very fine and fine roots between peds; abrupt smooth boundary.
90P4052

A3 -- 5 to 18 cm; very dark grayish brown (10YR 3/2) crushed moist clay loam; weak fine prismatic structure parting to strong fine subangular blocky; friable; common very fine and fine roots throughout; very few iron stains; clear wavy boundary.
34% clay
90P4053

AB -- 18 to 30 cm; very dark grayish brown (10YR 3/2) crushed moist clay loam; weak fine prismatic structure parting to moderate medium subangular blocky; friable; very fine and fine roots between peds and very fine and fine roots throughout; fine tubular pores; very few iron stains; clear wavy boundary.
38% clay
90P4054

Bt -- 30 to 48 cm; dark grayish brown (10YR 4/2) crushed moist clay loam; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; very fine roots between peds; very fine tubular pores; patchy distinct organic coats on faces of peds and in pores and patchy distinct clay films on faces of peds and very few patchy distinct iron stains; gradual smooth boundary.
39% clay
90P4055

Btk1 -- 48 to 71 cm; 30% grayish brown (10YR 5/2) exterior, 30% olive brown (2.5Y 4/4) exterior and 40% yellowish brown (10YR 5/6) exterior moist clay loam; common fine distinct mottles; moderate medium prismatic structure parting to moderate medium subangular blocky; firm; very fine roots in cracks; very fine tubular pores; patchy distinct organic coats on faces of peds and in pores and patchy distinct clay films on faces of peds and very few patchy distinct iron stains; coarse irregular soft masses of lime; strongly effervescent continuous; clear irregular boundary.
39% clay
90P4056

Btk2 -- 71 to 91 cm; 30% dark yellowish brown (10YR 4/6) exterior, 30% olive brown (2.5Y 4/4) exterior and 40% grayish brown (2.5Y 5/2) exterior moist clay loam; few fine prominent mottles; moderate medium prismatic structure parting to moderate medium angular blocky; firm; very fine roots in cracks; very fine tubular pores; very few iron stains; common medium irregular soft masses of [illegible] many [illegible] on [illegible] coarse [illegible] soft [illegible] lime; [illegible] strongly effervescent continuous [illegible] irregular boundary.

Table 3. Selected soil horizon characteristics of the master soil pedon sampled for site B1, Nebraska - Burchard clay loam.

Horizon	Thickness (cm)	Sand (%)	Silt (%)	Clay (%)	Texture[1]	Bulk Density (g/cm3)	Organic Carbon (%)	Coarse Fragments (%)	1/3 bar Water (cm/cm)	15 bar Water (cm/cm)
A1	0-3	28.1	41.0	30.9	SIL	.	10.09	Tr	.	24.6
A2	3-5	26.2	42.6	31.2	CL	.	4.32	3	.	18.1
A3	5-18	27.1	36.3	36.6	CL	1.56	2.32	2	28.1	16.4
AB	18-31	28.8	31.8	39.4	CL	1.76	1.25	2	26.8	17.7
Bt	31-49	30.1	31.1	38.8	CL	1.81	0.71	2	25.4	16.8
Btk1	49-72	29.2	37.9	32.9	CL	1.78	0.32	2	20.9	13.4
Btk2	72-92	30.1	37.3	32.6	CL	1.71	0.14	4	21.7	13.8
Btk3	92-110	29.4	38.6	32.0	CL	1.83	0.06	9	20.9	15.2
BC	110-140	31.1	37.0	31.9	C	1.90	0.02	2	23.3	14.8
C	140-160	32.8	33.6	33.6	C	1.73	0.03	3	21.8	15.9

[1]Key to texture; SIL=Silty loam, CL=Clay-loam, C=Clay.

Table 6. Average root biomass measured at 2 depths for sites B1 and B2 in Nebraska.

Site	Landscape Position	Depth (cm)	Root Biomass (kg/ha)	Sample Size
B1	Basal	0.0-2.5	3700.56	6
		2.5-10.0	205.14	6
B2	Basal	0.0-2.5	732.50	6
		2.5-10.0	173.75	6

Table 7. Average hydrologic characteristics of dry and wet antecedent moisture condition rainfall simulation runs for sites B1 and B2 in Nebraska.

Site	Cumulative Runoff (mm)	Cumulative Infiltration (mm)	Cumulative Sediment Yield (kg/ha)	Runoff Rate (mm/hr)	Infiltration Rate (mm/hr)	Sediment Yield Rate (kg/ha/hr)
At 60 Minutes During Dry Runs						
B1	25.14	25.32	203.74	34.93	9.09	80.76
B2	0.05	51.02	0.63	0.63	52.61	4.07
At 30 Minutes During Wet Runs						
B1*	6.82	9.61	26.61	27.72	3.45	37.99
B2	1.02	25.02	13.28	9.84	41.87	122.43

* Values reported are averages over 30 minutes or until rainfall ended if run time was less than 30 minutes.

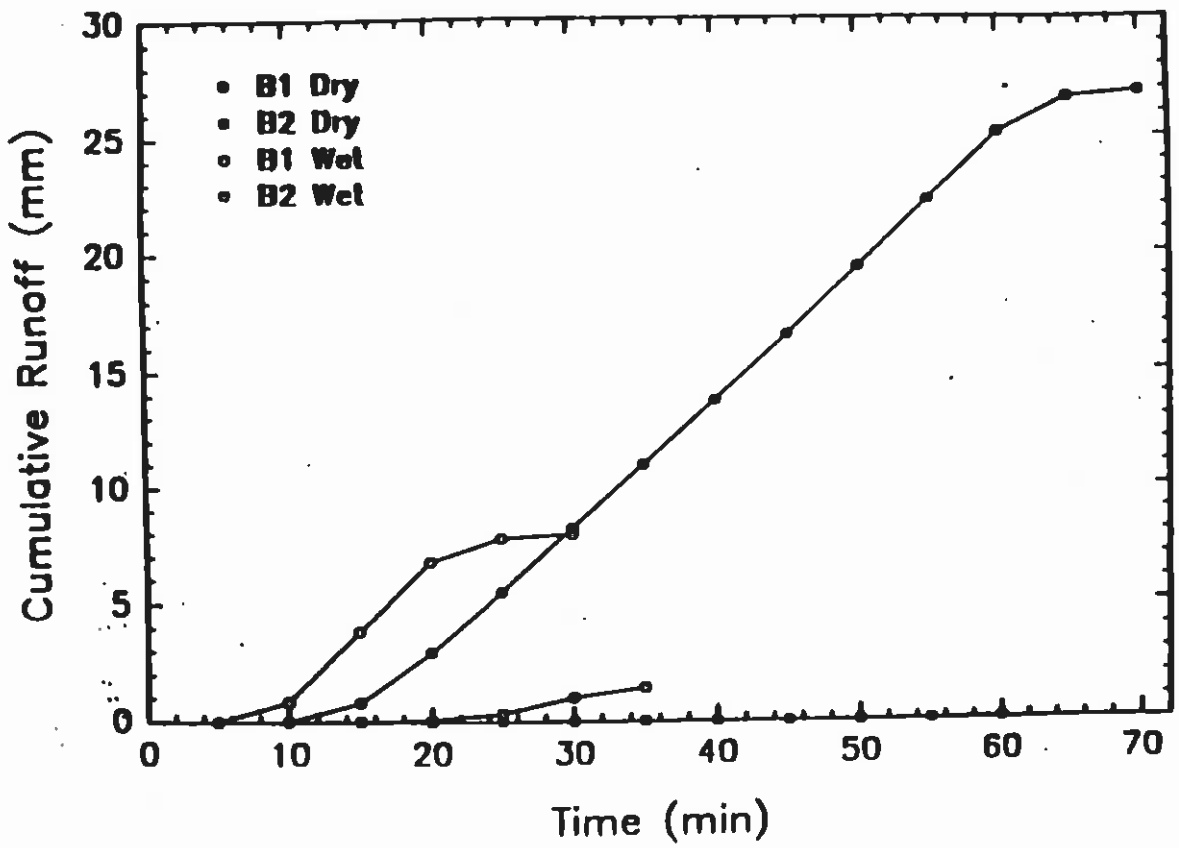


Figure 2. Cumulative runoff for sites B1 and B2 in Nebraska.

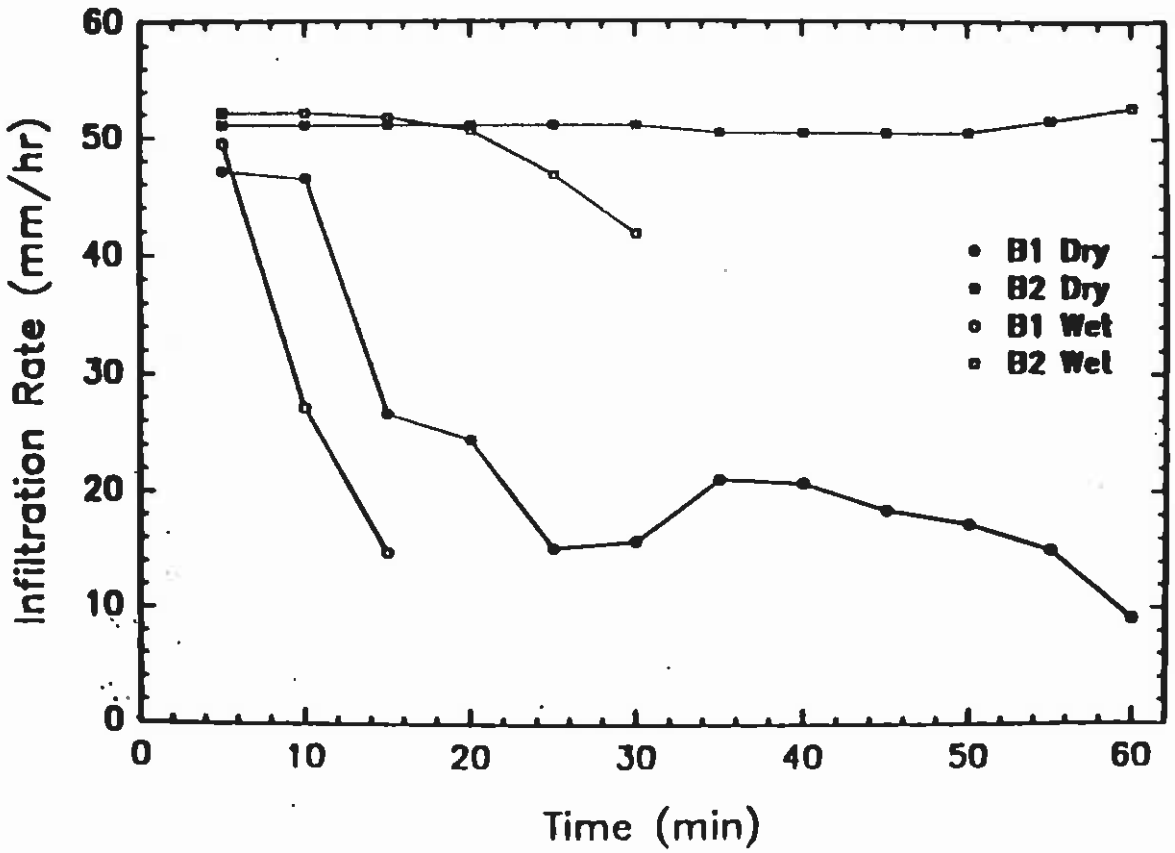


Figure 4. Instantaneous infiltration rate for sites B1 and B2 in Nebraska.

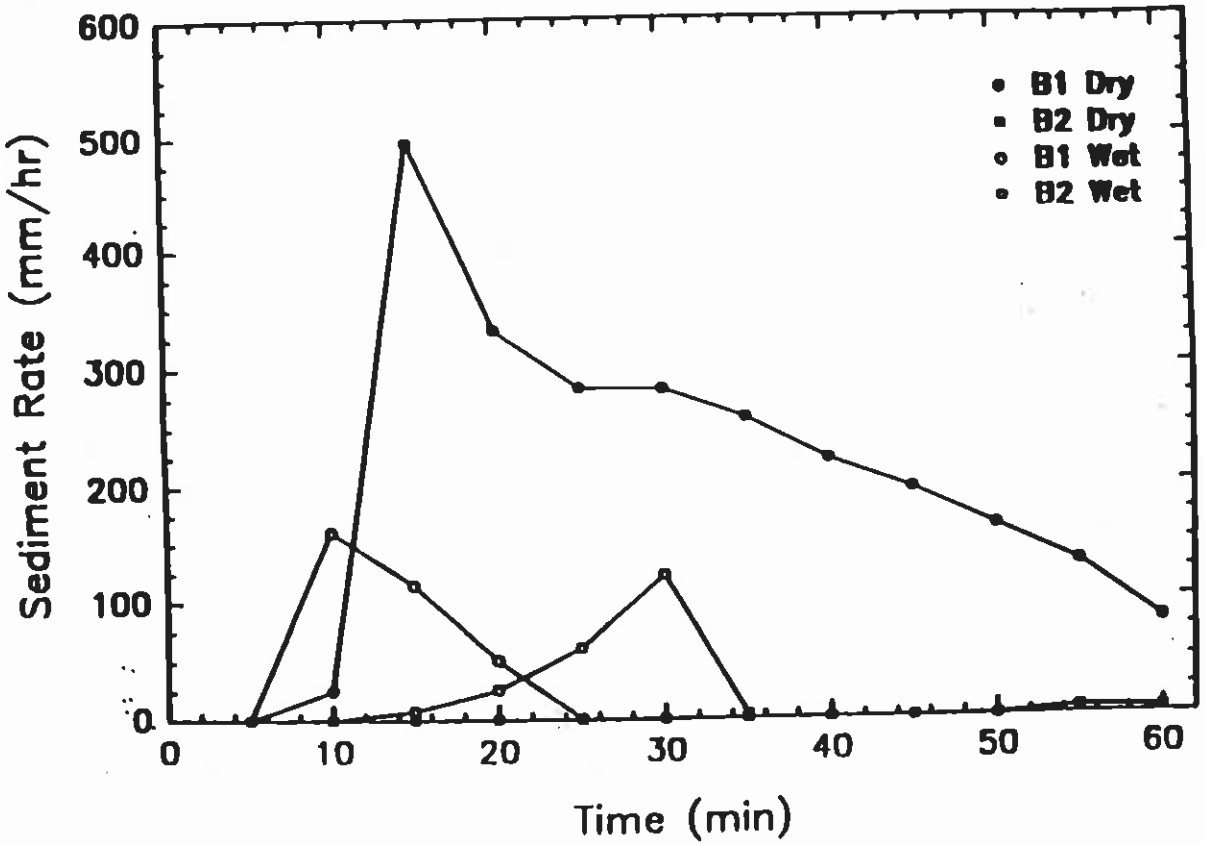


Figure 6. Instantaneous sediment yield rate for sites B1 and B2 in Nebraska.

RANGE TECHNICAL NOTE or BULLETIN ?

Interagency Rangeland Water Erosion Project FY - 1992 Annual Progress Report - present NE data only plus introductory information.

1. Copy of cover

2. Inside cover noting acknowledgement of contribution of NE individuals.

3. Executive Summary ii-iv, NE data summary papes 15-31.

4. Additional information contact KLH