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HYDROLOGY, CLIMATE AND SELECTED SOILS LITERATURE SAGERS WASH - EAST UTAH DELERT AREA

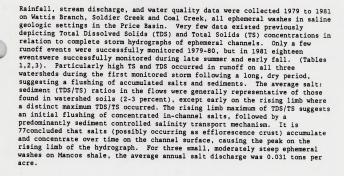


ABSTRACT

Jackson, William L.; R. Gordon Bentley and Scott Fisher. 1984. Salinity status report: 1980-82. Results of Bureau of Land Management studies on public lands in the Upper Colorado River Basin. Technical Note 364. USDI, BLM, Denver Service Center, Division of Resource Systems. 54p.

The purpose of this report was to summarize the most important results and conclusions from eight BLM salinity studies completed 1980-82. In addition, specific techniques and alternatives were reviewed for managing salinity from diffuse overland sources.

Salt and sediment yields on ephemeral washes: Price River Basin, Utah



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Table 1. Wattis Drainage Storm Summary

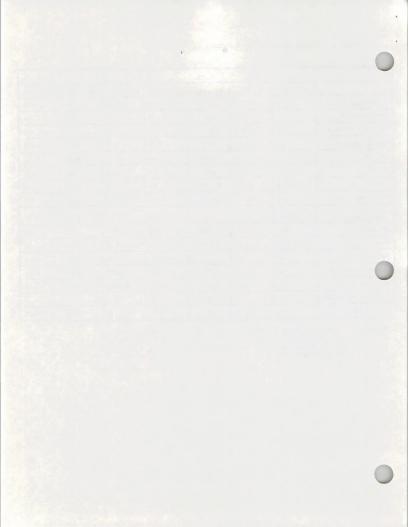
			DATE				
	8/23/81	9/5/81	10/3/81	10/11/81	10/11/81	10/16/81	10/17/81
Runoff Volume (RO), m ³	6,868	3,138	3,239	10,256	3,0521	14,192	8,439
Time to Peak, hrs	0.7	3.3	0.25	1.3	0.25	2.2	1.3
Duration of Runoff, hrs	1.5	10.0	1.7	6.0	3.0	7.0	7.0
Peak Discharge, m ³ /s	3.7	0.34	2.2	1.6	1.2	2.4	0.7
TDS Load, t	42.9	6.84	17.84	NA	4.94	19.57	11.74
TS Load, t	1,495	185	430	NA	206	547	1,675
Peak TDS, mg/1	60,000	7,000	25,000	NA	1,800	1,500	2,200
Paak TS, mg/1	680,00	100,000	310,000	NA	90,000	54,000	62,000
Averaga Salt: Solid Ratio. I	2.87	3.67	4.15	NA	2.41	3.58	7.05
Avaraga TDS, mg/1	7,682	2,177	5,495	NA	1,616	1,365	1,391
Averaga TS, mg/l	267,684	59,292	132,108	NA	67,158	38,414	19,699
Soil Loss, (USLE) t	NA	NA	NA	1,067	309	482	551
pitation (P), cm	NA	. 0.43	0.51	1.27	0.25	1.52	0.43
Runoff/Pracip. Ratio	NA	0.0560	0.0476	0.0601	0.0896	0.0698	0.146
Complataness of Samples	С	MF	с	PT	с	с	с
Sampling Method	м	м	м	ISCO	м	ISCO	ISCO

Notes:

C = Completely sampled PT = Partially sampled MF = Initial part of storm event sampled NA = Not available

1 m = 3.281 ft

1 t = 1.1 tons $1 mg = 3.53 \times 10^{-5}$ $1 liter = 61.02 in^{3}$



" Table 2. Soldier Creek Storm Summary.

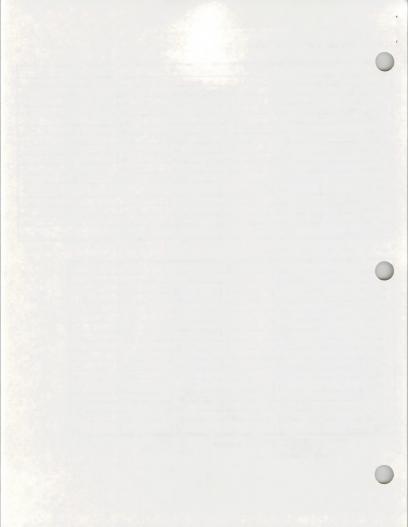
DATE									
	10/3/81	10/4/81	10/11/81	10/13/81	10/15/81	10/16/81			
Runoff Volume, m ³	5,883	101	10,949	4,826	12,478	19,765			
Time to Peak, hrs	2.3	0.6	1.0	1.0	1.0	3.5			
Ouration of Runoff, hrs	4.6	2.0	4.5	3.5	4.7	10.0			
Peak Discharge, #3/s	1.7	.045	3.1	10.5	2.6	2.1			
TDS Load, t	9.10	.18	8.77	6.02	14.47	KA			
TS Load, t	384.90	.87	174.72	63.61	452.27	XA			
Peak TDS, mg.1	9,000	3,000	1,200	2,000	1,900	NA			
Peak TS, mg/1	85,000	16,000	17,500	14,000	61,000	NA			
Average TDS, mg/1	1,564	1,776	808	1,244	1,154	NA			
Average TS, mg/1	65,531	8,621	15,853	13,414	38,414	NA			
Average Salt: Solid Ratio, 4	2.36	20.83	5.02	9.47	3.20	NA			
Soll Loss, (USLE) t	NA	KA	24.8	16.5	74.6	32.8			
Precipitiation (P), cm	1.00	0.51	0.66	0.38	1.02	1.65			
Runoff/Precip. Ratio	0.182	0.006	0.512	0.392	0.378	0.370			
Comments: Method of Sampling	ĥ	ç	ISCO	1SC0	ISCO	HF 1SC0			

Table 3. Coal Creek Storm Summary.

DATE								
	10/3/81	10/4/81	10/12/81	10/13/81	10/16/81			
Runoff Volume, m ³	113	20	1,062	1,039	2,020			
Time to Peak, hrs	0.5	0.4	0.3	2.3	1.3			
Ouration of Runoff, hrs	1.5	1.3	1.6	6.0	7.00			
Peak Olscharge, m ³ /s	0.055	0.012	03.10	0.240	0.290			
TDS Load, t	0.39	.004	.223	.2737	.419			
TS Load, t	26.21	.06	6.09	9.65	15.20			
Peak TDS, mg.1	410	210	250	410	260			
Peak TS, mg/1	19,800	3,400	19,000	16,000	12,200			
Average TDS, mg/1	380	181	218	262	207			
Average TS, mg/1	3,000	2,783	5,715	9,218	5,709			
Average Salt: Solid Ratio, *	13.0	7.0	3.80	2.83	2.75			
Soil Loss, (USLE) t	NA	KA	10.5	2.2	12.7			
Precipitiation (P), cm	0.510	1.02	1.65	.76	1.91			
Runoff/Precip. Ratio	0.021	0.0018	0.061	0.129	0.0998			
Comments: Method of Sampling	ĥ	C M	15C0	1SC0	1500			

Notes: C - Complete hydrograph sampled NF - Initial strom event record are not available NA - Not available - Hanad ISCF - Mattaling sampler

1 m = 3.281 ft 1 t = 1.1 tons 1 mg = 2.2 x 10⁻⁶ lb 1 liter = 0.2642 gal



Salt yields at three small basins: Badger Wash, Colorado

A gaging station with continuous discharge and periodic electrical conductivity sampling capability was operated 1977-82 on each of the following watersheds in the Badger Wash Experimental Area: Prairie Dog Reservoir, Middle Basin, and West Twin Basin. Beginning in 1982 samples were analyzed for suspended sediment concentration. Historic runoff from the 1966 to 1973 period was then used to extend the average Total Dissolved Solids (TDS) data to estimate a longer-term average annual salt yield from each basin.

Because of the infrequency of runoff events and the short period of gaging, only rough estimates of TDS yield and TDS to Total Solids ratios were developed. Still, the overall average annual salt discharge of 0.05 tons/acre/year further substantiates the rough estimates of salt yield and TDS/TS ratios developed in the Price River Basin for small, moderately steep ephemeral washes on Mancos shale.

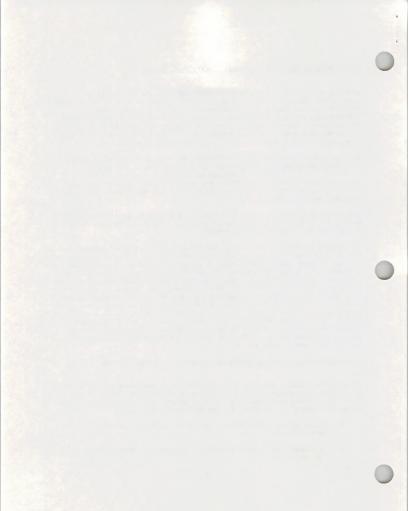
Individual basin average salt discharges for Prairie Dog, Middle and West Twin were 0.063, 0.058, and 0.023 tons/acre/year respectively. The mean TDS/TS ratio based on 4 samples was 3.8 percent.

The authors emphasized that neither the research design nor the quantity and precision of data collected warranted any extrapolation to conclusions of the original 20 year Badger Wash effects of grazing study by Luby with regard to sediment yield, livestock grazing, and salinity. However it was suggested that there is an important, though inconclusive relationship between salt and sediment yields. Where soils are more saline and less vegetated, there may be less opportunity to influence sediment yield and salt yields through grazing management. Since BLM showed in its first 1978 salinity progress report that Badger Wash soils are slightly to moderately saline, and that those soils are better vegetated than the highly saline soils common to the Mancos shale regions west of Badger Wash, salt management opportunities through grazing management alone may be more feasible at Badger Wash, than in the Eastern Utah mancos shale regions.

Soil geomorphology, soil salinity and vegetation: Woodside, Utah

The Woodside salinity research site in Emery County consisted of 5550 acres 12 miles south of Woodside and 13 miles northwest of the town of Green River, Utah. Three broad geomorphic units were recognized by a contract soil survey designed to improve a SCS Order 3. The units were as follows:

- A low relief shale pediment and recent alluvial surface in the western third.
- 2. A remanent old pediment surface developed from Mesa Verde sandstone colluvium.



3. Dissected Mancos shale uplands.

Eleven different soil series in 22 mapping units were recognized by the more detailed soil survey performed for Woodside. Eleven plant communities were recognized for the study area, distributed from elevation of 4500 - 5100 feet.

Rainfall simulation study of water, sediment, and salt yields on three soil landform units on Mancos Shale.

A Bureau of Land Management large-plot rainfall simulator patterned after one developed by M.E. Holland at CSU was used in the summer of 1981 to quantify relative yields of water, sediment and salt from three soil-landform units common in the Mancos shale regions of E- central Utah. The study site was the location of the previous detailed geomorphology, soil-salinity and vegetation study site located 12 miles south of Woodside, Utah.

Plots measuring 20 feet by 20 feet were located on 1.) a low-relief shale pediment on a gray, crusted, fine loamy shale - derived soil (Soil A), and 2.) the same shale pediment on a light brown, cracked, fine, loamy aeolian soil (soil D). A larger third plot encompassing a 2000 square feet microbasin was located on steep, dissected, raw shale babland. All plots had less than 20 percent vegetation cover, which is typical of the Mancos shale region. Two simulated rainfall runs of 33 - 40 minute storm were applied to each plot.

No runoff was generated from soil D. Electrical conductivity (EC) of runoff (which served as an index to TDS concentration) increased an average of 35 unhos/cm on soil A compared to EC of applied rain water.

This contrasts to an increase of 2400 umhos/cm over that in the rainfall on the dissected raw shale microbasin.

The study suggested that a similar rainfall-runoff event would produce considerably more salt and sediment from raw shale badlands than from lowerrelief gray fine loamy shale bottomland. The authors believe that the high sediment and salt concentrations in runoff from the dissected Mancos shale badland unit are due to the dominance of rilling as an erosion mechanism, and the continued downcuting through salt-rich Mancos shales.

The surprisingly low concentrations of sediment and salt from the gray, crusted pediment unit (soil A) appears due to: 1.) the erosion protection of the surface soil crusts and mild slopes; and 2.) less saline surface soils. Erosion rates on soil A were insufficient to expose deeper, more saline soils, and capillary processes were apparently insufficient to replenish surface salt concentrations to gray pediment soil.

Management of salinity in Mancos regions will require careful analysis of salinity sources as function of soil - landform characteristics, because of the highly variable runoff and erosion attributes of different soil units.



Rainfall simulation study of the effects of trampling on runoff and water quality of Mancos shale rangeland.

In the summer of 1981 a small drop-former type of rainfall simulator (plot size 9 feet square) was used by Simmons, Li and Associates for BLM to index the relative effects of vegetative cover and livestock trampling on water, sediment and salt yields of a gray, crusted, fine textured Mancos shalederived soil near Woodside, Utah. The soil was the same as soil A of the preceding rainfall simulation study, and was described by Schafer (1981) in the contract soil survey referred to earlier, performed 12 miles south of Woodside on 5550 acres. A total of 360 runoff events were simulated on 180 plots. The experimental design involved three vegetative conditions, four levels of livestock trampling, two antecedent moisture conditions and 15 replications.

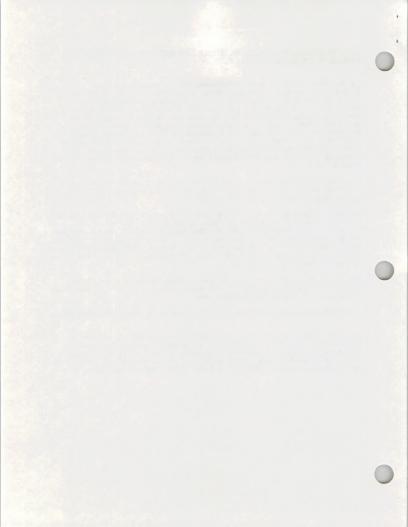
Key limitations were the small plot (3 foot by 3 foot) nature of the data, data only reflecting one soil-vegetation complex, and trampling intensities higher than actual utilization conditions.

Runoff from trampled plots had higher concentrations of sediment and salt than from the untrampled plots (7197 to 9324 ppm for sediment and 331 to 577 umhos/cm for EC). However increased trampling also increase infiltration and surface depression storage, resulting in decreased volumes of runoff from the plots, thus the physical and geometric surface effects of trampling produced a potential net decrease on total plot salt and sediment discharge at the 35 and 60 percent trampling intensities.

The results of trampling on infiltration rate and runoff were completely opposed to those found by the U.S. Geological Survey in 20 years of livestockhydrology effects research at Badger Wash.

Long-term sediment accumulation in retention basins in Mancos shale badlands.

The purpose of this study was to quantify long-term yields of sediment (and, by inference, salt) from unvegetated, steep dissected Mancos shale badlands, 12.8 miles to the west of the Utah communities of Castle Dale and Huntington. Twelve small basins created by BLM gully plug installation in the early 1970s were selected ranging in size from 0.2 to 3.2 acres in drainage area.



Results of the sediment accumulation survey are provided in Table 1.

Plug No.	Oreinage Area (m)	Plug Age (yrs)	Total Relief (m)	Weighted Wetershed Slope (%)	Weighted Channel Slope (%)	Weighted Channel Slope (%)	Volume Sediment (m)	Sediment Yield (t/hs/yr)	Sediment Yield (t/ac/yr)
1 3,720	3,720	3,720 7	37	47	18	14	13	7.81	3.4
2	6,970	7	42	41	12	12	35	11.22	4.9
3	13,000	7	62	54	23	21	49	8.37	3.6
4	7,150	7	41	45	19	18	29	9.11	4.0
5	2,410	6	32	55	33	32	9	10.04	4.4
6	2,230	6	30	53	18	18	10	11.90	5.2
7	2,690	6	37	59	25	25	15	14.76	6.5
8	1,000	6	27	58	33	32	1.0	2.67	1.1
9	820	6	16	34	22	18	1.3	3.97	1.7
10	1,610	6	16	36	23	20	1.9	3.10	1.3
11	1,300	6	10	18	10	10	0.7	1.49	0.6
12	910	7	7	20	13	12	3.9	9.49	4.1
2	3,650	6.4	30	43	21	19	14	7.81	3.4
s	3,660	0.5	16	14	7.4	7.3	16	4.15	1.8

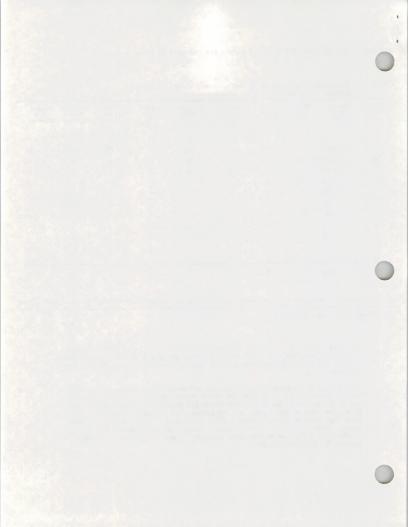
Table 1. Watershed characteristics and sediment yields, Huntington sediment basin survey.

X = mean, S = standard deviation

The data reveal that sediment accumulations behind the gully plugs average 3.45 tons/acre/year, and the highest accumulation was from the steepest basin. However sediment accumulations did not correlate well with measured watershed characteristics.

By applying a 3 percent salt content to sediments the authors estimated the average annual salt yield from the Mancos Shale badlands to the gully plugs was 0.10 tons/acre, which compares favorably to salinity yield estimations form other Mancos shale regions. In general, very rough estimates of long term soil erosion rates in Mancos shale range from 1 ton/acre/year on less steep moderately vegetated sites to 3.4 to 15 tons/acre/year on steep unvegetated dissected Mancos shale badlands. Salinity yields are roughly 3 percent of sediment yields.

7



Baseflow salt yield on small streams in the Price River Basin.

4 1

Concurrent with the study of salt and sediment yields on ephemeral washes in the Price River basin, described in an earlier abstract, weekly monitoring of discharge and salinity was also conducted at 5 intermittent stream sites and 13 perennial stream sites in the Price River basin. The purpose of the monitoring study was to determine average water quality as indexed by Electrical Conductivity (EC) of baseflows, and to contrast the relative importance of salt loading from baseflows with that from storm runoff.

The study results indicate that baseflows from ground water sources and irrigation return flows in the Price River basin contribute over three times the annual salt yield to the Price River at Woodside, than does the surface runoff from short duration summer convectional storms.

