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Streamflow and Sediment Study of Hosanna Creek near Healy, Alaska: 1986 Progress Report

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Hosanna Creek Streamflow and Sediment Study
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INTRODUCTION

The Hosanna Creek Streamflow and Sediment Study, hereafter called the Hosanna Creek Study, is a project undertaken by the Division of Mining and Geological and Geophysical Surveys to estimate the sediment yield of Hosanna Creek and selected tributaries above present day mining. Hosanna Creek (also known as Lignite Creek) basin is located near Healy, Alaska, and has a total area of approximately 48.1 square miles. Presently, coal mining occurs in the lower part of the basin at Poker Flats. An earlier, now abandoned mine site is near Gold Run Pass in the upper part of the basin. The basin geology includes the five formations of the coal bearing group described by Wahrhaftig and others (1969), Nenana Gravel, schists, alluvium and landslide deposits (Wahrhaftig, 1970). The lithologies of the coal bearing formations are mostly poorly consolidated clays-tones, siltstones, sandstones, and shales with high erosion potential. Due to the high permeability of the soils and sedimentary rock formations, many slopes within the basin are unstable, resulting in landslides and other forms of mass wasting that intrude upon stream channels and contribute sediment during runoff events. Because of the unusual lithologies and presence of mass wasting, the natural sediment transport of Hosanna Creek and its tributaries is remarkably high.

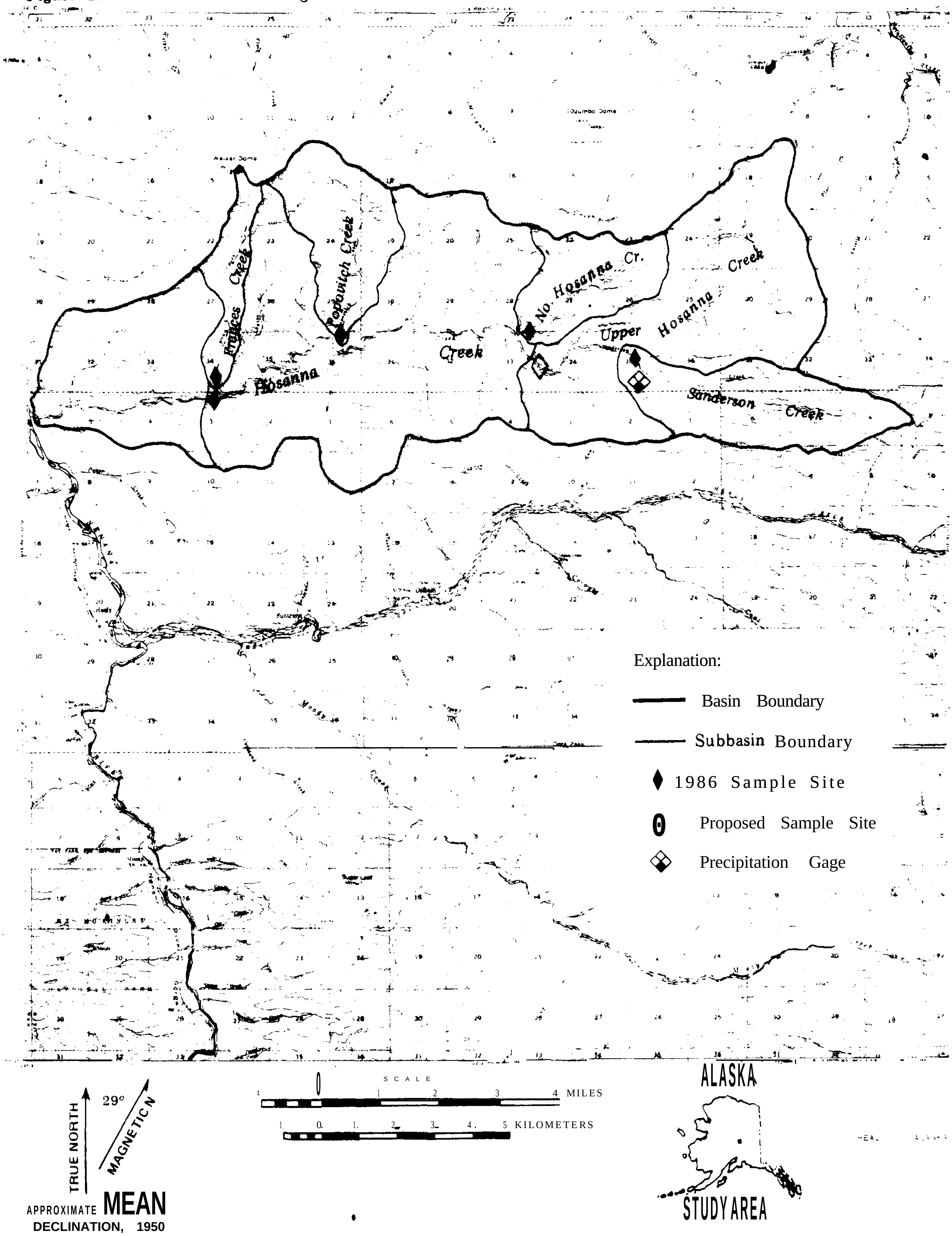
A work program to collect data that will allow estimation of the sediment yield of the Hosanna Creek basin was initiated during the 1986 summer. Five sites were chosen as being representative of the basin: Sanderson Creek (above any past mining), North Hosanna Creek (an unmined subbasin but with silty discharge), Popovitch Creek (unmined), Frances Creek (downstream of future mining), and Hosanna Creek at Bridge 3 (above present mining). Automatic samplers programmed to composite four samples into one bottle daily were placed at all five sites for collection of total suspended solids samples. Staff gages or flumes were established at all sites for flow estimation. To the extent available stream stage recorders were placed at these sites. At an upper basin site in Gold Run Pass, a Wyoming-type precipitation gage was installed in late September. Figure 1 shows the locations of sampling sites within the basin with the corresponding drainages outlined. Table 1 lists the basin characteristics of the sampling sites

Table 1. Characteristics of Hosanna Creek sites

Location	Area (sq mi)	Percent of Total Area	Principal Lithology	2 year * peak flow (cfs)
Sanderson Cr ab Mining	5. 07	11.58	Schist	103
North Hosanna Creek	3. 13	7. 15	Coal Brng Sandst	66. 8
Popovich Creek	4. 06	9. 27	Nenana Gravel	84. 2
Frances Creek	1. 71	3. 90	Nenana Gravel	39. 0
Hosanna Cr ab Brrdge 3	43. 8	100. 00	Mixed	699
Proposed Location				
Upper Hosanna Cr	16. 6	37.90	Mixed	295

* based on area-discharge regression of the published records of of five local-area streams gaged by the U.S. Geological Survey (Jones 1983).

Figure 1. Hosanna Creek Drainage.



RESULTS AND DISCUSSION

The 1986 field season was approached as a testing period to determine which methods might be most appropriate at the selected sites. Equipment was not installed at any site until mid August. One week later a flood occurred that disrupted data collection at every site, thus providing a good test situation for the extremes that can be expected in this basin. Appendix 1 contains the total suspended solids and discharge data collected this summer. This appendix also contains sediment load estimates which are the product of TSS concentrations and discharge multiplied by a constant (.0027) to make the units tons per day. Sediment load is shown only where both TSS and discharge are known. Below are comments specific to each site.

1. Sanderson Creek. Measured discharges on this stream ranged between 2.89 and 7.61 cubic feet per second (cfs). Total suspended solids (TSS) ranged between 16.8 and 59.5 milligrams per liter (mg/l) (only 3 samples). The automatic sampler did not work out well at this site during this period. The August 21 flood wiped out the intake and when it was reestablished on September 5, the sampler did not work properly, possibly because of incorrect programming.

2. North Hosanna Creek. Measured discharges ranged between 2.8 and 7.88 cfs. Total suspended solids varied between 306 and 26800 (August 21 flood) mg/l. The transducer for the datapod installed at this site

failed shortly after installation. The automatic sampler worked reasonably well.

3. Popovi tch Creek. This creek demonstrates extreme bed movement relative to suspended solids movement. Because of rapid channel switching due to bed movement, an H-flume was installed to maintain a constant channel. The H-flume and automatic sampler setup was silted in by bed movement within hours of installation. Replacement of the H-flume with a parshall flume had good results, although a larger parshall flume is necessary to measure high flows. An automatic sampler is not appropriate here because most sediment transport is through bed movement and missed by the automatic sampler. In 1987 a bed load sampling program will be used in addition to suspended solids sampling.

Recorded flows through the flume ranged as high as 2.80 cfs. This occurred during the August 21 flood event and, because the stream was flowing in other channels, represents only part of the total peak flow for that storm. Between August 27 and September 5 most of the flow was in a channel other than that being measured by the stage recorder. The higher value total suspended solids samples reported in Appendix 1 contained bed material and should not be considered representative of the suspended load of the stream.

4. Frances Creek. The automatic sampler worked reasonably well at

this site. A rectangular weir was initially set UP for flow estimation and it silted in within days (the August 21 flood wrecked it). The H-flume was removed from Popovitch Creek and worked reasonably well at this site. The H-flume should be large enough for the expected flow range for this creek. Observed flows ranged between 0. 13 and 0. 39 cfs. Total suspended solids varied between 18. 3 and 756 (August 20) mg/l.

5. Hosanna Creek at Brrdge 3. Measured flows ranged between 57. 6 and 29. 4 cfs. The August 21 peak was estimated to be 1200 cfs. Total suspended solids samples varied between 330 and 14800 (August 20) mg/1. The initial automatic sampler and staff gage setup was destroyed by the August 21 flood. The later setup worked well. If the August 21 flood is representative of annual events at any lower mainstream site such as this, it is unlikely that any of our sampler-gage configurations will survive, and likely that large storms will change the stage-discharge relationship at this site.

In general, it appears most of the sediment load at the Bridge 3 site is coming from North Hosanna Creek and locations other than the other three subbasins being monitored, possibly the main stem of Hosanna Creek. Table 2 shows the average sediment load contributions at the five sites based on four same-day visits during 1986. It demonstrates the relatively large contribution from North Hosanna Creck and small amount from Sanderson, Popovitch and Frances Creeks.

This relationship may change seasonally and at different flows, For the 1987 field season a station will be added in the upper Hosanna Creek basin to better account for the sources of the Hosanna Creek loads.

Table 2. Average Loads from the Hosanna Creek Basin *

Location	TSS (mg/l)	Discharge (cfs)	Load (ton/day)	Percent of total load	Percent of total area**
Sanderson Cr	41.6	5.16	0.58	0.75	11.58
North Hosanna Cr	2560	4.15	28.7	36.9	7.15
Popovich Cr	697	1.15	2.15	2.77	9.27
Frances	617	0.66	1.10	1.41	3.90
Hosanna at Bridge 3	666	43.20	77.7	100.00	100.00
Percent of load from other than subbasins				58.2	

* Average of values from four same-day visits to each site. Some missing values were estimated.

** From Table 1.

Much of the sediment that was transported out of the Hosanna Creek basin moved during the August 21 storm. Exact figures are not available, but assuming the Hosanna at Bridge 3 August 20 TSS value of 14,800 mg/l is representative of the average TSS during the storm and that the maximum average dally flow was 600 cfs (from an estimated instantaneous peak of 1200), the sediment load for the one flood day was 24, 000 tons. Even if that estimate is off by a factor of ten, a relatively large amount of material was moved by the storm when compared to the Hosanna Creek at Bridge 3 average of 78 tons per day reported in table 2.

FUTURE WORK

For the 1987 field season we propose to have six sediment sampling sites in the Hosanna Creek basin: the five used in 1986 and one additional site on upper Hosanna Creek (see figure 1). Stream stage will be recorded at all six sites using Omnidata datapod recorders attached to pressure transducers. Flumes will be used at Frances and Popovitch Creek. Automatic samplers will be at five sites (all but Popovitch Creek) programmed to be flow activated to collect sediment samples at one hour intervals during flood events. For Popovrtch Creek a bedload sampler will be constructed to collect bedload from the downstream end of the flume being purchased for that site. At all sites grab sampling methods will be used to collect sediment samples during normal flows. It will be important to be notified during flood events so that peak flows can be measured, samples can be collected at the Popovitch site, and all sites can be monitored for proper operation.

This work will be done in conjunction with the water chemistry monitoring program that will be done in 1987. The water chemistry program will include sampling for field chemistry parameters, major anions and cations, and major and trace metals at sites above and below mining and from water wells located near the present mining at Poker Flats.

REFERENCES CITED

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Wahrhaftig, Clyde. "Geologic Map of the Healy D-4 Quadrangle, Alaska." Geologic Quadrangle Map GQ-806. U.S. Geological Survey, Washington, D.C., 1970.

Wahrhaftig, Clyde, J.A. Wolfe, E.B. Leopold, and M.A. Lanphere. "The Coal-Bearing Group in the Nenana Coal Field, Alaska." Geological Survey Bulletin 1274-D. USGPO, Washington, D.C., 1969.

Appendix 1. **Suspended Sediment and Oischarge Data from Hosanna Creek Basin, 1986.**

Location	Date	Time	TSS (mg/l)	Oischarge (cfs)	Sediment Load (tons/day)
Sanderson Creek					
	081386	1030		5.13	
	090586	1045	16.8	2.89	0.13
	092386	1740	59.5	7.61	1.22
	092386	1800	37.6		
North Hosanna Creek					
	081386	1307		5.8	
	081486		3170		
	081586		1480		
	081686		1860		
	081786		2470		
	081886		1500		
	081986		6300		
	082086		6050		
	082186		26800		
	082286		20700		
	082386		7100		
	082486		9080		
	082586		8340		
	082686		5770		
	082786		2208		
	090586	1500	986	2.8	7.45
	090886		13200		
	090986		6220		
	091086		3530		
	091186		3450		
	091286		1410		
	091386		1190		
	091486		880		
	091586		2800		
	091686		3550		
	091786		4450		
	091886		6610		
	091986		4410		
	092086		2460		
	092286		1790		
	092386		306		
	101386	1400	2960	7.88	63.0

Appendix 1. Sediment and discharge data from Hosanna Creek

Location	Date	Time	TSS (mg/l)	Discharge (cfs)	Sediment Load (tons/day)
Popovitch Creek					
	081286	1655		0.33	
	081486	1230	178		
	081486	1315	624		
	082286	1845	17000		
	082686		340		
	082686		7780		
	082686		1250		
	082686	1240	2120		
	082686	1530		2.14	
	090486	1400	169	1.05	0.48
	090486	1400	169		
	090586	1740	221	0.96	0.57
	090686			0.96	
	090786	1510	1640	0.93	4.13
	090886			1.37	
	090986			1.09	
	091086	1910	8830	0.95	22.6
	091186			0.91	
	091286			0.89	
	091386		24800	0.86	57.4
	091486			0.87	
	091586			0.78	
	091686			0.93	
	091786			0.72	
	091886			0.78	
	091986			0.70	
	092086			0.78	
	092186			0.69	
	092286	1630	66.5	0.93	0.17
	092386			0.62	
	092486	0925		0.70	
	101386	1730	540	1.05	1.53
Frances Creek					
	081486	0900		1.92	
	081586		2130		
	081686		1730		
	081786		285		
	081886		679		
	081986		1810		
	082086		3160		
	082286	1800	4130		
	082386		2310		
	082486		1050		
	082586		480		

Appendix 1. Sediment and discharge data from Hosanna Creek

Location	Date	Time	TSS (mg/l)	Discharge (cfs)	Sediment Load (tons/day)
Frances Creek	082686	1600		0.39	
	082686	1842	239	0.39	0.25
	082786		332		
	082886		404		
	082986		162		
	083086		119		
	083186		96.1		
	090186		95.5		
	090286		81.9		
	090386		35.5		
	090486		18.3		
	090486	1415	171	0.17	0.08
	090586		52.4		
	090586	1800	54.5	0.13	0.02
	090686		73.2		
	090786		54.9		
	090786	1640	45.8		
	090886		264		
	090986		1180		
	091086		188		
	091086	1840	109		
	091186		139		
	091286		249		
	091386		69.9		
	091486		37.5		
	091486	1310	48.1		
	091586		92.1		
	091686		220		
	091786		118		
	091886		250		
	091986		130		
	092086		229		
	092186		273		
	092286		96.4		
	092286	1645	21.2	0.19	0.01
	092386		88.9		
	092486	1000	46.1	0.18	0.02
	101386	1750	72.5	0.25	0.05
Hosanna Creek at Bridge 3					
	081386	1700		50.2	
	081486		1490		
	081486	1200	573	32.6	50.4
	081586		1240		
	081686		698		
	081786		538		

Appendix 1. Sediment and discharge data from Hosanna Creek

Location	Date	Time	TSS (mg/l)	Discharge (cfs)	Sediment Load (tons/day)
Hosanna Creek	081886		7150		
at Bridge 3	081986		3030		
	082086		14800		
	082186			1200 (peak)	
	082686	1900	1100	57.6	171
	082786		1720		
	082886		1350		
	082986		1080		
	083086		1370		
	090186		653		
	090286		573		
	090386		676		
	090486		427		
	090486	1500	373	29.4	29.6
	090586		372	29.8	29.9
	090586	1810	330	29.6	26.4
	090686		546	28.6	42.2
	090786		425	27.1	31.0
	090886		391	40.5	42.7
	090986			57.1	
	091086		1620	46.7	204
	091086	1830	1040	44.9	126
	091186		1250	45.2	153
	091286			43.8	
	091386		600	40.8	66.2
	091486		465	37.9	47.6
	091586			35.6	
	091686			38.8	
	091786		1680	40.5	183
	091886		931	41.9	105
	091986		640	37.5	64.8
	092086			38.4	
	092186			42.9	
	092286		1010	40.1	109
	092286	1700	370	40.8	40.8
	092386		661	38.2	68.2
	092486	1024	214	36.9	21.3
	101386	1810	2990	114	920
Hosanna ab North Hosanna					
	101386	1427	2100		
Hosanna below Sanderson					
	101386	1452	1740		