Alaska—FRPA Region III
(Interior Spruce Hardwood Forest, North and West of the Alaska Range)

159) Aldrich, J.W., and C.W. Slaughter. 1983. Soil erosion on subarctic forest slopes. Journal of Soil and Water Conservation. 38: 115-118. (K)

Author abstract: Investigations of sheet-rill erosion in a permafrost-free subarctic setting indicated that stripping all vegetation from the soil surface increased rainfall erosion 16 times over that produced from an undisturbed forest, from a rate of 0.008 ton per acre per year to 0.13 ton per acre per year. Removing the trees from a forested area, with only minor disturbance of ground cover, did not increase erosion. Very low erosion, 0.03 ton per acre per year, was measured from a vehicle trail on permafrost terrain. Comparison of measured erosion with erosion predicted by the universal soil loss equation indicated that the equation overestimated annual rainfall erosion by an average of 21 percent and overestimated individual storm erosion by an average of 174 percent.

160) Aldrich, J.W., and R.A. Johnson. 1979. Surface erosion and sedimentation associated with forest land use in interior Alaska: Completion report. Institute of Water Resources, University of Alaska, Fairbanks, Report No. IRW-99. 87pp. (K)

Author abstract: The magnitude of sheet-rill erosion associated with various landscape manipulations is presented. The Universal Soil Loss Equation's usefulness for predicting annual sheet-rill erosion within interior Alaska is confirmed. Investigations of sheet-rill erosion indicate that removing trees from forested areas with only minor ground cover disturbance did not increase erosion. Removing the ground cover, however, increased erosion 18 times above that on forested areas. Erosion is substantially reduced when disturbed areas are covered with straw mulch and fertilizer. Comparison of the actual erosion and the quantity of erosion predicted with Universal Soil Loss Equation indicates that the equation overestimates annual erosion by an average of 21 percent. It overestimates individual storm erosion by an average of 174 percent. Data are also presented concerning sheet-rill erosion in a permafrost trail, distribution of the rainfall erosion index, and suggested cover and management factor values.

161) Anderson, G.S. 1970. Hydrologic reconnaissance of the Tanana Basin, central Alaska. USDI Geological Survey Hydrologic Investigations Atlas HA-319. 4 sheets. (G)

Electronic abstract: The Tanana basin in interior Alaska covers approximately 44,500 square miles with 576 square miles of its headwaters in Canada. This report is intended to define in broad terms the hydrology of the Tanana basin. Although basic data are limited, sufficient information is available to formulate a framework for further collection of basic data, preliminary development planning, and identification of problems. The Tanana basin is entirely within the discontinuous permafrost zone of Alaska. Groundwater in the Tanana basin occurs under unconfined and artesian conditions. Unconfined groundwater generally is found in unconsolidated alluvium in the valleys and in fractured bedrock beneath high slopes and ridges. Artesian conditions generally occur in the lower slopes where permeable beds are confined by permafrost or by impermeable sedimentary beds. Along the lower hillslopes, flowing artesian wells are common. The thermal effects of water exert a dominant control on the permafrost

regimen. Deeper lakes and rivers and the circulation of groundwater cause the degradation of permafrost and limit its distribution both vertically and aerially. The average streamflow of the Tanana River near its mouth is estimated as 37,000 cfs. Approximately 85% of this discharge originates in the Alaska Range; approximately 50% of the discharge is contributed by 4 tributaries from the south side, the Kantishna, Nenana, Nabesna, and Delta Rivers.

162) Ashton, W.S., and S.R. Bredthauer. 1986. Riverbank erosion processes on the Yukon River at Galena, Alaska. In: Proceedings of the Cold Regions Hydrology Symposium, University of Alaska, July 1986, Fairbanks. D.L. Kane, Editor. American Water Resources Association Technical Publication Series TPS-86-1. American Water Resources Association, Bethesda, Maryland. Pages 415-423. (A, F)

Author abstract: Periodic measurements of riverbank recession on the Yukon River at Galena, Alaska have been made since 1946. Intensive studies of channel shape and riverbank erosion were conducted in 1959, 1984 and 1985. Erosion rates varied from 0.3 m/yr (1.0 ft/yr) at banks with developed vegetative protection (peat or bank debris) to 10.8 m/yr (35.5 ft/yr) at steep banks with active thermoerosional niching. Comparison of channel profile measurements from June 1984 and June 1985 indicate that the thalweg did not significantly change location or elevation during a 10-year recurrence interval flood.

163) Brabets, T.P., B. Wang, and R.H. Meade. 2000. Environmental and hydrologic overview of the Yukon River Basin, Alaska and Canada. USDI Geological Survey, Anchorage, Alaska, Water-Resources Investigations Report 99-4204. 106pp. (G, I)

Author abstract: The Yukon River, located in northwestern Canada and central Alaska, drains an area of more than 330,000 square miles, making it the fourth largest drainage basin in North America. Approximately 126,000 people live in this basin and 10 percent of these people maintain a subsistence lifestyle, depending on the basin's fish and game resources. Twenty ecoregions compose the Yukon River Basin, which indicates the large diversity of natural features of the watershed, such a climate, soils, permafrost, and geology.

Although the annual mean discharge of the Yukon River near its mouth is more than 200,000 cubic feet per second, most of the flow occurs in the summer months from snowmelt, rainfall, and glacial melt. Eight major rivers flow into the Yukon River. Two of these rivers, the Tanana River and the White River, are glacier-fed rivers and together account for 29 percent of the total water flow of the Yukon. Two others, the Porcupine River and the Koyukuk River, are underlain by continuous permafrost and drain larger areas than the Tanana and the White, but together contribute only 22 percent of the total water flow in the Yukon.

At its mouth, the Yukon River transports about 60 million tons of suspended sediment annually into the Bering Sea. However, an estimated 20 million tons annually is deposited on flood plains and in braided reaches of the river. The waters of the main stem of the Yukon River and its tributaries are predominantly calcium magnesium bicarbonate waters with specific conductances generally less than 400 microsiemens per centimeter. Water quality of the Yukon River Basin varies temporally between summer and winter. Water quality also varies spatially among ecoregions.

164) Burrows, R.L. 1980. Cross-section, velocity, and bedload data at two erosion sites on the Tanana River near Fairbanks, Alaska, 1979. USDI Geological Survey, Anchorage, Alaska, Open-File Report 80-699. 32pp. (F, G, I)

Author abstract: In an effort to relate river processes to vertical and lateral erosion at two sites on the Tanana River in the vicinity of Fairbanks, measurements of depth, velocity, and bedload-transport rates were made at several sections at each site.

To facilitate comparison of the river processes and ongoing erosion, compilation and graphic presentation of the velocity distributions and bedload-transport rates are presented in conjunction with cross-section configuration immediately adjacent to the area of erosion.

Dry sieve analyses of the bedload samples give particle-size distribution. Approximately 85-95 percent of the material in transport at both sites was in the sand range (>0.062 millimeter <2.0 millimeters).

165) Burrows, R.L., and P.E. Harrold. 1983. Sediment transport in the Tanana River near Fairbanks, Alaska, 1980-81. USDI Geological Survey, Anchorage, Alaska, Water Resources Investigations Report 83-4064. 116pp. (G, I)

Author abstract: Suspended-sediment and bedload-transport rates for the Tanana River near Fairbanks, Alaska can be related to water discharge, and annual sediment loads can be computed using these relations. For a site at Fairbanks, the annual loads in 1980 were 22.0 million metric tons of suspended sediment and 272,000 metric tons of bedload; in 1981, 27.3 million metric tons of suspended sediment and 333,000 metric tons of bedload passed the Fairbanks site. Data collected at five other locations within a 40-kilometer reach of the river indicate very similar suspended-sediment-transport relations, but bedload-transport relations varied from site to site and between 1980 and 1981. For all sites bedload is usually 1 to 1.5 percent of suspended-sediment load.

Particle-size distribution for suspended sediment is similar at all six sites. Median particle size is generally in the silt range; only occasionally is it in the very fine sand range.

Median particle size of bedload varied from the gravel range to the medium sand range for five of the six sampling sites in both years. At the sixth site, the farthest downstream location, median particle size of bedload was in the sand range.

Bed material particles were somewhat coarser at the upstream sites than at the downstream sites. Coarser particles dominated the deeper portions of the channels and finer material was predominant on the bars and overflow parts of the channels. Median particle size of bed material was generally in the coarse gravel range, but was in the medium sand range at the farthest downstream site.

Water-surface profiles show that at all discharges the water-surface slope was steeper at the upstream sites than at the downstream sites.

166) Burrows, R.L., B. Park, and W.W. Emmett. 1979. Sediment transport in the Tanana River in the vicinity of Fairbanks, Alaska, 1977-78. USDI Geological Survey, Water Resources Division, Anchorage, Alaska, Open-File Report 79-1539. 37pp. (G, I)

Electronic abstract: Measurements of the sediment load of the Tanana River in the vicinity of Fairbanks, Alaska, show that suspended-sediment transport rate in tons per day, relates to water discharge, in cubic feet per second, as: Suspended-sediment transport rate (tons/day) = 5.717 x 10 to the minus 8th power x water discharge (cubic feet/second) to the 2.713 power, (where the correlation coefficient squared = 0.967). The bedload-transport rate is approximately 1 to 2 percent of the suspended-sediment transport rate. Data collected at Fairbanks and upstream from Fairbanks near North Pole, Alaska, show little difference in size distribution of suspended sediment between the two locations. The median particle size distribution of suspended sediment is generally in the silt range, but at some low-water discharges, the median particle size is in the very fine sand range. The median particle size is in the very fine sand range. The median particle size of bedload near North Pole is generally in the gravel range, but at some low transport rates, the median particle size is in the medium sand range. At Fairbanks, data collected in 1977 indicate median particle sizes of bedload comparable to those of the upstream location, whereas data collected in 1978 indicate a marked decrease in median particle size of bedload between the two locations. For both locations and at all water discharges and sediment transport rates, particles constituting the suspended load are significantly smaller than particles constituting the bedload.

167) Burrows, R.L., W.W. Emmett, and B. Parks. 1981. Sediment transport in the Tanana River near Fairbanks, Alaska, 1977-79. USDI Geological Survey, Anchorage, Alaska, Water-Resources Investigations Report 81-20. 56pp. (G, I)

Author abstract: Suspended-sediment- and bedload-transport rates for the Tanana River near Fairbanks, Alaska, can be related to water discharge, and annual sediment loads can be computed using these relations. For a site near Fairbanks, the average annual (1974-79) load is 24 million metric tons of suspended sediment and 321,000 metric tons of bedload. Upstream, near North Pole, the average annual load is 20.7 million metric tons of suspended sediment and 298,000 metric tons of bedload. For both sites bedload is usually 1 to 1.5 percent of suspended-sediment load. Particle-size distribution for suspended sediment is similar at Fairbanks and North Pole. Median particle size is generally in the silt range, but at some low-water discharges, it is in the very fine sand range. Median particle size of bedload near North Pole is generally in the gravel range, but at some low transport rates, it is in the medium sand range. In 1977 median bedload particle size was comparable at the two sites, but in 1978 the median size was markedly smaller at Fairbanks. In 1979 generally coarser material was transported at both sites, but the difference in bedload particle size was even greater between the sites. At both locations and all water discharges and sediment-transport rates, suspended-load particles are significantly smaller than bedload particles. At North Pole in 1979, median bed-material particle size was in the coarse gravel range; at Fairbanks it was in the medium gravel range in the main channel but in the fine sand range in the overflow part of the channel.

168) Chikita, K.A., R. Kemnitz, and R. Kumai. 2002. Characteristics of sediment discharge in the subarctic Yukon River, Alaska. Catena. 48: 235-253. (G, I, J)

Electronic abstract: The characteristics of sediment discharge in the Yukon River, Alaska were investigated by monitoring water discharge, water turbidity and water temperature. The river-transported sediment, 90 wt.% or more, consists of silt and clay (grain size =62.5 µm), which probably originated in the glacier-covered mountains mostly in the Alaska Range. For early June to late August 1999, we continuously measured water turbidity and temperature near the estuary and in the middle of Yukon River by using self-recording turbidimeters and temperature data loggers. The water turbidity (ppm) was converted to suspended sediment concentration (SSC; mg/l) of river water, using a relation between simultaneous turbidity and SSC at each of the two sites, and then, the suspended sediment discharge, approximately equal to water discharge times SSC, was numerically obtained every 1 or 2 h. It should be noted that the sediment discharge in the Yukon River is controlled by SSC rather than water discharge. As a result, a peak sediment discharge occurred in mid or late August by local sediment runoffs due to glacier-melt (or glacier-melt plus rainfall), while a peak *water* discharge was produced by snowmelt in late June or early July. Application of the "extended Shields diagram" indicates that almost all the river-transported sediments are under complete suspension.

169) Clark, R.A. 1992. Influence of stream flows and stock size on recruitment of Arctic grayling (*Thymallus arcticus*) in the Chena River, Alaska. Canadian Journal of Fisheries and Aquatic Sciences. 49: 1027-1034. (G)

Author abstract: The hypothesis that recruitment of Arctic grayling (*Thymallus arcticus*) in the Chena River is influenced by streamflow and stock size was tested using population data collected from 1976 through 1990. Recruitment may be influenced by streamflow during the initial weeks of life of Arctic grayling, namely during spawning, emergence, and the larval stage. Using correlation and regression analyses, streamflow during the time-frame was found to be a significant descriptor of variability in recruitment ($r = -0.751$, $p = 0.005$). Although streamflow was implicated in recruitment variation, creation of an environment-dependent, stock-recruitment model was not possible because estimates of measurement error were lacking. This was because of bias due to the relation between residuals and subsequent stock size, and because of the presumed autocorrelation of stock size. An alternative analysis was conducted to investigate the influence of stock size on recruitment when streamflow was thought to minimally affect recruitment. Using an estimate of natural mortality rate, and assuming no fishing mortality, the theoretical contribution of recruits to the spawning stock exceeded the maximum observed stock size. It was concluded that the maximum observed stock size failed to negatively influence recruitment, and the level of stock size that might influence recruitment is greater than the maximum observed stock size.

170) Clay, J.R. 1973. The drift of benthic invertebrates in Goldstream Creek, Alaska. M.S. Thesis, University of Alaska, Fairbanks. 83pp. (C, G, H, J)

Electronic abstract: The objectives were to determine if there was any diurnal variation in the amount of drift; what organisms were present in the drift; and to evaluate several physical parameters, including light intensity, water temperature and stream discharge with respect to their influence on the drift of macro-invertebrates in Goldstream Creek. Ephemeroptera (mayflies) and Diptera (two-winged flies) were the only orders represented consistently within the drift. Ephemeroptera exhibited a definite diurnal periodicity during the second, third and fourth (of four) sampling periods, while Diptera exhibited a similar periodicity during the third and fourth sampling days. Both orders peaked in abundance, as caught with a drift net, after sunset. The greatest numbers of both orders captured during the study were collected on the sampling day during which the highest water temperature was measured.

171) Collins, C.M. 1990. Morphometric analyses of recent channel changes on the Tanana River in the vicinity of Fairbanks, Alaska. US Army Corps of Engineers, Cold Regions Research and Engineering Laboratory, CRREL Report 90-4. 54pp. (A, F)

Author abstract: Long-term bank erosion rates and channel changes in 1 14-km stretch of the Tanana River centered on Goose Island were documented using historical aerial photography from 1938 through 1982. The construction effects of a causeway partially blocking the river and the time required to return to equilibrium after construction were studied. Erosion, averaged over the entire study reach, was not significantly different following causeway construction compared to that prior to construction. Significant short-term increases in localized erosion rates during post- vs pre-construction time periods were documented in south channels and islands downstream of the causeway. Deposition upstream of the river constriction formed by the causeway was dramatic. The Tanana River returned to near equilibrium by 1980, five years after the construction of the causeway, with some effects continuing in 1982. Due to additional in-river construction downstream of the study area in 1981, the separate effects from the causeway could not be monitored beyond 1982.

172) Cowan, C.A. 1983. Phenology of benthic detritus input, storage and processing in an Alaskan subarctic stream. M.S. Thesis, University of Alaska, Fairbanks. 98pp. (C)

Author abstract: Allochthonous leaf litter input, storage of benthic detritus, processing rates of leaf litter, and macroinvertebrate standing crop were measured in Monument Creek, a second-order stream in interior Alaska. Litter input and storage of benthic detritus was very low in comparison to temperate streams. Processing rates of 5 g experimental leaf packs of birch and willow were moderate, while alder was processed very rapidly. Insect densities on leaf packs were relatively high, and approached domination by shredders (consumers of whole leaf tissue) as processing progressed. Associations between size classes of benthic detritus and standing crop of invertebrate feeding groups were generally positive but very weak, despite high shredder densities and low detritus storage. Productive capacities of high latitude streams may be fundamentally limited by low allochthonous input.

173) Cowan, C.A., and M.W. Oswood. 1983. Input and storage of benthic detritus in an Alaskan subarctic stream. Polar Biology. 2: 35-40. (C)

Electronic abstract: Allochthonous leaf litter input and storage of benthic detritus were measured in Monument Creek, a second-order interior Alaskan stream. Litter input was very low, totaling 62.5 g ash-free dry weight (AFDW) $\cdot$ m^{-2} $\cdot$ y^{-2} in 1980. Peak input coincided with autumnal leaf fall. Benthic detritus storage was similarly low. CPOM (coarse particulate organic matter, > 1 mm) ranged from 2.8 to 28.9 g AFDW $\cdot$ m^{-2}, peaking in mid-September, MPOM (medium particulate organic matter, 250 µm - 1 mm) ranged from 3.7 to 10.9 g AFDW $\cdot$ m^{-2}, peaking in May. SPOM (small particulate organic matter, 80 - 250 µm) ranged from 2.0 to 9.0 g AFDW $\cdot$ m^{-2} and also peaked in May. Compared to streams in temperate regions, Monument Creek is receiving and storing less energy from the surrounding forest.

174) Cowan, C.A., and M.W. Oswood. 1984. Spatial and seasonal associations of benthic macroinvertebrates and detritus in an Alaskan subarctic stream. Polar Biology. 3: 211-215. (C)

Electronic abstract: Seasonal and spatial patterns of benthic invertebrate abundance were examined in relation to benthic detritus in Monument Creek, an Alaskan subarctic stream. The total macroinvertebrate fauna showed a mid-summer low in abundance, increasing to seasonal highs in winter/early spring (November/May). Shredders were a small portion of the benthic fauna or leaf pack fauna in summer but increased rapidly (in biovolume) following autumnal leaf fall to dominate the fauna by early winter (October/November). Abundance was strongly correlated with quantity of detritus in the sample. Each unit of benthic detritus in Monument Creek is associated with a relatively large number of small (low individual biomass) shredders compared to streams in temperate regions. Detrital resources in this subarctic stream were meager, compared to temperate streams, and appeared to strongly influence the spatial and temporal patterns of detritivores.

175) Dingman, S.L. 1971. Hydrology of the Glenn Creek watershed, Tanana River Basin, central Alaska. US Army Corps of Engineers, Cold Regions Research and Engineering Lab, Hanover, New Hampshire, Research Report 297. 112pp. (G)

Author abstract: The results of a four-summer (1964-1967) hydrologic study of the watershed of Glenn creek, about 8 miles north of Fairbanks, Alaska, in the Yukon-Tanana uplands physiographic province, are presented. This work was initiated to provide initial base line hydrologic data for a small subarctic watershed. The stream is second-order, and drains an area of 0.70 square mile. Basin elevations are from 842 to 1,618 ft. about half of the 12.3-in. normal annual precipitation is runoff. The remainder is the actual evapotranspiration, which equals only about 30% of estimated potential evapotranspiration. For individual storms, runoff-rainfall proportions were from 0.03 to 0.42, and were positively correlated with antecedent discharge of the stream. Peak discharges for individual storms were estimated by an equation including antecedent discharge, total precipitation and storm duration, and average recession constant. These results represent the first detailed hydrologic data from the discontinuous permafrost zone of the North American taiga and should be of significance to the international hydrological decade and international biological program.

176) Emmett, W.W., R.L. Burrows, and B. Parks. 1978. Sediment transport in the Tanana River in the vicinity of Fairbanks, Alaska, 1977. USDI Geological Survey, Anchorage, Alaska, Open-File Report 78-290. 28pp. (G, I)

Author abstract: Measurements of suspended- and bedload-sediment transport for the Tanana River in the vicinity of Fairbanks, Alaska, show that suspended-sediment load, G_s in tons per day, relates to water discharge, Q, in cubic feet per second as:

$$G_s = 1.66 \times 10^{-8} Q^{2.83}$$

The bedload transport rate is approximately one percent of the suspended-sediment transport rate.

The median particle size of suspended sediment is generally silt (<0.062 mm), but at some low-water discharges, the median particle size is very fine sand. The median particle size of bedload is generally gravel (>2.0 mm, and often in the range of 10 to 20 mm), but at some low transport rates, the median particle size is medium sand. At all water discharges and sediment-transport rates, the particles constituting the suspended load are significantly smaller than the particles constituting the bedload.

177) Fox, J.D., Jr. 1989. Simulating vegetation-water yield relations in interior Alaska. In: Proceedings of Watershed '89: A Conference on the Stewardship of Soil, Air, and Water Resources, 21-23 March 1989, Juneau, Alaska. E.B. Alexander, Editor. USDA Forest Service, Alaska Region, R10-MB-77. Pages 179-189. (G)

Author abstract: Spring runoff in cold climates is affected by the complex interaction of snowmelt rate and soil infiltration capacity. The former is affected by all factors influencing the snowpack energy balance, while the latter is affected by soil texture and the combination of autumn soil moisture, snowpack depth and air temperature that determines soil freezing and thawing. These complex relationships are also influenced by vegetative cover. Accordingly, a hypothesis has been made that runoff will increase after timber harvest, not only due to increased snowmelt rates and decreased transpiration, but also due to increased fall soil moisture and subsequent formation of concrete frost. Since no vegetation-water yield field experiments have been done in interior Alaska, a watershed model designed to study vegetation-water yield relations was modified to include a soil freeze-thaw algorithm (Stefan-St. Paul equations) and used to simulate the interaction of forest cover, soil moisture, soil frost, infiltration, and spring runoff. Simulation results support the hypothesis outlined above but also indicate the conditional nature of the vegetation-water yield connection. Simulations also indicate that the drier the initial soil conditions, the longer may be the delay in runoff response to harvest. The model does appear to realistically simulate the great variability in spring runoff patterns observed in interior Alaska and provides direction for further research. These results, as well as the general approach, should be useful to watershed managers in explaining the variability of spring runoff events and in estimating potential impacts of vegetation changes on water yield.

178) Freeman, M.W. (Editor). 2000. Region III forest resources & practices riparian management annotated bibliography. Report by the Alaska Department of Natural Resources Division of Forestry, and the Alaska Department of Fish and Game Habitat & Restoration Division. Report written for the Alaska Board of Forestry. 152pp. (A, D, F, I)

Compiler abstract: This annotated bibliography is a compilation of published research relevant to riparian management issues in interior Alaska. The bibliography is separated into seven topics: 1) buffer function and design; 2) factors affecting stream bank and river bank stability, with an emphasis on vegetation influences; 3) large woody debris; 4) permafrost and silty soils; 5) winter fish use of glacial streams; 6) fish use of upwellings; and 7) ice thickness and ice bridges. A brief summary of the referenced literature for each topic is provided at the beginning of each section of the bibliography.

179) Frey, P.J., E.W. Mueller, and E.C. Berry. 1970. The Chena River, the study of a subarctic stream. Federal Water Quality Administration, Alaska Water Lab, Fairbanks, Alaska. Reference FWQA project no 1610--10/70. 96pp. (C, I)

Electronic abstract: The Chena River is a subarctic stream flowing westerly from the low mountains of eastern Alaska to the Tanana River near Fairbanks. It is typical of many interior Alaska rivers with the exception that its lower reaches are highly polluted by domestic and industrial wastes from the Fairbanks area. The purpose of this 3-year study of the river was to understand the physical, chemical, and biological limnology of the river system and what effect man's influence--past, present and future--has on the river. Dissolved oxygen was one of the most critical parameters determined. In the summer it is close to saturation. During winter, in the lower river, the concentration approaches 1 mg/1. The biological community was studied through both quantitative and qualitative plant and animal collections. The upper reaches of the river are much richer in number of kinds of organisms than the lower reaches. Coliform bacteria counts range from very low in the upper river to over 500,000 per 100/m1 below Fairbanks. A flood control dam is planned for the river above the city of Fairbanks. Significant modification of the water quality and biota of the river can be expected following the construction of the dam. Proper management of the flow from the impoundment can reduce the objectionable effects of this dam on the river system.

180) Gatto, L.W. 1984. Tanana River monitoring and research program: Relationships among bank recession, vegetation, soils, sediments and permafrost on the Tanana River near Fairbanks, Alaska. US Army Corps of Engineers, Cold Regions Research & Engineering Laboratory, Special Report 84-21. 53pp. (A, F)

Author abstract: The objective of this analysis was to determine if available data are useful in identifying the characteristics that contribute to erodibility of the banks along two reaches of the Tanana River. Existing data on bank vegetation, soils, sediments and permafrost were used. Because these data were general and not collected for the purpose of site-specific analysis, my analytical approach was simple and did not include any statistical tests. The data were visually compared to the locations and estimated amounts of historical recession to evaluate if any relationships were obvious. The results of this analysis showed no useful relationships. Vegetation was similar in eroded and uneroded areas and its distribution did not show any obvious relationship to the locations of bank recession. Surface sediments and soils in the eroded areas had little, if any, effect on bank erodibility because the river erodes the bank over its entire depth, which is well below this surface zone. The subsurface sediment from eroded and uneroded well and along transects with high and low measured recession was similar. Permafrost occurrences are about equal in eroded and uneroded sites, although it appears that recession can be higher where permafrost is common than where it is absent. In most cases the existing data are either too general or not properly located to be useful in anticipating future locations of bank erosion. In order to predict future erosion, a field project should be initiated to evaluate the influence of bank characteristics and hydraulic forces on bank erosion rates.

181) Harrold, P.E., and R.L. Burrows. 1983. Sediment transport in the Tanana River near Fairbanks, Alaska, 1982. USDI Geological Survey, Anchorage, Alaska, Water-Resources Investigations Report 83-4213. 53pp. (G, I)

Author abstract: Suspended-sediment and bedload-transport rates for the Tanana River near Fairbanks can be related to water discharge and annual sediment loads can be computed using these relations. For a site at Fairbanks the annual loads in 1982 were 26.1 million metric tons of suspended sediment and 227,000 metric tons of bedload. Data collected at five other sites within a 40-kilometer reach of the river indicate very similar suspended-sediment-transport relations but bedload-transport relations varied from site to site. For all sites bedload is on the order of 1 percent of suspended-sediment load.

Particle-size distribution for suspended sediment is similar at all six sites. Median particle size is generally in the silt range; only occasionally is it in the very fine sand range.

Median particle size of bedload varied from the gravel range to the medium sand range at four of the six sampling sites. At the farthest downstream location, Byers Island, and the farthest upstream location, above Chena River Floodway, median particle size of bedload was always in the sand range.

Water-surface profiles show that at all discharges, the water surface slope was steeper at the upstream sites than at the downstream sites.

182) Hemming, C.R., and W.A. Morris. 1999. Fish habitat investigations in the Tanana River watershed, 1997. Alaska Department of Fish and Game, Habitat and Restoration Division, Juneau, Alaska, Technical Report No. 99-1. 83pp. (I)

Author abstract (Author Executive Summary): This report contains the results from 1997, the second year of a two-year field investigation undertaken in 1996 of juvenile fish and juvenile fish habitat in the Tanana River system. The goal of this study was to identify habitats used by juvenile fish and to describe the physical and water quality characteristics of these areas. We expanded the study in 1997 to include a sample area near Delta Junction, and continued sampling the Tanana River near Fairbanks (Ott et al. 1998). We captured fish in minnow traps and beach seines, and collected water samples at selected locations with each sample area. Water samples were analyzed for turbidity and total suspended solids.

Minnow traps were set at various locations within each sample area and left to fish overnight for about 24 hour intervals; sampling occurred monthly from May through August 1997. Minnow traps were set at up to 20 sites in the Fairbanks area, during the four sample periods, yielding 79 trap days of effort. Minnow traps were set at up to 15 locations during the four sample periods, for 58 trap days of effort in the Delta area. We captured 51 fish that included 7 species in the Fairbanks sample reach, and 179 fish included 5 species in the Delta area. We organized the minnow trap fish capture data into five water classes based on visual characteristics of the water. We tested the five water classes using turbidity and total suspended solids measurements and found a significant difference in water quality measurements between each of the five classes. We evaluated minnow trap fish capture results by water class and found the greatest number of species and the largest catches in groundwater and tannic-stained runoff habitats.

Beach seining was conducted at various sites in both sample areas. All seine sites occurred in turbid-water areas with similar velocities, depths, and water quality characteristics. Seining in the Fairbanks area yielded 1,642 fish including 12 species. Delta-area sampling captured 930 fish of 9 species. Beach seine results identified temporal and spatial patterns of fish use in each sample area. Fish species found in each area were similar, but catch numbers varied between the two

areas. Juvenile salmon were captured during the May and June sampling periods in both the Fairbanks and Delta areas; however, chum salmon (*Oncorhynchus keta*) fry were more frequently captured in the Delta sample area. Groundwater upwelling areas produced the largest catches of chum salmon fry in the Delta area. In the Fairbanks sample area we found a similar pattern to that found in 1996, with lake chubs (*Couesius plumbeus*) and longnose suckers (*Catostomus catostomus*) captured most frequently. Slimy sculpin (*Cottus cognatus*) and Chinook salmon (*Oncorhynchus tschawytscha*) were most often captured in association with gravel substrate areas.

183) Hughes, N.F. 1991. The behavioral ecology of Arctic grayling distribution in interior Alaskan streams. Ph.D. Thesis, University of Alaska, Fairbanks. 124pp. (K)

Author abstract: During the summer months Arctic grayling in interior Alaskan streams get bigger as you travel from downstream reaches to the headwaters. On a smaller scale, within individual pools, the largest fish holds position in the middle of the current, near the deepest part of the pool, and smaller fish hold positions progressively further downstream or to the side of the pool. The results of this study support the hypothesis that a single process – competition for profitable feeding positions – produces both the whole-stream and within-pool distribution pattern.

Field experiments showed that competition for desirable positions is responsible for the distribution patterns adopted by groups of fish sharing a pool, and for the size-gradient of fish over the length of the stream. In both cases large fish excluded smaller ones from the most desirable positions. Modeling work suggested that Arctic grayling locate and rank positions on the basis of profitability. Within pools this conclusion was supported by a close fit between the positions predicted by a foraging model and the positions actually selected by Arctic grayling. Over the length of the whole stream this conclusion was supported by the model's prediction that feeding positions become more profitable as you go upstream.

184) Irons, J.G., III, and M.W. Oswood. 1992. Seasonal temperature patterns in an arctic and two subarctic Alaskan (USA) headwater streams. Hydrobiologia. 237: 147-157. (J, H)

Electronic abstract: Monument Creek (MC) and Little Poker Creek (LPC) are subarctic streams in interior Alaska; LPC is in a permafrost-dominated valley. Imnavait Creek (IC) is an arctic tundra beaded stream in the northern foothills of the Brooks Range. Water temperatures were recorded with automated dataloggers hourly. Water temperature rose in the spring about twice as fast in MC as in LPC, and again about twice as fast in IC as in MC. A similar pattern was observed during the autumnal decline in water temperature. Maximum daily amplitude followed a similar pattern. Although it is about 450 km north of the other streams, the tundra stream (IC) accumulated more degree-days, had higher maximum and mean temperatures, greater daily temperature amplitude, and steeper slopes of vernal temperature rise and autumnal temperature decline than the subarctic streams (LPC and MC). The absence of a canopy of riparian plants, channel morphology, and continuous sunlight during the arctic mid-summer accounted for these higher temperatures. Beaded tundra streams provide a highly seasonal (< 120 d ice-free) and spatially and temporally complex thermal environment.

185) Irons, J.G., III, and M.W. Oswood. 1997. Organic matter dynamics in 3 subarctic streams of interior Alaska, USA. Journal of the North American Benthological Society. 16: 23-28. (G, I)

Electronic abstract: The predominant biome in interior Alaska is known as the taiga, or northern boreal forest. In these high latitude forests (about 60 degree N-67 degree N in Alaska), the angle of solar radiation with respect to the land surface is a major factor controlling ecological processes, including those relevant to organic matter dynamics in streams. Sun angle determines mean annual air temperature, which in interior Alaska is about -3.3 degree C. Temperature extremes in this continental climate can range from -50 to +35 degree C. One result of this harsh thermal regime is the presence of permafrost in the colder microclimates. Indeed, much of interior Alaska is in the zone of discontinuous permafrost, in which south-facing slopes are generally permafrost-free, and cold north-facing slopes and poorly drained valley bottoms are generally underlain by permafrost. Soil carbon densities reflect the balance between input (organic matter production) and decomposition. In the cold and often water-saturated soils common at high latitudes, decomposition is reduced and soil carbon may accumulate as peat over very long time periods. Thus there is often a positive relationship between the amount of soil organic matter and the amount of permafrost in a watershed. Permafrost affects the hydrological regimes of subarctic streams. Streams dominated by permafrost are more "flashy" than those that are relatively permafrost-free. Snowmelt runoff is later and greater in a permafrost-dominated basin than snowmelt runoff from a permafrost-free basin. Likewise, peak stormflow discharge from a permafrost-dominated basin is much higher than in a non-permafrost stream; but during rain-free periods and in winter, flow is much lower. This pattern is a result of the flow-paths of precipitation as it travels to the stream. On permafrost-dominated north-facing slopes, precipitation enters the thick organic layer and flows above the permafrost to the stream. On permafrost-free south-facing slopes, precipitation enters the groundwater and is released much more slowly to the stream. Differences in discharge result in different patterns of carbon and sediment flux from basins with differing amounts of permafrost.

186) Irons, J.G., J.P. Bryant, and M.W. Oswood. 1991. Effects of moose browsing on decomposition rates of birch leaf litter in a subarctic stream. Canadian Journal of Fisheries and Aquatic Sciences. 48: 442-444. (C, E)

Electronic abstract: The effects of moose browsing on decomposition rates of paper birch leaves was examined in Monument Creek, a subarctic headwater stream near Fairbanks, Alaska. Leaves from birch trees previously browsed by moose differed from leaves from unbrowsed trees in food quality for stream detrivores in an Alaskan subarctic stream. Leaves from previously browsed plants decomposed faster. Effects of browsing were tested by collecting leaves from previously browsed and unbrowsed trees and measuring loss of mass over time in an Alaskan subarctic stream. The browsing history of birch trees was associated with increased leaching rate of tannin, foliar nitrogen concentration , and rate of mass loss. All three factors were higher for leaves from trees previously browsed than for unbrowsed ones. Faster loss of tannin through leaching and higher foliar nitrogen concentration apparently caused birch detritus to be processed more rapidly by stream biota, potentially increasing secondary production of stream consumers. Hence, moose browsing was associated with important changes in the food quality of birch leaf litter, linking terrestrial herbivory and aquatic food webs.

187) Irons, J.G., S.R. Ray, L.K. Miller, and M.W. Oswood. 1989. Spatial and seasonal patterns of streambed water temperatures in an Alaskan subarctic stream. In: Proceedings of the Symposium on Headwaters Hydrology. W.W. Woessner and D.F. Potts, Editors. American Water Resources Association, Bethesda, Maryland. Pages 381-390. (J)

Author abstract: Streambed temperature profiles were determined for two years (October 1986 to October 1988) in Monument Creek, a second order subarctic stream. Hourly temperature recordings were made at two vertical profiles (near-bank and mid-channel). Air temperatures ranged from -41.6 C to +22.5 C, (mean = 3.8 C). Streambed surface temperatures (as measured in mid-channel) ranged between -0.1 and 13.0 C (year one), and -12.8 to 12.7 C (year two). In the first winter, the near-bank streambed repeatedly froze and thawed during the winter, while the mid-channel streambed never froze. In spite of very cold air temperatures, the coldest temperature reached in frozen stream sediments was -2.5 C. However, in the second winter, both profiles remained frozen (minimum -12.8 C) for most of the winter, although stream flow was still present. Spatial and temporal patterns in water temperature were complex and indicated that streambed water was derived from both streamwater and groundwater. Amount of rain (especially in late fall) was correlated with the hydrology and temperature dynamics of the streambed. In years with late autumn rains, stream sediments may remain unfrozen through the winter as groundwater slowly discharges to the stream; in drier years, sediments may freeze deeply, with profound effects on the availability of unfrozen 'refugia' for overwintering stream invertebrates and immature fishes.

188) Jackson, W.L., and B.P. Van Haveren. 1987. Predicting channel responses to changing flow regimes: Beaver Creek, Alaska. In: Erosion and Sedimentation in the Pacific Rim. International Association of Hydrological Sciences, Washington, DC, IAHS Publication No. 165. Pages 393-394. (A, G)

Electronic abstract: Beaver Creek is a north-flowing tributary to the Yukon River in central Alaska. The river is characterized by a gravel and cobble bed, numerous large meanders, oxbows, sloughs, bars, and multiple channels on certain low-sinuosity reaches. In 1986, a project was initiated (1) to determine the minimum quantity of water necessary to protect the outstanding recreation, aesthetic , and fishery values that made Beaver Creek a component of the Wild Rivers System, and (2) to recommend a legal strategy to protect the recommended instream flow regime. Beaver Creek streamflows were synthesized using regional techniques, indirect methods, and direct stream gaging. Hydraulic geometry relationships and indirect discharge rating curves were developed at 17 cross-sections. Relationships between bankfull discharge and bankfull width, depth, velocity, and wetted perimeter were also developed. Beaver Creek Wild River channel slopes range from 0.30 to 0.03 percent and occur in four distinct slope classes. Based upon the bankfull hydraulic geometry relationships and descriptions of channel morphology, uniform 10, 20 and 30% reductions in Beaver Creek's flood-frequency relationship will result in corresponding reductions of 5, 9, and 14% in bankfull width, depth and wetted perimeter.

189) Kane, D.L., and C.W. Slaughter. 1973. Seasonal regimes and hydrological significance of stream icings in central Alaska. In: The Role of Snow and Ice in Hydrology. Proceeding of the Banff Symposium, September 1972. International Association of Hydrological Sciences, Publication 107, Volume 1. Pages 528-540. (G)

Electronic abstract: Many streams in arctic and subarctic regions have accumulations of ice in the channel and nearby flood plain during the winter months. Field data on the rates of growth of these icings and on various climatic factors were collected at a small research watershed near Fairbanks, Alaska. The volume of icing growths was estimated from aerial photographs. Hydrologic implications were derived by comparing the volume of these icings with other elements of the hydrologic cycle. Water involved in icing formation is diverted from winter streamflow; this same water is released from storage by melt in late spring, augmenting streamflow after peak snowmelt runoff. Water yielded by melt of icing is largely available for streamflow, and does not contribute moisture to the soil mantle away from stream channels as does snowpack meltwater. Stream icing in the subarctic, upland research watershed constituted 4% of yearly runoff volume, but amounted to nearly 40% of winter streamflow. Melt occurred over a 4-week period, largely following ablation of the seasonal snowpack.

190) Kane, D.L, and P.M. Wellen. 1985. A hydraulic evaluation of fish passage through roadway culverts in Alaska. Report No. FHWA-AK-RD-85-24. Final report written by the Institute of Water Resources, Engineering Experiment Station, University of Alaska, Fairbanks. Written for the Alaska Department of Transportation and Public Facilities, Division of Planning and Programming, Research Section, Fairbanks, Alaska. 54pp. (K)

Author abstract: Culverts are a very simple hydraulic structure. However, because the engineer must design for peak flows passing through the culvert while fish are trying to move upstream serious problems arise. Almost all culvert installations in interior and northern Alaska were casually examined, with approximately 100 examined in detail where hydraulic problems existed that may retard fish passage. Data from the field program are included in an appendix to this report. The two major hydraulic problems in regard to fish passage were high velocities and perching; inlet drops caused by deposited sediment, aufeis, alignment of culvert with stream, and non-uniform culvert slopes are some of the other fish passage deterrents that were observed. Also, all known baffled structures were evaluated. Numerous recommendations were made that should improve the hydraulic conditions that exist at a culvert relative to fish passage. Also, it is recommended that further studies be carried out to evaluate the swimming performance of the native fish. Present design criteria are based on very limited studies. Lastly, it is recommended that the concept of the velocity in the occupied zone (area in culvert where fish swim) be considered as the culvert design velocity for fish passage in place of the presently used average cross-sectional velocity.

191) LaPerriere, J.D. 1980. Variation in invertebrate drift in subarctic Alaskan streams. Institute of Water Resources, University of Alaska, Fairbanks. 27pp. (C, E, I)

Electronic abstract: Data from thirteen streams in interior, subarctic Alaska are analyzed to find predictive equations that explain the amount of invertebrate fish-food drifting in the water column. The alkalinity of the water and the stream's average velocity are found to be the factors that influence the amount of drift expressed as concentration or export rate. The alkalinity is shown to be related to the invertebrates' food supply. Average velocity is speculated to be an indication of the shear force at the sediment-water interface where benthic invertebrates forage for their food. These shear forces are seen to operate on benthic invertebrates in an analogous way to that in which they operate in sediment transport. The algae of boreal streams in this region are shown to be somewhat reliant on alkalinity, but a highly significant relationship is shown between total phosphorus and algae when both muskeg (brownwater) and boreal (clearwater) streams are considered together. Brownwater streams of this region tend to have a higher total phosphorus concentration than clearwater streams, but to have a depressed pH that is characteristic of standing waters in muskeg.

192) LaPerriere, J.D. 1983. Alkalinity, discharge, average velocity, and invertebrate drift concentration in subarctic Alaskan streams. Journal of Freshwater Ecology. 2: 141-151. (C, G, I)

Electronic abstract: This study measured the associations of alkalinity, current and invertebrate drift among 13 streams in subarctic Alaska. A significant positive correlation was found between alkalinity and drift concentration expressed as numbers per unit volume. Significant inverse relations were found between stream discharge and drift concentration expressed as either numbers or weight. This "dilution" was to be expected since stream wetted perimeter, the source of invertebrates to drift, increases as approximately the square root of the discharge. Multiple regression analysis also showed a positive relation between stream average velocity and drift concentrations. Invertebrate drift was seen, therefore, to be somewhat analogous to sediment transport in streams.

193) LaPerriere, J.D. 1994. Benthic ecology of a spring-fed river of interior Alaska. Freshwater Biology. 32: 349-357. (C, E, I, J)

Electronic abstract: A massive aquifer between the Gerstle, Tanana and Delta rivers in interior Alaska receives water from them and from smaller streams that flow from the Granite Mountains in the Alaska Range. Groundwater from the aquifer intersects the surface in a mid-sized (20 m^3/s ± 10%) spring-fed stream, Clearwater Creek. Mean annual air temperature is about -2.6°C. However, even in winter when air temperature often reaches -40°C, the stream does not form a complete ice cover. Water temperature ranges from 0 to 7.8°C. Specific conductance and the concentrations of major ions vary little throughout the year, and summed ionic salinity exceeds 250 mg/l. Benthic algal standing crop (as chlorophyll *a*) was at least an order of magnitude higher than that in a nearby surface-water stream, the upper Chena River. Standing crop peaked in spring and autumn (about 20 mg/m^2) and averaged about half this value, although biomass of an early spring bloom of *Hydrurus foetidus* was underestimated. Algal standing crop was inversely related to the concentrations of inorganic nitrogen and orthophosphate-phosphorus in the water column. The ratio of total nitrogen to total phosphorus (as mass concentrations) was always about 30. Measurements of primary production made in Clearwater Creek were among the highest reported for streams in subarctic Alaska. Macroinvertebrate diversity in Clearwater Creek was low. Numbers of "morpho-species" in monthly Surber samples (0.09 m^2) averaged nine, and ranged from three to fourteen. However, benthos and drift densities were similar to those reported from other Alaskan streams. In early spring and autumn, drifting macroinvertebrates were primarily Ephemeroptera, Plecoptera and Trichoptera, but in summer, Diptera dominated the drift. The low diversity of macroinvertebrates is hypothesized to be a consequence of the small annual range in water temperature and the relatively constant discharge of Clearwater Creek.

194) LaPerriere, J.D., E.E. Van Nieuwenhuyse, and P.R. Anderson. 1989. Benthic algal biomass and productivity in high subarctic streams, Alaska. High Latitude Limnology. Reprinted in Hydrobiologia. 172: 63-75. (C, E, I)

Electronic abstract: Year-round measurements of the standing crop of epilithic algae (as chlorophyll *a* concentration) in two streams - one second and one fourth order (map scale 1:63 360) - in interior Alaska (64 degree -65 degree N) were only about one tenth that reported from streams of temperate North America. Cell densities in these streams, however, were similar to those in comparable temperate streams. Year-round domination of the benthic flora by very tiny diatoms (*Achnanthes* spp.) may explain the apparent disparity between low chlorophyll a content and nearly average cell densities. Chlorophyll *a* standing crop in a more alkaline groundwater-fed stream, however, was higher and within the range of similarly sized temperate streams. Maximum chlorophyll *a* standing crop varied positively with alkalinity in 5 clear-water streams where standing crop was measured on natural or artificial substrates. Seasonal mean concentrations of sestonic chlorophyll *a* (used as estimates of benthic algal chlorophyll *a* standing crop) varied directly and significantly with alkalinity among ten clear-water streams; and, with total phosphorus among 8 of 10 clear-water and 5 brown-water streams studied. During the summer, when there is little darkness, gross primary productivity (as estimated by the diurnal dissolved-oxygen method) was similar to that of northern temperate streams. Gross primary productivity was also seen to vary directly with alkalinity in 5 clear-water streams of this region.

195) Lilly, M.R., J. Mendez, R. McCaffrey, D.M. Nyman, and S. Swenson. 2001. Ground-water and surface-water interactions in Whitestone, North and Providence Creeks: Final Report. Written by GW Scientific and Alaska Boreal Forest Council, Fairbanks, Alaska and Restoration Science and Engineering, Anchorage, Alaska. Written for the Alaska Department of Environmental Conservation, Juneau, Alaska. 21pp. plus Appendix and a CD with project website content and data. (G, I, J)

Author abstract: Upwelling areas in Alaskan rivers and streams are identified to be a crucial link in anadromous fish spawning and rearing. Future development in watersheds where spawning is common relies on a better understanding of the dynamics of these areas. A study to characterize three clear-water tributary streams of the Tanana River was implemented in the fall of 2001, near the confluence of the Tanana and Delta Rivers. The streams monitored were Whitestone, North, and Providence Creek. Using measurements of specific conductance, dissolved oxygen, temperature, flow and visual observations, we mapped the streams for upwelling occurrences. One of the three streams, Whitestone Creek, was also continuously monitored to gain a better understanding of temporal variations in the groundwater and stream interactions throughout the year.

Results of the study indicate spatial and temporal variations in the occurrence of upwellings. Data indicates the lower section of Whitestone Creek experienced upwelling in the late-fall but became a loosing reach (recharged the groundwater) as local ground-water levels declined through the winter period. In early spring, the stream again became influenced by upwelling, or the discharge of groundwater. Visible ground water upwelling in the form of bubbling vents and springs were observed at different locations all the way from the headwaters to the mouth of Whitestone Creek, indicating a very heterogeneous spatial distribution. This visible upwelling evidence was also present in North and Providence Creek, with a high density of vents seen at the headwaters but also further downstream. Non-visible upwelling occurrence was also evidenced in these streams by an increase in discharge along reaches with no tributary contribution. Conclusions from the study indicate that a combination of warmer upwelling water, high flow velocities and stream depth could all contribute in different degrees to keeping reaches ice-free in these streams during winter. Winter aerial photography showing ice-free stream reaches, in combination with ground-based hydrology measurements and observations, may become a very useful tool for locating areas of groundwater upwelling and thus habitat favorable for winter spawning.

196) Loftus, W.F. 1976. Food habits of two species of juvenile salmon, *Oncorhynchus tshawytscha* (Walbaum) and *Oncorhynchus keta* (Walbaum), from the Salcha and Jim River drainages, Alaska. M.S. Thesis, Central Michigan University, Mt. Pleasant. 77pp. (C)

Author abstract: Between 16 May and 8 June 1973, 454 chinook salmon smolts and 121 chum salmon smolts were trapped in the Salcha River, Alaska. Smaller samples of Chinook fry were taken from two Salcha tributaries, Flat and Ninety-Eight Creeks, on 18 August 1973, and from the Jim River tributary, Prospect Creek on 25 September 1972. Stomach contents were examined, and food items classed to the lowest possible taxon. The results of the numerical, frequency of occurrence, and volumetric analyses were combined to yield an importance value for each taxon. The importance value is applied for the first time in a salmon food habits study, and its widespread use will enable results to be easily compared.

Immature aquatic insects of the orders Diptera, Plecoptera, and Ephemeroptera predominated in the diet of both salmon species. All other food items were relatively insignificant. Chironomidae was the most important family of food organisms. Chinook smolts, being larger fish, preyed more heavily upon Plecopterans than did chum smolts. Both species appear to feed primarily upon benthos and invertebrate drift. Competition for food between the two species is indicated by the data.

197) Lotspeich, F.B., and A.E. Helmers. 1974. Environmental guidelines for development roads in the subarctic. Ecological Research Series, EPA-660/3-74-009. US Environmental Protection Agency, Office of Research and Development, National Environmental Research Center, Corvallis, Oregon, and Arctic Environmental Research Laboratory, College, Alaska. Project 21ARX, Program Element 1BA021. 63pp. (K)

Author abstract: This set of guidelines is based on Federal and State regulations that set standards to protect the total environment. Although major highway construction is under stringent regulation, pioneer type access roads such as are needed by loggers, miners, land developers, etc. have been neglected. These smaller roads frequently pose serious erosion hazards because planning, design and construction of them is not thorough, as it is for major roads; this results in erosion, fire and insect traps, and generally unattractive roadways.

Suggestions and recommendations contained in these guidelines are for the use of operators with limited engineering and planning staffs. Although all examples of poor practice are from the vicinity of Fairbanks, all suggested treatments are taken from the literature from the conterminous United States, with some modifications for subarctic conditions. Most of these recommendations are simple in concept, and if properly applied, do prevent erosion and result in superior access roads which are esthetically pleasing.

198) Lubinski, B.R. 1995. Winter habitat of Arctic grayling in an interior Alaska stream. M.S. Thesis, University of Alaska, Fairbanks. 143pp. (A, G)

Author abstract: Placer mining and the lack of information on winter ecology of Arctic grayling *Thymallus arcticus*, has raised concern for this popular sportfish. A study was designed to validate aerial radio telemetry data and to locate and describe overwinter areas (OWA) of Arctic grayling in Beaver Creek, Alaska. Reliance on aerial data alone resulted in overestimation of survival and misidentification of 14 of 26 designated OWAs. Twenty-one Arctic grayling were tracked downstream 12-58 km to 12 OWAs spanning a 31-km section of Beaver Creek. Radio-tagged and untagged Arctic grayling occupied areas with ice thickness of 0.4-1.4 m overlying 0.06-0.52 m of water, flowing at 0.03-0.56 m/s. During winter, discharge, cross-sectional area, velocities, and water width in four OWAs decreased until late March; then, cross-sectional area increased due to an increase in discharge that pushed the ice upward. Adult Arctic grayling overwintered downstream of habitat disturbances, and occupied much shallower winter habitats than expected.

199) MacLean, R. 1997. The effect of permafrost on the biogeochemistry of two subarctic streams. M.S. Thesis, University of Alaska, Fairbanks. 69pp. (I)

Author abstract: Discontinuous permafrost has a profound effect on the hydrology of subarctic streams. Permafrost distribution is very sensitive to wildfire, changes in climate, and changes in land use. An understanding of the interactions between permafrost dominated soils and stream chemistry is important in predicting the effects of changing permafrost distribution on stream ecosystems and nutrient budgets in watersheds. Chemical measurements of groundwater, soil water and stream water were made in two watersheds in Interior Alaska. One watershed had extensive permafrost and the other had limited permafrost. Soil water collected within the rooting zone (0.3 – 0.5 m) in both watersheds was high in dissolved organic carbon (DOC), dissolved organic nitrogen (DON) and dissolved inorganic nitrogen (DIN) but low in dissolved minerals (dominantly Ca, Mg and Na) and conductivity. The presence of permafrost appeared to result in higher fluxes of DOC into stream water from upland soils.

200) Maclean, S.H. 2003. Influence of hydrological processes on the spatial and temporal variation in spawning habitat quality for two chum salmon stocks in interior Alaska. M.S. Thesis, University of Alaska, Fairbanks. 93pp. (B, G, I, J)

Author abstract: I investigated the hydrological mechanisms that influence spatial and temporal variability in incubation habitat quality for summer- and fall-run chum salmon. The intragravel habitat was characterized by measuring water velocity, temperature, and dissolved oxygen (DO). Habitat quality was characterized by determining the survival of eggs in gravel filled baskets. Summer-run egg survival was greatest in a zone of upwelling produced by hydraulic gradients between the main Chena River and a slough. Water took approximately one month to make this trip and microbial activity likely reduced the concentration of DO considerably. As a consequence of these processes, there was considerable spatial and temporal variability in upwelling velocity, DO, and temperature. Most variability in egg-to-fry survival was explained by DO, and, to a lesser extent, by water velocity. Fall-run fish used an area of groundwater upwelling on the south side of the Tanana River. Here physical habitat characteristics were spatially and temporally uniform compared to the summer-run site, a consequence of the larger spatial scale of processes generating the upwelling. Egg-to-fry survival was low despite high DO and favorable temperature. This was probably the consequence of glacial silt invading egg baskets and reducing intragravel flow related to falling groundwater tables.

201) Maurer, M.A. 1987. Compilation of stream macroinvertebrate data for the Birch Creek, Beaver Creek, Fortymile River, and Minto Flats drainages. Alaska Division of Geological and Geophysical Surveys, Alaska Public-Data File 87-30. 56pp. (C, I)

Author abstract (Author introduction): This report summarizes an investigation made by the State of Alaska, Department of Natural Resources, Division of Geological and Geophysical surveys (DGGS) in cooperation with the U.S. Bureau of Land Management (BLM) from August to November 1987. The objective of the investigation is to: (1) inventory the benthic invertebrate community in the Fortymile River drainage, (2) compile available benthic invertebrate data on the Fortymile River, Birch Creek, Beaver Creek, and Minto Flats drainages, and (3) determine whether cumulative placer mining impacts on the benthic invertebrate community in these four drainages have been documented.

202) McCaffrey, R. 2001. Aerial survey of ground-water upwelling in the Tanana River floodplain near Big Delta, Alaska. Written by the Alaska Boreal Forest Council, Fairbanks, Alaska. Written for the Alaska Department of Environmental Conservation, Juneau, Alaska. Work supported by Grant NP-01-16. 6pp. plus Appendices and 4 data CDs with georeferenced photo images and overlays. (G, J)

Compiler abstract: Upwellings in Alaskan rivers and streams are believed to be important spawning and rearing habitat for anadromous fish. The objective of this project was to map evidence of ground-water upwelling in the Tanana River floodplain near Big Delta, Alaska between its confluence with the Delta River and its confluence with Little Delta Creek. The typically warmer water from upwellings was hypothesized to result in retarded ice cover formation in the Fall, and in advanced ice breakup in the Spring. Therefore, evidence of upwellings was mapped by taking aerial photographs during Spring and Fall of 1999, Spring 2000, and Spring 2001, when the typically warmer water from upwellings would result in areas of open water in the otherwise frozen Tanana River. Georeferenced images and evidence of upwellings are provided on compact computer disks (i.e. CDs).

203) McFadden, T., and M. Stallion. 1976. Debris of the Chena River. U.S. Army Corps of Engineers, Cold Regions Research and Engineering Laboratory, Fairbanks, Alaska. Available from the National Technical Information Service, Springfield VA 22161 as ADA-029 357. 18pp. (D)

Electronic abstract: Debris over a 44-mile stretch of the Chena River was studied. The study area extended from the first bridge on the Chena Hot Springs Road to the Chena River Flood Control damsite. The purpose of the study was to assess the potential danger to the Chena River Flood Control Dam outlet structure. Debris was cataloged, log jams were measured, and sources of debris were studied. The average size of logs was determined, as well as the number of logs present on the river. It was concluded that a serious debris problem existed and would remain serious for the foreseeable future. Recommendations for debris handling were made.

204) Miller, M.C., and J.R. Stout. 1989. Variability of macroinvertebrate community composition in an Arctic and Subarctic stream. High Latitude Limnology. 172: 111-127. (C)

Electronic abstract: The macroinvertebrate community composition was compared in two Alaskan streams (USA) for numeric and species constancy during the ice-free period from 1981 to 1983. Imnavait Creek is a first order Arctic stream (60 degree 39' N, 149 degree 21' W) draining upland tundra in the foothills of the Brooks Range. Caribou-Poker Creek is a 4th order Subarctic stream (65 degree 08' N, 147 degree 28' W) draining the taiga forest north of Fairbanks, Alaska. The aquatic insect larvae and other macroinvertebrates were sampled with drift nets and Hess bottom samplers for four periods, each 1 week long in the ice free season of three years. We found 112 species in the Arctic stream and 138 species in the subarctic stream in a chironomid-dominated community. In any sample period the communities contained 51-60 species in the Arctic and 49-92 species in the subarctic. Between the four sample periods on average 39% and 50% of the species were present in two sequential samples in the Arctic and Subarctic stream, respectively. New immigrants, never before found in the system, averaged 37% and 31% of the community, respectively. These systems are exposed to several intermediate disturbances: prolonged and variable freeze-up, extreme variation in discharge, wide diel and seasonal changes in temperature, and erosion by frazil and anchor ice. The dipterans that compose the most numerous and variable taxa must have variable diapause, ability to grow in cold waters, and good dispersal powers, even migrating across drainages in the Arctic. Much of the seasonal dominance pattern appears therefore to be stochastic.

205) Neill, C.R., J.S. Buska, E.F. Chacho, C.M. Collins, and L.W. Gatto. 1984. Overview of Tanana River monitoring and research studies near Fairbanks, Alaska. US Army Corps of Engineers, Cold Regions Research and Engineering Laboratory, Special Report 84-37. 360pp. (A, F, G, I)

Author abstract: The Tanana Rive changes character in the vicinity of Fairbanks, from the braided pattern upstream of North Pole to the anastomosing or irregular meander patter upstream of the Chena River confluence. This transition in planform is accompanied by a marked decrease in gradient and a change in dominant bed material from gravel to sand. Within the past 50 years the river has been affected by a variety of human activities, including flood control works, access causeways and gravel extractions. The river's cross-section shows large variation in width and depth from one location to another, but total cross-sectional area and mean velocity are relatively constant at a discharge of about 60,000 cfs, close to the mean annual flood. Annual flow hydrographs are quite similar from one year to another. Sediment transport in the river average about 360,000 tons per year of bed load, approximately equally divided between sand and gravel sizes and about 28,000,000 tons per year of suspended load, of which about 35% is sand and the rest silt and clay. Natural channel processes are dominated by within-bank shifts in channel and bar patterns and cross-sectional shapes, erosion of the main floodplain and island banks being fairly localized and generally proceeding at modest rates. No relationships have been discerned between rates of bank erosion and soil, permafrost or vegetation factors. Response to human intrusions is generally difficult to distinguish from natural processes beyond the immediate vicinity of the intrusions and more than a short time after cessation of activity. Details are discussed regarding observation of inferred response to groin construction and gravel extraction. Generally structural intrusions and gravel extractions activities that have not constituted a major disturbance to the river system have achieved their desired result with no apparent adverse effects of any significance. Blockage of the north channel at Goose Island by causeways, reoccupation of gravel extraction areas from permanent bars and islands, and secondary channel closures are believed to have considerable effects on flow and erosional pattern for some distance downstream. The Phase III in-river levee and groin construction constituted a strong local disturbance of the river system where local river slope was steepened and large quantities of bed material were put into transport from pilot channel enlargement as the river adjusted to the new alignment. As of the end of 1982, the full and final effects of the disturbance were not clear. Recommendations are given regarding impacts from human activities, alleviation of impacts, levee protection, further interpretive analysis and future monitoring of river behavior.

206) Olsen, J.B., W.J. Spearman, G.K. Sage, S.J. Miller, B.G. Flannery, and J.K. Wenburg. 2004. Variation in the population structure of Yukon River chum and coho salmon: Evaluating the potential impact of localized habitat degradation. Transactions of the American Fisheries Society. 133: 476-483. (K)

Author abstract: We used microsatellite and mitochondrial DNA–restriction fragment length polymorphism (mtDNA–RFLP) analyses to test the hypothesis that chum salmon *Oncorhynchus keta* and coho salmon *O. kisutch* in the Yukon River, Alaska, exhibit population structure at differing spatial scales. If the hypothesis is true, then the risk of losing genetic diversity because of habitat degradation from a gold mine near a Yukon River tributary could differ between the two species. For each species, collections were made from two tributaries in both the Innoko and Tanana rivers, which are tributaries to the lower and middle Yukon River. The results revealed a large difference in the degree and spatial distribution of population structure between the two species. For chum salmon, the microsatellite loci (F-statistic [F_{ST}] = 0.021) and mtDNA (F_{ST} = -0.008) revealed a low degree of interpopulation genetic diversity on a relatively large geographic scale. This large-scale population structure should minimize, although not eliminate, the risk of genetic diversity loss due to localized habitat degradation. For coho salmon, the microsatellites (F_{ST} = 0.091) and mtDNA (F_{ST} = 0.586) revealed a high degree of interpopulation genetic diversity on a relatively small geographic scale. This small-scale population structure suggests that coho salmon are at a relatively high risk of losing genetic diversity due to localized habitat degradation. Our study underscores the importance of a multispecies approach for evaluating the potential impact of land-use activities on the genetic diversity of Pacific salmon.

207) Oswood, M.W. 1989. Community structure of benthic invertebrates in interior Alaskan (USA) streams and rivers. Hydrobiologia. 72: 97-110. (C)

Electronic abstract: Taxonomic composition of benthic invertebrates in interior Alaskan streams and rivers is summarized from published and unpublished data. Diptera dominate the Alaskan stream fauna and constitute a larger proportion of the benthos in Alaskan streams than in streams of temperate North America. Plecoptera and Ephemeroptera are the next most abundant in Alaskan streams with Trichoptera generally very scarce. Several orders that occur regularly in streams of temperate North America are absent (or in very low abundance) in interior Alaskan streams: Hemiptera, Odonata, Megaloptera, Coleoptera. Netspinning caddisflies, burrowing mayflies, and several families of stoneflies (Pteronarcyidae, Peltoperlidae and Perlidae) are conspicuous by their absence or extreme scarcity. Taxonomic composition varies significantly among hydrologic regions (major watersheds) and among stream types (springs, headwater streams, small rivers, and large rivers). Only two taxa (Chironomidae and Nemouridae) significantly increase in proportional contribution from south to north while many taxa decrease.

208) Ott, A.G., J.F. Winters, and A.H. Townsend. 1998. Juvenile fish use of selected habitats in the Tanana River near Fairbanks (Preliminary report). Alaska Department of Fish and Game, Habitat and Restoration Division, Juneau, Alaska, Technical Report No. 97-1. 133pp. (K)

Author abstract (Author Executive Summary): During the summer of 1996, we conducted the first year of a two year study of juvenile fish abundance in various habitats of the Tanana River. Limited sampling in 1994 provided guidance on techniques and locations. Fish were collected using seines, minnow traps, and electrofishing. Tanana River habitat types sampled included rocky bluffs, gravel bars, silt bars, root wads, cutbanks, backwaters, Clearwater tributaries, connected wetlands, and tannin-colored sloughs. Predominate fish species found were longnose sucker (*Catostomus catostomus*) and lake chub (*Couesius plumbeus*). These species were captured in most of the habitat types sampled. Young-of-the-year longnose suckers were most abundant in tannin-colored sloughs and the interconnected wetland complex. Backwater habitats within the active floodplain of the Tanana River were used preferentially by longnose suckers and lake chub. Coho salmon (*Oncorhynchus kisutch*) juveniles were abundant in late May/early June 1996 and catches were highest in the main channel of the river. Chinook salmon (*Oncorhynchus tshawytscha*) outmigrants were not found and a few chum salmon (*Oncorhynchus keta*) fry were caught in 1996. Arctic grayling (*Thymallus arcticus*), round white fish (*Prosopium cylindraceum*), least cisco (*Coregonus sardinella*), burbot (*Lota lota*), and northern pike (*Esox lucius*) were occasionally caught in the Tanana River or in the lower parts of tributaries and sloughs.

209) Ott, R.A. 1998. The impact of winter logging roads on vegetation, ground cover, permafrost, and water movement on the Tanana River floodplain in interior Alaska. Cooperative Agreement AK-DF-A97-RN0006, 10-97-052 report written by the Tanana Chiefs Conference, Inc., Forestry Program, Fairbanks, Alaska. Written for the Alaska Department of Natural Resources, Division of Forestry, Fairbanks, Alaska. 31pp. (K)

Author abstract: Winter logging roads are used in interior Alaska to cross floodplain wetlands underlain by permafrost in order to access productive forest stands. Although construction of winter roads is restricted to times when the active layer is frozen and/or when the presence of a snow layer helps protect the ground surface, winter roads still may impact floodplain areas. Potential effects of winter roads in these areas include: changes of water movement, increased active layer depth, development of thermokarst topography, removal of soil, and delayed re-vegetation of roadbeds.

During September 1997, I quantified active layer depths, and vegetation and ground cover patterns, on 2 winter roads and adjacent undisturbed areas in 8 plant communities (4 forest, 4 shrub) underlain by permafrost. The study was conducted on the Tanana River floodplain near the village of Nenana in central Alaska. Within each plant community 4 to 5 sample lines, oriented perpendicular to the roadbed and centered over it, were spaced at 30 ft. intervals. Data that were collected at 2 ft. intervals along each sample line were: active layer depth, erect vegetation occurrence by life-form for 3 height strata (>6 ft., 3 to 6 ft., and <3 feet), occurrence of mat-forming (ground layer) vegetation by life-form, ground cover occurrence, and ground surface height.

In general, roadbeds were dominated by graminoids. Short shrubs generally were the second most frequent erect life-form on roadbeds. Exposed soil was present in small amounts (1.2 to 14.6% occurrence) on the roadbeds, but was greater than in non-roadbed areas in 5 of the communities. Continued use of the winter roads keeps them in early seral stages of plant succession. It is expected that perennial graminoids will dominate winter roadbeds as long as they continue to be frequently used.

Surface permafrost has receded in the roadbeds of 6 sampled plant communities. During construction, standing vegetation and some or all of the organic mat was removed in the roadbeds. The ground was not shaded by tall vegetation initially after road construction. Although roadbeds are now covered with graminoids, shading effects are probably less than those produced by the several layers of vegetation that were present before road construction. The removal of the organic mat resulted in the reduction or elimination of the insulating properties of that layer. Increased active layer thickness of winter roadbeds was greatest in the 2 black spruce communities. Both spruce communities were located on the Cosna Road; the loss of the entire organic mat on that roadbed probably accounts for these sites being the most influenced of the 6 communities where roadbed permafrost has receded. In contrast, the other 4 plant communities where permafrost has receded in the roadbeds are located along Soldier Slough Road, which retained an insulating layer of organic material on the ground.

The 2 communities—shrub birch-leatherleaf-Labrador tea community and the leatherleaf community—where mean active layer depths indicated that permafrost actually aggraded in the roadbeds also were located on the Cosna Road. Taliks (thawed zones) were common under a thin layer of permafrost off the roadbeds in these 2 communities. These taliks are probably a result of

the winter of 1995-96. Cold temperatures with little snowfall during that winter probably resulted in the development of a thin permafrost layer that is now in the process of thawing. For reasons that are unknown at this time, the thin permafrost layer under the roadbeds of the shrub birch-leatherleaf-Labrador tea community and the leatherleaf community is not thawing as fast as in the non-roadbed areas.

Saturated substrates were only recorded in the roadbeds of the 2 communities that had tussocks—tamarack woodland community and cottongrass tussock community—and open water was present only in the roadbed of the cottongrass tussock community. Lowering of the ground surface through removal of tussocks in the roadbeds may have brought the water table closer to the surface. Water flow was not observed to be channeled along winter roadbeds. Erosion due to thawing of ice-rich soil was not observed.

210) Ott, R.A., and W.E. Putman. 1999. Monitoring riparian buffers along glacial rivers in interior Alaska: Procedures for data collection and processing. Cooperative Agreement AK-DF-A97-RN0006, 10-97-052 report written by the Tanana Chiefs Conference, Inc., Forestry Program, Fairbanks, Alaska. Written for the Alaska Department of Natural Resources, Division of Forestry, Fairbanks, Alaska. 14pp. (K)

Compiler abstract: Tanana Chiefs Conference Forestry Program (TCC Forestry) installed two monitoring sites in mature white spruce riparian buffers along the Tanana River and Tok River. The study was designed to increase understanding of (1) the persistence of riparian buffers in the absence of erosion, with an emphasis on the tree component; and (2) large woody debris (LWD) recruitment rates into rivers. TCC Forestry provided the Alaska Division of Forestry with an ArcView project (buffer_monitoring.apr) containing all data collected during monitoring site installations (summer 1997) as well as tree mortality data collected the following year (fall 1998). This document is a supplement to the ArcView project. It contains study site locations, data collection methods, procedures used to process and display the spatial data, and descriptions of variable names contained in the ArcView project.

211) Ott, R.A., M.A. Lee, W.E. Putman, O.K. Mason, G.T. Worum, and D.N. Burns. 2001. Bank erosion and large woody debris recruitment along the Tanana River, interior Alaska. Project NP-01-R9 report written by the Alaska Department of Natural Resources, Division of Forestry and the Tanana Chiefs Conference, Inc., Forestry Program, Fairbanks, Alaska. Written for the Alaska Department of Environmental Conservation, Division of Air and Water Quality, Juneau, Alaska. 34pp. (D, F, G)

Author abstract: The management intent of the Alaska Forest Resources and Practices Act (FRPA) for riparian areas is to protect fish habitat and water quality from significant adverse effects of timber harvest. Among other things, FRPA requires maintaining short- and long-term supplies of LWD, stream bank stability, and channel morphology. In interior Alaska, concerns have focused on forest harvest impacts on river bank erosion and large woody debris (LWD) recruitment along the 824 km-long Tanana River.

This project was initiated to quantify baseline conditions of the amount and spatial distribution of bank erosion, and the associated LWD recruitment along the entire length of the

Tanana River, which currently has been little impacted by contemporary forest harvest. River bank erosion and LWD recruitment were quantified for the 1978-80 to 1998-99 time period using change analysis within a Geographic Information System, and existing forest inventory data. Data were summarized by 10 km reaches.

For the entire river, 5,104 ha of river bank eroded, with 3,888 ha contributing LWD. The distribution of land area eroded was highly variable, and ranged from 0.3 ha to 309 ha/10 km of river. Based on erosion patterns, five distinct regions of the river were identified. The amount of land area eroded along the Tanana River was related to slope patterns and the distribution of silt-laden tributaries of glacial origin. Among vegetation size classes, eroded land area was distributed fairly evenly among stands of sapling-sized trees and dwarf forests (28.3%); stands of pole-sized trees (27.8%); and shrublands, wetlands, and other non-forested land cover (22.9%). Among vegetation types, erosion occurred most frequently in tall shrublands (21.0%), followed by stands of balsam poplar saplings (15.7%). A total of 4,266 individual erosion patches were identified along the entire Tanana River. Erosion patches varied in size from 0.01 to 58.84 ha, but the majority (78.0%) were 0.01 to 1.00 ha in size. Almost all (94.5%) of the erosion patches were ≤ 5.0 ha in size. The greatest cumulative amount of erosion (16.1%) occurred within patches that were 0.01 to 1.00 ha in size. Land area contained within erosion patches ≤ 5 ha was 47.2% of the total. Maximum erosion distance within an erosion patch varied from <2 m to 401 m, but was most commonly (26.6%) 10 to 19 m.

The volume of LWD recruited into the Tanana River totaled 448,070 m^3. The distribution of LWD was highly variable and ranged from 8.2 m^3 to 50,867 m^3/10 km of river. Spatial patterns of LWD recruitment were similar to land erosion patterns. Among vegetation size classes, the largest LWD volumes (47.6%) originated from sawlog-sized stands of trees. Among vegetation types, LWD volume was greatest (24.7%) from stands of white spruce sawlogs. Erosion patches 0.01 to 1.00 ha in size contributed the most LWD (10.6%). The majority of LWD (53.6%) was recruited from erosion patches ≤ 9 ha in size.

Information obtained from this project will allow resource managers to better understand natural processes of river bank erosion and LWD recruitment, and to highlight future research needs that can be used to assess the implications of management actions.

212) Perry, R.W., M.J. Bradford, and J.A. Grout. 2003. Effects of disturbance on contribution of energy sources to growth of juvenile Chinook salmon (*Oncorhynchus tshawytsha*) in boreal streams. Canadian Journal of Fisheries and Aquatic Sciences. 60: 390-400. (C, E)

Author abstract: We used stable isotopes of carbon in a growth-dependent tissue-turnover model to quantify the relative contribution of autochthonous and terrestrial energy sources to juvenile Chinook salmon (*Oncorhynchus tshawytscha*) in five small borel streams tributary to the upper Yukon River. We used a tissue-turnover model because fish did not grow enough to come into isotopic equilibrium with their diet. In two streams, autochthonous energy sources contributed 23 and 41% to the growth of juvenile salmon. In the other three, fish growth was largely due to terrestrial (i.e., allochthonous) energy sources. This low contribution of autochthonous energy appeared to be related to stream specific disturbances: a recent forest fire impacted two of the streams and the third was affected by a large midsummer spate during the study. These disturbances reduced the relative abundance of herbivorous macroinvertebrates, the contribution of autochthonous material to other invertebrates, and ultimately, the energy flow

between stream algae and fish. Our findings suggest that disturbances to streams can be an important mechanism affecting transfer of primary energy sources to higher trophic levels.

213) Peterson, L.A. 1973. An investigation of selected physical and chemical characteristics of two subarctic streams. M.S. Thesis, University of Alaska, Fairbanks. 185pp. (G, I)

Electronic abstract: The objectives were to delineate baseline physical and chemical characteristics of the Chatanika River and Goldstream Creek, ascertain the source of nutrients in the streams from breakup to freezeup, delineate any significant local variation within each stream and compare the physical and chemical characteristics between the streams. The concentrations of the selected physical and chemical parameters were generally low in both streams, remaining within expected levels of unpolluted fresh water streams in the Chatanika River. Five parameters exceeded expected levels of unpolluted fresh water streams at two or more sample sites on Goldstream Creek. The concentrations of nutrients in both streams were generally quite low from breakup to freezeup; there were no important single point sources of nutrients in the Chatanika River or Goldstream Creek. The Chatanika River did not exhibit any significant local variation in water quality in the study area. Two tributaries of Goldstream Creek and one area within Goldstream Creek exhibited significant local variation in water quality, which was caused by groundwater inflow of different quality at the three locations. the major differences in water quality between the Chatanika River and Goldstream Creek are due to topography and soil types, which cause surface and groundwater movement through Goldstream valley to be slower than through the Chatanika River valley, resulting in different quality surface and groundwaters entering these streams. The quality of the water in the Chatanika River is such that it would be an acceptable source for domestic and most industrial waters, and would be able to assimilate some waste without undue degradation of the water quality. Goldstream Creek should not be considered as a source for water or for waste assimilation due to low flow and poor water quality during winter.

214) Popovics, L.M. 1999. The effect of soil and stream water quality on primary and secondary productivity of Rock Creek, Denali National Park and Preserve, Alaska. M.S. Thesis, University of Alaska, Fairbanks. 98pp. (A, C, E, G, I)

Author abstract: Aquatic productivity may be affected by physical and chemical properties of soil water and streamwater. This study related primary and secondary productivity to parameters in relation to four soil mapping units within Rock Creek watershed. Physical and chemical properties of soil were measured on these four sites. Stream characteristics were determined using measurements on hydrology, stream water chemistry, organic matter retention, limiting nutrients, primary production and secondary production.

Geochemicals dominated the streamwater chemistry with concentrations typically greater than in soil water. Periphyton biomass and invertebrate densities were low in Rock Creek compared to other subarctic streams. Nutrient diffusing substrate studies indicated primary productivity increased in response to phosphorus- and some nitrogen-and-phosphorus treatments. This response is consistent with undetected streamwater levels of phosphorus. Physical factors affecting retention, stream discharge, and channel morphology were significant in limiting the primary and secondary productivity of Rock Creek.

215) Ray, S.R. 1988. Physical and chemical characteristics of headwater streams at Caribou-Poker Creeks Research Watershed, Alaska. M.S. Thesis, University of Alaska, Fairbanks. 172pp. (G, I)

Author abstract: The major-element hydrogeochemistry of four streams in the Caribou-Poker Creeks Research Watershed was studied during low-flow conditions. The flow of the streams was measured and samples analyzed for major ions at two-week intervals from November, 1985 through April, 1987. Samples were analyzed for Ca, Mg, Na, K, Al, Fe, Mn, Si, Cl, NO_3, SO_4, and HCO_3.

The streams are dilute calcium-bicarbonate waters with a range of 37 to 108 mg/l for TDS and 6.54 to 7.58 for pH. The variability in calcium concentration in the different streams depends on the amount and distribution of permafrost in the basin.

The ratio of baseflow to total runoff for each stream was constant, suggesting geomorphic control.

The effect of permafrost on the stream chemistry and baseflow was the major finding of this study.

216) Rickard, W.E., and C.W. Slaughter. 1973. Thaw and erosion on vehicular trails in permafrost landscapes. Journal of Soil and Water Conservation. 28: 263-266. (K)

Author abstract: Two types of off-road access trails constructed on permafrost terrain in central Alaska were monitored to determine the environmental consequences of off-road vehicular travel for both recreational and business pursuits on such terrain. Tractor-cleared trails showed severe permafrost thaw and soil movement the first season after use. A hand-cleared controlled-access trail was markedly more stable, showing lower levels of soil movement even after three seasons of frequent travel.

217) Schallock, E.W., and F.B. Lotspeich. 1974. Winter dissolved oxygen in some Alaskan rivers. Environmental Protection Agency, Arctic Environmental Research Lab, University of Alaska, Fairbanks, Ecological Research Series Report EPA-660/3-74-008. 33pp. (G, I)

Electronic abstract: Water samples collected during the years 1969 through 1972, from 36 selected Alaskan rivers were analyzed for dissolved oxygen, pH, conductivity and alkalinity. Dissolved oxygen (d.o.) ranged from 0.0 to 15.3 ml/l (106 percent saturation); pH from 6.2 to 8.4; conductivity varied from 105 to 3000 (umho/cm); and alkalinity from 28 to 410 (mg/l). Severe d.o. depletion during winter was found in many river systems large and small, and located in a range of latitudes (70 deg n to 61 deg n). Sufficient data were collected on the Chena, Chatanika, and Salcha rivers to reveal annual d.o. trends: near saturation during spring 'breakup' and fall 'freezeup' when water temperatures are near 0 deg c; somewhat lower d.o. concentrations during warm water summer periods; and yearly minimum concentrations during the winter (January-March) interval. Data indicate that d.o. depression begins in October and continues into February. d.o. from stations near the mouth of a river were generally depressed more than at upper stations. The latter trend was observed in the Yukon River which contained 10.5 mg/l (73 percent saturation) at the Canadian border but only 1.9 mg/l (13 percent) near the mouth. pH

gradually decreased in some rivers although alkalinity and conductivity increased. The depressed winter d.o. concentrations and low winter discharge in many Alaskan rivers are more severe and widespread than present literature indicates. Winter conditions may already limit aquatic organisms in some systems.

218) Slaughter, C.W. 1971. Caribou-Poker Creeks Research Watershed, interior Alaska, background and current status. US Army Corps of Engineers, Cold Regions Research and Engineering Laboratory, Special Report 157. 11pp. (G, I, J)

Electronic abstract: The Caribou-Poker Creeks Research Watershed was established in 1969 as a site for cooperative, inter-agency investigation of hydrologic and related aspects of a subarctic environment. The relatively undisturbed 40-square-mile drainage basin includes both permafrost-dominated and nonpermafrost watersheds, and has a variety of vegetation communities. Research is directed to hydrologic behavior of north-facing (permafrost) and south-facing (non-permafrost) basins in this upland setting. Air temperature and precipitation are monitored at three elevations (mouth, 1600 ft and 2100 ft); water temperature is measured at two locations, and streamflow is measured at periodic intervals. Related work is underway dealing with soil moisture relations, nutrient cycling in a black spruce environment, and surface water chemistry.

219) Smidt, S. 1997. Spatial variation in the community structure of stream macroinvertebrates within a subarctic Alaskan watershed. M.S. Thesis, University of Alaska, Fairbanks. 53pp. (C)

Author abstract: We investigated spatial variability in the community structure of stream macroinvertebrates at six reaches within Caribou-Poker Creeks Research Watershed differing in river continuum position (stream orders 1-4) and influence of permafrost. Leaf litter input, measured between July and October 1995, was similar among most reaches. However, observed differences in the phenology of input may be very important. We sampled benthic organic material and macroinvertebrates six times during the ice-free season between June 1995 and June 1996. Mean invertebrate abundance (range: 1160 – 14494 indiv./m^2) and biomass (range: 0.21 – 0.84 g ash-free dry weight/m^2) were significantly different among sites, the lowest values occurring in the stream draining a high permafrost basin. Taxonomic and functional feeding group differences among sites appeared to be related to the amount of the drainage basin underlain by permafrost and position along a truncated river continuum. This research highlights the importance of permafrost for stream communities.

220) Smidt, S., and M. Oswood. 2002. Landscape patterns and stream reaches in the Alaskan taiga forest: Potential roles of permafrost in differentiating macroinvertebrate communities. Hydrobiologia. 468: 95-105. (C)

Electronic abstract We investigated spatial variability in the community structure of stream macroinvertebrates at six reaches within Caribou-Poker Creeks Research Watershed in the Alaskan taiga forest. Stream reaches differed most notably in river continuum position (stream orders 1-4) and influence of permafrost. Permafrost may underly much of an entire watershed or may be only locally present in valley bottoms. Permafrost distribution influences hydrology, water temperature, and riparian vegetation. We sampled benthic macroinvertebrates six times during the ice-free season between June 1995 and June 1996. Mean invertebrate abundance (range: 1160-14494 individuals \ m^{-2}) was significantly different among sites, the lower values occurring in stream reaches affected by the local presence of permafrost and the highest value in a headwater stream unaffected by permafrost. Taxonomic composition of the macroinvertebrate community also differed among reaches, with the quantity of watershed-level permafrost and stream size providing the strongest influences. This research highlights the importance of permafrost at two spatial scales (watershed and reach) for macroinvertebrate communities of headwater streams at high latitudes.

221) Wellen, P.M., and D.L. Kane. 1985. Appendix to a hydraulic evaluation of fish passage through roadway culverts in Alaska: Data report. Final Report No. FHWA-AK-RD-85-24A written by the Institute of Water Resources/Engineering Experiment Station, University of Alaska, Fairbanks. Written for the Alaska Department of Transportation and Public Facilities, Division of Planning, Research Section, Fairbanks, Alaska. 240pp. (K)

Author abstract: Culverts are a very simple hydraulic structure. However, because the engineer must design for peak flows passing through the culvert while fish are trying to move upstream serious problems arise. Almost all culvert installations in interior and northern Alaska were casually examined, with approximately 100 examined in detail where hydraulic problems existed that may retard fish passage. Data from the field program are included in an appendix to this report. The two major hydraulic problems in regard to fish passage were high velocities and perching; inlet drops caused by deposited sediment, aufeis, alignment of culvert with stream, and non-uniform culvert slopes are some of the other fish passage deterrents that were observed. Also, all known baffled structures were evaluated. Numerous recommendations were made that should improve the hydraulic conditions that exist at a culvert relative to fish passage. Also, it is recommended that further studies be carried out to evaluate the swimming performance of the native fish. Present design criteria are based on very limited studies. Lastly, it is recommended that the concept of the velocity in the occupied zone (area in culvert where fish swim) be considered as the culvert design velocity for fish passage in place of the presently used average cross-sectional velocity.

222) Worum, G.T., D.N. Burns, W.E. Putman, R.A. Ott, and M.A. Lee. 2001. Images of bank erosion and large woody debris recruitment along the Tanana River, interior Alaska: Results of a change analysis. Volume I: Upper Tanana River, Volume II: Middle Tanana River, Volume III: Lower Tanana River. Project NP-00-N9 report written by the Alaska Department of Natural Resources, Division of Forestry and the Tanana Chiefs Conference, Inc., Forestry Program, Fairbanks, Alaska. Written for the Alaska Department of Environmental Conservation, Division of Air and Water Quality, Juneau, Alaska. (A, D, F)

Compiler abstract: In interior Alaska, concerns have been raised regarding the impact of forest management activities on fish habitat and water quality along the 824 km-long Tanana River. It has been suggested that the harvest of riparian timber along the Tanana River can increase riverbank erosion rates with the result that productive spawning or rearing areas could be degraded through sedimentation processes or changes in channel morphology. It has also been suggested that timber harvest near along the river will decrease the supply of LWD that is recruited into the river through natural erosion processes.

This project was conducted to quantify baseline conditions (1978-80 through 1998-1999) of the amount of bank erosion, and the associated LWD recruitment along the entire length of the Tanana River, which currently has been little impacted by contemporary forest harvest. Bank erosion and LWD recruitment were quantified by conducting a change analysis within a Geographic Information System (GIS).

This very over-sized three volume report contains the images used to conduct the change analysis, plus images showing the results of the change analysis, for the entire Tanana River. Each page contains three orthorectified images for one 10 km section of the river (except for the first reach at the source of the river, which was 4 km in length). The three images on each page are: 1) a late 1970s or early 1980s digital color infrared aerial photograph with the vegetation types delineated along the 10 km length of the river, 2) a late 1990s satellite image with the vegetation types delineated along the same section of river, and 3) the satellite image with colored polygons showing where bank erosion had occurred during the time period of study. In addition, each page contains a tabular summary of the results of the change analysis for the 10 km reach shown in the three images. The interpretation of the results of this project, and a more detailed description of the methods used, can be found in Ott et al. (2001).

223) Wuttig, K.G. 1997. Successional changes in the hydrology, water quality, primary production, and growth of juvenile Arctic grayling of blocked Tanana River sloughs, Alaska. M.S. Thesis, University of Alaska, Fairbanks. 105pp. (C, E, G, I, J)

Author abstract: A comparative stream study was conducted to assess the influence of development and blockage on the hydrology, water quality, primary production, and Arctic grayling of Badger Slough, Alaska. Data collected showed that Badger Slough exhibited stable, clear flows throughout the summer, and higher total and total dissolved phosphorus, orthophosphate, alkalinity, pH, conductivity, and average temperatures, and lower winter dissolved oxygen concentrations than both Piledriver and 23-Mile Sloughs. Mean algal biomass (3.3 mg m^{-3}) and primary production (6.9 g O_2 m^{-2} d^{-1}) are greater than that recorded for any other interior Alaska streams and percent fines in riffle substrates have increased. However, growth of age-0 grayling remains high. Badger Slough has eutrophied due to increased nutrients and stable flows, and the quality of rearing habitat for age-0 fish remains good. However, an annual flushing flow of 8.0 m^3 s^{-1} is recommended for controlling accumulations of fines and maintenance of grayling habitat.