Historical Channel Changes and Geomorphology of the Upper Yellowstone River[ps]

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In response to lateral erosion and flooding caused by near 100-year floods in 1974, 1996 and 1997, extensive segments of the upper Yellowstone River and flood plain have been modified using dikes, levees, riprap, and jetties (barbs). Confinement of river channels often leads to reduced migration rates, channel incision, bed coarsening, and loss of hydraulic connectivity with side-channels. As part of cooperative investigations sponsored by the Upper Yellowstone River Task Force, we (1) mapped the contemporary (1999) fluvial geomorphology of the upper Yellowstone River (137 km reach—Gardiner to pringdale, Montana) and historic channel changes (1948-1999), (2) developed a process-based geomorphic channel classification, e.g. modified Montgomery-Buffington, of the 1999 channel, (3) mapped contemporary and historic (1954, 1973, 1999) channel modifications

and revetments, and (4) measured and analyzed retrospective geomorphic effects of channel modifications (in progress). Dikes, levees, and road prisms have increased 265 percent (34,700 to 92,250 feet) between 1954 and 1999; riprap increased 400 percent (27,400 to 111, 260 ft), and jetties and barbs increased 600 percent (47 to 292). Of the total channel length, 14 percent (19 km) was strongly affected by channel modification (riprap, levees, etc); another 6 percent (8 km) was affected by combined natural and human constraints. Local channel response to confinement includes channel incision (Livingston area), aggradation and modification of channel alignment. In spite of these modifications, the channel is remarkably resilient and the overall stability and physical characteristics of about 80 percent of the study area remain similar to those of the Yellowstone River in 1948.