

Cross section PR163 was established in 1977 near the apex of a bend in Powder River whose active features included a 2.5-m-high cutbank in the Lightning terrace that formed the left margin of the channel, and a point bar and flood plain on the right margin that had been developing steadily at this site since at least 1939 (the year the first aerial photographs were taken; see Martinson and Meade, 1983, *their* sheet 2). This cross section was resurveyed annually (except for 1981 and 1983) through 2002. After a hiatus of eight years it was again surveyed in 2011, 2012, 2013, and 2014.

The greatest accretionary channel displacement during the flood of May 1978 that we were able to document fully on Powder River was measured at cross section PR163 (Meade and Moody, 2013, *their* Figure 19). During two weeks of flooding, the left-bank Lightning terrace was eroded back a lateral distance of 65 m, displacing some 160 m³ of terrace sediment for each meter of channel length. The right-bank flood plain was extended leftward some 55 m by the deposition of a ~2-m thickness of new sediment in the pre-flood river channel (stations 10 to 45) and a ~1-m thickness of new sediment atop the old point bar (stations 45-65). A new point bar, about a meter thick, was deposited in a segment of the cross section (stations -20 to +10) where, two weeks earlier, had stood a 2.5-m-high fluvial terrace. Flood waters that crossed the neck of the bend left overbank deposits of silt and sand, mostly 0.1-0.3 m thick, on a 500-m rightward extension of cross section PR163 (Moody and Meade, 2008, *their* Figure 6). Overbank material was also deposited by flood waters that overtopped the left-side Lightning terrace, but most of this freshly-deposited sediment was remobilized and carried away downstream as the cutbank receded during the flood; only a thin (~0.1 m thick) remnant survived the flood at stations -55 to -60.

Since the flood of 1978, the left bank has continued being eroded back into the Lightning and (since 1985) Moorcroft terraces. As of 2014, the terrace bank had lost another 35 m, or an average of a meter per year. Larger-than-average amounts of erosion of the left bank were recorded in the surveys conducted in 1984 (2.9 m), 1991 (3.0 m), 1993 (2.0 m), 1995 (3.4 m), 1996 (5.0 m), 1999 (2.0 m), and 2011 (9.7 m, most of which probably was eroded in 2008).

From 1978 through 1995, the new point bar that began to develop during the 1978 flood accumulated sediment intermittently (on a year-to-year time scale) between stations -15 and +15, until its upper surface lay near the level of the existing flood plain. Meanwhile, an even newer point bar developed between stations -15 and -35 (Moody and Meade, 2014). Between 1995 and 2008, the riverward edge of this newest point bar was extended laterally leftward to about station -55.

In 1996, the leveling survey of section PR163 was extended rightward to station 650. Station 650 was the location of the high water of the 1978 flood.

Martinson, H.A., and Meade, R.H., 1983, Channel changes of Powder River, 1938-78, Powder River County, Montana: *U.S. Geological Survey Hydrologic Investigations Atlas HA-661*, 3 sheets.

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- Moody, J.A., and Meade, R.H., 2008, Terrace aggradation during the 1978 flood on Powder River, Montana, USA: *Geomorphology*, v. 99, p. 387-403.
- Moody, J.A., Pizzuto, J.E., and Meade, R.H., 1999, Ontogeny of a flood plain: *Geological Society of America Bulletin*, v. 111, p. 291-303.
- Moody, J.A., and Meade, R.H., *accepted 21 April 2014*, Ontogeny of point bars on a river in a cold semi-arid climate, Submitted to GSA Bulletin,



PR163. **Top.** 13 July 1977. View downstream along the left-side cutbank, which, at the time of this photo, was eroding the Lightning terrace. E. Meade (~1.6 m tall) is standing on the line of section at about station 8. The left-side cutbank was eroded by the Flood of 1978 and moved laterally 65 m to the left during the flood.



PR163. **Top.** 11 May 1993. View downstream along the left bank, which is on the Moorcroft terrace. Water elevation is 963.10 m. **Bottom.** 30 August 1993. View upriver of left bank with J. Pizzuto is about 1.8 m tall and is standing on the line of section.



PR163. **Top.** 21 September 1994. View upriver of section. **Bottom.** 21 September 1994. View downriver from point ~80 m above section. Water discharge is about $1.5 \text{ m}^3 \text{ s}^{-1}$. Red lines indicates approximate line of section.



PR163. **Top.** 14 January 1996. View downriver of left bank. Erosion of bank is caused by melting snow on this bend that faces approximately southwest. Power pole appears in the photo taken on 11 May 1993. **Bottom.** 1 October 2013. View upriver of section. Tripod, level and D. Martin (~1.5 m tall) are 3 m downriver from station -94 (inside red circle on right edge). Vehicle (Chevrolet Suburban) is parked along the riverward side of a fence, which cross the section at station -122.0. The tailgate is about 4 m downriver of the line of section. Rodman (J. Moody (~1.9 m tall) is standing on the line of section, on top of left bank at station -91.5 (inside red center on left edge).



PR163. **Top.** 1 October 2013. View upriver of point bar. J. Moody (~1.9 m tall) is standing at station -27 (inside red circle). Log on point bar is the same log seen in photo taken on 21 September 1994. **Bottom.** 1 October 2013. Upriver view of point bar. A point at elevation 953.0 m above sea level on the point bar (see data files) has moved laterally 30 m, and the thalweg has moved 55 m since the Flood of 1978. J. Moody, with white rod, is on the line of section at station +7 (inside red circle). Station +10 was the left-side cutbank in 1977 (see photo above).



PR163. **Top.** 17 July 2014. View left bank. Water level is at 962.73 m above sea level and is 2.68 m below top of bank. Tripod is on the line of section shown approximately by the red line. Water discharge is $16.7 \text{ m}^3 \text{ s}^{-1}$. **Bottom.** 17 July 2014. Downriver view of point bar along right bank. Right edge of water is at station -46.0. Red line is the approximate line of section.