River Channel Movement and Boundary Law in Alberta

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Summary

In Alberta some property boundaries are defined by river channels. The law states that if such a channel moves due to accretion on a bank and erosion on the one opposite the property boundary moves with the active channel, whereas if the channel moves due to avulsion, the property boundary remains at the abandoned channel bed. Gravel- bed rivers in Alberta, however, commonly contain reaches in which two (or more) adjacent channels carry the flow, and such rivers exhibit a third type of change not recognized in law: a gradual transfer of active flow from one channel to another due to a series of perceptible events. Time-series air photographs provide evidence for this third type of change. Preliminary investigation indicates that gravel-bed rivers have discharges large enough to move bed load only on an intermittent basis, which precludes steady, continuous transfer of discharge.There is some degree of scale dependence; large rivers such as the Bow and the North Saskatchewan are stable over longer periods than their tributaries. It is not clear how the law should deal with change in river position caused by transfer of flow between channels, as opposed to lateral migration of channels.

The geosciences and the law are intertwined in many areas. In some cases laws pertaining to geological matters were laid out according to an understanding of the issue that has since become outdated. In such cases it is incumbent on the geoscientific community to provide the law community with the most up-to-date information so that the law more accurately reflects reality.

In the province of Alberta, rural property boundaries are mainly defined by the Dominion Land Survey Township and Range lines. However, in some cases property boundaries are defined by the edges of river channels. But river channels are not static; they move through lateral migration of meanders as well as through avulsion and channel transfer (Bridge, 2000). The current law in Alberta states that if a river bed moves “slowly and imperceptibly” (Ballantyne, 2007) the movement is ambulatory and the boundary moves along with the river bed. The practical effect of this is that “ [Land] Parcels increase in area through accretion, and decrease in area through erosion.” (*Ibid*) However if the movement and change of location is avulsive the boundary remains at the old river bed (*Ibid*).

What is not accounted for in these definitions is the case of two-channel systems in which river channel change takes place not by avulsion but by gradual transfer of flow from one channel to another; the original bed does not migrate but both channels are active for some time before the original channel dries up. The Alberta case of Robertson v Wallace in 2000 highlighted this discrepancy. The ownership of a land parcel was in dispute due to the movement of the river that comprised the natural boundary. The original river bed which had defined the property boundary lay to one side of piece of land while the current river bed lies on the other. The Alberta Land Surveyor, an expert witness, testified that he believed the active flow had changed by gradual shift from one bed to the other, so that the process should have been considered ambulatory and imperceptible, while the Geologist, also an expert witness, testified that there had to be a distinct first time when flow ceased in the now-dry channel, and therefore the

change could be considered a discrete, perceptible event. The judge had no previous case-law to guide her ruling and accepted the testimony of the Geologist as she deemed it more credible. The technical question remains: in a two-channel system does a gradual transfer of discharge from one channel to another constitute ambulatory/accretionary movement, avulsive movement, or does a new category of movement need to be addressed?

Evidence exists that gradual channel shift can occur in large multi-channel systems (Examples Bristow 1999, Brahmaputra, Morozova and Smith 1999, Cumberland Marshes), but clarification is required for smaller, dominantly single-channel rivers. Little to no mention is made of two-channel system behaviour in the literature, which focuses mainly on sand-bed rivers. In Alberta the vast majority of rivers are gravel-bed and two-channel systems around islands are commonplace. This study undertook to explore whether gradual river-channel shifts do occur and if so to investigate the unresolved point of law. Aerial photographs (air photos) of a number of rivers in Alberta were compared against airphotos of the same areas in different years. For many of the rivers photographs have been taken approximately every ten years for the last 80 years. In a number of cases the interval is even smaller. Where particularly good examples of gradual channel shift were identified and the locations were accessible, the sites were visited for direct field observation.

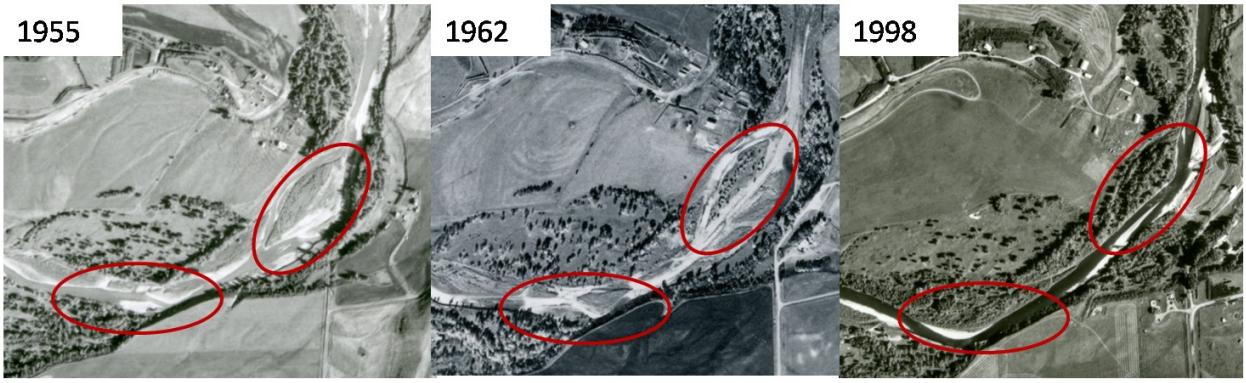

Figure 1: Sheep River. In both highlighted areas secondary channels become the sole active channel between 1955 and 1998.

In a number of Alberta rivers, two-channel systems containing an island can be observed developing from and then maturing back into a single-channel system. In the examples found, a small secondary channel branches off from the original, creating an island. Both channels carry active flow simultaneously for some time, with the secondary channel capturing more of the river's flow as time goes on. Eventually the original channel is abandoned. Field observations at Threepoint Creek revealed paleochannels around paleohighs adjacent to the current channel and the most recently abandoned channel, indicating that this process has taken place more than once.

Significantly, this process has only been observed so far on smaller-scale rivers; on the very large Bow River and North Saskatchewan River the islands and the surrounding channels have remained relatively stable over the 83 year period represented by the airphotos. Fieldwork on the Bow River has revealed paleochannels similar to those at Threepoint Creek, indicating that channel switching has likely occurred at some time.

Gravel-bed rivers also meander, which is channel migration by erosion on the outsides of bends and deposition on the insides of bends. In the same way as two-channel flow transfer, meandering appears to occur as a series of small discrete steps rather than as a continuous

process in all rivers studied to date. This is expressed by vegetation banding on point bar deposits or on the edges of abandoned channels and indicates that deposition (and by extension, erosion) occurs only periodically in gravel-bed rivers.

Field observations indicate that summer and early fall flows are not competent to transport bedload in either the Bow River or Threepoint Creek, leading to the hypothesis that flow transfer (as well as channel migration) is a non-continuous processes because stream power is only intermittently great enough to cause change. Air photo analysis and fieldwork are ongoing to investigate the mechanisms and relationship between effective stream flows and gravel-bed river behaviour.

It is clear that transfer of active flow from one channel to another, gradual in the long run but intermittent in the short term, does occur within some Alberta rivers. Such change can result in a net movement of the position of the river, and hence have a bearing on boundary locations. It remains to be seen how such flow transfer should be classified under the law. It may not necessarily be viewed as accretionary because it is not imperceptible but rather occurs as a series of perceptible events, and yet neither may it necessarily be viewed as avulsive, as it occurs through a series of discrete events but is by no means sudden.

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