Sailor, Matthew NWK

From: Richard Geekie [rfgeekie@gmail.com]
Sent: Friday, April 03, 2015 11:36 AM
To: Sailor, Matthew NWK
Cc: MDNR MVS External Stakeholder; ssatterthwaite@kdheks.gov; Mike Odell; David Williams; BHall@nhcweb.com
Subject: [EXTERNAL] Comments on dredging permit applications of Holliday Sand and Gravel
Attachments: Dredging and Channel degr Missouri River.pptx

Categories: Red Category

Dear Mr. Sailor:

Mike Odell asked me to submit the attached PPT summarizing some of my observations from my studies of the Missouri River. This is a somewhat abbreviated presentation because I did not want to make the PPT too long and also I just wanted to suggest that if dredging has an impact on channel degradation, the process is complicated.

The conclusions that that I have come to, and not all are presented in this PPT are the following:

1) that dredging does not cause a nick point and therefore does not cause head cutting. A preliminary investigation demonstrated this, however, the "test period" was only about two weeks. Further investigation over a longer period is required to confirm this result during extended periods of dredging.

2) the constriction of the floodplain at river mile (RM) 374.1 (I-435 Bridge) and also the constriction of the floodplain on the south end of the airport have caused most of the degradation.

3) It may be possible that dredging has contributed to channel degradation in the KC reach during the drought of 2000 to May 2007 because little bed-material load was coming from upstream.

4) The channel degradation in KC reach has appeared to stop since about 2007 (the end of the drought) and the channel upstream and downstream of the Kansas River has rebounded, that is, aggradation has occurred, even during significant amounts dredging in the KC reach.

5) The sills upstream of the I-435 Bridge may also have and still contribute to head cutting upstream of the Bridge.

The attached PPT has not been vetted by sediment transport experts and has not been peer reviewed. This PPT is derived from tow write-ups that I have been developing on dredging and channel degradation.

If you have any questions, please let me know.

Regards,

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The correlation between dredging and degradation of the Missouri River channel in the Kansas City reach

The Kansas City reach is between River miles (RM) 340 and 410

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April 2015

Summary:

1) Channel degradation has been greatest in the Kansas City reach, approximately RM 340-410.
2) Corps-measured low-water surface profiles (75%) indicate that the channel bed has degraded significantly before 1974.
2) These low-flow measurements indicate that the channel in the Kansas City reach has been recovering (aggradation) since about 2006.
3) Significant dredging occurred after 2006.
4) A drought as measured by Kansas City gage discharge occurred from 2000 to May 2007; this drought appears to be correlated with increased or accelerated degradation at KC.
5) The end of the drought in early May 2007 appears to coincide with beginning of aggradation in the KC reach.
6) There are two slopes to the Kansas City channel: a steepening upstream above about RM 374 and flattening below about RM 374; these changes in water-surface slopes indicate degradation.
7) The water-surface slope above RM 374 begins to decrease in 2008 while the slope below RM 374 begins to Increase.
8) There is the possibility that large dredging amounts during a drought or low flow (low bed-material load from upstream) might result in head cutting.

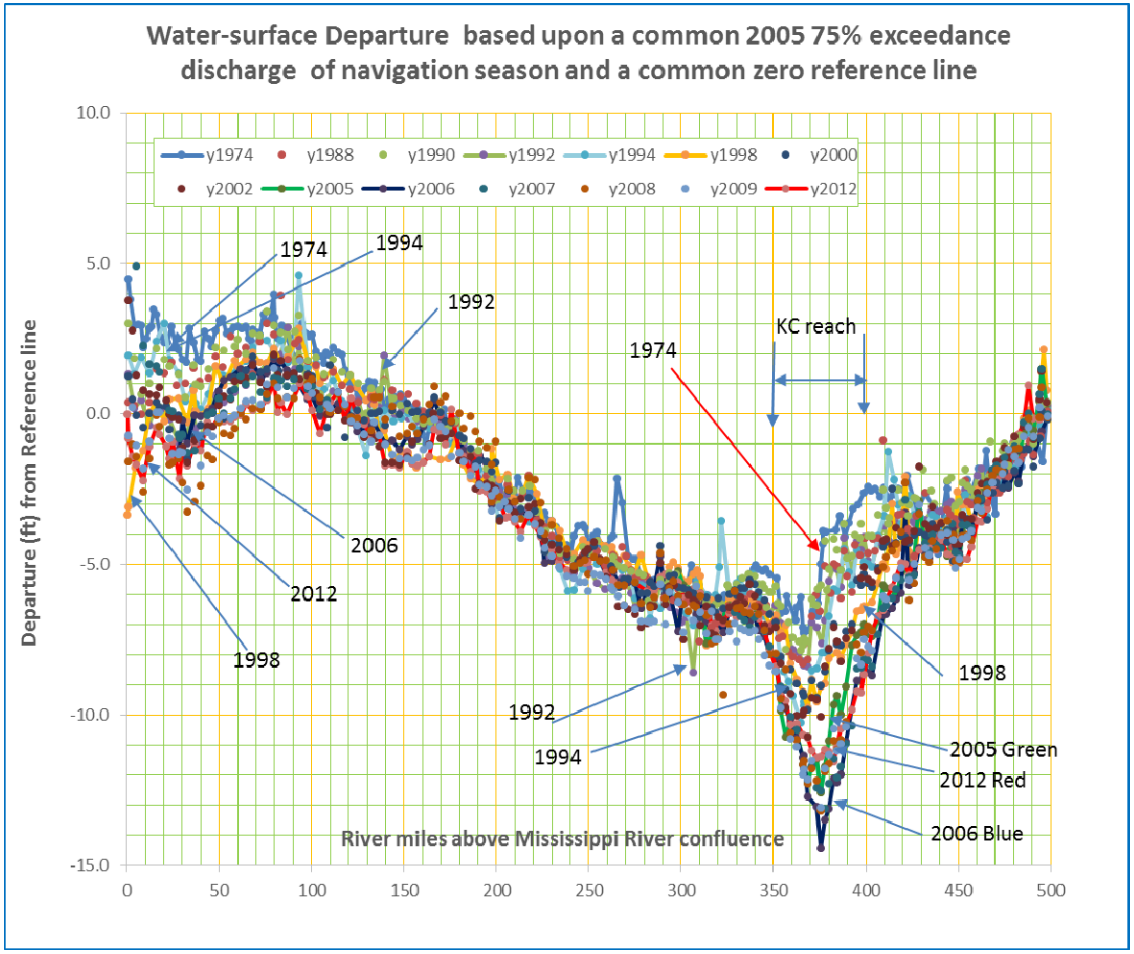

Figure 1 - A measure of channel degradation from the departure of 2005 75% water-surface profiles from common reference line shown as “0.0” on vertical axis

1) The greatest departures (degradation) from the reference line in the ***above figure 1*** are between RM 340 and 410.

2) There are also large departures (degradation) above RM 410 and below RM 340.

3) There are changes in slope of the departure “curves” at about RM 340 and above RM 420.

4) These changes of slope may be due to different degradation processes.

5) Notice the movement upstream of the low point from RM 366 to 374 between 1974 to 2006.

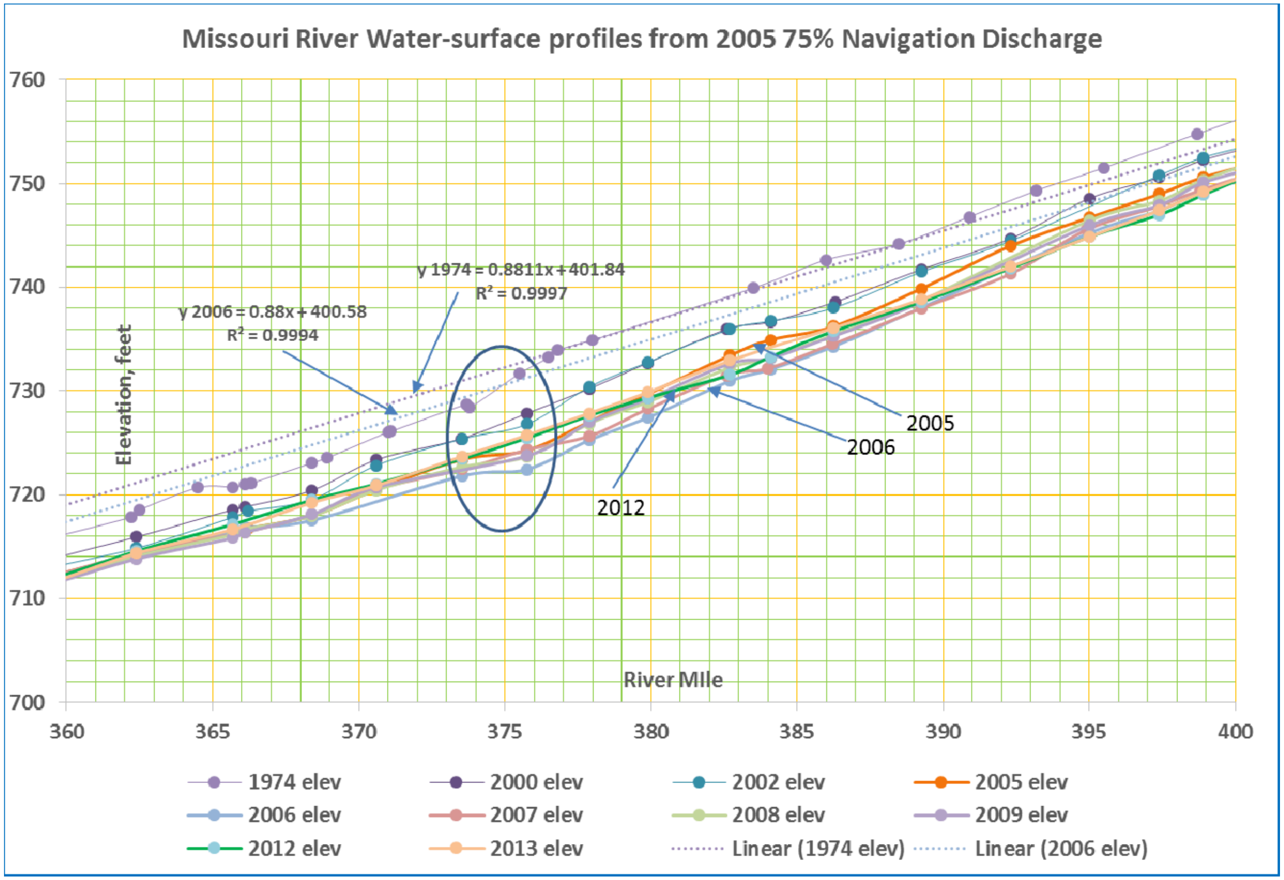

Figure 2 - Selected Low-flow water-surface profiles. Profiles after 2006 have shifted above the 2006 profile indicating channel recovery or aggradation.

A possible cause of the beginning of degradation in Kansas City reach:
a nick point and head cutting at river mile 374 and constricted floodplain just below Kansas River, between Broadway Bridge and I-35 Bridge (1450 feet floodplain width).

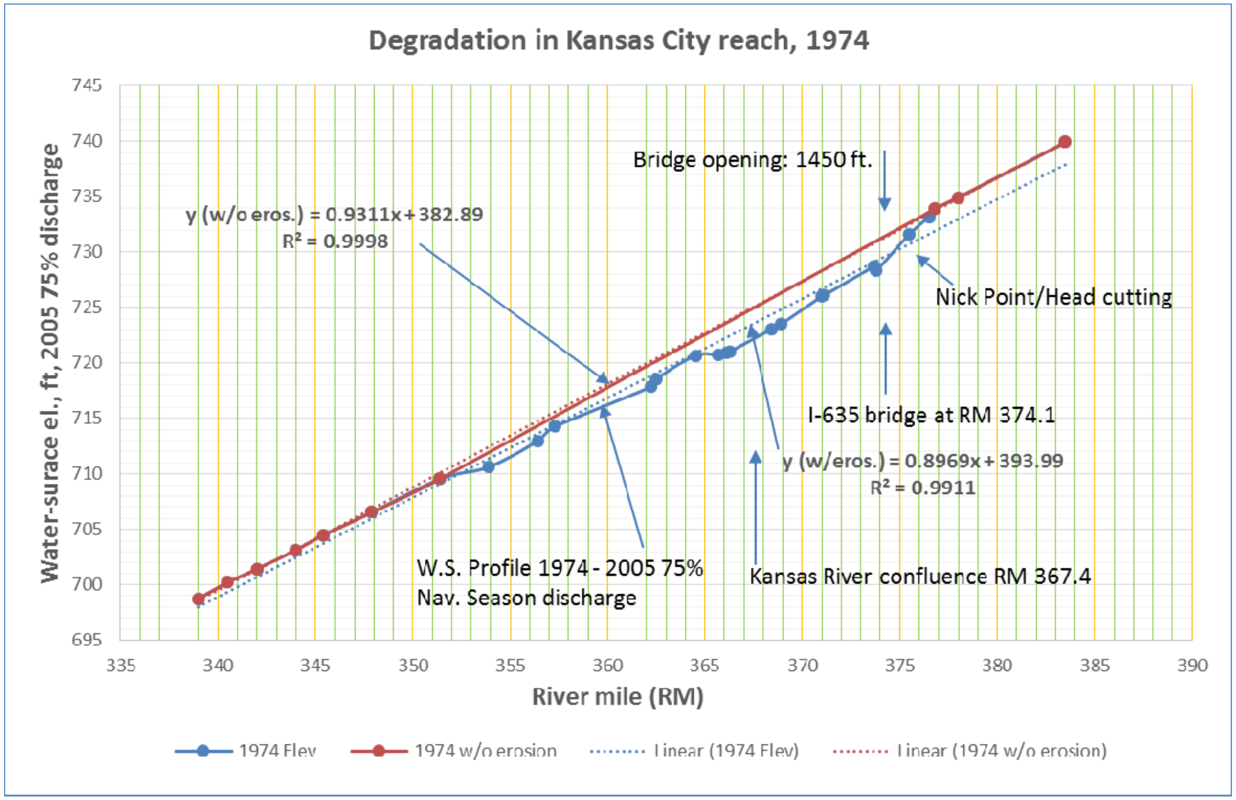

Figure 3 – Floodplain constriction at RM 374.1 and adjacent to Downtown Airport, RM 366.1 to RM 364.6

Head cutting is a process that can explain the steeping of the upstream slope, above RM 366 or RM 374 and flattening of the downstream slope. It is also possible in this case that sills above RM 383 are too high.

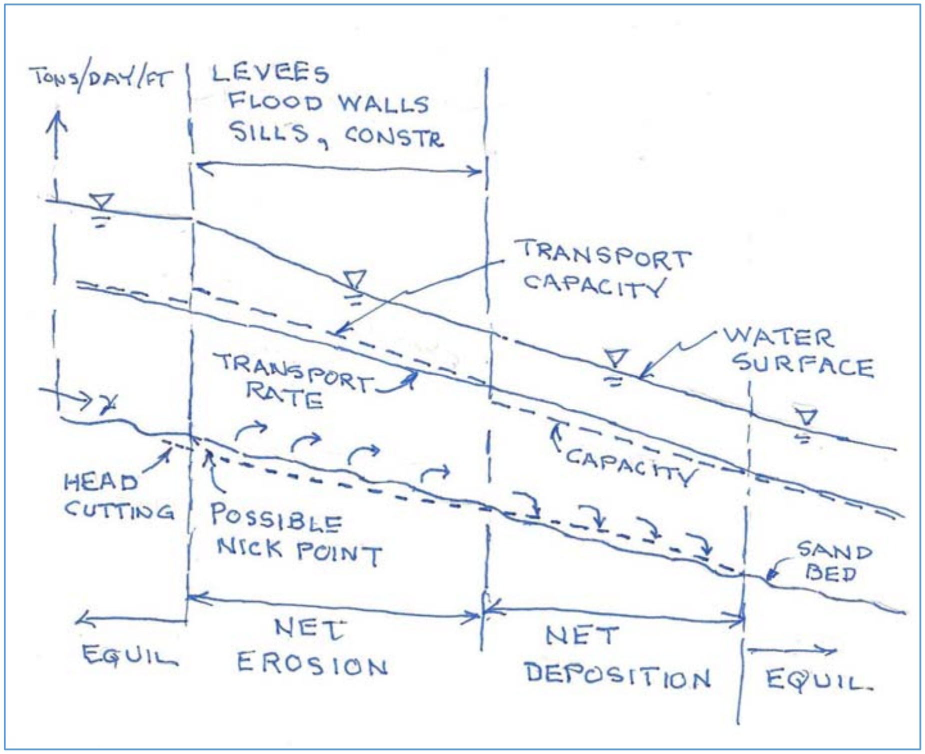

Figure 4 – Process of head cutting

Table 1 - Water-surface slopes of Missouri River below Rulo, NE (2005 75% discharge of the navigation season) Source: slopes calculated from KCD, USACE data contained in a spreadsheet

	feet per mile								
Year	498.1 -28.2	150-350	293-366	340-366	340-374	380-410	366-448	410-454	454-498
1974	0.88	0.87	0.89	0.82	0.84	0.94	0.94	0.88	0.94
1988	0.88	0.86	0.88	0.82	0.87	0.97	0.94	0.90	0.96
1990	0.88	0.86	0.87	0.80	0.86	0.95	0.95	0.92	0.96
1992	0.89	0.86	0.89	0.81	0.84	0.94	0.95	0.91	0.96
1994	0.88	0.87	0.85	0.72	0.78	1.00	0.96	0.86	0.98
1998	0.88	0.89	0.85	0.78	0.79	1.00	0.97	0.92	1.00
2000	0.88	0.86	0.85	0.75	0.77	1.01	0.97	0.89	0.97
2002	0.88	0.86	0.83	0.71	0.77	1.03	0.98	0.91	0.99
2005	n/a		0.82	0.70	0.72	1.04	1.00	0.94	1.00
2006	0.88	0.87	0.83	0.71	0.70	1.11	1.03	0.95	0.97
2007	n/a			0.70	0.71	1.10	1.02	0.94	1.00
2008	0.88	0.86	0.84	0.69	0.70	1.12	1.02	0.89	1.00
2009	0.88	0.86	0.83	0.71	0.73	1.08	1.01	0.93	0.99
2012	0.88	0.86	0.84	0.72	0.75	1.08	1.00	0.92	1.03
2013	n/a		0.83	0.73	0.76	1.04	1.00	0.93	1.01

Low-flow water-surface slopes above RM 374 have increased from 1974 to about 2008 while water-surface slopes between RM 340 – 366 and RM 340 – 374 have decreased from 1974 and 2008. These trends reverse after 2008.

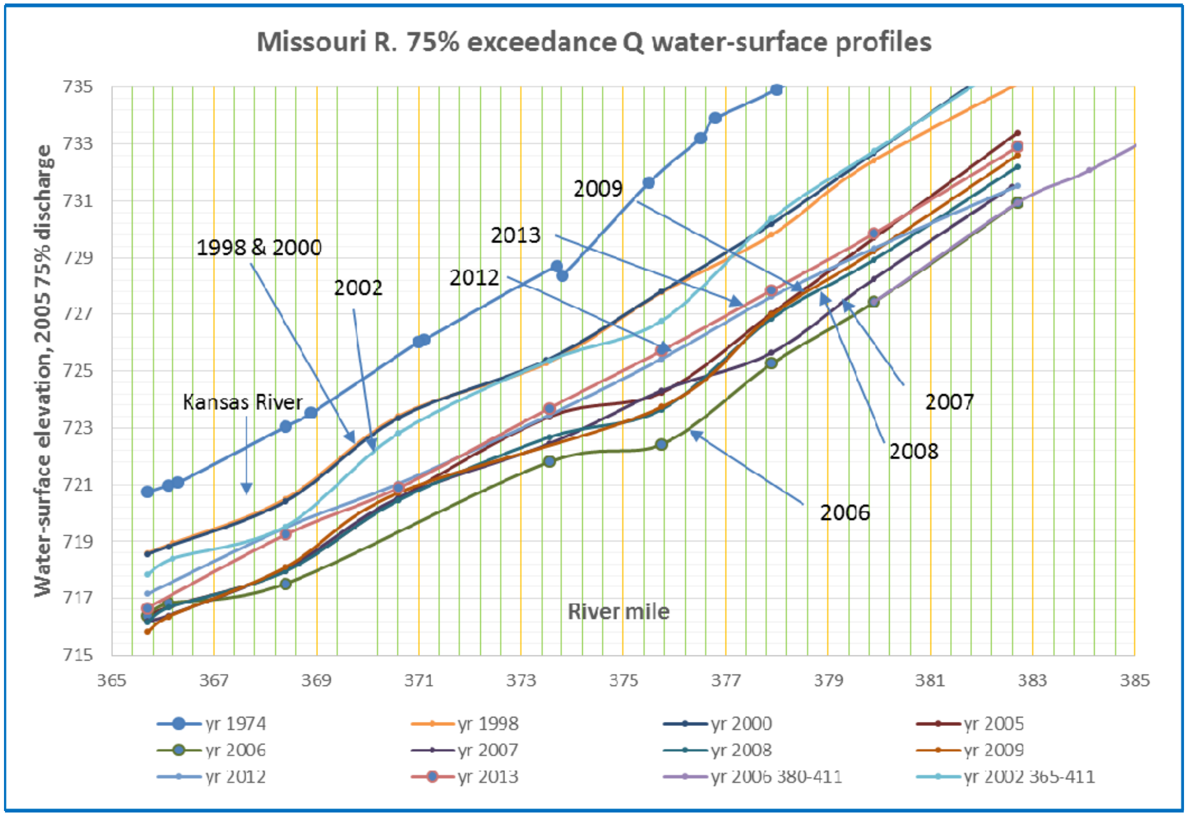

Figure 5 - Low-flow water-surface profiles have shifted up above the 2006 water-surface profile beginning in 2007, indicating deposition has occurred after 2006 for all profiles.

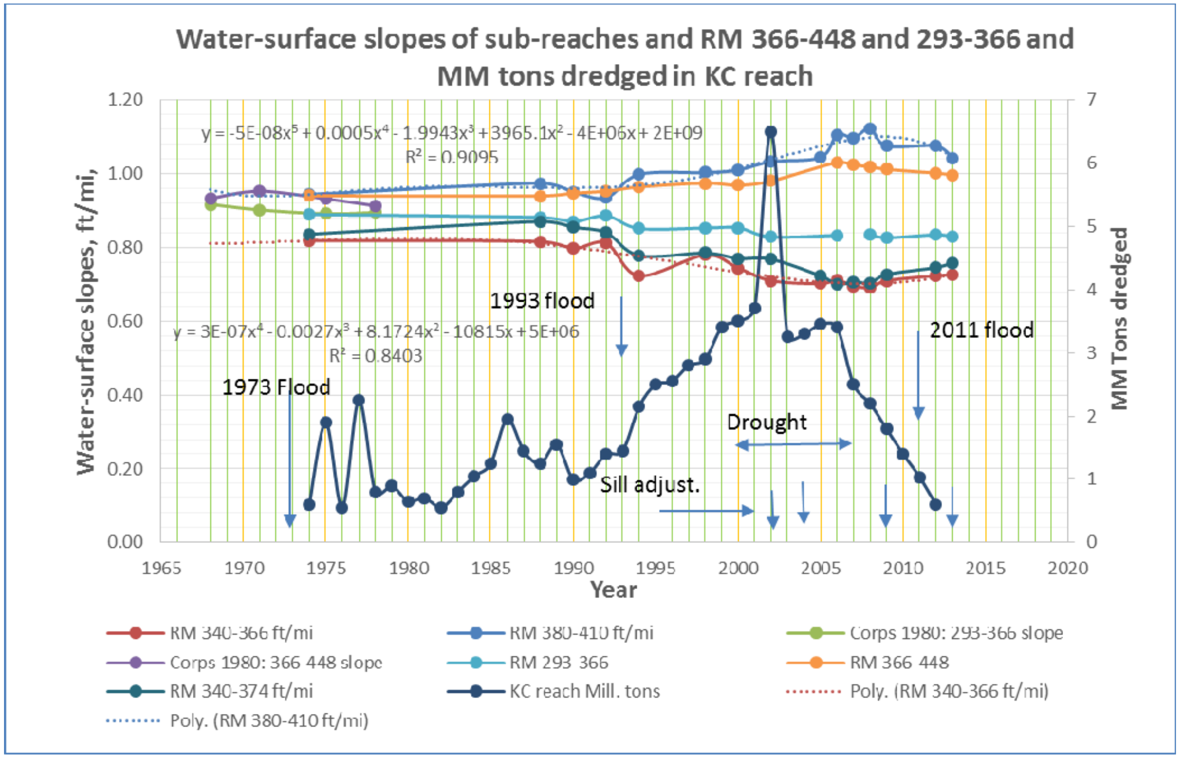

Figure 6 – Correlation between dredging in Kansas City reach and channel slopes

The slope of RM 380-410 begins to decrease or stabilize after 2007 while the slope of RM 340-366 (= RM 340-374) begins to increase or stabilize after 2007. These changes in slopes indicate deposition. Dredging in 2008 is about 2.4 MM tons.

Figure 6:
Between 1995 and 2001, there is significant increase in dredging but no change in the sub-reach slopes of RM 340-366 and RM 380-410.

After 2006, there appears to be some deposition in lower sub-reach and upper sub-reach as the dredging decreases. However, the precipitous decrease in annual dredging between 2006 and 2011 does not appear to correlate very well with the small changes of the two sub-reaches.

The drought ended in early May 2007 which suggests that the bed-material load increased which would offset any effects of dredging on channel degradation.

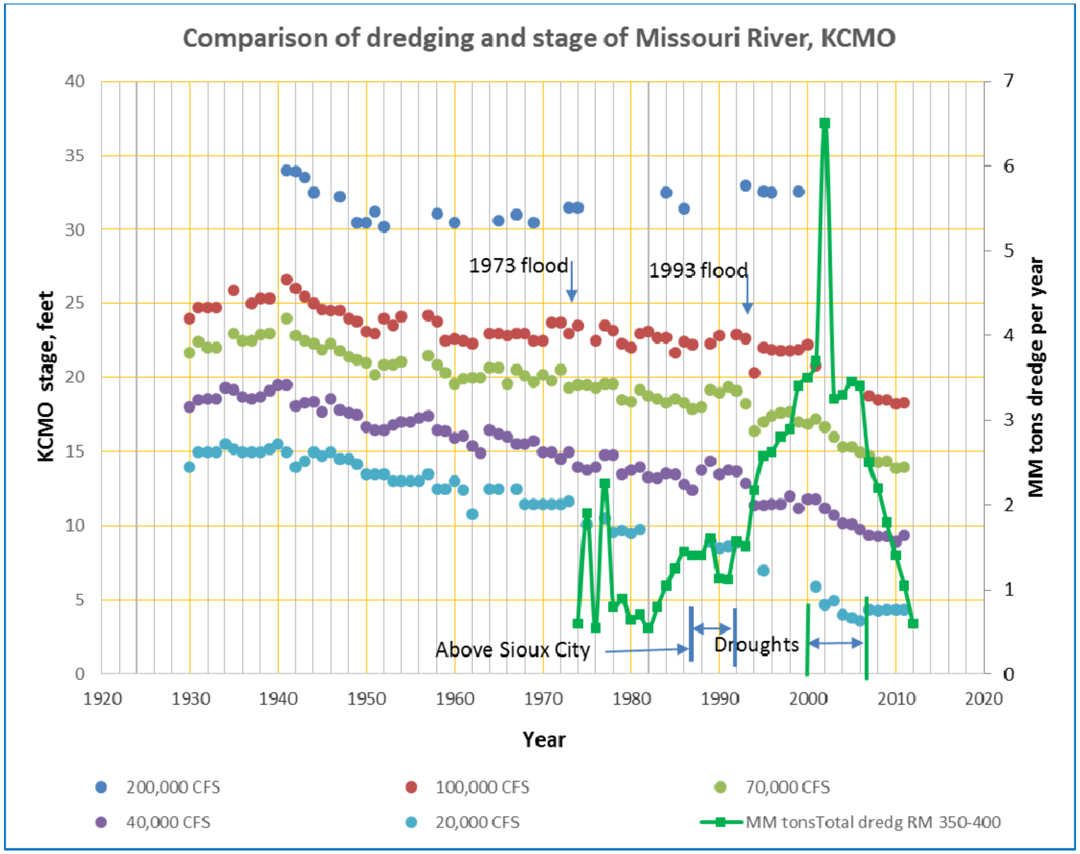

Figure 7 – Correlation between dredging and channel recovery after drought (2000-May 2007) Kansas City gage stage begins to stabilize in 2007. Dredging was above 2.0 MM tons from 2007 through 2009.

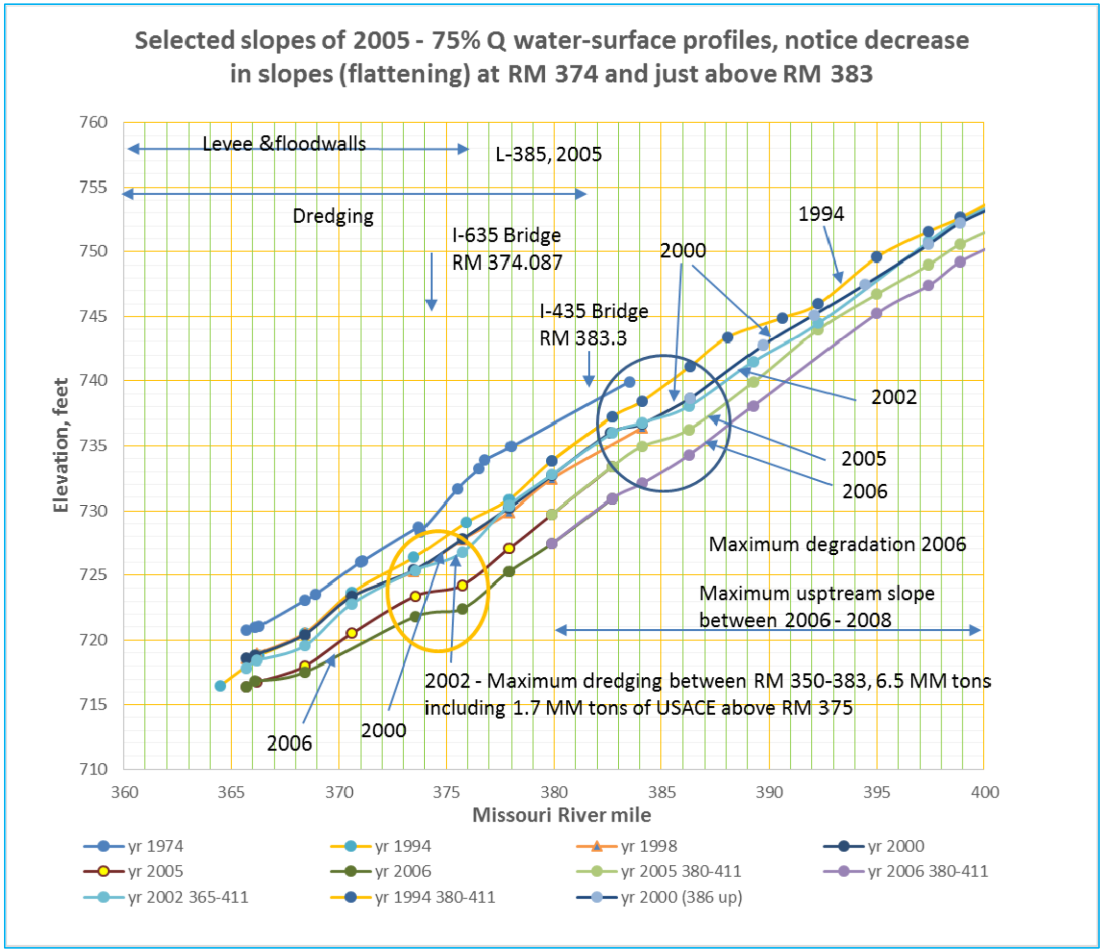

Figure 8 – Flattening of 75% water-surface profile at RM 374.1 (I-635 Bridge)

Possible causes (processes) of slope “flattening” in Figure 8 (RM 374 and RM 383) along with increasing of water-surface slopes and lowering of upstream low-flow water-surface profiles

1. Error in surveying such as incorrect bench mark elevation.

2. Scour hole downstream of dredging pit (hole) and head cutting from downstream scour hole, starting in 2002. There was no dredging above RM 383, however, the flattening at this location may be the result of deposition at RM 382.7 between 1998 and 2000. Again, the drought began in 2000 and ended in May 2007.

3. Sills and dikes upstream of I-635 and I-435 bridges confined flow more frequently over time resulting in increases bed shear more frequently. For example, the 2011 flood was contained within the Kansas City reach channel.

4. Drought was from 2000 through early May of 2007. The West Consultants L-385 report says that degradation appears to occur during low flow and aggradation appears to occurs during high flow.

Conclusions:

1) Dredging in a large sand-bed river with a small profile gradient does not cause head cutting, at least from the upstream edge of the dredge hole (pit). This was not discussed explicitly in this presentation. The Missouri River has a profile gradient of less than 1.0 foot per mile.

2) Figures 6 and 7 suggest that dredging is not correlated that well with channel degradation in the Kansas City reach, except perhaps during extended drought conditions. See discharge records at Kansas City gage between 2000 and 2007.
3) Dredging in the Kansas City reach below the Kansas River could be increased to about 2.0 MM tons per Year.