Water Table Response to an Incising Stream

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With Catherine Noll

and

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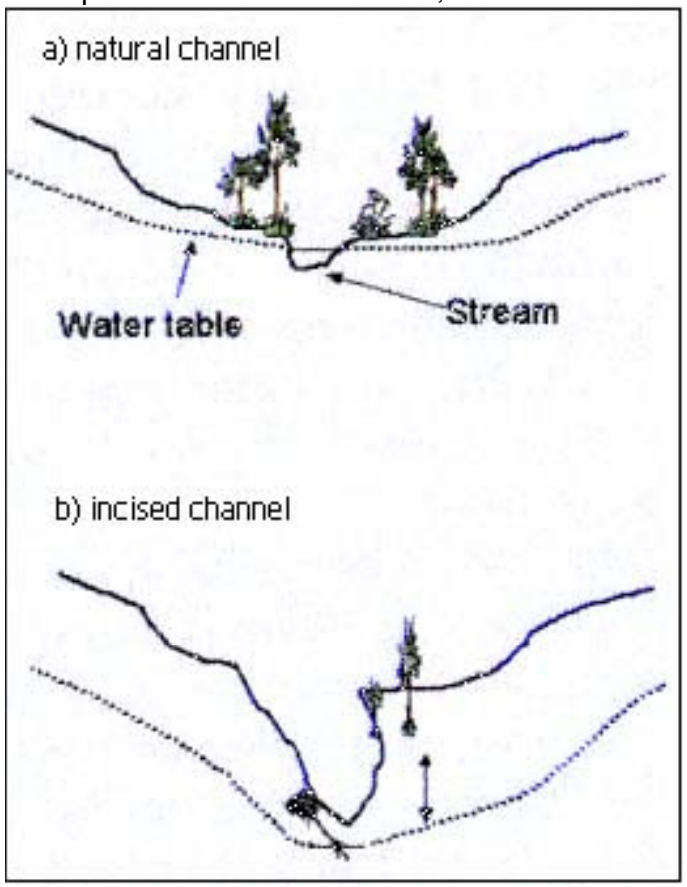
Adapted from Groffman et al., 2003



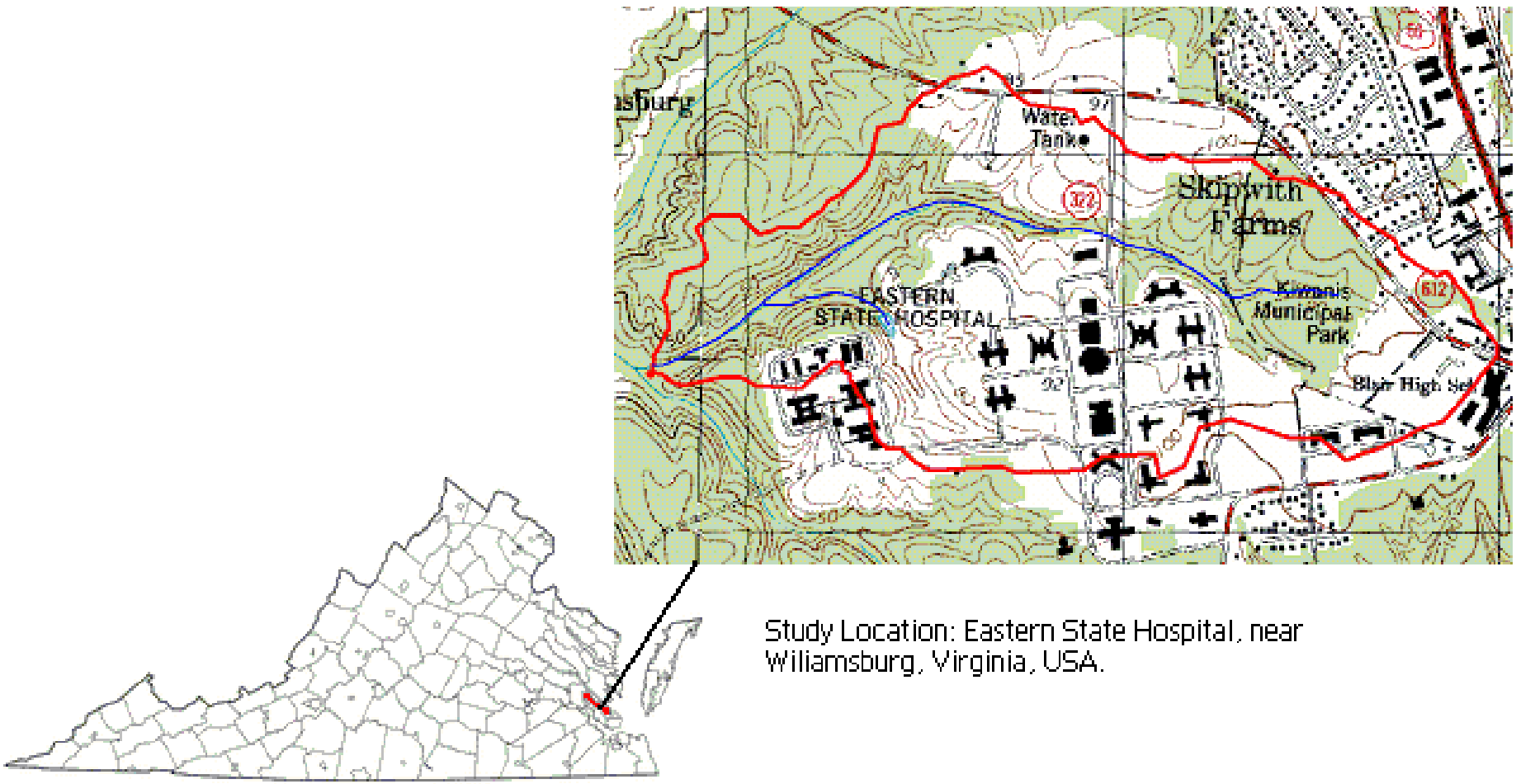
How stream incision lowers the water table level in the adjacent floodplain

head = potential energy

Hypotheses

- Groundwater will flow towards incised stream and parallel to unincised stream
- Channel incision will lower water table levels in floodplain
- Water table will dip steeply toward incised stream channel
- Less recharge of water table will occur in incised stream floodplain following precipitation events

Study Location: Upper Chisel Run

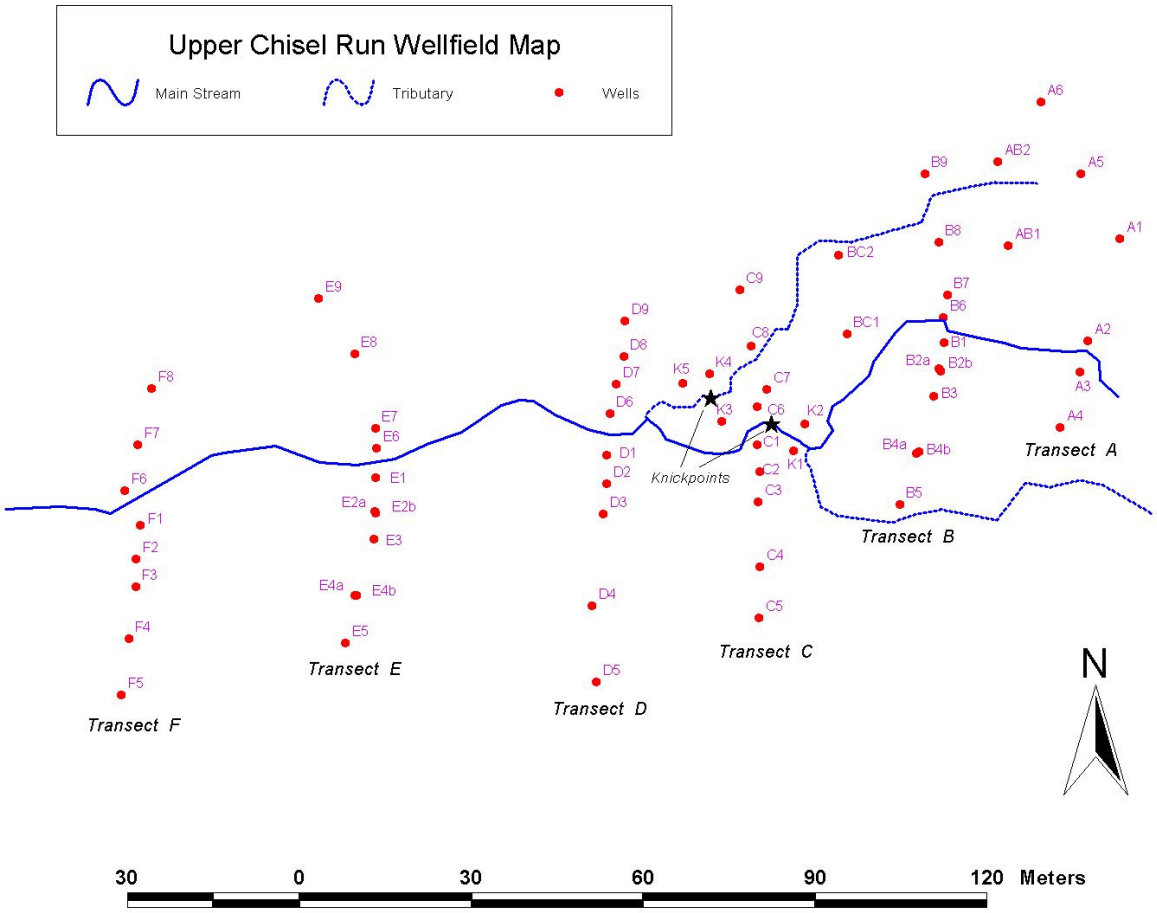


Basin: moderately developed, 15% impervious surface area, 1.5 km2

Development at Eastern State occurred in the 1950s-1970s

Methods

- Install piezometers (monitoring wells) on the north side of the stream
- Gauge wells weekly and around storm events
- Pressure transducers on two wells in B and E transects
- Contour and cross-section maps

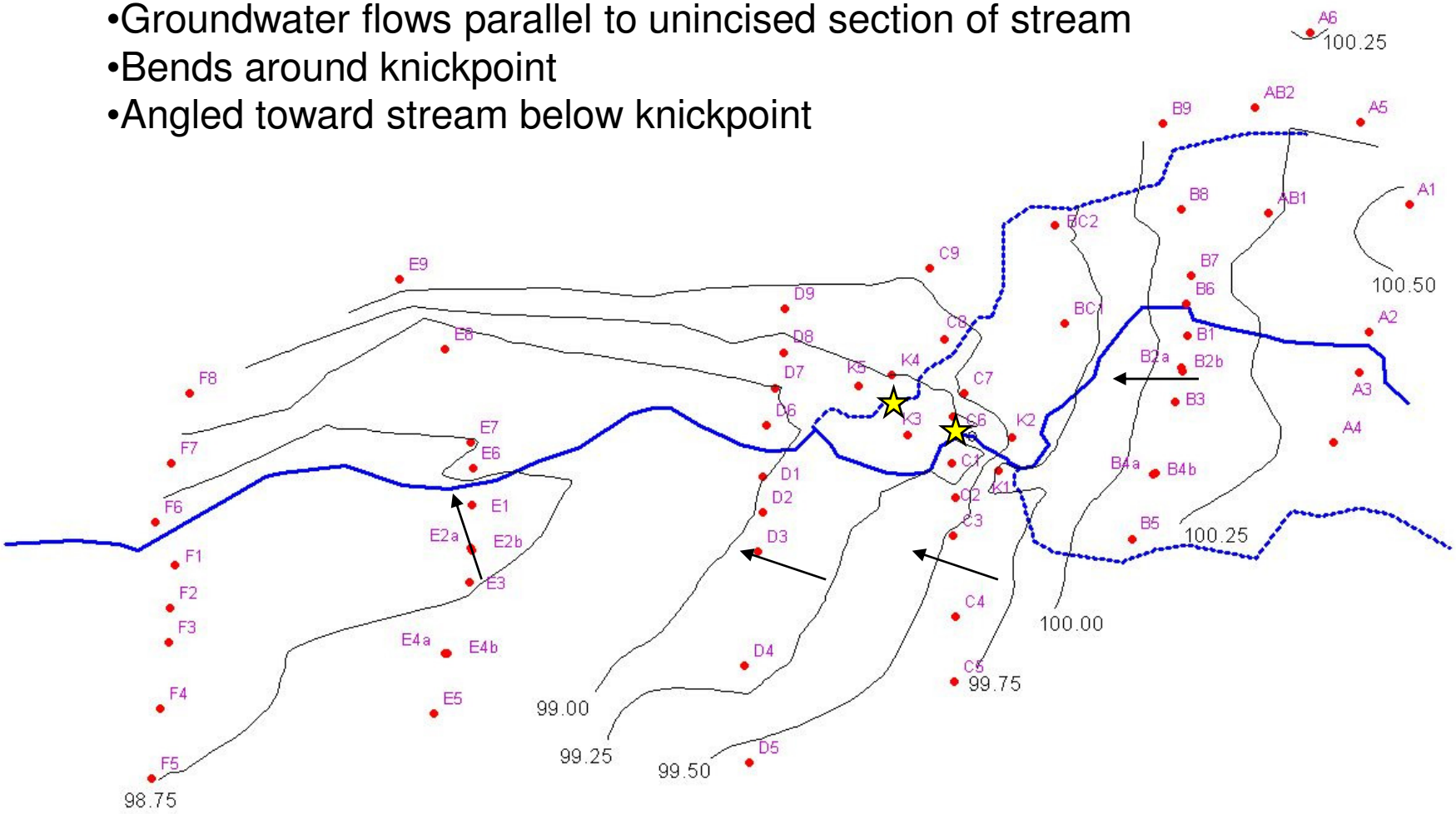


Why Do We Care?

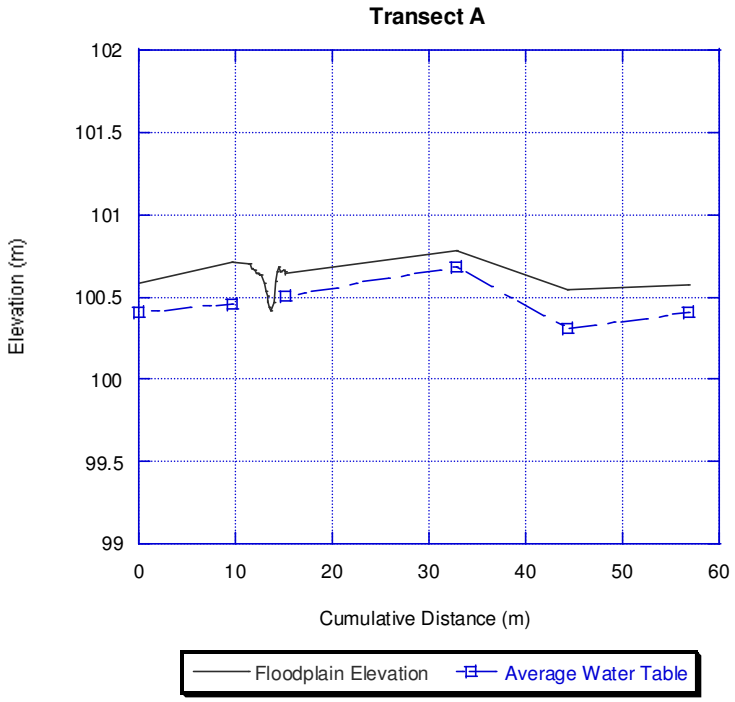
•Loss of habitat for wetland flora and fauna
•Buffer zone impaired: denitrification, other pollutants
•Stream instability

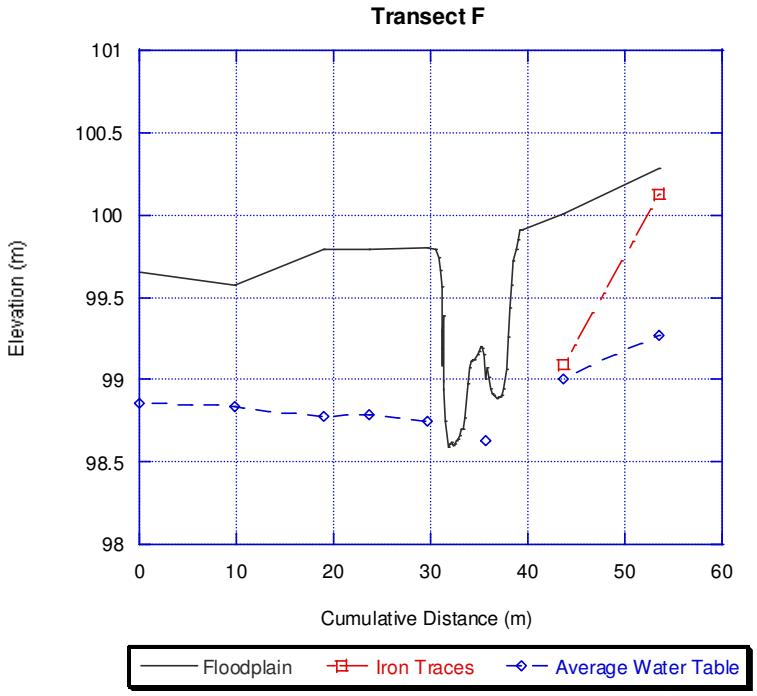
Flow of Groundwater

- Groundwater flows parallel to unincised section of stream
- Bends around knickpoint
- Angled toward stream below knickpoint



Water Table is Lowered



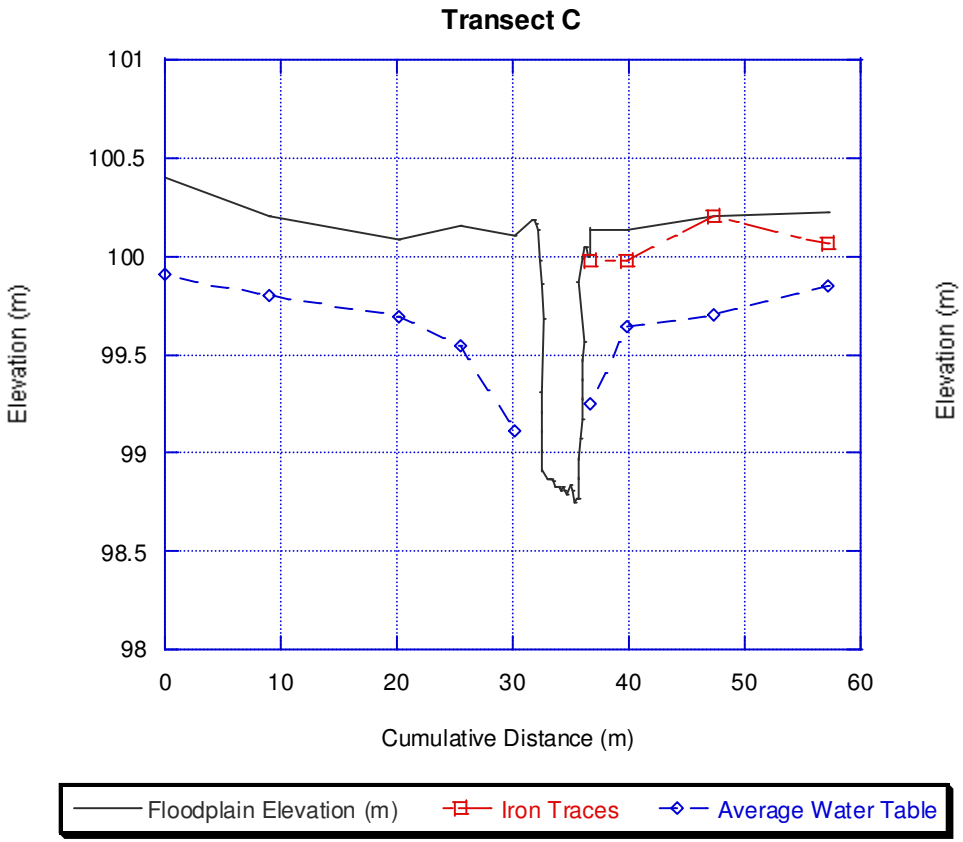


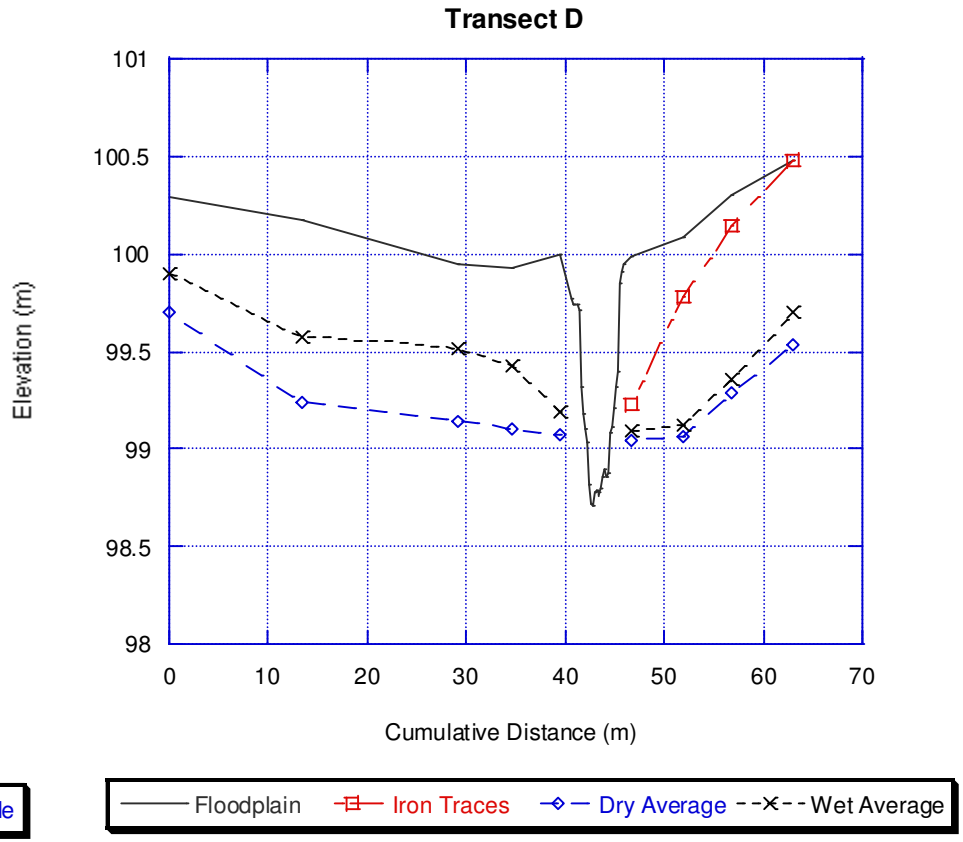
- Water table above knickpoint is 0.28 meters below floodplain surface (average)

- Water table in incised section is 0.89 meters below floodplain surface (average)
- Iron oxide traces show historic water table level
- Water table does not deep steeply toward channel

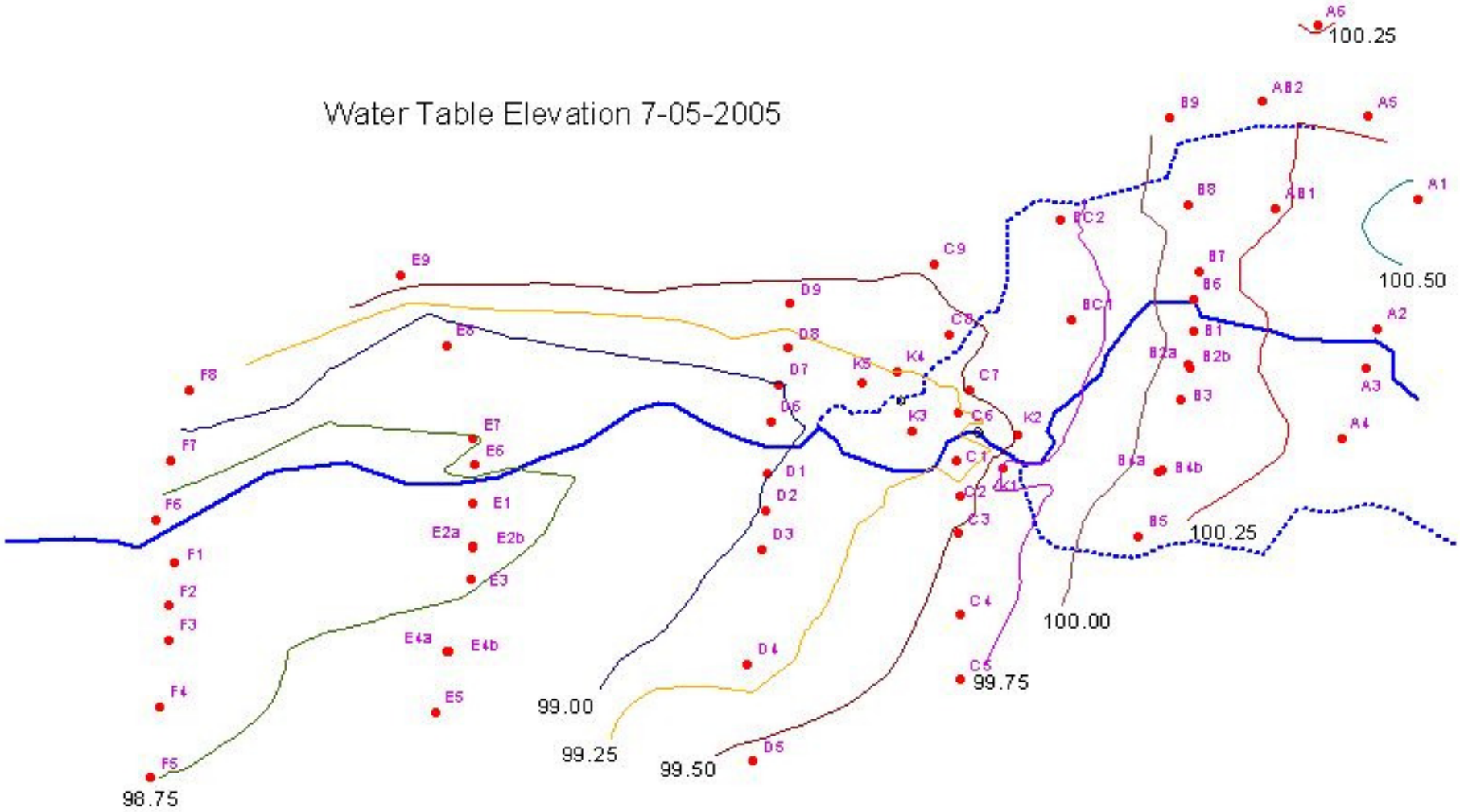
Water Table Levels

•Water table only dips steeply toward channel in C transect and in D transect after rainfall
•C transect has been most recently incised, four to five years ago





Water Table Response to Precipitation



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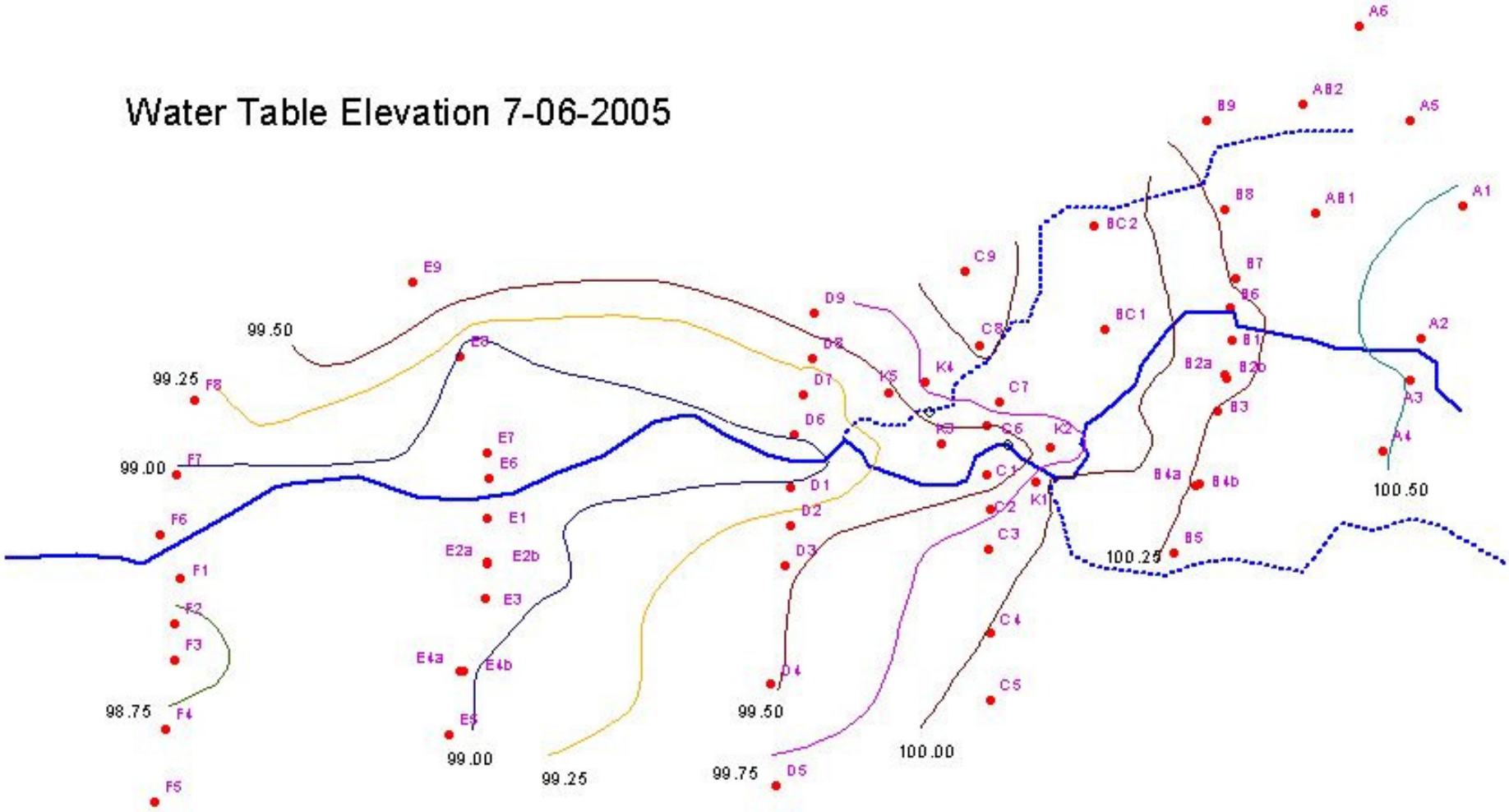
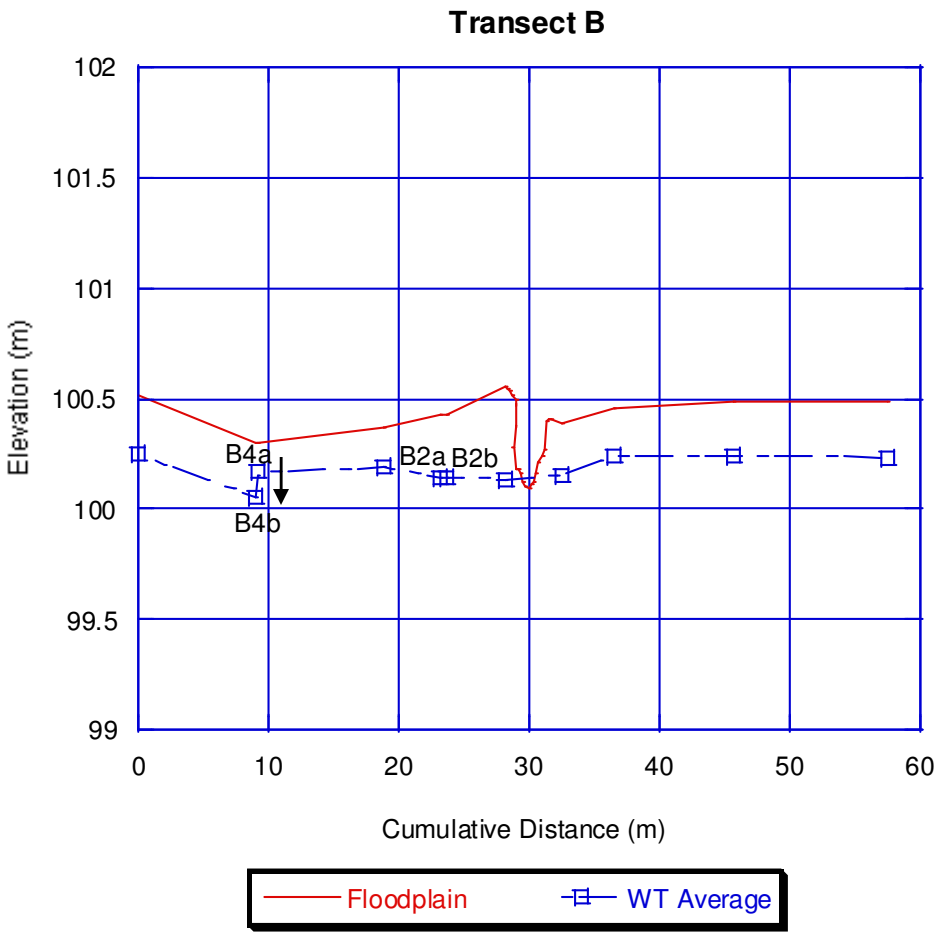
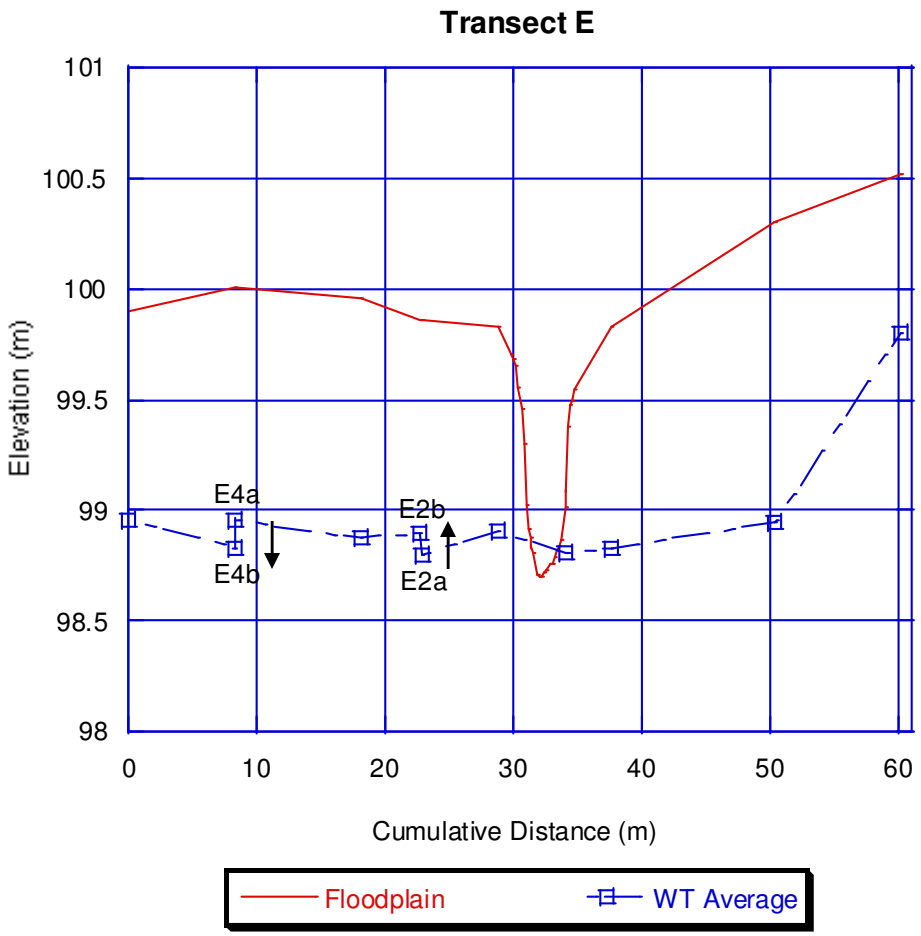


July 5- 34.04 mm of rain in 6 ½ hours

Vertical Movement of Groundwater

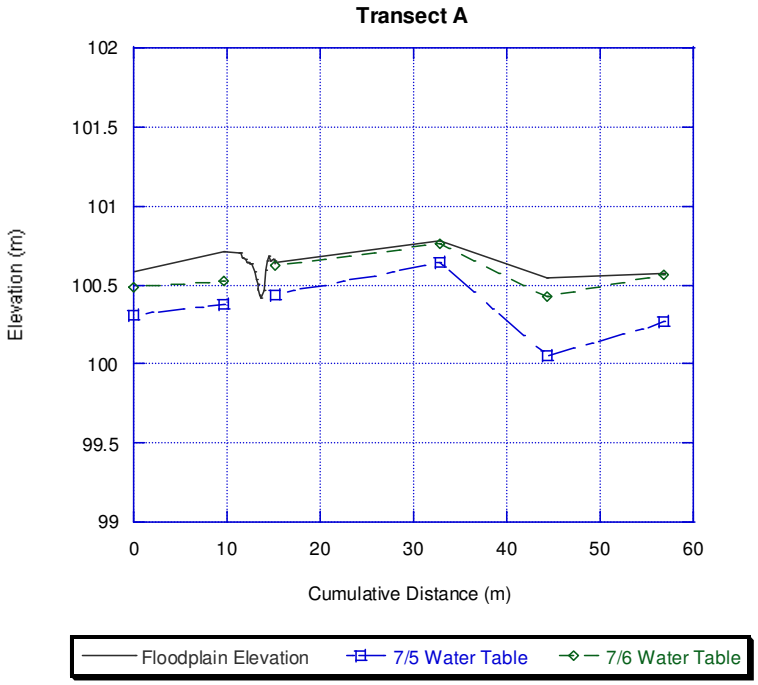


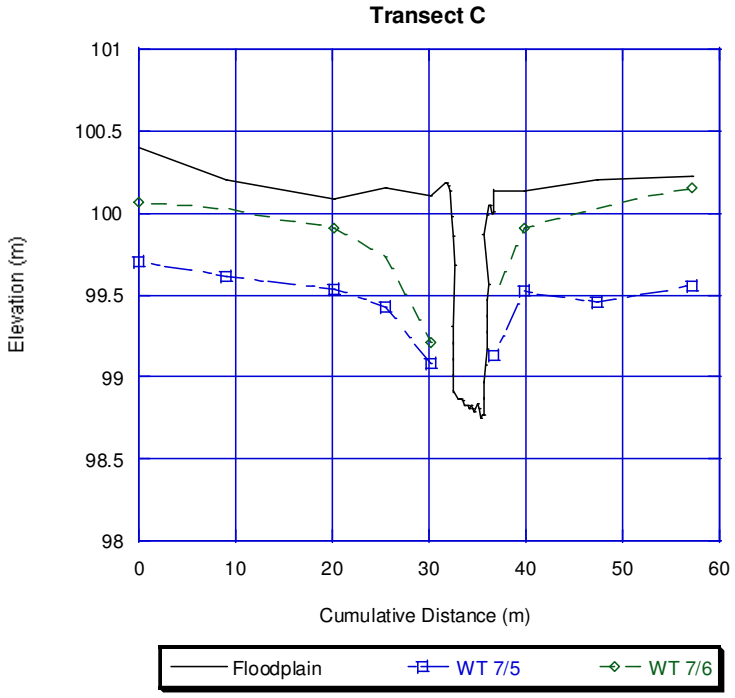


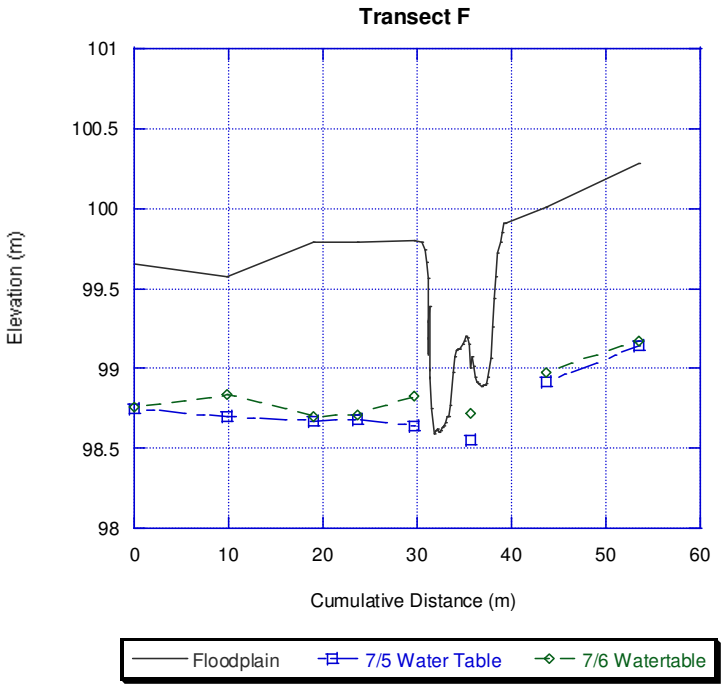
- Groundwater flows downward in both transects at 20 meters from the stream
- There is little vertical movement of groundwater in the B transect 5 meters from the stream
- Groundwater flows upward in the E transect 5 meters from the stream

Water Table Response to Precipitation

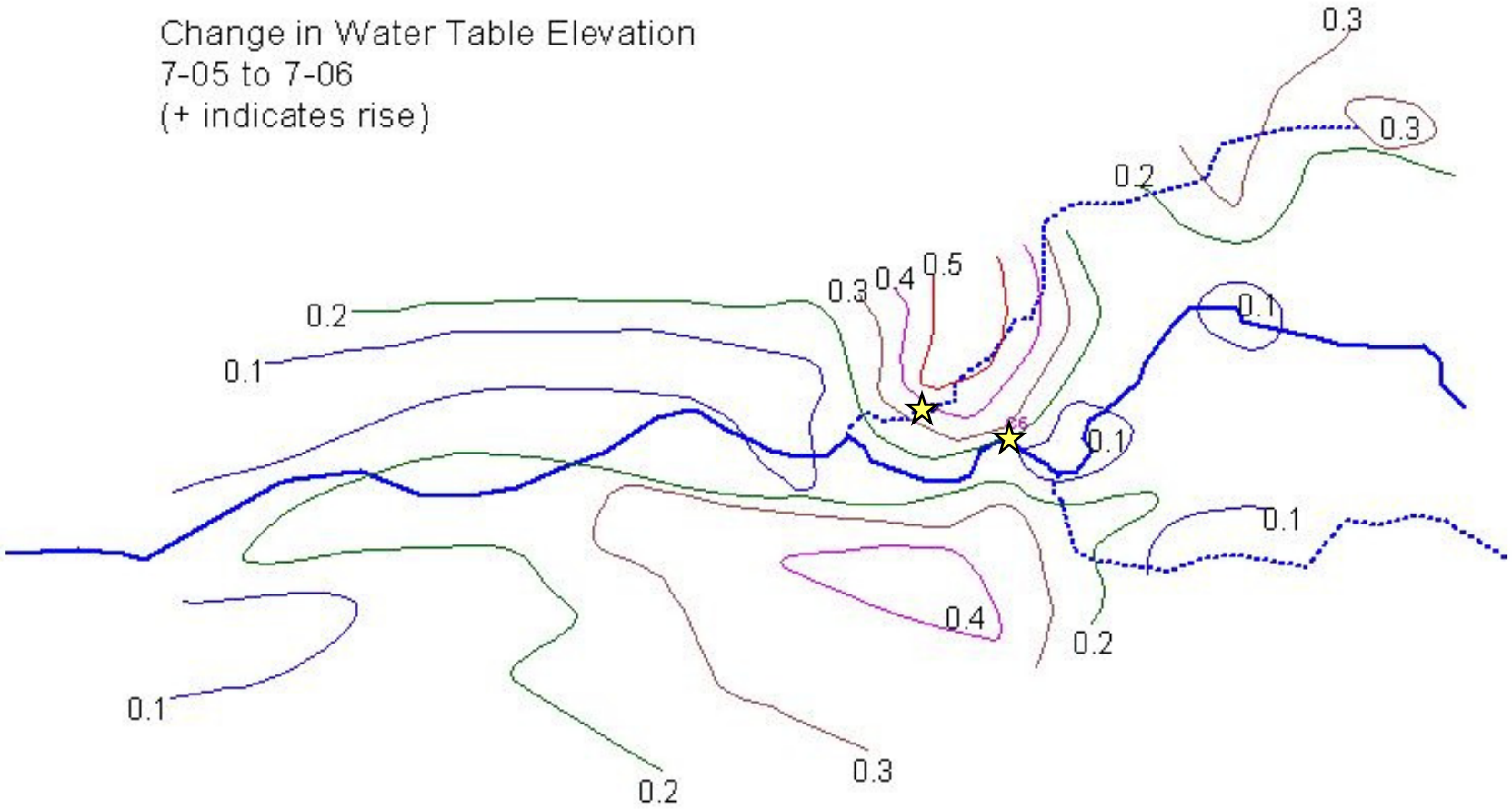
- Greatest response to precipitation event was in C transect, near knickpoint
- Least response was in incised F transect, farthest downstream
- Moderate response in unincised A transect- water table reached surface





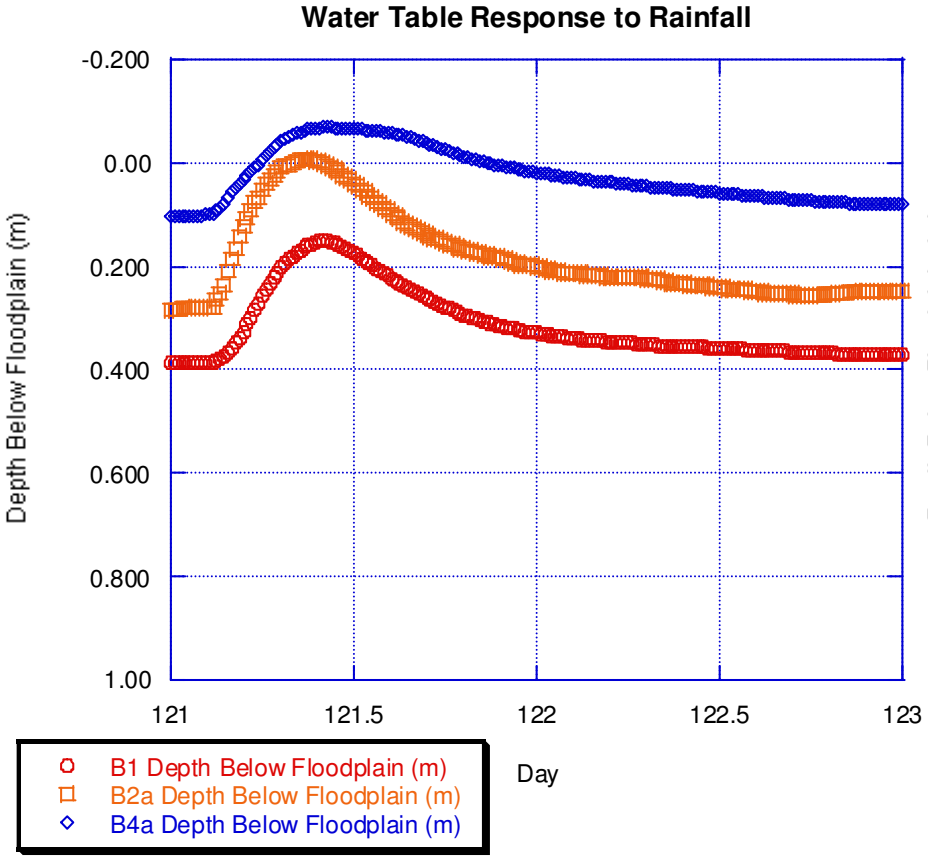


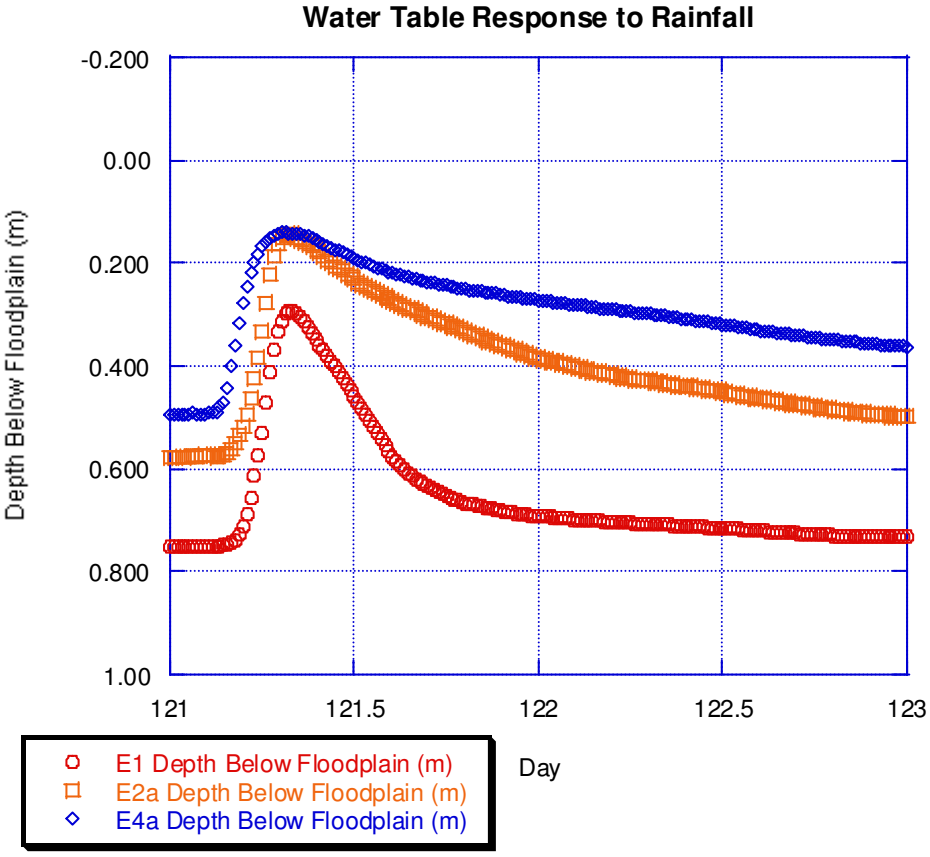
Water Table Response to Precipitation



Water Table Response to Precipitation

- Wells in B transect rise at same time, gradual rise and decline
- Wells closest to stream in E transect rise most, but also drop faster
- E well farthest from stream rises less, but drops slower

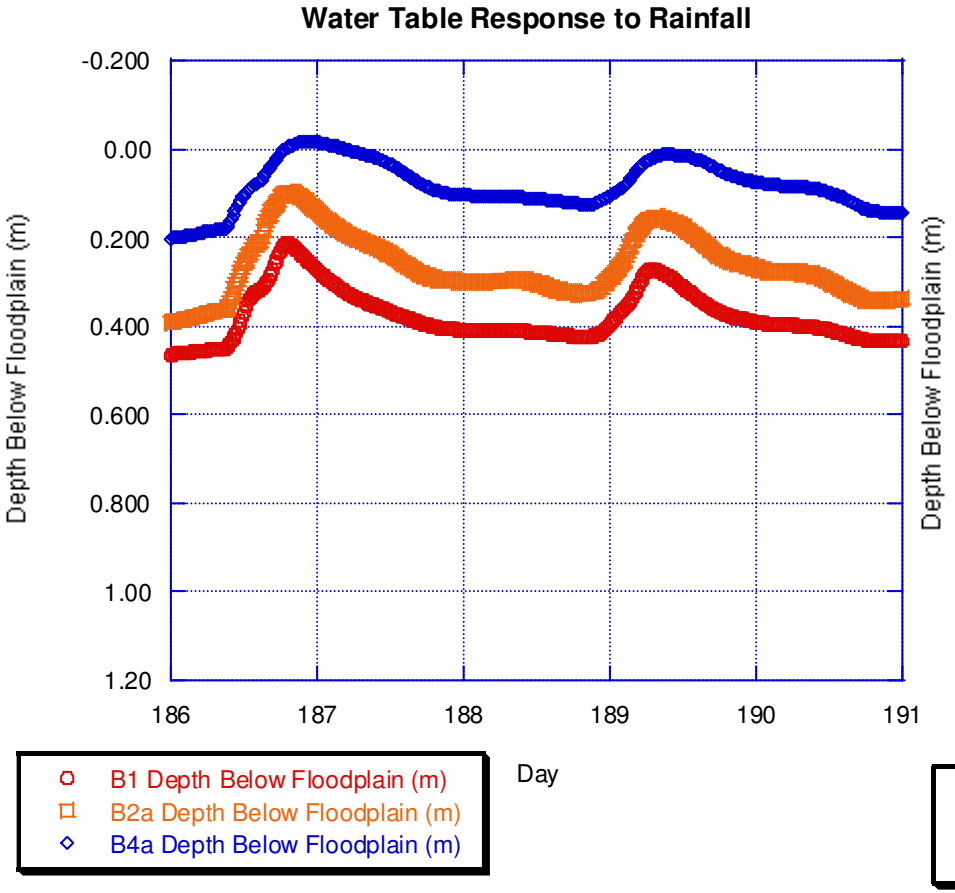


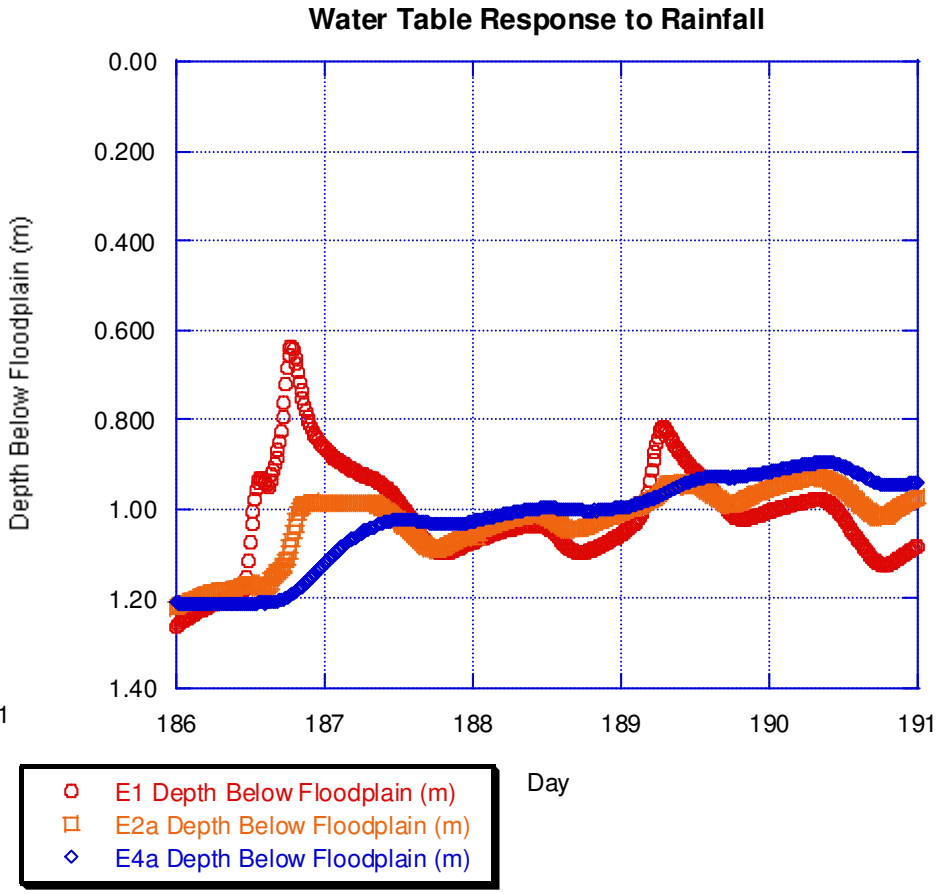


Day 121- 30.99 mm of precipitation in 6.72 hours

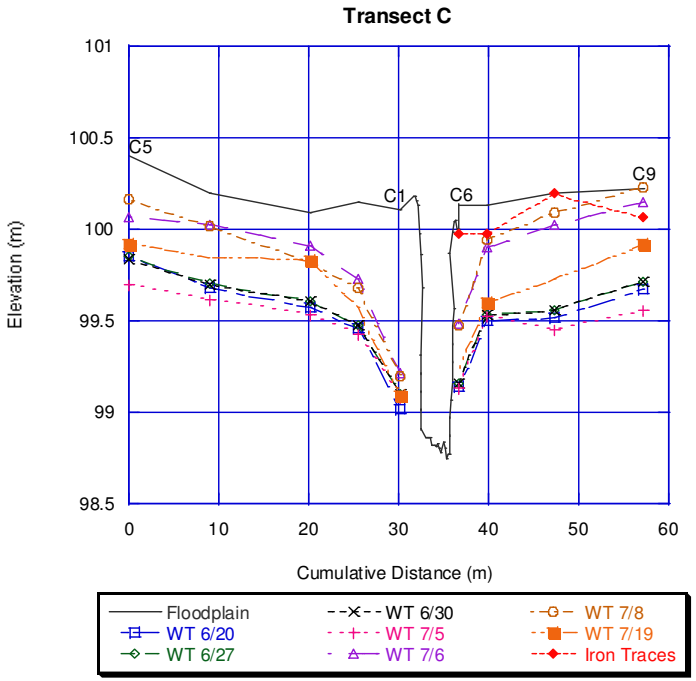
Water Table Response to Precipitation

- E transect water table dropped more during drought, by 0.4-0.7 m, vs. 0.1 m in B transect
- B transect response to storm after drought is similar to response with normal antecedent rainfall
- E transect response after drought: E1 rises as flood peak passes, but drops quickly
- Bank recharge hardly affects E2a, doesn't affect E4a
- Groundwater from upstream and hillslope is recharging E4a



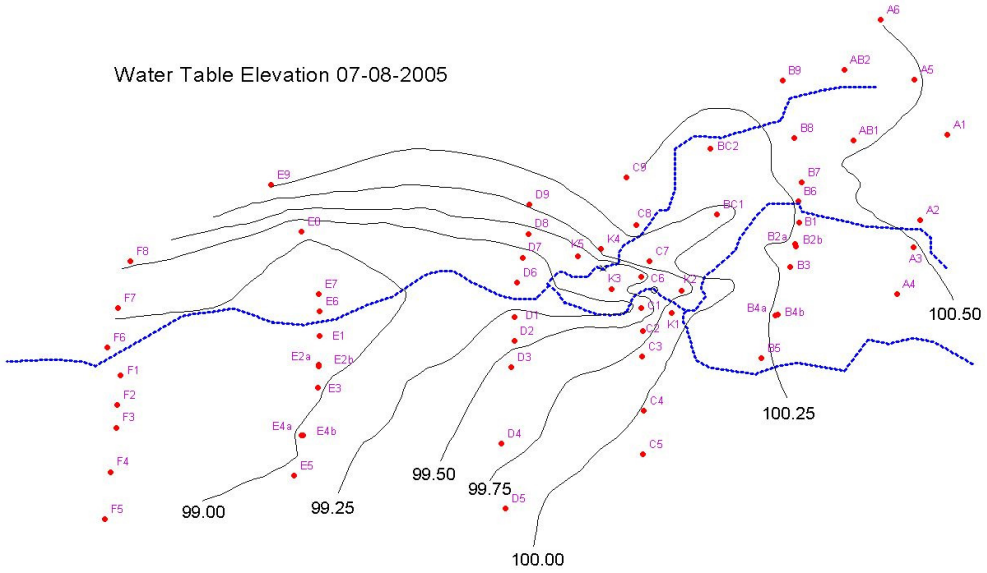


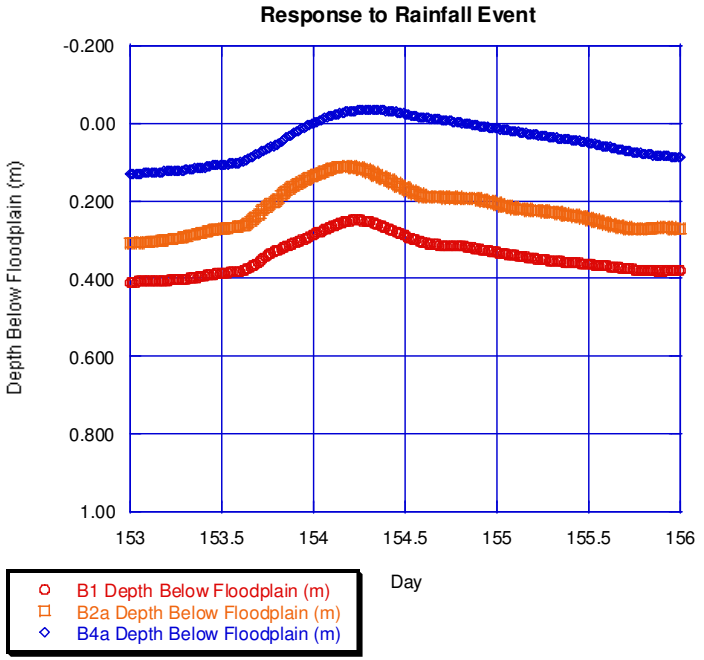
Day 186- 34.04 mm, Day 189- 4.32 mm. Last previous rainfall >20 mm: Day 153- 22.6 mm



Conclusions

- Incision of stream channel affects riparian water table
- Water table is lowered
- Groundwater flows toward incised channel
- Dip of water table towards channel and response of water table to rainfall depends on distance from channel and distance from knickpoint





Thank You:
Greg Hancock, Advisor
Chris Bowles
Catherine Noll