The Formation Process of Water Quality: the Fletcher's Creek project

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Objectives and Targets

The Objective of the project:
to create the database for Separated Flow Approach (SFA) evaluation

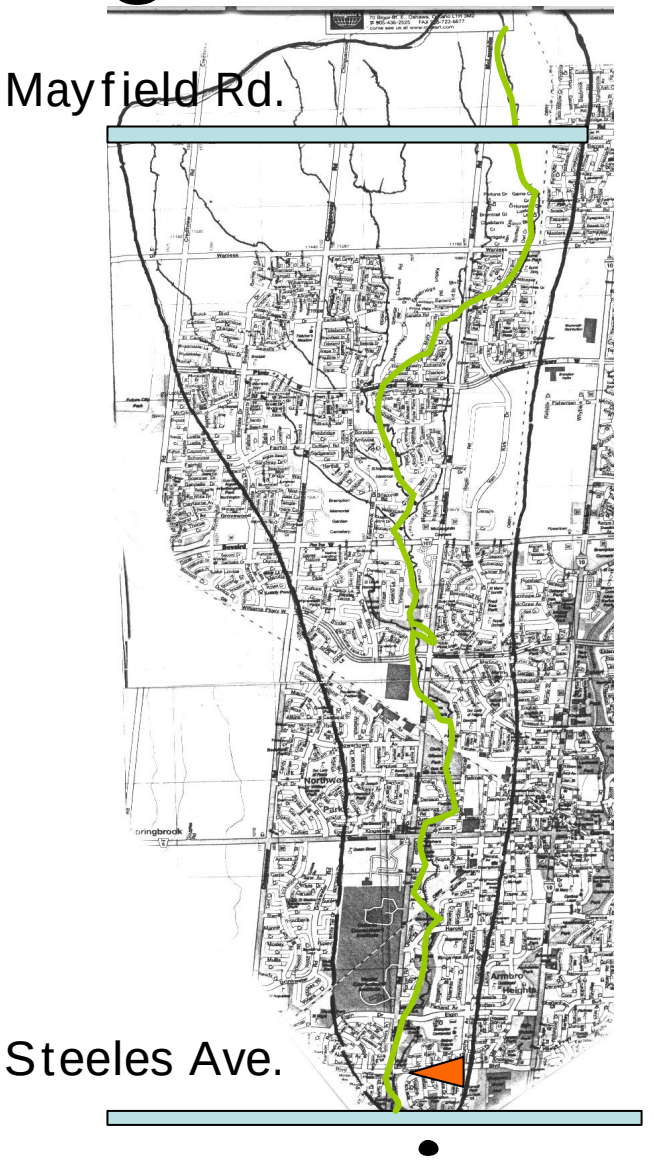
The Objective of this analysis is

Based on the features of SFA to designate the transported substances pathways, **to show how continuity and incompressibility of water facilitate the process of water quality formation in different phases of the hydrological regime**

The Targets are:

•To find the hydrological indicators of water quality conditions, which characterize the transport and solvent capacity of the creek

•To estimate the criteria for monitoring sufficiency



The SFA conception

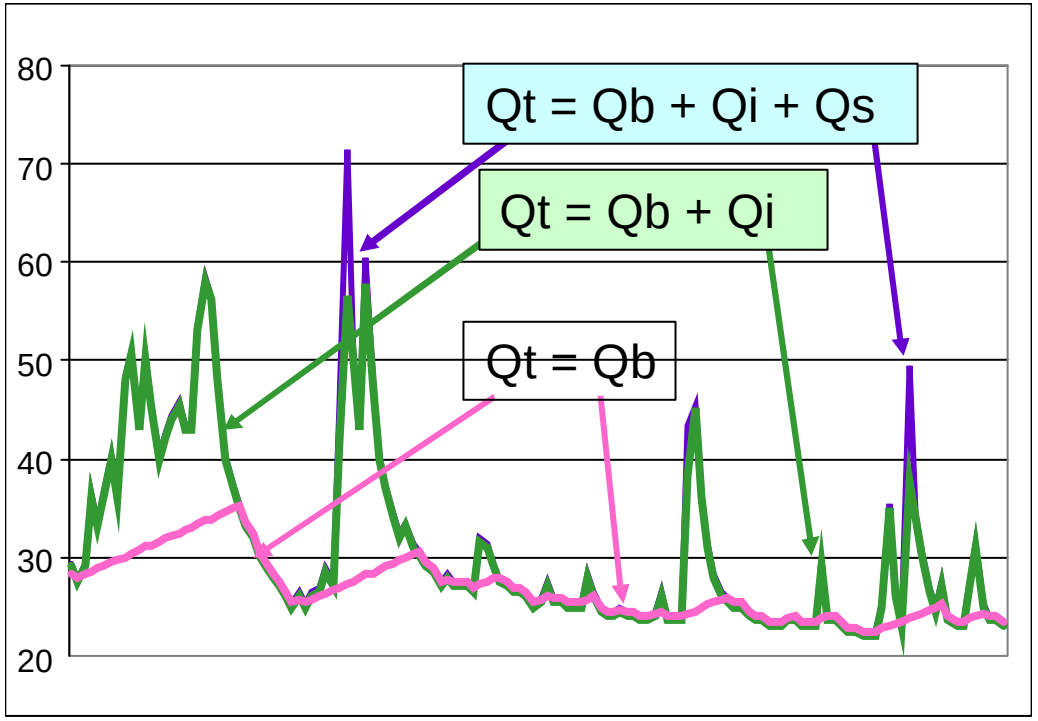
Ct = (Qb*Cb + Qi*Ci + Qs*Cs)/Qt
Ct = (Qb*Cb + Qi*Ci)/Qt
Ct = Cb

Ct, Qt - Total flow concentration and discharge
Cb, Qb - Baseflow concentration and discharge
Ci, Qi - Interflow concentration and discharge
Cs, Qs - Surface flow concentration and discharge

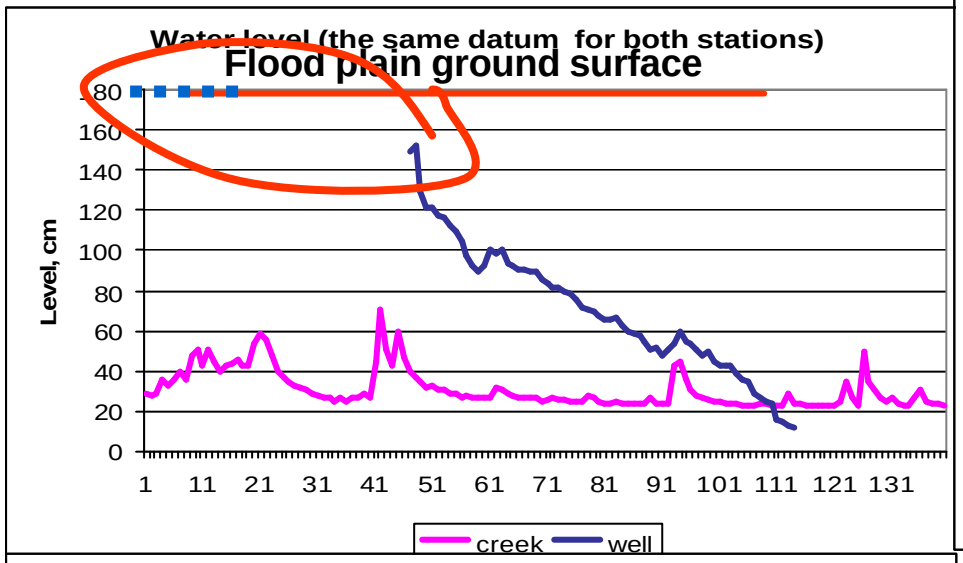
In different phases of water regime each flow component has different patterns

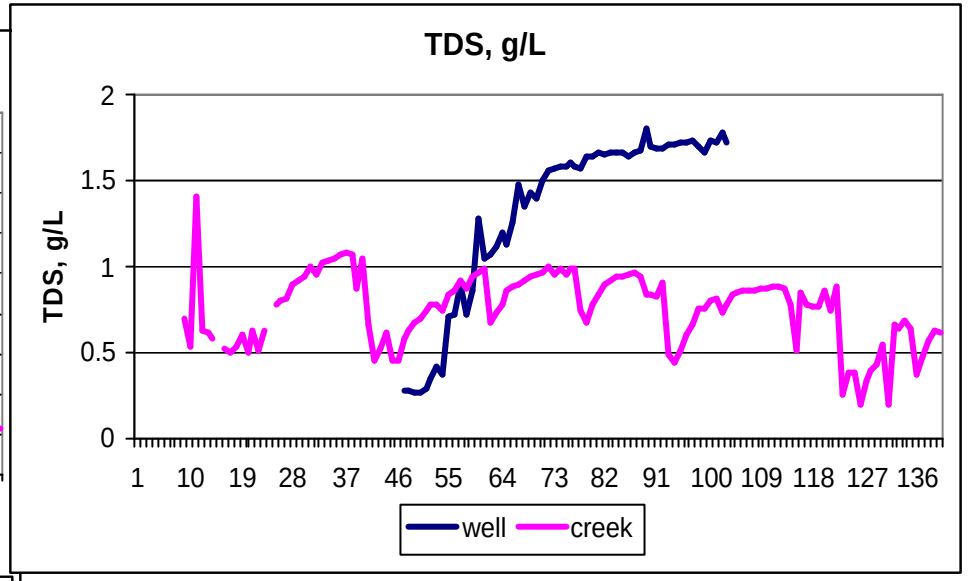
Criteria of separation:

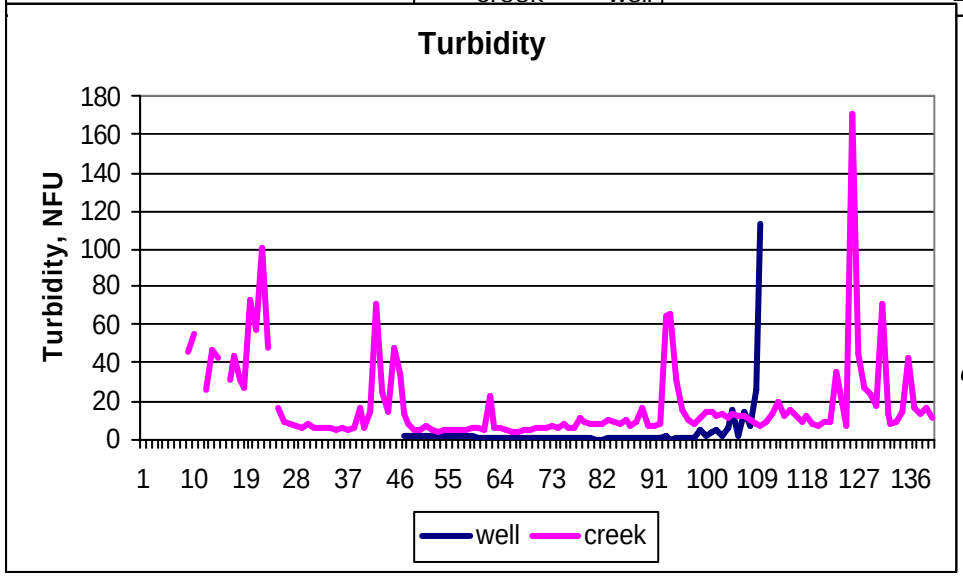
Baseflow from total flow – the highest number of flow responses; Storm flow from interflow – the Golden Proportion

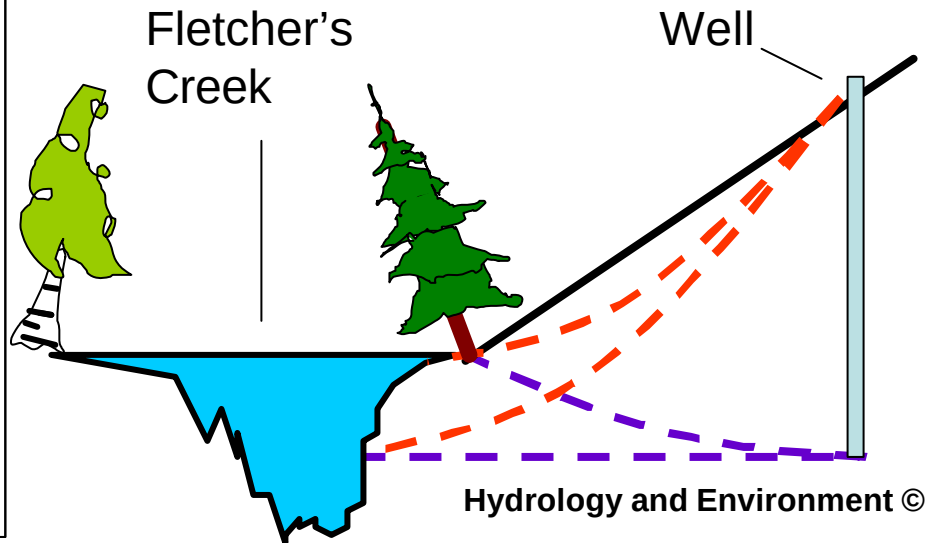


Daily measurement results: creek and well

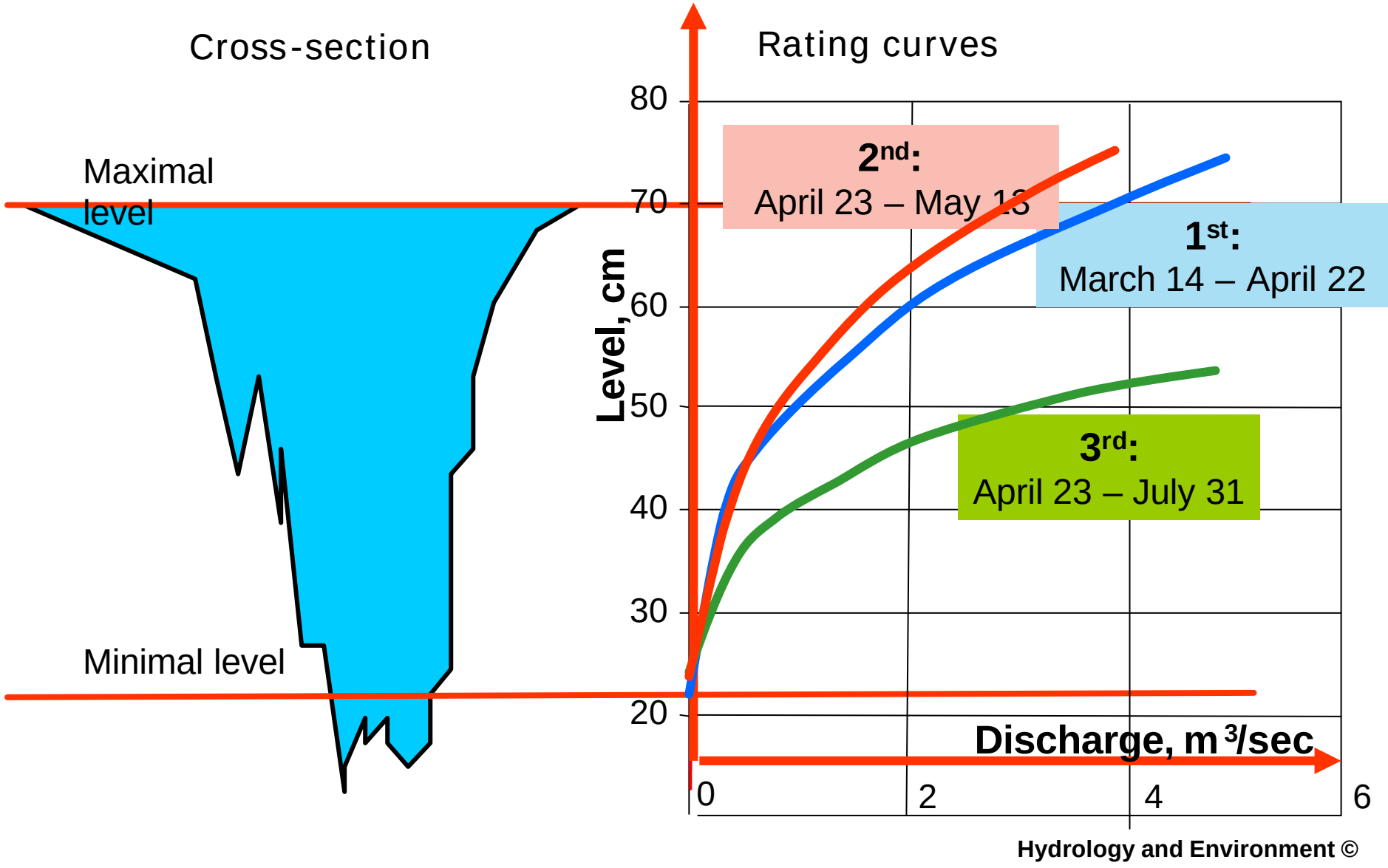




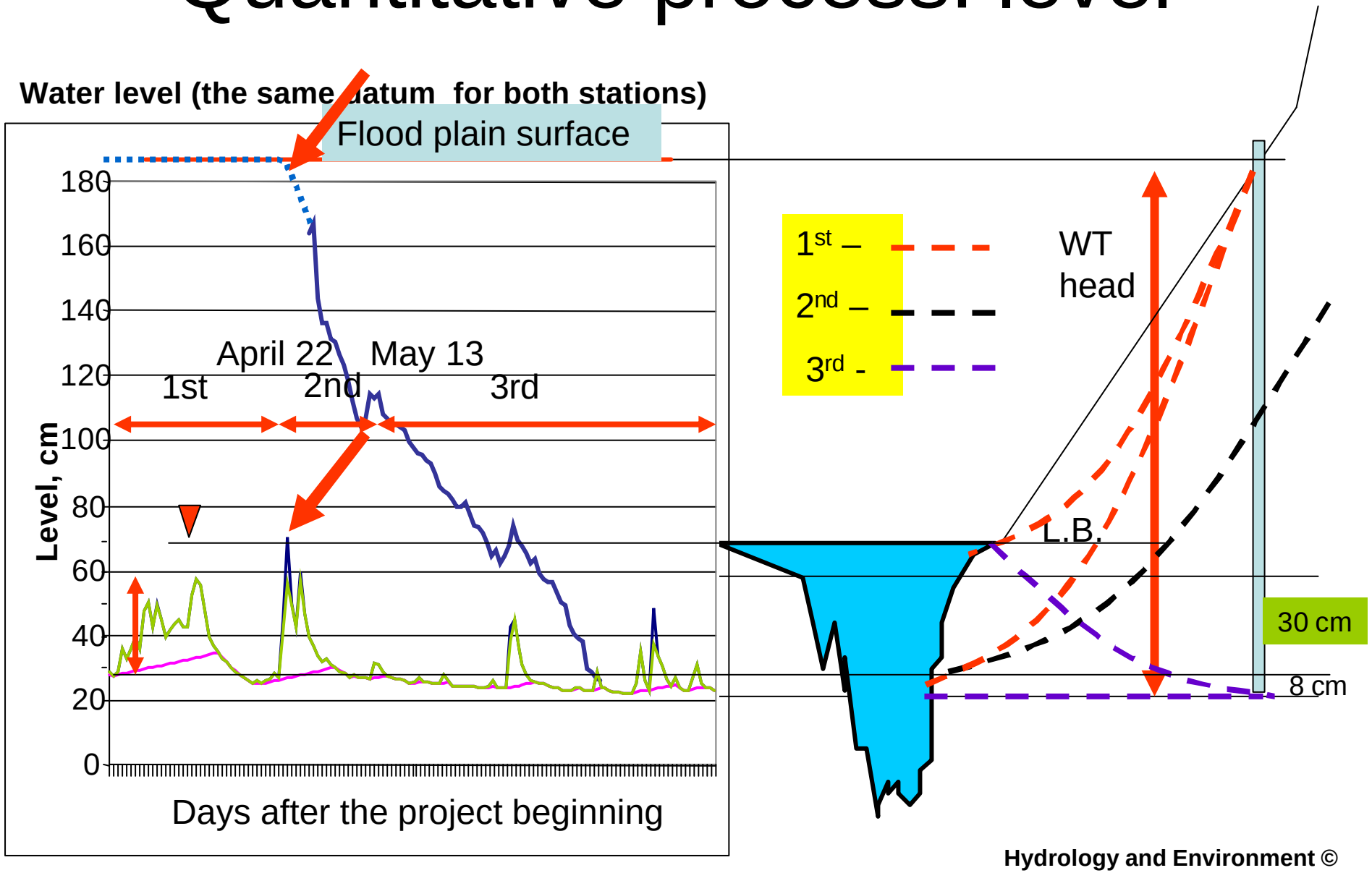




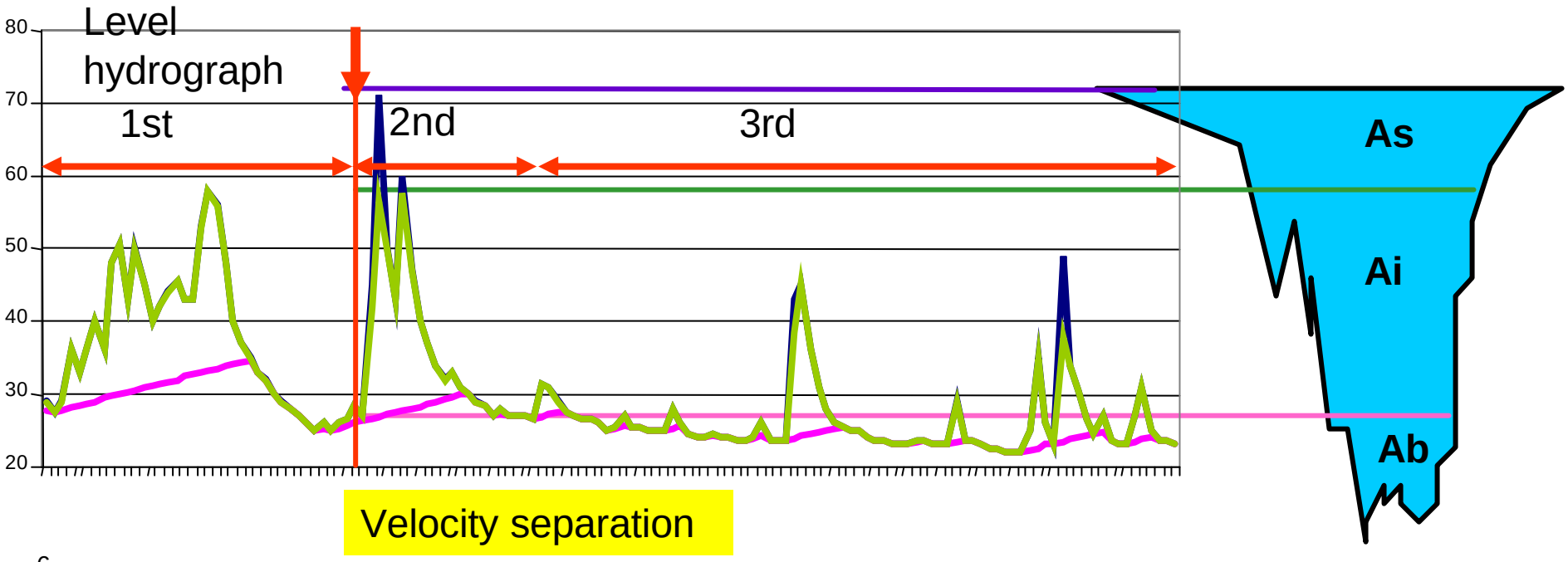
Rating curves



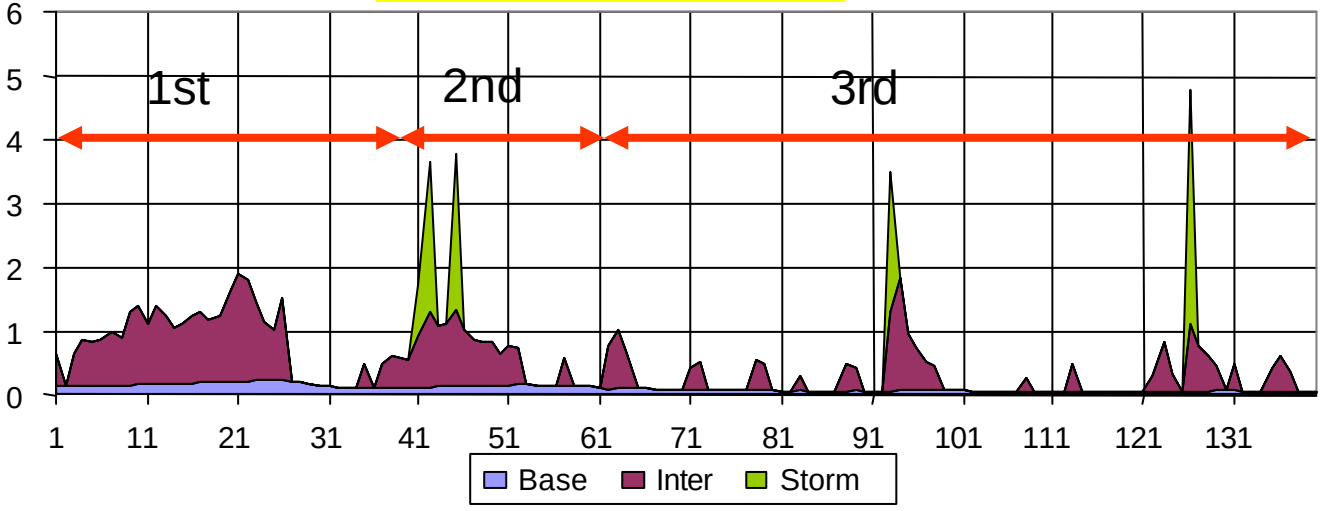
Quantitative process: level



Quantitative process: velocity



Velocity separation



At = Ab+Ai+As

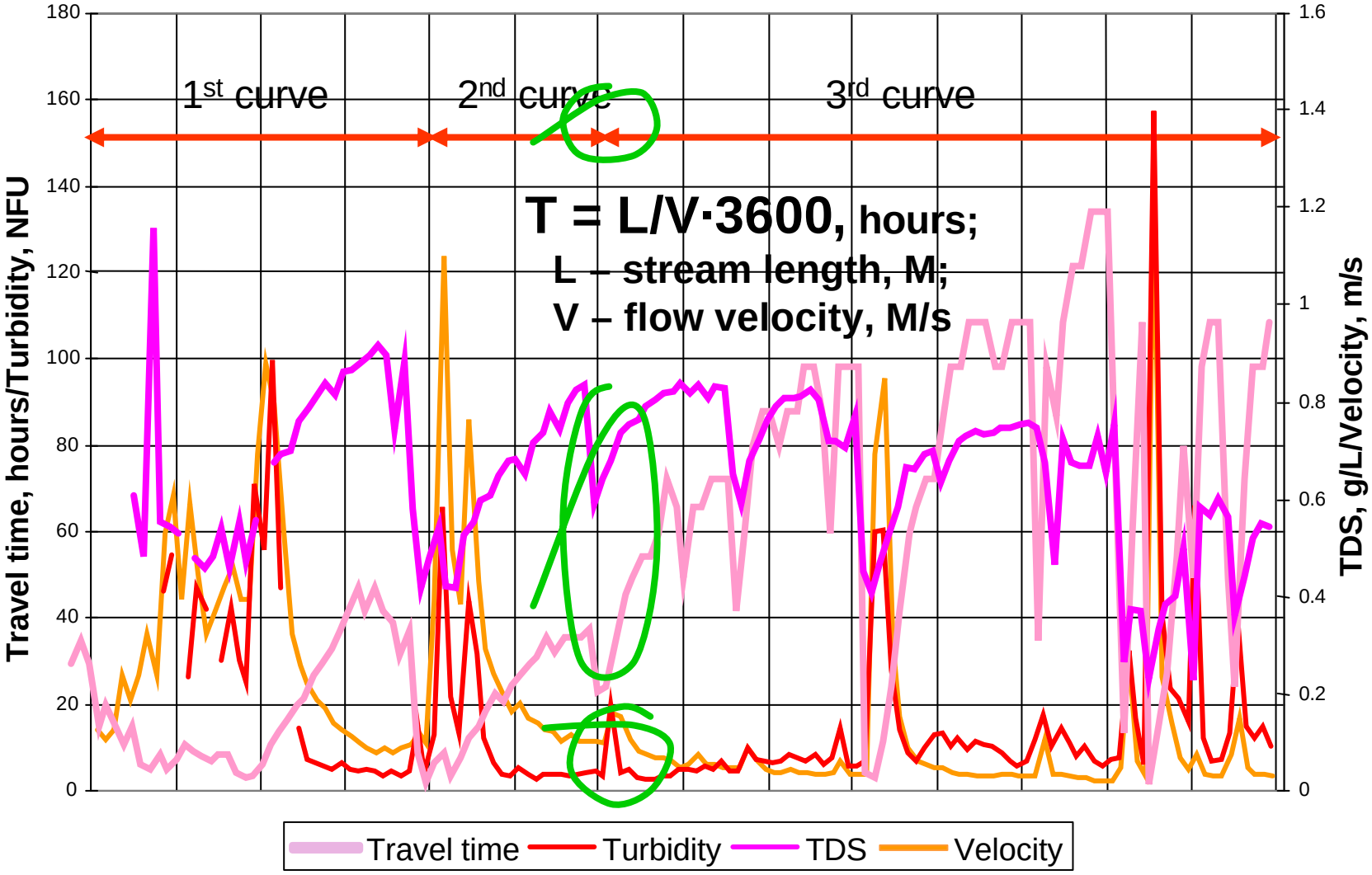
Vt = Qt/At

Vb = Qb/Ab

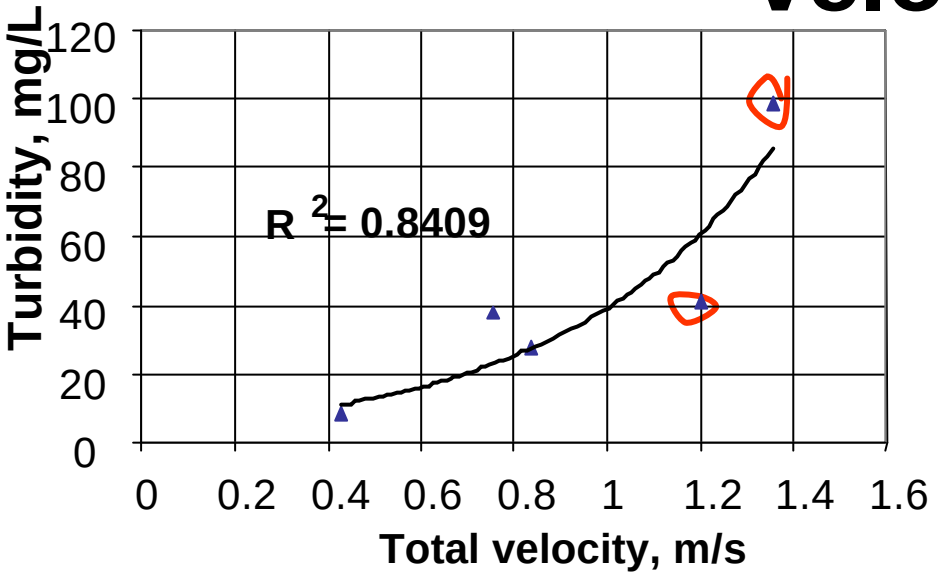
Vi = Qi/Ai

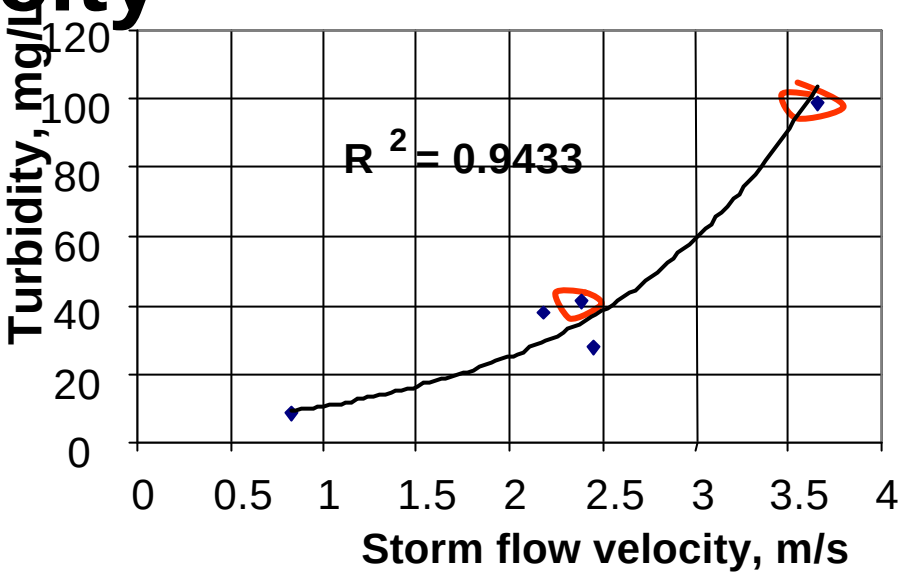
Vs = Qs/As

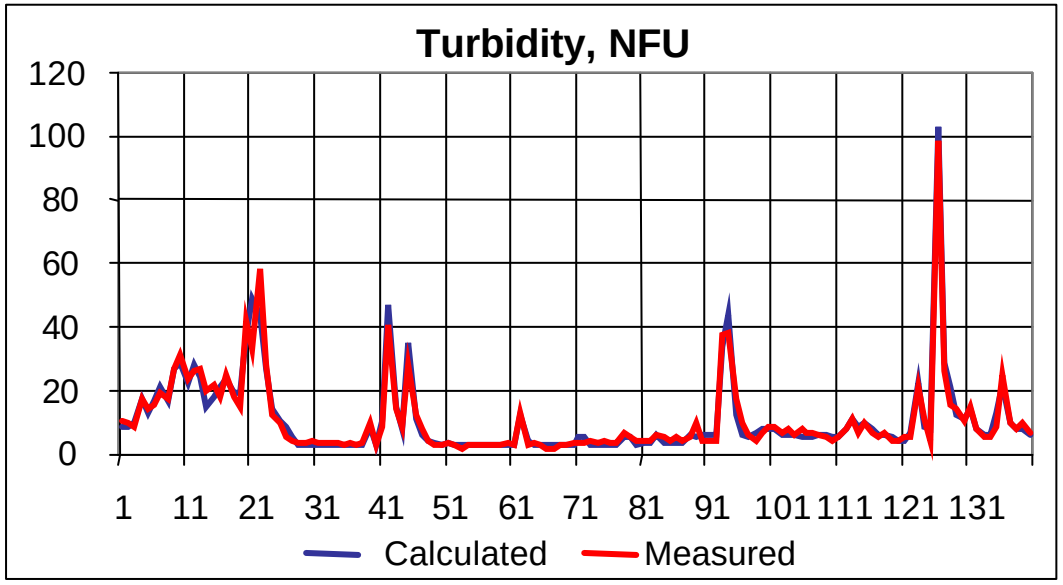
Quality-quantity relationship overview



Qualitative process: turbidity vs velocity

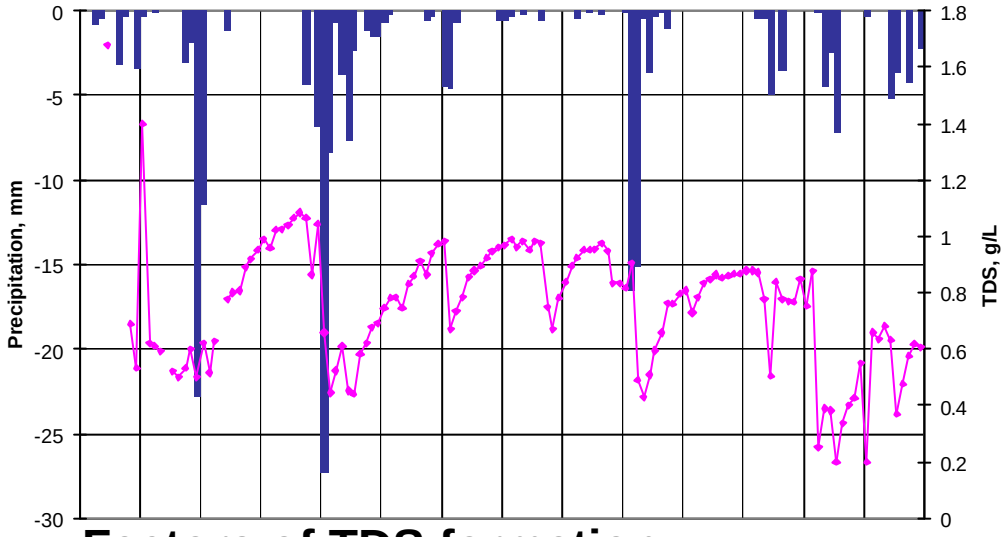






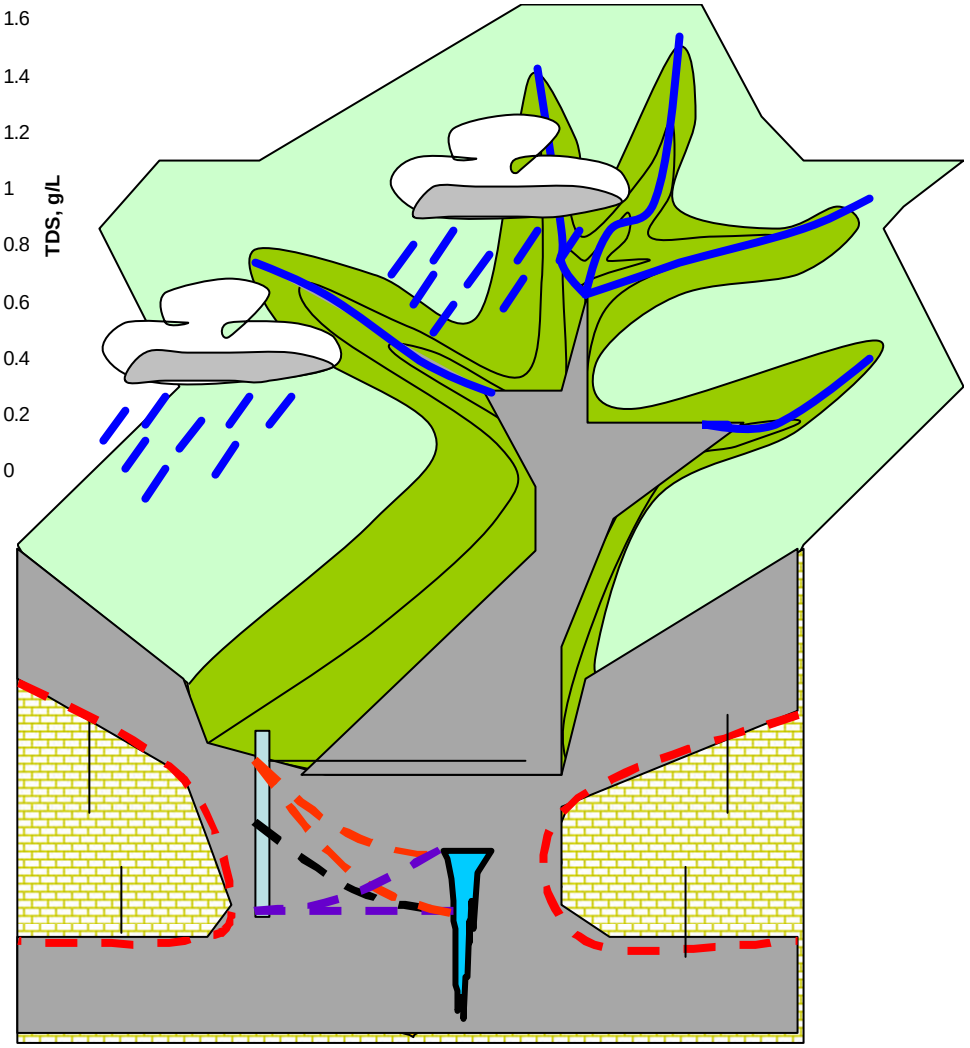
Correlation between measured and reconstructed daily data:
R = 0.972

Qualitative process: TDS



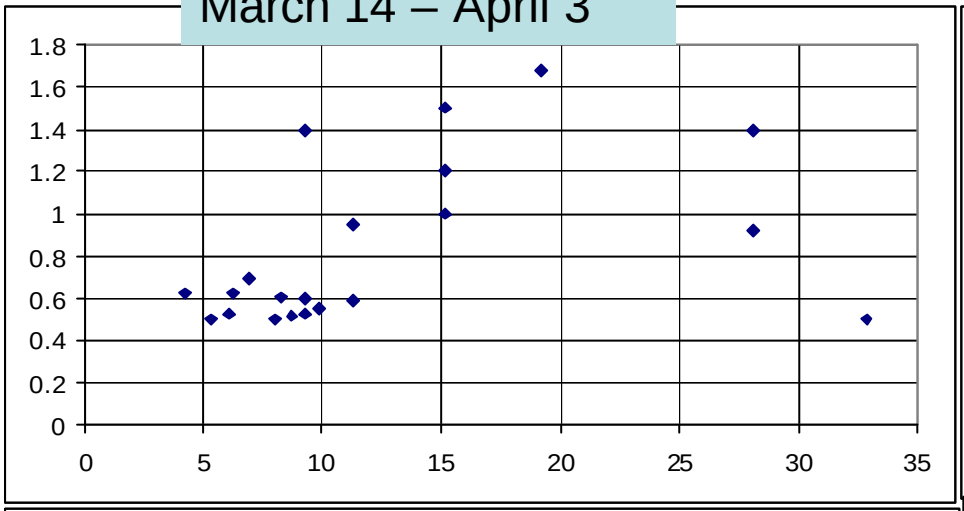
Factors of TDS formation:

1. Groundwater (base + inter)
2. Surface/storm water
3. Bonding with suspends/ Consumption by biota
4. Precipitation on the stream surface
5. Road salt application

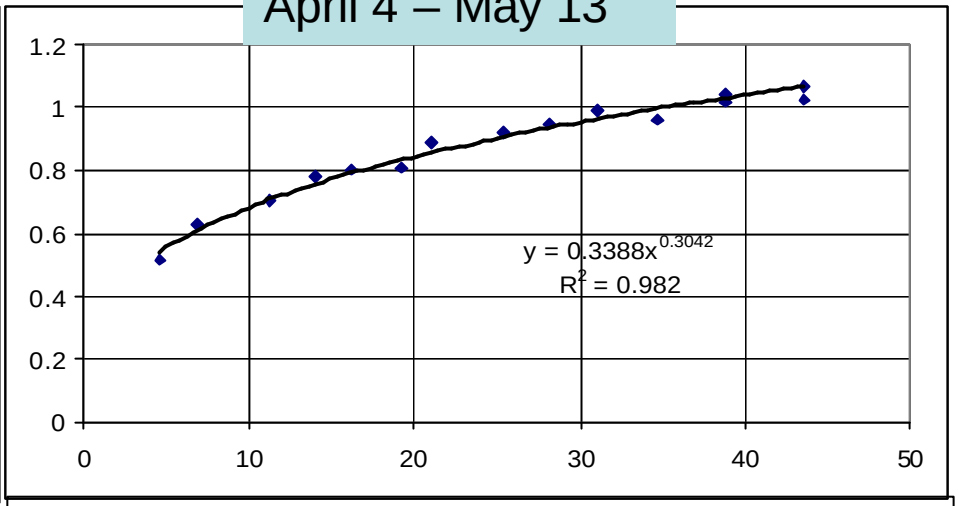


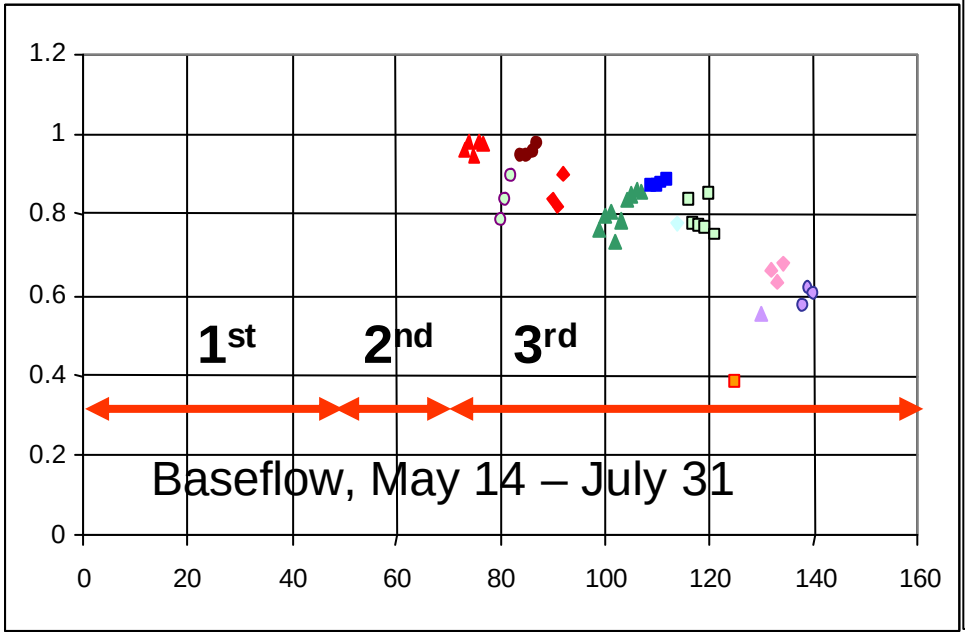
Qualitative process: TDS vs travel time

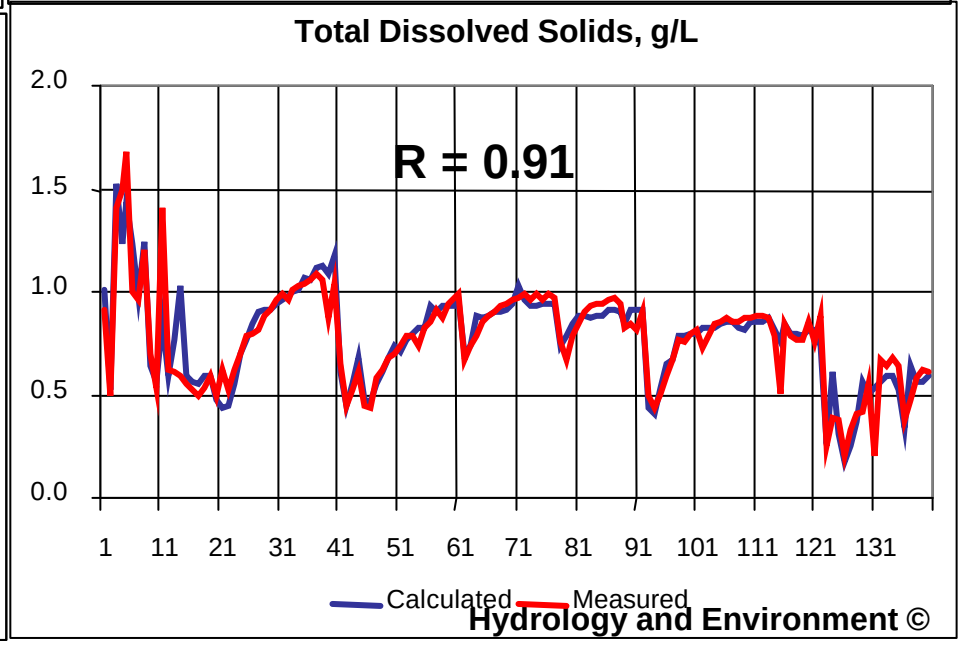
March 14 – April 3



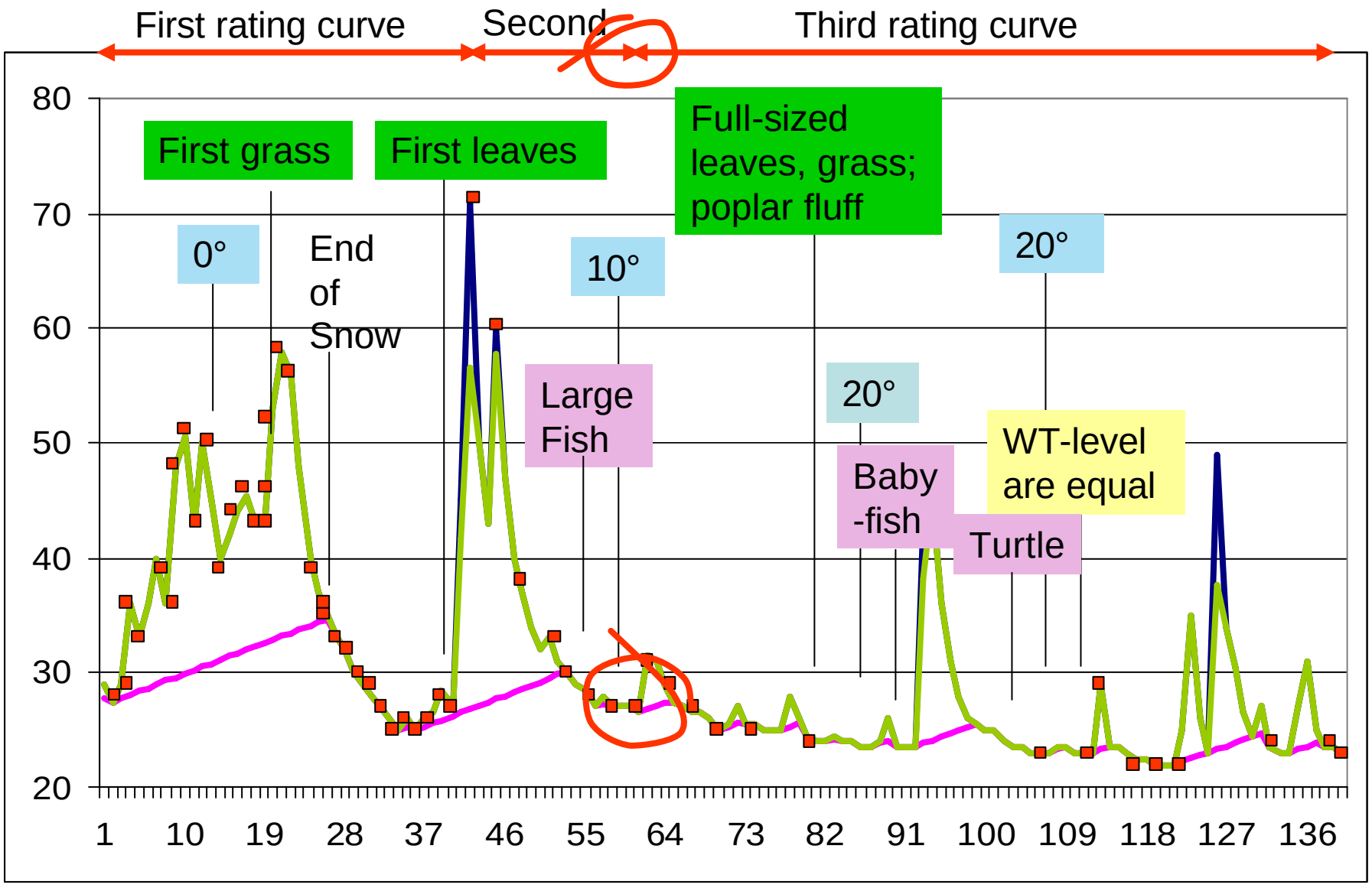
April 4 – May 13



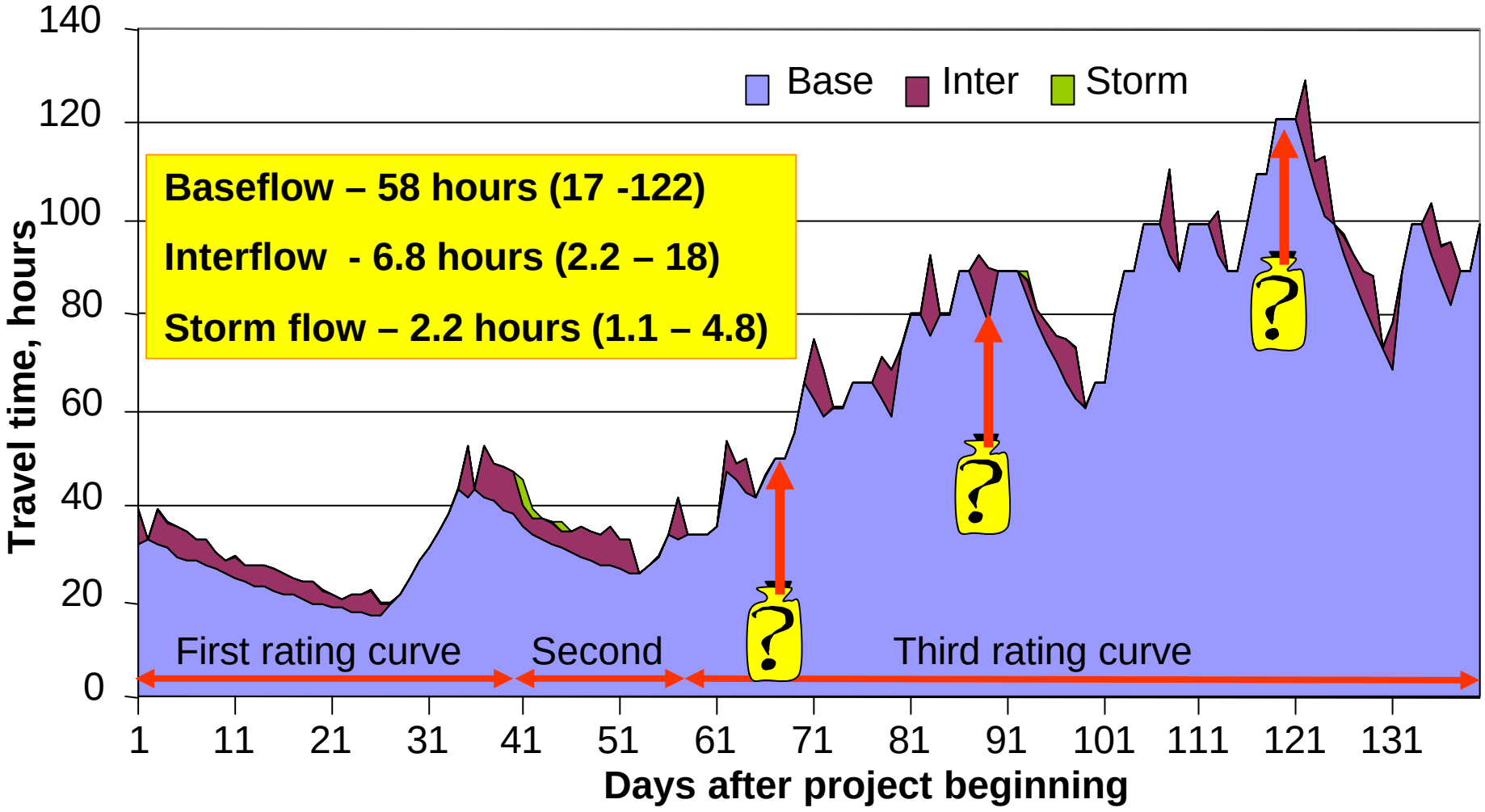




Rating curves' and the other periods



Residence/ Travel time of flow components



Lesson learned

Despite the use of systematic daily scheme for water quality and quantity monitoring, the reconstruction of daily regime of TDS using obtained “TDS-travel time” relationship was not as good as turbidity.

In order to provide a better correlation between quantitative and qualitative parameters, and to obtain the detail description of the quality formation process:

- the creek level measurements in the examined location have to be continually or hourly measured with 1 mm resolution
- the groundwater level has to be measured from the very beginning to the very end of the project

Summary

High groundwater level during the snow melting period provides high, one-way gradients and high velocities in the stream with the stable and prolonged (2 – 6 weeks) quantity-quality patterns. Continuity in this period plays a role of a bond for separated components keeping their parameters relatively close.

As soon as the ground water table drops, continuity is no longer the dominant feature of the quantity-quality relationship in the stream: it takes the appearance of the short (1 hour – several days) push-pull events conditioned by incompressibility of water

Accurate estimation of the water level in this period and identification of flow components and their shares in a sample is the key to the accuracy of water quality assessment

The quantitative parameters of creek flow such as velocity and the travel or residence time are the hydrological indicators of water quality regime, namely, turbidity and TDS.

Acknowledgement

- I would like to take this opportunity to express my deep appreciation to **Bill Cotigane**, the coordinator of the Environmental Program at Sheridan College, for his help in realization of the Fletcher's Creek project.