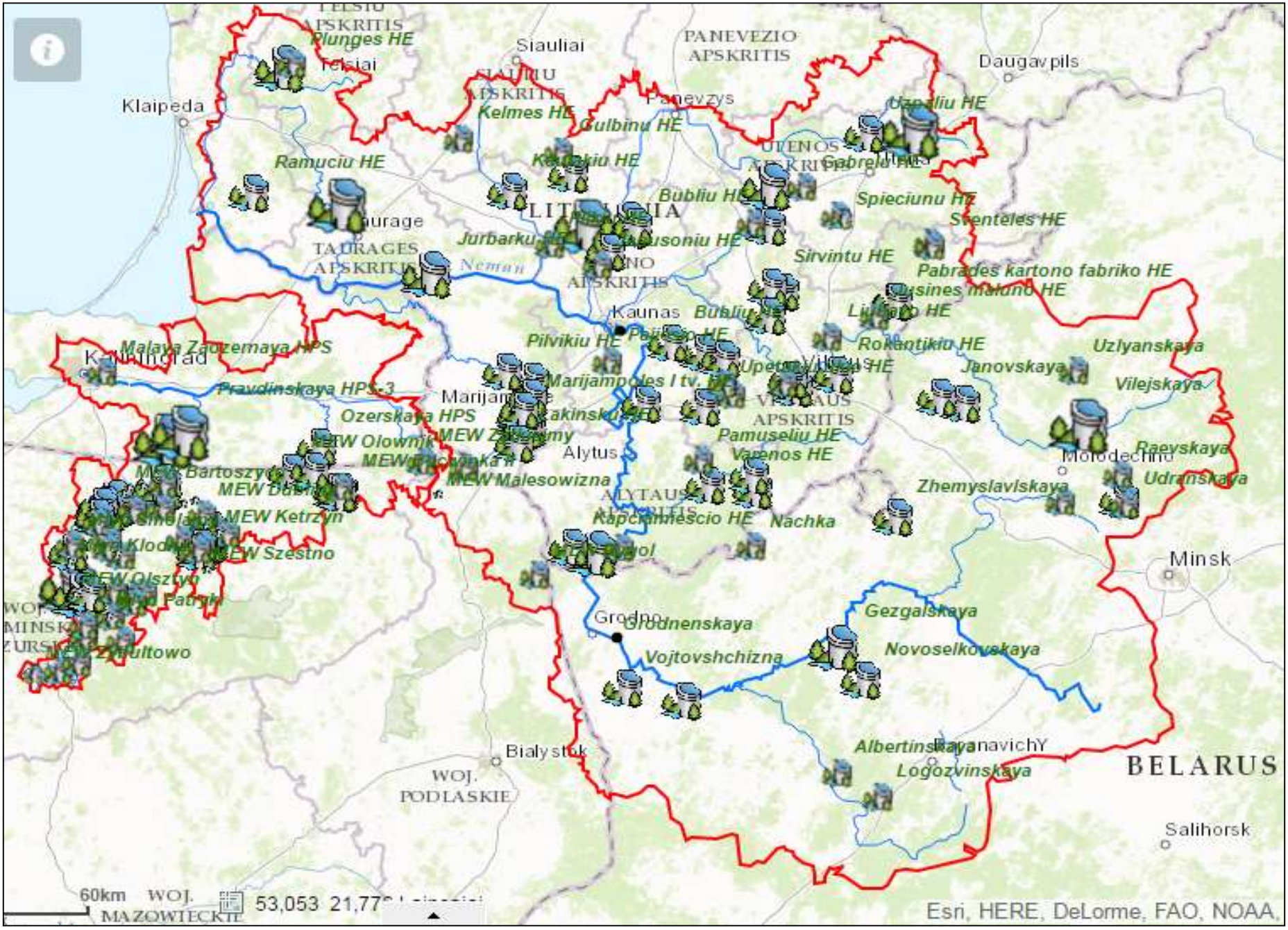
Gintaras
Valiuškevičius

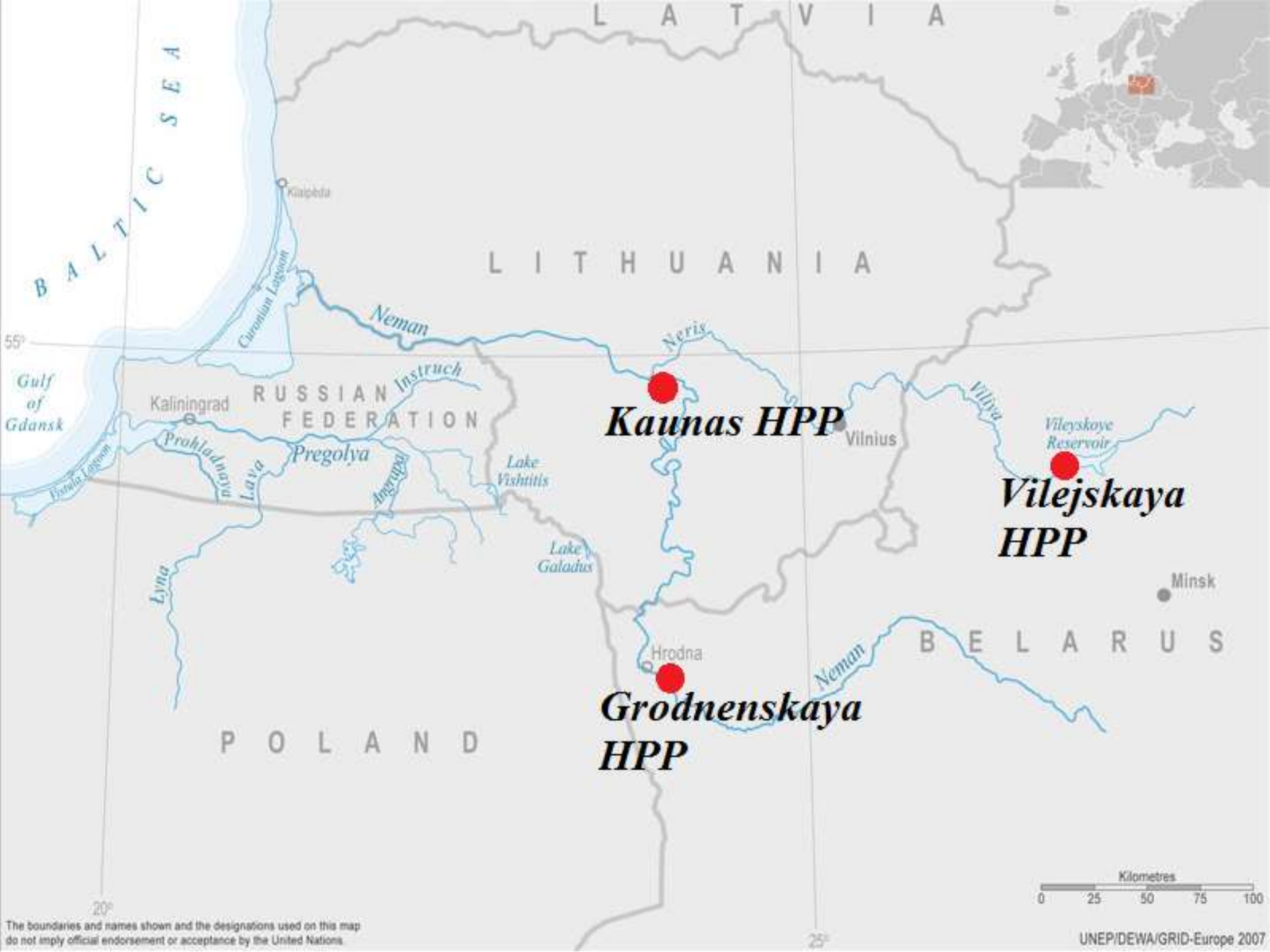
Impact of river regulation on hydrological regime of Neman and Neris

2016-04-11



http://levis-gdb.sggw.pl/neman_pregolya/

Parts of the Neman River basin and the Neris River basin in Lithuania


L A T V I A
B A L T I C S E A
Klaipeda
L I T H U A N I A
Curonian Lagoon
Neman
Neris
55°
Gulf of Gdansk
Kaliningrad
R U S S I A N
F E D E R A T I O N
Instruch
Kaunas HPP
Vilnius
Vilnya
Vileyskoye Reservoir
Vilejskaya HPP
Prohladnaya
Lava
Pregolya
Angrapa
Lake Vishtitis
Lake Galadus
Lyna
Minsk
Hrodna
B E L A R U S
Neman
Grodnenskaya HPP
P O L A N D
20°
25°
Kilometres
0 25 50 75 100
The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations
UNEP/DEWA/GRID-Europe 2007

Kaunas Hydropower Plant

Country: **Lithuania**

The River: **Neman (Nemunas)**

Distance from river mouth: **223.4 km**

Build: **1955-1960**

Began operating: **1959**

Maximum capacity: **100.8 MW**

Annual electricity production: **370 GWh**

Current owner**: *Lietuvos energija***

Dams type: **Ferroconcrete, Earth**

Pressure height: **15 m**

Dam length: **1530 m**

Gateway: **Not**

Turbine type: **rotatable vane**

Turbine discharge: **4 × 190 m³/s**

Hydro generators power: **4 x 25.2 MW**

Kruonis Pumped Storage Plant

Country: **Lithuania**

Upper reservoir: **Kruonis Upper**

Upper res. Capacity: **48 000 000 m³**

Lower reservoir: **Kaunas Reservoir**

Lower res. Capacity: **460 000 000 m³**

Build: **1978-2000**

Began operating: **1992**

Maximum capacity: **900 MW**

Maximum annual electricity production: **472 GWh** (2012)

Current owner**: *Lietuvos energija***

Dams type: **Ferroconcrete, Earth**

Turbine type: **rotatable vane**

Turbine discharge: **4 × 226 (189) m³/s**

Hydro generators power:

4 x 225 (217) MW

Vilejka (Vilejskaya) Hydropower Plant

Country: **Belarus**

The River: **Viliya (Neris)**

Distance from river mouth: **402.0 km**

Build: **1995-2002**

Began operating: **1997-2002**

Maximum capacity: **1.63 MW**

Annual electricity production: **7.5 GWh**

Current owner**: *Минскводоканал***

Dams type: **Ferroconcrete, Earth**

Pressure height: **8.4 m**

Dam length: **6013 m**

Gateway: **Not**

Turbine type: **propeller turbine (*ГА-8*)**

Turbine discharge: **4 × ? m³/s**

Hydro generators power: **4 x 0.5 MW**

Vileyka-Minsk water system

Country: **Belarus**

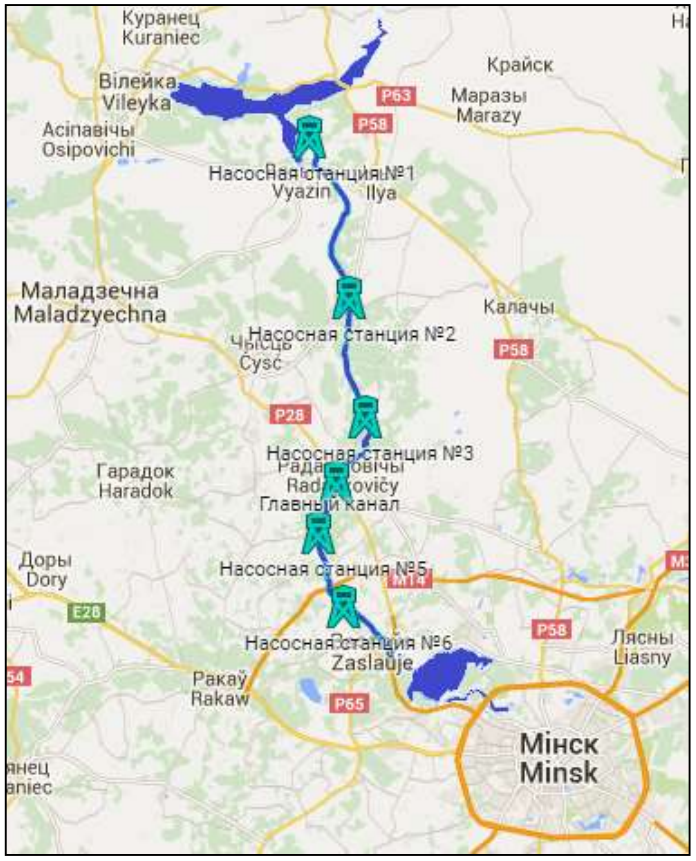
The River: **Viliya (Neman basin) → Svisloch (Dnieper basin)**

Build: **1968-1976**

Began operating: **1976**

Maximum pump flow rate: **22 m³/s**; Average flow rate: **12 m³/s**

Вилейско-Минский канал / Vileyka-Minsk water supply system (*www.panoramio.com*)



Hrodna (Grodnenskaya) HPP

Country: **Belarus**

The River: **Neman**

Distance from river mouth: **539.0 km**

Build: **2008-2012**

Began operating: **2012**

Maximum capacity: **17.00 MW**

Annual electricity production: **84.4 GWh**

Current owner**: *Белэнерго***

Dams type: **Concrete, Mound Embankment**

Pressure height: **7 m**

Dam length: **95 m**

Gateway: **Not**

Turbine type: **rotatable vane**

Turbine discharge: **5 × 60 m³/s**

Hydro generators power: **5 x 3.4 MW**

Regulation impact: positive and negative signs

+

- Renewable energy
- Water resources
- Recreation at reservoirs

–

- Fish migration
- Navigation in rivers
- Possibility of technical disaster
- Landscape changes

±

???

Hydrological regime of rivers

Regulation impact on hydrological regime of rivers

Kaunas HPP

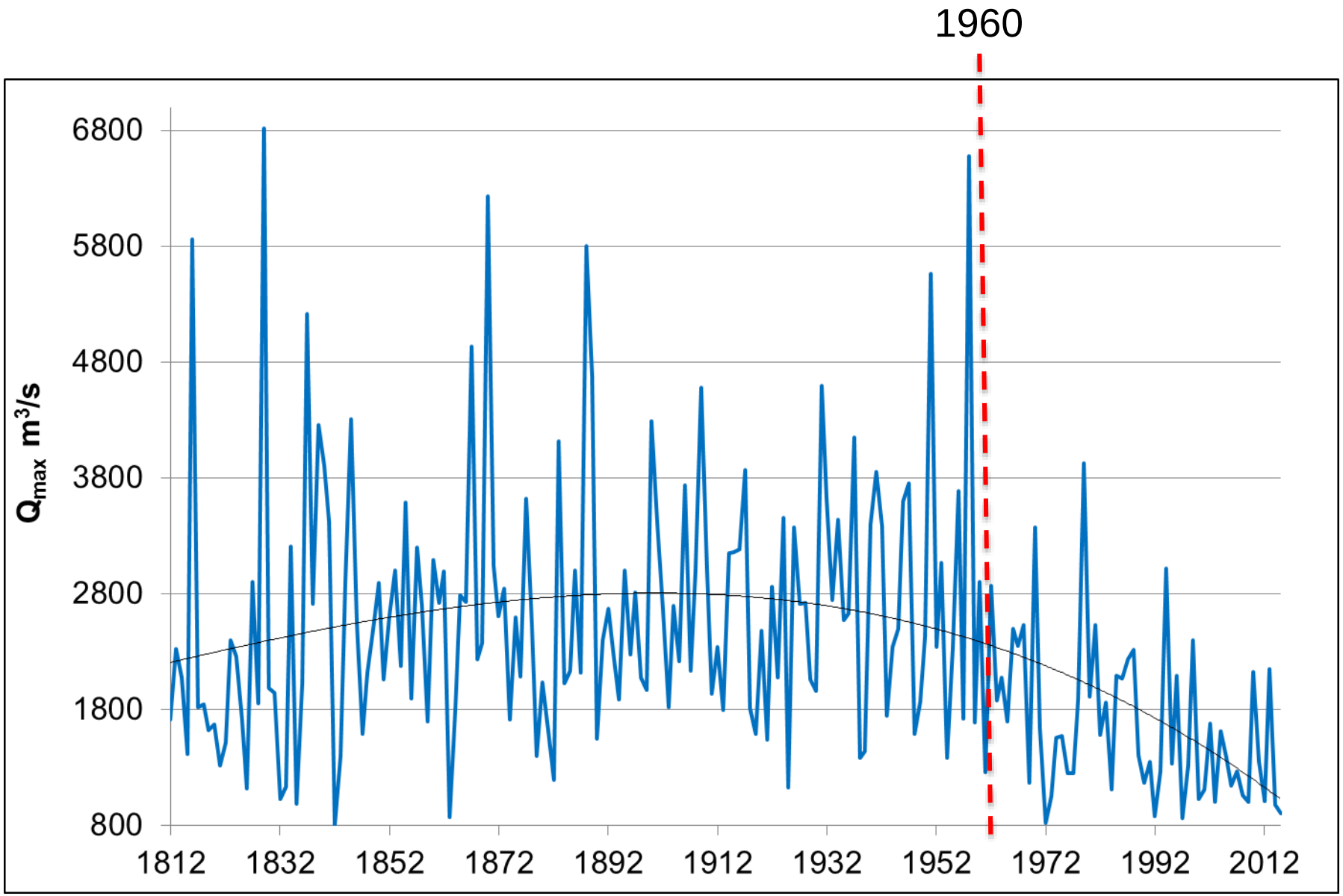
Catastrofic Floods in Kaunas:

1715, 1811, 1829, 1855, 1906, 1926, **1931**, 1936, 1940, 1946, 1947, 1951, 1958.

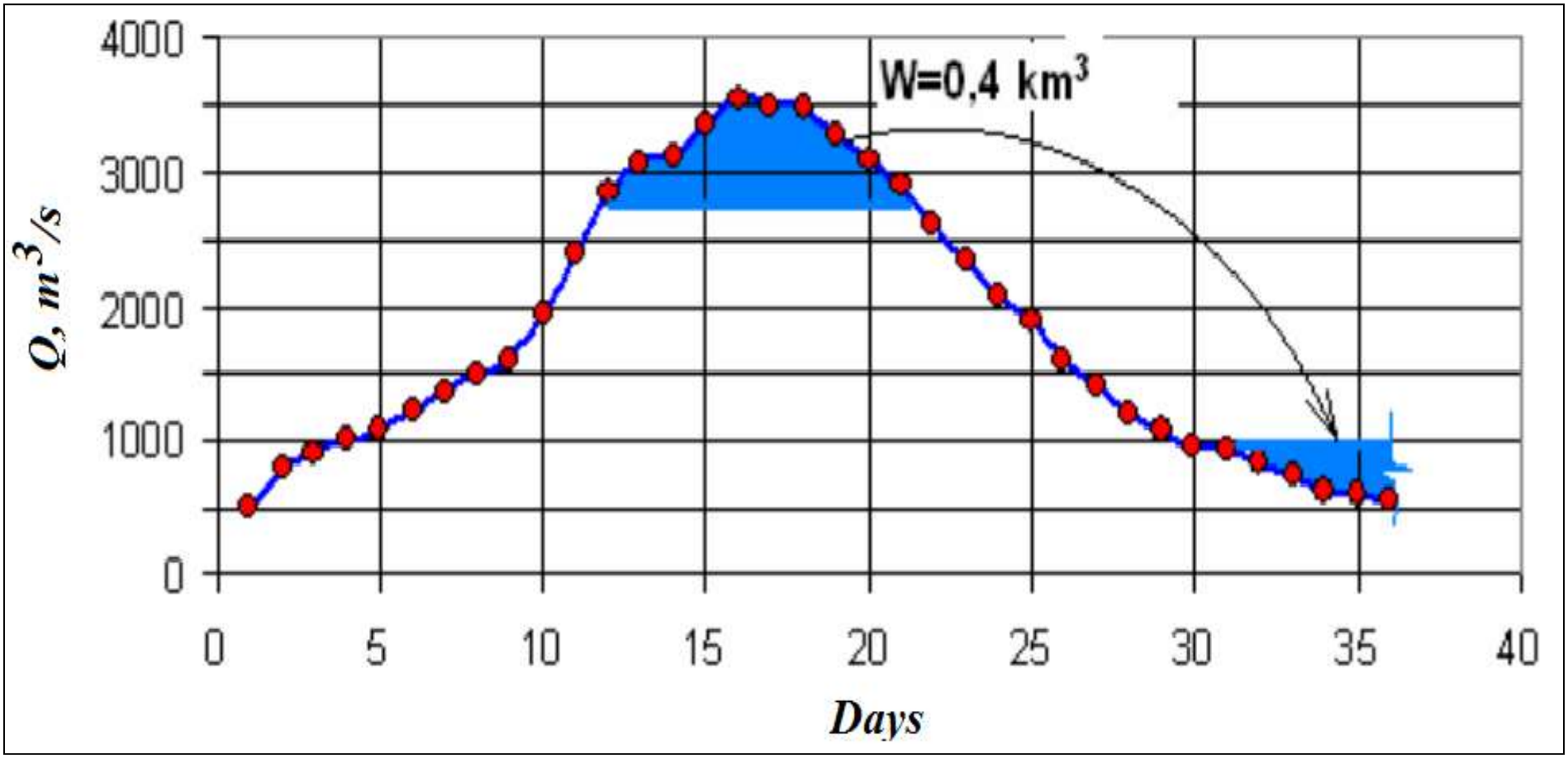
http://www.kaunomuziejus.lt/kauno-potvyniai

Ice jam in the Neman River near the Kaunas Old Town Pier, 1931

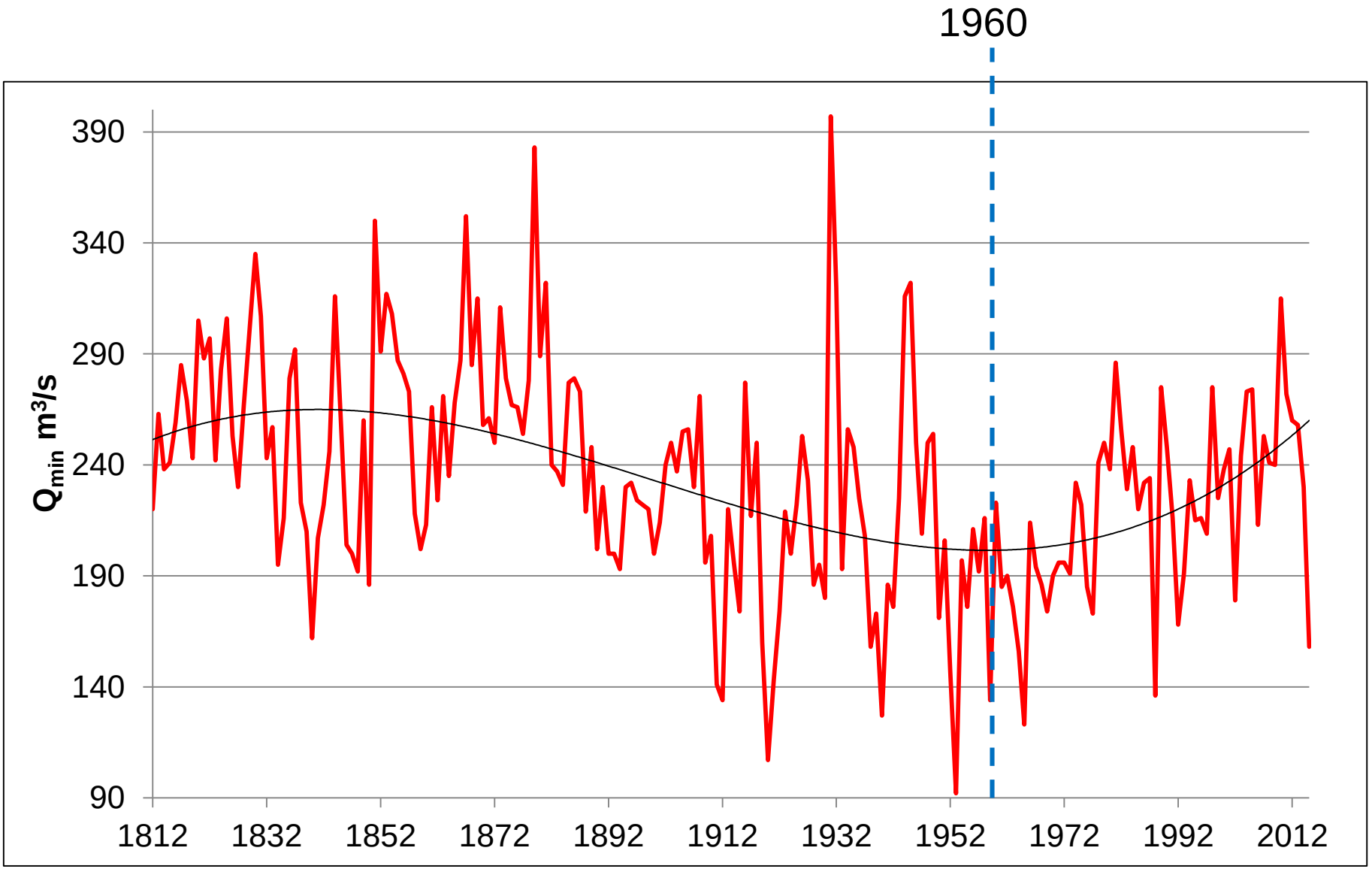
The Neman River flood consequences in Kaunas, 1926



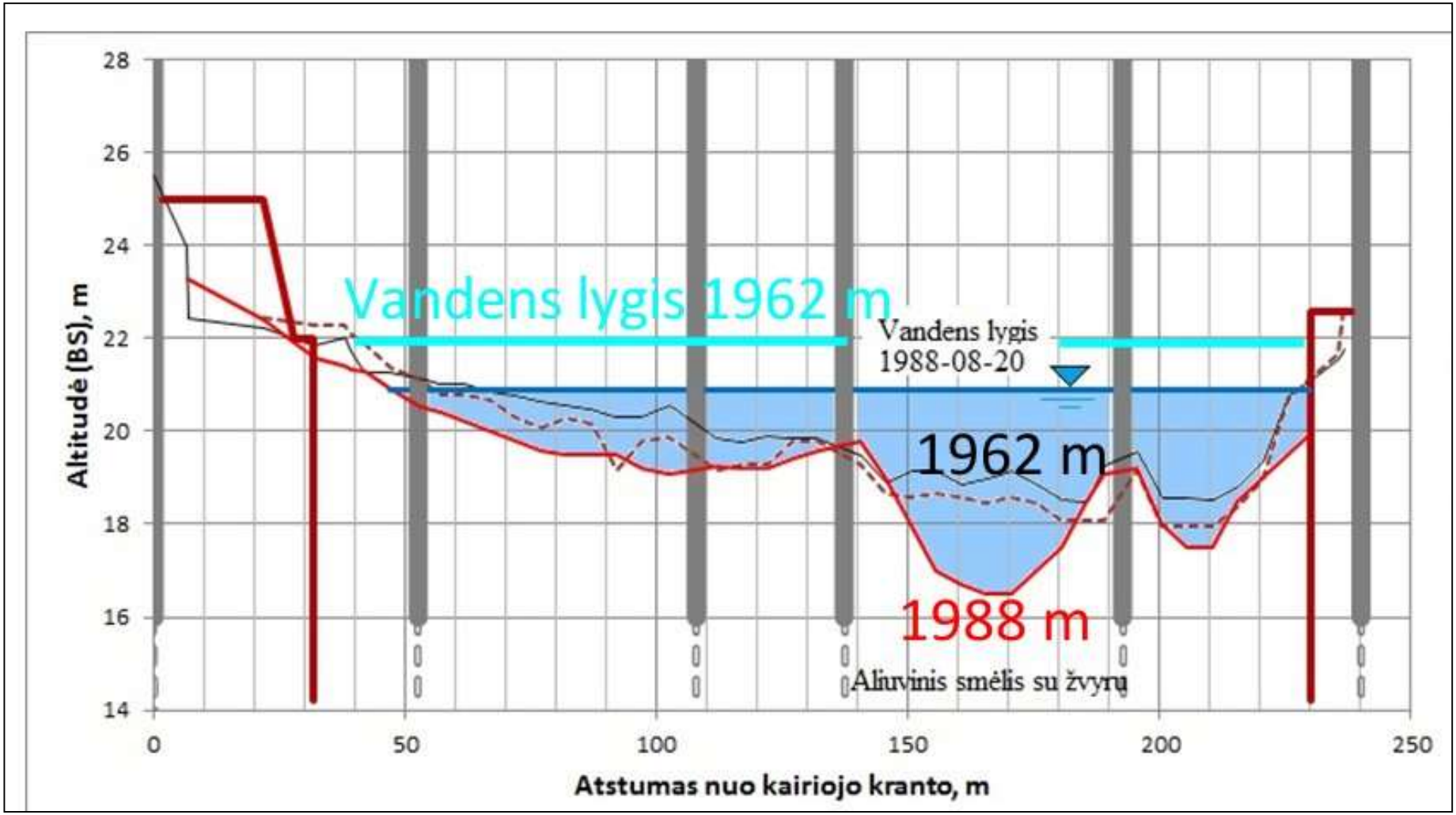
Change of the Neman River maximum discharge in lower reaches
(Smalininkai hydrological station)



The Neman River 1958 spring flooding hydrograph at Kaunas and potential Kaunas HPP influence on flood wave characteristics (*Simaitytė, 2007*)



Change of the Neman River minimum discharge in lower reaches
(Smalininkai hydrological station)



Neman riverbed changes at Aleksotas bridge (1963 -1988).
(*Punys, 2015*)

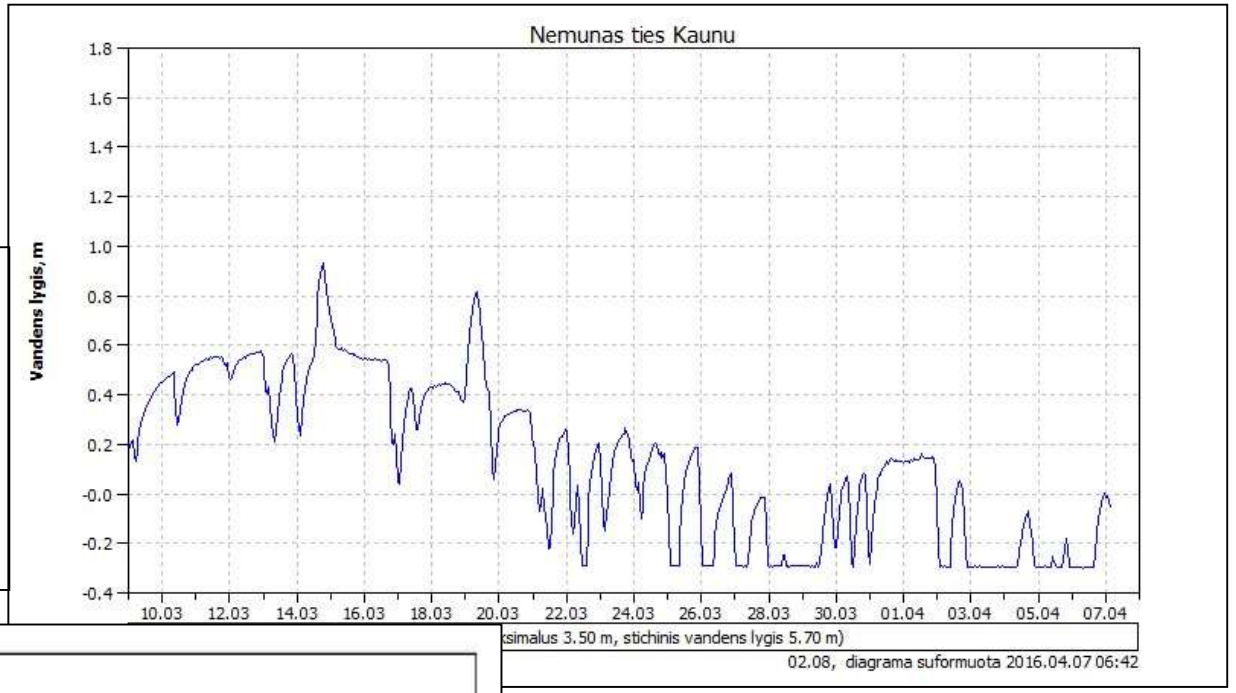
Ecological and water quality problems in Kaunas Reservoir (*Kauno marios*).

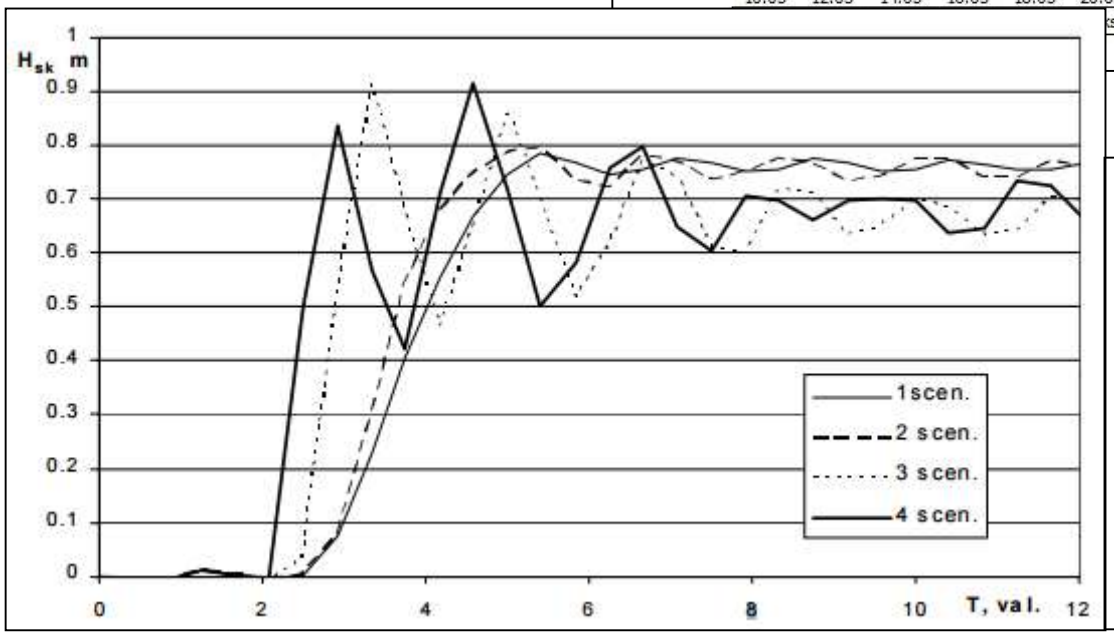
http://kauno.diena.lt

Regulation impact on hydrological regime of rivers

Kruonis PSP

Influence of Kruonis PSP work on the Neman River water level in Kaunas (*www.meteo.lt*)





Flood wave height change to Kaunas HPP dam at four different Kruonis PSP dam collapse scenarios (inflow to the Kaunas reservoir 120 m³) (*Gailiušis et al., 2006*)

Regulation impact on hydrological regime of rivers

Vileyka-Minsk water system and Vilejka Hydropower Plant

Catastrofic Floods in Vilnius:

1925, 1931, 1946, 1951, 1956, 1958.

Flood in Vilnius, 1931 (*nac.gov.pl*)

-3 %
Before 508 m^3/s
After 492 m^3/s

-10 %
Before 170 m^3/s
After 154 m^3/s

-23 %
Before 71.6 m^3/s
After 54.0 m^3/s

-24 %
Before 68.6 m^3/s
After 52.2 m^3/s

-4 %
Before 445 m^3/s
After 429 m^3/s

-15 %
Before 108 m^3/s
After 91.8 m^3/s

-60 %
Before 27.8 m^3/s
After 11.2 m^3/s

Vileyka-Minsk water system impact on Neris and Neman runoff:
~ 12 m^3/s to Svisloch; **~ 4.5 m^3/s** evaporation and infiltration

Negative effect of Vileyka-Minsk water system on the Neris River characteristics in Vilnius

- The Neris River ecology (sanitary) water discharge in Vilnius (summer > 51.5 m^3/s; winter > 45.0 m^3/s): **28 % of cases summer flow was lower**;
- More frequent long-term hydrological droughts in the end of summer below Vileyka dam.
- Increase of nutrient concentration in the Neris River water during the warm season.

Regulation impact on hydrological regime of rivers

Hrodna (Grodnenskaya) HPP

???

The water reservoir filling: 2012 June – August

Impact of river regulation in the future

Forecast of winter runoff change in 2021-2050 (*Nemuno upės..., 2014*)

Forecast of summer runoff change in 2021-2050 (*Nemuno upės..., 2014*)

Problems in the XXI century

- droughts
- poor water quality
- unexpected storm floods

Positive changes in the XXI century

- lower spring floods
- less frequent ice jams

The main problem - lack of information

Lithuanian Hydrometerological Service every day receives data about water levels and discharges from stations:

Neman - Stolbcy
Neman - Belica
Neman - Mosty
Neman - Grodno
Slonim - Schara
Neris - Stieshicy
Neris - Mikhailishki

Lithuanian Hydrometerological Service once a month receive a monthly hydrological reviews.

Data about HPP work regime is confidential information!