

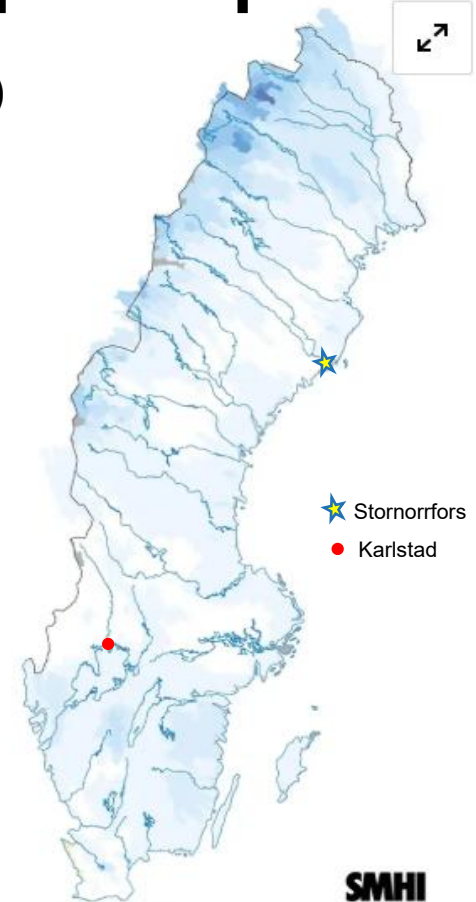
An aerial photograph of the Stornorrfors dam, a concrete structure with multiple spillways, situated on a rocky riverbed. The dam is surrounded by lush green forests and a large reservoir of blue water. In the foreground, a road and parking area are visible. The text "IMPROVED FISH MIGRATION STORNORRFORS" is overlaid in large white letters across the center of the image.

IMPROVED FISH MIGRATION STORNORRFORS

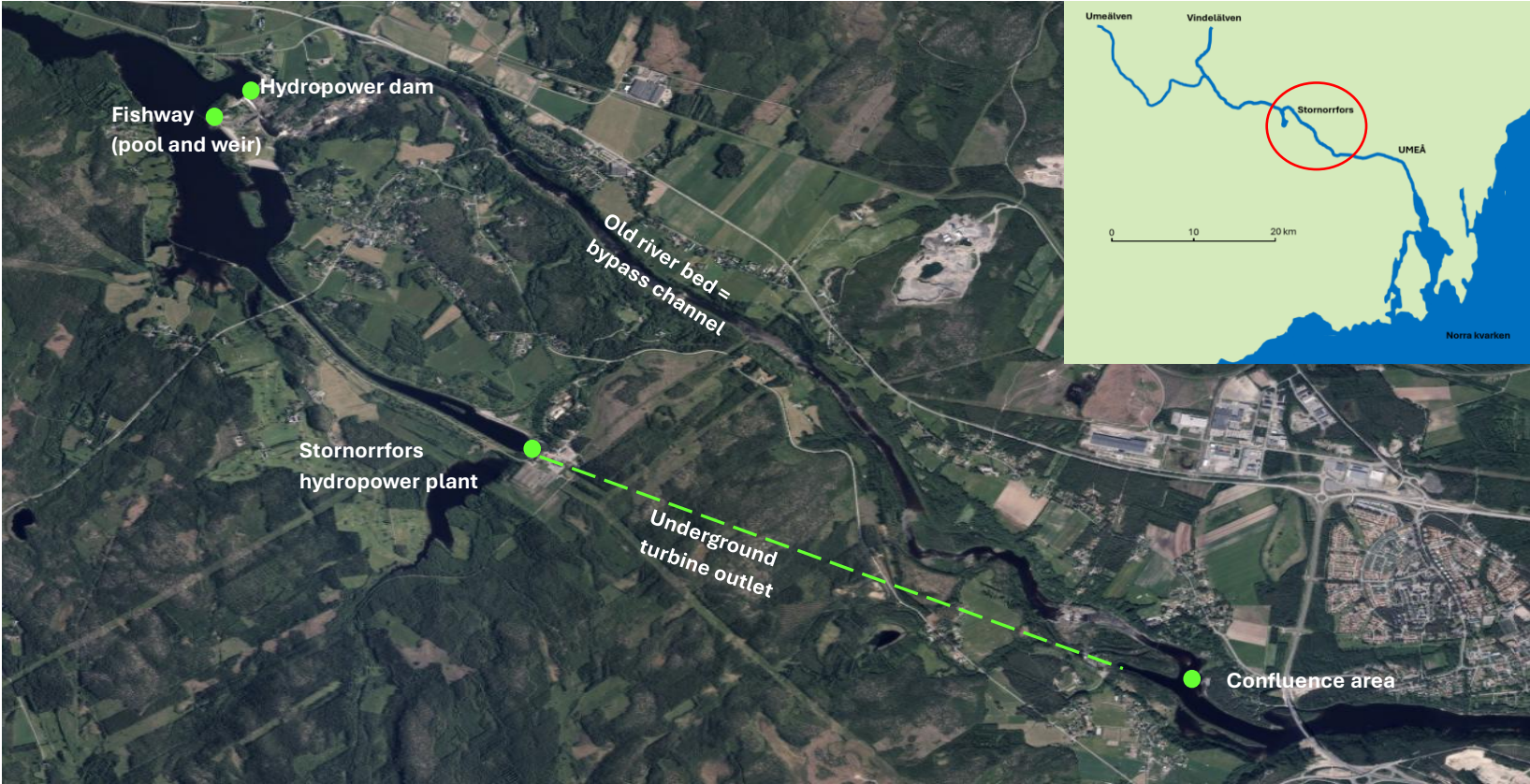
Background Stornorrfors hydropower plant

1. First hydropower plant in Umeälven (from the sea)
2. Fall height 75 m
3. Annual production ~2256 GWh
4. Tributary Vindelälven

→ salmon and sea trout have to pass Stornorrfors



Overview



Mitigation measure at Laxhoppet



Photo: Vattenfall

Mitigation measure at Kungsmofallet



Mitigation measure at Baggböleforsen



Photo: Vattenfall





The physical model

- 1:50
- 8 m long, 2 m wide

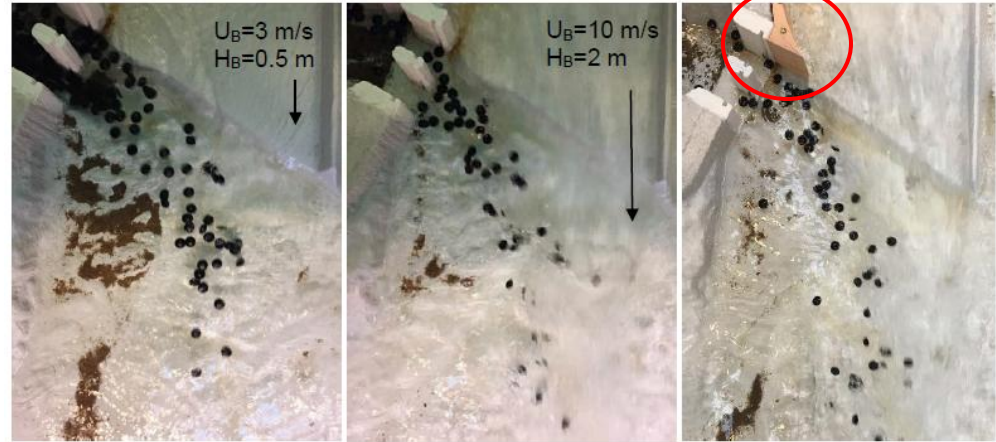
	IRL (m ³ /s)	Model (l/s)
Attraction flow	21	1.19
Spill flow	50	2.83
Spill flow	400	22.6



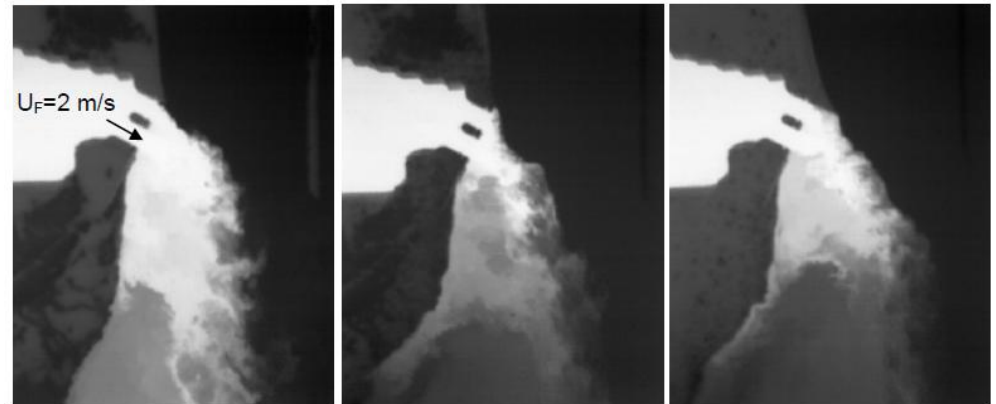
Photo: Åke Forssén

Tests

- Particle Tracking Velocimetry (PTV)
- Hot water and FLIR camera



Figur 4. $Q_B=50 \text{ m}^3/\text{s}$, $Q_B=400 \text{ m}^3/\text{s}$ utan kil och $Q_B=400 \text{ m}^3/\text{s}$ med kil. Lockvattnet visualiserat med svarta partiklar.



Figur 5. $Q_B=50 \text{ m}^3/\text{s}$, $Q_B=400 \text{ m}^3/\text{s}$ utan kil och $Q_B=400 \text{ m}^3/\text{s}$ med kil. Varmt lockvatten visualiserat med FLIR-kamera.



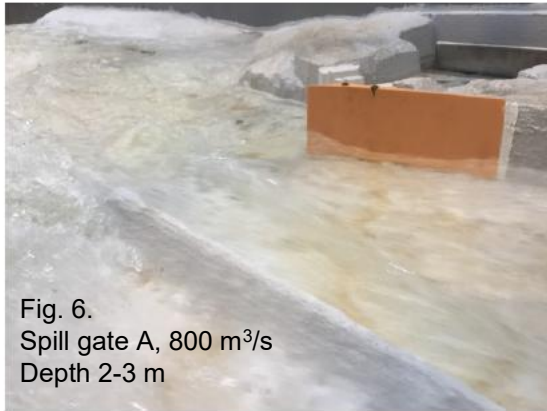


Fig. 6.
Spill gate A, 800 m³/s
Depth 2-3 m

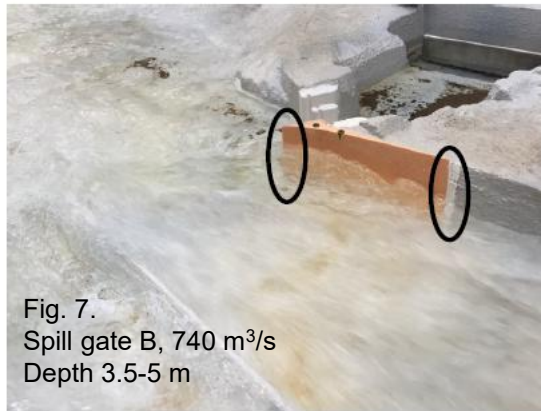


Fig. 7.
Spill gate B, 740 m³/s
Depth 3.5-5 m

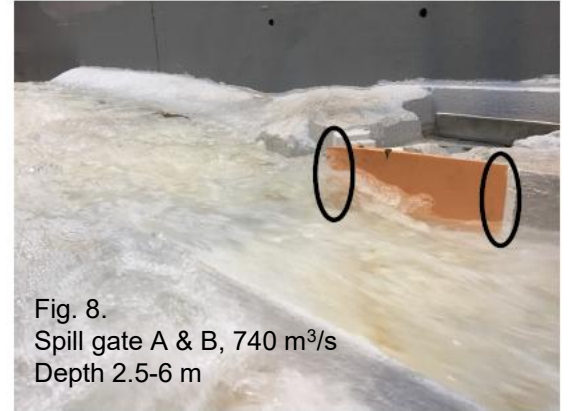


Fig. 8.
Spill gate A & B, 740 m³/s
Depth 2.5-6 m

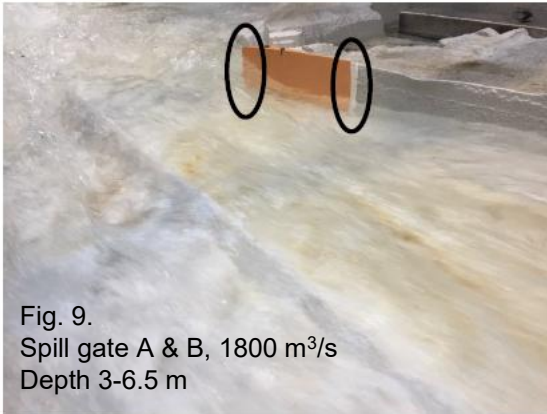


Fig. 9.
Spill gate A & B, 1800 m³/s
Depth 3-6.5 m

Wedge height?

Requirements: only floodgate B and
 $400 \text{ m}^3/\text{s}$

→ 3.5 meters height is enough



Figur 10. Lite öppen B-lucka med spillflöde ca $Q_B=400 \text{ m}^3/\text{s}$ (lucka A helt stängd). Vattendjup vid början av kilen ca 2.0 m och vid slutet av kilen ca 3.5 m som mest.



Figur 11. Verifierande test av den kapade kilens (höjd 3.5 m över botten) funktion: Lite öppen B-lucka med spillflöde ca $Q_B=400 \text{ m}^3/\text{s}$ (lucka A helt stängd).







Thank you!

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