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Confirmed by EKOenergy's Board on 15.02.2018

Øvre Vinstra, Nedre Vinstra and Hunderfossen hydropower plants

The background of the hydropower plants

This is a report for the approval of three hydropower plants in the Gudbrandsdalslågen river catchment area – Øvre Vinstra, Nedre Vinstra and Hunderfossen. The specific information for each power plant is added below (see annex), but the overall environmental conditions of the impact area are analysed and summarised together, as the ecological issues are catchment-wide, not power plant specific.

Øvre Vinstra and Nedre Vinstra are impoundment-type power plants capturing water from the Vinstra watercourse and the glacial rivers of the mountainous area of Oppland (central Norway) into regulated lakes/reservoirs: Bygdin, Vinsteren, Nedre Heimdalsvatn, Kaldfjorden (Øyvatt) and Øyangen reservoirs for Øvre Vinstra, and Olstappen lake (in addition to the 5 other reservoirs) for Nedre Vinstra. Water is stored in these lakes before the flow is directed through tunnels towards the power plants (see annex, figure 1). Hunderfossen is a run of the river power plant downstream from Øvre and Nedre Vinstra, utilising water flow in the main stem of Gudbrandsdalslågen river (see annex, figure 2).

The Gudbrandsdalslågen river catchment area

Gudbrandsdalslågen river is a river in Oppland, Norway. Its source is the Lesjaskogsvatn lake in the Lesja municipality in Oppland. It flows through the valley of Gudbrandsdalen before terminating in the Mjøsa lake. It has many tributaries, including the Vinstra river where the Øvre Vinstra and Nedre Vinstra power plants (and their intake reservoirs) are located.

In the environmental reports carried out by the local authorities, Øyangen (intake for Øvre Vinstra) and Olstappen (intake for Nedre Vinstra) reservoirs are classified as highly modified water bodies (HMWB) and have good ecological potential. The stretches of river Gudbrandsdalslågen downstream from the Nedre Vinstra outlet, upstream of Hunderfossen, and downstream of Hunderfossen have good ecological state. The stretch between the intake and outlet of Hunderfossen power plant (on Gudbrandsdalslågen river) is a HMWB and has moderate ecological potential.

There is limited hydro-peaking in the intake reservoir of Øvre Vinstra (Øyangen) with the maximum variation in water level of 0.21 m/day and 0.31 m/week.

Fish

- Have migratory fish moved upstream before the power plants were built: *No for Øvre and Nedre Vinstra (natural obstacle downstream), yes for Hunderfossen*
- Is there a fish pass or other solution to safeguard the migration of fish upstream and downstream: *A fish pass at Hunderfossen.*

Due to the landlocked nature of this river system (the source and delta are both lakes) only brown trout (*Salmo trutta*) are listed as a salmonid species of interest in this area.

With regards to the Øvre and Nedre Vinstra power plants, there has never been any upstream migration of brown trout on the Vinstra river system (that nowadays consists of the six regulated lakes) due to the steep nature of the source rivers and a natural waterfall (Kamfoss) immediately downstream of Olstappen lake (see picture in Figure 3). This waterfall is an absolute obstacle for upstream migration of fish.

Hunderfossen is located on a calmer, wider stretch on the main stem of the Gudbrandsdalslågen river where fish migration up and downstream past the hydropower plant is possible. Because of this, there is a fish pass at Hunderfossen power plant (see next section for details).

Mitigating measures

- Are there measures identified to minimise the impact of these power plants? *Yes, several measures have been carried out: a fish pass built in 1963 at Hunderfossen. Brown trout surveys, monitoring and restocking projects in the impact area have been funded by the producers since 1970s, and continuous minimal flow between Kaldfjorden (Øyvatn reservoir) and Olstappen since 2008.*

A fish pass was built at Hunderfossen in 1963. The fish pass is operational from May till November annually (to coincide with the natural upstream and downstream migration of brown trout). Its function and use is monitored automatically via a video fish counter and the rate of water flow can be adjusted according to use/requirements. Hunderfossen also has minimum ecological flow requirements (since 1963). In addition, a pilot scheme on water release and environmental improvement is currently being carried out (2017-2021).

Since 1990 the hydropower producers and the environmental authorities in Oppland have established a cooperation project to monitor the fish populations in the regulated lakes and rivers in the area. The monitoring is used as a base for decisions on re-stocking. The monitoring has a typical rolling interval of 5 years for each reservoir and regulated river, but these can be extended/shortened if new research becomes available.

The regulation licenses for the six regulated lakes on the Vinstra watercourse were revised in 2008. As a result of this, a continuous minimum flow in the natural river stretch between Kaldfjorden (Øyvatn) reservoir and Olstappen was established. The possibility of continuous flow downstream of Olstappen (the natural stretch of river Vinstra before it joins Gudbrandsdalslågen river) was also assessed. The authorities concluded that the economic costs due to loss of production and the limited environmental improvements would not make continuous flow a viable measure in this reach, therefore priority was given to the upper stretch, where the recreational and ecological potential was higher.

Conclusion

This part of the Gudbrandsdalslågen catchment consists of heavily modified water bodies in a relatively pristine habitat of Norwegian highlands. Much of the flowing water here is directed towards power production in one way or another. Despite this, we believe the three power plants mentioned above qualify for the sales of EKOenergy certified electricity.

There has been a lot of scientific research carried out in the area assessing the environmental conditions and potential of the regulated lakes and rivers, and most report on good environmental conditions (even with the heavily reduced water flow in some of the upstream rivers). There is a functional fish pass at Hunderfossen. There is continuous minimum flow in the natural river stretch between Kaldfjorden (Øyvåtn) reservoir and Olstappen.

Finally, during our research on these power plants, the energy producers have been forthcoming in providing all the information we have requested (copies of the permits, environmental reports, average flow data, etc), therefore this is a partnership the EKOenergy Secretariat would like to support.

References

http://www.opplandenergi.no/Kraftverkoversikt/Ovre_Vinstra/

http://www.e-co.no/Norsk/Forside/Kraftverk/Nedre_Vinstra/

<http://www.opplandenergi.no/Kraftverkoversikt/Hunderfossen/>

<http://www.nhm.uio.no/forskning/publikasjoner/lfi-rapporter/151.pdf>

https://www.fylkesmannen.no/Documents/Dokument%20FMOP/Milj%C3%B8%20og%20klima/Vann/Fisk%20i%20regulerte%20vassdrag/Overv%C3%A5kingsrapporter/Vinstra_elv_2015.pdf

<http://www.miljodirektoratet.no/Documents/publikasjoner/M49/M49.pdf> (a report on planned reviews and updates of hydropower plants/dams, in Norwegian)

<http://www.miljodirektoratet.no/en/Areas-of-activity1/Species-and-ecosystems/Salmon-trout-and-Arctic-char/Pressures-on-salmonids/River-regulation-for-hydropower-production/> (a report on hydropower and Norwegian salmon rivers, in English)

ANNEX

1. Øvre Vinstra power plant

- Name: *Øvre Vinstra*
- Owner: *Opplandskraft DA*
- Year of construction: *1960*
- Fall height and tunnel length: *330 meters fall height, 60 km operational tunnel*
- Installed capacity: *178 MW*
- Annual electricity production (on average): *610 GWh*
- Turbine number and type: *Two Francis turbines*

2. Nedre Vinstra power plant

- Name: *Nedre Vinstra*
- Owner: *Vinstra kraftselskap*
- Year of construction: 1958
- Fall height and tunnel length: 448 m height, 22 km tunnel length
- Annual electricity production (on average): 1.19 TWh
- Installed capacity: 355 MW
- Turbine type: *Five Francis turbines*

3. Hunderfossen power plant

- Name: *Hunderfossen*
- Owner: *Opplandskraft DA*
- Year of construction: 1963
- Fall height: 46 meters
- Installed capacity: 126 MW
- Annual electricity production (on average): 605 GWh
- Turbine number and type: *Two Kaplan turbines*

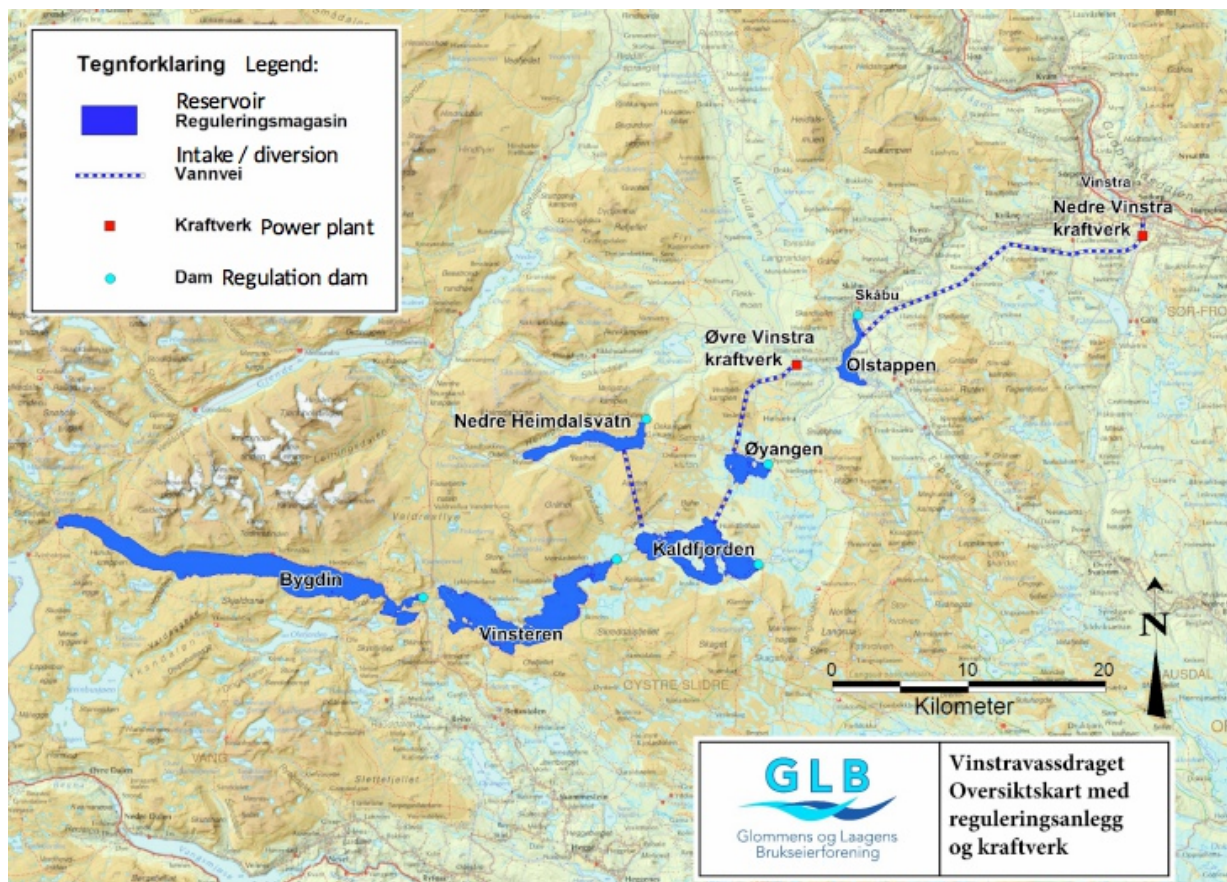


Figure 1. Øvre and Nedre Vinstra power plants (red squares) with their intake reservoirs (dark blue), dams (light blue) and tunnels (dashed line). Map reproduced with permission from the owners.



Figure 2. Hunderfossen power plant (red square) on the main stem of Gudbrandsdalslågen river. Dashed line is the power production tunnel, indicating the intake and outflow. Map reproduced with permission from the owners.



Figure 3. Kamfoss waterfall just downstream of Olstappen lake. A natural barrier for fish migration in Vinstra river system. Photo: Sven Gjessing, Norsk Skogmuseum (The Norwegian Forest Museum).