Statement to the Environmental Report of Mura's hydropower plant Hrastje-Mota in respect of the effects to the FFH habitat types 91E0 (softwood alluvial forest) and 91F0 (hardwood alluvial forest)

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List of Content

1 Summary of the conclusions

1. The assessment of the Environmental Report (ER) of the impacts of the planned Mura hydro power plant Hrastje-Mota (HPP) on the flood and groundwater regime and thus floodplain forests has significantly shortcomings and weaknesses for a proper finalisation of the ER:
    - Important parameters like extreme floods, spatial extension of floods, flood duration and water depth for different return intervals, which are essential for the proper assessment of the flood regime and impacts on FFH-habitats (91E0, 91F0), are not analysed and documented before and after construction of HPP.
    - The analysis of the ground water situation is restricted mainly to static aspects in the ER; the impacts of the HPP on dynamic aspects and ground water table fluctuations and thus on FFH-habitats (91E0, 91F0) are neglected and not analysed at all.
    - Effects of changed groundwater table and especially of the drastic reduced ground water dynamics to soil moisture (including the soil structure and depth of topsoil) and especially to soil aeration during the vegetation period are not analysed.
    - The impacts on hydro-morphodynamics are not analysed.
2. The negative impacts of the planned Mura hydro power plant Hrastje-Mota HPP to the softwood and hardwood forest (FFH-Types 91E0 and 91F0) are significantly higher than documented in the Environmental Report (ER), which makes the compensation of the impacts impossible:
    - The permanent loss of the FFH habitat type 91E0 (softwood alluvial forest) due to physical destruction are more than twice as high for all mentioned variants of power plants as quantified in the ER.
    - According to the ER one of the main objectives of the HPP Hrastje-Mota is to maintain the current flood regime on the inundations of Mura. Especially, it is stated, that the flood regime for smaller floods will stay the same. However, for bigger floods the prediction is that flood protection will increase. A possible impact on bigger floods in the inundation area is in contradiction to the point of nature conservation and the preservation of floodplain forests.
    - There is no spatial documentation and quantification of the different habitat types (91E0, 91F0), which are affected by the hydropower plant due to changed flooding regime and the changed groundwater situations.
    - Physical disturbances of large areas of the FFH habitat types are in contradiction to the rule of the FFH Directive, which does not allow any deterioration.
    - The loss of the potential improvement of the riparian ecosystem by river restoration due to the HPP prevents to reach the favourable conservation status of the affected FFH habitat types.
3. The possible negative impacts of the planned Mura hydro power plant Hrastje-Mota HPP to the softwood and hardwood forest (FFH-Types 91E0 and 91F0) beyond the immediate project area are not assessed in the Environmental Report (ER):
    - The conclusion in the ER that no further impact on floodplain forests downstream the hydropower plant (deepening section) is expected, is not comprehensibly and supported by data and an appropriate assessment.

- In general the ER promise, that “mitigation measures” will solve all the environmental problems, but it is not documented how this will be done.
- No assessment has been done of the potential transboundary impacts of planned hydropower plant Hrastje-Mota HPP on changed flood and sediment regime and impacts on FFH-Habitat types and Natura 2000 sites in Croatia (SAC HR2000364) and Hungary (SAC HUBF20043).
- There’s neither statement nor assessment of the cumulative effects of the up to eight planned hydro power plants at the Mura River in Slovenia and Austria.

2 Introduction and tasks of the expertise

In 2005, based on the regulation of water use for electricity generation on the Mura river section from Sladki vrh to Veržej (Uredba o koncesiji za rabo vode za proizvodnjo električne energije na delu vodnega telesa reke Mure od Sladkega Vrha do Veržeja (Uradni list RS, št. 120/05), the approval to build power plants on the Mura river was granted to hydropower company Dravske elektrarne Maribor (DEM). In the following years several preliminary studies were implemented by the investor (DEM). Based on the proposal of the investor (DEM) from the year 2012, the procedure of the preparation of the governmentally spatial planning started.

The study of different power plant variants (Državni prostorki načrt za hidroelektrarno Hrastje-Mota na Muri – Študija variant (prepared by Urbis d.o.o., Maribor, November 2016)) with several related studies (carried out by several companies and institutes), the Environmental Report (Okoljsko poročilo za DPN za HE Hrastje-Mota na Muri; prepared by VGB Maribor d.o.o., št. proj. 3421/13, October 2016, supplemented in April 2017, Maribor), and the appropriate assessment of Natura 2000 (Dodatek za varovana območja - Presoja sprejemljivosti DPN HE Hrastje-Mota na Muri na varovana (Natura 2000 in zavarovana) območja; prepared by VGB Maribor d.o.o. and CKFF, št. proj. 3421/13-D, October 2016, supplemented in April 2017, Maribor) were conducted in November 2016 and supplemented in May 2017. Based on these studies the procedure of Strategic Environmental Assessment followed.

The area of the planned hydropower plant Hrastje-Mota at the Mura River between Gornja Radgona and Dokležovje is characterized by large softwood and hardwood alluvial forests and other specific wetland habitats. Therefore, the area is designated as an international protected Natura 2000 site. The legal regulations are based on the Flora Fauna Habitat (FFH) Directive and the Wild Birds Directive, which implicate a strict rule of non-deterioration and additionally require improvement of affected FFH habitat types to reach the favourable conservation status.

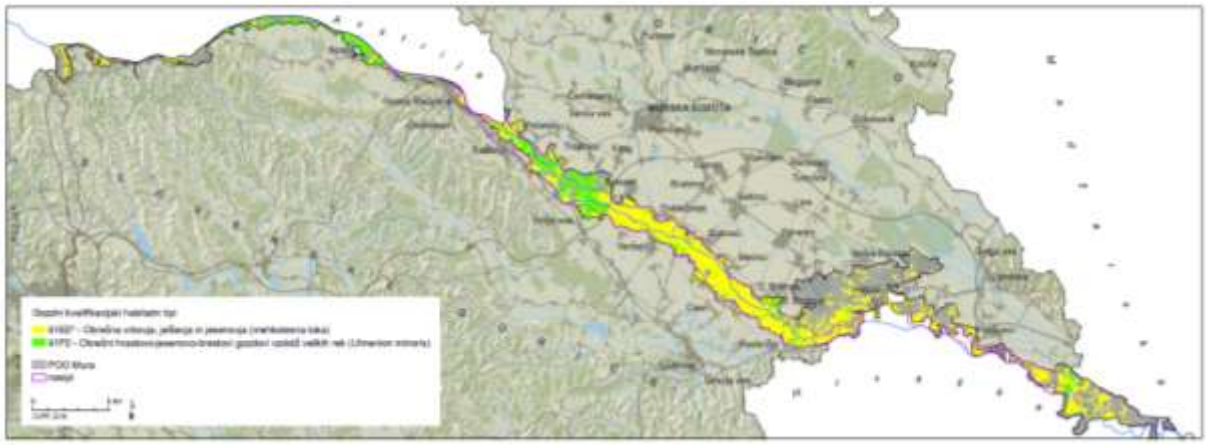

Figure 1: Natura 2000 area SAC (SL3000215) along the Mura River from Gornja Radgona to the Croatian border (source: G2_Mura_HT_A3_kvalif_HT_2016_priloga2)

The general objective of this statement is to evaluate and analyse the quality of the assessment of the Environmental Report (ER) of the planned Mura's hydropower plant Hrastje-Mota and its impacts on floodplain forests concerning the habitat types 91E0*[1] (Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae); "softwood alluvial forest") and 91F0 (Riparian mixed forests of *Quercus robur*, *Ulmus laevis* and *Ulmus minor*, *Fraxinus excelsior* or *Fraxinus angustifolia*, along the great rivers (Ulmenion minoris); "hardwood alluvial forest") of the Natura 2000 area SAC Mura (SI3000215).

More in detail:

- Critical analysis of data quality and methods of assessment
- Summarize major shortcomings of impact assessment and of conclusions taken
- Summary of the most important conflicts to the FFH directive
- Provide conclusions of the analysis

3 Study area

The expert study of the area started at the section of the Mura Bridge in Gornja Radgona (stationed at river kilometre 107 + 363) and went down to the village Dokležovje (stationary at river kilometre 89 + 304). The river section comprises approximately 17.5 km of the Mura River. In this study area the floodplains on the left and right banks of the river are approximately 500 m to 1800 m wide. At the flood return period Q100, the floodplain surface in this section is about 20 km^2.

[1] * Priority habitat type.

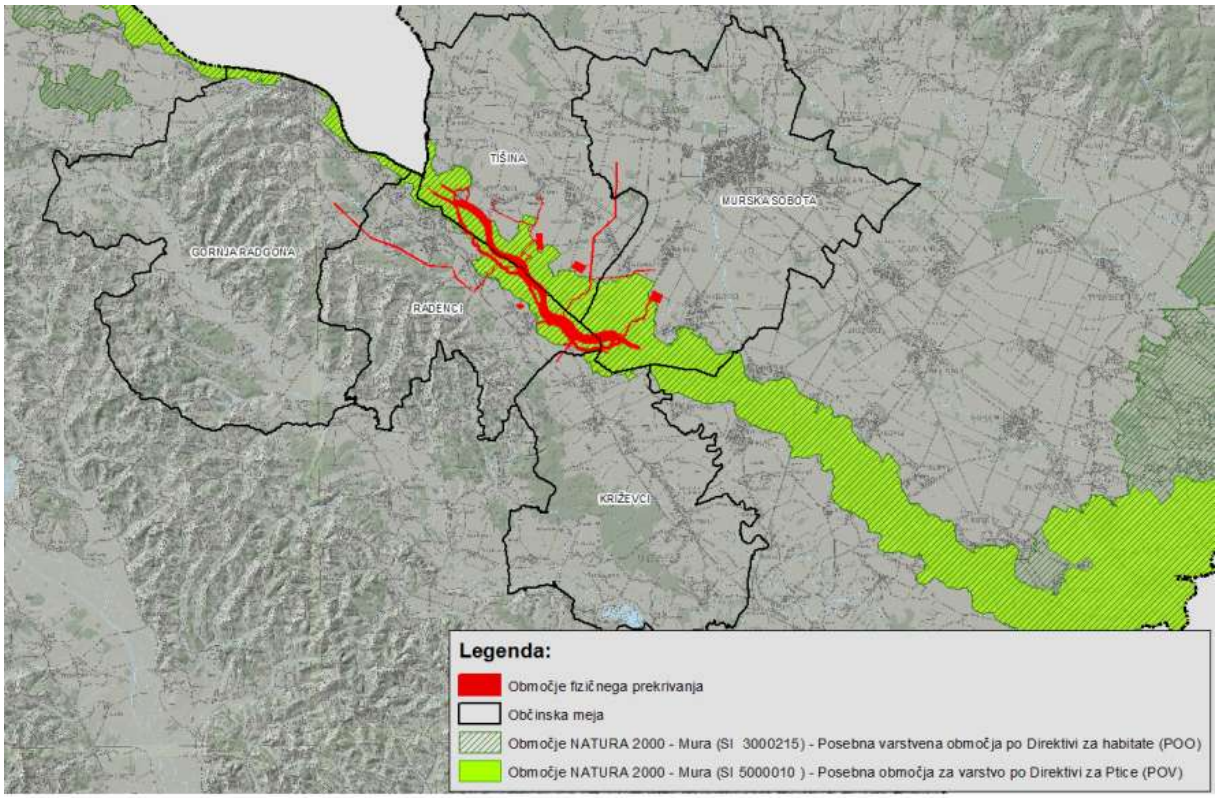

Figure 2: Study site of planned Mura hydro power plant Hrastje-Mota (red area; source: Environmental Report, Slika 1)

The main tributaries to the river Mura are on the left river bank Drauchenbach, Kučnica, Mokoš, and on the right river bank the stream Hercegovščak and its tributaries Črešnjevski potok, Boračevski potok and several small ones.

The study of power plant variants comprised three different variants of the HPP: Both variants 1and 2 included in each case one dam, but variant 3 contained two dams.

In variant 1 the dam is situated at river kilometre 89.50 and in variant 2 the dam is located at river kilometre 87.80. In both variants, the reservoir is at a height of 198.00 m a.s.l. The length of levees in variant 1 are 4 km on the left bank and 4.5 km on the right bank. In variant 2 the length of levees are 5.7 km on the left bank and 6.2 km on the right. Both variants foresee the same water drop height at the dam with 8 m. The maximum height of the levees in variant 1 is 8.5 m and in variant 2 it is 10 m. To reach the required water drop in variant 1, it is foreseen to deepen the river bed after the dam location in a distance of approx. 2.6 km with a maximum depth of 1.5-1.7 m. The variant 3 foresees two lower dams, one at river kilometre 91.00 and the other at river kilometre 87.08. The damming level of the first dam is at a height of 198 m a.s.l. and of the second dam at a height of 193 m a.s.l. The maximum height of the levees in variant 3 is 5.5 – 6 m. No river bed deepening is foreseen for variant 3 (further characteristics see Table 1).

Table 1: Selection of the main characteristics of the three variants (IDR, Technical report – version 17/ Tehnično poročilo - verzija 17, HSE, avgust 2016)

Characteristics	Variant 1	Variant 2	Variant 3
Location [km]	89.50	87.64	91.64+87.64
Number of dams	1	1	2
Downstream riverbed deepening, distance after dam	2.5 km (the deepest to 1.5-1.7 m)	no	no
Height of the dam [m]	8.5	10	5.5-6.0

Characteristics	Variant 1	Variant 2	Variant 3
Length of levees (left bank/ right bank) [km]	5.3/5.3	7.1/7.2	7.1/7.2
Volume of accumulation [Mio m³]	2.8	5.5	3.3
Retention time [h]	4.9	9.6	5.8
Damming level of the first dam [m a.s.l.]	197	197	197+192.4
Damming level of the second dam [m a.s.l.]	188.87	187.73	192.4+187.9
Production per year [GWh]	89.18	99.59	95.7

4 Data base

- Nature Conservation Act (Zakon o ohranjanju narave (Uradni list RS, št. 96/04 – uradno prečiščeno besedilo, 61/06 – ZDru-1, 8/10 – ZSKZ-B in 46/14)
- Natura 2000 Management plan of the study site:
  - For habitat type 91E0 following relevant conservation goals are written in the Natura 2000 management plan: The size of the habitat type has to be restored, natural hydromorphology of waters has to be restored, connectivity of the habitat type has to be restored, no invasive non-indigenous species conditions have to be restored.
  - For habitat type 90F0 following relevant conservation goals are written in the Natura 2000 management plan: The size of the habitat type has to be restored, natural hydromorphology of waters has to be restored, connectivity of the habitat type has to be restored, no invasive non-indigenous species conditions have to be restored, groundwater level has to be adjusted to ecological requirements of the habitat type.
- Environmental Report (ER) (Okoljsko poročilo za DPN za HE Hrastje-Mota na Muri), prepared by VGB Maribor d.o.o., št. proj. 3421/13, October 2016, April 2017 in Maribor.
- Appropriate assessment for Natura 2000 (AA) (Dodatek za varovana območja - Presoja sprejemljivosti DPN HE Hrastje-Mota na Muri na varovana (Natura 2000 in zavarovana) območja), prepared by VGB Maribor d.o.o. and CKFF, project n. 3421/13-D, October 2016, supplemented in April 2017 in Maribor.
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- DIREKTIVA SVETA 92/43/EGS z dne 21. maja 1992 o ohranjanju naravnih habitatov ter prosto živečih živalskih in rastlinskih vrst (EGT L 206, 22.7.1992, s. 7)
- VGB MARIBOR d.o.o. in CKFF: Petrinec, V., B. Trčak, E. Erjavec, A. Marinšek, M. Govedič, 2015a. Kartiranje in naravovarstveno vrednotenje habitatnih tipov na območju reke Mure. Končno poročilo. VGB MARIBOR d.o.o., Maribor in Center za kartografijo favne in flore. 88 str., digitalne priloge.

5 Assessment and statement to the major shortcomings of the Environmental Report of hydropower plant Hrastje-Mota

Permanent loss of habitat areas due to the physical destruction

The loss of habitat areas due to the physical destruction are quantified in the Environmental Report (ER) for 91E0 as 6.04 ha (V1), 6.40 ha (V2) 6.53 ha (V3) and for 91F0 as 38.63 ha (V1), 51.29 ha (V2), 54.33 ha (V3). According to the ER the surface balance does not include the power line. In all variants the construction of the power line is planned on the area SCA Mura as cable installation mainly directed on existing and on new roads. The ER mentioned that the destructed surfaces of qualifying habitat types (HT) are "*relatively few*". Anyway, the impact of the power line has to be included in the surface balance. Additionally the area of permanent loss is defined too small in the ER. For instance area of permanent loss is defined only to distance 2, 5m away from the drainage dich, the same goes also for most of other infrastructure.

The map of the FFH types in the ER is not correct (Habitatni tipi Slovenije HTS, 2004, Republika Slovenija, Ministrstvo za okolje, proctor; in energijo - Agencija Republike Slovenije za okolje, 2004). Along the river Mura a part of the floodplain forest is declared as the vegetation type "Hedgerows and small groups of trees and shrubs" (Mejice in manjše skupine dreves in grmov (Physis 84.2)). Field verification has confirmed that this vegetation type has to be assigned to the 91E0. Therefore, the surface balance of the potential loss of FFH habitat type 91E0 is approx. 8 ha larger than mentioned in the ER (= more than 100 % higher for all three variants!).

The ER did not propose any mitigation measures directly linked to floodplain forest. There are only mitigation measures foreseen in the chapters transport of sediment, groundwater and impact on hydromorphology of surface waters.

Flood regime

A reduction in flow magnitude from dam operation could result in a decline in channel migration and pioneer vegetation recruitment (Friedman et al., 1996). Altered flow regime can have consequent impact on biotic composition, life history strategies of aquatic species, longitudinal and lateral connectivity, and on the success of exotic and invasive species (Bunn & Arthington, 2002). Flow stabilization can result in channel stabilization, minimal cotton recruitment, and decreased deciduous shrubs (Polzin & Rood, 2000).

The flood regime conditions before and after the construction of the HPP Hrastje-Mota, which are an essential basis for assessing the impacts on floodplain forests, are calculated with a 2D-HN model. This method is state-of-the-art. However the model calibration (comparison of measured and modelled water tables and spatial extension of floods for different discharges) is not documented in the ER. Therefore, it is not possible to evaluate the quality of the model results.

According to the ER one of the main objectives of the HPP Hrastje-Mota is to maintain the current flood regime on the inundations of Mura. Especially, it is stated, that the flood regime for smaller floods will stay the same. However, for bigger floods the prediction is that flood protection will increase. A possible impact on bigger floods in the inundation area is in contradiction to the point of nature conservation and the preservation of floodplain forests. Beside this it would be essential for the scientific expertise in the ER and for a proper assessment of the impacts on floodplain forests, to document the flood regime more in detail:

- The documentation of the flood regime includes only the inundated area with the return periods of Q3 and Q5. Apart from these relatively often and recurrently flood events, also extreme floods (Q50, Q100) are not analysed and respectively not documented in the ER. Extreme flood events are an important driving force for disruption and disturbance of floodplain vegetation and for creating new pioneer habitats. In addition to the flood protection, also from the ecological point of view, it is important to document the effects of extreme floods by an appropriate HD-modelling.
- Besides the spatial extension of the floods, further parameters which are essential for the assessment of the flood regime and for assessing the impacts on floodplain forests, are not documented in the ER. These missing parameters are flood duration (for different reference years and vegetation periods[2]) and water depth for different return intervals.
- There is no information about the impact on flood duration and water depth, and thus also no separation of the impacts on the floodplain forests before and after the construction of HPP.
- In the report, there is only a short verbal, qualitative description which areas are affected by the HPP. There is no spatial documentation (map) and no quantification (surface balance) of the different habitat types (91E0, 91F0) which are affected by the hydropower plant due to the changed flood regime.
- The results of the ER do not include any information about the flooding sensitivity of the indicator plants of the 91E0 and 91F0 habitat types before and after construction of HPP (related to flood recurrence, water depth and flood duration).

Groundwater

Accelerated siltation processes in the receiving river reduce the vertical connectivity between river and groundwater (Fette et al., 2007). Modified hydrology downstream of dams reduces groundwater recharge in the riparian zone which indicates a falling off the groundwater table and results in a reduced extent of the active floodplain (Nilsson & Berggren, 2000).

The raising and the reduction of groundwater table, the change in the direction, and the flow rate of the groundwater are calculated by a state-of-the-art groundwater model. This model included the specific flow rates, the permeability and the porosity of the different sediments in the study site. But without a documentation of the location of the measurement points of the groundwater (map), it is not possible to evaluate the interpretation of the groundwater situation.

Therefore, the assessment of the impact of HPP Hrastje-Mota to the FFH habitat types 91E0 and 91F0 is not done in a proper way in the ER, because of the following aspects:

- The analysis of the groundwater situation is restricted mainly to static aspects in the ER. Even if the yearly mean value of the groundwater table is not changed significantly by a HPP, the change of a dynamic groundwater situation without HPP to a stabilized groundwater table due to HPP has dramatically impacts to floodplain forest habitat types (Egger, 1992). These impacts on FFH habitats 91E0 and 91F0 have not been assessed at all in the ER.
- The ER declares that the groundwater dynamic will be significantly reduced, because of the modified differences of the yearly minimum and maximum values. Besides the very general analysis of the changed differences of the yearly minimum and maximum values, all dynamic aspects are neglected

[2] Years and vegetation periods with different flow regime; e. g typically “dry”, “moderate”, “wet” and “extreme wet” years/vegetation periods

in the ER. Especially, the impacts of the missing groundwater table fluctuations ("Pegelweg[3]") due to the HPP Hrastje-Mota are not analysed.

- Effects of changed groundwater table and especially of the drastic reduced groundwater dynamics regarding to soil moisture (including the soil structure and depth of topsoil) and to soil aeration during the vegetation period, is not analysed in the ER. This basic knowledge is a necessary information to analyse the consequences of the changed groundwater conditions to the floodplain vegetation.
- The result of the ER does not include any information about the sensitivity of the indicator plants of the 91E0 and 91F0 habitat types in relation to soil moisture sensitivity before and after construction of HPP Hrastje-Mota.
- The ER has no spatial (maps) and quantitative documentation (surface balance) of the affected FFH habitat types by the hydropower plant due to changed groundwater conditions.
- Against this background, it is incomprehensible how the ER comes to the conclusion that "*no significant impact on protection goals of habitat types in case of raised water level will be expected*"!

Hydro-morphodynamics

One of the most important effects of hydropower plants is the interruption of the sediment transport. Due to the low flow velocity, the sediment will be deposited in the reservoir. The main impact downstream of the hydropower plant is an increased river bed incision which has negative effects to groundwater and flood regime. A further effect of HPs is, that the operator has to flush out the sediments regularly from the reservoir. As a result, the water becomes completely murky and muddy, the impact on the ecosystem downstream is dreadful.

The ER claims that sediment transport will be ensured and that there will be no river bed deepening because of riverbed erosion downstream due to mitigation measure. But the fact is that there is no quantification or any other detail information on how when and where. It is written that all this will be defined in later stages of the procedures when the "Programme of measures" will be prepared and confirmed. Beyond that the ER does not show any significant impact on floodplain forest downstream from the dam due to decreased sediment transport.

Additionally, the long-term effect will be a reduction of the connection of side channels at the downstream floodplains (Bonacci & Oskorů, 2009; Dister et al., 1990; Globevnik & Mikoš, 2009; Holubová et al., 2005). Both, the hydrological and geomorphological changes combined, prevent seedling recruitment, which lead inter alia to a dramatic decline in young cottonwood (Benjankar et al., 2012; Polzin & Rood, 2000).

Riparian vegetation

Altered physical processes modify riparian vegetation and the average age of all the vegetation types increases in post-dam conditions (Benjankar et al., 2012). The natural hydrological pattern is altered by dam operation and flow management, riparian vegetation follows succession toward mature vegetation, due to the lack of disturbance in the system (Benjankar et al., 2012).

[3] Total of absolute values in water level variations.

Requirements of FFH Habitat Directive

The Appropriate Assessment for Natura 2000 report (AA) already declares significant impact (D) for all variants on Natura 2000 habitats, habitat types and conservation goals. Besides the severity of negative impacts, the analysis of the ER resulted of an underestimation of the impacts to the FFH floodplain forest types 91E0 and 91F0 in many aspects:

- Damming a river causes a fundamental change of the entire river-floodplain ecosystem. A flowing water system with a highly dynamic water table will be changed into a nearly stagnant water body with a drastically reduced flow dynamic. The reduction of the dynamic flow regime causes also decrease of groundwater dynamics. Additionally, due to the levees nearby both riversides, the river and the floodplain are disconnected, which is one of the most major negative impacts to riparian ecosystems in a long-term perspective.
- Therefore, the ongoing negative trend of river regulation will be strengthened due to the construction of the hydropower plant.
- Besides these dramatically long-term effects, the construction of the infrastructure for the hydropower plant (levees, dam, station, roads etc.) disrupt abruptly large areas of near to natural and international protected habitats (e.g. softwood alluvial forest (91E0) nearby the river banks). Especially the bank zone close to the river is characterized with the great potential for river restoration. All biotope types and their typical flora and fauna in the bank zone are more or less highly endangered or already extinct! With the construction of the hydropower plant, especially this critical bank zone will be replaced by technical infrastructure, whereby an improvement of the ecology of the river-floodplain is not possible in future any more.
- Due to ongoing river bed incision activated by river regulation and bank protection, the ecological conditions especially of the softwood alluvial forests (91E0) are not in a favourable conservation status. The morphodynamic of the floodplain is drastically reduced, the groundwater level is too deep and the flood recurrence is too low. Independently from the negative environmental consequences of the planned HPP Hrastje-Mota, the current situation of the flood regime and groundwater level should be improved. Otherwise the existing long-term process of the succession of the priority softwood alluvial forest 91E0 to a hardwood alluvial forest (91F0) and the long-term reduction of habitat diversity would be irreversible. Apart of the drastically physical destruction of large areas of 91E0 and 91F0, this effect is one of the most negative impacts of the projected HPP Hrastje-Mota especially in a long-term perspective.
- In the ER, there is no statement about cumulative effects of the up to eight planned hydropower plants along the Mura River in Slovenia and Austria.

For this reason, the projected HPP Hrastje-Mota is completely contradicted to the requirements of the Flora Fauna Habitat Directive. All types of projects, measures, changes, or interferences which might deteriorate the area significantly, are prohibited. This applies in particular if a priority habitat type as the softwood alluvial forest 91E0 is affected. Therefore, the physical disruption of large areas of the FFH habitat types 91E0 and 91F0 are contradicting the rule of non-deterioration of the FFH-Directive. Additionally, the loss of the potential improvement of the riparian ecosystem by river restoration due to the HPP, prevents to reach the favourable conservation status of the affected FFH habitat types. This is also in conflict with the FFH Directive. If the disturbance is sustained (a press disturbance) and causes a complete loss of critical habitat elements, ecological integrity cannot be maintained which makes a restoration to original conditions almost not possible (Gore & Shields, 2012).

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