Test Case Presentation:

Altheim

Isar, Germany

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1. Description of the Test-Case

1.1. Description of the water bodies related to the HPP

River Isar is an Alpine river with its mouth being located in Austria, 1600 m above sea level. The river passes Alpine mountains, pre-alpine moor lands and also the city of Munich. After a length of 260 kilometers, the Isar enters the Danube River at 300 m above sea level below the city of Deggendorf. The catchment area including the incoming rivers Loisach and Amper is about 8960 m². The Isar is generally divided into 3 sections, the upper, the middle and the lower Isar; the test case is located in the lower Isar.

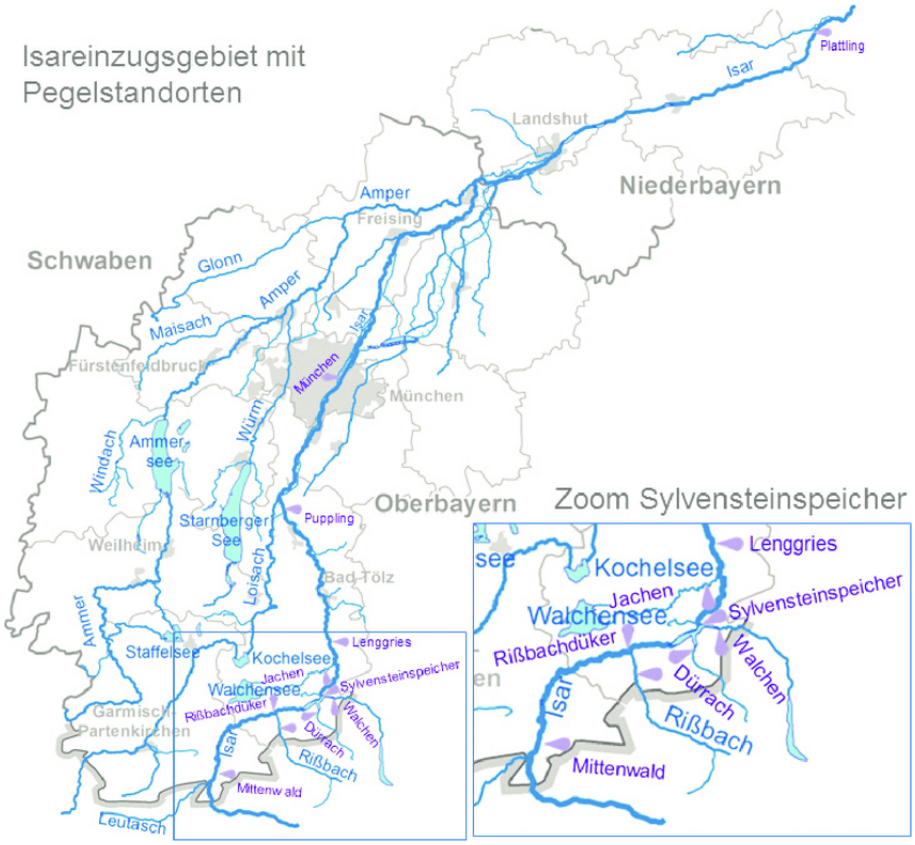

Figure 1: The water bodys related to the HPP Altheim

The water body including the case study site is named 1_F429 and includes the Isar from the entry of the Isar channel (MIK) to the city of Plattling. The water body has a catchment area of 88,2 km² and is about 73 km long. It is classified as HMWB with poor ecological potential.

- The water body upstream is 1_F405 and is classified as natural water body with good ecological status.
- The water body downstream is 1_F430 and is classified as natural water body with moderate ecological status.
- The water body entering from the right side is 1_F433 and is classified as natural water body with bad ecological status.

1.2. Main pressures on the relevant water body

The main pressures on water body 1_F429 that might according to the river base management plan 2016-2021 be causative for the status of the river stretch are:

- Nutrients
- River specific pollutants
- Soil feed
- Hydromorphological changes

1.3. Measures to be implemented at water body 1_F429 according to the river basin management plan

- Reduction of nutrients coming from agriculture
- Improvement of linear connectivity
- Improvement of dynamic habitat development
- Improvement of floodplains
- Connection of side arms

1.4. Presentation of the HPP

1.4.1. Location of the HPP

The plant is located at km 67.2 of the river Isar near Altheim

Figure 2: Top view of the HPP altheim

Downstream the test case site, 7 other HPP follow in the same water body.

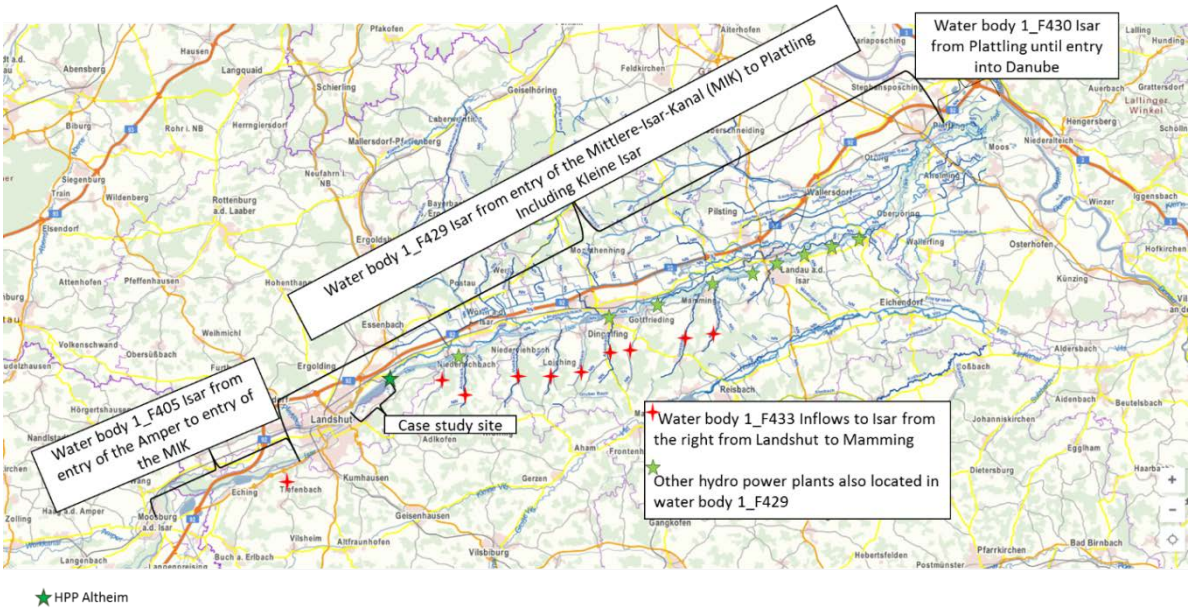

Figure 3: The location of the HPP Altheim and other HPPs on the Isar

1.4.2. Hydrology and technical data of the test case

Watercourse	Isar
Situation :	Altheim
Inter-annual discharge	163 m³/s
Low-water flow :	50.9 m³/s
Instream flow :	
Function of the dam :	Hydropower
Lenght of headrace canal :	n.a.
Length of bypassed reach :	n.a.
Maximum turbine discharge:	270 m³/s + station supply 11.7 m³/s
Species concerned :	Barbus barbus, Hucho hucho (L = 100 cm)

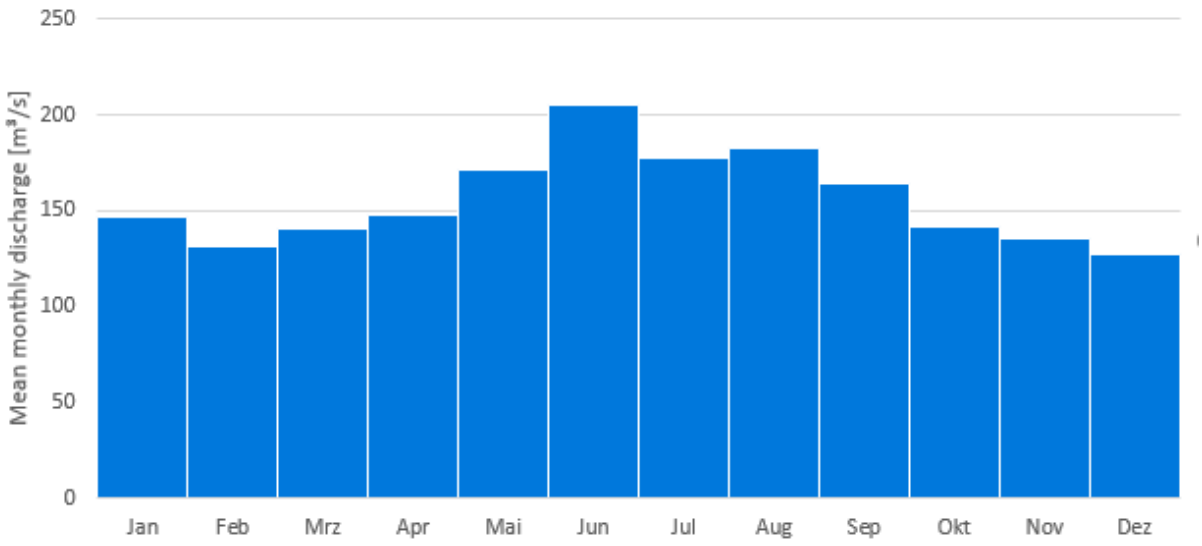

Figure 4: Mean monthly discharge at HPP Altheim average 2017 - 2019

About the HPP Altheim:

- Year of commissioning: 1951
- Installed capacity: 17.8 MW
- Mean annual output: 91.4 GWh
- Head height: 8.2 m/

The HPP consists of 5 Kaplan turbines:

	3 Kaplan turbines	1 Kaplan turbine (house machine)	1 Kaplan turbine (discharge to Längenmühlbach)
Installed capacity	8.0 MW	0.8 MW	0.1 MW
Discharge per turbine	90 ³/s	12 m³/s	3.2 m³/s
Nominal speed	107 rpm	300 rpm	775 rpm

Minimum diameter of runner	4080 mm		
Number of blades	24		

The normal operating level is at 384,00 m above sea level, in hydropeaking mode it can be lowered by 1,00 m. On average there are 2 peaks per day, where the flow changes roughly between 50 m³/s and 170 m³/s with ramps of about 100 m³/s per hour or change of water level +45 cm/h or -30 cm/h. The plant has a head storage volume of 1980000 m³. The plant has 4 weir fields right of the power house.

1.4.3. E-flow

HPP Altheim is a block-type HPP in the river Isar and part of a chain of power plants. For the main flow in river Isar no e-flow regulations are agreed. Nevertheless, a full stop of machines is never operated. A minimum flow of 40 m³/s is always maintained voluntarily. For own purposes one machine for station supply must always be operated with 11.7 m³/s. The connected small stream Längenmühlbach has an agreed minimum e-flow of 3.2 m³/s all year, but is not in the focus of the Altheim TestCase within FIThydro.

1.4.4. Downstream migration devices

The river is dominated by potamodroumous species. No downstream migration device is installed at this plant, as downstream migration facilities for this size of river are not available and downstream migration is not a major focus of research for areas dominated by potamodroumous species.

1.4.5. Upstream migration devices

The upstream migration facility, which has been built in 2015, consists of a rough channel for the downstream connection at the entry of the fish pass. An existing drainage channel has been used to facilitate the fish passage over 4.5 km and for providing new hydromorphological structures and habitats in the fish pass. The fish pass entry is located on the right -hand side of the river Isar following the main migration route. On the upstream side a vertical slot connects the nature-like fish pass to the river. The vertical slot structure overcomes 1.45 m of height with 13 sections. The whole migration facility is always supplied with a minimum flow of 450 l/s (up to 800 l/s).

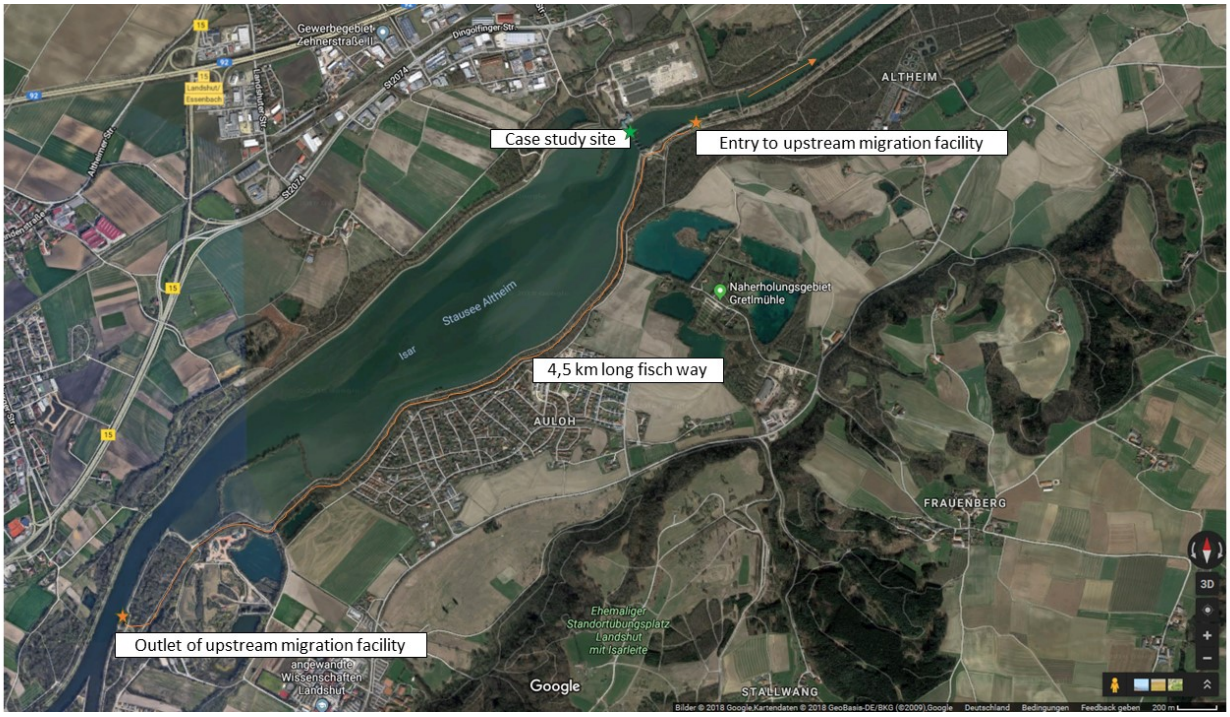

Figure 5: Location of the fishway at HPP Altheim

Geometrische Bemessungswerte

Tabelle 1: Geometrische Bemessungswerte – Schlitzpass (Vertical–Slot), Staustufe Altheim

Abmessung	Bezeich-nung	Grenz-wert	Sicherheits-beiwert	Bemessungswert	Planung
Schlitzbreite [m]	min_s	0,35	1,0	0,35	0,35
lichte Beckenbreite [m]	b_B	2,0	1,0	2,25	2,25
lichte Beckenlänge [m]	l_B	3,0	1,0	3,0	3,0

1.4.6. Sediment Management

No measures for sediment management are in place.

2. Description of the planned work

Within the project the fish pass at the plant shall be evaluated regarding the existing hydromorphological structures in the fish pass. Both the variation of the original structures to the current status as also the usage of the existing habitats by fish shall be evaluated. Upon the results a concept for improved hydromorphological measures should be developed under the aspect of usage by fish and expenses for maintenance. Moreover, the maintenance effort for the long nature-like bypass channel shall be evaluated and improved for future upstream migration facilities. This will be relevant for further decisions on the implementation of upstream migration measures.

Within the course of this assessment we expect to gain more knowledge on the design of habitat structures in nature-like fishpasses, answering the questions which and how many are needed over a certain length. Moreover, we want to prove the value added by “articifically” created habitat structures. Finally, a reduced effort for maintaining these structures will support future decisions between choosing a technical fish pass or a nature-like fishpass where possible.

This evaluation will feed back into the cost effectiveness analysis within FIThydro. The development of cost efficient and effective measures is a key focus within FIThydro.

3. Presentation and results of activities in FIThydro

The waterbody 1_F429 suffers from a substantial lack of dynamic habitat development. Especially in heavily modified water bodies nature like fish ways offer the possibility to improve the ecological potential essentially. Creating connectivity can be combined with spawning grounds and habitats for juvenile fish. Often the availability of habitats is even more important for the development of the population than the mere connectivity. On the other hand, nature-like fish passes often require a significant amount of maintenance due to their length, the difficult balance between what is “nature” and what is functionality and also the maintenance of hydromorphological structures with an all year steady flow.

Along river Isar the existing drainage stitches have been used for long nature-like fish passes. The assessment within FIThydro is designed to evaluate the benefit of artificial habitat structures within nature-like fish passes for fish and macroinvertebrates.

Mapping of the available structures in the 3.5 km long fish pass

Previously, the quality of the structures in the fish pass was not defined. During the original design some structures had been implemented to enable the development of habitats, but the availability of these structures is not given anymore. Therefore, the full length of the fish pass needed to be mapped in order to track all currently available structures in the fish pass. For the mapping it is important to include the water depths, flow velocities and substrate conditions. Moreover, the existing structures need to be evaluated regarding their benefit for fish. Therefore, certain structures are observed via video monitoring to assess the usage frequency by fish. Moreover, the usability for spawning shall be evaluated.

Development of an improved structural concept in two steps

Based on the ecomapping and the knowledge about the benefit of the existing structures, a concept was developed containing 5-6 standard structures and a geographical plan in which areas to implement them. The assignment differentiates between the minimum amount of structures needed and the maximum number of structures (2-step approach) that can be implemented to find the optimum needed allow the spawning grounds and juvenile habitats in the fish pass needed. Especially for operators the amount of structures is essential, as they require significant effort for maintenance to ensure their usability in the future.

Implementation of measures

In autumn 2019, the selected structures were installed. Over a total length of 1.5 km of the natural fish pass one habitat structure every 100 m has been implemented. The structures mainly consist of dead wood and spawning gravel and were constructed as spawning habitats, juvenile habitats or shelter but also to generally increase the variability in flow conditions. 5 structures are being observed with underwater photography in comparison to similar locations within in the fish pass without structural improvements to compare the effects and benefits. The first impressions indicate that the new habitat structures show a much higher density of the relevant fish species.

Evaluation of the effort for maintenance of the fish pass

The nature-like fish pass did long suffer from driftwood getting stuck at the outlet upstream. To solve this, a floating wooden bar had been installed to drift off branches and boughs. In the

course of FIThydro implemented measures shall be evaluated according to their effectiveness to support the development of self-sustaining fish populations, but also regarding the costs and effort for construction and maintenance. Accordingly, at Test Case Altheim the effort for maintenance of the fish pass will be described, differentiating between regular maintenance measures and ad-hoc measures. Moreover, the description will point out, which measures are related to the length of the fish pass and which are general measures regardless of length. This evaluation will feed back into the cost effectiveness analysis within FIThydro.

Figure 6: Structural measures for the improvement of habitat in the fishway. Top: adding of gravel; Bottom: deadwood and gravel banks