LATVIJAS VIDES, ĢEOLOĢIJAS UN METEOROLOĢIJAS CENTRS

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# River Habitat modelling & E-flow estimation

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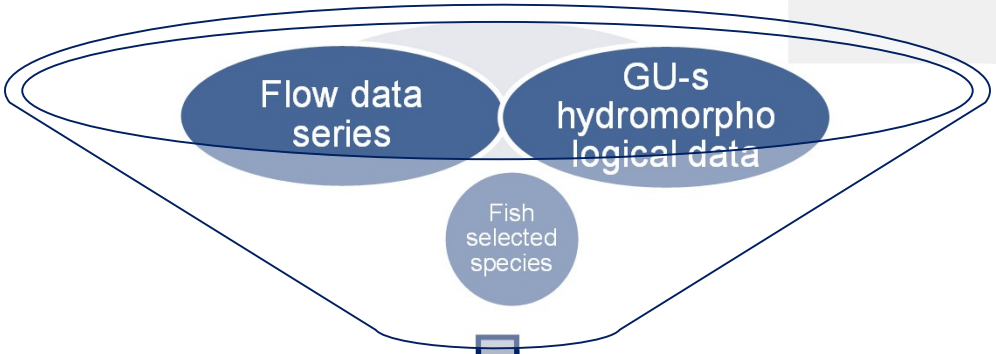
# INTODUCTION: MesoHABSIM

- The results of MesoHABSIM is a background for integrative analyses of many aspects of the ecosystem.
- It allows to recreate reference habitat conditions and evaluate possible instream and river basin restoration measures, such as fish-pass construction or changes in HPP operations.
- From the perspective of water resource management, it not only allows for quantitative measures of ecosystem' sustainability, but also creates a basis for balance between water resources use and ecological quality – evaluation of ecological flow.

# INTRODUCTION. SimStream Model

**SimStream is a computer model that integrates field collected hydro-morphological data with biologic data (fish).**




## SIM-STREAM MODEL

- Habitat-Water Flow rating curve
- Habitat Suitability maps
- Habitat spatial and temporal suitability indices

# Hydro-morphological data collection







# INTRODUCTION. HABITAT INDICES

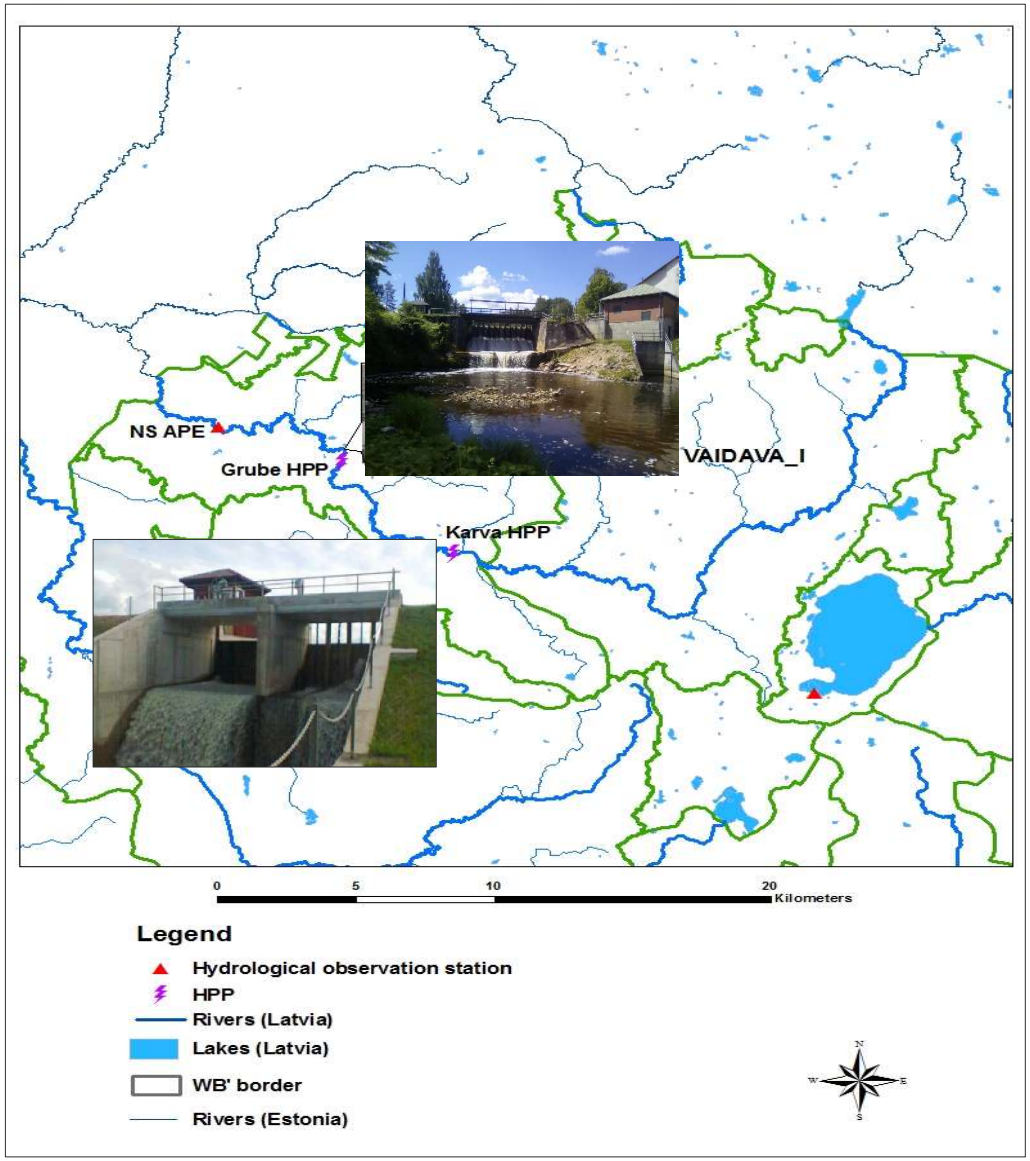
| IH | Class |
|---|---|
| IH ≥ 0.80 | High |
| 0.60 ≤ IH < 0.80 | Good |
| 0.40 ≤ IH < 0.60 | Moderate |
| 0.20 ≤ IH < 0.40 | Poor |
| IH < 0.20 | Bad |

Spatial Habitat Availability Index (ISH) – Ratio of Habitat effective areas in reference and altered conditions

Temporal Habitat Availability Index (ITH) shows the difference in amount of Stress days (habitat area is below treshhold) for reference and altered conditions

Index of Habitat Integrity (IH) is a mimimum value of ISH & ITH. This index is related to the ecological status of water body, and should be not less than 0.6 in accordance with WFD.

# HPPs on Vaidava River (trans-boundary waterbody G235)




Two HPPs are located on Vaidava River in the trans-boundary waterbody Karva HPP consists two Kaplan type turbines:

- 320 kW with the head 11.08 m,
- 160 kW with the head 9.65 m

Turbines water discharge - 0.2-5.5 $m^3$/sec.

Ecological flow – 0.94 $m^3$/sec

Fish pass' flow – 0.16 $m^3$/sec

Grube HPP consists one Kaplan type turbine with capacity 250 kW

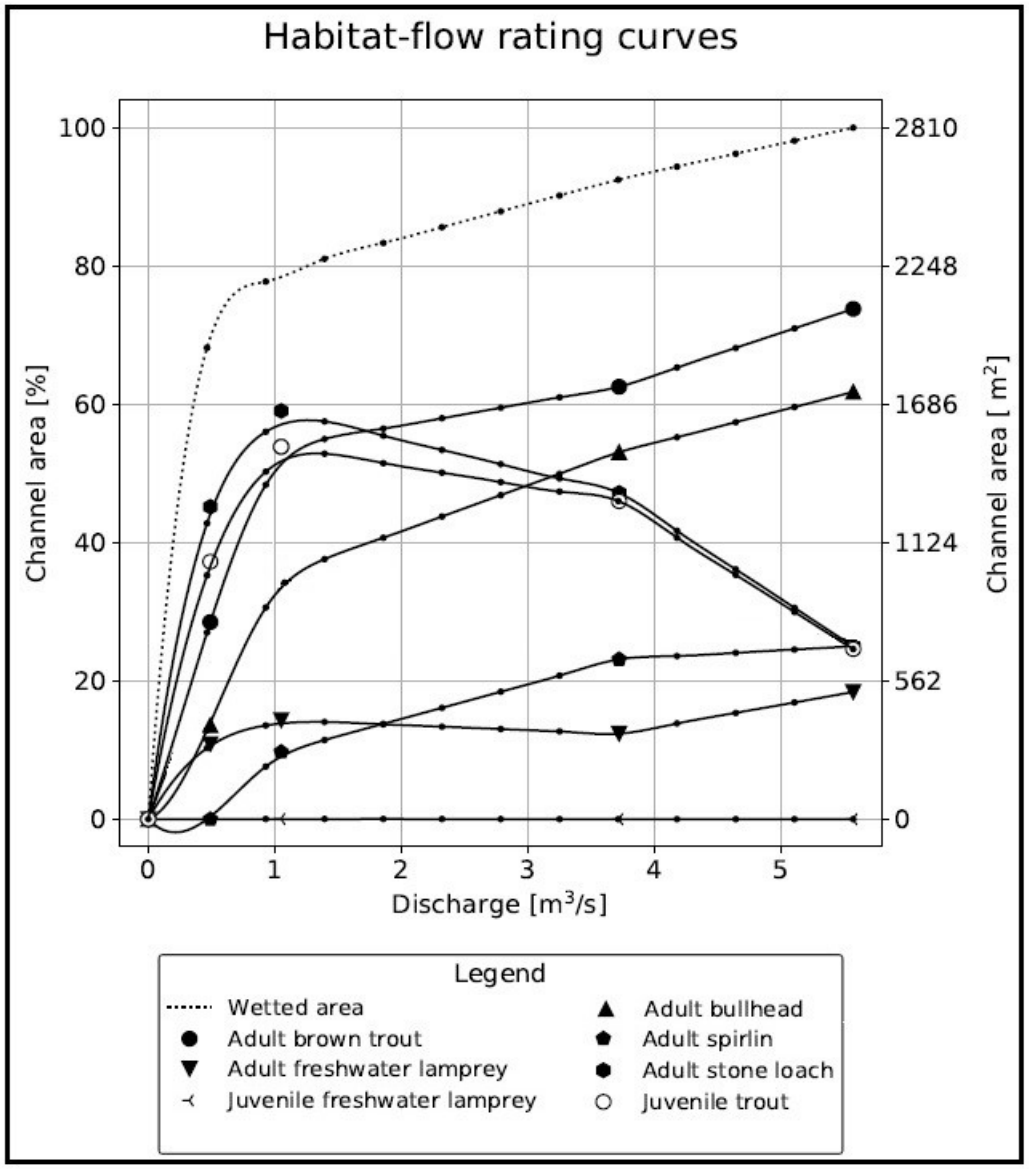
The head of HPP is 6 m.

Turbines water discharge is 5.0 $m^3$/sec.

Ecological flow – 0.57 $m^3$/sec.

Fish pass doesn't constructed

# Modelling results
# Vaidava River downstream Karva HPP

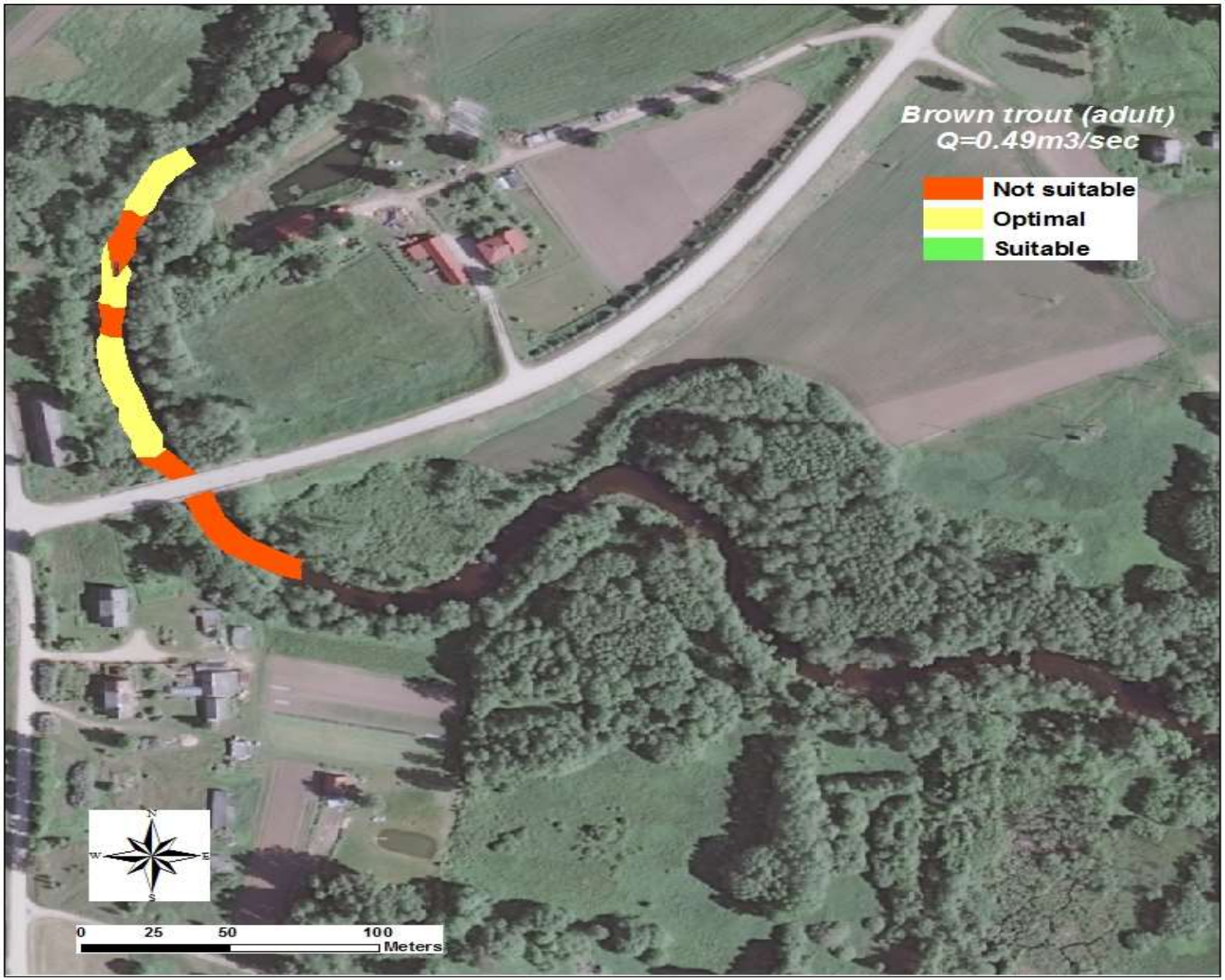



Vaidava is a salmonid type river. Karva HPP is one of two HPPs on Vaidava River.

Habitat curves for selected fish species depending on flow rate were modelled for each fish species of interest (brown trout, stone loach, bullhead, etc.) that was pre-selected by fish expert.

Q ecological = 0.94 $m^3$/sec (almost is equal to project offered value)

# Modelling results
# Habitat suitability map downstream Karva HPP



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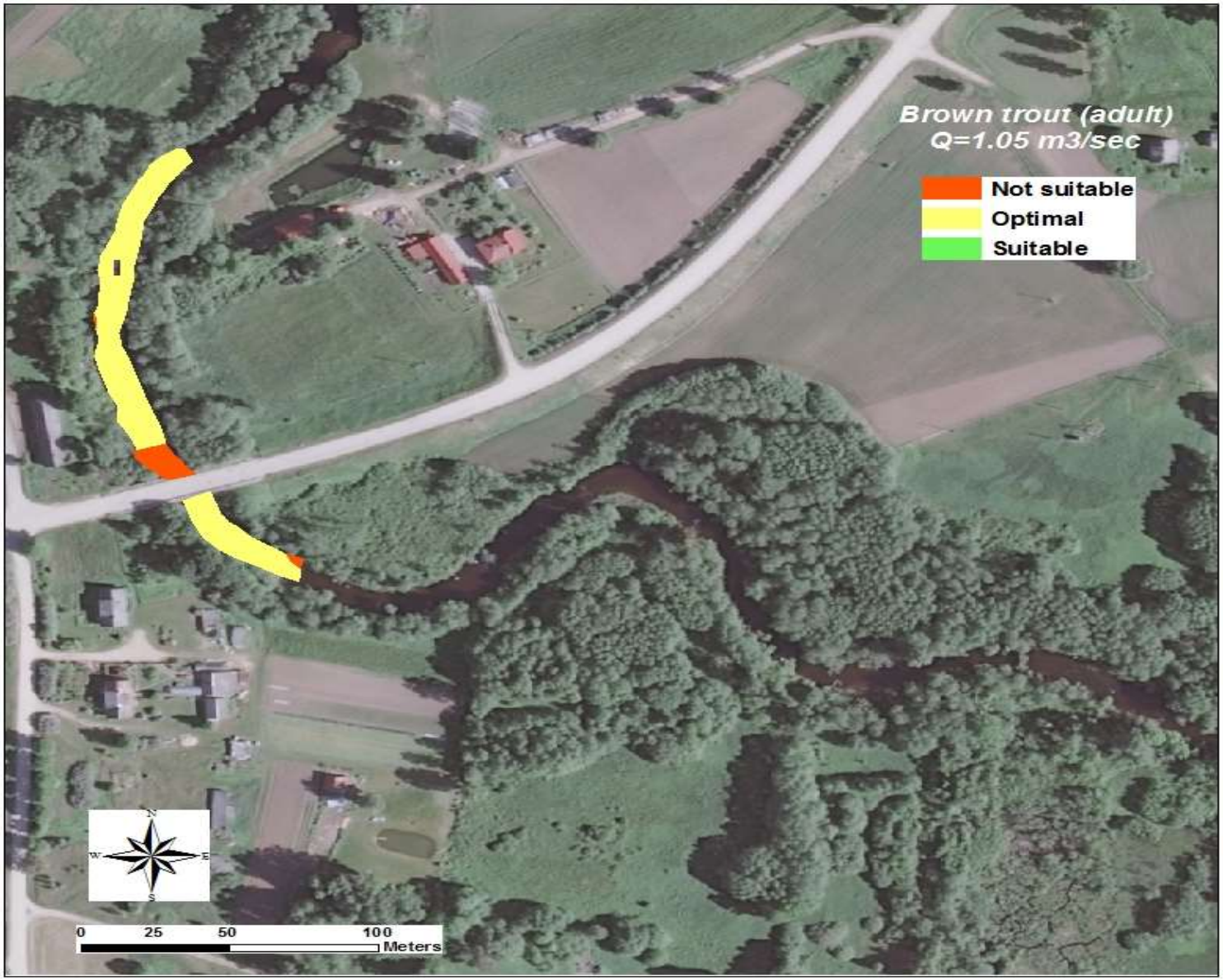

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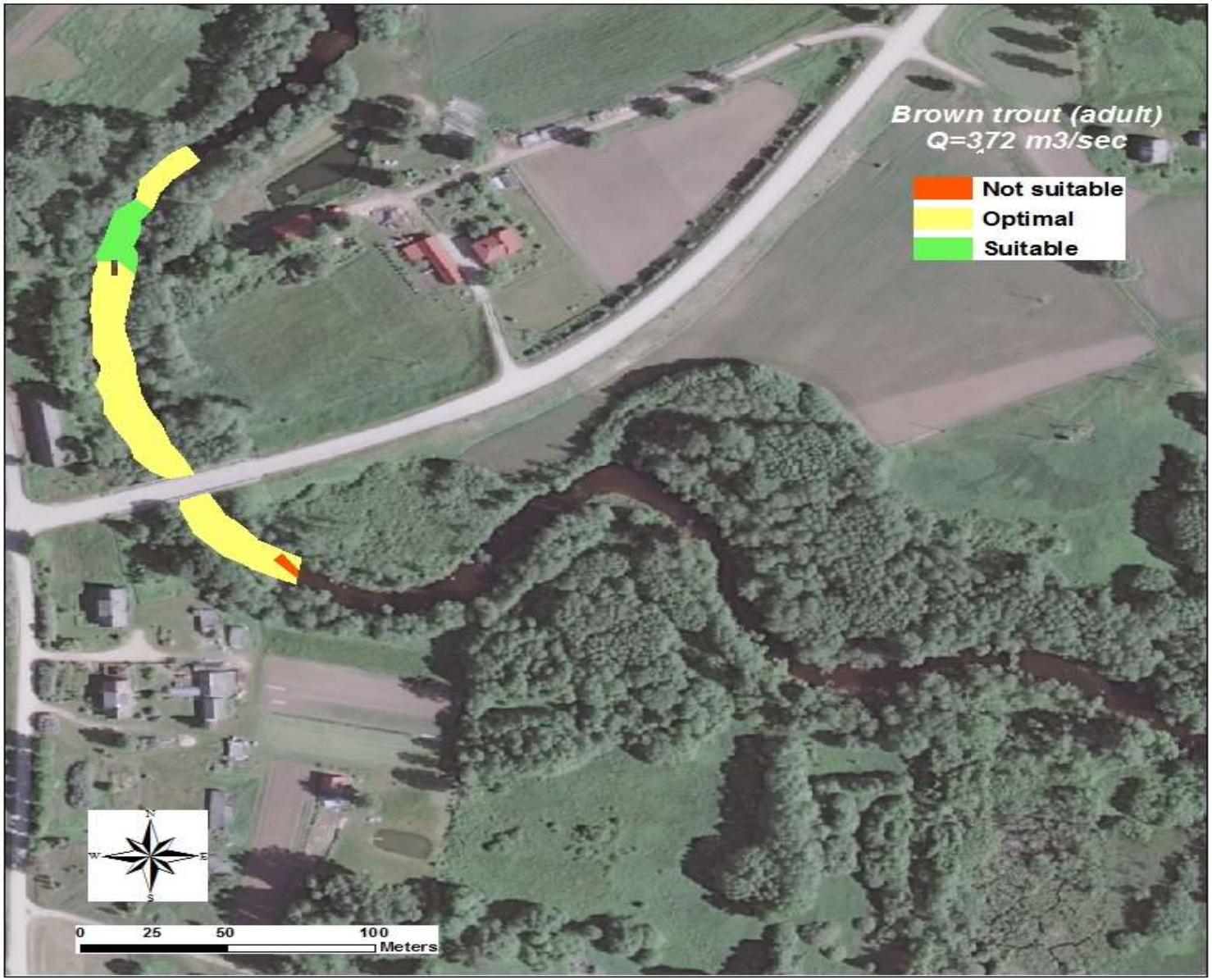

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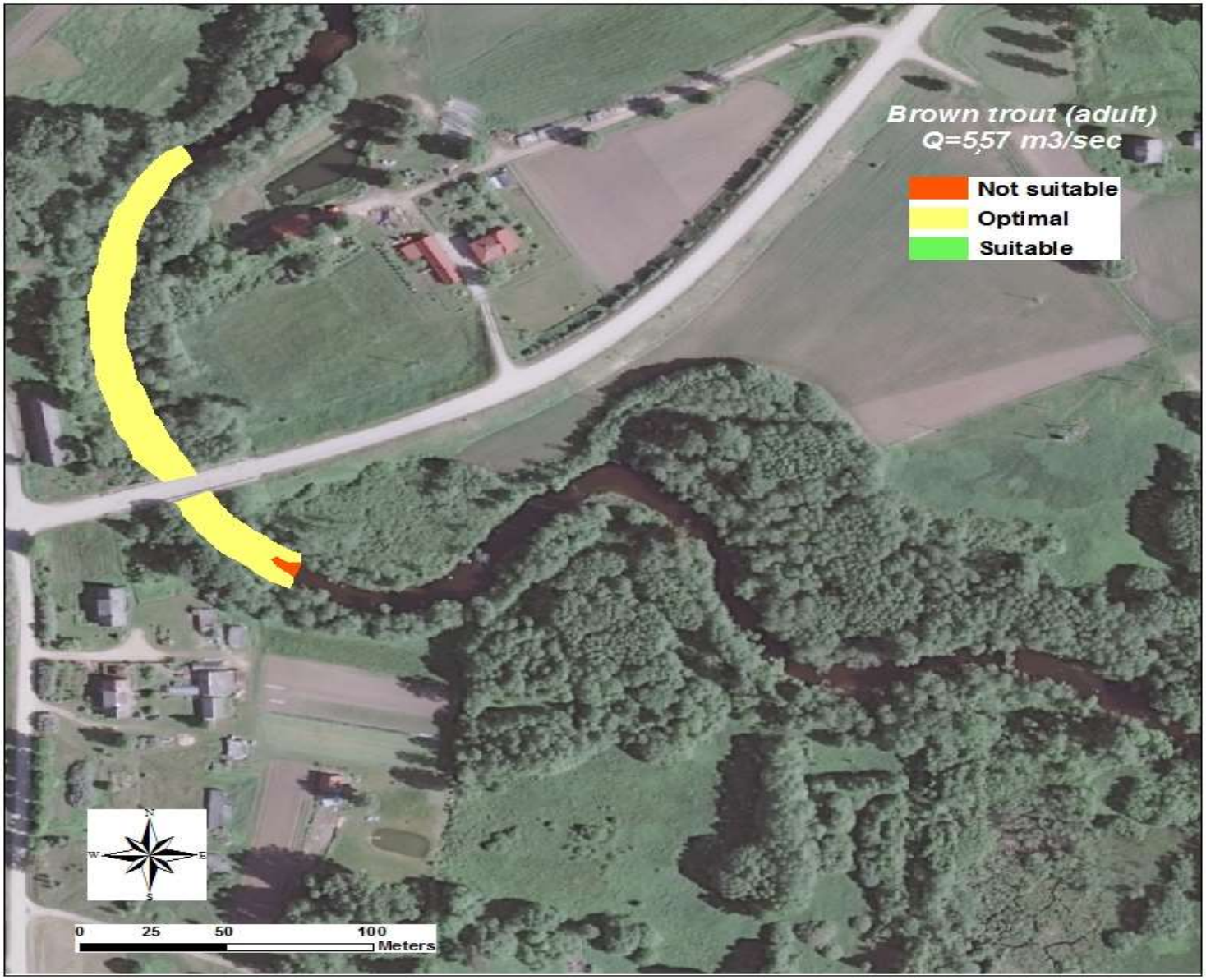
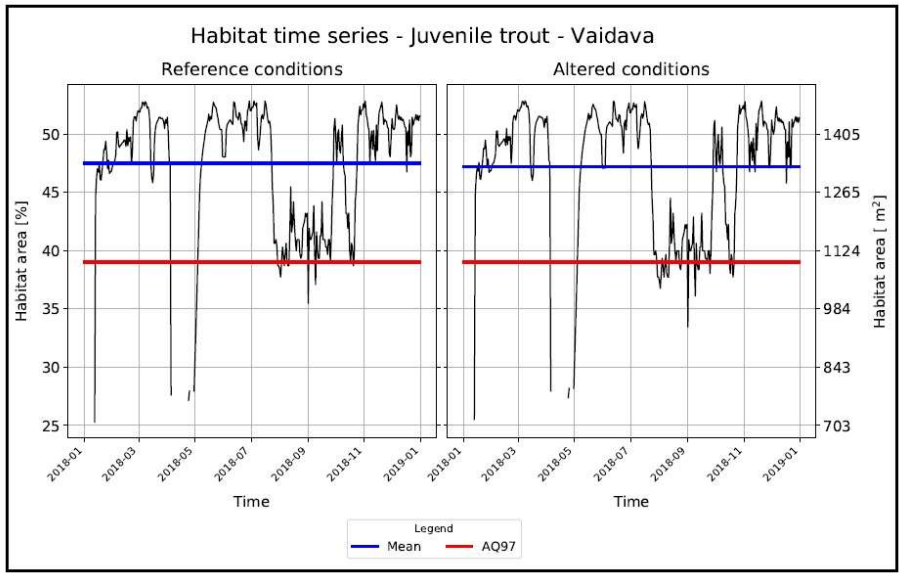
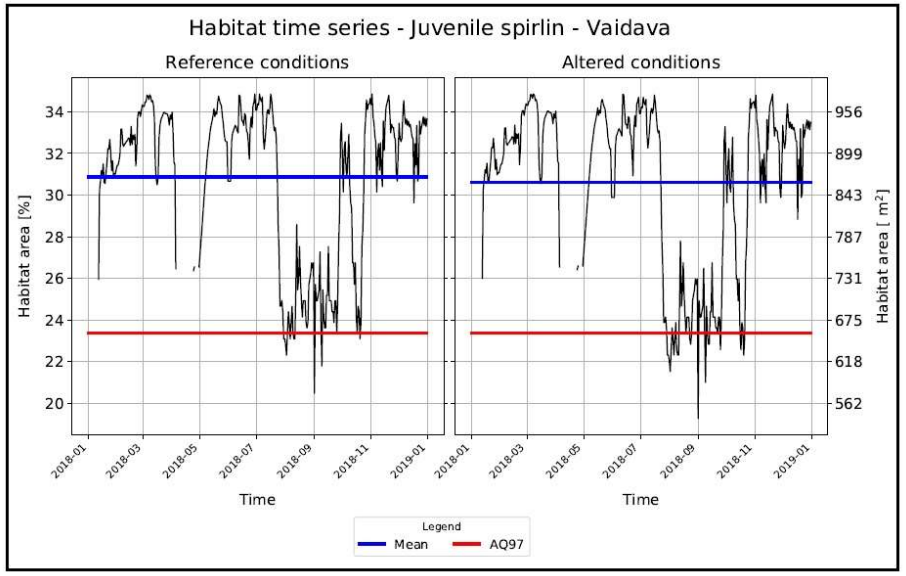
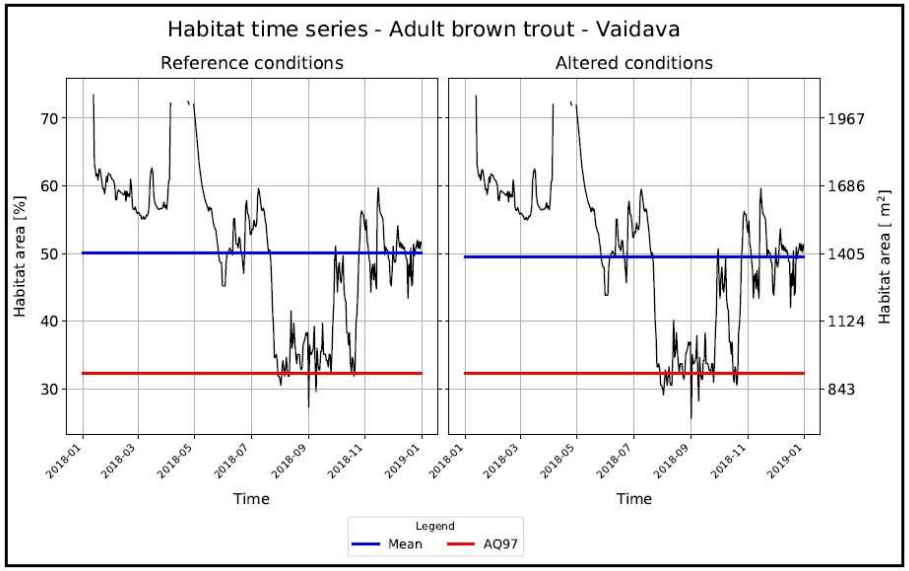
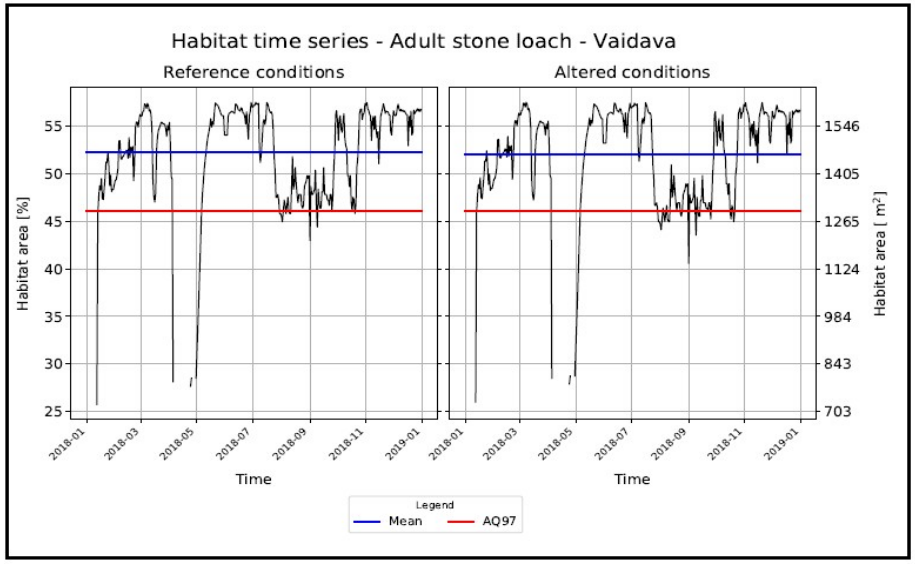


# Modelling results
# Habitat time series downstream Karva HPP



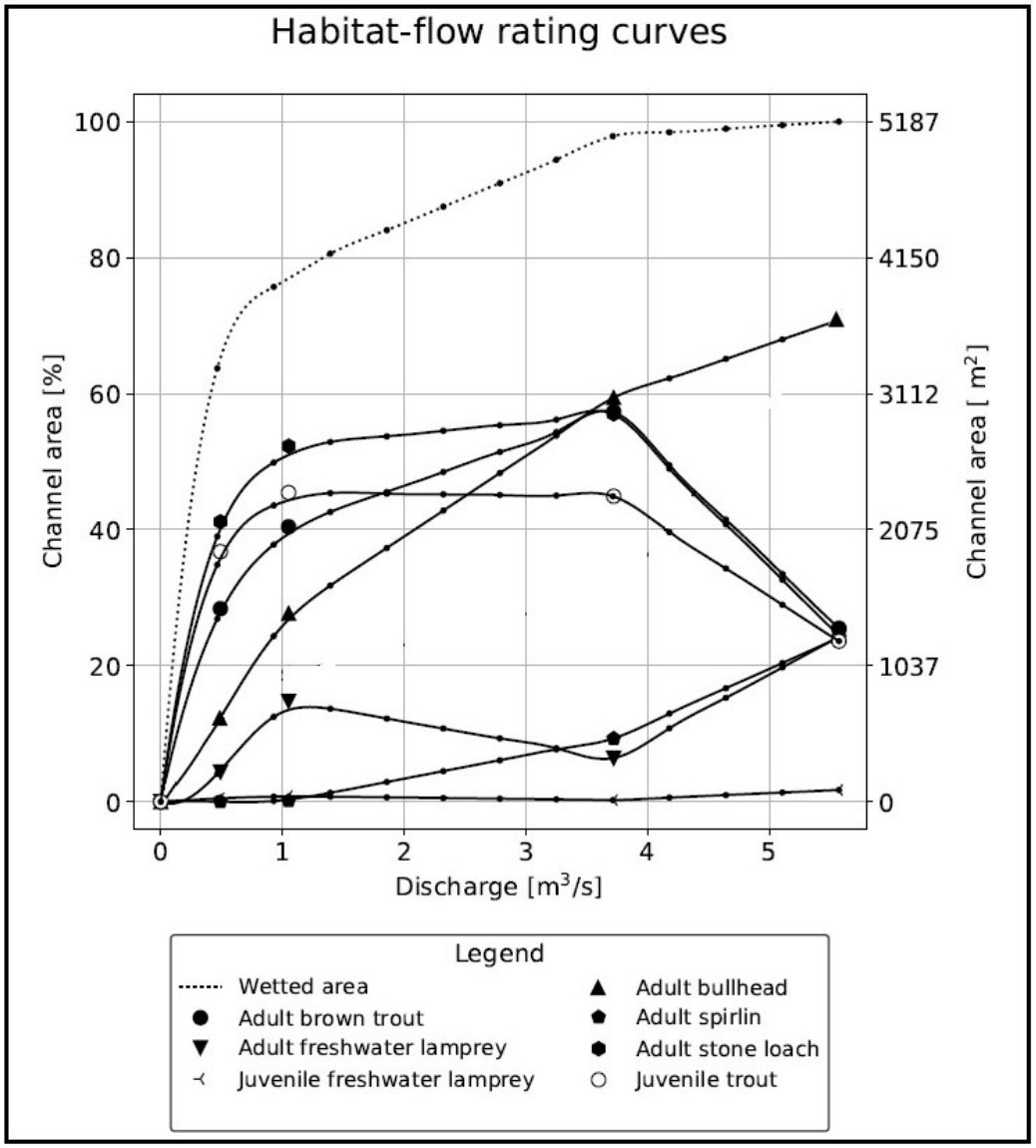



# Modelling results
# Vaidava River downstream Karva HPP

| Fish species | DRY YEAR | | Integrity index IH |
|---|---|---|---|
| | ISH | ITH | |
| Adult brown trout | 0.99 | 0.59 | 0.59 |
| Adult bullhead | 0.98 | 0.59 | 0.59 |
| Adult stone loach | 1.00 | 0.35 | 0.35 |
| Juvenile trout | 0.99 | 0.47 | 0.47 |
| Adult freshwater lamprey | 0.97 | 0.73 | 0.73 |
| Juvenile freshwater lamprey | 0.97 | 0.99 | 0.97 |
| Adult spirlin | 0.97 | 0.74 | 0.74 |
| IH (total): | 0.35 | | |

# Modelling results
# Vaidava River downstream Grube HPP

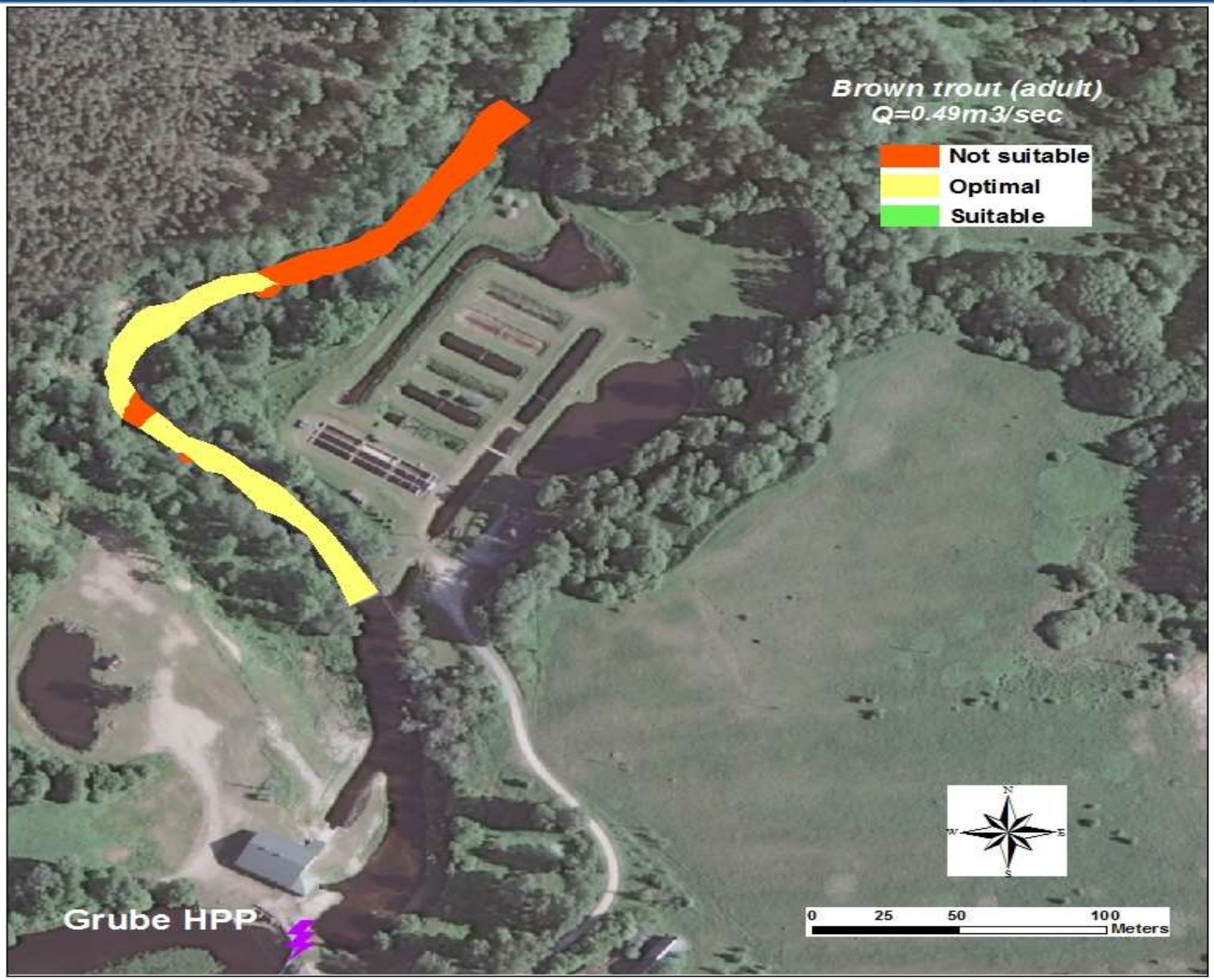



**Vaidava is a salmonid type river**

**Grube HPP is the second one on Vaidava River that located 11 km below Karva HPP.**

**Q ecological = 0.57 $m^3$/sec (almost is equal to project offered value),**

# Modelling results
# Habitat suitability map downstream Grube HPP



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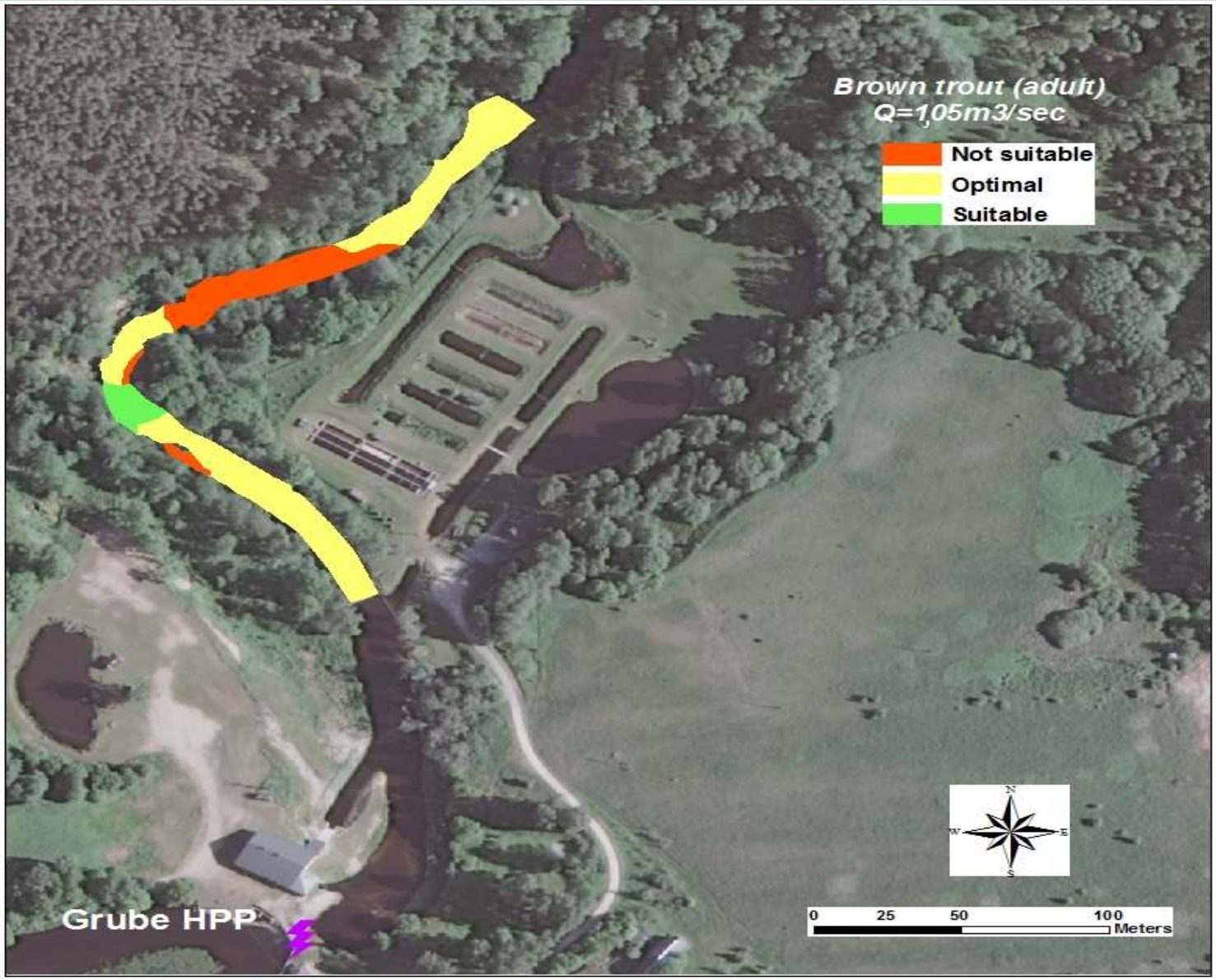

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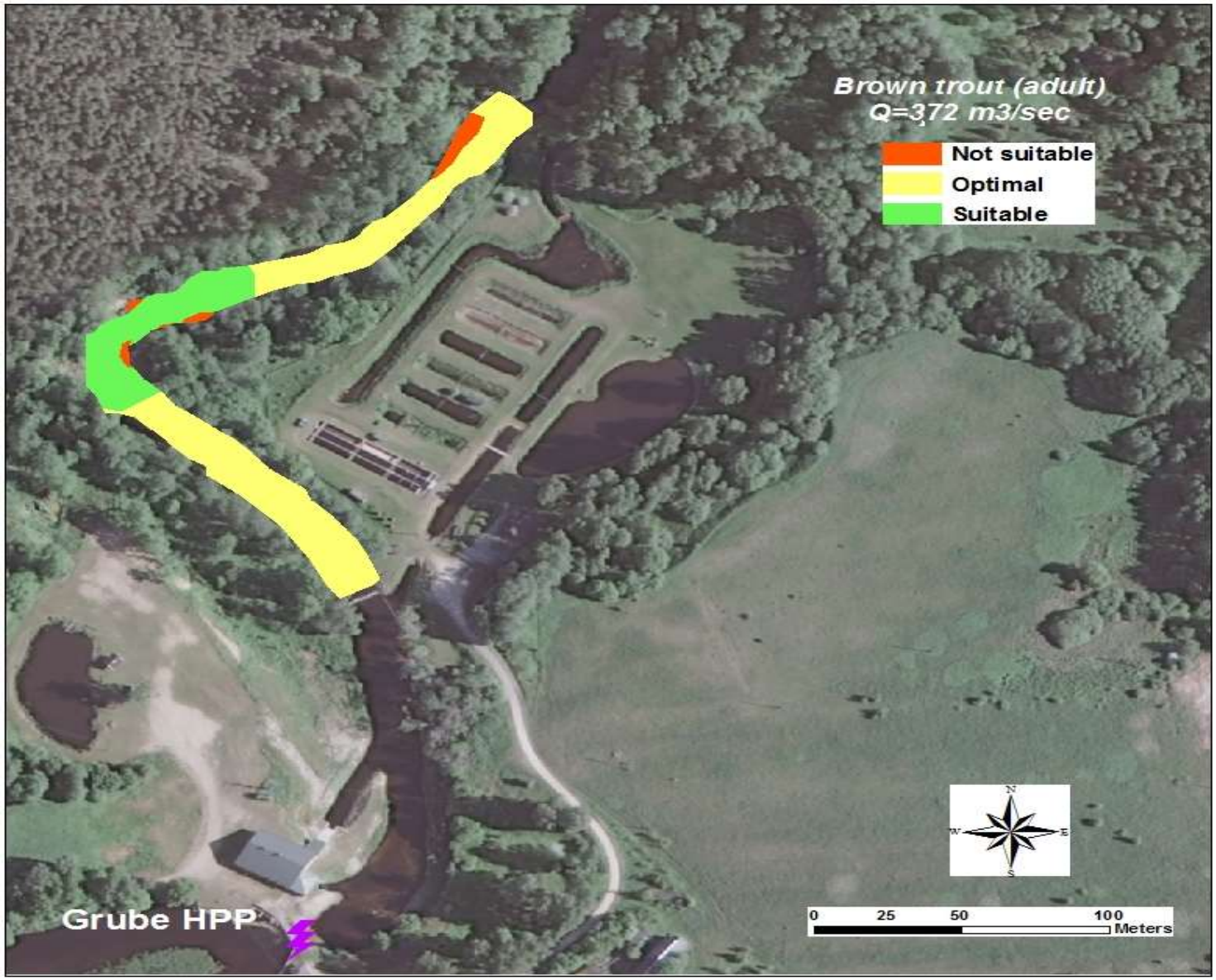

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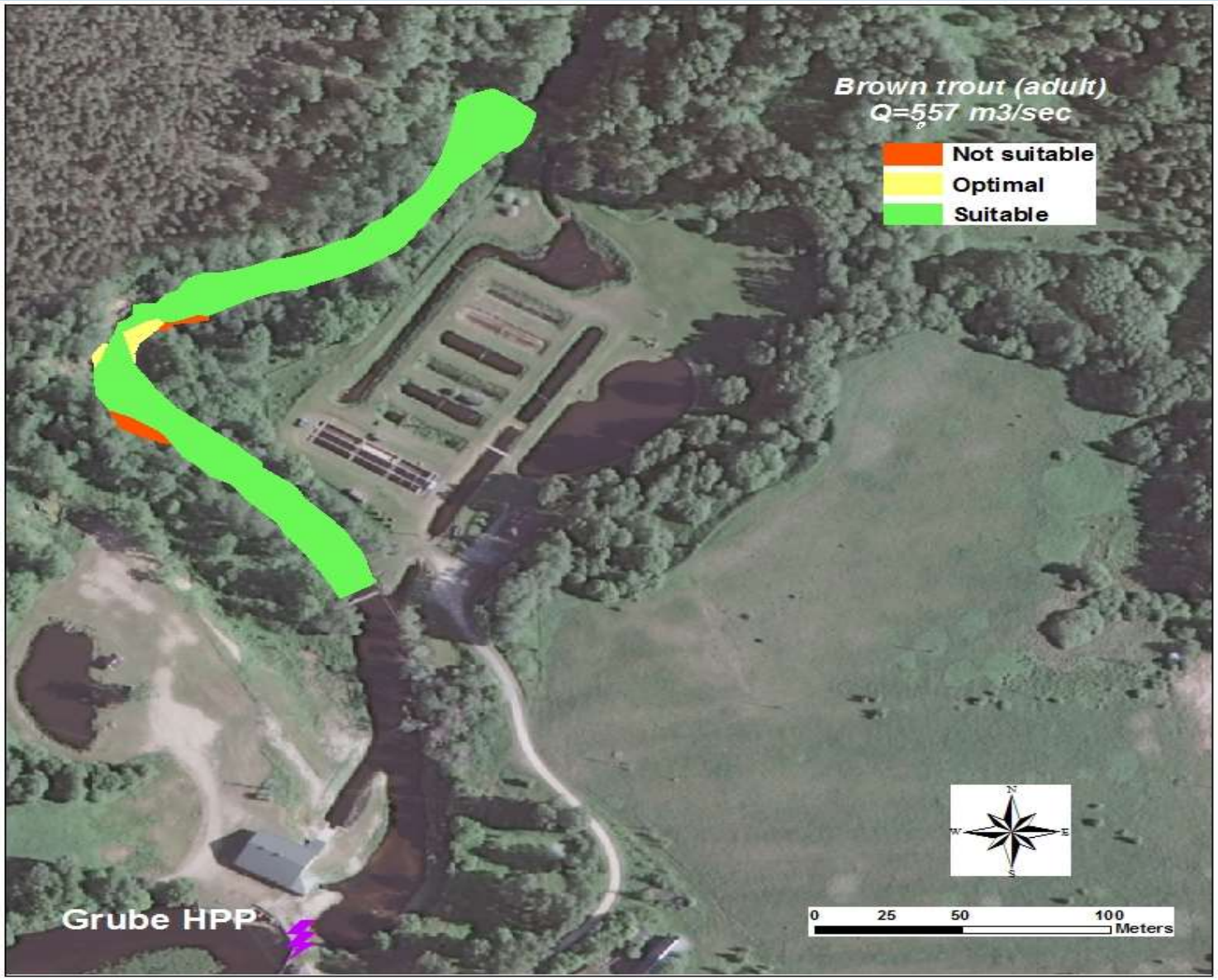
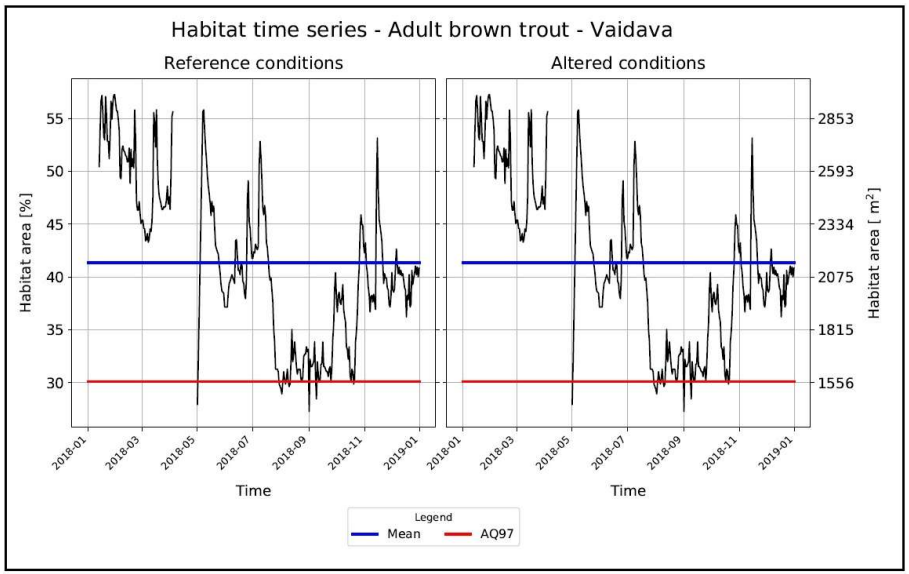
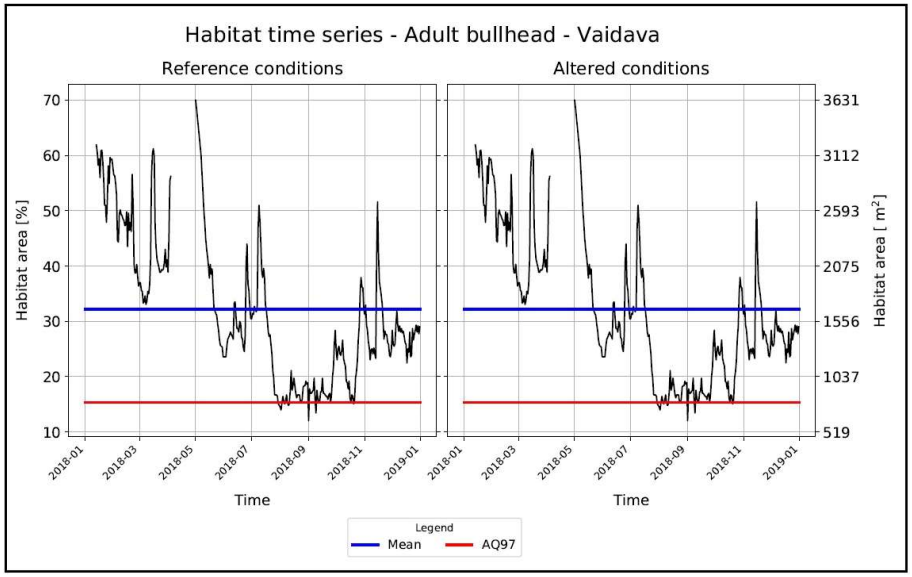
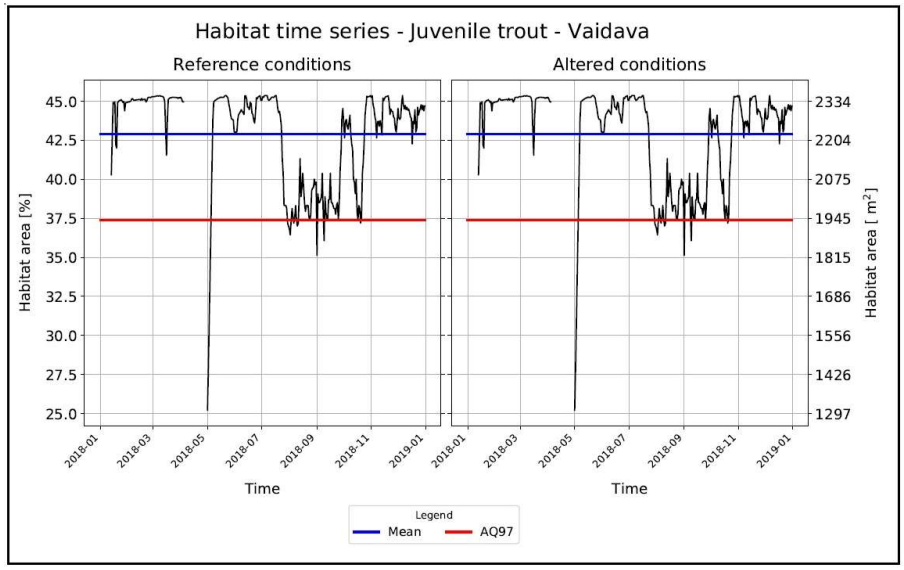
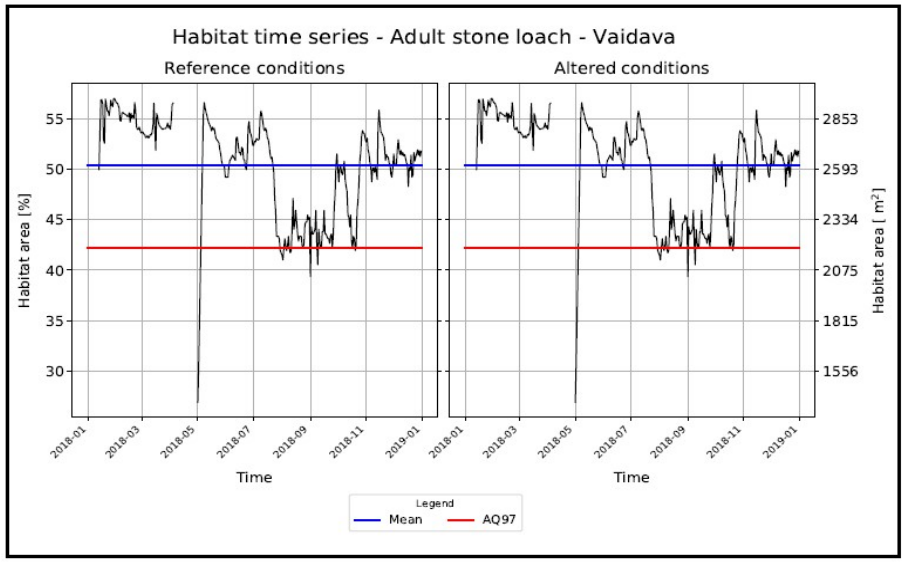


# Modelling results
# Habitat time series downstream Grube HPP



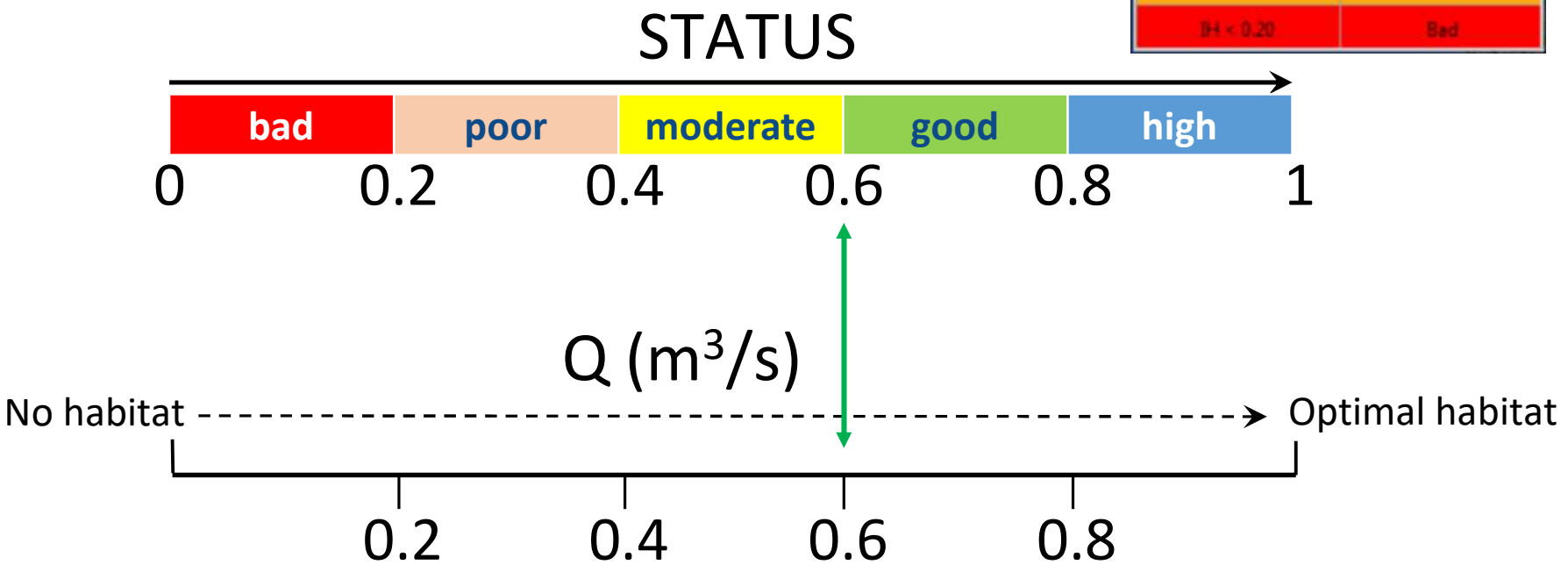



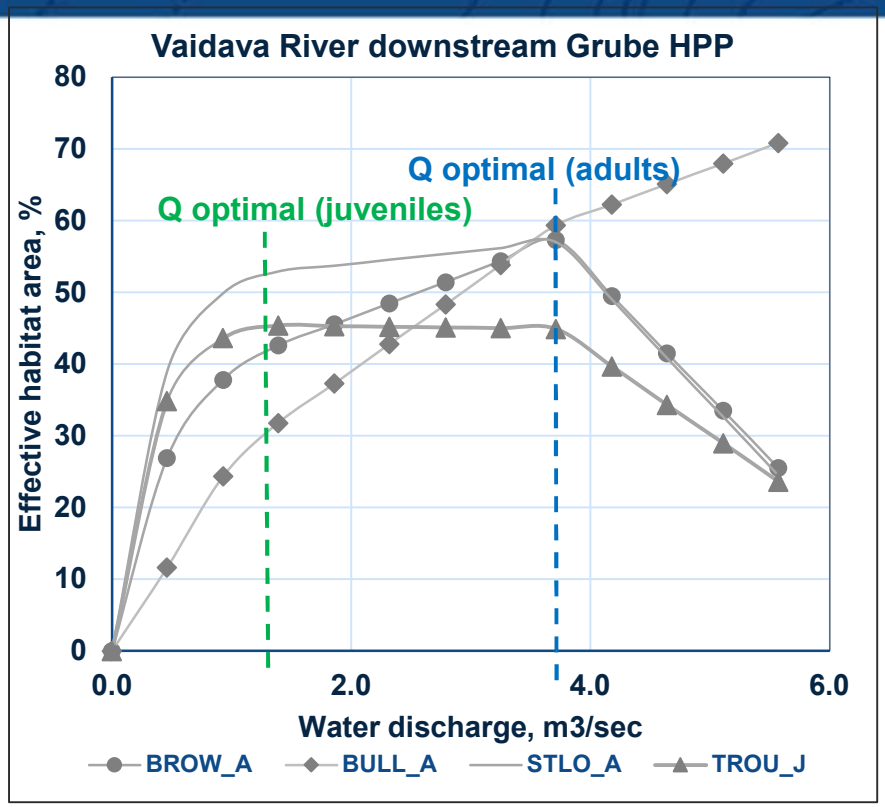



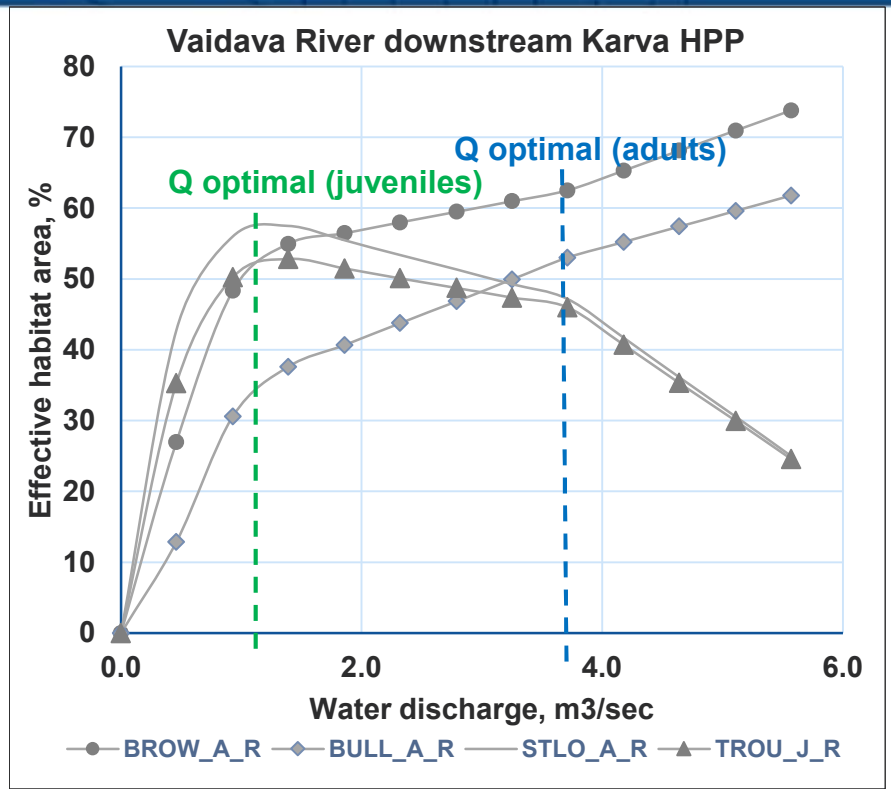
# E-flow estimation
# Ecological status of waterbody

| IH | Class |
|---|---|
| IH ≥ 0.80 | High |
| 0.60 ≤ IH < 0.80 | Good |
| 0.40 ≤ IH < 0.60 | Moderate |
| 0.20 ≤ IH < 0.40 | Poor |
| IH < 0.20 | Bad |



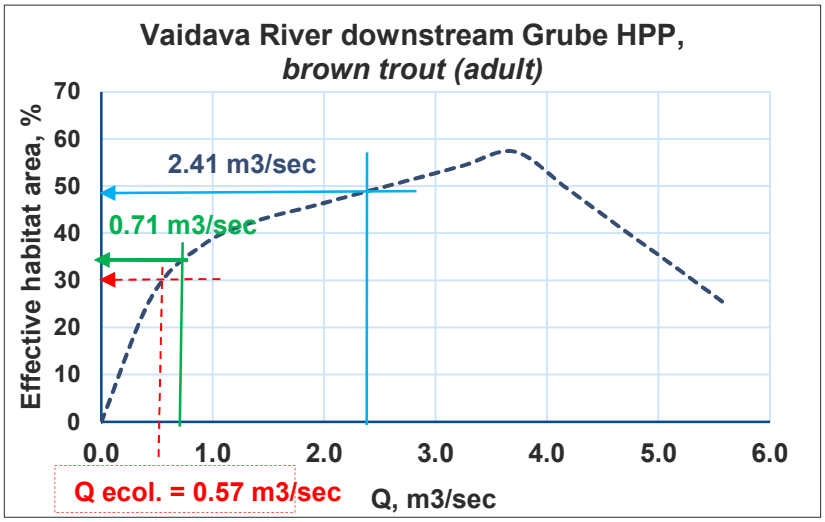
# E-flow estimation
# Optimal habitat & flow

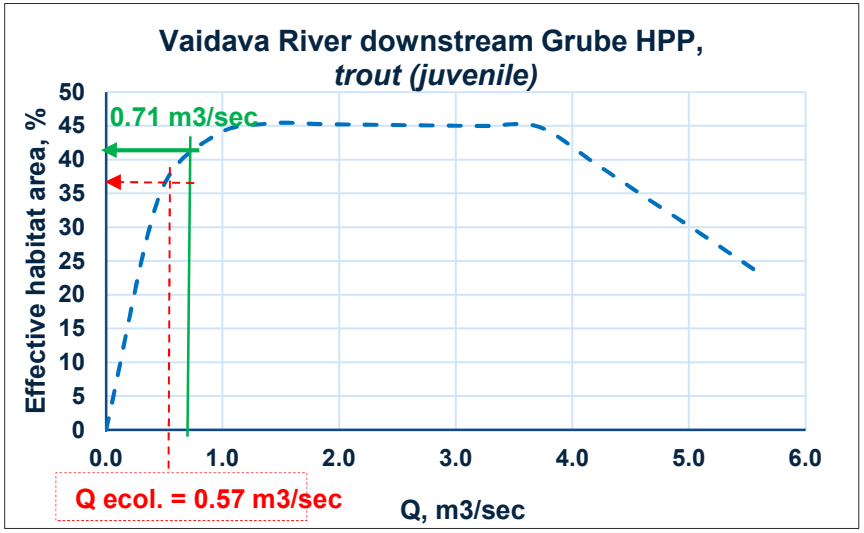


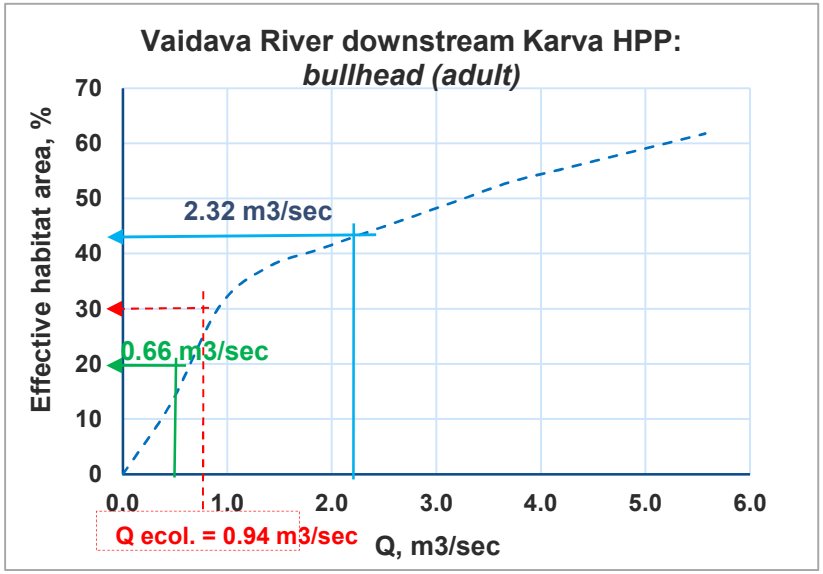



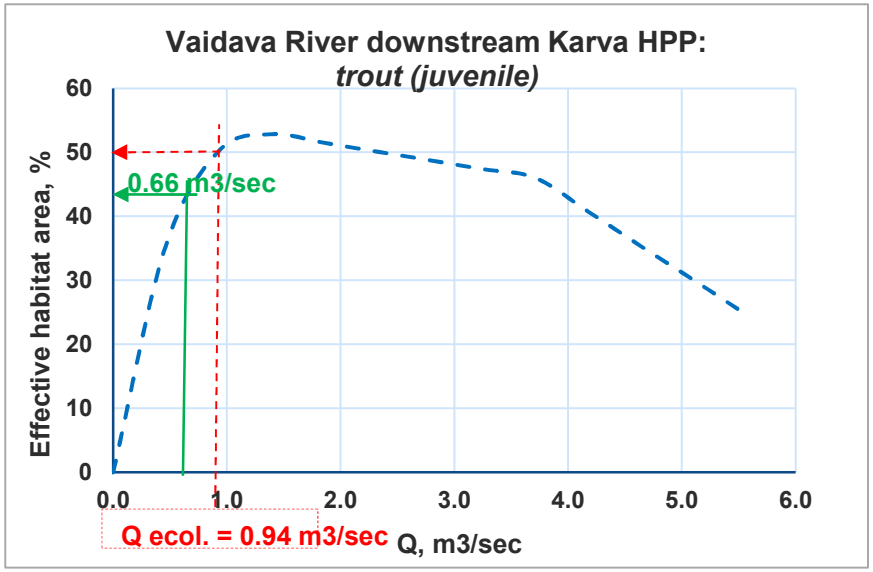

| | Karva HPP | Grube HPP |
|---|---|---|
| **Q optimal (adult) * 0.6** | **2.32** | **2.41** |
| $Q_{average}$ winter season | *2.34* | *2.53* |
| **Q optimal (juvenile) * 0.6** | **0.66** | **0.71** |
| $Q_{80\%}$ summer low flow period | *0.70* | *0.76* |

# E-flow estimation
# Vaidava River downstream Grube & Karva HPP



# CONCLUSIONS

- Modelling results show the closed relations between water flow and habitat availability as well as fish species presence and abundance in altered conditions.

- Currently existing ecological flow in Vaidava HPPs does not completely support the sustainability of Vaidava River' aquatic ecosystems.

- Generally, project results show the necessity to provide the "ecological regime" in regulated Vaidava River, and allow to estimate "winter E-flow" for fish spawning periods (from mid-October to May) and "summer E-flow" for growing of juveniles (from June to October).

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# Thank you for attention!

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