

## **OSIJEK MULTIPURPOSE HYDROPOWER SYSTEM**

### **OVERVIEW OF PLANNED ACTIVITIES AND POSSIBLE ENVIRONMENTAL IMPACT**

February, 2013

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## 3 Description of Planned Activity and Its Objective

### Planned Activity Type

Construction and use of a multipurpose hydropower system on the Drava River in the Republic of Croatia.

### Scale of the Planned Activity

The Osijek Multipurpose Hydropower System (Osijek MHS) Project will be implemented by construction of embankments upstream from the City of Osijek on the Drava River which will create 35.5 km long and 3,740 ha in area impoundment basin. The impoundment will be achieved by construction of an embankment dam and a concrete dam, a ship lock and the power house for the hydroelectric power plant. The facility is adjacent to the dam, run off the river plant.

### Objective of the Planned Activity

The objective of the Osijek MHS is multipurpose development, protection and usage of the Drava River water and part of the land belonging to the river basin on about 30km long river reach, i.e. protection against the adverse effects of the Drava river (flooding and river bed and bank erosion), use of water (for water supply, navigation, irrigation, fish farming, power generation, recreation) and protection of natural water related habitats.

### Explanation of Planned Activity

The Project is planned in compliance with the Physical Planning Strategy and Programme for the Republic of Croatia, and the land-use plans for the municipalities, cities and counties. Strategic reasons for launching of the Osijek Multipurpose Hydropower System Project construction include:

- improvement in public safety (improvement in flood control and land drainage, improvement in drinking water supply and quality, and improvement in safety of transportation and energy supply in the county),
- improvement in quality of living conditions for the county population by changes in social, recreational and health-related conditions, particularly those connected with the water supply of the population,
- improvement in nature preservation conditions within the greater Project area (conservation of flood forests, endangered aquatic and wetland habitats along the Drava, Kopački Rit, the Old Karašica course),
- improvement in conducting business operations in various sectors which are of public interest (water resources, municipal utilities and power generation sectors, transportation, food production (irrigation, fish farming and fisheries)),
- providing conditions for sustainable development of limited own water resources under changing climate and hydrological conditions and limited own energy resources,
- improvement in other economic conditions (transportation of goods and people on the Drava River, real estate trade, tourist industry and catering, building industry, electrical equipment industry).

### Overview of the Basic Concept Elements

The following concept has been adopted for the Osijek Multipurpose Hydropower System Project:

- facility type: adjacent to the dam, run off the river plant,
- dam site at the Drava station 29+000 km,
- pool level 89.50 m a.s.l.,
- rated discharge 1,000 m<sup>3</sup>/s,
- rated turbine power 4x16.13 MW,
- annual power output 237 GWh,
- impoundment basin length 35.5 km,
- average impoundment basin width 1,000 m,
- impoundment basin area 3,740 ha,
- total impoundment basin capacity 190 mil. m<sup>3</sup>,
- average height of the impoundment basin embankment 3.5 m,
- duration of the project preconstruction and construction stage is 7 years.

## Description of Planned Activities

Organization of the Osijek MHS Project construction is determined by the following important baselines:

### *1. Works along the Impoundment Basin Route*

The impoundment basin (reservoir) consists of an embankment and a lateral canal in the left Drava River bank (total length approx. 28 km), and an embankment and a lateral canal in the right Drava River bank (total length approx. 17.5 km). Each side of the basin is built as a separate technological unit. Construction of the right side of the basin is much more simple because of its length, a larger number of access roads and vicinity of a settlement. This is a good location to set up the temporary site facilities (construction worker camp, workshops, warehouses, garages, separation plant, etc.) since the utility connections are available. Additionally, only one larger Drava River arm that should be cut by the embankment route is present on this site. For the Project activities to start, the mine clearance has to be finished at the work route, and the Drava River cut made at the route of the basin and major river training structures in order to stabilize the riverbed.

The activities include only earthworks, with excavation of about 5,000,000 m<sup>3</sup> of sand and silt along the lateral canal route, partly in dry ground and partly under water, and backfilling 5,000,000 m<sup>3</sup> of mostly the same excavated material into the embankments with a compound cross-section (poorly permeable core of silty material and embankment body of sand). Other works include shaping of embankments and canals, protection against erosion, shaping of the embankment crest as auxiliary activities.

Since all these works are carried out in the Drava River floodplain, they are to be scheduled off the regular flood season so that the erosion and flood control structure are finished before the floods come. The works are generally carried out from the upstream part of the basin towards the downstream part.

### *2. Works at the Dam Site*

The following works will be carried out at the dam site (the left Drava River bank, on 200 m distance from the riverbed):

- site protection against the Drava floods (construction of a 350 x 450 m cofferdam around the site,
- construction of clay-concrete diaphragm for the construction pit protection (33,000 m<sup>3</sup> )
- installation of a pumping system for lowering of the groundwater level within the construction pit,
- the construction pit excavation in silt and sand (dry ground), excavation quantity 5,000,000 m<sup>3</sup>
- concrete works for dam, power house and ship lock, concrete quantity 300,000 m<sup>3</sup>
- construction of stilling basin using rock and concrete blocks, 130,000 m<sup>3</sup>
- installation of hydromechanical equipment,
- excavation of a cut upstream and downstream from the dam site, excavation quantity 2,000,000 m<sup>3</sup>
- installation of turbines and other electromechanical and electrical equipment

Characteristic of this location it is that is situated in the Drava River floodplain and exposed to regular annual flooding at the end of spring and beginning of summer. Considering the foreseen duration of all construction works at this location is 5 years, temporary construction site facilities (concrete mixing plant, warehouses, machinery garages, construction workers camp, and facilities of the client and site manager) have to be located outside of the floodplain (behind the dyke on the left bank of the Drava) and be connected to the construction site with a 2000m road, or partially be located on a backfilled platform along the south coffer dam edge (which will later be an integral part of the ship lock platform).

#### 4 Site Description

The Osijek Multipurpose Hydropower System is a Project planned to be built on the Drava River in Osječko-Baranjska County, located some 10 km to the west from the City of Osijek. The Project will be realized by construction of a dam on the 29<sup>th</sup> kilometre of the Drava River from its mouth into the Danube, and by impoundment of a basin running to the 65<sup>th</sup> kilometre. The Project is situated on the territory of the following municipalities: Darda, Jagodnjak, Marijanci, Petlovac and Petrijevci, and the cities: Belišće, Donji Miholjac and Valpovo.

According to the map of protected areas developed by the State Institute for Nature Protection, the entire Project is located within the Mura – Drava Regional Park. The Regional Park stretches through the Međimurje, Varaždin, Koprivnica-Križevci, Virovitica-Podravina and Osijek-Baranja Counties, at the Mura and Drava rivers area, and encompasses a surface area of 87,680.52 ha. The area share of the Regional Park per county varies, but the part of the Regional Park belonging to the territory of the Osijek-Baranja County in respect to other counties, amounts to 30%. The Regional Park Mura-Drava is included in the UNESCO Man and Biosphere (MAB) programme as a transboundary biosphere reserve, with most of its area lying in the Republic of Croatia (63% of the total core, buffer and transitional zone), and a smaller part in the Republic of Hungary (37% of the total surface area).

#### 5 Description of the Impact of the Planned Activity and Possible Transboundary Impact

##### Overview of the Environmental Impact of Planned Activities

The Project environmental impacts are divided primarily according to area of consideration; impacts on the immediate area of the Osijek MHS Project and impacts which are transferred onto the broader area of the Project. These impacts are also divided according to significance and type to impacts through which the subsistence of the general purpose functions of the space are threatened (in this case the natural characteristics), and those impacts that threaten the other functions of the space (cultural, historical, economical). Of all the considered adverse impacts of the Project on the environment and nature, the following can be considered most significant:

- impacts on surface waters – impacts on the velocity in the area of the impoundment basin (as an impact on the sedimentation conditions, retaining of nutrients and heavy metals in that reach), as well as the impact of the sediment transport downstream of the Project site (as an impact to morphological changes in the Drava river bed)

- impacts on groundwater – impact on the groundwater level in the area of Kombinat Belišće (recognized as an impact on the soil bearing-capacity), on agricultural land and conditionally in some lowland settlements in south-west Baranja (as an impact on the functioning of the drainage system), and on the area of the flood forests (as an impact on the pre-existing forest stand),
- impacts on biological and ecological conditions in the watercourse – impacts on the phytoplankton and zooplankton species composition and abundance and change in the benthos community, and increase in trophic level of the watercourse
- impacts on habitats – the loss of some important aquatic habitats (river banks and sandbars) and forest habitats on the immediate area of the Project,
- impacts on species – the decrease in number of certain fish species, loss of part of habitats significant for bird nesting and fish spawning, cutting the migratory paths for some fish species, and disturbing some bird species which inhabit the area of the planned Project,
- impacts on cultural and historical elements– impact on the landscape along the Drava river on the stretch of the Project (recognized as a loss of some landscape elements along the banks of the Drava River), impact on historical buildings and archeological sites,
- impacts on the economy – impact of loss of forest surfaces which brings increment of wood stock, causing possible damage to areas of the rest of the flood forest (encompassed under the impact on groundwater), furthermore the loss of part of hunting productive areas, and loss of possible attractiveness of the area for tourist visits of specific groups of visitors,
- impacts to other values of the area – impact on the local population due to loss of the general-purpose functions of the forest, followed by impact on the scientific values of the area through loss of natural-science research areas (natural habitats and endangered species), as well as impact on the value of the space for future generations through significance attributed to them by the eco-groups.

During construction and operation of the MHS, there are possible impacts of the Project on air quality, climate and disturbance of the local population and species due to noise, and these impact are analyzed separately.

#### Overview of the Impact of the Planned Activities to on Ecological Network

Possible impacts on the ecological network during construction of the Osijek MHS relate to disturbance of animals as a result of construction works. It is estimated that the impact will not be significant for larger and more mobile species, but will be of certain significance for the small and less mobile species. Therefore, the impact mitigation requirements should be demand that the construction and land clearing works be conducted outside the reproductive period of these species.

Particular possible impacts during the operation are permanent and are related to the loss of existing habitats in which important species of the Ecological Network reside. Such an impact does not have to be significant because the loss of part of the habitat of individual species can be minimal in comparison with the total surface area of that habitat occupied by the species in the Republic of Croatia or on the broader Project area, and these species can move to other areas within the Ecological Network in the Project neighbourhood. Still, for individual species the impact could be significant if they are not sufficiently represented in the wider area or if they are not capable of moving from the Osijek MHS Project area. The loss of certain habitats on the area of the planned Osijek MHS impoundment basin will

be reduced through revitalization of similar habitats outside the impoundment basin. For migratory fish species, a fish ladder will be built in order to enable upstream and downstream migration by the Drava River, which will also be enabled with the functioning of the ship lock.

#### Overview of Measures for Avoiding and Mitigating the Impacts

The environmental impact of the planned Project must be avoided, or if this is not possible, reduced to a minimum. Protection measures are based on legal, administrative, technical and technological requirements. Implementation of protection measures is foreseen during the Project construction, operation and in case of an ecological accident of the Project.

An overview of possible solutions for avoiding adverse impacts, as well as possible solutions for mitigating and controlling the impacts are given below.

#### *1) Solutions for Avoidable Impacts*

##### ***Solution for impacts on Kombinat Belišće***

The impact of rising of the groundwater level on the soil bearing-capacity in the area of Kombinat Belišće is resolved either by construction of a pumping system in the area of Kombinat to lower the groundwater level or retrofitting the equipment installed in the Kombinat Belišće to meet new operating conditions. The safest complete solution adopted for the groundwater level control at the most important locations of Kombinat Belišće is with the assistance of a series of extraction wells with corresponding equipment and pipelines, and with the regulation of the river banks and other infrastructure.

##### ***Solution for the impact on drainage of agricultural surfaces and settlements***

The impact of the increase in groundwater level on agricultural land and in lowland settlements in south-west Baranja is solved with a change in the water transfer mode from existing canal network (primarily in Bakanka pumping station), reconstruction of the existing drainage system of the south-west part of Baranja (regulating and equipping of the Lanka mouth into the Toplica with control weirs at the location of the Bakanka pumping station and watercourse regulation) and if required, a pipe drainage upgrade at the most threatened agricultural land at Bolman and Novi Bezdán (on about 50 ha) and also, if required, by construction or participation in construction of the sewerage system in settlements closest to the Project site (Novi Bezdán, Bolman, Novi Bolman and Majske Međe). In the right hinterland, these impacts are resolved with regulation of the Gatski canal discharge into the Osijek MHS impoundment basin via a new pumping station, and performing a connection of the Karašica and Vučica rivers with an additional canal before Valpovo.

#### *2) Solutions for Impact Mitigation*

##### ***Solutions for compensation of lost values***

The solutions are primarily related to the loss of parts of forest and hunting areas due to construction of the Project as well as the damage caused on parts of the flood forests along the immediate area of the Project due to the change in water regime. Compensation fees are a solution for these lost values and they are invested by the current users of these surfaces into solutions for the improvement of the state (growing new forest stands, eliminating damage and improving the quality of the hunting and forest

resources). Fees are thereby determined either according to the legislation of the Republic of Croatia or the rules of profession. In the case of Osijek MHS, the following fees are foreseen:

- Compensation for increased damage to flood forests along the impoundment basin during the period of forest adaptation to the new groundwater regime, which is used for the cutting of older, inadaptable and farming of new stands,
- Compensation for loss of forest land within the impoundment basin, as a one-time compensation to the current user of that land for the growth of new forest stands on a new/substitute location,
- Compensation for the reduction of hunting productive areas within the basin for alternative solutions such as establishing new hunting areas, improved management of existing hunting areas, improved services and increased income from the services,
- Compensation for the loss of the general-purpose function of the forest until reaching suitable substitutes for the forest stands through forest farming on a new location (for flood forests this renewal period is estimated to around 20 years).

#### ***Impact mitigation solutions for surface water quality***

Reduction or control of the Project impact on the quality, namely the ecological and chemical status of surface waters is basically applied only to the reach of the Drava River within the impoundment basin. The construction of the wastewater treatment plant for the upstream settlements and industry is an obligation which is gradually being fulfilled, and the cooperation with upstream neighbouring countries, members of the EU, is established based on implementation of Water Framework Directive principles. Thus, the remaining possible method for action is implementation, or participation in research and surface water quality monitoring upstream and in the area of the project (pursuant to the programme of Hrvatske vode) and the establishment, or participation in establishing biological water eutrophication control methods in the impoundment basin (through fish stocking which is already being implemented in the Drava river in the framework of sport-fishing societies).

#### ***Impact mitigation solutions for sedimentation and sediment transport***

Impact mitigation for sediment transport and sedimentation in the impoundment basin is possible to achieve by the design of the impoundment basin and dam site, and especially the embankments, and regulation of the operation mode of the Project during the Drava floods. This is determined by modelling, and elaborated in design documentation and operating manuals which are a constituent of the Project costs.

#### ***Impact mitigation solutions for on the landscape***

It will be possible to reduce the impact of the Project on the landscape by design and planting of the impoundment basin embankments, design and shaping of certain sections of the banks inside the impoundment basin, and bringing certain forest area sections closer to the impoundment basin in order to achieve similar landscape characteristics on sections of the Project area to the present characteristics. Excess material from the excavation of cuts and lateral canals can be used for shaping of the banks (and possible future sandbars and islands) within the impoundment basin, as well as for shaping certain sections of the embankments towards the hinterland in order to achieve sections of the Project similar in shape to the current landscape.



### ***Impact mitigation solutions for valuable bird habitats***

Shaping of the banks within the impoundment basin in order to reduce the impact of the Project on the landscape will at the same time create substitute habitats for some valuable bird species (The Eurasian Stone-curlew, Common Sandpiper, Common Kingfisher, The Sand Martin, Bluethroat). The implementation of additional research on these bird species can be considered the only additional mitigation measure cost. This research is important for determination of adequacy of these measures and conditions for their implementation.

### ***Impact mitigation solutions for fish***

Impact mitigation for the ichthyofauna is achieved by shaping of the lateral canals and their connection with hinterland water surfaces (old river arms, ponds and still waters) by constructing lateral canals, adding weirs, steps and smaller fish ladders along the canals. This is, together with the system for discharge of the Drava water from the impoundment basin, an integral part of the solution for hinterland water management and revitalization of natural hinterland habitats of the Drava River. Along with this, the construction of fish ladders on the dam site in order to ensure upstream migration conditions is also a component of the solution (one is an integral part for the ship lock design and another would be constructed at the most favourable position along the dam site). Furthermore, the solution includes construction of special barriers on the dam and power house for the protection of downstream fish migration, construction of specially shaped banks in the impoundment basin (as shelter and spawning areas) which is also a component of the landscape solution, and stocking of the basin with rheophilic fish species (which is solved within the measures for surface water quality control).

### ***Impact mitigation solutions for scientific research***

In order to reduce the loss in scientific research due to construction of the Osijek MHS, implementation of some of the most important research according to special programmes and comprised of nature scientist of different specialties is foreseen prior to construction of the Project.

### ***Impact mitigation solutions for tourism and the Ecological Network***

Impact mitigation for tourism development related to protected areas is resolved with solutions for realization of tourist activities on the Osijek MHS Projects itself, where the main components would be the area of Lanka, the Boroš pond and upstream natural course of the Drava River until about 10km before Donji Miholjac. In this sense, the implementation of a certain level of special protection measures for this area is foreseen (through the Regional Park Management Plan). The loss of part of the income due to absence of special groups of visitors during the construction and habitat revitalization period in the Project area will be considered a direct loss.

Pursuant to the above overview of impacts of the Osijek MHS on pre-existing values of the space, the costs of elimination of these impacts, compensation costs and mitigation costs are estimated. They are expressed as nonrecurring costs (construction of various projects and implementation of one-time measures) and as annual costs (implementation of continuous measures). However it should be noted that within these costs, the costs relating to the adjustment of the very project to technical solutions are excluded.

### Possible Transboundary Impact

The Osijek Multipurpose Hydropower System Project construction has been conceived to have no adverse impact on the Republic of Hungary as regards the environment and valuable natural assets, including possible impacts on infrastructure and social and economic aspects. The Project has actually been conceived to avoid permanent flooding of floodplain in Hungary (the impoundment effect is limited to the main river bed only, so only the natural flooding cycle is retained in the floodplain), and to prevent increase in groundwater levels when it would affect vegetation overgrowth, infrastructure and land use (double drainage system along the left-hand side of the impoundment basin combined with a pumping system used for regulation of seepage water quantity leaking from the impoundment basin into the river valley), to prevent impact on drainage of the river valley (connecting of the drainage system to the drains along the impoundment basin and retaining of the water level within the main Drava River bed in the upstream section), to avoid adverse impact on habitats and protected flora and fauna (particularly with regard to preservation of migratory ichthyofauna species for which, in addition to two fish ladders on the dam centre line, a course parallel with the Drava River set up to connect the upstream part of the impoundment basin with the drains, with old river arms and with the Drava downstream from the dam centre line).

The Project, on the other hand, has multiple favourable transboundary effects for the Republic of Hungary, from stabilization of the river level in the main Drava River bed and creating conditions for revitalization of endangered aquatic and wetland habitats in the Drava floodplain and the greater area (particularly regarding the wetland habitats and ornithofauna), to improvement in navigation conditions on the river reach to the Donji Miholjac.

2.6 Project plot plan

