



# LJUBLJANICA CONNECTS

LIFE10 NAT/SI/142

## IMPROVEMENT OF THE AMBROŽEV TRG BARRIER – UPDATING THE GATE LIFTING SYSTEM AT AMBROŽEV TRG



Action: C3

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## **INTRODUCTION**

The sluice gates at the Ambrožev trg square were built in the 1950s and have not been updated until now. They are built of wood and steel. Under action C3, the gate lifting system at Ambrožev trg, allowing for a precise regulation of the gate and thus precise regulation of the water level in the Ljubljanica river, was updated. Prior to the updating, the situation was critical particularly during low flows, when the inability of appropriate (i.e. fine) regulation of the gate could cause instantaneous deterioration of ecological conditions in the Ljubljanica river.

This action was not put in place in the way proposed and planned originally in the Grant Agreement because the sluice gates have the status of a cultural monument of national significance, which means that its external appearance must not be changed. As a consequence, we were allowed to carry out restoration measures only at the right gate, while the reconstruction works at the left gate could interfere with the architecture of the barrier, which is under cultural heritage protection. Nevertheless, despite the changes the action's objectives were met, because the operation of the right gate now allows for a more precise regulation of the gate and thus smaller instantaneous changes in the water level. Prior to the reconstruction of mechanical and electrical equipment of the sluice gate, these changes caused silting of the water, which resulted in the mortality of fish and other organisms. The equipment was upgraded to allow for automated gate operation.

Most of the time intended for the activities under action C3 was taken up by red tape of acquiring the necessary design requirements and permits, adjustments, i.e. modification of the actions that should be admissible and whose implementation would lead to reaching the objectives set, and waiting for the right time to implement the relevant measures (e.g. due to above-average river flows).

External contractors were necessary to implement the measures envisaged. These contractors were selected based on invitations to tender, by selecting the most economically advantageous and complete tender bid submitted in a timely manner.

### **Problems encountered**

The gates at Ambrožev trg have been protected as cultural heritage, i.e. a monument of national importance, since 18 July 2009, with the Order Declaring the Work of Architect Jože Plečnik in Ljubljana a Cultural Monument of National Importance (Official Gazette of the RS, Nos. 51/2009-2500, 88/2014-3553, 19/2016-720); accordingly, any works that could change the exterior of the gates are prohibited. This was not envisaged during the project application procedure. Because of this the measures within this action were somewhat changed in comparison with those provided for in the Grant Agreement; however, the change did not affect the goals set, but the project duration was extended due to the complexity of implementation. The modifications made to this action were confirmed by the European Commission as non-substantial modification by Email of 22 August 2014.

Any spatial developments that could permanently or temporary affect the water regime and water status can be implemented only based on the water consent, pursuant to Article 150 of the Water Act (Official Gazette of the RS Nos. 67/02, 2/04 – ZZdl-A, 41/04 – ZVO-1, 57/08, 57/12, 100/13, 40/14, and 56/15). The necessary water consent for the reconstruction of the mechanical and electrical equipment of the sluice gate at Ambrožev trg was issued by the Slovenian Environment Agency on 2 June 2015 (Annex 10 of the Final Report). Design requirements had to be acquired even prior to the issuing of the water consent. Notably, the water consent is issued only after the intended, i.e. planned, intervention meets the requirements prescribed.

In June 2015 we started the procedure of selecting the relevant contractor for implementing the reconstruction measures of the gate lifting system. Due to the complexity of the requirements we were limited with the number of the appropriate service providers. The tender process for selecting the most favourable providers was guided separately for both the reconstruction of mechanical equipment and for reconstruction of electrical equipment. This was met by complications and extension of the procedure as the originally selected tenderer withdrew from the tender. Namely, the same tenderer also made a bid for the reconstruction of mechanical equipment of the sluice gate, but the bid was not the most favourable and was not selected. Then, the selected provider delayed with the signing of the contract for reconstructing the electrical equipment and finally, by agreement, withdrew from the bid. Therefore, the selection procedure for the reconstruction of the electrical equipment had to be repeated. All of this delayed the start of works at the gates; the works finally started in August 2015.

Next to the problems of selecting the contractors and adjusting the actions, these delays were also due to very high flows of the Ljubljanica in 2013 and 2014, as reported in the Progress Report No 2 (reporting date 29 January 2015) (Figure 1, Figure 2). During the execution of the works the gates were non-operational, so we needed to make sure that there would be no need to use the gates to regulate the water level for at least 14 days. For the duration of the work on the gates, the Hydrological Forecasting Office of the Slovenian Environmental Agency (ARSO) provided us with flow forecasts for the next days, based on meteorological forecasts. The delay in this action did not affect the implementation of other actions.

From hydrograph we can see that in comparison with water discharge in year 2012 (light blue curve) the discharge was higher for the whole time in year 2013 (green line) except in August and almost through the whole year 2014 (blue line). The most obvious exception is caused by high water peak in June 2012. There is a big difference between discharges in those three years especially in February and March 2014 when water was much higher than it was in previous years (maximum difference in discharge between 2012 and 2014 is more than 250 m<sup>3</sup>/s in late February which exceeds even the maximum discharge in 2012).

Average values of discharge shows that in year 2013 discharge was approximately 25 m<sup>3</sup>/s higher than in year 2012 and 10 m<sup>3</sup>/s higher than long term average (measured from 1947 to 2013). Differences in average annual discharge are even higher in year 2014 when average annual discharge was higher for 40 m<sup>3</sup>/s in comparison with average value from year 2012 and for 26 m<sup>3</sup>/s than long term average.

On duration curve there is presented number of days when discharge was at least a certain value on y axis; for example minimum discharge in year 2014 was equal to 13 m<sup>3</sup>/s, therefore in every day of the year the discharge was at least as much or more so duration of that discharge was 365 days.

From duration curve we can see that measured daily discharges were lower than long term average discharge for 280 days in year 2012, for 215 days in year 2013 and only for 160 days in year 2014.

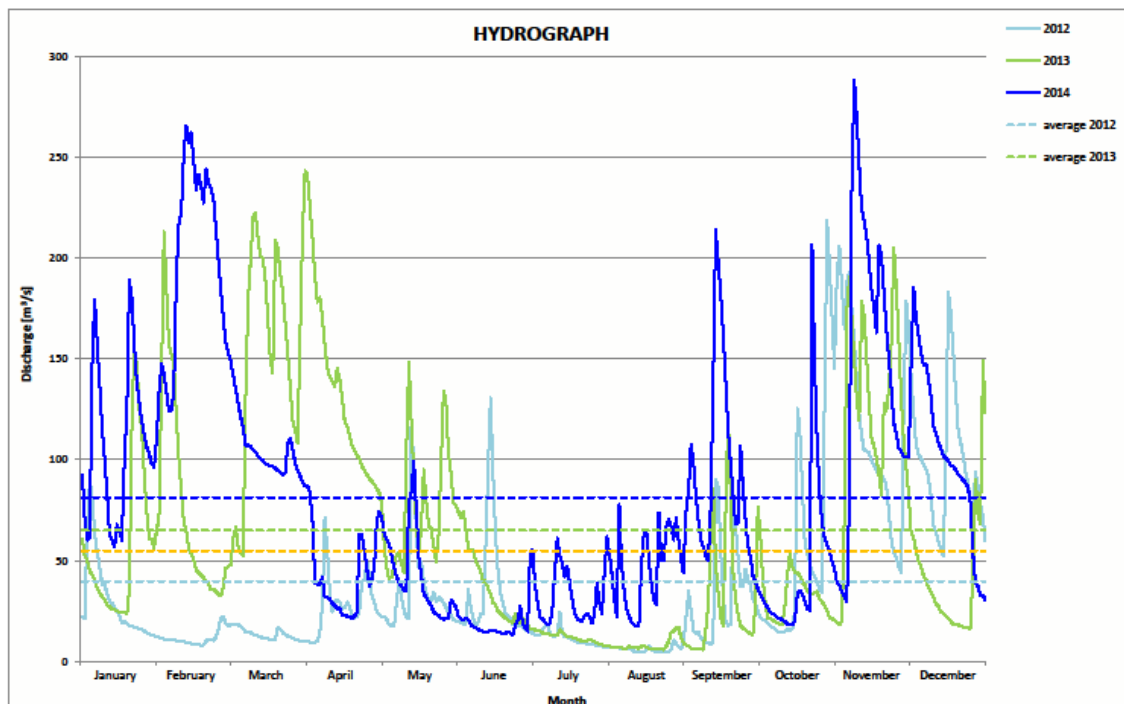


Figure 1: Hydrograph of the Ljubljana River at Moste

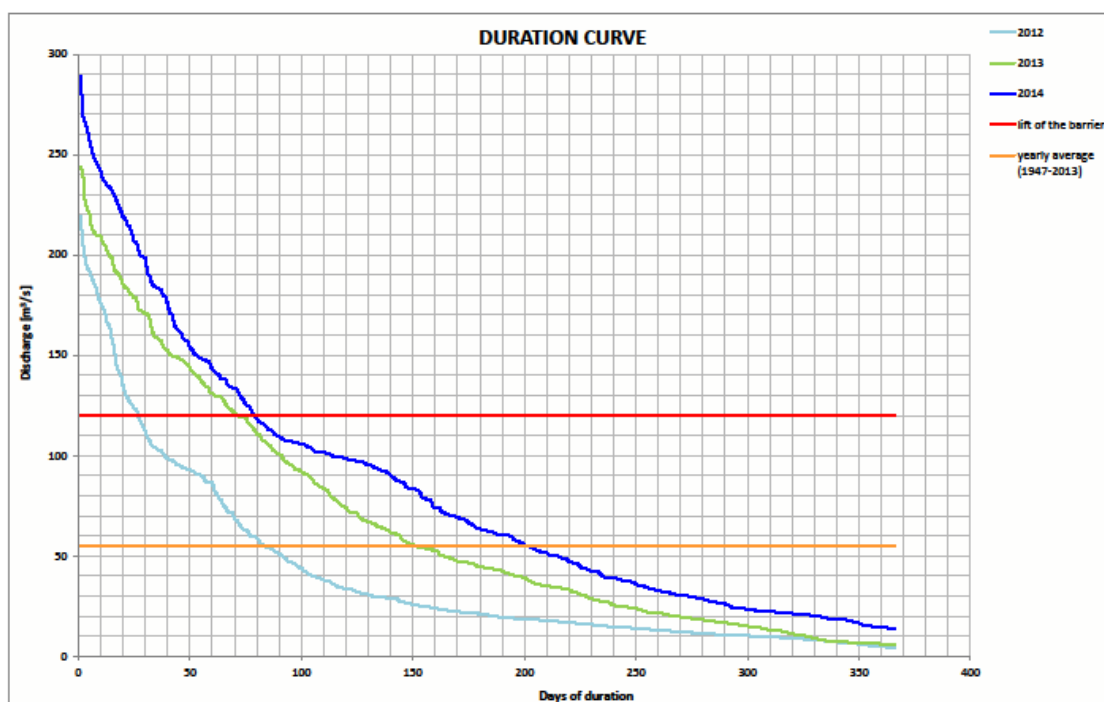


Figure 2: Duration curve of the Ljubljana River at Moste

## THE REPORT

### Description of the activities undertaken and outputs achieved

Under action C3 we reconstructed and updated the mechanical and electrical equipment at Ambrožev trg gate for regulating the flow up to 10 m<sup>3</sup>/s below the gate during the low flows of the Ljubljanica. The gate lifting system was redesigned in a way to allow the travel of the gate of up to 200 mm above the weir with a fine regulation of the orifice with a minimum increment of 5 mm. The lift of the gate above 200 mm remained unchanged. The improved lifting system thus allows for a continuous regulation of low flows, which is hugely important for the conservation of favourable ecological conditions on the Ljubljanica river for various living organisms, particularly the target species in our project: striped chub (*Leuciscus souffia*), Danube salmon (*Hucho hucho*), and Danube roach (*Rutilus pigus*).



Figure 3: Sluice gates at Ambrožev trg

In the interest of cultural protection of the sluice gates at Ambrožev trg we were required to adjust the measure of improving the gate lifting system. In 2014 we applied for non-substantial modifications, which were approved by Email dated 22 August 2014 by Ms Muriel Drukman. The modification of the action is set out in the following table.

Originally foreseen	Approved changes
Flap with specially designed hydraulic cylinder will be installed together with new hydraulic aggregate and electrical installation	New system for lifting of the right lower gate will be installed so that the barrier's shift will be allowed to 200 mm above the weir with fine regulation with the smallest lift of 5 mm.
Side sealing wall and protection mask will be reconstructed	Reconstruction of the mechanical part will consist of installation of a new electric motor with the possibility of manual drive, production of mechanical situation table,

	and of parts which are necessary for the measuring devices for controlling the situation of the lower barrier
Old chains used for panel movement will be renewed by a self-lubrication mechanism	The commanding table of the barrier will be replaced
Wooden sealing part of the barrier panel will be replaced by Teflon sealing	The measurement device for controlling the right gate position will be installed

The machinery part of the gate reconstruction consisted of installation of a new electric motor with a manual drive option, production of a mechanical indicator of the situation of the gate and of the parts necessary for the installation of measuring equipment of the position of the lower gate. A new junction box was installed for the right gate, where all the necessary elements for a safe and reliable gate operation are installed. The controller installed in the junction box allows for both automatic and manual adjustment of the river flow below the right lower gate according to the data received (increment of 5 mm). All the relevant data are displayed on the operation panel installed on the doors of the new junction box. In the future we will be able to transfer these data via the existing communication system or wireless to a predefined point.

Machinery works consisted of external works and works in the machinery of the gate without changing the gates' exterior. External works consisted of setting up a mechanical indicator of fine regulation of 10 mm along the lifting chain in the niche of the right pillar. The mechanical indicator indicates the position of the gate either on the sill or in regulating position. The machinery works consisted of upgrading the chain drive of the right lower panel, replacing the electric motor with a new one, checking the braking system, clutch, and manual drive, modifying the new electric motor, and repainting and installing a new base plate. Next to this, measuring equipment controlling the position of the right lower flap (the so-called encoder) was installed, inserted with a screw joint into the driving gear axis of the chain drive of the lower right flap. The measuring device was secured in an appropriate mount.

The reconstruction of electrical equipment was urgently necessary as the last reconstruction was carried out in 1981, meaning that older type electric motors were installed, which no longer fit the today's standards and IEC recommendations. The electric motors had no brakes. Electromagnetic brakes served for braking and controlling the gates. The acceleration upon initial start-up was large, the drive was pretty loud, and the stopping was not instantaneous. Nevertheless, all electrical equipment operated correctly, with the exception of one limit switch that was not functional for unknown reasons. The refurbishing did not cover the entire electrical equipment. For example, a defects inspection was not undertaken, and the inoperative limit switch was not replaced; however, this does not affect the quality of updating the gate lifting system.

#### Gate operation prior to the works undertaken:

Using a portable commands tablet, the operator operated both gates with a cable connected to the divider R2. The gate operation is separate and the parallel lifting of both movable parts was not in place. Also, on the structure there was no device that the operator could use to determine how much the gates moved or what was their current position. The technical solutions for determining whether the gate was lowered to the sill were also not provided. Manual gate operation was put in place by using a special mechanism to connect the rotating handle to the other axis of the electric motor. During the manual braking of the drum brake, using rotation of the handle, the gate moved into the desired direction. After reaching the wanted position, the brake of the drive had to be released.

After the implemented reconstruction works the operator had the option of determining the openness of the lower gate. The gear of the drive mechanism was installed with an absolute

encoder sending signals to the controller, based on which it calculates and shows the position of the gate on a touch screen. The on-screen control panel is designed to serve the input of the new desired position of the gate. The controller was equipped with a module with a connection to the Ethernet, which will in the future allow for connection to the Internet, sending of information about the gate, and the potential distance-controlled gate operation.



Figure 4: Touch screen indicating the position of the gate (left) and the main switchboard (junction box) (right)

All works were carried out at the right gate while the works at the left gate could interfere with the architecture of the barrier, which is under cultural heritage protection. So the left gate still has the same function that it had before.

In June 2015 we started the procedure of selecting the relevant contractor for implementing the reconstruction measures of the gate lifting system. Due to the complexity of the implementation requirements we were limited by the number of appropriate, i.e. competent operators. The tender process for selecting the most favourable provider was guided separately for both the reconstruction of mechanical equipment and the reconstruction of electrical equipment. The latter led to complications and, eventually, repetition of the procedure, as the originally selected tenderer withdrew from the tender. Namely, the same tenderer also made a bid for the reconstruction of mechanical equipment of the sluice gate; however, the bid was not the most favourable and was not selected. Then, the selected provider delayed with the signing of the contract for reconstructing the electrical equipment and finally, by agreement, withdrew from the bid. Therefore, the selection procedure for the reconstruction of the electrical equipment had to be repeated. All of this prolonged the start of works at the gate which started in August 2015 and ended in September 2015 (Figure 3).

Four tenders were received for the reconstruction of mechanical equipment, and the most favourable one, made by Montažna in ključavničarska dela Rudi Prosenik s.p., was selected. (Annex 2). For the reconstruction of the electrical equipment in the first repetition of the invitation to tender three tender bids were received. The most economically advantageous tender was made by Frili d.o.o., which later withdrew from signing the contract due to the aforementioned reasons. In the second repetition of the invitation to tender we received two tenders. The most favourable tender was submitted by Elektro Damjan Popelar s.p. (Annex 3). The works at the gate were supervised by the concessionaire operating the gates, i.e. Hidrotehnik Vodnogospodarsko podjetje d.d. (Annex 4).



For the duration of the work on the gates, the Hydrological Forecasting Office of the Slovenian Environmental Agency (ARSO) provided us with flow forecasts for the following days, based on meteorological forecasts.

### Comparison with planned output and time schedule

As we mentioned in the chapter on the problems encountered, the action was not implemented in a way that was predicted originally, because the gates are under cultural heritage protection and any actions undertaken at the gates are very limited. So we limited ourselves to the improvement of the lifting system operation of the right gate, while the same intervention at the left gate could interfere with the architecture of the barrier, which is under cultural heritage protection. Despite the execution of the measure at one gate only, we achieved the goal of improving the lifting system, thus enabling continuous regulation during low flows – this was the most critical aspect prior to the upgrading, because the fast drop in the water level instantaneously deteriorated the ecological conditions for fish and other living organisms.

OUTPUTS			
Planned:	Fully achieved	Partly achieved	Not achieved
Improvement of Ambrožev trg barrier	X		

	2014		2015		
	III	IV	I	II	III
Predicted	X	X	X		
Actual	X	X	X	X	X

Figure 5: Predicted and actual implementation of the measures under action C3

### Activities outside LIFE

We identified no outside LIFE activities in the area during the implementation of the project. The activities at the gates are implemented throughout the year by the gate operator (concessionaire), Hidrotehnik Vodnogospodarsko podjetje d. d., taking care of gate maintenance; however, due to the lack of funding, they are unable to invest in the updating of the system.

### Perspectives for continuing the action after the end of the project

The upgrading of the gate lifting system at Ambrožev trg is the goal of many experts and the lay community, particularly due to the exceptional significance of the gates for the quality of life of the population of Ljubljana and its surroundings. In the past several projects for modernisation of the gates were produced; however, until now none of these project was undertaken. Most reservations are due to the gates' status of a cultural monument of national significance – this status precludes any modification to the gates' exterior. We will need to find a solution that will allow for improvements of the gate system without modifying the exterior.



## **CONCLUSION**

The project's objectives under this action were met despite the complications that led to adjustments of the measures. The right gate can be operated in a way to allow for precise raising and lowering in increments of 5 mm. This is of particular importance during low and medium flows when the gates regulate the water level and impact the water level upstream all the way to Ljubljansko barje (Ljubljana Marshes); consequently, this is important for Ljubljana and its greater region (including Ljubljansko barje). Without the gates, Ljubljansko barje would dry out, causing an ecological catastrophe. By regulating the water level of the Ljubljanica river, the proper ecological conditions for flora and fauna and their diversity in the areas under Natura 2000 are preserved.