



Improvement of the Vásárhelyi Plan

The overflow reservoir of Tiszaroff





Overflow reservoirs to serve flood control alongside the River Tisza

– The overflow reservoir of Tiszaroff –

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New challenges to flood control and the solution

Hungary was the endured of repeatedly passing and intense flood waves in the course of years at the turn of the millennium. Between 1998 and 2001 four extraordinary flood waves were passing down the River Tisza which occasionally exceeded the ever measured highest water level even by one metre. The floods brought about severe damages and the restoration consumed huge amounts of money.

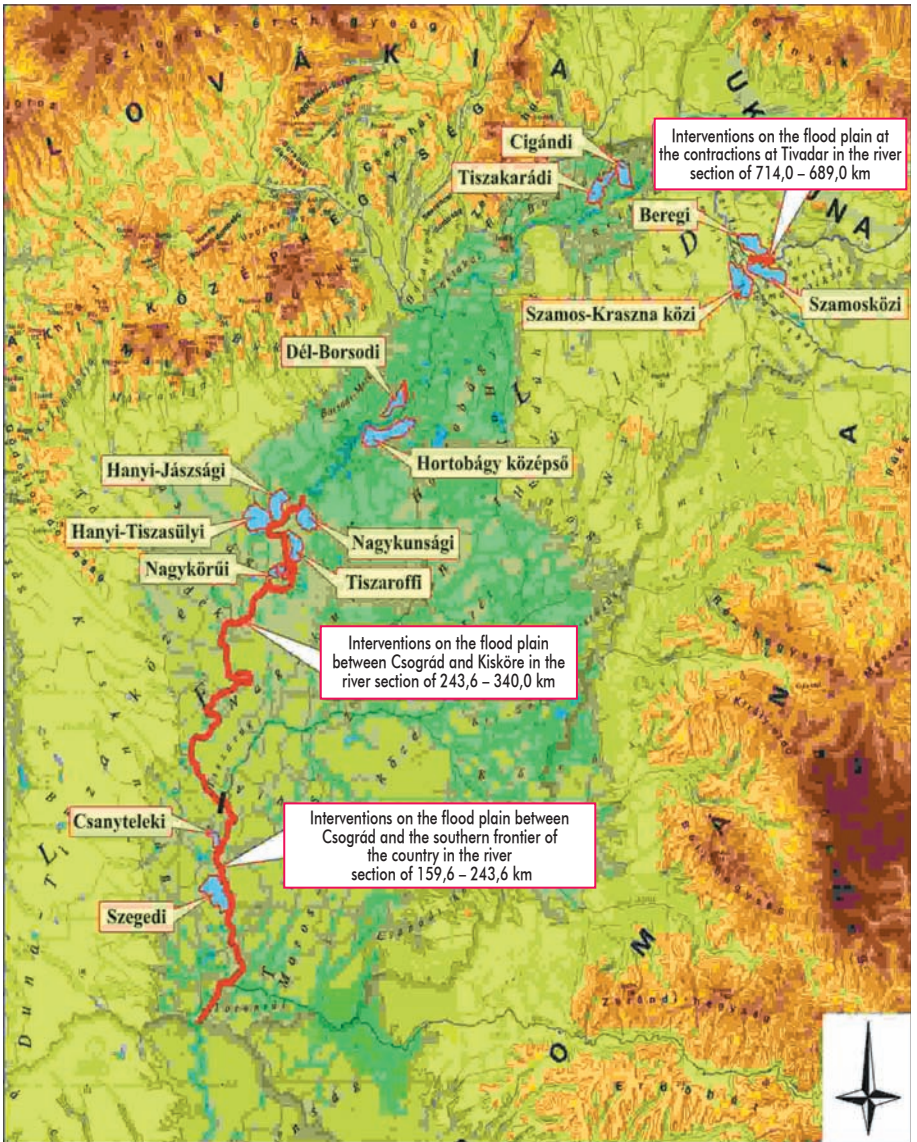
Searching for reasons it can be explained that the situation is the result of joint effect of more factors. Hungary is situated in the lowest part of the Carpathian Basin consequently our country has to cope with the water rushing down in large quantities from the Carpathian Mountains following the sudden thawing of the snow and heavy rains.

After the Second World War the flood control set the increase of height of embankments as an aim. In the course of the past couple of decades the high-water river bed has considerably narrowed due to excessive deposit of mud and silt, building up as well as because of the abundance of cultivated and wild growing vegetation. It has become clear that the protection capability of the flood prevention system can no longer be increased beyond any bounds by increasing the height of embankments as this approach would require the reconstruction of all construction works including bridges crossing the river resulting in considerable increase of investment costs.

Experts of water management kept on searching for solution to the problem. The aim of work commenced in the Ministry of Environment and Water and its professional background institutions at the turn of the millennium was to develop a concept on flood control which could find answer for questions related also to social and economic problems besides addressing flood prevention tasks.

One of the most important problems among those of overriding importance is, because of climate conditions, the unsatisfactory water supply of the ground alongside the Tisza. This fact adversely influences cultivation works and living circumstances of local farmers.

The solution has been found in the program named as Improvement of the Vásárhelyi Plan (in Hungarian: Vásárhelyi Terv Továbbfejlesztése, referred to as IVP in what follows). According to its concept the harmful excess water of flood waves passing down is discharged under controlled conditions into the new overflow reservoirs constructed alongside the river which may serve both landscape management purposes and balanced water supply during low-water periods, too. Accordingly, on the base of topographic, transportation and settlement location aspects ten to fourteen potential sites have been selected where the implementation of retention basins could be possible. In the first phase of the program there are six ones planned for accomplishment: Cigánd – Tizakarád, Inter-Szamos-Kraszna, Hanyi – Tizsasüly, Nagykunság, Tiszaroff and Bereg. Besides, there are accomplishment surveys in progress on further sites (in the region of Szeged, in South-Borsod, on the Hortobágy, Csanytelek, in the Körös Corner and the Jászság).



According to the plans of the Ministry of Environment and Water the full implementation of the new flood prevention system in the Tisza Valley can be realized within 25 years. The expenses of implementation will amount to 120 to 150 billion Hungarian Forints, besides, it will be necessary to restore the high-water discharge capacity of the River Tisza and to further develop also the current flood control equipment, such as the reinforcement of embankments, renovation of floodgates and dikes.

The engineering concept completed in 2001 analyzed in details the possibilities of flood management safety of the Tisza Valley, among others the improvement of discharge capacity of the high-water bed, too. The general statement of the plan was that the flood levels could be significantly decreased by improvements in discharge capacity; however the planning of intervention requires great cautiousness as

- the acceleration of passing may cause more severe conditions downstream, moreover,
- the interventions significantly influence the land use, consequently they may generate social opposition.

Accordingly, for planning interventions the following principles have been formulated:

The floods themselves bear the characteristics of the catchment basin alongside the River Tisza. The flood waves rushing suddenly down on steep slopes slow down on the lowlands with extremely slight declination. The flood waves arriving from sections of steeper declination catch up the former ones to merge and join to each other. Of course, there are other elements to influence and control the passing down of flood waves such as regulations, discharge capacity of tributary streams and the water level of the Danube which, practically, means a limiting condition for the passing flood waves at the estuary.

Nevertheless, it is important to remark that, as a result of river regulation and flood control works commenced in the middle of the past century, a uniform flood prevention system had formulated along the lower lowlands section of the River Tisza.

Cut-offs and the following bend developments have determined the main stream direction of the river. In the meanwhile the flood control embankments along the river bed have been reinforced more times resulting in large sizes for today.

This flood prevention system has rendered development of such settlement and transportation structure, as well as cultivation system possible that have become stabilized in the course of the past more than 100 years. So, it can be said that, with few exceptions, the river bed and its embankments can be considered as status quo. Its modification is only possible on the base of prudent considerations and profound feasibility studies, as well as scale model experiments.

Surveying the land use on the flood plain the significant decrease of grass-land can be observed the consequences of which influence unambiguously unfavourably the high-water discharge capacity especially on narrow flood plains.

Neglected condition and unauthorized height increase of summer dikes are also significant and negative factors in the modification of land use on the flood plain which narrow the high water bed resulting in backwater effects and their consequences are superposed alongside the river.

The high-water discharge capacity and, as a consequence, the formation of the flood level on the river is significantly influenced by contractions. Especially unfavourable are the contractions at Tivadar, the condition of the Szolnok municipal area section, the unfavourable conditions developed in the great bend at Vezseny, as well as those created by the bridge of Tiszaug and the closure embankments of the Tisza III barrage.

The complex utilization of the flood plain and its water protection aspects can be formulated as follows:

- primary role of flood plains is to discharge the yield of floods, including also icy ones, consequently, the complex use of flood plains must unconditionally be governed by the priorities of flood control aspects.
- at the same time, the flood plains are excellent habitats, as well; for this reason their environmental and ecological importance is significant,
- on flood plains there are areas being suitable mainly for silviculture, but there are also rich fields for agricultural production, while the proximity of the river, the natural environment and climate on the flood plain offer excellent opportunities for riverside holiday and recreation, too.

Planned flood plain interventions are for the sections between Kisköre and Szolnok, Szolnok and the southern frontier of the country, the contraction at Tivadar, and in the long run, on the up-stream of Kisköre, respectively.

The expenses of the implementation will be covered not only from Hungarian resources, i.e. from the national budget, but also European subsidies are available. Between 2006 and 2013, an amount of the order of 100 billion HUF can be appropriate for this purpose which will cover the expenses of implementation the above mentioned reservoirs. The developments constitute the part of the New Hungary Development Plan, more precisely, the part of the Environment and Energy Operative Program (EEO) that of.

The first element of the program was the reservoir of Cigánd – Tiszakarád

The first element of the Improvement of the Vásárhelyi Plan was the reservoir of Cigánd – Tiszakarád. The completed reservoir was inaugurated by Mr. Imre Szabó, Minister for the Environment and Water on 14th November, 2008.

The reservoir is situated among four settlements in the Bodroglak: Cigánd, Nagyzságy, Pácin and Ricse. One of the characteristics in the Bodroglak micro-region is the extreme flow regime: in case of high water level on the Tisza the ground water is under pressure and neither discharge of inland waters is always possible. On the other hand, the soil dries out rapidly and cracking. The two extremities appear often even within the same year, consequently, the problems of draught follow those generated by inland waters. Cultivation is unable to adjust to such circumstances.

Total area of the reservoir covers 25 square kilometres – approximately equals to that of the Lake Velence. The height of embankments, that are grass-covered earthworks, is 4.5 metres on average with a crown width of 5 metres and their total length is 23.8 km. The retention basin is able to receive and store approximately 94 million cubic metres of water when filled up.

The height of embankments has been determined to provide the most effective solution on the base of characteristics of floods passing on this section of the River Tisza and, there will be a protective belt of 40 to 80 metres afforested on the sections exposed to excessive wave motion. It's consequently all about serious earthworks for which totally 2.1 million cubic metres of material, excavated on the area of the reservoir, has been used. According to engineering professionals the water level should not rise above 4 metres on average if fully inundated, thus, in case of a flood the high-water level will remain 1 metre below the crown of embankments. In order to prevent overcharge of the retention basin double floodgates have been applied.



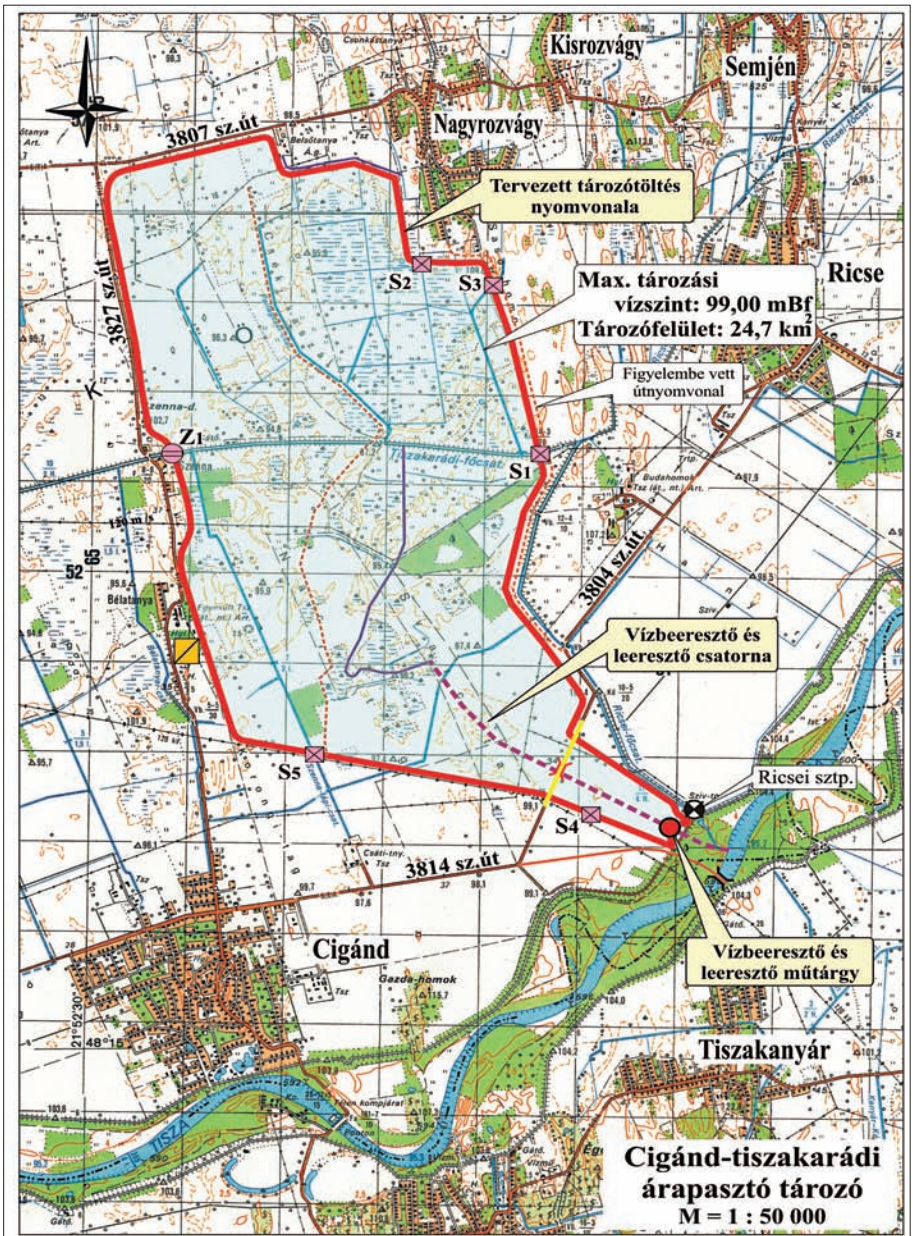
Minister Imre Szabó inaugurates the reservoir of Cigánd

For seepage prevention purposes there has been an impermeable clay layer, so-called "clay tooth", installed in a depth of 1 metre into the waterside of embankments and, where the ground structure made it necessary, also cut-off walls were constructed in a depth of 4 metres.

If, in spite of all technical obstructions a small amount of water could get through the embankment walls onto the protected side a bit more than half metre deep drainage ditch, excavated for 10 metres from the embankment, will collect and drain it into the inland water channels.

According to the related calculations inundations may happen every 30 to 40 years. Depending on the actual circumstances complete filling up of the retention basin may require 3 to 10 days and the water should be retained for about a month.

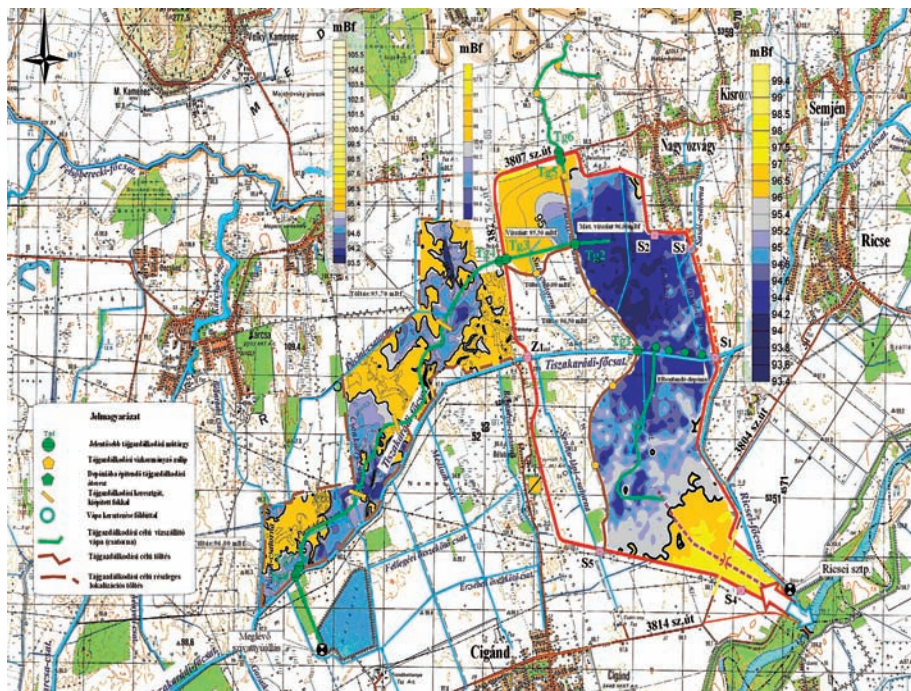
The water level in the reservoir can be regulated by operating the inlet and outlet floodgates. At the "entrance" of the retention basin, on the lower level of the bi-level hydraulic structure, made of armoured concrete at the River Tisza, there are outlet ports located through which water for landscape cultivation can be provided – these ports provide the opportunity of water supply for landscape cultivation even in case of slight rise of water level on the River Tisza. Above these there are



General map of the Cigánd – Tiszakarád reservoir

much larger sluice-gates available for allowing excess water pass into the reservoir which, in case of emergency, are suitable for discharging even 430 cubic metres per second. Considering the dimensions, the construction for water level regulation is of entrancing and, at the same time, its size is the symbol of the power required for the water management.

The gates can be opened and closed, respectively, by so-called “push-type segmented panel” and “roller-type flat panel” elements that are operated by electric motors. The heavy-duty sluice-gates ensure that the river water can be captured under any pressure; at the main gates there are two segmented panels installed for each chamber.



The Cigánd – Tizskarád reservoir and the adjoining landscape management model area

Facts and figures about one of the largest hydraulics engineering project in Hungary

- there were 60 people working with 10 large trucks and 2 column cranes for 11 months,
- the height of pillars is 9.3 metres and the structure is 43 metres wide,
- for technical reasons the bed plate of the structure had to be moulded within 30 hours, therefore 8 truck mixers continuously supplied and discharged the concrete into the prepared form-work;
- for full completion of the entire sluice-gate system 20,000 cubic metres of armoured concrete was necessary that could have been enough to build 25 to 30 ten-storey buildings;
- the sluice board panels are made of 1.5 cm thick steel sheet plate and, in order to cope even with the pressure of extraordinary flood, their material strength can be compared to that of armour;
- for the sake of highest security each gating is of double construction.



A segment plate of the inlet structure during installation



Installed segment plates in July, 2008



Baffle blocks in the stilling basin of the inlet structure



The hydraulic structure with the inlet channel, seen from the River Tisza



The bridge of the road No. 3804 over the inlet channel that has been raised in the course of the project



A landscape structure of mosaic character on the area of the reservoir



Wetland on one of the excavation sites



Program Management Office in relation with the landscape cultivation at Pácín

Distribution of resources to the Project (Million HUF)

Resources	HUF	%
Contribution from the Central Budget	2 757,3	16,7
Contribution from the European Regional Development Fund (ERDF)	8 272,0	50,0
Other resources (according to the Act No. CXVI of the year 2003, and the Decree of the Government No. 1022/2003 (III.27))	5 496,9	33,3
Resources total:	16 526,2	100

Accomplishment of the Cigánd Project 2005–2008	Net (M Ft)	Gross (M Ft)
Structures of landscape management	3 196,29	3 840,49
Construction of embankments (structures of water management, „Phase A”)	5 195	6 234
Inlet structure, reconstruction of main channel	2 950	3 540
Replacement of the public road No. 3804 and the bridge	799,846	966,02
Replacement of the potable water source at the road to Pácín		10
Replacement of electric lines		150
Miscellaneous (acquisition of land, engineering, PR, procurement of machinery)		1 785,69
Total:		16 526,2

Through improving the security, the retention basin may render the inhabitants of the Tisza Valley a precious service, since the water quantity up to almost 100 million cubic metres will generate a water level reduction by 25 cm in the River Tisza in this river section. The reservoir is operated by the North Hungarian Environment and Water Directorate.

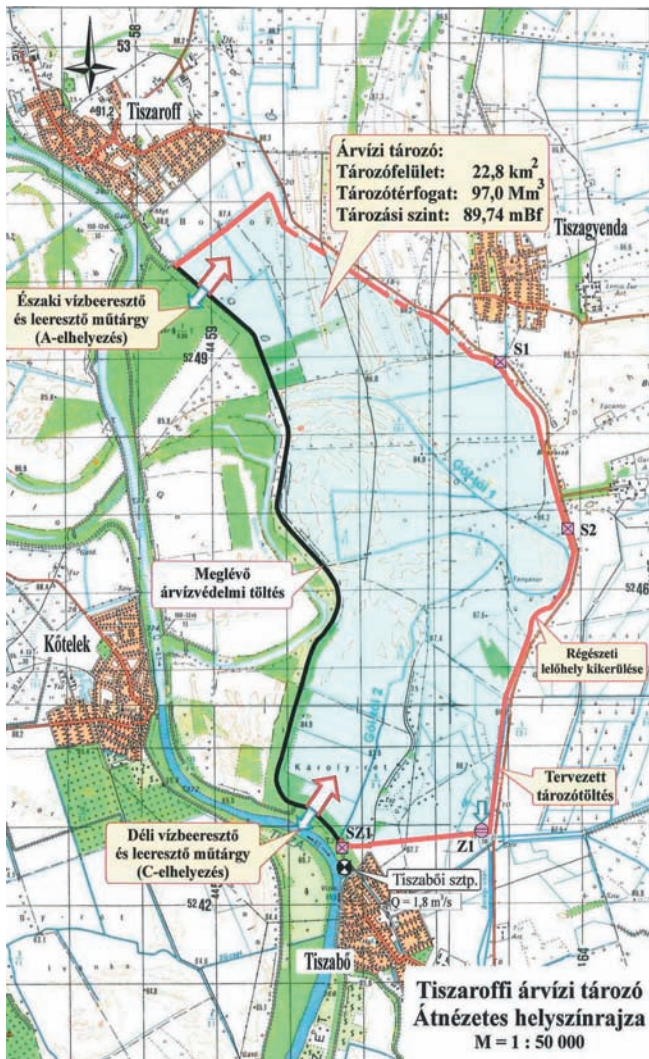
The second element of the Program is the accomplished Tiszaroff reservoir

One of the largest flood prevention developments, the overflow reservoir of Cigánd-Tiszakarád, implemented within the framework of the Improvement of the Vásárhelyi Plan, was inaugurated on 14th November, 2008. For the second, the Tiszaroff reservoir was completed in July, 2009. The area encircled by embankments on total length of 23 km is suitable for receiving water up 97 million cubic metres; as a result of discharging water into the retention basin the level of flood waves can be reduced by 16 cm in this section of the Tisza. This is the second element of the reservoir system consisting probably of 13 to 14 individual retention basins with the help of which a new approach can be applied to the efficient management of floods passing down on the River Tisza.

The overflow reservoir inaugurated on 9th July, 2009 is the second development of the Improvement of the Vásárhelyi Plan and is situated among three settlements, namely Tiszaroff, Tiszabő and Tiszagyenda. The mitigation of risk as a result of reinforced flood control construction affects 5255 residents and 1992 households in the three settlements.

Total area of the retention basin covers approximately 23 square kilometres (more exactly 22.8). The height of its embankments, that are grass-covered earthworks, is 4.5 metres on average with a crown width of 5 metres and their total length is 23.1 km. The planned reservoir is partly encircled by the existing main flood control constructions on a section of 8840 metres, while there are new embankments constructed on the rest. On the full length of the crown there will be a three-metre wide paved operation road constructed which will be suitable for connection to the national bicycle road network. The retention basin can receive and store approximately 97 million cubic metres of water when filled up.

The height of embankments has been determined to provide the most effective solution on the base of characteristics of floods passing on this section of the River Tisza and, there will be a protective belt of 40 to 80 metres afforested on the sections exposed to excessive wave motion. It's consequently all about serious earthworks for which totally 1.6 million cubic metres of material, excavated on the area of the reservoir, has been used. The height of embankments equals with that of flood control dikes, consequently, the risk of overcharging does not exist. According to engineering professionals the water level should not rise above 4.3 metres on average if fully inundated, thus, in case of a flood the high-water level will remain 1 metre below the crown of embankments.



The reservoir of Tiszaroff

On both sides of the embankments there are maintenance strips provided with a width of 10 metres each and, on the protected side, there are drainage ditches constructed and connected mainly with them. In order to prevent foot seepage there is so-called "clay tooth" installed in a depth of 1 metre along the full length of the protective line (except the flood-free banks) on the waterside base of the embankments.

According to the related calculations inundations may happen every 30 to 40 years. Depending on the actual circumstances complete filling up of the retention basin may require 3 to 10 days and the water should be retained for about 1 to 2 months. Discharge of the reservoir takes probably 15 to 20 days.

The water level in the reservoir can be regulated by operating the inlet and outlet floodgates. Both on northern and southern part of the reservoir there are the same constructions installed.



One of the segment plates of the northern structure during installation



Installation of segment plates in March, 2009

The northern structure is suitable not only for inlet but also for discharging according to the different water levels. Supply and discharge of water is achieved through 3 gates of 8 metres wide located at a height of 86,60 mBf (Hungarian abbreviation for 'metres above Baltic Sea level'). The gate openings are closed by 3 shifting segment boards on the side from the River Tisza. The capacity of the structure is 300 cubic metres per second; on its side from the River Tisza there are stilling basins connected just like at the inlet structure of Cigánd reservoir.

The gates can be opened and closed, respectively, by so-called "push-type segmented panel" elements that are operated by electric motors. The heavy-duty sluice-gates ensure that the river water can be captured under any pressure. In order to prevent seepage there are cut-off walls under the structure while there will be armoured concrete walls built for prevention of seepage above the ground level.

The southern water inlet and discharge structure is used mainly for discharging the reservoir; for filling up it is only used, practically, in case of emergency. The structure is of 3 gate type with "roller-type flat panel" closing elements for water inlet under pressure, and its discharge capacity is 150 cubic metres per second. The construction consists of a central monolithic reinforced concrete block to which there are stilling basins connected on both sides. As an extension to the stilling basins, just like at the northern section, there are inlet and discharge channels constructed. Both the northern and the southern water inlet and discharge structure was constructed on the protected side of the embankments in order to provide its protection connected to which there was also a new U-shaped dike section constructed.



Segment plates of the northern structure from the protected side



Segment plates of the northern structure from the flood plain

Facts and figures about northern and southern water management construction of the Tizaroff reservoir

- *It is true for both: consists of a central monolithic reinforced concrete block; the two side pillars are 2.4 metres high while the central one is 3 metres wide.*
- *Thickness of the bed plate of the structure block is 1.2 metres.*
- *The sluice board panels are made of 1.5 cm thick steel sheet plate, and their material strength can be compared to that of armour in order to cope even with the pressure of extraordinary flood.*



The structure under construction in May, 2009



Segment plates shot from the top of the structure



The southern structure under construction



The stilling basin of the southern structure under construction

The reservoir was accomplished within the frameworks of the Improvement of the Vásárhelyi Plan by using exclusively domestic resources up to an amount of approximately 7.6 billion HUF. Construction works have been executed by the Alterra Hídépítő Konzorcium (Alterra Bridge Construction Consortium).



The reservoir of Tiszaroff was inaugurated by the Minister Imre Szabó

Through improving the security, the retention basin may render the inhabitants of the Tisza Valley a precious service, since the water quantity up to almost 100 million cubic metres will generate a water level reduction by 16 cm in the River Tisza in this river section.

The reservoir is operated by the Middle-Tisza District Environment and Water Directorate. Currently, there is no protected natural area of national importance to be found on the area of the planned reservoir. Decisively 90 percent of the retention basin area is under agricultural cultivation and the proportion of grass-lands is 7 percent, rather scattered mainly in small plots. The proportion of forests is 2 to 3 percent and that of wetlands is negligible (less than 1 percent).

The Tiszaroff reservoir is the second retention basin in the investment project in relation with the Improvement of the Vásárhelyi Plan. Although, infrastructural investments have not been accomplished according to the needs of landscape cultivation but later on, in case there will be a demand from the part of the population, these can be supplemented within frameworks of other projects.

Property security

The main goal of constructing the reservoirs is to improve the security of people living in the settlements on the Tisza Ridge and along the lower sections of the river, respectively. In 1999 and again in 2000, the central section of the River Tisza was affected by record-breaking floods, both in terms of the height of water and the number of people threatened by the flood.

In March 2001, one third of the settlements in the Bereg region were flooded. In 2006, the people living along the River Tisza were protected and saved from the imminent disaster only because of the intense concentration of financial resources and human efforts. Construction of the overflow reservoir system and the improvement of the discharge capacity of the high-water bed decrease the water

level of the River Tisza by totally 1 metre in case of floods. In recent years, it was often a question of centimetres whether a dam burst or retained the water. The possibility of reduction by 1 metre means that the water level would probably not exceed the design flood, consequently, the existing dikes would be sufficient for protection against even more powerful damaging effects of floods than those which have been experienced so far.

Developing region

Parallel with the execution of the investment goals there will also be infrastructural developments, as well as local and rural development programs accomplished in the region. The IVP – in addition to the flood control – renders local inhabitants the opportunity for changing the quality of their life in positive directions. Roads and sewage channels can be constructed, the quality of drinking water can be improved and also the situation of drainage can be solved in the settlements. Farmers can introduce cultivation methods that meet on higher level the market requirements and improve their living standard at the same time.

Infrastructural and rural development

On the base of the IVP, according to which the ease of troubles in flood control can be combined also with rural development tasks, the affected communities benefit significant rural development subsidies, as well.

In 2004, within framework of the planning process, a survey was conducted in order to define infrastructural supply and development needs of settlements (41, at that time) affected by the first phase of the IVP. Following this, in 2005-2006, based on the resources of the National District and Regional Development Office (NDRDO) and the Ministry of Environment and Water (MoEW) the necessary permissive plans could have been completed, a copy of which was sent to the relevant local governments.

Development of affected municipalities is greatly supported by the improvement of infrastructural supply, for this reason, the plans for sewerage system and road constructions have received support in the first step. This is how the drainage, sewage discharge and treatment, as well as road construction plans were prepared.

Following this, it is the duty of the relevant local governments to raise the necessary financial means for the realization of the available plans by applying for funds from different application resources and to track down the appropriate contractors for the execution and sign a contract with them.

Infrastructural developments related to the Tiszaroff reservoir

Investments accomplished up to now: The infrastructural developments related to the Tiszaroff reservoir that have been accomplished up to now, are listed in the Annex No. 1. Besides those listed in the chart, there was also a maintenance road accomplished with a length of close to 14 km on the embankments of the retention basin which, considering its structure, is suitable for bicycle traffic, as well.

Investments to be accomplished:

- **Drainage, sewage discharge investments on the municipal area of settlements Tiszaroff and Tiszagyenda.**

These investments could be realized by using domestic budgetary subsidies. On the session, held on 27th May, 2009, the Northern Great Plain Regional Development Council, provided 548,15 million HUF to the realization of the investment in a value of 577 million HUF in the settlement Tiszaroff and 366.7 million HUF to the development total of 386 million HUF in the settlement of Tiszagyenda to the debit of the funds available for the Improvement of the Vársárhelyi Plan in 2009 in the District and Regional Development Earmark Funds (DRDEF). In both cases the conclusion of the assistance contract is expected to be undersigned until the end of July 2009, while the planned accomplishment of the investments is the end of 2010.

- **Investment to the improvement of the drinking water quality at Tiszagyenda.**

Tiszagyenda participated in the first phase of the Drinking Water Quality Improvement Program of the Northern Great Plain Region. Because of the high arsenic content of the potable water there is a municipal waterworks reconstruction program in progress in the settlement: there will be equipment installed for making the water free from arsenic, iron and manganese. The investment is in progress and, according to the plans, will be completed at the end of 2009. (Total costs of the investment amount gross 25.6 million Euro, approximately 6.5 billion HUF.)

- **Investment to the improvement of the drinking water quality at Tiszaroff and Tiszabó**

In the potable water of Tiszaroff the ammonium content, while in that of Tiszabó the arsenic and nitrite content exceed the allowable limit values. The two settlements participated in the second phase of the Drinking Water Quality Improvement Program of the Northern Great Plain Region. Currently, there are the preparations of the projects in progress and their applications will be submitted probably in the first half of the coming year. In case the applications will be judged favourably, the execution works could be completed in the course of 2011-2012. In Tiszaroff, the developments of water treatment technology and network reconstruction have been planned. Earmarked funds of the investment amount to 180 million HUF. Within the frameworks of the project the extension of the water base has been planned with one new well as well as the reconstruction of the network at Tiszabó. Earmarked funds of the investment amount to 169 million HUF.

- **Development of sewerage system at Tiszaroff and Tiszagyenda**

The extension of sewerage system at Tiszaroff and Tiszagyenda has been planned for realization by using the funds made available by the resources of Environment and Energy Operative Program Section 1.2.0 Sewage Discharge and Treatment. Earmarked funds of the investment amount to total 521 million HUF, from which amount an assessed proportion of 284 million HUF falls to the share of Tiszaroff, while of 208 million HUF of Tiszagyenda. Furthermore, the planning and management cost amount to 29 million HUF.

Additional information:

- In the Section of Development of drinking water quality improvement at Tiszagyenda and Tiszabő of the documentation sent by the Ministry of Environment and Water the following was written: "Currently, the preparation of the projects is in progress, the applications are expected to be submitted in the first half of the coming year. In case the applications will be judged favourably, the execution works could be completed in the course of 2011-2012." According to the notice by the Northern Great Plain Regional Development Agency, currently, the preparation of the projects is in progress and the associations are going to submit their application for the announcement EEOP 1.3.0 probably during the second half of 2009 or the first half of 2010.
- In 2005, in the course of the survey for infrastructural needs the demand for road construction and reconstruction was not raised by the relevant local governments but the demand for bicycle roads was indicated. In the case of Tiszaroff a bicycle road of 14 km, while in case of Tiszagyenda 0,4 km and of Tiszabő 0,2 km bicycle road sections have been mentioned in connection with reservoir embankments. From domestic resources the HÖF, LEKI and TEUT earmark funds provide subsidies for road construction and reconstruction and, if the bicycle road section in question is the part of the EuroVelo network, the Road Fund provides subsidies for the investment. Considering the resources from the European Union the following application possibilities are available: the accomplishment of road construction and reconstruction investments of local governments are promoted by the following constructions included in the Action Plan for 2009-2010 of the Northern Great Plain Operative Program (NGPOP): 3.1.2 Development of roads of local governments; 3.1.4 Infrastructural development of communal transport.
The construction of bicycle roads of local governments for tourism purposes is supported by the following constructions of the Action Plan for 2009-2010 of the NGPOP, Sections 2.1.1/B2 Development of bicycle roads and narrow-gauge railways for tourism purposes and 3.1.3 Development of bicycle traffic network. For the development of bicycle road network for employment purposes also by the Action Plan for 2009-2010 of the NGPOP provides subsidies within the frameworks of 3.1.3 Development of bicycle traffic network.
- For completion of their own share being necessary for European Union developments local governments and their associations may apply to the EU Own Resource Fund.

According to the Decree No. 19/2009 (IV.8.) ÖM among the goals that can be supported the water-flow regulation, the quality improvement of potable water, sewage treatment, as well as the development of local road network any bicycle roads are included alike. On the base of the regulation in 2009, the support from Own Resource Fund could be not more than 60 percent of the own share in the case of the first two investments, while 50 percent in latter case. In case the applying settlement belongs to the group of those most disadvantageous ones to be supported by complex program as defined by the Governmental Decree No. 311/2007 (XI. 17.) the rate of support may reach the 75 percent of the own share in relation with both investment goals (Tiszaroff and Tiszagyenda belong to the most disadvantageous Tiszafüred micro region).

Table 1: Accomplished infrastructural investments

Name of the Local Government	Type of the investment (inland water drainage, sewage discharge, road reconstruction, etc.)	Resource of support / announcement	Date of winning the support/ competition; in case the application was unsuccessful then the date of its submission	Total costs of the project/ investment (HUF)	Obtained subsidies (HUF)	Duration of the investment	Date of accomplishment
Tiszaroff Municipality Local Government	Construction of common sewage treatment plant for Tiszaroff, Tiszagyenda and Tiszabura; work up of transmission line to Tiszaroff and Tiszagyenda and partial accomplishment (56,35%) of canal network for both settlements	TRFC	31 st March, 2006.	947046.667	947046.667	2006-2008	2008
Tiszaroff Municipality Local Government	Extension of sewage network at Tiszaroff and Tiszagyenda	TRFC	16 th October, 2007.	105.660.100	105.547.980	2007-2008	2008
Tiszabó Municipality Local Government	Drainage and development of road network on municipal area	TRFC	31 st March, 2006.	429.650.556	429.650.556	2006-2008	2008
Tiszabó Municipality Local Government	Development of road network on municipal area at Tiszabó; reconstruction of road of lot No. 466 at Tiszabó	TRFC	16 th October, 2007.	74.940.769	74.861.230	2007-2008	2008
Tiszaroff Municipality Local Government	Erection of selective waste collection islands	MTRFH által biztosított forrás	15 th December, 2004.	3.956.250	3.560.625	2005	2005

Remark: TRFC – Hungarian abbreviation for District and Regional Earmark Funds; MTRFH - Hungarian abbreviation for the Office of Hungarian District and Regional Development

Source: Ministry of National Development and Economy District Development Department

Compensation

Of course, the land owners having properties on the area of the reservoir will receive compensation. At the beginning of construction works the state has expropriated the necessary areas; the grounds have been acquired at reasonable prices. Prior to the expropriation the land was appraised. The positive approach of the state to expropriation is proven by the fact that a higher purchase price was paid for the land than the appraised value. In case of conflict there was the opportunity for requesting the appraisal by the court however, in the vast majority of cases the fair approach of the purchaser proved to be sure.

People who own a property on the area of the reservoir receive a single non-recurrent compensation of a larger amount; moreover, at any time the reservoir is inundated the farmers working on the area receive a full compensation up to the value of lost production.

Curiosities of archaeological excavations

Before commencing the execution works the area of the reservoir was the site of archaeological researches and excavations. The research works started at springtime 2006 conducted by the experts of the Damjanich János Museum of Szolnok and the Hungarian National Museum.

The professionals have performed archaeological excavations altogether on 17 sites.

Archaeological excavations performed along the location line of the reservoir's embankments revealed the traces of more thousands years old Gepida, Sarmatian, Avar settlements from the age of the great migrations.

Form among the objects the grave of a Gepida clan head being in the Avar service is of outstanding which explored at the limits of Tiszagyenda, in one of the dead stream branches of the River Tisza, as well as a unique graveyard containing amputated and disjointed corpses.

Also the result of archaeological excavations performed prior to reservoir construction works is the coin collection hidden during the age of the Ottoman Turkish occupation of Hungary. The treasure finding consists of 63 silver thalers and a golden ducat from the age of Ferdinand II. the King of Hungary and German-Roman Emperor. The excavation works had been conducted parallel with that of construction and, as in the course of construction works remains of settlement from the middle ages (Lakfalu) were opened in the location line of the reservoir's embankments, for this reason the location line had to be corrected in 2006.



Archaeological findings: silver thalers from the 17th century



Excavated rock chapel

Sources:

- Governmental Decree No. 1003/2007 (I. 24.)
- Official documents of the Interdepartmental Committee for the Improvement of the Vásárhelyi Plan
- Floodwater Retention Reservoirs to Reduce Floods in the Tisza Valley
 - The Cigánd-Tiszakarád Floodwater Retention Reservoir



Published by the Central Directorate for Water and Environment
Director – Dr. József Váradi
1012 Budapest, Márvány u. 1/d

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