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ENVIRONMENTAL IMPACT ASSESSMENT OF ANDREJOVSKY STREAM REGULATION

Floods threaten the lives and health of the population, cultural heritage, the environment, cause damage of the property and limit economic activity. It is hard to avoid them, but the degree of flood risk can be estimated and effective measures to mitigate their adverse consequences should be done. Flood risk management includes structural and non-structural measures. Mainly structural measures reduce flood risk by constructed of these objects have usually serious impact on the environment, mainly in the process of their construction. The proposal of flood protection objects is the subject of environmental impact assessment process in the Slovak Republic. The Directives on Environmental Assessment aim to provide a high level of protection of the environment and to contribute to the integration of environmental considerations into the preparation of projects, plans and programmes with a view to reduce their environmental impact. In the paper is mentioned how the water structures with flood protection function affect the environment in negative as well as in positive way. Environmental impact assessment of Andrejovsky stream regulation in the village Andrejova in eastern Slovakia is the core of the paper. From the presented evaluation of the assessment of potential impact of Andrejovsky stream regulation is obvious that stream regulation it better solution for the inhabitants as well as for the environment in village Andrejova.

Keywords: environmental impact assessment, stream regulation, Andrejovsky stream

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1. Introduction

The objective of the paper is to assess environmental impacts of activities in water management, exactly flood mitigation measures with goal to select the best option for the permission process. One of the objectives of the environmental impact assessment is to establish whether the activity will improve the environment compared to the zero alternative.

Importance of an environment impact assessment is to detect the potential risks associated with construction and operation of specific structures in the particular locality before starting their construction or usage [1].

After the more detailed review and evaluation of the possible positive or negative impacts of constructions on the environment the mitigation measures that ensure the protection of the environment in conjunction with the development of society may be adopted.

Floods are the most frequent natural disaster worldwide and a major natural hazard in Europe in terms of social and economic impacts. In the last 15 years, Europe has suffered over 100 major damaging floods which have caused more than 1,000 casualties, affected more than 3.4 million people, about half a million of whom have been displaced, and at least € 25 billion in insured economic losses. Additionally, floods also cause important environmental impacts since they seriously affect the quality of water bodies and can mobilize large amounts of sediments and pollutants [1].

The aim of this paper is to analyze and evaluate the environmental impacts of proposed activities in water management – water stream regulation in village Andrejova, eastern Slovakia [3].

If the purpose of water stream regulation is also flood protection function its impact on the environment has to be assessed according to legislative. According Annex no. 8 to the Act No. 24/2006 Coll. (The National Council of the Slovak Republic) flood protection objects are included in list of proposed activities which are subject to the EIA in field no 10 water management, whose departmental authority is Ministry of Environment of the Slovak Republic.

2. Material and Methods

2.1. Study area

Andrejova village is located in the north-east of Slovakia in Presov region in Bardejov district (Fig. 1). Andrejovsky stream flows through the village, which in the past as well as these times causes damages due to floods at the time of high water levels. Stream during the flood situation threatens human properties, lives and it also causes a lot of environmental damages.

The aim of the proposed flood mitigation measure at Andrejovsky stream in the village Andrejova is to achieve the necessary protection of endangered

areas by flood water, reduce flood damage and improve drainage conditions in the catchment area of Andrejovský stream.

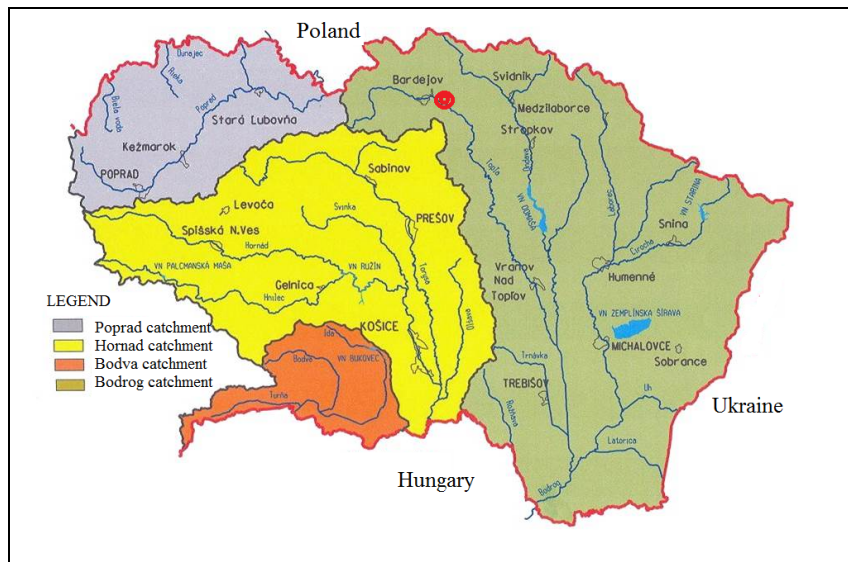


Fig. 1. Andrejova village and its surroundings

Rys. 1. Miejscowość Andrejova i jej okolica

2.2. Technical solution

The purpose of the flood mitigation measure is to propose dam construction on Andrejovský stream in Andrejova village.

Water stream regulation of Andrejovský creek was chosen as an alternative of object of flood protection. The regulated part of the creek is located within the boundaries of the village Andrejova. The proposed alignment follows the former river bed and is adapted to local needs in maximum rate. The purpose of the structure is to minimize the risk of flooding in the urban village. The catchment area covers an area of 58 km². The highest point of the regulated section is in the altitude of 302.5 m asl and the lowest 298.6 m asl. Maximum discharge Q_{\max} is 112 m³/s, average discharge $Q_{\text{av}} = 0.51$ m³/s and minimum discharge $Q_{\min} = 0.01$ m³/s. The technical solution includes a description of stream alignment, longitudinal profile, cross section and fortifications of riverbed.

✓ Stream alignment

The length of water stream regulation is 352 m. Stream alignment respect all requirements of national standards. Design includes five meanders cut by straight lines. The stream alignment follow the current river bed of the stream.

✓ Longitudinal profile

Longitudinal inclination has been proposed with respect on height conditions and spatial possibilities. The existing average longitudinal inclination in the regulated part is 11.1 ‰. Based on former situation three inclinations were designed in the studied part of stream: rkm 0.000 to 0.178 $i = 6 ‰$, 0.178 to 0.325 rkm $i = 9 ‰$, and from 0.325 to 0.352 rkm $i = 18 ‰$. On the route 7 stabilization grades have been proposed.

✓ Cross section

Parameters of cross section based on the design discharges $Q_{100}=Q_{max}$, longitudinal inclination and hydrodynamic calculation. Throughout the whole stream regulation (rkm 0.000 to rkm 0.352) open trapezoidal profile (Fig. 2), bottom width $b=3.44$ m, slope of 1:1.5 and a depth of 3.95 m has been designed. At the time of maximum discharge the water level reaches the maximum height 3.45m.

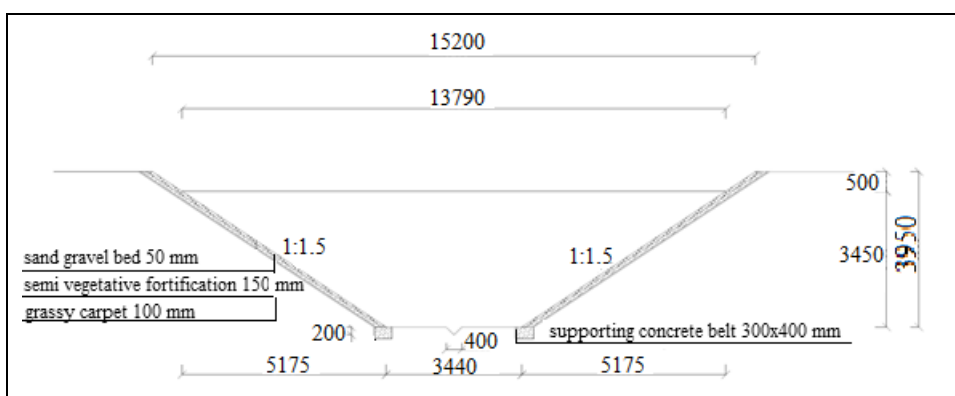


Fig. 2. Cross section

Rys. 2. Przekrój poprzeczny strumienia

✓ Stream bank fortification

The fortification is designed for Q_{100} discharge based on hydrodynamic calculation taking into account the circumstances in stream alignment. The bottom is in former, sand-gravel with the roughness $n = 0.025$ in good condition. On the heels of a bottom prefabricated basement (300x450 mm), placed on gravel of thickness 100 mm. Fortification slopes was entirely designed semi-vegetative blocks with (roughness $n = 0.033$) on the substrate of gravel of thickness 50 mm.

3. Results and Discussion

Potential impacts of the Andrejovský water stream regulation on the environment are identified and briefly described in this chapter. These impacts on the environment are assessed in accordance with the Law 24/2006 Coll. On the environmental impacts assessment (Law 24/2006, 2006).

3.1. Impact on inhabitants

The population will be potentially affected by noise, by dustiness from mechanisms during the construction and by increased intensity of freight transportation during the construction. These impacts will be temporary and should not lead to significant disturbances of residential environment. The construction will have a positive impact on the population as the main purpose – flood protection of the urban area will be ensured.

3.2. Impact on rock reserves, mineral resources, geodynamic phenomena and geomorphological conditions

Building operation on Andrejovský creek will lead to a minimum of interference to the rock during construction. Mineral resources will not be affected.

3.3. Impact on climatic conditions

Water stream regulation of Andrejovský creek has no potential risk in microclimate changes.

3.4. Impact on atmosphere

No significant effects on the atmosphere are expected. Potential disturbances may arise during building operations, eg. increasing dustiness depending on climatic conditions. Noise and exhaust emissions will affect only a small area around the construction site and the access road. These impacts are temporary and will disappear after the construction.

3.5. Impact on aquatic conditions

No new water surface will be created so any changes in surface and ground water levels are expected. Exception is only during the flood situation when the river bed has to drainage flood discharges and eliminate of flooding the surroundings.

3.6. Impact on aquatic soil

The proposed regulation of the stream in some places deviates from its original river bed with respect the morphology of the territory, the existing property-state and hydrodynamic calculation. There will be new permanent oc-

cupation of the land but because the former channel is filled up, so the total area of occupation and the newly formed land areas remains unchanged.

3.7. Impact on fauna a flora

Because of realization of construction termination respectively decreasing of the incidence of certain types of animals living in the surroundings. It is mainly on small mammals, wild animals and birds. On the contrary the creation of water surface brings possibilities to appearance of new habitats (both terrestrial and aquatic). In the immediate surroundings of the construction site a minimal trees excavation to obtain manipulation areas is expected.

3.8. Impact on the landscape - the structure and land use, landscape character

Andrejovsky creek regulation has no change in the structure of the country or only a little change will be significant in nature, respectively. The area of interest is located within the boundaries of the Andrejova village on lands of permanent grassland, water bodies and other areas. Due to the character of construction there will be excavation of accompanying trees and shrubs. Water stream regulation will have a significant impact on the aesthetics condition of the area. Water surface will be a positive aesthetic element in the area.

3.9. Impact on the protected areas and zone of protection

There are no protected areas in the locality of interest, so there will be no impact on these kinds of areas and zones.

3.10. Impact on the territorial system of ecological stability

Water stream regulation may temporarily negatively affect the function of local bio-corridor Andrejovsky stream.

3.11. Impact on the urban complex and land use

Study area is not interesting in the aspect of tourism. Regulation of the stream is located in a place where no land management carried out and therefore no impact on agricultural production is assessed.

3.12. Impact on cultural and historical monuments

The structure will have no impact on the cultural and historical monuments in the area.

3.13. Impact on archaeological sites

There are no archaeological sites in the study area.

In Tab. 1 are selected potential impacts on environment of the water stream regulation that are assessed according to verbal numeric scale, where +5 is the most positive impact and -5 the most negative impact.

Table 1. Assessment of potential impact of Andrejovsky stream regulation

Tabela 1. Ocena potencjalnego wpływu regulacji strumienia Andrejovskiego

Types of impact	Assessment	Zero Alternative
Impact on inhabitants		
Quality of residential environment	+4	-3
Effect on landscape scenery	+3	-3
Job opportunities	+1	0
Noise	-1	0
Emission	-1	-1
Vibration	-1	0
Effect on economic activity	0	0
Risk of transport collision	-1	0
Impact on rock reserves, mineral resources, geodynamic phenomena and geomorphological conditions		
Impact on raw material deposit	0	0
Disturbance of geology environment	-1	-1
Contamination of geology environment	-1	0
Impact on climatic condition		
Macroclimatic changes	0	0
Microclimatic changes	0	0
Impact on air		
Impact on air quality – pollutants	-1	0
Dustiness	-1	0
Impact on aquatic environment		
Impact on surface water quality	0	-1
Impact on regime of surface water	+3	-2
Impact on groundwater water quality	0	0
Impact on regime of groundwater	-1	0
Impact on soil		
Soil occupation	-1	0
Mechanical degradation and contamination of soil	-1	0
Soil erosion	+3	-2
Impact on fauna and flora		
Extraction and planting of trees and shrubs vegetation	-2	0

Impact on valuable biotopes	0	+1
Impact on aquatic animals migration	-1	0
Impact on protected species of vegetation	0	0
Impact on protected species of animals	0	0
Impact on protected trees	0	0
Impact on landscape – structure and using of land, land character		
Impact on landscape aesthetic	+3	-2
Impact on protected areas and zone of protection		
Impact on protected bird area	0	0
Impact on protected area Natura 2000	0	0
Impact on protected areas of water management	0	0
Impact on protected zones of natural sources of mineral and thermal water	0	0
Impacts on the territorial system of ecological stability (TSES)		
Impact on local TSES	+1	+1
Impact on regional TSES	0	0
Impact on supraregional TSES	0	0
Impacts on the urban complex and land use		
Restriction or development of industrial production	0	0
Intervention to industrial areas	0	0
Recreation and tourisms	+2	0
Sports and recreation areas	0	0
Impact on agricultural production	0	0
Intervention to agricultural area	0	0
Contamination of agricultural soils	0	0
Forest land occupation	0	0
Impact on protected zones of water sources	0	0
Impact on waste management	0	0
Wastes formation	-1	0
Loading of local communications	-1	0
Traffic restriction affected by construction	-1	0
Impact on engineering networks	-1	0
Impact on cultural and historical monuments		
Impact on cultural monuments, architecture and settlements	0	0
Impact on archaeological site		
Impact on archaeological sites	0	0

The result from the environmental impact assessment is +2 for the proposed activity of flood protection – water stream regulation in village Andrejova while the current state of the stream and its impacts for the environment was assessed for -13. The environmental impact assessment of the Andrejovsky stream regulation shows that the most serious negative impact on the environment will be extraction of the tree and devastation of shrub vegetation along the stream as well as in other locations necessary for the storage of materials and in manipulation areas. The most significant positive impact on the environment will be the flood protection as well as improvement of the environment for residents and mitigate the devastation of surrounding landscape.

4. Conclusion

EIA is a necessary step during the early planning stages of flood protection object in order to gain clear insights of the structures' probable impacts with respect to the different components of the total environment. The purpose of the environmental impact assessment is to identify, describe and evaluate how the construction will affect the environment, either positive or negative aspect. If the potential negative effects are known, it is possible to prevent, or eliminate them entirely. Assessment is an effective process, which should be used for prevent the pollution and environmental degradation and to sustain appropriate conditions for the living organisms existence, including humans.

Floods threat the lives and health of the population and caused damage for property and environment. The most effective and cheapest way of flood protection is to create the necessary area for flow. Water stream regulation means creation of area for safe flow. This paper evaluates the impacts of stream regulation for environment. From the evaluation presented in Table 1 assessment of potential impact of Andrejovsky stream regulation is obvious that stream regulation it better solution for the inhabitants as well as for the environment in village Andrejova.

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Streszczenie

Powodzie zagrażają życiu i zdrowiu ludności, dziedzictwu kulturowemu, środowisku, powodują uszkodzenia własności i ograniczają działalność gospodarczą. Są one trudne do uniknięcia, ale stopień ryzyka powodzi może być oszacowany i powinien być skutecznie zmierzony w celu minimalizować ich niepożądane konsekwencje. Zarządzanie ryzykiem powodzi obejmuje środki konstrukcyjne i niekonstrukcyjne. Środki konstrukcyjne redukują ryzyko powodzi przez budowę obiektów mających zazwyczaj poważny wpływ na środowisko naturalne, głównie w procesie ich wznoszenia. Propozycja ochrony obiektów przed powodzią jest tematem procesu środowiskowej oceny oddziaływania w Słowacji. Dyrektywy odnośnie Oddziaływań Środowiskowego mają na celu zapewnienie wysokiego poziomu ochrony środowiska i przyczyniają się do integracji środowiskowych rozważań podczas przygotowania projektów, planów i programów mając na uwadze redukcję ich oddziaływań na środowisko. W artykule wspomniano jak budowle wodne z funkcją ochrony przed powodzią wpływają na środowisko w sposób negatywny jak i pozytywny. Głównym zagadnieniem opracowania jest ocena wpływu środowiskowego regulacji Andrejovský'ego strumienia w miejscowej Andrejova we wschodniej Słowacji. Przedstawione oszacowania potencjalnego wpływu regulacji Andrejovský'ego strumienia wskazuje, że te prace są dobrym rozwiązaniem dla mieszkańców jak również dla środowiska w miejscowej Andrejova.

Słowa kluczowe: ocena oddziaływania na środowisko, regulacja strumienia, Andrejovský strumień

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