Institut za građevinarstvo “IG” Banja Luka

Modrica irrigation subproject (ESMP)

Final version

Irrigation development project at the location of Miloševac cadastral borough (Krušici locality), Garevac cadastral borough (Jabuka locality) i Dobrinja cadastral borough (Pašinac locality), Municipality of Modriča

Banja Luka, June, 2024

Institut za građevinarstvo "IG" Banja Luka
Naučno istraživački institut
Br. reg. upisa: U/I-1-11425-00 Osnovni sud Banja Luka
Matični broj: 1928694
JIB: 4400918310005
PDV broj: 400918310005
Žiro račun: 555-007-00004438-38
Nova banka a.d. Banja Luka
World Registrar Group
Banja Luka, Kralja Petra I Karađorđevića 92-98 tel: 00387(0)51/348-360; lab. 00387(0)51/533-380 fax: 00387(0)51/348-372 e-mail: info@institutig.ba

SUBJECT	Environmental and social management plan irrigation development project at the location of Miloševac cadastral borough (Krušici locality), Garevac cadastral borough (Jabuka locality) and Dobrinja cadastral borough (Pašinac locality), Municipality of Modriča AGRICULTURAL RESILIENCE AND COMPETITIVENESS PROJECT (P171266)
CLIENT:	**Municipality of Modriča** Vidovdanska br. 1 74 480 Modriča
CONSULTANT	CIVIL ENGINEERING INSTITUTE IG LLC Banja Luka *www.institutig.ba*
PROTOCOL	IZ-IGBL-IN-EK - 808 /24
TEAM	Dušica Lemez, MSc civ. eng. Boško Mijatović, MSc el. eng. Radojka Popović, grad. eng. technology Željka Stojanović, grad. eng. agriculture Snježana Savić, grad. spatial planner Siniša Cukut, msc. chem. eng. Ljubiša Gatarić, grad. biologist Ranka Pušić, grad. biologist Đorđe Gašić, grad. ecologist Jelena Vučenović, grad. ecologist Danijela Đervida, BSc civ. eng.

Acting manager

mr sci Duško Hinić

TABLE OF CONTENTS:

LIST OF FIGURES:

LIST OF TABLES:

USED ACRONYMS AND ABBREVIATIONS

APCU - Agriculture Project Coordination Unit
ARCP - Agricultural resilience and competitiveness project
BiH - Bosnia and Herzegovina
BD - Brčko District
EA - Environmental assessment
EIA - Environmental impact assessment
EK - European Commission
EMF - Environmental Management Framework
ESIA - Environmental and Social Impact Assessment
ESMF - Environmental and Social Management Framework
ESMP - Environmental and Social Management Plan
EU - European Union
FBiH - Federation of Bosnia and Herzegovina
GAP - good agricultural practice
GBV - gender-based violence
GRM - Grievance resolution mechanism
IDA - International Development Association
IDP - Irrigation Development Project
IPA - Instrument for Pre-Accession Assistance
IPM - Integrated pest management
KUD - cultural-artistic society
LMP - labour management procedure
LDPE - low-density polyethylene
NVO - Nongovernmental Organisation
PEHD -high-density polyethylene pipes
PUO - Waste management plan
RS - Republika Srpska
RPF - resettlement policy framework
SEA-SH - Sexual exploitation and harassment and sexual harassment
SN - irrigation system
UKV - Association of water users
USAID - United States Agency for International Development
USD - American Dollar
WB - World Bank

1. INTRODUCTION

As a reliable partner, The World Bank (WB) provided financial resources to support Bosnia and Herzegovina (BiH) through the Agricultural Resilience and Competitiveness Project (ARCP). The project will be implemented in both entities of BiH (Federation of Bosnia and Herzegovina and Republika Srpska). Sub-projects in Republika Srpska (RS) will be implemented by the Agricultural Projects Coordination Unit - APCU within the Republika Srpska Ministry of Agriculture, Forestry and Water Management (MAŠV RS).

The project supports five broad outcomes:

(i) increased productivity and diversification of agricultural production;
(ii) increased knowledge and adoption of climate-smart agricultural practices and increased resistance of agricultural production to climate change;
(iii) improved integration of smallholder farmers into green and effective value chains with greater gender equality;
(iv) improved water management in agriculture and the introduction of climate-smart irrigation technologies; and
(v) improved food safety and quality standards and increased competitiveness and potential for access to higher value markets.

The Environmental and social management plan refers to the Project for the construction of an irrigation system for agricultural areas at the locality of Garevac cadastral borough, Municipality of Modriča.

The ARCP project is designed to achieve its goals through four components:

- **COMPONENT 1. Strengthening public support to resilience and monitoring,** with the following subcomponents:
  - Pod-component 1.1 – Improvement of agricultural information systems.
  - Pod-component 1.2 – Support to agriculture resistant to climate change.

- **COMPONENT 2. Improvement of agricultural productivity, adaptation to climate change and strengthening of links with markets**, with subcomponents:
  - Pod-component 2.1 – Strengthening the value chain and developing a productive partnership.
  - Pod-component 2.2 – Improvement of irrigation and drainage systems with the aim of adapting to climate change.

    This subcomponent will help improve the development and management of irrigation and drainage systems in the RS and strengthen climate-smart agricultural practices as two key elements of the resilience and adaptation program in agriculture. In RS, access to irrigation enables earlier planting and creates opportunities for double vegetation and crop diversification - all aspects that are crucial for obtaining higher prices due to the possibility of early entry to the market and increased productivity per hectare due to more intensive use of available land. The subcomponent complements investments within subcomponent 2.1 and will be implemented in coordination with commercial investments in value chains.

Specific activities within this sub-component include the following:

(i) **Reconstruction/modernisation of selected irrigation and drainage systems**. This includes investments in the construction of new or rehabilitation of existing water intake infrastructure, main and secondary irrigation networks, including the introduction of modern pressure systems that increase the efficiency of water use. Beneficiaries of the irrigation program are expected to benefit from available state- and EU-sponsored subsidies and matching grant schemes to improve farm irrigation systems, which is key to realizing the return on the overall investment. Infrastructure investments within this sub-component will be supplemented by strengthening market opportunities through grants within sub-component 2.1.

Sub-projects judged to be high risk will be exempted from funding, such as:

- sub-projects for which a potential conflict of interest related to water exploitation could arise;
- sub-projects that use potable water or involve large dams for irrigation schemes;
- extensive and elaborate irrigation schemes located within or adjacent to sensitive areas or could be further expanded in the future.

(ii) **Strengthening institutions for irrigation and drainage management**. This will include building the capacity of the municipalities that benefit from the projects, and establishing and strengthening the participation of water user associations (WUA), municipal public utility companies (PUC) or joint PUCs for participation in the operation and maintenance of systems reconstructed or built within the Project, including the development of arrangements for operation and maintenance; determination, collection and management of fees for irrigation services; modernisation of water management practices on farms to reduce water wastage; and creation of a database on all irrigation systems, including GIS mapping of existing irrigation and drainage networks and assessment of their functionality, which helps municipalities and ministries in managing irrigation and drainage assets and the creation of regular maintenance and irrigation plans. The project will only deal with irrigation systems for which cooperation and operation and maintenance arrangements have been agreed.

- **COMPONENT 3. Improving food quality and safety**, with the following subcomponent:
  - Pod-component 3.1 – Food quality and safety standards.
  - Pod-component 3.2 – Information technology systems for improving food safety.

- **COMPONENT 4. Project management**.

Planned activities within sub-component 2.2 include the construction/rehabilitation of irrigation schemes, which were prepared within the Irrigation development project (Irrigation Development Project - IDP). There are several other potential schemes to be considered for support under the ARCP according to agreed criteria, for which feasibility and design studies have yet to be carried out.

Activities within the Project are planned with the aim of:

1) improvements in agricultural information systems;
2) improving capacity for the production of certified seeds and seedlings and improving advisory services;

3) provision of appropriate grants for purchasers and farmers (in selected sub-sectors: fruits and vegetables and dairy products) in accordance with market requirements;
4) improvement of agricultural infrastructure - water catchment structures, main and secondary irrigation networks;
5) capacity building of municipalities benefiting from the project, municipal public utility companies or associated PUCs in participating in the operation and maintenance of systems renovated or built within the project;
6) development of a database on all irrigation systems, including GIS mapping;
7) strengthening food systems that deal with quality and safety standards related to animal health protection, food safety and protection, and plant protection in cooperation with appropriate laboratories;
8) development and upgrading of IT software and hardware systems to improve national food safety standards.

Project beneficiaries include farmers, agricultural organisations, private enterprises, collectors, agro-processors and collection centres working in the horticulture and animal husbandry subsectors in the project areas. The corresponding grant program will provide technical and financial support to about 30 collectors and 1,000 small farmers in the RS. The project will focus on improving water management in selected project areas, and the main beneficiaries would be private farmers using communal irrigation schemes with a minimum cultivable management area of 30 ha. In the public sector, the project will support the institutional strengthening of the Food Safety Agency of the Ministry of Agriculture and Forestry, state veterinary offices, plant protection authorities and state research institutes, with the aim of achieving 50 percent of trained personnel for vocational training and food safety. Farmers and businesses across the country will benefit from the support provided to public institutions.

The main responsibility for implementation rests with the RS Ministry of Agriculture and Forestry and the RS Agricultural Projects Coordination Unit (APCU). This ministry has experience in implementing Bank-financed projects such as ARDP, IDP and other externally funded agricultural sector projects.
In the past period, RS APCU served as the main unit for the preparation and implementation of agriculture and irrigation projects. APCU has expert staff in agriculture and water management, and in procurement, financial management and general project management and supervision. As part of the APCU, experts in the field of environmental and social issues are also engaged, and they will be engaged in the implementation of this ESMP.

In previous agreements with the World Bank, several projects were successfully implemented in Republika Srpska where investments were made in infrastructure for irrigation and drainage, for example: in Ljubinje field; in 20 local communities of Bratunac municipality; at the location of Maglajani, RS Agricultural Institute Banja Luka; the Osorna canal, the municipalities of Laktaši and Gradiška, with a total system area of 818 ha (+ about 3000 ha, the Osorna canal) for the four proposed project locations, etc.

1.1. World Bank requirements

The World Bank's Environmental and Social Framework (2016) came into force in October 2018. This Framework establishes the bank's commitment to sustainable development through its policy and a set of Environmental and Social Standards designed to support the

Borrowers' projects, in order to end extreme poverty and promote shared prosperity. The Bank's framework consists of three parts:

- Visions of sustainable development - which defines the bank's efforts in terms of environmental and social sustainability
- Environmental and social standards - which determine the mandatory requirements that apply to the borrower and the project
- Environmental and social policy of WB for financing investment projects - which determines the mandatory requirements that apply to the bank

Borrowers and projects must also apply the relevant World Bank requirements, the Environmental, Health and Safety Guidelines Group (EHSG). These are technical reference documents, with general and industry examples of Good International Industrial Practice (GIIP).

The Bank is committed to supporting the Borrowers in the development and implementation of projects that are sustainable in terms of the environment and society, as well as strengthening the capacities of the ecological and social frameworks applied by the Borrowers in the

assessment and management of risks and impacts on the environment and society. For these purposes, the Bank established special ESSs designed to avoid, minimise, or mitigate negative risks and impacts on the environment and society that projects have.

Below is an overview of the World Bank's environmental and social standards as well as a brief explanation of their importance

Table 1. ESSs considered significant for ARCP at the time of assessment

ESS		Significance to ARCP	Significance to the project
ESS1	Assessment and management of risks and impacts on the environment and society	This standard serves as a guideline for the development of E&S instruments, including those developed for the Project: (i) ESMF, (ii) SEP, (iv) LMP and appropriate risk assessment for certain activities carried out within the project.	The Contractor will himself prepare the appropriate documentation based on the recommendations referred to in the ESMP plan, acceptable for the specific construction site/ to the Engineer for review and approval
ESS2	Labour and working conditions	This standard serves as a guideline for creating healthy relations between workers and management. The main risk related to the workforce is the risk of informal work. Risks of unpaid and underpaid work, work overload, poor employment conditions, lack of occupational health and safety measures, denied access to social, pension or health insurance are associated with informal work. In order to ensure the compliance of third parties, i.e. of different contractors with the requirements referred to in ESS2, a checklist was created for checking the workforce and compliance and monitoring and evaluation procedures that should be included in the tender documentation.	Considering the project size, a small number of labour is expected, which will be easier to control during the execution of the works
ESS3	Resource efficiency and pollution management and prevention	This standard establishes the requirements for solving the issues of resource efficiency and pollution prevention and pollution management during the entire life cycle of the project. As most activities involve construction work, the main risk is that contractors will not be familiar with best practices for avoiding or minimising pollution from project activities or avoiding or minimising adverse impacts on human health and the environment. The sitespecific ESMP will serve as guidance for contractors to implement appropriate pollution prevention and management measures.	The contractor will develop a training plan for workers to prevent/remediate the specific type of pollution expected on the project

ESS4	Health care and community safety	This ESS establishes the requirements for avoiding or minimising the exposure of the community to traffic and road safety risks, diseases and hazardous materials related to the project, as well as establishing effective measures for emergency events. The works envisaged in this project will be carried out mainly in remote areas or in areas with no access to the public, and the project does not use or produce hazardous substances and waste. The main risk related to the project relates to the health and safety of the workers involved in ESS2	The contractor will develop a detailed plan for the movement of machinery from the construction site to the main road with an emphasis on the populated area with specific measures to overcome risks in relation to the community
ESS5	Land acquisition, land use restrictions and forced resettlement	This ESS provides guidelines for procedures to avoid forced and economic resettlement or to carry out forced and economic resettlement with the least possible impacts. The sub-project of the Garevac cadastral borough irrigation system construction does not include the possibility of land purchase because these plots are state-owned, and they are given as a concession to agricultural producers/farmers for 25 years of use.	There will be no land purchase on the project
ESS10	Involvement of stakeholders and disclosure of information	This ESS serves as a guideline for the involvement of relevant stakeholders in the project life cycle. In accordance with the requirements of this ESS, a stakeholder involvement plan, including a grievance resolution mechanism, was developed for this project. The main risk is related to the proper implementation of the SEP.	During the project, the contractor will be obliged to inform the stakeholders of the progress of works and actively participate in the elimination of possible disagreements with the local community

WB Guidelines for Ecology, Health and Safety (EHS)

The Environmental Health and Safety (EHS) Guidelines are technical reference documents with general and specific examples of good international practice. The EHS guidelines contain levels of effects and measures that are generally considered achievable in new facilities/structures using existing technology at reasonable costs. These Guidelines contain information on various environmental, health and safety issues that are potentially applicable to all industry sectors.

According to the General EHS Guidelines, effective environmental, health and safety (EHS) management requires incorporating EHS considerations into business processes at the organisation and plant level in an organised, hierarchical approach that includes the following steps:

- Identifying EHS-related hazards and risks as early as possible in the facility development or project cycle, including incorporating EHS considerations into the project site selection process, design process, engineering planning process for capital

requirements, engineering work orders, facility modification authorisations, or changes to schedule plans and processes.

- Involvement of EHS experts who have experience, expertise and competence in assessing and managing effects and risks related to EHS, and performing specialised environmental management functions including preparation of plans and procedures specific to the project or activities that include technical recommendations relevant to the project specified in this document.

Understanding the probability and magnitude of EZS-related risks, based on:

  - Nature of project activities, such as whether the project will generate significant amounts of emissions or wastewater, or involve hazardous materials or processes;
  - Potential consequences for workers, communities or the environment if hazards are not adequately managed, which may depend on the proximity of project activities to the people or environmental resources on which they depend.

- Prioritizing risk management strategies with the aim of achieving overall risk reduction for human health and the environment, with an emphasis on preventing irreversible and/or significant impacts.
- Favouring strategies that eliminate the cause of hazard at the source, for example, by choosing less hazardous materials or processes that avoid the need to control the impact on EHS.
- When avoiding impacts is not feasible, incorporating engineering and management controls to reduce or minimise the possibility and magnitude of adverse consequences, for example, by implementing pollution controls to reduce the level of pollutants emitted to workers or the environment.
- Preparing workers and nearby communities to respond to accidents, including providing technical and financial resources to effectively and safely manage such events, and restoring work and social environments to a safe and healthy state.
- Improving the efficiency of EZS through a combination of continuous monitoring of plant efficiency and effective accountability.

1.2. The aim of social and environmental impact assessment

The aim of preparing the ESMP for the Project for the Garevac cadastral borough irrigation system construction, Municipality of Modriča is to: (i) analyse the policies, legal and administrative framework relevant to the construction of irrigation infrastructure, (ii) analyse available basic data on environmental issues and their trends, (iii) to identify possible negative and positive impacts of the project on the environment, the social segment and proposes mitigation measures, (iv) to specify the key criteria for monitoring the environment quality in the project implementation area; (v) develop guidelines for environment-friendly construction practices; (vi) assist in the inter-institutional coordination and process of public/NGO debates and (vii) to integrate the significant features of the prepared SEP, LMP and ESMF documents for the ARCP.

2. PROJECT DESCRIPTION, LOCATION, PURPOSE AND SIZE

2.1. Description of the proposed new irrigation system

Water supply concept

Two conceptual designs were developed, out of which the first was rejected after a detailed analysis. In the second conceptual design, variants V1, V2, V3 of the organisation of Garevac locality primary irrigation network were considered. Variant 3 was adopted, in which the system is organised on an area of 97ha, out of which the main design refers to an area of 50ha that includes the existing well, and where the expansion of the system is planned in the following phases.

Depending on the crop being grown and irrigation, a certain method is adopted. As part of the concerned project, at the level of its preparation, no specific data on the crops to be grown were adopted. For this reason, a multi-purpose irrigation system was designed that will enable the cultivation of several different crops, so that through further phased development, users could decide on the irrigation method that suits them best.

It was necessary to plan the system as a system with a phased upgrade, due to the planned expansion of the system in the future, as well as an increase in the number of users.

In addition to the phased upgrade of the system, the project will contain general elements that make an integral part of all types of irrigation systems, so further users will develop the system in accordance with the type of irrigation they choose, i.e. depending on the crop they choose to grow.

In the concerned case, in order to examine the existing well at the project location, investigative works were carried out on the well in order to establish its capacity, its condition and the possibility of its implementation in the main project. Prepared document titled "Study on the engineering-geological-geotechnical and hydrogeological research carried out for the pilot area, irrigation development at the Garevac CB location, Municipality of Modriča". The results of measurement, i.e. monitoring of the water level, showed that the exploitation capacity of the existing well is 42 l/s. The maximum permitted lowering of the level is 3.72 m.

The designed irrigation system consists of:

- an existing well,
- designed pumping stations,
- a pump,
- the main distribution pipeline,
- hydrants,
- water manholes and all related water fittings.

Transport infrastructure, i.e. access to the location is via a local macadam road with a width of 3.5 m, which, at the intersection with plot no. 3067, turns into a planned access macadam road with a width of 3.5 m as well.

The macadam road is positioned directly next to the concerned plot of land, and touches it at a single point on its western side.

The designed road provides access to the pumping station structure, the planned transformer station and the 14 m x 10.5 m plateau, which is located directly in front of the entrance to the pumping station structure.

Existing well

A well-type point water intake is located on the concerned location as an existing structure. The study on the engineering-geological-geotechnical and hydrogeological research carried out established the condition of the existing well, as well as its capacity. In a part of the existing condition description, the characteristics of the well are listed which are significant for the further development of the project. In order to ensure that the control and protection of the well is as easy as possible, the main project plans the construction of a building above the well.

The existing well is tapped, as such it must be maintained and cleaned regularly. This document also contains agronomic calculations showing the required amount of water. The required amount of water, i.e. the required maximum capacity in the hydraulic dimensioning of the system is 39 l/s, which automatically means that the exploitation capacity of the existing well of 42 l/s is a sufficient source of water for the designed irrigation system. Further phased upgrading of the system will require new calculations, as well as the discovery and positioning of new water sources.

The pump

In order to select and adopt the type of pump, it is necessary to determine the height of the pump, as shown in Figure 1.

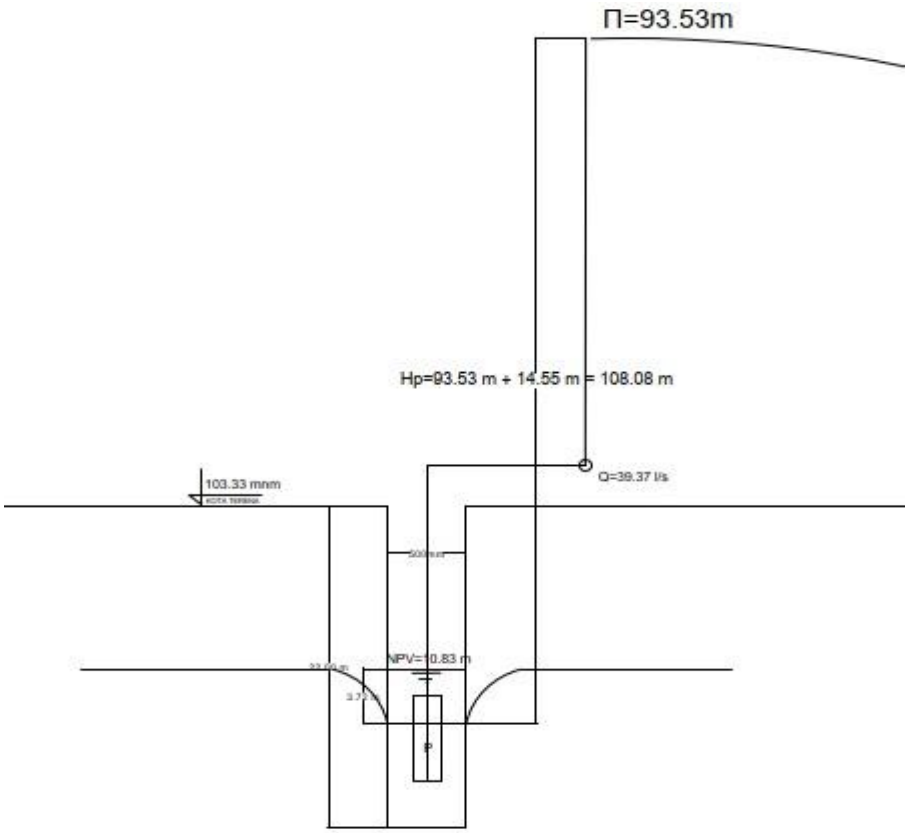


Figure 1. Sketch of the pump's required lift height

A multi-stage pump for horizontal or vertical installation with an underwater motor has been adopted, which meets the required lifting height, flow rate, operating system and installation method. The working characteristics of the pump, as well as a detailed description, can be found below.

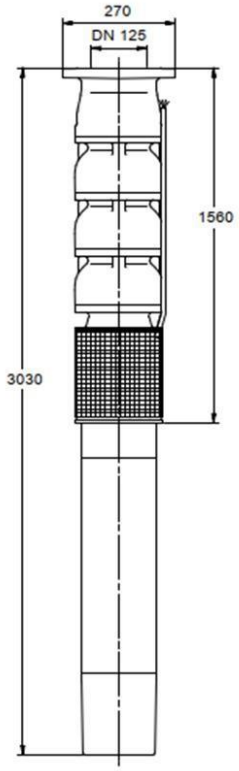


Figure 2 A detail of the adopted submersible pump

The submersible pump adopted as the concerned solution is intended for the transport of clean water medium, maximum temperature 20 ºC and has the following hydraulic characteristics:

Table 2. Hydraulic characteristics of the submersible pump

	Min Permissible flow for permanent stable operation	operation	max
Q (l/s)	14	40	46
H (m)	170	109	80
(more than or equal to) eta(%)	-	76	-
(more than or equal to)			

Pumping station

The concerned pumping station building was designed above the existing well with a diameter of 500 mm. The building is semi-buried, number of floors P+0+Po, rectangular base, dimensions 400 x 600 cm and floor height 310 cm.

Entrance to the building is planned on the south side. From the entrance, you can access the plateau at an elevation of +0.20 from the ground level, and then the staircase, which leads to the bottom of the building, where the pump from the well is connected to the main water pipeline using shaped pieces and plumbing fittings. The pump itself is of the submersible type, as already mentioned in the text, and is located inside a tapped well.

The basic structure of the pumping station building is reinforced concrete. The foundation depth of the building is 1.5 m.

A crane structure was designed for the installation and placement of a 125 kg submersible pump.

Facade walls of the building are planned to be made of aerated concrete blocks, with appropriate thermal insulation of the walls and waterproofing of the underground parts of the building.

The roof structure is wooden, and the roof covering consists of a trapezoidal sheet of appropriate pitch.

Detailed elaboration as well as descriptions related to the pumping station will be processed in further project documentation.

Pipeline

The main distribution pipeline was designed from the pumping station, all the way to the last hydrant located within the water manhole marked as node 1. The diameter of the pipeline was adopted in relation to the hydraulic calculation that was done in EPA NET, guided by the

condition that at the most critical position of the hydrant, we meet the pressure of 7 bar, i.e. 70 m, the diameters are Ø 160 and Ø 180. Its position is downstream of the existing well, which aims to further expand the system in that direction.

PEHD water pipes PN 16 bar (PEHD - high-density polyethylene pipes) will be used as type of pipes. Some of the main characteristics of this type of pipe are flexibility at low and high temperatures, resistance to wear and impact, resistance to corrosion, light weight, resistance to various chemicals and acids. As such, these types of pipes are considered an ideal solution for applications in irrigation systems. The length of the main distribution pipeline will be 960.33m.

The length of the Ø160 mm pipeline is: 714.98 m, while the length of the Ø180 mm pipe is: 245.35 m.

Water manholes

As an integral part of the conceptual design, water manholes are positioned at the locations of planned hydrants. Manholes are reinforced concrete, dimensions of the light opening: 140 cm x 180 cm x 150 cm. The thickness of the walls is 20 cm. Within the project, we have 9 (nine) RC manholes.

Plumbing fittings and shaped pieces are located in the plumbing manholes, and they are used to connect the hydrants to the main pipeline.
As the designed system is planned to be used by different agricultural producers, it was necessary to foresee water metres in each manhole, so that the consumption could be controlled and distributed. The type of water metre that is planned are impulse water metres, as a more advanced version of the water metre.

The primary idea of the irrigation project is the rational consumption of water. In certain periods of the year, month, even day, there will be a situation where one plot needs to be irrigated, while the other does not. In order to ensure alternating (rotational) or controlled irrigation, valves are provided as part of the RC manholes. There are two types of valves: mechanical and electromagnetic.

Inside the manhole, it is necessary to install climbing steps, in order to enable easy access to the network elements. The manholes are closed with a 60 x 60 cm cover, D400 type.

Hydrants

The irrigation system is designed with general elements and the possibility of phase upgrades. An indispensable system element is the hydrant. The number of hydrants planned in this phase of the project is 9 (nine).

The type of hydrants planned as part of the solution are DN 80 underground hydrants, which are located inside the water manholes, and which must be installed together with all the accompanying design elements, and placed in vertically.

The hydrant cap should also be installed, in order to provide access to the hydrant bonnet.

In order to provide uninterrupted functioning to the most distant user, it is necessary that the pressure at the last hydrant be 7 bar, that is, 70 m.

The hydrants will work according to the schedule that is adopted after the organisations of the irrigation system users on the plots.

The concerned area of 50ha consists of several different plots (cadastral plots). For this reason, the hydrants are positioned on plot borders, in order to ensure unhindered access for the users of the surrounding plots.

Figure 3 Underground hydrant

2.2. Considered variants

According to the terms of reference submitted by the municipality of Modriča, hereinafter referred to as the Investor, the selection of the location where the agricultural areas irrigation system project will be implemented was started. Agricultural plots in locations belonging to the following cadastral boroughs were analysed:

- Miloševac cadastral borough (Krušici locality),
- Garevac cadastral borough (Jabuka locality) and
- Dobrinja cadastral borough (Pašinac locality),

all in the Modriča municipality area. Due to the proximity of the locations of Jabuka and Pašinac, these locations were analysed and observed as a single entity.

The designer was given the task of observation and analysis in order to single out one site in the area of Miloševac and the other between Garevac and Dobrinja. It is planned to analyse the scope for irrigation up to 150 ha in size, which represents one unit, and within that scope to define an area of 30 to 50 ha on which the project will be implemented and for which all the necessary documentation will be prepared.

After a visit to the field, consultations with the Investor, interested users of the irrigation system, as well as analyses of valid documentation, additional guidelines were generated:

It was necessary to plan the system as a system with a phased upgrade, due to the planned expansion of the system in the future, as well as an increase in the number of users. In addition to the phased system upgrade, the project will contain general elements that are an integral part of all types of irrigation systems, so further users will develop the system in accordance with the type of irrigation they choose, i.e. depending on the crop they choose to grow.

- **Krušici locality, Miloševac cadastral borough**

The cadastral municipality of Miloševac belongs to one of the 17 rural local communities comprised by the Municipality of Modriča. The locality of Miloševac covers an area of 17.17 km^2. According to the 2013 census, the number of households in this cadastral municipality was 471, and the population was 1,323.

In Miloševac cadastral borough, it was planned to design an irrigation system on agricultural areas of about 40ha.

The area has a favourable geographical position. The Bosna River is located about 2 km northwest of it. The agricultural land in this locality is of the first land capability class and mostly owned by individual agricultural producers of the municipality of Modriča who are engaged in fruit (nursery production), vegetable and crop growing. The altitude of this area is balanced at about 90 masl.

By visiting the subject Krušica site, two wells were located in the site's vicinity.

Figure 4 Razmatrana lokacija „Krušik“ u k.o. Miloševac

However, both are incorporated in the water supply systems of the population and could not be taken into further consideration as sources of irrigation for the project in question. Wells are included in water supply systems as follows:

1. the artesian well, which was planned as a source of the irrigation system according to the terms of reference, was handed over to the relevant utility company a.d. „Vodovod i kanalizacija-Modriča“ MODRIČA, in order to expand the city's water supply system for the population, and could not be taken into consideration for the concerned project.
2. the second on-site well that became a target of interest, was immediately rejected as a new source for the reason that the local population testified that it was included in the local water supply system of the surrounding hamlets.

Based on the facts, the irrigation project implementation at this location was abandoned.

- **Jabuka locality, Garevac cadastral borough and Pašinac locality Dobrinja cadastral borough**

Due to the proximity of the locations of Jabuka and Pašinac, these locations were analysed and observed as a single entity.

The agricultural land in this locality comprises of a high number of plots of the second to fourth land capability class. In this area, arable crops are mainly grown for the needs of dairy and fattening cattle farms and for commercial production.

For the concerned location, two state-owned areas A1 (Jabuka) and A2 (Krušik) (marked in the following figure) with an area of 137ha were analysed. An existing irrigation well is located within plot A1 and is intended to be used in the irrigation system. Within plot A2, the positions of 2 potential newly planned wells are marked. Technical documentation has been created for these wells, which can be used when creating new technical documentation.

Parts of the proposed plots are under concession or leased to private individuals, but they are fully owned by the state, which in this case facilitates the further development of the project.

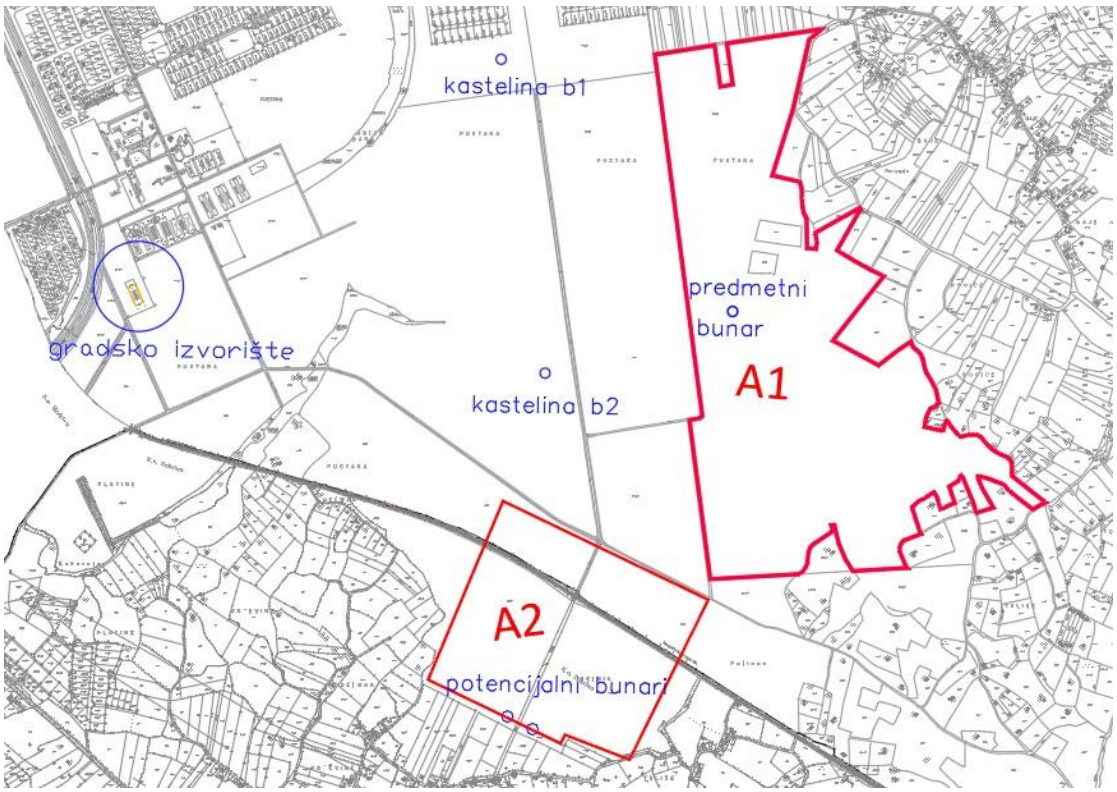


Figure 5 Jabuka (A1) and Krušik (A2) locations

According to the terms of reference, the area on which the irrigation project will be implemented should be in a range of 30-50 ha.

In order to determine the exact location where the project will be implemented, i.e. the construction of an irrigation system, variant solutions were developed in this location.

VARIANT 1

n VARIANT 1 considered to include parts of A1 and A2 areas, in such a way that parts of both proposed areas are taken and the existing well is included. However, the total analysed area of 104.30 ha significantly exceeded the required area of 30-50 ha referred to in the terms of reference.

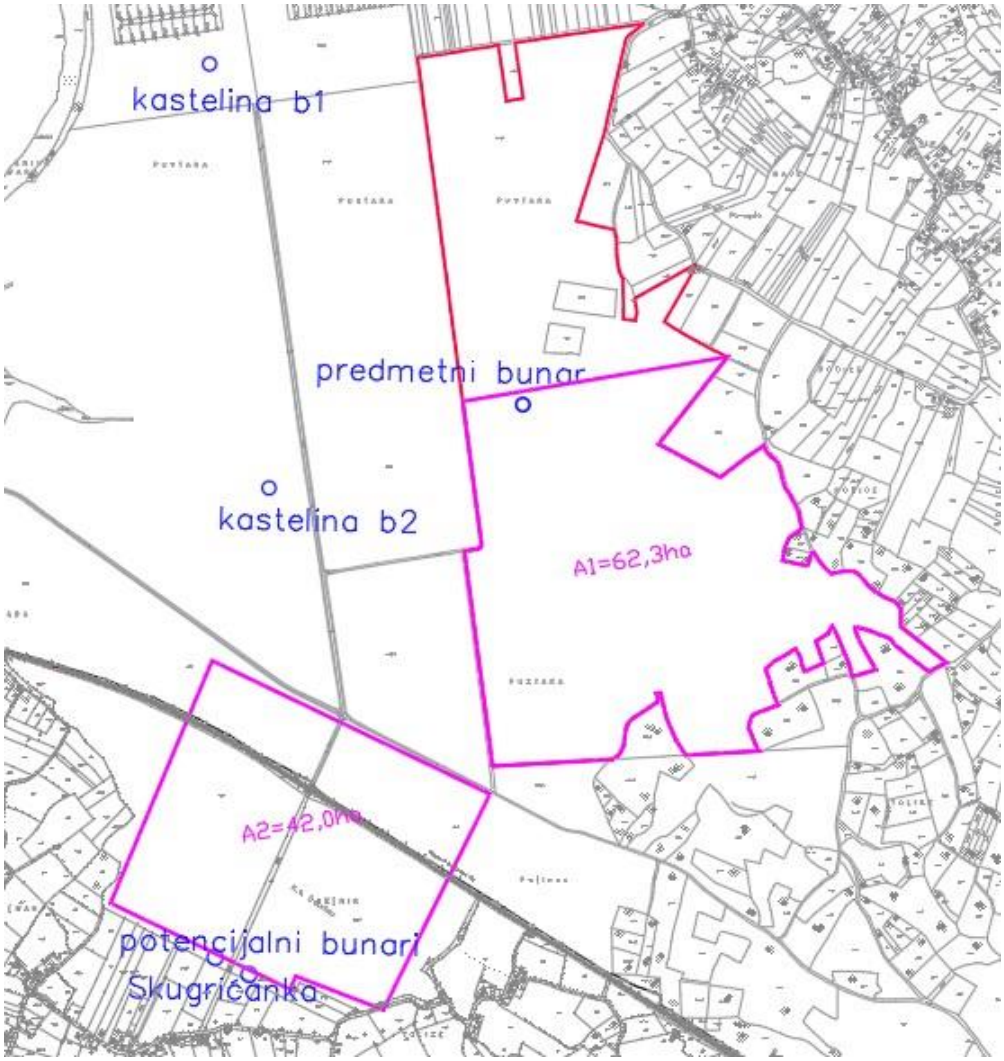


Figure 6. Variant 1

VARIANT 2

Variant 2 included more parameters in the analysis. In addition to the balance of areas, the possibilities of connection to the electrical grid as well as the connection of A1 and A2 areas were considered. The existing power line is over 1km away in a straight line from the location of the well. Separate plots according to this variant were also rejected for the reason that 2 irrigation systems are not established, that is, several kilometres of pipelines and supporting structures are not built. The chosen variant, at this moment of irrigation system development, must be economically justified.

In consultation with the Investor, it was decided that, for the beginning, for the first phase of the irrigation system construction, a single area around the existing well should be determined, and that emphasis should be placed on the possibility of expanding the irrigation system in the future.

As the well in question is located on plot 2673/1, which is owned by Republika Srpska and has a total area of approx. 97ha, it was decided to allocate 50ha for the project implementation within this plot, concentrating around the location of the existing well and lowering the surface southwards to the existing access roads.

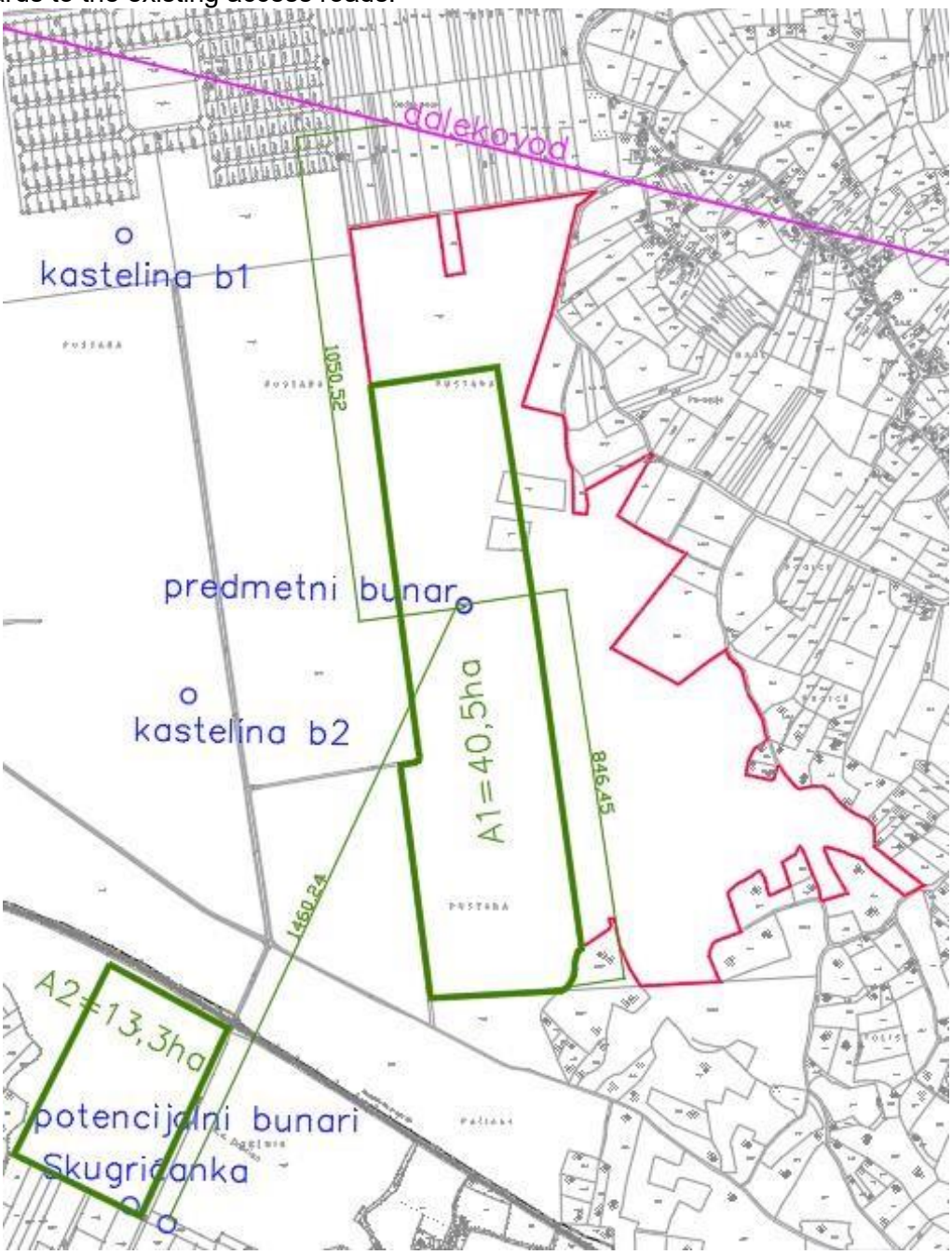


Figure 7 variant 2

During the preparation of variants, the Investor received data on the lease of state land, shown in the following picture. Plot 2673/1 is divided into several parts and leased to different users. These data facilitated the selection of an area of 50 ha for irrigation, which was processed in variant 3.

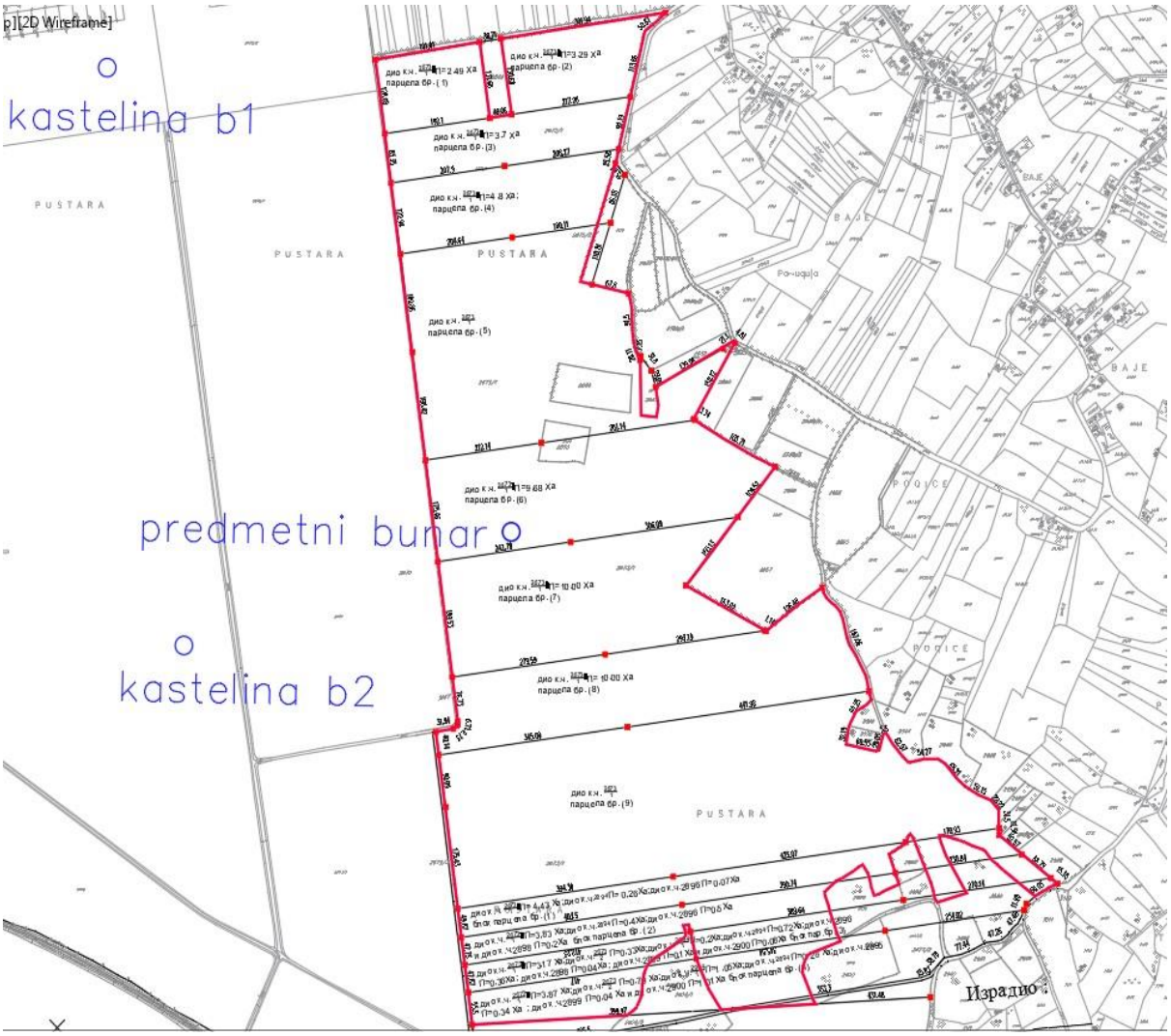


Figure 8. plot 2673/1 allocated for lease

VARIANT 3

As part of variant 3, an agricultural plot at the location of Jabuka Garevac cadastral borough was considered. Total area is about 97ha. Within that area, plots of approx. 50ha (green line) have been set aside for the project implementation. The existing well is located in the selected area. The optimal variant was selected, observing it from the technical, user and economic aspects.

As there is a high number of agricultural areas in the entire area of the cadastral borough and the municipality of Modriča itself, it is highly likely that such a compact irrigation system would be the trigger for the further development of local and regional irrigation in the following phases.

In the next stages of the irrigation system development, the irrigation requirement should also be taken into account on the plots of the "Skugrićanka" concessionaire, as well as the existing technical documentation of potential "Skugrićanka" wells.

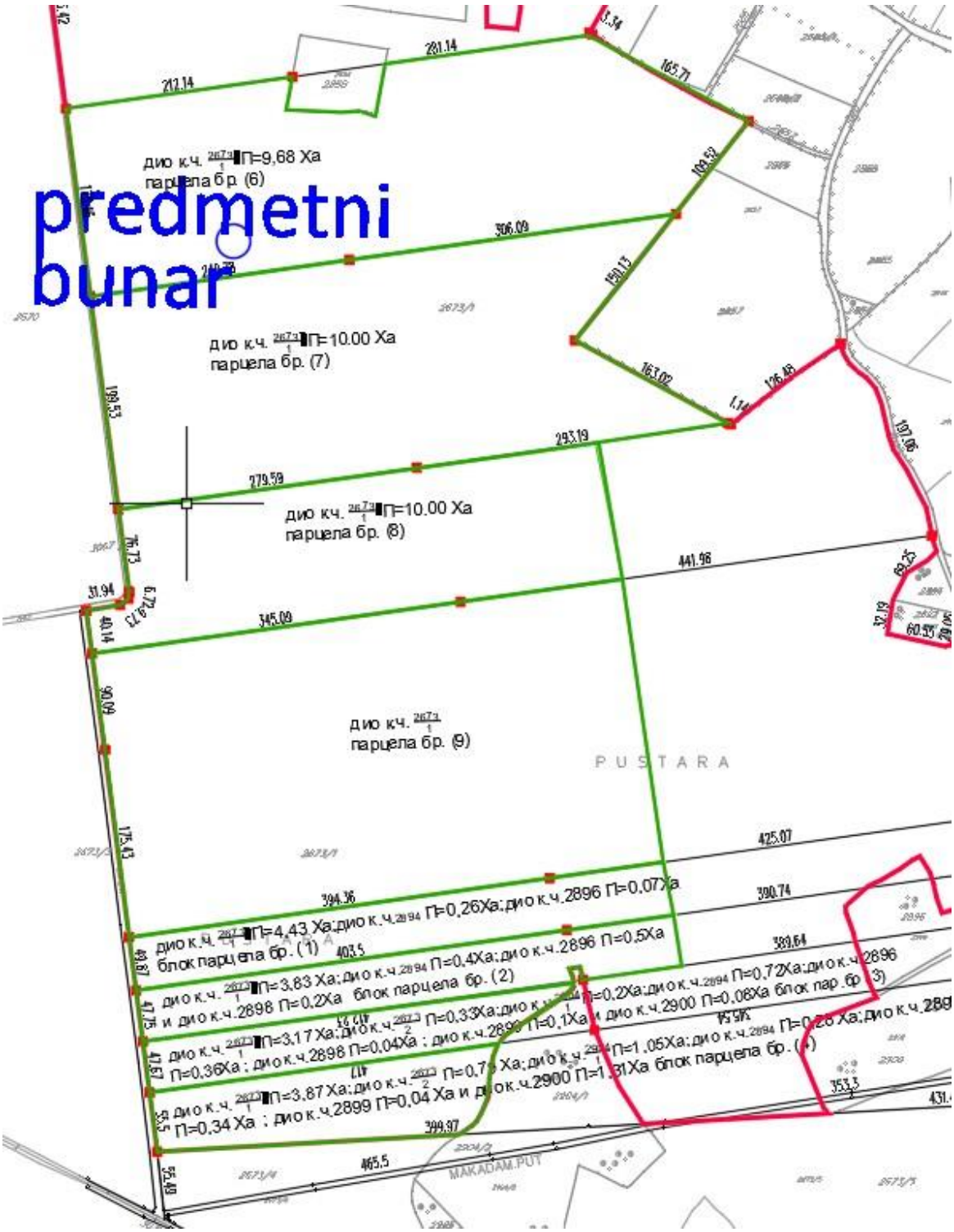


Figure 9. adopted variant 3

After a detailed analysis, variant 3 was adopted, which organises the irrigation system on an area of 50ha, within which there is an existing well, and for this scope documentation is further elaborated.

2.3. Description of the project location

The site in question, where the irrigation system construction is planned, is situated within the Garevac cadastral borough, Municipality of Modriča.

The area of Modriča municipality is located in the northeastern Republika Srpska, it is spread over three geographical areas covering a small part of each of them: part of the Bosnian Posavina plain with the Bosna river valley, the area of the Vučijak mountain massif on the left Bosna river bank and the area of the Trebava mountain massif on the right Bosna river bank. It borders the town of Gradačac in the east, the municipality of Šamac in the northeast, the city of Doboj in the west and south, the municipality of Vukosavlje in the north, and a smaller part of the city of Derventa in the northwest.

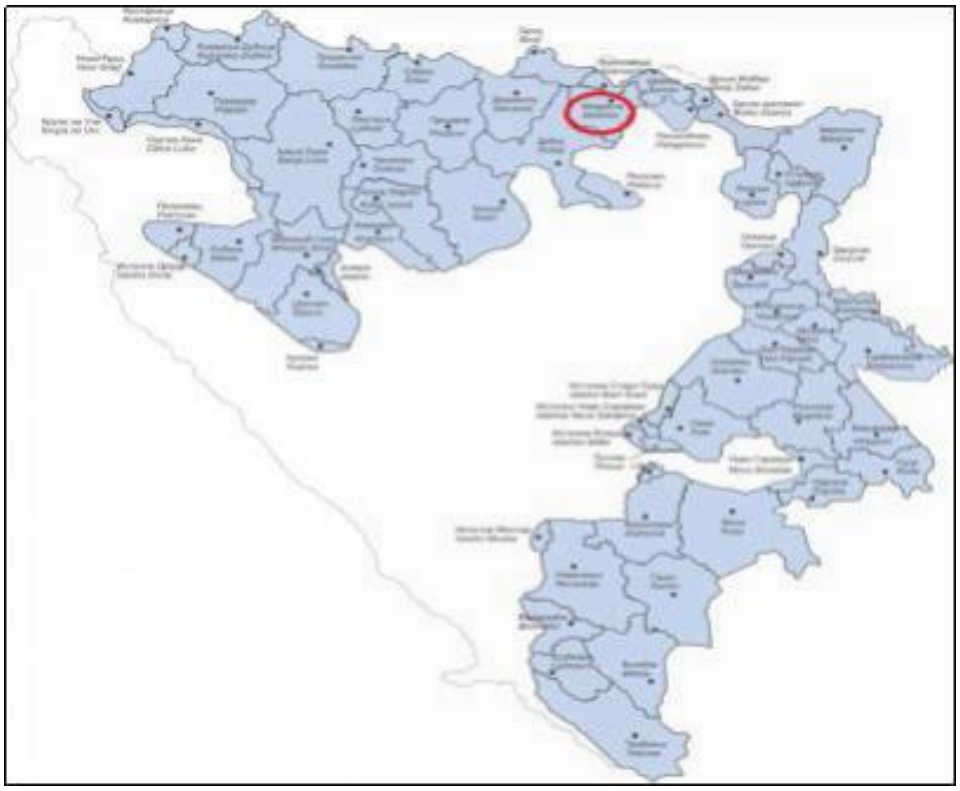


Figure 10. Geographical location of the research area, the area marked in red

Due to its climatic and orographic characteristics, the Municipality of Modriča is predestined for the development of various types of agricultural production. It covers an area of 36,300 hectares. Out of the total area, agricultural areas occupy 21,322 hectares. The structure of agricultural areas is as follows: arable land 72.50%, orchards 10.25%, meadows 5.62% and pastures 11.63%.

The territory of Modriča includes a total of 24 local communities, 5 urban (Modriča I, Modriča II, Modriča III, Modriča IV, Modriča V), 2 suburban (Dobrinja, Tarevci) and 17 rural (Babešnica, Borovo Polje, Botajica, Vranjak, Vranjak 1, Garevac, Dugo Polje, Kladari Gornji, Kladari Donji, Koprivna, Koprivnska Trebava, Krčevljani, Miloševac, Riječani, Skugrić, Tolisa and Čardak).

Micro-location

Garevac cadastral borough belongs to one of the 17 rural local communities, comprised by the Municipality of Modriča. The locality of Garevac covers an area of 17.50 km^2. According to the 2013 population census, the number of households in this cadastral borough was 899, and the number of inhabitants was 2993. According to the data from the last census, this local community is the most numerous rural community in the Modriča municipality area.

The agricultural land in this locality comprises of a high number of plots of the second to fourth land capability class. In this area, arable crops are mainly grown for the needs of dairy and fattening cattle farms and for commercial production.

The location where irrigation development is analysed and planned is located southeast of the Modriča centre at about 4000 m. The position of the site is at an altitude of up to 105 m, the terrain is flat, surrounded by agricultural land. The plots belong to Garevac cadastral borough, are owned by the state and are given under concession and lease to agricultural users for a period of 25 years. It is important to emphasise that all plots included in the project are stateowned and that there are no private plots, so there is no impact related to permanent or temporary expropriation of land. Also, it is important to note that in no case will there be restrictions on access to plots by the lender, while the Contractor will be careful not to cause damage to agricultural crops, which will be dealt with in more detail in the description of measures for prevention, mitigation and monitoring of the project's harmful effects on the environment.

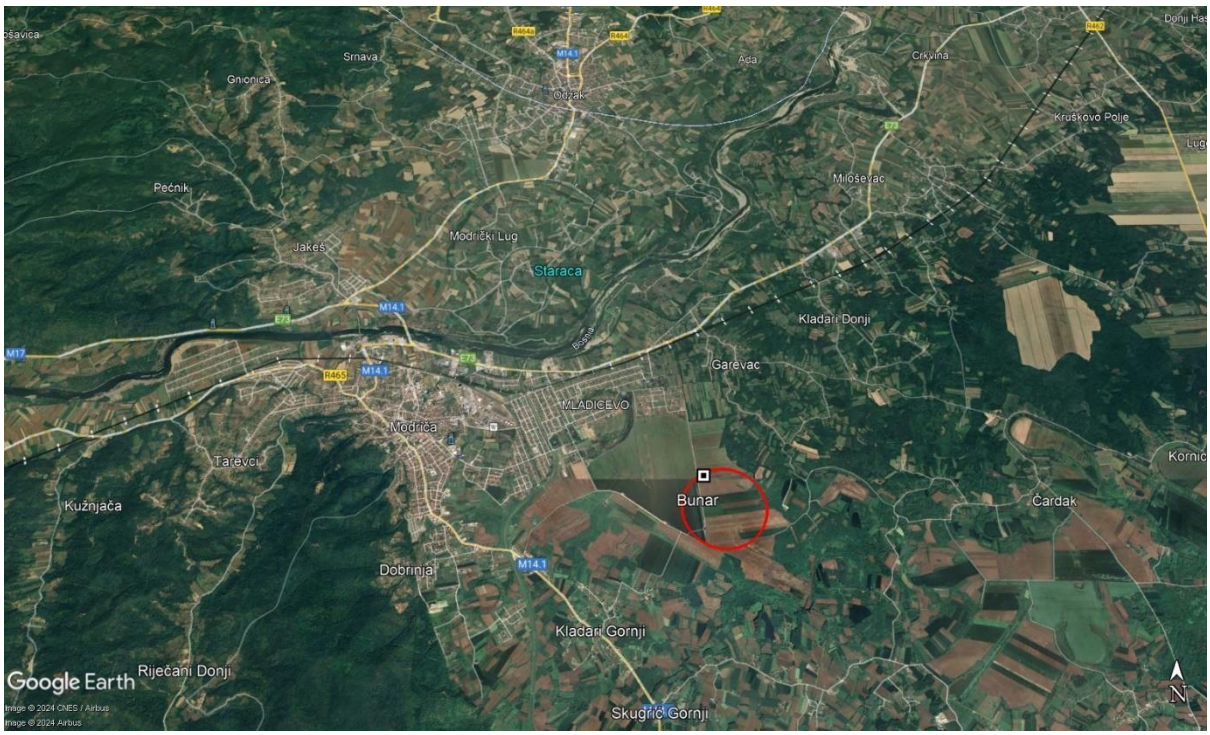


Figure 11. wider locality of the subject area

Access to the site is via a macadam road, which for the purposes of the project will be sufficiently repaired to withstand the passage of mechanisation during construction but also during use - the road remains macadam. The nearest residential buildings are located approx. 550 m northeast and approx. 900 m north of the location. The source of the "Modriča field" waterworks is located approximately 1,800 m to the west, while the Modriča - Šamac railway line and the M17 main road are located approximately 2,000 m to the north. The distance of

the Bosna River as the main watercourse in the observed area is 2600 m northwest of the location. Possible temporary adverse effects as a result of the irrigation system construction and operational activities at the Garevac project location may be short-term traffic interruptions on the access roads to the agricultural land. The location is not covered by the city's sewage network, nor is it provided with electricity.

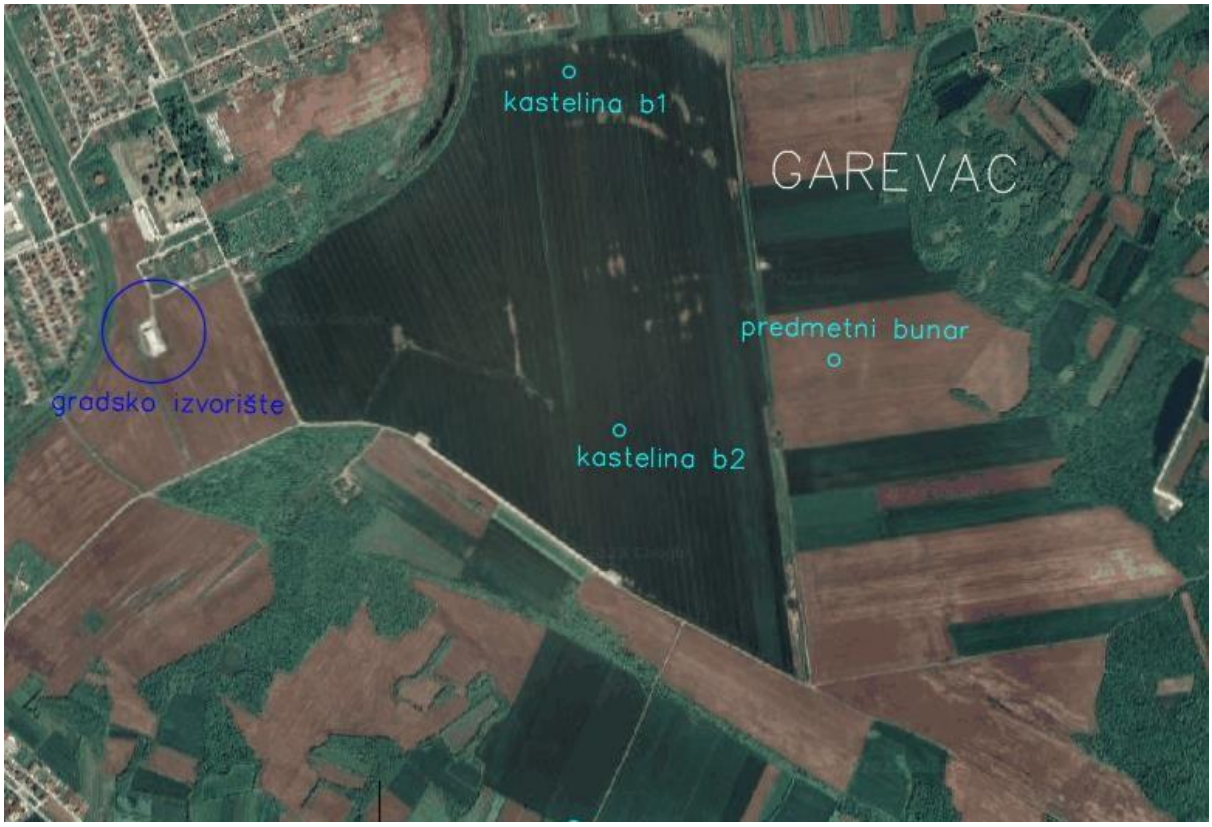


Figure 12. Scope of the Project for the construction of irrigation systems for agricultural areas

2.4. History of agricultural production at the site

The Municipality of Modriča covers an area of 36,300 hectares. Out of the total area, agricultural areas occupy 21,322 hectares. The structure of agricultural areas is as follows: arable land 72.50%, orchards 10.25%, meadows 5.62% and pastures 11.63%.

The land area of 50 ha at the location of "Jabuka" Garevac cadastral borough, which is the subject of the Main Irrigation Project, is owned by the state and is currently used for the production and cultivation of arable crops. In the mentioned area, production is carried out by agricultural producers engaged in milk production and fattening cattle. Furthermore, it is planned to be leased by private users, who will engage in agricultural production and use irrigation systems.

The main reasons for irrigating agricultural areas are: increasing the yield of plant crops, stabilising production in dry periods and changing the sowing structure, orientation towards the market economy and highly profitable crops, reduced supply of domestically produced vegetables, global climate change, water shortage, reduction of available space for food production, accessible available water capacities, high level of underground water, negative water balance in the growing season.

2.5. Description of previously used irrigation systems

Due to the variability of rainfall and the lack of moisture in the summer period, the production of spring plant species is significantly limited, endangered and practically unprofitable without the use of irrigation.

Bearing in mind that there is no irrigation system on this land complex, while there are underground water resources and the possibility to apply irrigation, considering that in the immediate vicinity there are also wells that are used for water supply of the city of Modriča, as well as local wells.

On the plot in question there is a well that is planned to be an exploitation well for the irrigation system. In the form of exploratory works, a Study on the engineering-geological-geotechnical and hydrogeological research carried out was prepared, where information was obtained that the capacity of the well in question on the day of exploratory works was: Q=42 l/s, and it was concluded that a significant amount of water can be exploited from the said well, without major consequences for other users on this terrain.

The irrigation system is planned to be built in accordance with the users' requirements and the structure of production with the application of new technologies and modern methods of irrigation.

2.6. Water demand

Irrigation mostly depends on the climatic characteristics of the area, today there are different methods and criteria for determining the irrigation requirement when growing cultivated plants. The most reliable assessment of the irrigation requirement is obtained by analysing the available and required amount of water for each month in the growing season. If the available water is subtracted from the total amount of water, the irrigation rate is obtained, i.e. the amount of water that is missing and must be compensated by irrigation.

The following parameters were determined for the calculation of the required irrigation water amount:

- reference evapotranspiration
- effective precipitation
- water demand
- relevant consumption

Data from the Slavonski Brod meteorological station for a period of 30 years (1989-2018) were used for the analysis of climatic parameters for irrigation purposes.
The calculation of potential evapotranspiration, effective precipitation, plants' water requirement, irrigation program was performed using the FAO methodology:

2.6.1. Reference evapotranspiration (ETo)

The amount of water that is necessary for the growth and development of plants is identical to the value of evapotranspiration. Evapotranspiration represents the loss of water by evaporation from the soil surface, as well as the loss by transpiration from plants. Total evapotranspiration today is obtained indirectly or by methods based on climatic elements: temperature, relative air humidity, wind speed and solar radiation. In order to determine the plants' water demand, in addition to the reference evapotranspiration, precipitation data is also needed. Reference

evapotranspiration (ETo) is the water that is lost by evapotranspiration from a certain surface in a certain time, that is, it is the evapotranspiration of an 8-15 cm high grass cover, which completely shades the surface and does not lack water. The Penman-Monteith method was used to calculate the reference evapotranspiration.

Table 3. Reference evapotranspiration according to the Penman-Monteith method, Modriča (1989 – 2018)

month	average monthly				work in	evapotranspiration	
	temp. °C	air humidity %	wind speed u m/s	sunshine h/day	mm/day day	mm/month	mm/mj
January	0.6	85	1.2	2	4.4	0.36	11.16
February	2.7	78	1.4	3.2	7.1	0.68	19.04
March	7.3	71	1.6	4.6	11.2	1.4	43.4
April	12.2	70	1.5	6	15.8	2.3	69
May	16.8	71	1.5	7.6	19.9	3.3	102.3
June	20.4	72	1.4	8.5	22	4	120
July	22.3	71	1.3	9.2	22.4	4.29	132.99
August	21.8	72	1.2	8.7	19.9	3.81	118.11
September	16.4	77	1.2	6	13.7	2.34	70.2
October	11.4	81	1.1	4.5	9	1.26	39.06
November	6.4	84	1.2	2.6	5.1	0.65	19.5
December	1.4	86	1.2	1.6	3.6	0.38	11.78
∑×	**11.6**	**77**	**1.3**	**5.4**	**19.3**	**2.06**	**756.54**

In the area of Modriča, the annual evapotranspiration is 756.57 mm, which is an average of 2.06 mm/day. The highest reference evapotranspiration is in July (132.99 mm/month or 4.29 mm/day) and June (120 mm/month or 4.29 mm/day), and the lowest is in December and January, 11.88 and 11, 16 or 0.38 and 0.36 mm/day, respectively.

2.6.2. Effective precipitation (Eff)

Not all precipitation is usable for plants, a part is lost through surface runoff and percolation into deeper layers, and the other part remains on the plants and evaporates directly. For the above reason, the term Effective precipitation was introduced. Effective precipitation is part of the precipitation that the plant uses for evapotranspiration, and it is located in the zone of the physiologically active soil layer. The value of effective precipitation is about 85% of the total precipitation, which depends not only on the physical and chemical properties of the soil, but also on the amount, distribution and intensity of precipitation, the slope of the terrain and other factors. Effective precipitation is calculated using a method developed by the United States Bureau of Reclamation (USBR) exclusively for calculating irrigation water.

Station: Modrièa

Eff. rain method: USDA Soil Conservation Service formula:
Peff = Pmon * (125 - 0.2 * Pmon) / 125 for Pmon <= 250 mm
Peff = 125 + 0.1 * Pmon for Pmon > 250 mm

	Rain mm	Eff rain mm
January	48.8	45.0
February	43.8	40.7
March	48.5	44.7
April	60.9	55.0
May	77.1	67.6
June	86.0	74.2
July	77.5	67.9
August	63.9	57.4
September	79.8	69.6
October	71.7	63.5
November	65.3	58.5
December	57.4	52.1
Total	780.7	696.1

Table 4. Precipitation and effective precipitation Modriča 1989 – 2018 in a dry year

precipitation	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	year
1989-2018													
total	48.8	43.8	48.7	60.9	77.1	86	77.5	63.9	79.8	71.7	65.3	57.4	781
Eff	45	40.7	44.7	55	67.6	74.2	67.9	57.4	69.6	63.5	58.5	52.1	696
75 % probability (drought)													
total	27.2	22.5	38.9	35.2	43.8	54.4	47	28.7	47.8	44.2	46	30.8	467
Eff	27.9	20.6	31.6	30.6	36.3	44.8	38.5	36	38	28.2	34	22.8	391

2.6.3. Relation between ETo and Eff

The relation between reference evapotranspiration, precipitation and effective precipitation, and between reference evapotranspiration and 75% precipitation is shown in the following tables.

For the multi-year average, the difference between reference evapotranspiration and effective precipitation amounts to 189 mm, that is, effective precipitation is 189 mm less than evapotranspiration, while this difference in the vegetation period is 307.7 mm. With a precipitation probability of 75%, the difference between reference evapotranspiration (ETo) and effective precipitation (Eff) is 511.7 mm per year, or 493 mm in the vegetation period. Higher

reference evapotranspiration than effective precipitation indicates the irrigation requirement, and we get a more complete picture of the irrigation requirement by balancing the water in the soil. The relationship between evapotranspiration, precipitation and effective precipitation in an average and dry year is shown in the following figure.

Table 5. Monthly evapotranspiration, precipitation and effective precipitation in an average year, Modriča 1989 – 2018

months	ETo	precipitation	Eff	ETo	precipitation	Eff
	mm/month	mm/month	mm/month	mm/month	mm/month	mm/month
	A	B	C	A1	B1	C1
	annually			in the vegetation period		
January	11.2	48.8	45			
February	19	43.8	40.7			
March	43.4	48.5	44.7			
April	69	60.9	55	69	60.9	55
May	102.3	77.1	67.6	102.3	77.1	67.6
June	120	86	74.2	120	86	74.2
July	133	77.5	67.9	133	77.5	67.9
August	118.1	63.9	57.4	118.1	63.9	57.4
September	70.2	79.8	69.6	70.2	79.8	69.6
October	39.1	71.7	63.5			
November	19.5	65.3	58.5			
December	11.8	57.4	52.1			
Sum	756.6	780.7	696.2	612.6	445.2	391.7
	A-C=60,4 mm			A-C=221,0mm		

Table 6. Monthly evapotranspiration, precipitation and effective precipitation in a dry year Modriča 1989 – 2018

months	ETo	precipitation	Eff	ETo	precipitation	Eff
	mm/month	mm/month	mm/month	mm/month	mm/month	mm/month
	A	B	C	A1	B1	C1
	annually			in the vegetation period		
January	11.2	27.2	26			
February	19	22.5	21.7			
March	43.4	38.9	36.5			
April	69	35.2	33.2	69	35.2	33.2
May	102.3	43.8	40.7	102.3	43.8	40.7
June	120	54.4	49.7	120	54.4	49.7
July	133	47	43.5	133	47	43.5
August	118.1	28.7	27.4	118.1	28.7	27.4
September	70.2	47.8	44.1	70.2	47.8	44.1

October	39.1	44.2	41.1			
November	19.5	46	42.6			
December	11.8	30.8	29.3			
Sum	756.6	466.5	435.8	612.6	256.9	238.6
	A-C =320.8 mm			**A-C=374.0mm**		

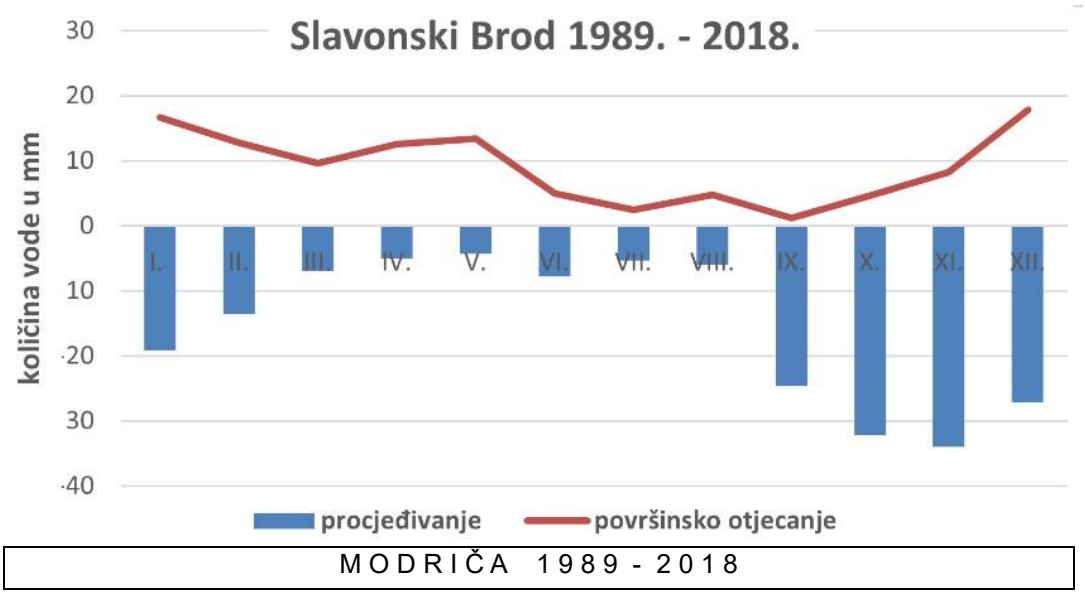


Figure 13 The ratio of evapotranspiration, precipitation and effective precipitation in an average and dry year

2.7. Crop water requirements

2.7.1. Evapotranspiration of crops (ETc)

Evapotranspiration of crops (Etc) is calculated by multiplying the reference evapotranspiration and the crop coefficient:

ETc = ET x Kc

ETc - evapotranspiration of crops,
ET - reference evapotranspiration (calculated according to the Penman-Monteith method), Kc - crop coefficient

Evapotranspiration of crops is higher the longer the growing season and for those crops whose critical period for water is during July and August when evapotranspiration is the highest. Four developmental stages (phases) are important for irrigation purposes:

- **initial stage of development – A**: from the beginning of sprouting or the movement of vegetation up to 10% of the area covered by the crop,
- **developmental stage – B**: continues after the initial stage and lasts until the complete development of the vegetative mass of woody plants, i.e. the beginning of the flowering of herbaceous crops, which is when the LAI reaches the value of 3.
- **middle stage – C:** continues after the development stage and lasts until the beginning of technological maturity, which is reflected in the yellowing or falling of the leaves,
- **late or final stage of the crop – D**: lasts from the end of the middle stage until harvest.

The crop coefficient reflects the physiology of crops and the degree of soil coverage, and the coefficients of crops for certain stages of development (initial, developmental, middle and late) are shown in the table. The lowest water consumption is in the initial (A) and late (D) stages, and the highest in the middle (C) stage.

Table 7. Appearances and duration of a certain stage of development of certain crops by month

crop	duration of a certain stage (phase) of a crop			
	initial -A	developmental - B	middle - C	late - D
wheat - winter	October -February	March	April - May	June
barley - winter	October - March	April	May	June
corn - mercantile	May	June	July - August	September
triticale	October - March	April	May	June
sunflower	April	May - June	July - August	September
oilseed rape	September - February	March	April- May	June
sugar beet	March - April	May - June	July - August	September
tomato	May	June	July - August	September
onion	October - March	April	May	June-July
beans	May	June	July	August
cabbage	June	July	August	September
potato	March - April	May - June	July	August
carrot	March - April	May	June	July
parsley	March - April	May	June	July
corn -silage-double cropping	July	August	September	October
buckwheat-double cropping	June	July	August	September
pasture	all stages in one month (four mowings on average)			
lawns -DTS	all stages in one month (four mowings on average)			
alfalfa	all stages in one month (four mowings on average)			
soybeans	April	May - June	July - August	September
apple	April	May	June - August	September
hazelnut	April	May	June - August	September
pear	April	May	June - August	September
walnut	April	May	June - August	September
rose hip	April	May	June - August	September

plum	April	May	June - August	September
sour cherry	March - April	May	June	July

Table 8. Appearances of a certain stage by month

crop	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
wheat - winter	1	1	2	3	3	4				1	1	1
barley - winter	1	1	1	2	3	4				1	1	1
corn - mercantile					1	2	3	3	4			
triticale	1	1	1	2	3	4				1	1	1
sunflower				1	2	2	3	3	4			
oilseed rape	1	1	2	3	3	4			1	1	1	1
sugar beet			1	1	2	2	3	3	4			
tomato					1	2	3	3	4			
onion	1	1	1	2	3	4	4			1	1	
beans					1	2	3	4				
cabbage						1	2	3	4			
potato			1	1	2	2	3	4				
carrot			1	1	2	3	4					
parsley			1	1	2	3	4					
corn -silage-double cropping						1	1	2	3			
buckwheat-double cropping						2	2	3	4			
pasture					1	3	3	4				
lawns -DTS					1	1	1	1	1	1		
alfalfa					1	1	1	1	1	1		
soybeans				1	2	2	3	3	4			
apple				1	2	3	3	3	4			
hazelnut				1	2	3	3	3	4			
pear				1	2	3	3	3	4			
walnut				1	2	3	3	3	4			
rose hip				1	2	3	3	3	4			
plum				1	2	3	3	3	4			
sour cherry			1	1	2	3	4					

Table 9. Crop coefficients (kc) by stages of development

crop	crop coefficient (kc)			
	initial -A	developmental - B	middle - C	late - D
wheat - winter	0.3	1	1.05	0.25

barley - winter	0.3	0.9	1.05	0.25
corn - mercantile	0.4	0.75	1.1	0.55
triticale	0.3	0.9	1.05	0.25
sunflower	0.35	0.75	1.1	0.75
oilseed rape	0.35	0.6	1.05	0.4
sugar beet	0.45	0.8	1.1	0.65
tomato	0.6	1.05	0.9	0.15
onion	0.3	0.4	0.95	0.75
beans	0.35	0.75	1.1	0.7
cabbage	0.4	0.9	0.95	0.85
potato	0.35	0.6	1.05	0.7
carrot	0.45	0.85	1	1
parsley	0.4	0.85	1	1
corn -silage-double cropping	0.4	0.75	0.83	0.55
buckwheat-double cropping	0.4	0.8	1	0.6
pasture	0,85			
lawns -DTS	0,85			
alfalfa	0,85			
soybeans	0.35	0.75	1.1	0.75
apple	0.5	0.75	1.1	0.85
hazelnut	0.5	0.75	1.1	0.85
pear	0.5	0.75	1.1	0.85
walnut	0.5	0.75	1.1	0.85
rose hip	0.5	0.75	1.1	0.85
plum	0.5	0.75	1.1	0.85
sour cherry	0.5	0.75	1.1	0.85

Tables below show the evapotranspiration of crops that are planned to be grown in the project area, by individual stages of growth and development, i.e. by month.

Table 10. Evapotranspiration of crops (ETc).

crop	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**IX**	**X**	**XI**	**XII**
reference	11.16	19.04	43.4	**69**	**102.3**	**120**	**132**	**118.11**	**70.2**	**39.06**	**19.5**	**11.78**
wheat - winter	3.35	5.71	43.4	72.45	107.42	30	0	0	0	11.72	5.85	3.53
barley - winter	3.35	5.71	13.02	62.1	107.42	30	0	0	0	11.72	5.85	3.53
corn - mercantile	0	0	0	0	40.92	90	146.29	129.92	38.61	0	0	0
triticale	3.35	5.71	13.02	62.1	107.42	30	0	0	0	11.72	5.85	3.53
sunflower	0	0	0	24.15	76.73	90	146.29	129.92	52.65	0	0	0
oilseed rape	3.91	6.66	26.04	72.45	107.42	48	0	0	24.57	13.67	6.83	4.12
sugar beet	0	0	19.53	31.05	81.84	96	146.29	129.92	45.63	0	0	0
tomato	0	0	0	0	61.38	126	119.69	106.3	10.53	0	0	0
onion	3.35	5.71	13.02	27.6	97.19	90	99.74	0	0	11.72	5.85	3.53
beans	0	0	0	0	35.81	90	146.29	82.68	0	0	0	0
cabbage	0	0	0	0	0	48	119.69	112.2	59.67	0	0	0
potato	0	0	15.19	24.15	61.38	72	139.64	82.68	0	0	0	0
carrot	0	0	19.53	31.05	86.96	120	132.99	0	0	0	0	0
parsley	0	0	19.53	31.05	86.96	120	132.99	0	0	0	0	0

corn -silage-double cropping	0	0	0	0	0	0	53.2	88.58	57.92	0	0	0
buckwheat-double cropping	0	0	0	0	0	48	106.39	118.11	42.12	0	0	0
pasture	0	0	0	0	86.96	102	113.04	100.39	0	33.2	0	0
lawns -DTS	0	0	0	0	86.96	102	113.04	100.39	59.67	33.2	0	0
alfalfa	0	0	0	0	86.96	102	113.04	100.39	59.67	0	0	0
soybeans	0	0	0	24.15	76.73	90	146.29	129.92	52.65	0	0	0
apple	0	0	0	34.5	76.73	132	146.29	129.92	59.67	0	0	0
hazelnut	0	0	0	34.5	76.73	132	146.29	129.92	59.67	0	0	0
pear	0	0	0	34.5	76.73	132	146.29	129.92	59.67	0	0	0
walnut	0	0	0	34.5	76.73	132	146.29	129.92	59.67	0	0	0
rose hip	0	0	0	34.5	76.73	132	146.29	129.92	59.67	0	0	0
plum	0	0	0	34.5	76.73	132	146.29	129.92	59.67	0	0	0
sour cherry	0	0	21.7	34.5	76.73	132	113.04	0	0	0	0	0

2.7.2. Net irrigation water requirement

The movement of water in the soil and its exchange with other bodies is called the water regime of the soil. From a hydropedological point of view, this means the entry of water into the soil, its retention and loss from the soil in the soil-plant-atmosphere system.

Water requirement can be calculated in different ways. The CropWat computer program is acceptable and the most used, where the water requirement is calculated based on the difference between and effective precipitation. If effective precipitation is subtracted from the evapotranspiration of crop, a water deficit is obtained, which is compensated by irrigation.

The need for crop irrigation can be represented by the formula:

$$PNk = ETc – Pef$$

where:
PNk –crop irrigation requirement,
ETc – evapotranspiration of crops,
Pef – effective precipitation

The irrigation requirement of certain crops in a dry year or actual water needs are given below.

Table 11. Total monthly and annual net requirement in an average year in mm.

crop	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	year
Average effect. prec.	45	41	45	55	68	74	68	57	70	64	59	**52**	**696**
Reference	0	0	0	14	35	46	65	61	1	0	0	0	**221**
wheat - winter	0	0	0	17	40	0	0	0	0	0	0	0	**57**
barley - winter	0	0	0	7	40	0	0	0	0	0	0	0	**47**
corn - mercantile	0	0	0	0	0	16	78	73	0	0	0	0	**167**
triticale	0	0	0	7	40	0	0	0	0	0	0	0	**47**
sunflower	0	0	0	0	9	16	78	73	0	0	0	0	**176**
oilseed rape	0	0	0	17	40	0	0	0	0	0	0	0	**57**
sugar beet	0	0	0	0	14	22	78	73	0	0	0	0	**187**
tomato	0	0	0	0	0	52	52	49	0	0	0	0	**152**
onion	0	0	0	0	30	16	32	0	0	0	0	0	**77**
beans	0	0	0	0	0	16	78	25	0	0	0	0	**119**

cabbage	0	0	0	0	0	0	52	55	0	0	0	0	**107**
potato	0	0	0	0	0	0	72	25	0	0	0	0	**97**
carrot	0	0	0	0	19	46	65	0	0	0	0	0	**130**
parsley	0	0	0	0	19	46	65	0	0	0	0	0	**130**
corn -silage-post.	0	0	0	0	0	0	0	31	0	0	0	0	**31**
buckwheat-double cropping	0	0	0	0	0	0	38	61	0	0	0	0	**99**
pasture	0	0	0	0	19	28	45	43	0	0	0	0	**135**
lawns -DTS	0	0	0	0	19	28	45	43	0	0	0	0	**135**
alfalfa	0	0	0	0	19	28	45	43	0	0	0	0	**135**
soybeans	0	0	0	0	9	16	78	73	0	0	0	0	**176**
apple	0	0	0	0	9	58	78	73	0	0	0	0	**218**
hazelnut	0	0	0	0	9	58	78	73	0	0	0	0	**218**
pear	0	0	0	0	9	58	78	73	0	0	0	0	**218**
walnut	0	0	0	0	9	58	78	73	0	0	0	0	**218**
rose hip	0	0	0	0	9	58	78	73	0	0	0	0	**218**
plum	0	0	0	0	9	58	78	73	0	0	0	0	**218**
sour cherry	0	0	0	0	9	58	45	0	0	0	0	0	**112**

Table 12. Total monthly and annual net requirement in a dry year in mm

crop	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**IX**	**X**	**XI**	**XII**	**year**
Effective prec.-75%	26	22	37	33	41	50	44	27	44	41	43	**29**	**436**
Reference	0	0	0	36	62	70	89	91	26	0	0	0	**381**
wheat - winter	0	0	0	39	67	0	0	0	0	0	0	0	**113**
barley - winter	0	0	0	29	67	0	0	0	0	0	0	0	**96**
corn – mercantile	0	0	0	0	0	40	103	103	0	0	0	0	**246**
triticale	0	0	0	29	67	0	0	0	0	0	0	0	**96**
sunflower	0	0	0	0	36	40	103	103	9	0	0	0	**290**
oilseed rape	0	0	0	39	67	0	0	0	0	0	0	0	**106**
sugar beet	0	0	0	0	41	46	103	103	2	0	0	0	**294**
tomato	0	0	0	0	21	76	76	79	0	0	0	0	**252**
onion	0	0	0	0	56	40	56	0	0	0	0	0	**153**
beans	0	0	0	0	0	40	103	55	0	0	0	0	**198**
cabbage	0	0	0	0	0	0	76	85	16	0	0	0	**177**
potato	0	0	0	0	21	22	96	55	0	0	0	0	**194**
carrot	0	0	0	0	46	70	89	0	0	0	0	0	**206**
parsley	0	0	0	0	46	70	89	0	0	0	0	0	**206**
corn -silage-post	0	0	0	0	0	0	10	61	14	0	0	0	**85**
buckwheat-double cropping	0	0	0	0	0	0	63	91	0	0	0	0	**154**
pasture	0	0	0	0	46	52	70	73	0	0	0	0	**241**
lawns -DTS	0	0	0	0	465	52	70	73	16	0	0	0	**257**
alfalfa	0	0	0	0	46	52	70	73	16	0	0	0	**257**
soybeans	0	0	0	0	36	40	103	103	9	0	0	0	**290**
apple	0	0	0	1	36	82	103	103	16	0	0	0	**341**
hazelnut	0	0	0	1	36	82	103	103	16	0	0	0	**341**
pear	0	0	0	1	36	82	103	103	16	0	0	0	**341**
walnut	0	0	0	1	36	82	103	103	16	0	0	0	**341**
rose hip	0	0	0	1	36	82	103	103	16	0	0	0	**341**
plum	0	0	0	1	36	82	103	103	16	0	0	0	**341**
sour cherry	0	0	0	1	36	82	70	0	0	0	0	0	**189**

Table 13. Total monthly and annual net requirement in an average year in m^3

crop	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**IX**	**X**	**XI**	**XII**	**year**
wheat - winter	0	0	0	0	0	0	0	0	0	0	0	0	**0**
barley - winter	0	0	0	0	0	0	0	0	0	0	0	0	**0**
corn – merk.	0	0	0	0	0	0	0	0	0	0	0	0	**0**

triticale	0	0	0	0	0	0	0	0	0	0	0	0	**0**
sunflower	0	0	0	0	0	0	0	0	0	0	0	0	**0**
oilseed rape	0	0	0	11.866	27.074	0	0	0	0	0	0	0	**38.94**
sugar beet	0	0	0	0	11.534	17.658	63.495	58.742	0	0	0	0	**151.43**
tomato	0	0	0	0	0	2.59	2.59	2.445	0	0	0	0	**7.625**
onion	0	0	0	0	2.959	1.58	3.184	0	0	0	0	0	**7.723**
beans	0	0	0	0	0	1.58	7.839	2.528	0	0	0	0	**11.947**
cabbage	0	0	0	0	0	0	2.59	2.74	0	0	0	0	**5.33**
potato	0	0	0	0	0	0	8.609	3.033	0	0	0	0	**11.642**
carrot	0	0	0	0	1.355	3.206	4.556	0	0	0	0	0	**9.117**
parsley	0	0	0	0	774	1.832	2.604	0	0	0	0	0	**5.21**
corn -silage- double cropping	0	0	0	0	0	0	0	92.612	0	0	0	0	**92.612**
buckwheat-double cropping	0	0	0	0	0	0	10.393	16.392	0	0	0	0	**26.785**
pasture	0	0	0	0	0	0	0	0	0	0	0	0	**0**
lawns -DTS	0	0	0	0	0	0	0	0	0	0	0	0	**0**
alfalfa	0	0	0	0	4.645	6.672	10.834	10.318	0	0	0	0	**32.47**
soybeans	0	0	0	0	9.49	16.432	81.525	75.422	0	0	0	0	**182.86**
apple	0	0	0	0	1.095	6.936	9.407	8.703	0	0	0	0	**26.14**
hazelnut	0	0	0	0	548	3.468	4.703	4.351	0	0	0	0	**13.07**
pear	0	0	0	0	1.095	3.468	9.407	8.703	0	0	0	0	**26.14**
walnut	0	0	0	0	548	6.936	4.703	4.351	0	0	0	0	**13.07**
rose hip	0	0	0	0	548	3.468	4.703	4.351	0	0	0	0	**13.07**
plum	0	0	0	0	1.095	6.936	9.407	8.703	0	0	0	0	**26.14**
sour cherry	**0**	**0**	**0**	0	548	3.468	2.708	0	0	0	0	0	**6.724**
Uncultivated	**0**	**0**	**0**	0	0	0	0	0	0	0	0	0	**0**
TOTAL	**0**	**0**	**0**	**11.866**	**63.306**	**86.23**	**243.25**	**303.39**	**0**	**0**	**0**	**0**	**708.05**

Table 14. Total monthly and annual net requirement in a dry year in m³

crop	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	year
wheat - winter	0	0	0	0	0	0	0	0	0	0	0	0	**0**
barley - winter	0	0	0	0	0	0	0	0	0	0	0	0	**0**
corn - mercantile	0	0	0	0	0	0	0	0	0	0	0	0	**0**
triticale	0	0	0	0	0	0	0	0	0	0	0	0	**0**
sunflower	0	0	0	0	0	0	0	0	0	0	0	0	**0**
oilseed rape	0	0	0	26.69	45.366	0	0	0	0	0	0	0	**72.056**
sugar beet	0	0	0	0	33.323	37.503	83.259	83.042	1.239	0	0	0	**238.367**
tomato	0	0	0	0	1.034	3.815	3.81	3.945	0	0	0	0	**12.604**
onion	0	0	0	0	5.649	4.03	5.624	0	0	0	0	0	**15.303**
beans	0	0	0	0	0	4.03	10.279	5.528	0	0	0	0	**19.837**
cabbage	0	0	0	0	0	0	3.81	4.24	779	0	0	0	**8.828**
potato	0	0	0	0	2.482	2.676	11.537	6.633	0	0	0	0	**23.328**
carrot	0	0	0	0	3.238	4.921	6.264	0	0	0	0	0	**14.423**
parsley	0	0	0	0	1.85	2.812	3.58	0	0	0	0	0	**8.242**
corn -silage-double cropping	0	0	0	0	0	0	28.797	181.712	41.031	0	0	0	**251.54**
buckwheat-double cropping	0	0	0	0	0	0	16.981	24.492	0	0	0	0	**41.473**
pasture	0	0	0	0	0	0	0	0	0	0	0	0	**0**
lawns -DTS	0	0	0	0	0	0	0	0	0	0	0	0	**0**
alfalfa	0	0	0	0	11.101	12.552	16.69	17.518	3.737	0	0	0	**61.598**
soybeans	0	0	0	0	37.466	41.912	106.901	106.622	8.892	0	0	0	**301.792**
apple	0	0	0	156	4.323	9.876	12.335	12.303	1.868	0	0	0	**40.861**

hazelnut	0	0	0	78	2.162	4.938	6.167	6.151	934	0	0	0	**20.43**
pear	0	0	0	156	4.323	9.876	12.335	12.303	1.868	0	0	0	**40.861**
walnut	0	0	0	78	2.162	4.938	6.167	6.151	934	0	0	0	**20.43**
rose hip	0	0	0	78	2.162	4.938	6.167	6.151	934	0	0	0	**20.43**
plum	0	0	0	156	4.323	9.876	12.335	12.303	1.868	0	0	0	**40.861**
sour cherry	**0**	**0**	**0**	78	2.162	4.938	4.172	0	0	0	0	0	**11.35**
Uncultivated	**0**	**0**	**0**	0	0	0	0	0	0	0	0	0	**0**
TOTAL	**0**	**0**	**0**	**27.47**	**163.124**	**163.631**	**357.21**	**489.093**	**64.085**	**0**	**0**	**0**	**1.264.612**

2.8. Norm, ration, rotation and hydromodule of irrigation

2.8.1. Norm of irrigation

The norm of irrigation is the total lack of water during the vegetation season, while irrigation ration is the amount of water that is added in one irrigation, i.e. the irrigation ration is part of the norm of irrigation and primarily depends on the depth of soil wetting and the depth of the main mass of the roots of the cultivated crop. The soil is moistened up to the humidity of the field water capacity (PKv), and it is recommended that the humidity be maintained between the PKv (0.33 bar) and the lento capillary humidity of the soil (6.25 bar), because this is the optimal soil moisture for plant cultivation. When the soil moisture drops to the value of 65% of the field water capacity, i.e. to the lento capillary soil moisture, irrigation should be started.

2.8.2. Irrigation ration

Irrigation ration is calculated before the start of irrigation for each cultivated crop and each stage of development, which means that irrigation ration is calculated for field, industrial, vegetable and woody crops using expressions for two different depths. The first depth refers to the initial A stage, and the second to all other stages of growth and development.

O = 10 x d x (PKv – LKv)

where:
O – irrigation ration in mm, d
– depth of soil wetting in m,

- depth of wetting in the initial stage of development of all crops = 0.15 m,
- depth of wetting in other phases of the growth and development of vegetable crops = 0.25m,
- depth of wetting in other development stages (field and industrial crops) =0.30m and
- depth of wetting of woody crops = 0.40m.

PKv – field water capacity (up to the depth of wetting) in vol %, PKv =37.0 vol %
LKv – lento capillary soil moisture (up to the depth of wetting) in vol %, LKv =24.1 vol%

- Irrigation ration in the initial stage of development of all crops (d=0,15 m)

O = 10 x d x (PKv – LKv)
O = 10 x 0.15 (37.0 – 24.1) O
= 19.4 mm

- Irrigation ration in other phases of the growth and development of vegetable crops (d=0.25m)

O = 10 x d x (PKv – LKv)

O = 10 x 0.25 (37.0 – 24.1) O
= 32.3 mm

- Irrigation ration in other stages of the development of field and industrial crops (d=0.30m)

O = 10 x d x (PKv – LKv)
O = 10 x 0.30 (37.0 -24.1) O
= 38.7mm

- Irrigation ration for woody crops (d=0.40m)

O = 10 x d x (PKv – LKv)
O = 10 x 0.40 (37.0 – 24.1)
O = 51.6 mm

2.8.3. Rotation

The daily consumption of water is calculated from the ratio of the total monthly evapotranspiration and the number of days in the month. For the calculation, the highest monthly evapotranspiration is taken, which is during July when it amounts to 132.99 mm, which corresponds to a daily water consumption of 4.72 mm/day. Based on irrigation rations and daily water consumption, irrigation rotation is calculated for certain stages of growth and development, that is, at different depths.

$$T = \frac{O}{Ud}$$ where:

T – irrigation rotation in days
O – irrigation ration in mm
Ud – daily consumption of water mm/dan

Irrigation rotation in the initial stage of development of all crops (d=0,15m)

$$T = \frac{19{,}4\ \text{mm}}{3{,}43\ \text{mm}} = 6\ \text{days}$$

Irrigation rotation in other stages of development of vegetable crop (d=0,25m)

$$T = \frac{32{,}3\ \text{mm}}{3{,}43\ \text{mm}} = 9\ \text{days}$$

Irrigation rotation in other stages of development of field and industrial crops (d=0,30m) T

$$= \frac{38{,}7\ \text{mm}}{3{,}43\ \text{mm}} = 11\ \text{days}$$

Irrigation rotation of woody crops (d=0,40)

$$T = \frac{51{,}6\ \text{mm}}{3{,}43\ \text{mm}} = 15\ \text{days}$$

2.8.4. Net operating hydromodule of irrigation

The net operating hydromodule of irrigation is calculated for each crop group according to the expression:

$$Hnr = \frac{O}{T \, x \, t}$$ where:

O – irrigation ration (l/ha),
T – irrigation rotation (days),
T – working hours of irrigation (sec) – (number of hours x 3600).

For this irrigation system, the irrigation duration of all crops was assumed to be 16 hours/day.

Net operating hydromodule of irrigation for all vegetable crops is:

$$Hnr = \frac{323\,000 \text{ mm}}{9 \, x \, 57\,600} = \mathbf{0,624} \; \frac{l}{s}/ha,$$

Net operating hydromodule of irrigation for field and industrial crops is:

$$Hnr = \frac{387\,000 \text{ mm}}{11 \, x \, 57\,600} = \mathbf{0,611} \; \frac{l}{s}/ha,$$

Net operating hydromodule of irrigation for woody crops is:

$$Hnr = \frac{516\,000 \text{ mm}}{15 \, x \, 57\,600} = \mathbf{0,598} \; \frac{l}{s}/ha,$$

The maximum net operating hydromodule at system operating hours of 16 h/day occurs in July and amounts to 0.624 l/s/ha. When we take into account system efficiency and losses, we get:

Gross operating hydromodule Hbr= 0,78 l/s/h

The required maximum capacity for the hydraulic dimensioning of the system is:

0.78 * 50 ha = 39 l/s

2.9. Irrigation system usage and maintenance

After the construction of an irrigation system, the organisation, management and maintenance of the new system is very important and a key condition of sustainability. If the system is left to itself, without organised care and quality maintenance, it would be out of order very quickly. In order to adequately answer this question, the Investor is suggested to form the so-called work department that will be in charge of exploitation and maintenance of the system. Initially, they would need adequate assistance in managing and maintaining the system, which the local utility is expected to be able to provide. All costs of use and maintenance would be borne by the users of the respective plots. Sub-component 2.2 of the ARCP Project envisages the strengthening of user capacities related to the operation and maintenance of the irrigation system.

3. DESCRIPTION OF THE ENVIRONMENT WHICH COULD BE AFFECTED BY THE PROJECT

3.1. Physical factors

3.1.1. Climate features

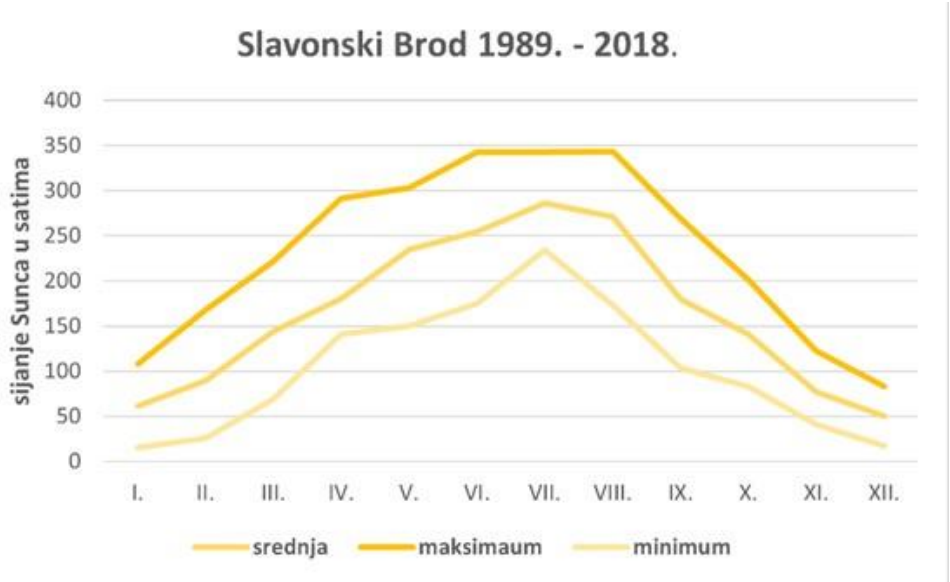
For the purpose of analysing the basic climate parameters in the project area in Modriča, data from the Slavonski Brod meteorological station was used for a period of 30 years (1989-2018). Below are given all climate data needed to calculate the plants' water requirement.

Insolation

In the area of Modriča, the sun shines for an average of 1969 hours or 5.4 hours daily. The sunniest year was 2000, when the sun shone for 2,341 hours, or 606 hours more than in 2014, when there were only 1,735 hours of sunshine, or the least in that period. The fewest hours of sunshine are in December, which is the foggiest month of the year and when the sun shines for only 1.6 hours on average.

Table 15. Monthly, daily annual sums of sunshine duration in hours (1989- 2018)

	months												annual
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
mean	**61.3**	**89.5**	**144**	**181**	**235**	**255**	**286**	**271**	**179**	**141**	**77.1**	**50.5**	**1969.2**
daily	1.9	3.2	4.7	6	7.5	8.5	9.2	8.7	5.8	4.5	2.6	1.6	5.35
maximum	108	168	222	291	303	343	342	343	269	201	123	83.2	2794.6
year	2007	1998	2012	2007	1997	2000	2017	2012	1997	1995	2015	1994	2000
minimum	15.2	25.6	69..0	141	150	175	234	173	104	82.9	40.7	17.6	1158.6
year	1997	2013	1994	2006	1991	1992	1989	2005	1996	2015	1999	1995	2014
amplitude	92.7	142	153	151	153	167	108	170	165	118	82	65.6	606



MODRIČA 1989 - 2018

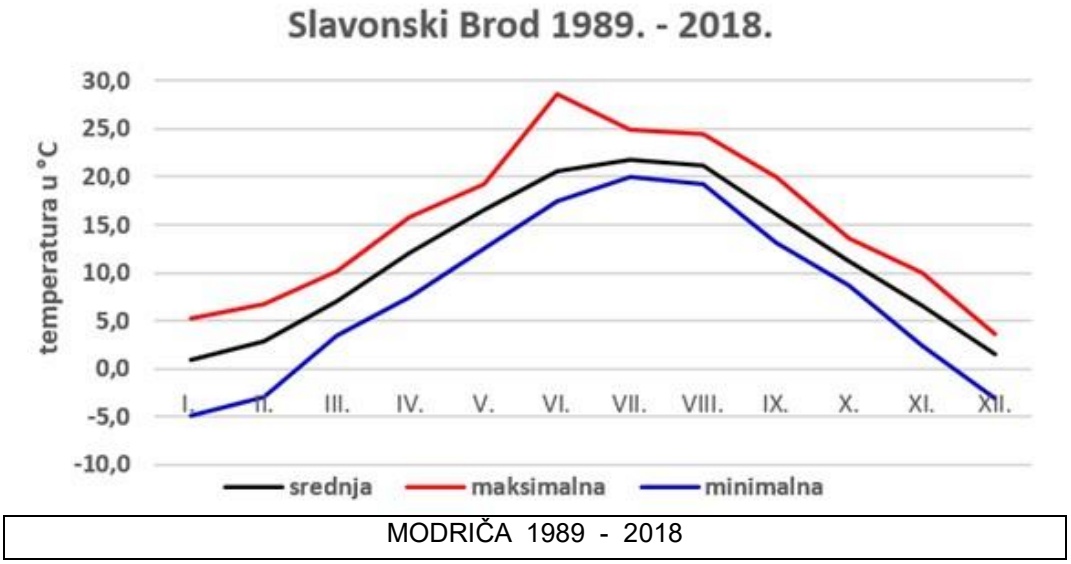
Figure 14. Annual overview of insolation

Temperature

Mean, maximum and minimum monthly and annual air temperatures for a thirty-year period are shown in the following table and figure. The mean annual air temperature is 11.6 ˚C. The coldest year was 1996 with an average annual air temperature of 10.3 ˚C, and the warmest was 2013 with 12.6 ˚C, so the annual amplitude for the mentioned period is 2.3 ˚C. The coldest months are: December, January and February with an average monthly temperature of: 1.4˚C, 0.6˚C, 2.7˚C, respectively, and the warmest are July and August with 22.3˚C and 21.8˚ C. In the mentioned period, June 2003 was exceptionally warm, with an average maximum air temperature of 28.7˚C.

Table 16. Mean monthly and annual air temperatures (1989 – 2018)

	months												annual
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
mean	0.6	2.7	7.3	12.2	16.8	20.4	22.3	21.8	16.4	11.4	6.4	1.4	11.641667
maximum	5.2	6.8	10.2	15.9	19.3	28.7	24.9	24.5	20	13.6	10	3.6	15.225
year	2007	2007	2001	2018	2018	2003	2015	2012	2011	2001	1999	2014	2013
minimum	-4.8	-2.9	3.5	7.5	12.5	17.5	20	19.2	13.2	8.7	2.4	-3.1	7.8083333
year	2017	2012	1996	1997	1991	1989	1996	2005	1996	1997	1999	1998	1996
amplitude	10	9.7	6.7	8.4	6.8	11.2	4.9	5.3	6.8	4.9	7.6	6.7	7.14

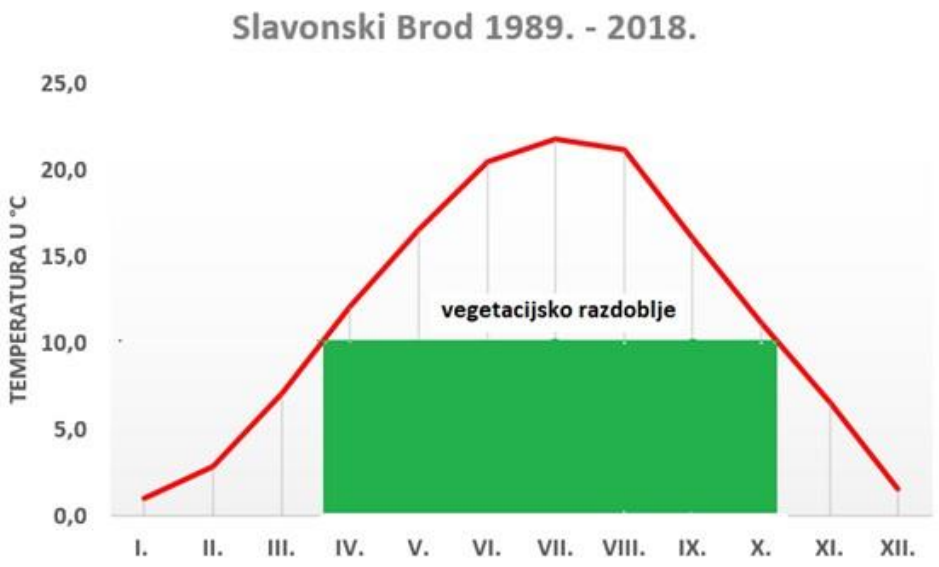


MODRIČA 1989 - 2018

Figure 15. Annual distribution of mean, maximum and minimum temperatures

The following figures show the annual movement of air temperatures for a multi-year period on which a threshold of 10˚C is drawn, which determines the vegetation period and the temperature trend over a thirty-year period. In the area of Modriča, the vegetation period lasts from the second decade of March to the second decade of October, i.e. about 220 days. Such a long vegetation period here enables the sowing of all thermophilic crops, as well as a second harvest in one season.

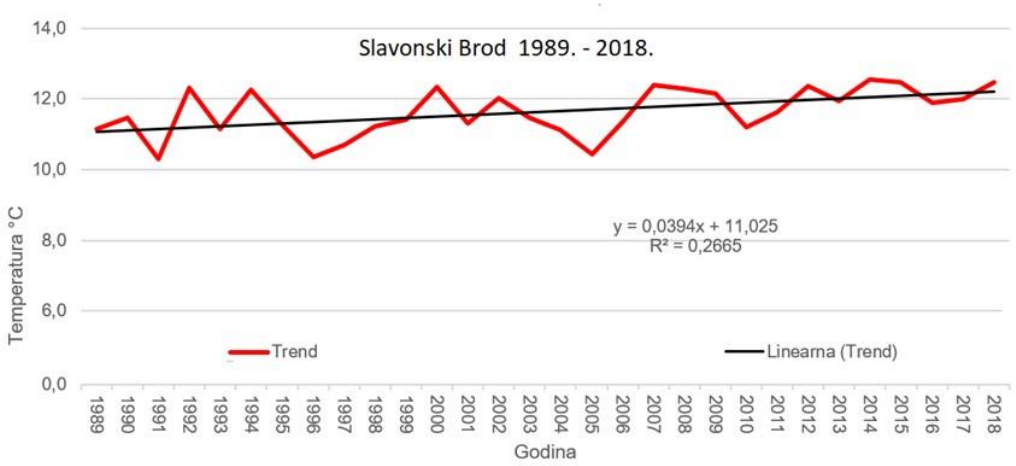
The linear temperature trend is slightly increasing (R=27), and the increase has been visible since the beginning of the 21st century, in which the highest annual temperature was in 2013, at 12.6˚C.



MODRIČA 1989 - 2018

vegetacioni period

Figure 16 Annual temperature changes and vegetation period



MODRIČA 1989 - 2018

Figure 1. Temperature trend

Precipitation

Monthly and annual mean, maximum and minimum amounts of precipitation in the area of Modriča are given in the following table, and the figures show the changes in precipitation, the ratio of mean and 75% probability of precipitation, which is considered a dry year, and the trend of precipitation in the specified period.

Table 17 Mean, maximum and minimum monthly and annual sum of precipitation

	months												annual
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
mean	**48.8**	**43.8**	**48.5**	**60.9**	**77.1**	**86**	**77.5**	**63.9**	**79.8**	**71.7**	**65.3**	**57.4**	**780.7**
maximum	104	91.8	98.9	170	180	191	210	232	224	183	126	116	**1007**
year	1995	2018	2008	2004	1989	2001	1999	2005	2001	1992	1992	2005	2005
minimum	12.4	3.3	1.3	7	17.3	24.5	6.4	10.5	10.6	4.1	4.2	1.2	433
year	1989	1993	2012	2007	1990	2000	1995	2012	2011	1995	2011	2013	2011
amplitude	91.6	88.5	97.6	163	162	167	204	222	213	179	122	115	574

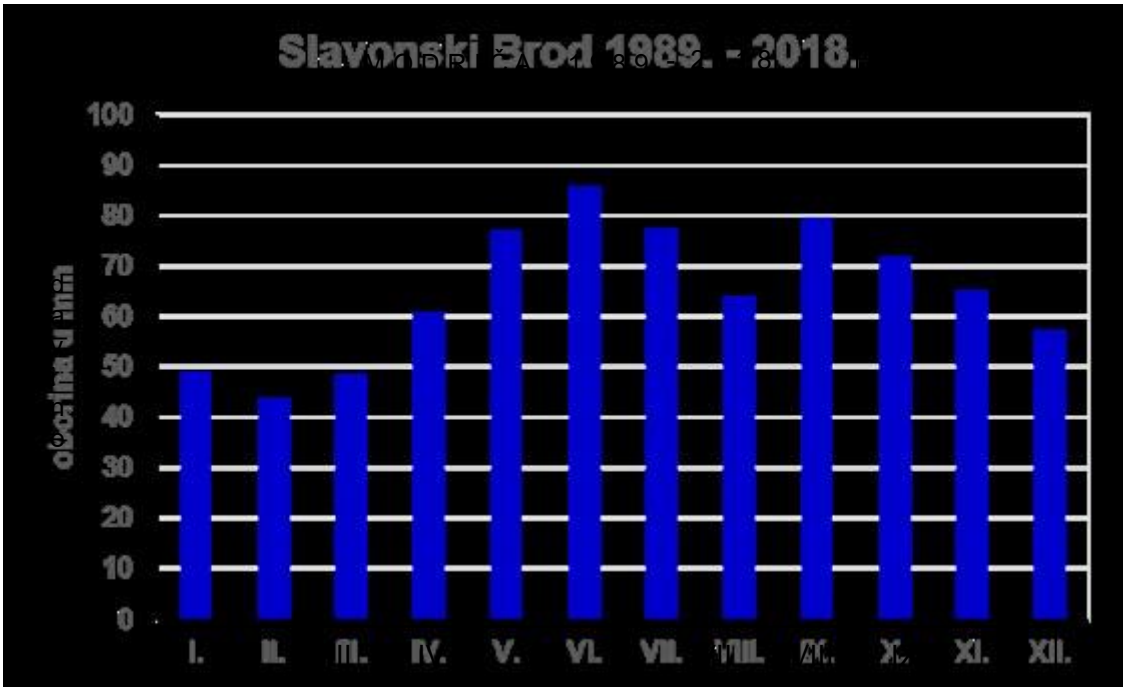
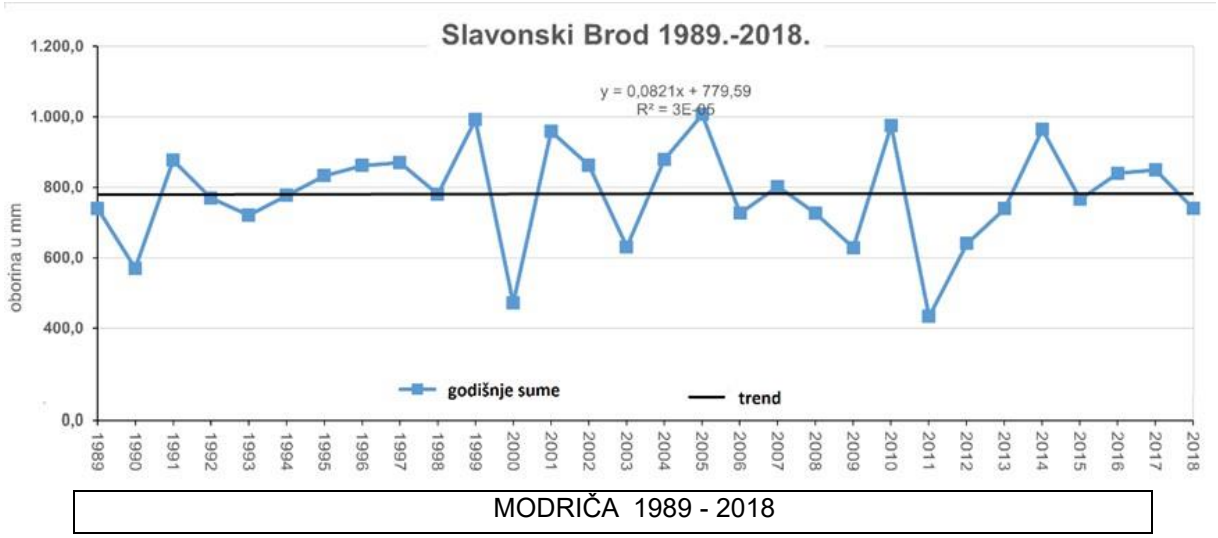


Figure 17. Annual changes in precipitation



MODRIČA 1989 - 2018

padavine

Figure 18. Precipitation trends

Annual sum of precipitation for the period 1989-2018 is 781 mm. The rainiest year in the mentioned period was 2005, when 1007 mm fell, and the year with the least precipitation was 2010, when only 433 mm fell, so the amplitude of precipitation was 574 mm. On average, the most precipitation falls in June, 86 mm, and in September 2001, 224 mm fell, which is the highest monthly amount of precipitation in that period. The least rain falls on average in January and February, 48.8 mm and 43.8 mm. Not a single month was without precipitation, and the lowest amount was recorded in 2013, when only 1.2 mm fell in December and only 1.3 mm in March. Precipitation, unlike temperature, has a negative trend in the specified period.

The following table shows the probability of occurrence according to Hazen, and the monthly and annual sum of precipitation in an average and dry year, and the figure annual changes in precipitation by season in an average and dry year.

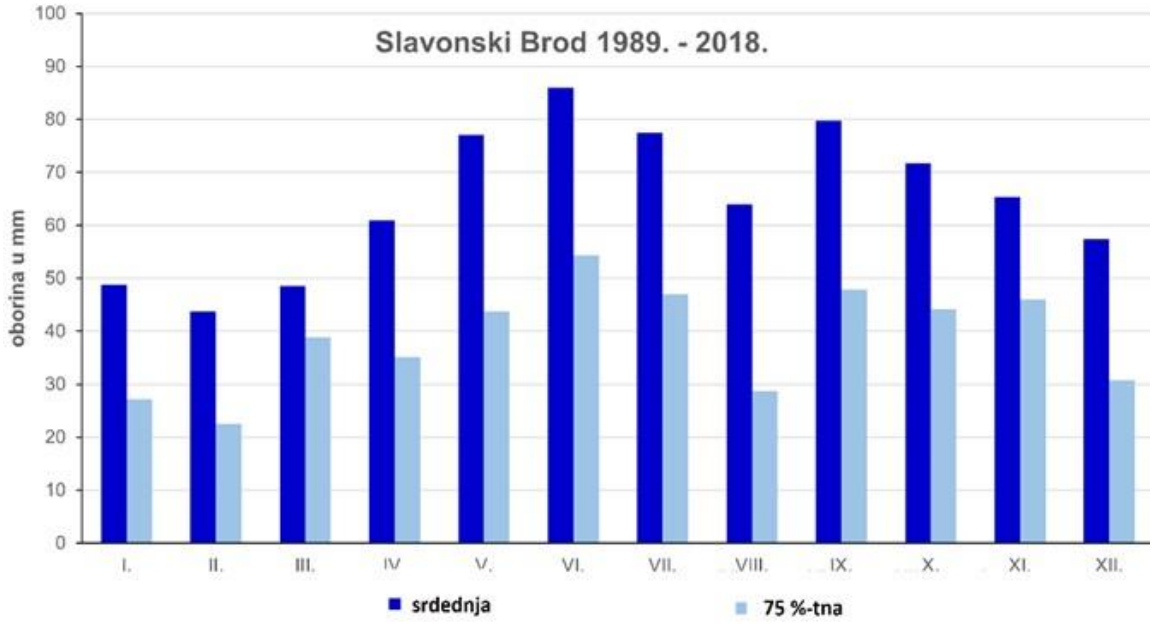
Table 18. Probability of monthly precipitation in mm Modriča (1989-2018)

rang	prob. %.	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	sum
1	1.67	104	91.8	98.9	170.3	179.5	191.4	209.9	232	224	183.4	125.9	116.1	**1927.2**
2	**5**	**86.9**	**87.4**	**88.1**	**121.4**	**174.6**	**176.9**	**174.9**	**175.5**	**173.8**	**166.9**	**123.8**	**113**	**1663.2**
3	**8.33**	**81**	**81.8**	**86.2**	**119**	**161.4**	**164.5**	**170.5**	**131.4**	**135.8**	**149**	**116.6**	**106.1**	**1503.2**
4	**11.67**	**79.5**	**79.5**	**80.8**	**107.4**	**143**	**149.6**	**140.6**	**124.6**	**120.1**	**144.4**	**116.5**	**101.5**	**1387.5**
5	**15**	**75.5**	**77**	**66.1**	**83.7**	**134.1**	**119.8**	**122.9**	**122.3**	**115**	**130.1**	**115.6**	**98.1**	**1260.2**

6	**18.33**	**70.7**	**72.3**	**65.4**	**82.4**	**115.2**	**119.2**	**108.7**	**89.6**	**114.2**	**119.7**	**95.5**	**92.5**	**1145.4**
7	**21.67**	**69**	**69.2**	**64.7**	**74.3**	**104.8**	**117.1**	**105.5**	**88.3**	**112.6**	**97.8**	**90**	**78.8**	**1072.1**
8	**25**	**68.8**	**63.6**	**56.3**	**73.5**	**98.8**	**103.8**	**87.6**	**83.7**	**96.9**	**97.8**	**86.1**	**75.6**	**992.5**
9	**28.33**	**66.4**	**58.2**	**54.5**	**72**	**97.9**	**99.6**	**86.8**	**78.5**	**90.9**	**86.7**	**85.9**	**74.9**	**952.3**
10	**31.67**	**62.9**	**57.2**	**53.9**	**71.4**	**85.4**	**96.8**	**86.5**	**70.6**	**90.6**	**84.3**	**77.3**	**74.9**	**911.8**
11	**35**	**62.6**	**55.7**	**52.4**	**69.7**	**82.5**	**94.7**	**84.6**	**68.5**	**90**	**84.2**	**75.8**	**70.5**	**891.2**
12	**38.33**	**61.8**	**51**	**49.5**	**66.7**	**79.6**	**88**	**78.1**	**61**	**88.2**	**80.2**	**72.5**	**69.4**	**846**
13	**41.67**	**60.2**	**47.7**	**47.4**	**64.9**	**76.6**	**86.5**	**76.2**	**57.5**	**88.1**	**70**	**71.5**	**68.5**	**815.1**
14	**45**	**55.4**	**44.3**	**47.2**	**63.7**	**74.4**	**84.5**	**70.3**	**51.3**	**83.8**	**64.2**	**68.1**	**67.4**	**774.6**
15	**48.33**	**53**	**43**	**45.8**	**60.7**	**70.4**	**78.2**	**62.2**	**49.5**	**83**	**60.1**	**65.4**	**61**	**732.3**
16	**51.67**	**42.2**	**42.9**	**45.2**	**60.7**	**69.3**	**77.2**	**61.2**	**44.3**	**74.7**	**58.8**	**64.9**	**60.9**	**702.3**
17	**55**	**41.9**	**40.4**	**44.3**	**56.8**	**62.6**	**73.8**	**61.1**	**43.8**	**73.5**	**58.2**	**61.8**	**46.8**	**665**
18	**58.33**	**38.4**	**33.2**	**42.6**	**52.9**	**54.7**	**73**	**61.1**	**40.6**	**71.1**	**55.6**	**56.1**	**45.7**	**625**
19	**61.67**	**37.1**	**31.3**	**41.4**	**52.9**	**54.1**	**68.9**	**57.2**	**34.9**	**67.1**	**49.9**	**54.6**	**45.4**	**594.8**
20	**65**	**33.6**	**30.8**	**41.3**	**44.2**	**49.8**	**66.6**	**56.5**	**34.8**	**49**	**49.2**	**53.3**	**44**	**553.1**
21	**68.33**	**28.7**	**28.6**	**41.2**	**43.3**	**47.5**	**64.5**	**55.5**	**34.2**	**48.9**	**45**	**50.1**	**40**	**527.5**
22	**71.67**	**28.6**	**26.2**	**40.6**	**40.5**	**46.7**	**54.8**	**47.3**	**31.6**	**48.5**	**44.6**	**48**	**36**	**493.4**
23	**75**	**27.2**	**22.5**	**38.9**	**35.2**	**43.8**	**54.4**	**47**	**28.7**	**47.8**	**44.2**	**46**	**30.8**	**466.5**
24	**78.33**	**26.5**	**19.7**	**38.2**	**32.8**	**43.6**	**51.2**	**46.3**	**27.7**	**47.5**	**35.9**	**30.5**	**29.3**	**429.2**
25	**81.67**	**26.4**	**16.6**	**36.1**	**28.2**	**41.5**	**47.4**	**45.8**	**27**	**47.3**	**32.1**	**25.1**	**26.8**	**400.3**
26	**85**	**19.6**	**14**	**35.9**	**23**	**30.6**	**46.7**	**42.3**	**25.8**	**29.5**	**22.5**	**23.5**	**19.7**	**333.1**
27	**88.33**	**15.8**	**10**	**26.7**	**17.7**	**29.6**	**44**	**34.8**	**19.8**	**29.3**	**11**	**20.1**	**18.2**	**277**
28	**91.67**	**15.2**	**7.2**	**23**	**17.7**	**26.2**	**36.3**	**20.9**	**18.4**	**28.9**	**10.6**	**19.6**	**4.5**	**228.5**
29	**95**	**13.1**	**7.2**	**6.6**	**13**	**18.4**	**26.3**	**15.2**	**10.8**	**12.4**	**10.5**	**15.1**	**4.2**	**152.8**
30	**98.33**	**12.4**	**3.3**	**1.3**	**7**	**17.3**	**24.5**	**6.4**	**10.5**	**10.6**	**4.1**	**4.2**	**1.2**	**102.8**

Table 19. Monthly and annual sum of precipitation in an average and dry year in mm (1989-2018)

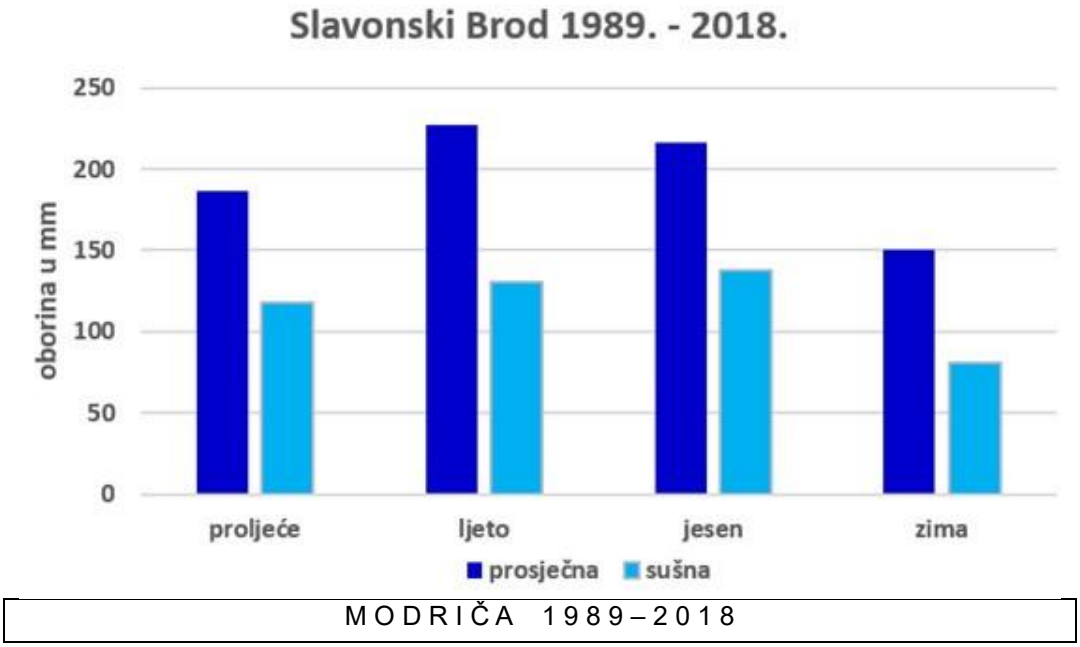
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	sum
average	48.8	43.8	48.7	60.9	77.1	86	77.5	63.9	79.8	71.7	65.3	57.4	780.9
dry	27.2	22.5	38.9	35.2	43.8	54.4	47	28.7	47.8	44.2	46	30.8	466.5



M O D R I Č A 1 9 8 9 – 2 0 1 8

Figure 19. Ratio of precipitation in an average and dry year (75% probability of precipitation)

In a dry year, 60% of the annual average precipitation falls. 47% of precipitation falls during autumn and winter, 24% in spring, and 29% in summer.



M O D R I Č A 1 9 8 9 – 2 0 1 8

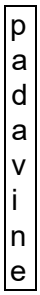


Figure 20. Annual overview of precipitation by season

Air humidity

According to the data in the following table, the mean annual air humidity in the area of Modriča is 77% for the observed period, which indicates that the air is moderately humid. The highest air humidity was 85% in 2012, and the lowest in 2000, when it was only 70%. The highest relative air humidity is in the autumn and winter months, when the days are shortest and the cloudiness is highest, and the lowest in April, when the air is dry with 69.9% humidity.

Table 20. Monthly and annual mean, maximum and minimum air humidity (1989 – 2018)

	months												annual
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
mean	**85**	**78.2**	**70.6**	**69.9**	**71.3**	**72.1**	**70.5**	**71.9**	**77.4**	**80.8**	**83.7**	**86.4**	**76.48**
maximum	94	87	80	81	84	88	83	88	85	90	92	95	**87.25**
year	1989	1991	1991	1991	1989	1989	1989	2002	2007	1993	1993	1990	1991
minimum	75	66	55	59	62	57	59	51	66	71	75	78	70
year	2012	2008	2012	2007	1997	2000	2012	2012	2011	2018	2000	2017	2000
amplitude	19	21	25	22	22	31	24	37	19	19	17	17	7

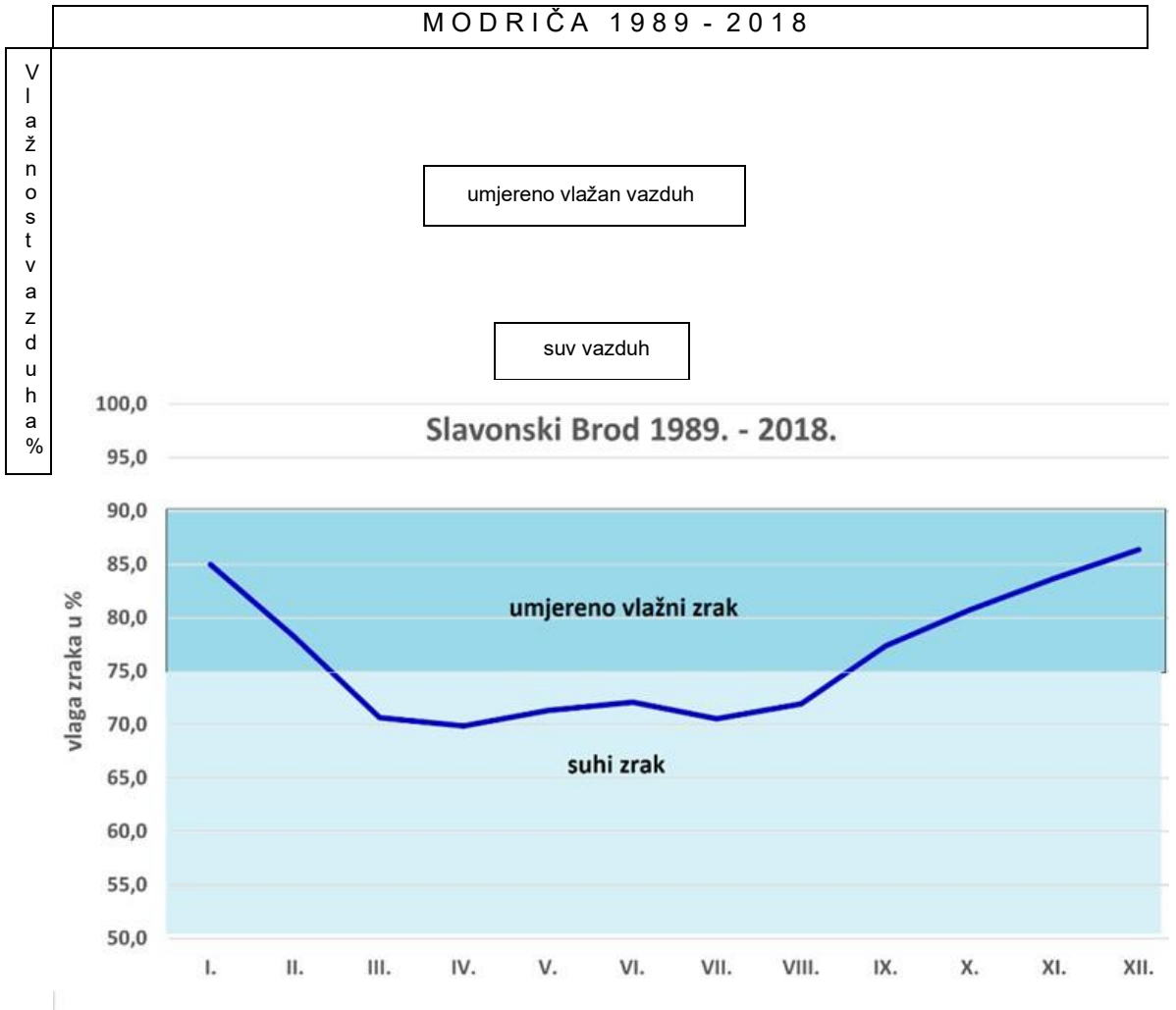


Figure 21.. Overview of relative air humidity

Wind

The mean wind speed (for the period 1989 – 2018) is important for determining evapotranspiration and is 1.3 m/s. It is the highest in March and the lowest in October. The

windiest year was 1997, and the year with the least wind was 1992, so the wind amplitude was 0.9 m/s.

Table 21. Monthly and annual mean, maximum and minimum wind speed in m/s (1989-2018)

	months												annual
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
mean	**1.2**	**1.4**	**1.6**	**1.5**	**1.5**	**1.4**	**1.3**	**1.2**	**1.2**	**1.1**	**1.2**	**1.2**	**1.3**
maximum	1.7	1.8	2.2	2.1	2.1	1.9	1.8	1.7	2	1.6	1.9	1.8	**1.7**
year	2006	2018	2000	1992	1991	1999	1995	1996	1996	1995	1995	1997	1997
minimum	0.8	0.9	0.6	1	0.7	0.7	0.5	0.3	0.5	0.5	0.6	0.6	0.7
year	1995	1999	1994	1006	1992	1992	1992	1992	1992	2006	1992	1993	1992
amplitude	0.9	0.9	1.3	1.1	1.4	1.2	1.3	1.4	1.5	1.1	1.3	1.2	0.9

Figure 22. Wind speed in m/s

Agricultural assessment of climate

The table below shows the climate assessment for the period 1989 - 2018 and for the extremely dry year 2012 and the wet year 2006, which were selected based on the Palmer Index (PIN). According to the PIN, dry is the year whose PIN in the summer months is < 1, and wet is the year whose index is > 1 in that period.

Table 22. Agricultural assessment of climate 1989-2018, 2006, 2012.

	months												annual
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
1989-2018													
precipitation (mm)	48.8	43.8	48.5	60.9	77.1	86	77.5	63.9	79.8	71.7	65.3	57.4	780.7
temperature (˚C)	0.6	2.7	7.3	12.2	16.8	20.4	22.3	21.8	16.4	11.4	6.4	1.4	11.64
heat mark	hl	hl	uhl	t	t	vr	vr	vr	t	ut	uhl	hl	ut
K fm, Gračanin	81.3	16.2	6.6	5	4.6	4.2	3.5	2.9	4.9	6.3	10.2	41	67
humidity	ph	ph	sh	sa	sa	sa	sa	a	sa	sh	h	ph	h

Moist - 2006

precipitation (mm)	**37.1**	**31.3**	**65.4**	**121**	**54.7**	**73.8**	**55.5**	**176**	**12.4**	**22.5**	**46**	**30.8**	**726.4**
temperature (˚C)	-1.8	1.4	5.9	12.3	15.9	19.8	23	19.3	17.3	12.7	7.5	3.1	**11.4**
heat mark	n	hl	uhl	t	t	t	v	t	t	t	uhl	hl	ut
K fm, Gračanin	0	22.4	11.1	9.9	3.4	3.7	2.4	9.1	0.7	1.8	6.1	9.9	64
humidity	0	ph	h	h	sh	a	a	h	ph	a	sh	hl	h

Dry - 2012

precipitation (mm)	**28.7**	**43**	**1.3**	**74.3**	**98.8**	**66.6**	**20.9**	**10.5**	**48.5**	**84.3**	**50.1**	**113**	**640**
temperature (˚C)	1.7	-2.9	9.1	12.4	16.1	22.4	25.3	24.5	18.3	11.7	9.3	0.6	**12.4**
heat mark	hl	n	ut	t	t	v	v	v	t	ut	ut	hl	t
K fm, Gračanin	16.9		0.1	6	6.1	3	0.8	0.4	2.7	7.2	5.4	188	52
humidity	ph	ph	pa	sh	sh	a	pa	pa	a	h	sh	ph	sa

n- levelling (average monthly air temperature < 0.5 ˚C, hl- cold (0.5-4.0 ˚C), uhl- moderately cold (4.0-8.0˚C), ut- umjereno topao (8.0-12.0˚C), t- warm (12.0-20.0˚C), v –hot (>20.0 ˚C), pa-perarid (if Gračanin's monthly factor (< 1.6), a arid (1.7-3.3), sa – semiarid (3.4 – 5.0), sh- semi humid (5.1 – 6.6), h – humid (6,7 – 13 ,3) , ph – perhumid (>13.3)

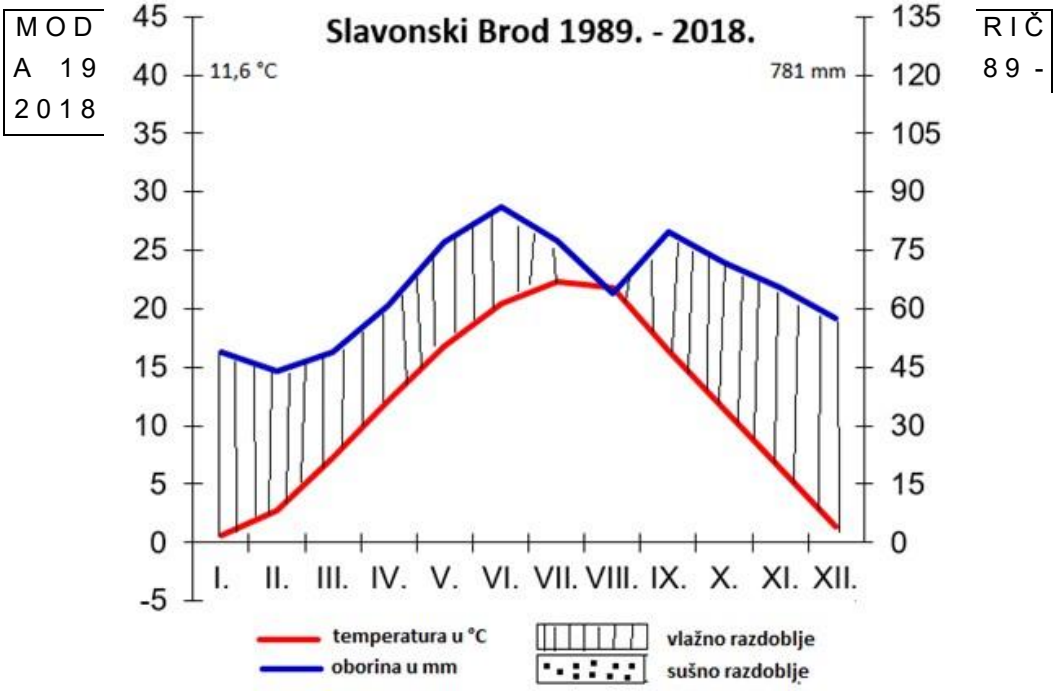


Figure 23. Walter climate diagram- average (1989-2018)

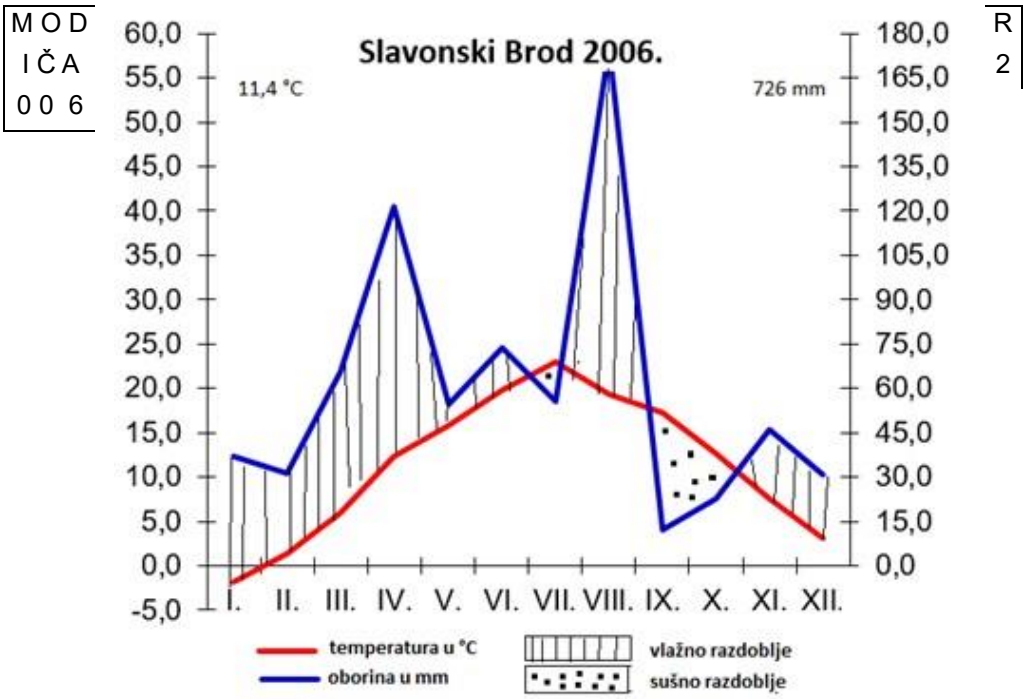


Figure 24. Walter climate diagram 2006 (extremely moist)

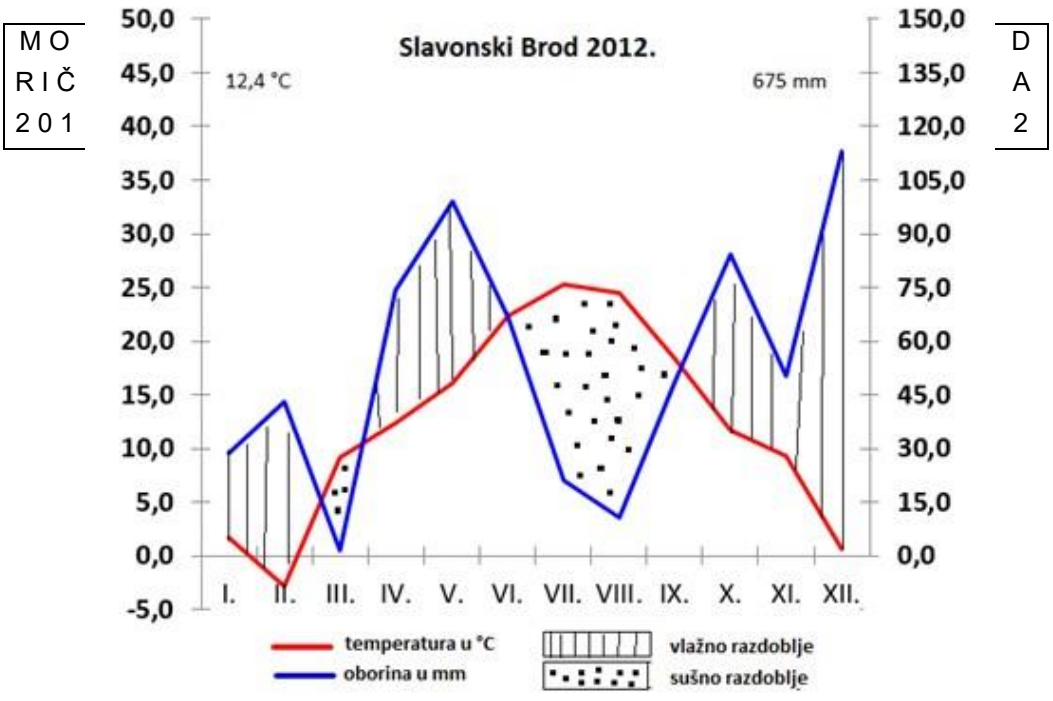


Figure 25.. Walter climate diagram 2012 (extremely dry)

According to the climate data, the subject area with an average annual temperature of 11.6˚C and 781 mm of precipitation is a moderately warm, humid area with thin forest (Lang's rain

factor is 67). Warm months are: April, May and September. Hot months are: June, July and August. October is moderately warm. Cold months are: January, February and December, while March and November are moderately cold.

According to Gračanin's monthly factor, April, June and July are semiarid, and August is an arid month. October, November and March are humid, while January, February and December are perhumid.

In both selected years, less precipitation fell than the average, but in the rainy year, 66% of 726 mm fell in the period from the sixth to the eighth month, and in the dry year, only 42% of the 640 mm of precipitation fell. That is why in a wet year a longer dry period occurred only in September, when it is desirable due to the ripening of crops, and in a dry year the drought that occurred in the last decade of June lasted until the middle of September, as can be seen on the climate diagrams according to Walter.

Palmer index

The Palmer index value for Modriča (1989 - 2018) is shown in tables below. In the thirty-year period, there were nine exceptionally dry years in which the PIN for the summer period of June, July and August was < -1. The extremely dry years were in the period from 2007 to 2009 and 2011 to 2013.

Table 23. Palmer index (PIN) 1989 – 2018.

godina	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	sred.
1989	-0.22	-0.5	-0.61	0.12	1.22	1.66	1.83	2.31	2.54	2.49	-0.22	-0.45	**0.85**
1990	**-0.65**	**-0.84**	**-0.92**	**-0.95**	**-1.27**	**-1.3**	**-1.36**	**-1.44**	**-1.39**	**-1.43**	**-1.44**	**0.08**	**-1.08**
1991	**-0.04**	**-0.04**	**0.01**	**0.45**	**0.88**	**0.72**	**1.74**	**2.02**	**1.69**	**2.5**	**2.84**	**-0.2**	**1.05**
1992	0.44	**-0.52**	**-0.65**	**-0.76**	**-1.04**	**-0.68**	**-0.74**	**-1.07**	**-1.32**	**0.96**	**1.63**	**-0.01**	**-0.39**
1993	**-0.13**	**-0.38**	**-0.36**	**-0.5**	**-0.71**	**-0.83**	**-0.88**	**0.22**	**0.37**	**0.23**	**0.85**	**1.31**	**0.07**
1994	**1.44**	**1.76**	**1.55**	**1.63**	**1.08**	**1.79**	**1.83**	**1.98**	**1.97**	**1.97**	**1.32**	**1.08**	**1.62**
1995	**1.72**	**1.77**	**1.93**	**1.59**	**1.66**	**2.19**	**1.64**	**2.16**	**2.41**	**1.75**	**1.6**	**2.05**	**1.87**
1996	**2.02**	**2.06**	**2.17**	**2.26**	**2.58**	**2.11**	**1.83**	**1.62**	**2.52**	**2.48**	**2.96**	**3.21**	**2.32**
1997	**3.43**	**3.37**	**3.14**	**3.28**	**2.85**	**2.72**	**3**	**3.11**	**2.72**	**3.17**	**3.35**	**3.51**	**3.14**
1998	**3.56**	**2.89**	**2.75**	**2.59**	**2.3**	**1.82**	**1.65**	**1.67**	**1.93**	**2.01**	**2.28**	**2.22**	**2.31**
1999	**2.46**	**2.6**	**2.45**	**2.41**	**2.43**	**2.3**	**3.54**	**3.49**	**3.32**	**3.08**	**3.66**	**4.09**	**2.99**
2000	**-0.19**	**-0.32**	**-0.32**	**-0.43**	**-0.8**	**-1.46**	**-1.55**	**-2.01**	**-2.22**	**-2.56**	**-2.96**	**-2.92**	**-1.48**
2001	**-2.7**	**-2.85**	**-2.61**	**-2.43**	**-2.71**	**1**	**1.04**	**0.78**	**2.06**	**1.5**	**2.04**	**1.86**	**-0.25**
2002	**1.39**	**1.5**	**0.95**	**1.39**	**1.33**	**0.93**	**0.8**	**1.32**	**1.88**	**2.06**	**2.01**	**1.67**	**1.44**
2003	**1.96**	**-0.18**	**-0.54**	**-0.86**	**-1.1**	**-1.69**	**-1.99**	**-2.23**	**-2.43**	**0.75**	**0.62**	**0.28**	**-0.62**
2004	**0.71**	**0.85**	**0.77**	**1.93**	**1.96**	**2.07**	**1.96**	**1.67**	**1.28**	**1.28**	**1.44**	**1.46**	**1.45**
2005	**1.16**	**1.31**	**1.49**	**1.7**	**1.35**	**1.47**	**2.42**	**4.12**	**4.28**	**3.73**	**3.12**	**3.65**	**2.48**
2006	**3.47**	**3.28**	**3.5**	**4.08**	**3.83**	**3.75**	**3.41**	**4.35**	**-0.35**	**-0.7**	**-0.87**	**-1.12**	**2.22**
2007	**-1.22**	**-1.31**	**-1.21**	**-1.61**	**-1.7**	**-1.79**	**-2.22**	**-2.39**	**-2.11**	**-1.74**	**-1.57**	**-1.4**	**-1.69**
2008	**-1.48**	**-1.8**	**-1.43**	**-1.32**	**-1.34**	**-1.28**	**-1.18**	**-1.3**	**-1.24**	**-1.43**	**-1.45**	**-1.59**	**-1.4**
2009	**-1.47**	**-1.57**	**-1.57**	**-1.92**	**-2.17**	**-2.07**	**-2.22**	**-2.46**	**-2.88**	**-3.06**	**-3.03**	**-275**	**-2.26**
2010	**-2.43**	**-2.08**	**-1.99**	**-1.98**	**-1.45**	**-0.83**	**-0.85**	**-0.9**	**-0.8**	**-0.81**	**-0.77**	**-0.65**	**-1.29**
2011	**-0.78**	**-0.95**	**-1**	**-1.32**	**-1.5**	**-1.79**	**-1.71**	**-2.05**	**-2.67**	**-2.93**	**-3.27**	**-3.27**	**-1.94**
2012	**-3.53**	**-3.48**	**-4.02**	**-4.01**	**-3.8**	**-3.91**	**-4.45**	**-4.97**	**-5.19**	**-5.05**	**-5.1**	**-4.65**	**-4.35**
2013	**-4.49**	**-4.04**	**-3.73**	**-3.78**	**-3.64**	**-3.56**	**-3.39**	**-3.39**	**-3.28**	**-3.43**	**-3.37**	**-3.75**	**-3.65**
2014	**-4.03**	**-4.05**	**-4.08**	**0.52**	**1.09**	**1.11**	**1.29**	**1.99**	**2.41**	**2.75**	**2.17**	**2.27**	**0.29**
2015	**2.53**	**2.93**	**2.71**	**2.23**	**2.69**	**2.02**	**0.83**	**0.66**	**0.4**	**0.95**	**0.89**	**0.29**	**1.59**
2016	**0.51**	**0.82**	**1.37**	**1.33**	**1.06**	**1.29**	**1.87**	**1.75**	**1.54**	**1.41**	**1.45**	**0.81**	**1.27**
2017	**0.69**	**0.98**	**0.9**	**1.02**	**1.86**	**-0.26**	**-0.67**	**-1.14**	**0.24**	**0.35**	**0.15**	**0.3**	**0.37**
2018	**0.36**	**0.98**	**1.6**	**-0.44**	**0.05**	**0.28**	**0.76**	**-0.14**	**-0.48**	**-1.03**	**-1.32**	**-1.57**	**-0.08**

3.1.2. Air quality

Since there is no district heating system in the subject area, it is possible to identify local stationary sources of pollution, which include industrial facilities, and residential and business facilities that use different types of fuel for production and heating purposes. In addition to these sources of emissions, traffic emissions as well as emissions from waste dumps and agricultural production play a significant role in air pollution. The most important industrial facilities in the Modriča municipality area are the Oil Refinery, which is the main engine of economic development and the protective symbol of the city and other branches of industry such as shoemaking, textile, chemical, wood, food and beverage production.

Given that continuous air quality measurement has not been established in the municipality of Modriča, the assessment of air quality can be given on the basis of climatic, geographical and other indicators, and on the basis of the use of quantitative data obtained at the measuring locations of infrastructure projects throughout the municipality. There is available data from the Environmental Impact Study for the Vc Corridor Motorway Project. The selection of measurement sites was made based on the impact zone of the future motorway, with the aim of assessing the current state of air quality near the Bosna River. Air quality measurement includes data on concentrations of sulphur dioxide (SO2), carbon monoxide (CO), nitrogen oxides (NO, NOx, NO2) and ozone (O3). According to the measurement, the air quality met the prescribed standards.

3.1.3. Geomorphology of the area

Geomorphological characteristics of the terrain directly depend on a number of factors, first of all on the geological structure of the terrain, then on the strength of the effects of endogenous and exogenous (internal and external) forces, as well as the weather factor. Fluvioaccumulation forms of relief prevail in the research area. Fluvio-accumulation forms are formed by the deposition of river material in places where the transport power of the river flow is weak. Fluvio-accumulation forms that have arisen include: river islands, deltas, alluvial plains and accumulation river terraces.

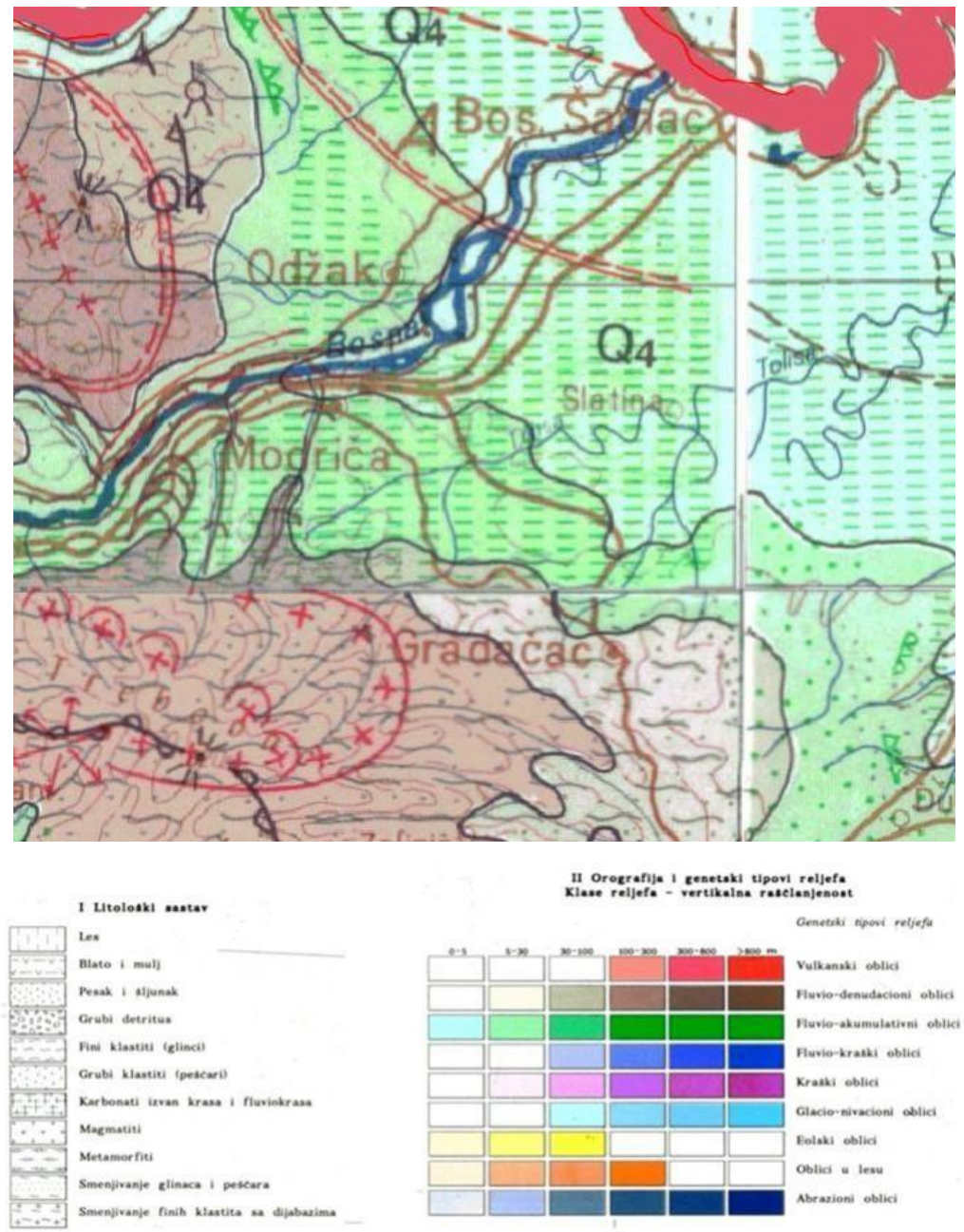


Figure 26. 1:500,000 geomorphological map of Bosnia and Herzegovina (extract), with the subject location marked

3.1.4. Geological composition and structure of the terrain

Quaternary formations (Q)

Quaternary formations on the treated terrain developed over a relatively large area, in the northeastern part of the sheet, which really represents the lowland part of the Bosnian Posavina. In addition, they can also be found in the valley extensions of the Bosna, Spreča, Usora, Foča, Tinja, Veličanka, Tolisa and Rajska rivers, where they appear as alluvial deposits of the aforementioned river courses. In general, as far as the Quaternary formations are concerned, the Doboj sheet can be dated to the Holocene development for now.

Flood facies (ap)

This type of facies development of Quaternary formations on the Doboj sheet is represented by the upper part of the alluvium composed of a clayey-sandy component. In fact, these sediments are clay silt formations that lie over formations described as river bed facies. These quaternary formations are created during floods when the river leaves its bed. A decrease in the variety of layered structures is characteristic, and weakly wavy and horizontal laminae are most often present. Very often, in places suitable for observing this type of quaternary formations, the reappearance of certain "types" of layered structures can be observed.

Dead-river facies (am)

In the researched part of the terrain, Doboj sheet, as well as old or dead ones, represent parts of an abandoned river bed. Here on the Doboj sheet, these are the meanders of the rivers Bosna, Tolisa, Spreča and others. Fine-grained silts and clays are mainly formed in them. There is no flysch made of fossil material in them. These old abandoned parts of the river bed are mostly overgrown with marsh vegetation and are quite inaccessible. In the village of Garevac, one such abandoned watercourse has already entered the stage of waterlogging and is very inaccessible.

3.1.5. Engineering geological features

The research area covers the Basic geological map, i.e. Doboj OGK list 1:100,000, from where basic data on the geological structure of the terrain for the requested research area were obtained. The wider surroundings of the research area are made up of rocks of Quaternary age. Below is given a brief description of the geological units.

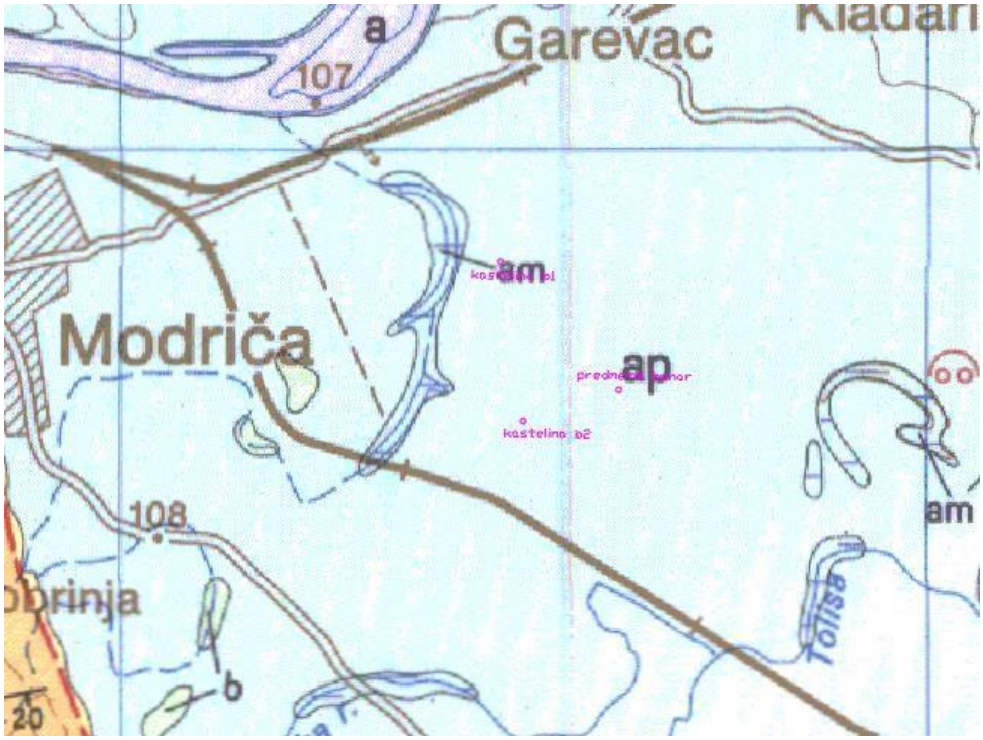


Figure 27. Excerpt of the geological map with the subject location marked

(Doboj M OGK 1:100.000)

A description of the engineering geological characteristics of the terrain is based on the analysis of the geological structure, the performed investigation works, geomorphological, hydrogeological and geotechnical factors that in the course of geological history influenced the qualitative-quantitative variability of the rock masses along the planned section of the route.

According to engineering geological categorisation, rocks in the research area are divided into the following categories:

- environment 1 – loose soil
- environment 2 – loosely bound soils.

Environment 1 – this environment is represented by a complex of loose sediments, which includes sand, gravel and dust. Unbound rocks are characterised by low compressibility, high water permeability and porosity. In a wet state, the mass of dusty rocks is poorly bound, and when saturated with water, it becomes mushy and fluid. They are quite porous. The movement of water in them is slow, and the height of capillary rise and hygroscopicity are high.

Environment 2 –represented by loosely bound sediments, clays. The properties of loosely bound rocks are conditioned by the ratio of solid, liquid and gaseous phases in a unit volume. When they come into contact with water, hydrophobic properties such as sticking, tarnishing and swelling occur. Their porosity is very high, they are practically impermeable to water and drain poorly. The strength parameters depend on the water content. In a dry state, they are moderately compressible, and in a water-saturated state, they are very compressible.

3.1.6. Hydrological and hydrogeological characteristics of the research area

The main surface stream in the research area is the river Bosna. The Bosna is the central river in Bosnia and Herzegovina. It springs from about thirty karst springs in the village of Vrutci near the town of Ilidža at the foot of Mount Igman at 500 meters above sea level. The location of the source itself is called Vrelo Bosne and has become a famous Sarajevo picnic spot.

It flows through the central part of Bosnia, and near Šamac it flows into the Sava River. The Bosna River belongs to the Black Sea Basin. In the middle course, it makes its way through gorges cut into hard rocks, Vranduk-Nemila and Maglaj-Doboj, and in the lower course from Doboj to the mouth, it flows along an unstable bed through the alluvial plain where it makes several backwaters, river islands and meanders.

The Bosna River is 273 km long, 1-3 m deep (up to 10 m in eddies) and 35 to 170 m wide. It is narrowed the most between Maglaj and Doboj. Its average drop is 1.48 m-km, and the mean amount of water flow is about 100m3/s. The highest water level is in the period March-May and in November, and the lowest in August and September.

Basic data on the hydrogeological characteristics of the terrain were obtained from the Basic Geological Map Doboj sheet 1:100,000.

In the research area, the rock masses are classified into the rock category based on the tectonic structure, position in the terrain structure, structural porosity and lithologicalpetrographic properties:

- intergranular type of porosity.

The intergranular type of porosity is represented by gravels, sands and gravelly-sandy sediments.

These hydrological and hydrogeological characteristics are crucial for understanding water resources in the Modriča municipality territory and have a significant impact on the management and use of these resources in this region.

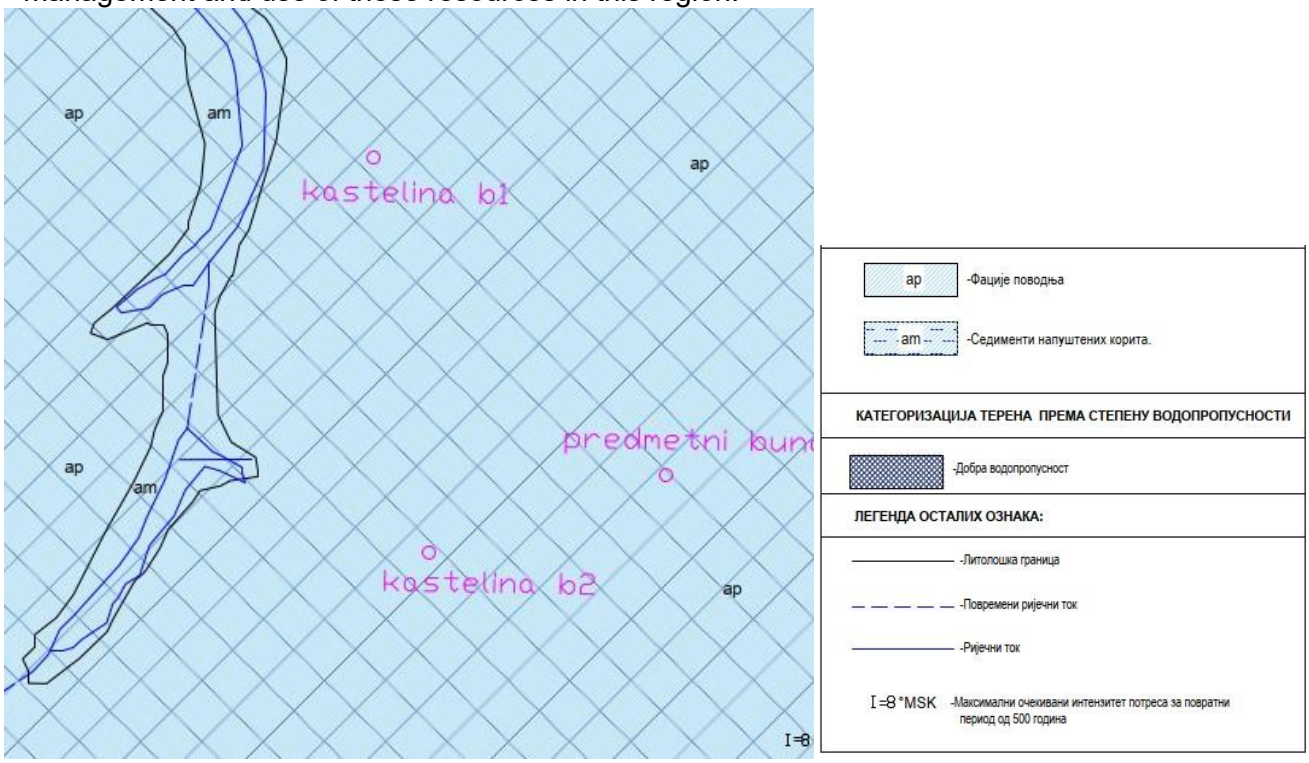


Figure 28. Hydrogeological map

3.1.7. Springs used for water supply

The 117 km long water network is managed by the company a.d. "Vodovod i kanalizacija-Modriča", which has been in majority private ownership since 2002. Currently, the water supply in the municipalities of Modriča and Vukosavlje covers a total of 18,000 inhabitants, that is, 15,885 inhabitants of the municipality of Modriča and about 1,500 inhabitants of the municipality of Vukosavlje. This makes 62% of the inhabitants of the municipality of Modriča and 25% of the inhabitants of the municipality of Vukosavlje. The number of inhabitants without access to public water supply is around 9,500.
The town of Modriča and the surrounding settlements are supplied with potable water from the springs "Modriča field " captured by means of drilled wells. There are currently 3 wells in operation at the source with a total annual average of Q= 80 l/s. The capacity of the source fully meets the needs of the population and economy in the municipality.

As far as sanitary protection zones are concerned, the well for irrigating agricultural plots is in any case outside the immediate protection zone and is located approximately 1800m west of the public source. Exploitation of groundwater downstream of a public source can have a positive effect on the protection of the source, because agrochemicals that can be used on agricultural land will not be able to go upstream if the exploitation of groundwater is carried out on the same plot, thus creating a local erosion basis for the radius of action of each well. In this way, we believe that the well will not negatively affect the public spring when it comes to water quality.

The spring "Modriča field polje" is a source of underground water in an aquifer with an internal type of porosity and according to the Rulebook on protection measures, the method of determining and maintaining sanitary protection zones and belts, the areas where the springs are located, as well as water bodies and water intended for human use, three zones of sanitary protection of the Source and two zones of protection are determined.

Sanitary protection zones are:

a) Zone of immediate protection - a zone of the strictest protection regime;
b) Zone of narrow protection - a zone of limited protection regime;
c) Zone of wider protection - a zone of mild protection regime,

Zone of immediate protection (a zone of the strictest protection regime – spring zone)

Subject to the application of prescribed protection measures, other water structures can be built or located in the Zone of immediate protection of the source, such as water catchment structures, reservoirs, access and internal roads and other structures that are necessary exclusively for the water supply system operation.

Utility company a.d. „Vodovod i kanalizacija-Modriča“ manages and maintains water and other structures with associated equipment, and it should be, like the competent authority of the municipality of Modriča, responsible for the implementation of all protection measures in the area of the immediate sanitary protection of the spring.

The competent body of Modriča municipality is obliged to enact measures and determine in advance the procedures and on-call service with the appointed responsible person, who will be responsible for the coordination and implementation of rehabilitation activities in the event of an accident.

Access to the areas of the Zone of Immediate Protection of the Spring is allowed only to persons employed in the maintenance and security of facilities and zones of immediate protection, the competent inspection authorities and, exceptionally, persons who, for justified reasons, receive the approval of the Utility company a.d. "Vodovod i kanalizacija" Modriča.

Zone of narrow protection - a zone of limited protection regime of the Spring comprises a wider area located immediately after the zone of immediate protection.

In the area of the Narrow Protection Zone of the Spring, it is prohibited to carry out works, build buildings and carry out activities that can pollute the spring, and in particular:

a) execution of works, construction of facilities and performance of activities prohibited in the Wider Protection Zone of the Spring;
b) construction of industrial facilities, craft shops, agricultural buildings and warehouses of building materials, except for smaller plants that do not use or produce dangerous and harmful substances, specified in the Rulebook on conditions for discharge of waste water into surface waters (Republika Srpska Official Gazette, 44/01) and the Rulebook on conditions for discharge of waste water into public sewers (Republika Srpska Official Gazette 44/01), and which receive a water management consent or permit from the Ministry of Agriculture, Forestry and Water Management;
c) construction of roads, railways, parking lots and reservoirs of any purpose, if protection measures are not implemented in accordance with the best available techniques and if they do not receive water management consent or permission from the Ministry of

Agriculture, Forestry and Water Management for that section;
d) construction of a sewage collector, except for an impermeable one, which serves only for buildings located in that area;
e) construction of fish ponds;
f) construction of camping grounds, sports grounds, tourist and residential facilities of collective housing;
g) transport of radioactive and other substances harmful and dangerous to water, without special announcements and the implementation of special escort and protection measures through those areas, and with the implementation of a plan for accidental pollution;
h) any storage of oil and oil derivatives;
i) any mining and construction activity that damages the protective cover or enables open collection of water, except for testing activities that are intended and serve the function of water supply;
j) opening of gravel pits and sand pits, clay borrow pits, cuttings, quarries, undertaking any agricultural and forestry interventions that could damage the active soil zone or reduce the thickness of the roof, promote or accelerate soil erosion, except for actions that prevent it;
k) installation of pens, except for grazing;
l) open storage and application of artificial fertilisers and pesticides;
m) camping and swimming in surface waters;
n) washing vehicles, work machines and devices, as well as changing oil, spare parts, etc.;
o) opening of new cemeteries and burials in existing cemeteries;
p) surface and deep blasting;
q) use of soil for agricultural purposes, except meadows and
r) other activities that are determined to have negative consequences to the source.

In the area of narrow Spring zone protection, already existing residential buildings can remain, as well as individual buildings for breeding livestock and poultry that were constructed alongside these residential buildings. Works aimed at ongoing maintenance are allowed on these buildings, in accordance with the conditions defined by the document on construction, issued by the relevant authority. Sanitary waste water from buildings in the area of narrow Spring zone protection must be collected and transported by a properly designed and executed sewage system. The sewage system must be watertight in the area of narrow Spring zone protection.

All activities that are not directly related to the operation and maintenance of water catchment structures are prohibited in the area of narrow Spring zone protection. Activities carried out for the purpose of operation and maintenance of water catchment structures must not have a harmful effect on the Spring.

As an exception to the above, and in connection with the restrictions in the Narrow Protection Zone, the following activities are permitted to the extent that they do not affect the quality of the groundwater at the Spring:

a) Implementation of sewerage and other installations, which are used for the normal operation of water supply facilities/structures, in which case it is necessary to ensure that these installations cannot endanger the Spring with appropriate design and construction solutions;
b) Movement of the population without restrictions, controlled recreational activities, which may include paths for walking, jogging and cycling, parks for walking and sitting, etc. where the construction of sports and recreational facilities is not allowed;

c) Maintenance of existing facilities, aimed at ensuring the proper functioning of existing facilities, primarily from the aspect of receiving and draining waste water, and removing solid waste, whereby no change of purpose of facilities is allowed.

Zone of wider protection - a zone of mild protection regime of the Spring comprises a wider area located immediately after the narrow protection zone.

In the zone of wider Spring protection, it is prohibited to carry out works, build buildings and carry out activities that can pollute the Spring waters, and in particular:

a) discharge of waste water into the soil;
b) construction of base industry facilities that release radioactive or other substances harmful and dangerous to water or waste water (oil refineries, nuclear reactors, metal processing plants, chemical factories, etc.)
c) disposal, retention or removal of the introduction of radioactive substances underground.
d) disposal, retention, introduction underground, of substances hazardous and harmful to water that are specified in the Rulebook on the conditions for the discharge of waste water into surface waters and the Rulebook on the conditions for the discharge of waste water into public sewers, unless these are substances that can be discharged into the public sewer and if these harmful substances are completely removed by an impermeable sewer outside the affected area;
e) construction of pipelines for liquids that are harmful and dangerous to water;
f) storage of radioactive and other substances harmful and dangerous to water, except for the storage of household heating oil and fuel for agricultural machines, if the best available techniques are implemented, as well as safety measures for construction, delivery, filling, storage and use;
g) construction of tanks and transfer stations for oil and oil derivatives, radioactive and other substances harmful and dangerous to water;
h) execution of exploratory and exploitation wells for oil, natural gas, mineral water, radioactive materials and construction of underground storages;
i) open storage and application of chemical agents harmful to soil and water, pesticides and agents for regulating and growing plants;
j) the use of waste water in agriculture, including rainwater from traffic areas, and the discharge of this water into the reservoir or its tributaries;
k) construction of settlements, hospitals, resorts, industrial and craft facilities, unless the waste water from them is completely drained by an impermeable sewer outside the protection zone;
l) construction of livestock, poultry and other farms and feedlots;
m) construction of air traffic runways;
n) construction of military warehouses and similar military facilities;
o) construction of railway and bus stations and car transport terminals;
p) construction of waste water treatment facilities and garbage incinerators;
q) construction of new cemeteries and expansion of existing cemeteries (human and cattle);
r) establishment of solid waste landfills, verge buckets, slaughterhouses, car waste and scrap metal;
s) use of materials harmful to water during the construction of buildings (e.g. resin, bituminous materials, slag, etc.);
t) emptying the vehicle for the removal of faeces;
u) discharge of cooling and thermal waters into the ground;
v) opening excavations in the surface protective layer, except at the construction sites;

w) exploitation of mineral raw materials;
x) vehicle washing and oil change with surface water;
y) feeding livestock from surface waters and chasing livestock across watercourses;
z) commercial fish breeding except for biological maintenance and stocking in natural streams;
zz) deforestation and other activities that cause soil erosion.

In the Wider Protection Zone area, already existing residential buildings can remain, as well as individual buildings for breeding livestock and poultry that were built next to these residential buildings, provided that only works aimed at ongoing maintenance are allowed on these buildings, and in accordance with the conditions defined by the document on construction, issued by the competent authority.

Sanitary waste water from facilities in the Wider Protection Zone area must be collected and transported by a properly designed and constructed sewage system. The sewage system must be watertight in the Wider Protection Zone area.

Protection belts - a zone of special protection regime is established around the transport pipeline and the tank and around the transport pipeline includes a 2 m wide space on both sides of the transport pipeline, i.e. 2 m on all four sides of the tank.

In the protection zones area, it is forbidden to carry out works, build buildings and carry out activities that can adversely affect the water potability.

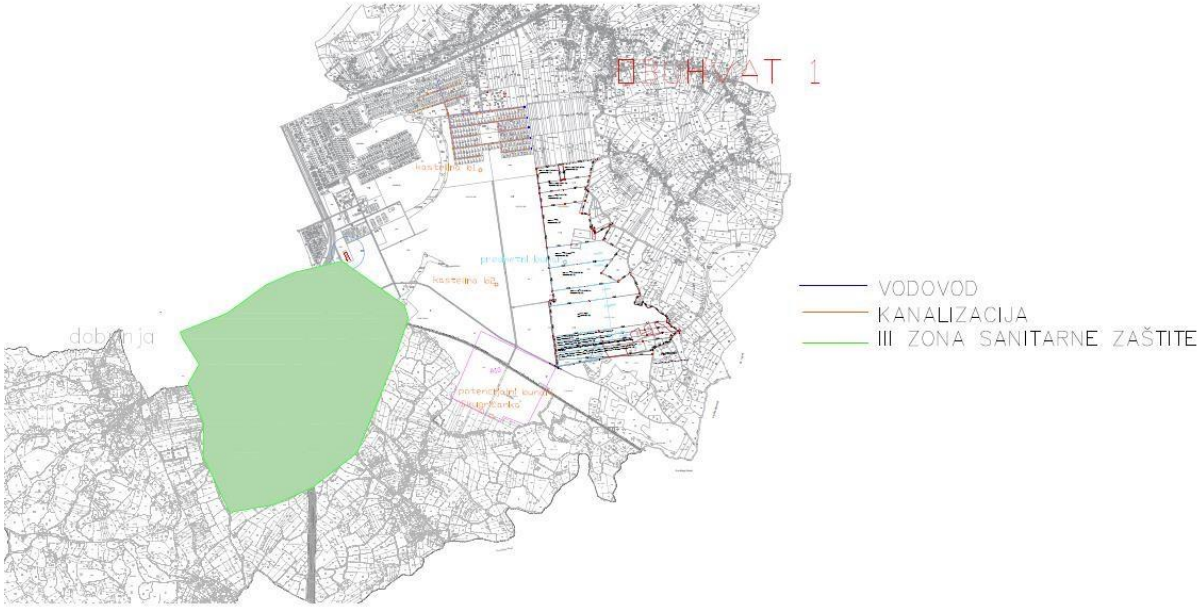


Figure 29. third zone of sanitary protection of the Modriča field spring in relation to the project scope

3.1.8. Seismological characteristics

The assessment of seismic hazard, i.e. the basic level of seismic intensity, was carried out based on valid Seismological maps and the Seismotectonic map of Bosnia and Herzegovina.

In our practice, the Seismological Map of Yugoslavia, scale 1:1 000 000, (published by the Seismological Association of SFRY - Belgrade, 1987) is used for these purposes.

The map is based on complex seismological, geological and geophysical surveys of Bosnia and Herzegovina and a joint synthesis of the results of those surveys.

According to the above map, maximum earthquake intensities of 8 (eighth) degree on the MSK - 64 scale for a return period (T) of 500 years with a probability of occurrence of 63% are expected in the area of the researched terrain.

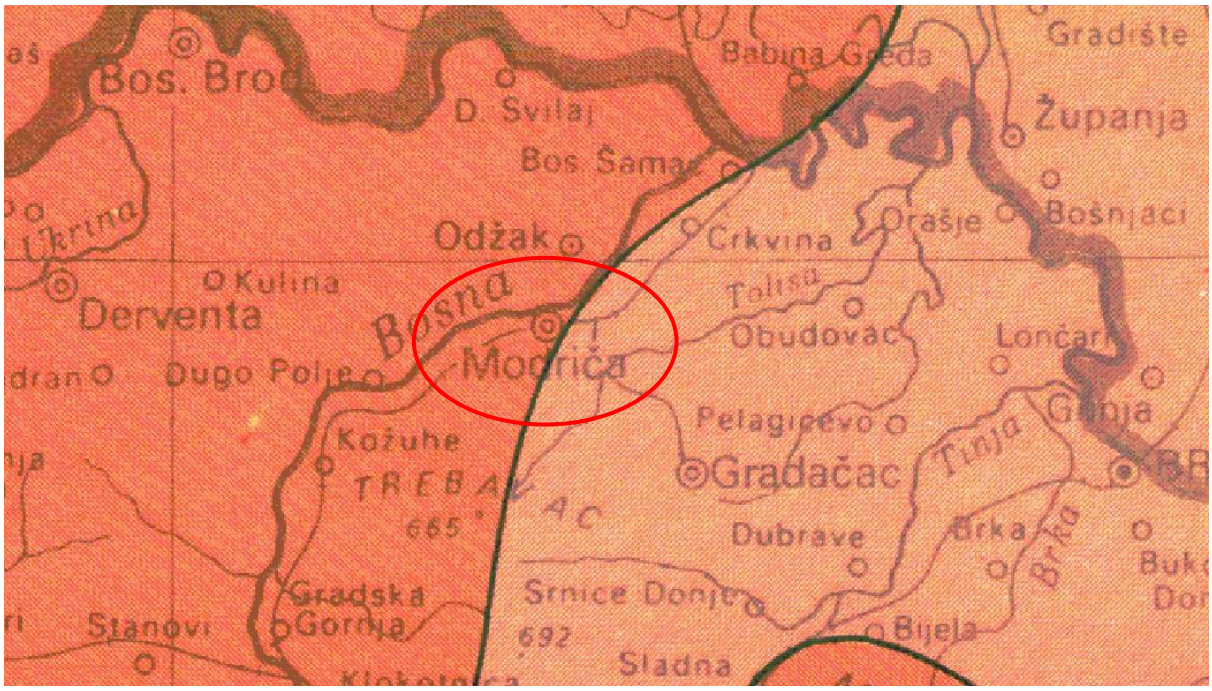


Figure 30. Seismological map of SFRY for a return period ff 500 years (extract)

3.1.9. Waste management

The company that manages waste in the Modriča municipality area is "Komunalac", a.d. The coverage of municipal waste collection service is 30% in the municipal area, and 80% in the area of the city itself. One of the biggest problems in this area is that there is no landfill for temporary waste disposal in the municipality.

In the Modriča municipality area, waste is collected in an organised manner from approximately 3,733 households and 410 legal entities, and in this way approximately 4,671 t of waste is collected and disposed of at the municipal landfill annually.
Currently, municipal waste is not separated for recycling in the municipality. There are no MBO waste processing facilities, nor an incinerator for municipal waste, in the territory of the municipality.

One landfill "Modrički lug" has been officially registered in the territory of the municipality, with an area of 18,712 m2, where about 42,000 m3 of waste was deposited until 2014.
The waste landfill in Modrički Lug was closed by order of the Republic Sanitary Inspector after the May 2014 floods.

As prescribed by the Law on Waste Management (Republika Srpska Official, 111/13, 106/15, 16/18, 70/20, 63/21 and 65/21), and the RS Waste Management Strategy, local selfgovernment units municipal waste should be taken to regional sanitary landfills in regional centres determined on the basis of valid spatial planning documentation as well as the on-site situation. From there, municipal waste from the Modriča municipality area is taken to the regional landfill in Doboj.

3.2. Biological characteristics

The narrow microlocality of the subject area is represented exclusively by agricultural crops, because the entire project area is represented exclusively by agricultural areas that are regularly cultivated and grown, mostly annual agricultural crops. This means that the vegetation of the area in question is extremely poor in species, and the poverty of the flora follows the poverty of the animal life. A vegetation-flora cover within the wider project area consists of forest and non-forest vegetation and flora, as well as fauna that accompany different types of habitats.

Forests

The wider area can be divided into a lower and a higher part. The highlands belong to the plant-geographic Illyrian province of Illyrian beech forests, and the lower part to the plantgeographic Central European province of Illyrian hornbeam forests. This area is characterised by the following forest phytocenoses, which were formed depending on the relief, climatic conditions, etc. factors:

1. Forests of pedunculate oak and Illyrian common hornbeam
2. Forests of sessile oak and common hornbeam
3. Mountain beech forest of the Illyrian area
4. Oak and hornbeam forests of the Illyrian region

Flora

Lawns and arable land are ecological systems created by direct or indirect human influence on areas that were naturally covered by forest. Lawns, despite the fact that they are not of natural origin, represent habitats that greatly enrich the biological diversity of the municipal area. They are inhabited by plant species that partly come from forests, partly from other, especially the steppe areas of Eastern Europe and Asia, while some taxa of polymorphic species have developed precisely thanks to anthropogenic influences on lawns. In the affected area, an extensive method of using grasslands has traditionally been applied, most of which are endangered because they have been converted into arable land. Lawns are characterised by various species from the families of grasses (Poacae), aster (Asteracae), then rushes (Juncus), mints (Mentha), which particularly like moist habitats.

Grassland areas that have resisted anthropogenic impacts are areas of diverse representatives.

Characteristic continental meadows that are characteristic of the municipality area are:

- *as. Arrhenatheratum eltioris* meadow,
- *as. Bromo-Cynosuretum cristati* meadow,
- *as. Bromo-Plantaginetum mediae* meadow.

Arable fields, as artificially created ecological systems, are intended exclusively for agricultural production, and they are cultivated in a way that does not sufficiently respect the protection of biological diversity, because they are used intensively with the application of artificial fertilisers and chemical agents for plant protection.

These are nitrophilous ecological systems that include orchards, vineyards, gardens, marginal areas next to fields, canals and houses, treaded surfaces of roads and yards, and waste disposal sites. Their common feature is an increased amount of nitrogen, which leads to a floristic affinity that is reflected in the multitude of common nitrophilic plants (so-called Ruderal communities). Here, a strict selection of plants is carried out using various agricultural measures (ploughing, digging, fertilising, application of pesticides).

Fauna

Common and well-known European animals are widespread in the area of the municipality of Modriča. Of the mammals, foxes and smaller animals, minks, skunks, stoat, weasels, badgers, along with otters live there, then there are ordinary rabbits, shrews, moles, hedgehogs, small rodents such as mice, voles, hamsters, squirrels, dormouse, etc. The American muskrat has settled along the waters. Various bats also live there, and wild boars, roe deer and deer stay in the forests, and in some hunting grounds there are also fallow deer.

This area is rich in birds: swallows, warblers, flycatchers, thrushes nightingales, pipits, Motacillidae, finch, goldfinch, buntings, tits, lark, starling, golden oriole, magpie, jay, jackdaw, crow then cuckoos, quails, hoopoe, European roller, kingfishers, falcons, kestrel, hawks, woodpeckers, etc. Pigeons, turtle doves, woodpecker, grey-headed and lesser spotted eagle live in the forest areas, and there is also a black stork near waters. Woodcocks stay in humid forests during the summer and even have chicks. In the villages in the lowlands, white storks nest, and by the ponds and marshes herons, ducks, grebes, cormorants, coots, crakes, marsh warblers, warblers, curlew sandpipers, sanderlings, common sandpipers, common gull, terns, bald eagles, fish hawk etc. In recent years, the ringed turtle dove has spread a lot. Out of the snakes, the most common is the common European adder, and the horned viper is rare.

Among grass snakes, the so-called double stripe feature is dominant. Then there live smooth snakes, and out of lizards, the most common are grey and wall lizard, and slowworm is frequent. Pond turtles come along the waters. Out of frogs we shall mention fire-bellied toad, tree frog, edible frog, common toad and European green toad and the common spadefoot is rare. Italian crested newts live everywhere. Large areas of cultivated soil favour insects, especially grasshoppers, but there are hemipterans, turtles, butterflies, dipterans, hymenopterans and others. Steppe forms also appear among them. There are numerous insects and large agricultural and forest pests, such as gypsy moth, potato beetle and others. Various dragonflies, ephemeroideans, caddisflies, stoneflies and mosquitoes fly along the water. A variety of freshwater beetles swims in the waters, such as diving beetles, water scavenger beetles, vrtice, then hemipterans backswimmers, giant water bugs, and common water-measurers in calm waters. Larvae of mosquitoes and similar dipterans, ephemeroideans, caddisflies, stoneflies and dragonflies develop in the water. Among the snails, barnacles, and some smaller ones such as *Neritine, Amphimelanije* etc are common.

Various Diplopoda and Chilopoda, and many spiders linger on the ground. In the water of arachnids there is often a water mite, and of real spiders there is the water spider.

In rivers and other waters, the fish are most often cyprinids, such as carp, crucian carp, tench, barbel, common nase, common bream, various sunbleak, perch, pike, zander, sterlet. The biggest fish is the catfish, which can grow to over 100 kg, and the huchen are also large, and can weigh over 30 kg. The North American species brown bullhead and pumpkinseed moved into some rivers from the ponds.

In the bogs, ponds and lakes, a plankton life community has developed, in which there are a large number of microscopic protozoa, as well as ciliates, flagellates and larger planktonic animals such as numerous Copepods, water fleas and wheel animals. Of the insect larvae, only the larvae of the *Chaoborus crystallinis* mosquito float in such warm waters. There are no specially protected parts of nature in the area of the municipality of Modriča.

3.3. Natural and cultural heritage

No natural assets of special value, cultural assets, material assets including cultural-historical and archaeological heritage have been identified in the zone of direct influence of the subject project.

In the Modriča municipality area, today there are only modest remains of architectural heritage, the most significant of which is the old town of Dobor, which, by the Decision of the BiH Commission for the Preservation of National Monuments, is a national monument as "building complex - Old Town of Dobor".

Figure 31. Dobor fortress

The Church of Ascension of Holy Mother of God in Modriča is on the temporary list of national monuments.

The construction of the temple began in 1914. In the same year, Petar Zimonjić, archbishop of Dabar-Bosna consecrated the foundations of the temple. The church was completed in 1921, burned down in 1992, and rebuilt in 1997.

On the list of petitions for the declaration of an asset a national monument, in the narrow Modriča municipality scope, there are:

- Ali beg mosque in Islam Varoš,
- Bijela (Šijić) mosque, - a mosque in Gornji Tarevci,
- a mosque in Modrički Lug.

3.4. Sociological characteristics

The planned areas for irrigation are located in the populated place Garevac, which territorially belongs to the municipality of Modriča.
The territory of Modriča comprises a total of 24 local communities, 5 urban (Modriča I, Modriča II, Modriča III, Modriča IV, Modriča V), 2 suburban (Dobrinja, Tarevci) and 17 rural (Babešnica, Borovo Polje, Botajica, Vranjak, Vranjak 1, Garevac, Dugo Polje, Kladari Gornji, Kladari Donji, Koprivna, Koprivnska Trebava, Krčevljani, Miloševac, Riječani, Skugrić, Tolisa and Čardak).

According to the official and published 2013 census of the Agency for Statistics of Bosnia and Herzegovina, a total of 25,720 inhabitants live in the Modriča municipality territory, which represents 2.1% of the census population of the RS. According to the 1991 census, the municipality had 35,413 inhabitants, that is, 27% more. The reasons for the decrease in population are population migration in the war and post-war years, and displacement outside the borders of Bosnia and Herzegovina.

According to the current data of the Republika Srpska Institute of Statistics in 2020, 23,416 inhabitants lived in the municipality of Modriča. According to the analysis of the data, a constant decline in the number of inhabitants is evident. The reasons for the decrease in population are displacement outside the borders of BiH, moving to larger cities, leaving Bosnia and Herzegovina.

The main reasons for the negative population policy, i.e. the decline in the birth rate in the municipality of Modriča, as well as at the level of Republika Srpska, are the result of unemployment, political crises, and the decrease in the number of births is particularly influenced by the emigration of the young reproductive population, the shifting of the marriage limit and the postponement of childbearing due to poor economic situation. In 2020, 249 more people died than were born in the municipality of Modriča.

From the aspect of age structure, according to the estimate of the Republika Srpska Institute of Statistics in 2020, in the territory of the municipality of Modriča, the most numerous residents are between the ages of 15-64, that is, they make up 66% of the Modriča municipality population. At the same time, this number also represents the total working age population. 22% of the population belongs to the old category, and 12% are young people under 15 years of age. The gender structure in the municipality of Modriča is almost equal, i.e. 51% of the population is female, and 49% is male.

The population density in the Modriča municipality territory is 70.5 inhabitants per square kilometre, while the population density at the Republika Srpska level is 46.1 inhabitants per square kilometre. We can conclude that the Municipality of Modriča, compared to other municipalities and the Republika Srpska level, is one of the more densely populated.

The Municipality of Modriča is extremely rich in fertile land and small watercourses, and on the other hand, Modriča is also a city with a significant industrial tradition. In addition to the oil refinery, which is the main driver of economic development and the protective symbol of the city, other branches of industry such as shoe, textile, chemical, wood, food, beverage and other industries have been developed in Modriča. "Modriča" oil refinery occupies a dominant position in industrial production, in terms of results and number of employees, in the economy of Modriča.

The textile, leather and footwear sector also has a long tradition and a trained and competitive workforce. The shoe industry is a significant source of employment in the municipality of Modriča. There are several companies in Modriča that are engaged in the production of footwear, and some of them already cooperate with foreign companies such as "Komo" a.d. and "Thema" d.o.o. through "LOHN" business (with the companies "RELAXSCHOE" from Italy and "THINK SCHUHWERK" from Austria).

The number of business entities in the municipality of Modriča in 2020 was 561, which is a 4.4% increase compared to 2016. A comparative analysis, accordingly, shows a decrease in the number of unemployed persons. The number of unemployed in 2020 is lower by 171% than in 2016. However, it must be borne in mind that this growth is not sufficient and does not enable the employment of less employable persons, especially persons aged between 50-55. The structure of legal entities is dominated by the area of wholesale and retail trade, motor vehicle and motorcycle repair with 30% participation in the total number of legal entities, with 6.2% traffic and storage, art, entertainment and recreation with 8.9%, while 18.3 % are other service activities, etc. In the structure of entrepreneurs registered in the municipality, the area of trade dominates, which makes up 36% of the total number of registered entrepreneurs, processing industry with 12%, activities of providing accommodation, food preparation and serving, hotel and catering with 16%, traffic and storage with 8.2, while other service activities make up 14%, etc.

Apart from industry, the Municipality of Modriča relies heavily on the development of agriculture. Almost two-thirds of the land (62%) in the municipality of Modriča is arable land, and the share of arable land with favourable soil quality is a good assumption for the development of agricultural production.

There are 567 agricultural holdings registered in the Modriča municipality area. Out of the total agricultural area of 21,322 hectares, 72.50% is arable land, 10.25% orchards, 5.62% meadows, and 11.63% pasture. In the production structure on arable land in 2020, grains dominate with 75%, vegetables with 9%, fodder plants with 15% and industrial plants with 1% of the area. In agricultural production, grains (corn, wheat, barley) and fodder plants are the most represented, and the smallest percentage is occupied by industrial plants (tobacco, soybeans). In 2020, 7,050 tons of wheat, 64,370 tons of corn, 2,600 tons of barley and 2,915 tons of potatoes were produced in Modriča. Most of the produced corn and barley end up on the farm for their own use for feeding livestock, while the produced wheat and part of the corn are purchased by the purchasers MPI "Modriča" Modriča and "Đurić" d.o.o. Modriča.

Out of the total number of inhabitants, 4,680 are employed, or 19%. The average net salary in 2020 in the municipality of Modriča amounted to BAM 837, which is at the level of 87% of the average in Republika Srpska. In the last two years, there has been a slight upward trend in the

average salary in the municipality of Modriča, but generally speaking, the salary trend is stable without excessive oscillations.

In the municipality of Modriča, there is a noticeable downward trend in the number of domestic and foreign guests in the last five years (2016 to 2020). According to records in 2020, there are two hotels, two motels, and one lodging house in the municipality of Modriča. Data on overnight stays are unavailable. The analysis of tourist arrivals and overnight stays (domestic and foreign) indicates a significant decrease in 2017 and 2018, and an increase in 2019, while in 2020, due to the COVID-19 (corona virus) pandemic and epidemiological measures, the number of registered tourists is insignificant

If we observe the sectors with the highest number of employees, it can be seen that the processing industry leads the way with 35% of the total number of employees, followed by wholesale and retail trade; vehicle and motorcycle repair with 16%, and education and health care and social work activities with 7.9%, etc.
For the sake of comparison, the highest number of registered legal entities and entrepreneurs is in wholesale and retail trade, repair of motor vehicles and motorcycles, followed by the processing industry, while the analysis indicates that the highest number of employees are in the processing industry, followed by wholesale and retail trade.

When it comes to the age structure of the unemployed in the Modriča municipality area, the highest number is made up of young people and elderly people before retirement. There is a noticeable trend of increasing registered unemployed in these two groups. Young people find it extremely difficult to find employment due to low economic activity and an insufficient number of jobs, while older people aged 50-60 have difficulty finding a job due to employers' lack of interest in this type of workforce. It is necessary to develop programs that especially treat these two vulnerable groups of registered unemployed persons, through active social policy measures, in order to remove the negative consequences of the high unemployment of these groups. In the structure of the unemployed, persons aged between 50-55 predominate with 12% in 2020, and in terms of professional qualifications, qualified workers.
An overview of the situation shows that the number of unemployed has a tendency to decrease, so that the total number of registered active job seekers in the territory of the municipality in 2020 amounted to 1,302 unemployed persons, which is 117% less than in 2016.

Regarding the specific area that is planned for irrigation, the following table shows a list of land users with the date until which the lease lasts. It is stated which crops were grown in the past 5 years and the area used by each lessee individually. The mechanisation used by farmers is listed with the approximate age of the mechanisation as well as the attachments used.

Table 24. list of users of the project area

No.	Lessee's name and surname	Lease contract (duration)	Area/ ha	Crops grown on the plot	Mechanisation used
1.	Dragan Gavrić	12.12.2030	17.68 ha	Corn	Tractor, disc harrows, ploughs aged 18 years
2.	Jovo Stević	12.12.2030	11.35 ha	Corn, wheat	Tractor with attachments aged 16 years
3.	Goran Ilić	12.12.2030	2.57 ha	Corn, wheat	Tractor with attachments aged 10 years

4.	Stojan Stević	12.12.2030	3.23 ha	Corn, wheat	Tractor with attachments aged 20 years
5.	PZ “Skugrićanka”	12.12.2030	15.17ha	Corn, wheat, soybeans, oilseed rape	Tractor with attachments aged 9 years

Based on the crops that are grown on the areas in question, it is necessary to synchronise the time of works in order to avoid damages caused by the project implementation. Before the works commencement, coordinate the agricultural producers who use the Contractor's plots so that, if possible, the works are carried out in the non-vegetation period (late autumn - early spring), while it would be agreed with the lessees and concessionaires to try to avoid sowing winter crops during the project. Otherwise, the measures should provide for compensation for damage due to the destruction of the sown crops.

Based on an analysis of the concerned area, population, scope of the project, state of the environment carried out as part of the available data specified in the ESMP, it was concluded that the project can only affect the local community in a way that can lead to minor occasional traffic jams. Activities for the sub-project realisation will be carried out on state land that has been given agricultural users (lessees) for use. No activities will take place outside the defined plots, and activities such as installation of pipes, generators, temporary storage of equipment will be within the plots. The contractor will determine the storage space for the materials and machinery needed for the project in such a way as to minimise any damage caused to the agricultural plot users. If there is no area that is a tailings dump in terms of agricultural production, provide for compensation for damages in measures due to the occupation of the area.

Analysing the location in question from the aspect of traffic, it was concluded that local macadam roads are used exclusively for the departure/arrival of agricultural producers to plots for the cultivation of various crops. These roads are in bad condition and are not used for traffic between populated areas, so only agricultural machinery moves on them. When arriving at the location, the Contractor will pass through the populated area by the nearest route from the main road, and given the project scope, the amount of machinery will not be a burden for the local community. In any case, it is necessary to adhere to appropriate measures in order to avoid any possibility of endangering traffic along the planned routes. In the following figure, the possible directions of movement from the site in question to the main roads that will be used by the Contractor are shown in blue.

Figure 32. possible road routes

It is noted from the attached that there are three road routes that can be used to reach the location in question, whose choice by the Contractor will depend on the condition of the road and the consideration of avoiding conflicting traffic situations. Process in more detail through the TMP plan in agreement with the local community, as well as the foreseen measures to prevent the impact on the local community.

Figure 33. subject location

Figures 34, 35 show the location in question, where it was determined by field research that there is no informal settlement or nomadic population groups nearby, so it is likely that the outcome of the project will not have a negative impact on vulnerable or marginalised population groups. In addition to the project beneficiaries, agricultural producers whose subsistence occupation is agricultural production will also benefit from the project, because there is a realistic basis for expanding this project after additional analyses of well capacities in the area.

3.5. Cultural characteristics

The Serbian Cultural Centre (SKC), founded in 1992 as a public company, is located in the city centre, at Dr. Milan Jelić Square. It also includes the "Vuk Karadžić" Library with sections for children and adults with around 32,000 titles, as well as a cinema hall.

Within the Cultural Centre, there is a Blue Hall with a capacity of 250 people, intended for organising conferences and stage performances, theatre plays, as well as smaller rooms with a capacity of up to 50 people where literary evenings, public debates, workshops, seminars and various promotions are held. The hall itself and the corridors provide opportunities to display figures and other art objects such as handicrafts, icons, objects found during archaeological excavations, etc. The furbished Ljetna stage *(Summer Stage)* of the SKC provides opportunities for holding various cultural events in the open space. The only media in the territory of the municipality - Radio Republika Srpska - Modriča Studio is located within this cultural institution, which provides the opportunity to inform the entire community.

Cultural life in Modriča is certainly enriched by nine cultural and artistic societies: KUD „Aktiv 4“, KUD „Zavičaj“, KUD „Zoran Tomušilović Dugo Polje-Botajica“, „KUD Vranjak“, KUD

„Miloševac“, KUD „Modriča“, KUD „Trebava“, KUD „Savska Mačak“ and KUD „Ševko Avdić“, which have a total of 561 young members.

The Municipality of Modriča was, and still is, known as the "City of Sports". It is a healthy environment in which there are 33 sports organisations and associations. As part of the Cultural and Sports Centre (KSC) there are: tennis courts, open sports courts and a sports hall with a capacity of about 3,000 spectators, in which numerous and diverse competitions are held, together with the stadium of the "Modriča Maksima" Football Club with a capacity of 6,000 spectators (1,300 seats), which also includes auxiliary fields, represent representative sports facilities that enable enviable sports events.

Football and volleyball are certainly the most trophy sports of the municipality. The municipality has the most registered football clubs, but other sports are represented to a lesser extent (table tennis, kayaking, martial arts: karate, kickboxing, jiu-jitsu, etc.). It is also important to note that the City Stadium is one of the most modern stadiums in the area that complies with the criteri for playing European matches.

The citizens' association "Athletic Recreational Club" Modriča was founded in 2018 and since then it has been working on the promotion of sports as a healthy way of life and the promotion of Modriča. Members of the association recreationally participate in sports events under the auspices of the International Street Racing Organisation (IAFF).

As part of the work of the JU „Kulturno sportski centar“ (KSC) the following sports and cultural manifestations take place every year: the Sveti Sava indoor futsal competition, men's and women's volleyball club matches, as well as their younger selections, the Vidovdan table tennis tournament, matches (competition) STK "Modriča-Spin", Final indoor futsal competition – SŠC „Jovan Cvijić“, Final basketball tournament – SŠC „Jovan Cvijić“, Indoor futsal tournament– on the occasion of Day of the Republika Srpska Police, seminar of basketball coaches – KK „Modriča“; the Sveti Sava Academy, festival of cultural-artistic societies, Children's New Year as well as concerts by various artists. The sports centre, which includes a football stadium and a sports hall, was enriched by the construction of an indoor swimming pool. Within the facility there is a 25x15.5 m² swimming pool, suitable for people with disabilities, a spa centre and a restaurant. With the construction of a swimming pool in the territory of the municipality, a swimming club was also formed.

Health care in the municipality of Modriča is provided by the PJU "Dom zdravlja Modriča" as well as nine regional health institutions (family medicine surgeries). Out of the total number of family medicine surgeries, 5 are located in the rural part of the municipality, while the remaining three are located in the urban part of the municipality. The Modriča Health Centre functions as a public health institution that is responsible for organising primary health care for the Municipalities of Modriča and Vukosavlje.
The Modriča Health Centre has the following organisational units: Family Medicine Department; Service for specialist consultations in paediatrics and gynaecology; Dentistry service (general, preventive and children's dentistry); Hygiene and Epidemiological Service; Emergency medical assistance service; Laboratory diagnostics service; Service of ultrasound and X-ray diagnostics; Centre for Mental Health; Centre for physical rehabilitation in the community and Service of common affairs. The health centre currently has 119 employees, out of which: 86 medical and 33 non-medical employees.

There are a total of 75 non-governmental organisations in the territory of the municipality. Sports were mentioned in the previous text, and the other 44 civil society organisations are from the fields of culture, art and literature; youth (12); rights of war veterans (4); rights of

refugees, displaced persons (1); marginalised groups (1), gender associations (1); rights of returnees (4); entrepreneurship, economy, agriculture (3); health care (2), pensioners (1); humanitarian work (2); rights of marginalised groups (2); environmental protection (1) preserving tradition (2) improving the position of children (1) and others (5) such as beekeepers, hunters, divers, mountaineers, media.

4. DESCRIPTION OF POSSIBLE ENVIRONMENTAL IMPACT OF THE PROJECT

4.1. Impact in the planning/design phase

4.1.1. Project's impact of the on the "Modriča field" spring

Groundwater in the considered area is fed from the Bosna River. Bearing in mind this way of replenishing the aquifer and the fact that there are three wells on the project site from which water is drawn for the water supply of the population, below are given certain data on the investigation works on the irrigation well in question and its impact on the groundwater regime.

Therefore, as part of the system contains the source of water for the water supply of Modriča, a careful approach was taken to defining the positions of the wells and analysing the possible impact on the modes of operation of the "Modriča field" well, as well as neighbouring wells that are already used for irrigating agricultural plots.

4.1.1.1. Conducted investigative works

Field research was started with detailed engineering geological mapping in order to create an engineering geological map. The main goal of the engineering geological map was the detailed determination of the geological structure of the terrain, that is, the separation of lithofacies units according to the superposition principle and their representation in the structure of the terrain, as well as the registration of all hydrogeological and hydrological phenomena.

At the location in question, pumping tests were performed, i.e. step test, as well as monitoring the behaviour of the groundwater level in the surrounding wells, all with the aim of determining the impact of the well in question on the surrounding wells during the step test.

The goal of conducting the water pumping test was to obtain the most reliable data on the characteristics of aquifers, that is, to obtain the necessary data on yield and lowering of the level, as well as data on the maximum capacity of the well.

Testing was done with three capacities with flow and dynamic level measurement as well as level recovery. The testing was done at the location of Platine where it was determined that the depth of the well in question was approx. 22 m, the depth of the groundwater level was 11.17 m, and the diameter of the well in question was ϕ500 mm.

Figure 34. Positions of the subject wells

Testing of exploitation well B-1 was carried out on 30 October 2023 according to the Terms of Reference. A step test with three capacities was performed on the well in question, as well as a groundwater level recovery test.

The level of underground water in the well was measured with an electric level gauge, and the amount of pumped water was determined using a graduated container. The time mode of measurement, as well as all other test data, are given in tables as part of this study. The determined depth of the well before pumping was 10.83 m.

Figure 35. Performing pumping tests on the subject well and monitoring GWL on neighbouring wells

Below are tables with the results of testing the well in question.

Table 15. Results of testing the well B-1

First flow				
Date and time	Duration (min)	Flow (l/s)	Depth to the level	Depression (m)
30.10.2023 7:00	0	1	10.83	
30.10.2023 7:01	1		10.88	0.05
30.10.2023 7:03	3		10.91	0.08
30.10.2023 7:05	5		10.91	0.08
30.10.2023 7:08	8		10.93	0.10
30.10.2023 7:10	10		10.94	0.11
30.10.2023 7:15	15		10.94	0.11
30.10.2023 7:20	20		10.94	0.11
30.10.2023 7:25	25		10.94	0.11
30.10.2023 7:30	30		10.94	0.11
30.10.2023 7:45	45		10.94	0.11
30.10.2023 8:00	60		10.94	0.11
30.10.2023 8:30	90		10.94	0.11
30.10.2023 9:00	120		10.94	0.11
Second flow				
30.10.2023 12:00	300	2	10.83	0.00
30.10.2023 12:01	301		10.92	0.09
30.10.2023 12:03	303		10.93	0.10
30.10.2023 12:05	305		10.96	0.13
30.10.2023 12:08	308		10.96	0.13
30.10.2023 12:10	310		10.96	0.13
30.10.2023 12:15	315		10.98	0.15
30.10.2023 12:20	320		10.98	0.15
30.10.2023 12:25	325		10.98	0.15
30.10.2023 12:30	330		10.98	0.15
30.10.2023 12:45	345		10.98	0.15
30.10.2023 13:00	360		10.98	0.15
30.10.2023 13:30	390		10.98	0.15
30.10.2023 14:00	420		10.98	0.15
30.10.2023 14:30	450		10.98	0.15
30.10.2023 15:00	480		10.98	0.15
Third flow				
30.10.2023 17:00	600	4	10.83	0.00

30.10.2023 17:01	601		10.95	0.12
30.10.2023 17:03	603		10.98	0.15
30.10.2023 17:05	605		10.99	0.16
30.10.2023 17:08	608		11.00	0.17
30.10.2023 17:10	610		11.03	0.20
30.10.2023 17:15	615		11.03	0.20
30.10.2023 17:20	620		11.03	0.20
30.10.2023 17:25	625		11.03	0.20
30.10.2023 17:30	630		11.03	0.20
30.10.2023 17:45	645		11.03	0.20
30.10.2023 18:00	660		11.03	0.20
30.10.2023 18:30	690		11.03	0.20
30.10.2023 19:00	720		11.03	0.20

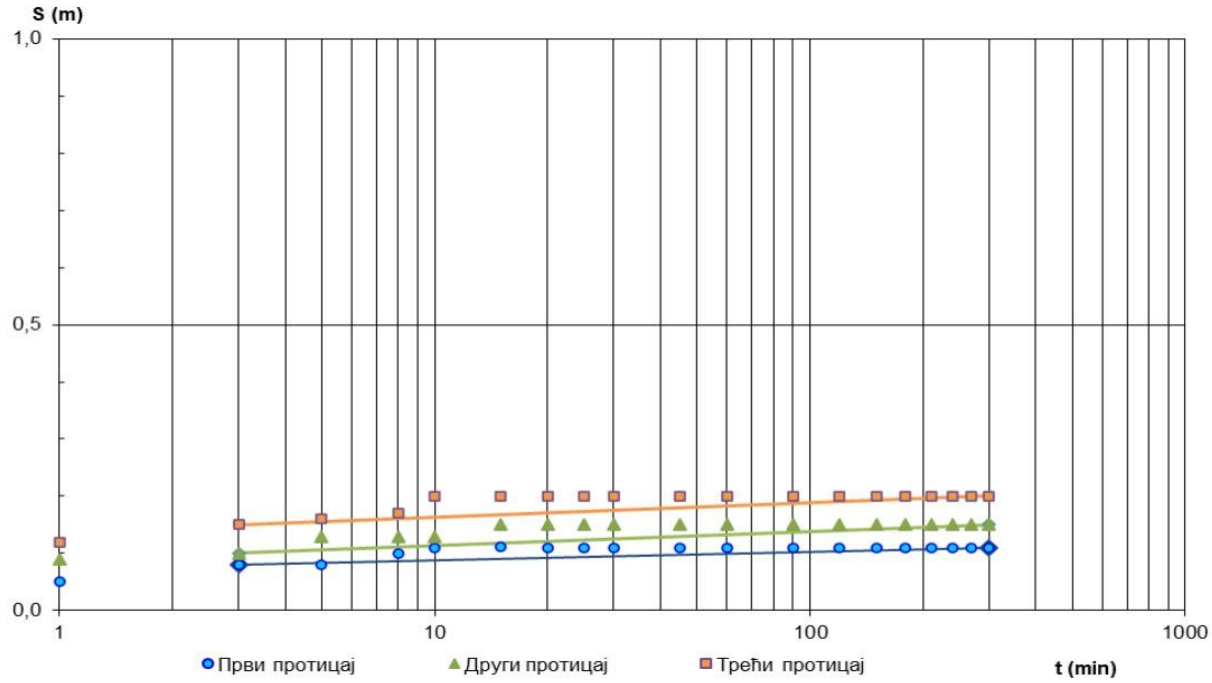


Figure 2. S=(log (t))

The data obtained from the pumping test were processed using the grapho-analytical method S=(log(t)). By applying this method, it is possible to determine the filtration characteristics of the aquifer zone, that is, to calculate the coefficient of water permeability (T).

The following data were obtained for the well in question.

S log(t)	prvo sniženje			
T =	1,22E-02	m^2/s	K1=	1,09E-03

S log(t)	drugo sniženje			
T =	1,46E-02	m^2/s	K2=	1,31E-03

S log(t)	treće sniženje			
T =	2,93E-02	m^2/s	K3=	2,62E-03

Where:

Ksr=	1,67E-03	m2/s

The parameters of the aquifer obtained in this way indicate that it is an aquifer with relatively good filtration characteristics.

Specific capacity of the well

This parameter is a characteristic constant of the constructed well and represents the capacity of the installed pump per unit of groundwater level lowering. In this case, pumping tests were performed with three different capacities, i.e. a step test, and based on this, the value of the specific yield was determined and it amounts to:

Q_1 =1 l/s	s_1=0.11m	q_{sr}= 9.09 l/s/m
Q_2 =2 l/s	s_2=0.15m	q_{sr}= 13.33 l/s/m
Q_3 =4 l/s	s_3=0.2m	q_{sr}= 20 l/s/m

The mean value of the specific capacity of well marked as B-1 was achieved during test pumping and can be determined using the form:

$$Q = q_{sr} \times S$$

$$Q = 14.14 \text{ l/s/m} \times 3.72 = 52.6 \text{ l/s}$$

$$Q_{eks} = Q \times 80\ \% = 42 \text{ l/s}$$

Where:

q_{sr}= 14.14 l/s/m - specific capacity of the well
S= 3.72 m – maximum permissible lowering of the water in the well.

Based on the capacity value obtained using the method of analogy, it can be assumed that the exploitation capacity of the well at the test time is Q_{eks}= 42 l/s.

In order to obtain the most reliable data on the well's capacity, it is important to monitor the well's capacity during different seasons in order to obtain comprehensive figures on its performance. Climatic conditions, including changes in precipitation and temperature, can significantly affect groundwater levels and well capacity.

Only performing pumping tests in different seasons allows a better understanding of variations in capacity and helps in planning the sustainable use of water resources throughout the year. Given that no data was provided on the lithological profile of the well in question, assuming that the well was built in alluvial deposits (OGK Doboj sheet), the water levels in these deposits can vary significantly and depend on various factors, including their thickness, material permeability and characteristics of groundwater.

Conclusion

At the location in question, a well marked as B-1 at the location of Platine, Garevac cadastral borough was pumped. Based on the performed pumping tests, it was established that it is a aquifer with relatively good filtration characteristics.

During the pumping test, the groundwater level was measured in two neighbouring wells and it was established that the examined well had no negative impact on it.

The established depth of the well in question is 22 m, in order to determine the actual depth of the well in question, it needs to be cleaned. The diameter of the well in question is ϕ500 mm, while the measured groundwater level at the time of measurement was 10.83 m.

The well's calculated exploitation capacity at the time of measurement was 42 l/s with a maximum allowable lowering of 3.72 m.

The conducted research showed that the planned project, that is, the amount of water that will be used, will not have a significant impact on the existing spring, which was also confirmed by the competent water company of the Municipality of Modriča, which gave its consent to the implementation of the project in question. It was also established that the project area is outside the sanitary protection zones (Figure 34.).

In order to obtain the most reliable and high-quality data, it is necessary to observe the well in question for at least one hydrological year. Climatic conditions, including changes in precipitation and temperature, can significantly affect groundwater levels and well capacity. Only performing pumping tests in different seasons allows a better understanding of variations in capacity and helps in planning the sustainable use of water resources throughout the year.

4.2. Impact during the construction period

Planned construction works will be aimed at the construction of a new irrigation system. The works will be implemented in areas that shall precisely be defined by location requirements in dependence of pipeline alignment and positions of reservoirs and wate intake structures.

Bearing in mind a fact that the project is related to the construction of an irrigation system, its direct environmental impacts are expected to be low to insignificant. Regardless of the impact quantity, measures for their prevention/mitigation must be integral part of the design process and implementation.

Potential negative impacts of the project include:

1. damages caused by the contractor's works in the construction, including deposition of excavated soil and other materials;
2. long-term risk of contaminating surface waters and groundwater due to agrochemical pollution as a result of usage of pesticides, which will remain on the same level as presently
3. erosion of soil connected with the existing practices of agricultural production, however it will be reduced as much as possible because the selected irrigation systems do not allow that.

The construction of the irrigation system requires the presence of construction mechanisation (trench excavator, bulldozer) of smaller dimensions and workers in the field, as well as the establishment of the construction site zone.

Principal impacts will include the management of excavated soil and construction waste and waste water, and fuel and lubricants at the construction site, but they can also include:

1. disruption of access and movement,
2. disruption of agricultural activities that ensue from access limitation, soil compaction and canal excavation,
3. waste, noise, mud and dust at the location and on access roads,
4. disturbance of animals in and near the area.

4.2.1. Impact on soil quality

Construction works, including the removal of surface soil layer (humus), excavation, as well as the very presence of machines and workers at the construction site can have negative impacts on soil quality as well. Thus, the following impacts were identified:

- Soil pollution due to spilling or disposal of oil and oil derivatives, motor oil and similar waste that ensues from devices and vehicles at the construction site;
- Soil pollution due to uncontrolled disposal of solid waste on the soil;
- Soil pollution due to uncontrolled discharge from workers' toilets at the construction site on the soil;
- Stimulation of erosion with the wind and water;
- Delaying the restitution of the land in its original state.

In the areas where it is necessary to pass over steep inclinations, construction works can cause soil erosion and deposits transport. Implementation of proposed measures for impact mitigation, such as employment of temporary dykes, fences and trenches that would reduce and limit pollution level, will minimise the mentioned impact.

Soil restoration in its original state is a standard procedure that is conducted after welding and backfilling of pipes. Soil restoration in its original state will strive to achieve two goals:

- short-term goal that reflects in backfilling, dewatering and stabilisation of soil with the aim of permanent prevention of erosion and recultivation, it is to say depositing the preserved or substitute surface layer in order to enable the growth of autochthonous vegetation and

- long-term goal that reflects in the establishment of an adequate vegetation cover, which would be aimed at restoring local plant communities and ecosystem into their original state. Delaying the restitution of the land in its original state can cause aggravation of the quality of preserved surface soil layer, as well as increase costs of subsequent restitution of soil into its original state

The above-mentioned impacts are temporary and restoration into original state is possible. Impact can be significant unless the measures of good construction practices are applied in line with the Law on Civil Engineering.

4.2.2. Impact on water quality

It is estimated that construction works might also have a negative impact on the quality of groundwater, notably:

- pollution of groundwater due to spilling or disposal of oil and oil derivatives, motor oil and similar waste that ensues from devices and vehicles at the construction site;
- changes in the quality of groundwater due to uncontrolled discharge from workers' toilets at the construction site.

The aforementioned impacts may be permanent if adequate mitigation measures are not taken. This document will propose mitigation measures that will try to reduce negative impact during the construction phase.

4.2.3. Impact on air quality

As a consequence of construction works is expected an increased concentration of polluting substances, primarily dust and exhaust gases from motor vehicles. Activities that will cause the emission of polluting substances are: transport of uncovered construction material, movement of machines and vehicles at the construction site, as well as the works in the excavation of trenches in which pipes will be laid.

Impact on air quality is expected in an area that is several hundred meters away from the works location. Still, a significant impact on the local population is not expected, or exceeding the law-prescribed concentrations of emissions in the air. Hence all impacts are closely related to the works location, their presence is temporary with a tendency of restoration into the original state upon the termination of works.

4.2.4. Impact on noise level

The construction will progress gradually, which will cause occasional noise. Construction process cannot be assessed at this degree, but since it depends on multiple factors such as the number of workers, types of mechanisation, types of soil, presence of other factors (existing underground pipes) etc. Construction works will mostly be done during working hours during the day, but depending on the nature of works, there is a possibility that some activities will be done out of the mentioned time framework.

Hence, impact mitigation measures will prescribe day working hours in the zones that are most affected. This impact is assessed as temporary and less significant.

4.2.5. Impact on flora and fauna

During construction, fauna will inevitably be disturbed due to the operation of construction machinery: noise, dust particles and emissions of exhaust gases and particles. These impacts are limited to a narrow construction area and are temporary and are therefore considered acceptable. Impacts can be mitigated by appropriate good construction practices: organisation of construction sites, regular maintenance of equipment, sound attenuators, etc.

During the execution of works, the risk of the spreading of foreign invasive species of flora and fauna will increase. It is necessary to ensure measures to prevent their spreading: clean the machinery and vehicles before using them in the project area, and after the construction works, allow the surfaces that were excavated during the works to be restored to their initial state. In case of encountering a foreign invasive species, it is necessary to try to prevent its spreading and remove it.

4.2.6. Impact on protected areas

The planned irrigation system is not located within the protected area, so there will be no negative impact on them. In terms of protected parts of nature, it was established that there are no rare or protected species and habitat types of flora and fauna in the affected area. The construction of the subject irrigation system will not have a negative impact on the protected species of flora and fauna of the wider area.

4.2.7. Impact on waste generation

Vegetation material and excavated soil that cannot be reused for the works will make up a bulk of the generated waste, as well as inert construction waste. Servicing and maintenance of machinery and equipment and installation work can generate waste such as metal waste, empty lubricant containers, plastics, rubber, etc. Also, this includes packaging materials, wrappers, used polyethylene bags, food waste, used bottles, etc., which were used by construction workers.
The project does not envisage the removal of existing asbestos pipes, so this type of waste has not been identified.

4.2.8. Impact on the population

Taking into account that the project involves the movement of machines on local roads and the digging of trenches for the laying of pipelines, there is a possibility that the mentioned activities will interfere with the usual movement routes of the population and motor vehicles. In chapter **3.4. sociological characteristics**, a map is given with possible routes of the contractor's mechanisation. It is evident from the attached that traffic jams can occur during the arrival and departure of machines and mechanisation at the construction site. As a low number of mechanisation units is foreseen, no significant impact on the local population of Garevac local community is foreseen. However, these impacts can be mitigated by applying measures of good construction practice including planning the deployment of machinery and equipment in

cooperation with the local population and authorities. In addition, there is a potential health hazard related to the presence of open trenches near neighbouring agricultural plots, which can be mitigated by appropriate signalisation and fencing.

In general, all impacts caused by construction works are temporary and it is possible to restore to the original state before the works were carried out. Impacts can be mitigated by appropriate good construction practices that will be prescribed by this document.

4.2.9. Impact on occupational safety and health

Occupational safety and health issues associated with the proposed construction include:

1. Workers exposed to toxic waste, dust, noise and vibrations;
2. Risk of accidents and injuries due to the use of machinery and equipment and material management at the construction site, such as:

   - danger of tripping and falling;
   - risk of working with water under high pressure;
   - risk of demolition of existing manholes and other structures;
   - risk of collapse of pipe laying trenches;
   - dangers from excavation;
   - fall of equipment on workers;
   - lifting heavy structures;
   - hazards associated with handling materials (e.g. lifting, being struck or hit, stuck, etc.);
   - welding and other works that emit hot and glowing particles;
   - work with electrical installations and equipment.

In accordance with the existing Republika Srpska legislation, all workers will undergo health checks for the work they perform, as well as training for high-risk workplaces if the project envisages performing work with increased risk. The contractor will regularly carry out training of working personnel with increased risk as well as providing first aid.

4.2.10. Impact on GBV/SEA-SH

Considering the nature of construction projects and the characteristics of the RS labour market, the number of female workers on construction sites is expected to be minimal, so the risk related to GBV/SEA-SH on the construction site is low. The risk of GBV/SEA-SH in local communities can also be considered low by respecting the local context, and by implementing appropriate measures and awareness raising activities.

4.2.11. Impact on archaeological and other immovable culturalhistoric asset

During the execution of civil works, since these are excavations, there is a possibility of finding archaeological remains or other material and non-material cultural-historic heritage.

There shall be no negative impact on natural assets of special value, cultural assets, material assets including cultural-historical and archaeological heritage, which were previously described, considering that the project in question does not conflict with them, i.e. the project will be implemented in an area not planned for protection. If possible archaeological findings are accidentally discovered during the works execution, immediately stop the works and inform the competent Engineer and the Institute for the Protection of Cultural and Historical Heritage until the final determination of the findings. Defined through protection measures.

Generally speaking, all impacts caused by construction works are temporary and its restoration into the condition of before the execution of works is possible. Impacts can be mitigated with adequate construction practices that will be prescribed by this document.

4.3. Impact during the exploitation phase

Apart from many significant benefits of the irrigation in agricultural production, irrigation can also have negative consequences, especially if it is incorrectly applied or is applied under inadequate conditions. Potential negative impacts that are identified during the exploitation phase relate to:

1. problems with salinization, becoming marshy and soil erosion, this should not occur because design irrigation norms are insufficient to cause the land to become marshy, irrigation water quality is adequate and will not lead to salinization, and the designed irrigation systems do not lead to soil erosion especially when it comes to flat terrain.
2. quality of surface waters and groundwater due to agro-chemical pollution, Washing off due to irrigation will be almost inexistent because these are lower irrigation norms,
3. and disorders in the ecological balance in terms of the occurrence of specific types of vermin and weed.

4.3.1. Impact on soil quality

In general, the negative impact of irrigation on soil are divided into chemical, physical and biological soil degradation.

The process of soil acidification is accelerated on lands where hydro and agromelioration operations have been carried out and on lands where a larger quantity of physiologically acidic mineral fertilisers is applied. Soil acidification has multiple negative effects on physical, chemical and biological characteristics, and through them on soil fertility.
Soil salinisation can be caused by the raising of groundwater that is salty and the exploitation of water that contains an increased amount of salt. The same applies to the use of polluted water (heavy metals, nitrites, nitrates).
Soil salinization occurs when the groundwater level exceeds a critical height that is inconvenient for the development of the majority of agricultural crops. Then the soil is completely saturated with water. Silted soils cannot timely be prepared for sowing or prepared at all, or sowed in time. Dewatering and application of other agro-amelioration measures are necessary for resolving salinization problems.
Degradation of the soil's physical characteristics can occur as a consequence of a decrease in the content of humus (primarily in the arable soil layer), which results in deterioration of the soil structure. It arises as a result of more intensive soil cultivation and humus mineralisation.

The result of joint action of the degradation of the physical and chemical characteristics of soil leads to a disruption of the relationship between the physiological groups of microorganisms.

Soil compaction reduces the aeration of microorganisms, and as a result, an increased number of beneficial anaerobes occurs. Soil acidification favours the development of acidophilic microorganisms (fungi) to the detriment of beneficial bacteria. Reduced soil biogenicity is one of the reliable indicators of reduced soil fertility, and it refers to the reduced representation and activity of macrofauna.
The impact on land during the use of the irrigation system in question largely depends on the responsible use of the planned system and sustainable land management under irrigation conditions. The key prevention measure refers to the application of correct irrigation methods and good agricultural practices, as well as monitoring the quality of the soil being irrigated.

By applying mineral fertilisers and other preparations, it is possible to change the pH of the soil locally. In this way, soil conditions for the root system activity are improved, mineral nutrients are transferred from inaccessible forms to accessible forms, microbiological activity is activated and the micro conditions for the development of flora and fauna are improved.

Key preventive measures relate to permanent education of farmers on good irrigation methods and good agricultural practices, and monitoring of the quality of the irrigated soil.

4.3.2. Impact on water quality

The application of chemical agents in agriculture including the application of phytopharmaceutical agents and mineral and organic fertilisers can reach the surface water and groundwater through transport percolation mechanisms and surface runoff and jeopardise their quality in this way. The groundwater level is relatively close beneath the terrain surface; thus possible impacts would be more intensive. From the aspect of prevention of impacts, it is necessary to apply preventive measures that are primarily related to permanent education of farmers on proper irrigation methods and good agricultural practices including integral pest prevention measures.

Monitoring plan will envisage regular analyses of the quality of water in the intake structure not only in order to establish impacts of the project on quality but in order to establish the quality of water that will be used for irrigation in order to avoid negative impacts on crops and soil.

Taking into account presented analysis results of impacts on the sub-drainage basin it is not expected that intaking water for irrigation will jeopardise either quality or quantity of water available for water supply of the settlement, or any other users.

4.3.3. Impact on air quality

No significant impact on air quality is expected during the use of the project. Occasionally, during agricultural work, emissions of exhaust gases from agricultural machinery will occur, especially if the machinery is older. In chapter **3.4. sociological characteristics**, the machinery is described to be 2 to 20 years old. Anticipate the replacement of older machinery within a reasonable time, and the exploitation of modern machinery and fuel with a lower sulphur content to reduce these emissions even more.

4.3.4. Impact on noise level

No increased noise emissions are expected during the use of the irrigation system. A possible source of noise is the operation of the pump. In order to prevent noise, the selection of pumps

was made on the basis of operating characteristics and maintenance of equipment operation in the optimal range.

4.3.5. Impact on fauna

Majority of pest prevention agents in agriculture represents dangerous poisons to bees and other useful insects. In order to avoid bees poisoning when these are applied, it is necessary to apply adequate measures for application of these agents, which relate to irrigation times, weather and pesticide selection. Also, it is necessary to make contacts with beekeepers' associations, and timely notify them of the agents' usage actions so that they could timely act and close the bees in bee-hives. The irrigation project relates to the areas where agricultural production is already done, which means that no enlargement to bigger areas is planned and no significant disturbance of the environmental balance and increased pest invasion are expected. However, the application of good agricultural practices, including integral pest prevention measures is necessary. Principal aim of the application of this integral plan is to prevent and reduce application of pesticides, and at the same time keep the pest population at an acceptable level.

4.3.6. Pest and weed management

When using the irrigation system, the appearance of additional unwanted pests and weeds is possible due to the formation of favourable conditions (humidity) for their development. Plant diseases are present in the subject area, as in other areas of BiH: powdery mildew, blight and various fungal rots. Plant aphids, which attack fruit crops, also cause less damage. The subject area is also under the influence of invasive weed species whose seeds are carried by the wind. Among the weed species, the most common are: *Ambrosia artemisiifolia L.* – ragweed, *Convolvulus arvensis L.* – field bindweed, *Arctium lappa L.* – greater burdock, *Cirsium arvense* (L.) Scop. – creeping thistle, *Artemisia absinthium L.* – common wormwood*, Hordeum secalinum* Schreb. – meadow barley.

Proper pest and weed management implies correct and timely recognition, knowledge of biology and life cycle, monitoring of numbers and exploitation of biological methods where possible. Constant education of farmers on good agricultural practices including integral pest prevention measures is necessary. The main goal of implementing an integral plan is to prevent and reduce the use of pesticides, while at the same time maintaining the pest population at an acceptable level. Integral plan for Pest Control should serve the farmers to acquire necessary information on good agricultural practices in order to reduce the burden of pollution in the environment caused by excessive usage of pesticides and to reduce the risk to human and animal health by complete exclusion of pesticides from usage. Ministry of Agriculture, Water Management and Forestry, Agricultural Project Implementation Unit (APCU) will follow up the implementation of project and make sure all activities in project area are done in line with the Integral Plan for Pest Control.

4.3.7. Impact on protected areas

The planned irrigation system is not located within a protected area, so there will be no negative impact on them.

4.3.8. Impact on waste generation

Waste that will be generated during the exploitation phase includes:

1. non-hazardous waste, such as: packaging waste, wooden sticks, plastic shading films, metal wires, organic biodegradable waste (crop residues), manure, machine waste such as old tires, etc.);
2. hazardous waste, such as: packaging waste of chemicals and biocides after use, oils and lubricants from machines, etc.

4.3.9. Impact on human health from the use of pesticides

Because pesticides are poisonous, they are also potentially dangerous to humans, animals, other organisms, and the environment. Therefore, people who use pesticides or regularly come into contact with them need to understand the relative toxicity, potential health effects and preventive measures to reduce exposure to the products they use. The hazard depends on the toxicity of the pesticide and the amount of exposure to the pesticide and is often illustrated by the following equation:

Hazard = Toxicity x Exposure

The operational phase of the Project is likely to involve the use of pesticides by project beneficiaries who may practise excessive use of chemicals in agriculture, causing soil and water pollution. Such potential negative environmental impact will be avoided through the implementation of Integrated Pest Management (IPM). Under Good Agricultural Practice (GAP), the most common method is the agro-technical method of mowing weed species and its storage and drying for fodder.

The ARCP project effectively promotes the use of IPM principles, such as the application of pesticides only when the economic threshold of harm is reached, to reduce the use of agrochemicals such as pesticides and herbicides in favour of more environment-friendly methods such as the use of beneficial bacteria to combat plant diseases, beneficial insects and organic (plants).

Contemporary agricultural practices and intensive crop production usually require the adoption of agrochemicals. It is therefore essential to ensure that the project beneficiaries participating in the project are adequately informed and taught the correct procedures for the safe use, handling, application, storage and disposal of agrochemicals. Only approved pesticides should be used at the recommended rate and frequency with proper application techniques to ensure the most effective control of target insects is used, using a narrow band and minimum quantity of targeted pesticides.

During the preparation and application of pesticides, in case of inadequate user protection, pesticide poisoning can occur through inhalation, through the skin or by swallowing. Poisoning can be acute (single intake of a large amount of pesticides, direct contact with the skin) or chronic (long-term and constant intake of smaller amounts of pesticides). Therefore, when applying pesticides, it is necessary to use protective equipment (rubber gloves, rubber boots, protective suit, head covering, glasses and mask for nose and mouth).

Packaging waste resulting from the application of pesticides is considered hazardous waste and as such should be adequately temporarily stored and disposed of in cooperation with operators authorised for further treatment of this waste.

4.3.10. Impact on community health and safety

Irrigation and drainage projects contribute to the conditions that promote good health – food security and economic progress that allow rural households greater purchasing power for medicines and health services. However, there may also be negative impacts on human health that are projected through the development of water-borne infections (infections are mainly transmitted by mosquitoes, flies and snails, which breed in shallow banks, water weeds, dam overflows, etc.). Infections occur mainly in hydraulic structures with stagnant water, e.g. drainage channels, which can be prevented by designing them in such a way as to enable independent emptying or under certain conditions using suitable pumps. Aquatic weed clearing is extremely important in reducing human health risks.

The impact on human health can also occur due to the use of pesticides that do not meet the Bank-prescribed criteria that they must have a negligible negative impact on human health. Inappropriate use of pesticides and fertilisers can lead to surface and underground water pollution, which can result in potable water pollution and thus endanger human health.

4.4. Cross-border impact

All works that are planned for implementation as part of the irrigation project are located in the Republika Srpska territory, in the Modriča municipality area. The entity border is more than 6 km away from the project location by air line, and the interstate border with Croatia is more than 16 km. Given that it is an irrigation system, no blasting will occur during construction and no work of such intensity will be carried out that could have an impact on other Entity or the State. On the basis of the above, it can be concluded that the irrigation system construction project in question will not have an impact on other Entity or the State during construction or during exploitation.

4.5. Project's positive impacts on environmental management

The irrigation system construction will provide economic, social and environmental benefits to the users of land and local community in this area. Earlier experiences of similar projects show that the project will have many positive environmental impacts through the promotion of good practices of land usage, growing methods and pest control.

The project should help strengthen environment-friendly approach to agriculture development.

Potential positive environmental impacts of the implementation of this Project include:

- better monitoring of the water resources usage;
- more rational usage of water resources through improved work and maintenance;
- decreasing the risk of water pollution with chemicals through the implementation of the Integral pest control plan;
- reduction of consumption of energy producing products because the designed irrigation system will employ a principle of gravitation flow.

Proposed project activities in the construction of a new irrigation system will lead to improvement of business operations of individual producers, but also to a certain improvement

in the sector of agricultural production in the whole municipality of Modriča. These activities, however, cannot have a significant impact on a wider social and political framework. Significant effects on the economic-social situation and employment in agriculture require provision of other elements as well: market for the produce, easier access to incentives and other types of aid.

Construction of a new irrigation system is only a first step in the provision of support to agricultural activity. Agricultural production involves a chain of diverse institutions and users. A quality product is a fist instance after which other equally significant issues arise: the issue of project maintenance agents, the issue of project dissemination, the issue of product sale, the issue of equalised legislation. Thus, the irrigation system construction certainly opens a new network, a new path to agriculture development. But this does not mean that the mere implementation of the Irrigation project will give great effects in the domain of economic situation improvement.

Expected positive effects of the project on agricultural production are: increase in the yield, introduction of new crops in the production, standard improvement, employment. Participants in the research emphasised the importance of inclusion of individual farmers into irrigation project so that the project would have a greater impact.

Also, capacity strengthening in local and private sector will enable an indirect impact on conditions in which individual farmers practise agricultural production.

5. DESCRIPTION OF THE MEASURES FOR PREVENTION, MITIGATION AND REMOVAL OF HAZARDOUS ENVIRONMENTAL IMPACT OF THE PROJECT

Environmental Management Plan was prepared based on the results of the environmental impact assessment, and it incorporates measures that will be applied during the project implementation to mitigate possible negative impact, as well as a cost assessment and responsibility for their implementation.

Mitigation measures are categorised as:

- Mitigation measures in the phase of designing/planning,
- Mitigation measures in the phase of construction; -
  Mitigation measures in the phase of exploitation
- Mitigation measures in the phase of project removal.

Mitigation measures in the phase of design and planning refer to obtaining all relevant permits, planning related to the selection of sources of supply, the best spatial organisation and methods of carrying out works.

Mitigation measures in the phase of construction mainly refer to the implementation of good construction practices in order to avoid negative impacts on soil stability, water and soil quality, and noise level. Adjust the execution of works to avoid possible conflicts with the local population in traffic, adjust working hours at the construction site. Maintain regular contacts with the local community, do not usurp other people's land and local roads. Their implementation is the Contractor's obligation and they must be included in the contract with the Contractor, along with the Environmental Monitoring Plan. The costs of implementing these

measures should be included in the construction costs, and it is necessary to emphasise that the costs could be significant if the Contractor does not comply with the provided measures and good construction practices and causes significant damage. The client and the designated supervising engineer will supervise the implementation of mitigation measures and the Monitoring Plan. A List of good construction practices (Annex 1) and Waste management plan (Annex 2) that should be incorporated in the contract with the contractor.

Mitigation measures in the exploitation phase relate to the mitigation of negative impacts that can occur as a consequence of inadequate usage and maintenance of the system, and usage of phytopharmaceutical agents.

5.1. Plan of measures for prevention/mitigation of environmental impact

Table 16 Plan of measures for the prevention and mitigation of environmental impact

Phases	Problem	Mitigation measure	Costs		Institutional responsibility		Comments
			Planning	Implementation	Planning	Implementation	
Planning/ designing.	Assure compliance with relevant legislation in the field of construction, water management, environment and concessions	Acquire the Environmental permit, Town Planning Permit, Water management guidelines, Concession for water usage.	-	-	Project applicant.	Project applicant.	
Planning/ designing.	Potential damages to the existing infrastructure and structures, especially underground installations (water supply and sewerage pipeline etc.) that cause disturbances in the provision of services to beneficiaries.	Precisely locate the position of infrastructural structures and underground installations in cooperation with relevant institutions at all levels of authority and end users (tenants/concessionaires). Change the alignment or design solution of the irrigation system in order to mitigate or avoid possible damages. Arrange cooperation with providers of communal and other services in order to take necessary joint steps in order to prevent disruption of services provision or timely notify the public of temporary disruption of services	-	-	Designer.	Project applicant in cooperation with designers and representatives of relevant institutions of local authority and end users (tenants/concessionaires).	

Planning/ designing.	Unauthorised supply of raw materials and construction material represents a pressure on natural resources.	Supply construction material from legal entities registered for subject activity and with valid necessary permits (environmental, water management, etc.) as well as good practice with regard to labour rights and occupational safety and health.	-	-	Project applicant.	Contractor.	Problems will be regulated by the tender documentation.

Phases	Problem	Mitigation measure	Costs		Institutional responsibility		Comments
			Planning	Implement ation	Planning	Implementation	
Planning/ designing.	Negative public reactions due to lack of information and coordination of activities	Hold public debates with irrigation system users and the local community	-	-	Project applicant	Project applicant in cooperation with the consultant	Problems will be regulated by the tender documentation
Planning/ designing.	Increased possibilities of employment and income gaining for the local community.	Prioritise employment of qualified local population.	-	-	Project applicant.	Contractor.	Problems will be regulated by the tender documentation
Construction	Soil erosion as a consequence of clearing, cleansing, excavation	Provide for slope protection (compaction, stabilisation by planting vegetation, lining slopes). Determine the location for disposal of earth material, and humus with grass cover is to be disposed separately so that it could be reused. Perform substitute planting or replanting of vegetation. Implement the Waste management plan given in Annex.	-	-	Contractor.	Contractor.	Problems will be regulated by the Works Execution Contract.
Construction	Violation of the vegetation cover	Perform substitute planting or replanting of vegetation (mandatory use of autochthonous species). Apply the measures of good construction practices given in Annex.	-	-	Contractor.	Contractor.	Problems will be regulated by the Works Execution Contract.

Phases	Problem	Mitigation measure	Costs	Institutional responsibility	Comments

			Planning	Implement ation	Planning	Implementation	
Construction	Emissions of dust from the disposal location for earth material, due to the movement of vehicles on macadam roads and execution of construction works.	Compact the disposed earth material. Spray water over dust sources in order to mitigate dust impacts on the surrounding population. When transporting powdery material, cover the vehicles with a protective tarpaulin in order to reduce pollution Control the speed of vehicles in order to reduce dust emissions. Prepare and implement the Construction Site Organisation Plan that will include the measures of good construction practices given in Annex. Adhere to the measures defined by the Labour Management Procedure (LMP).	-		Contractor.	Contractor.	Problems will be regulated by the Works Execution Contract.
Construction	Emission of gases and particles from vehicles, mechanisation and generators.	Regular equipment maintenance. The contractor is obliged to enclose proof of worthiness for vehicles in line with the regulations on hazardous gases emission. Prepare and implement the Construction Site Organisation Plan that will include the measures of good construction practices given in Annex.	-	-	Contractor.	Contractor.	Problems will be regulated by the Works Execution Contract.

Phases	Problem	Mitigation measure	Costs		Institutional responsibility		Comments
			Planning	Implement ation	Planning	Implementation	

Construction.	Noise when working with heavy mechanisation and generators.	Use machinery and vehicles that have the necessary documentation that they are roadworthy (use permits, traffic permits, certificates of technical worthiness) in order to emit lower levels of noise and have less impact on the surrounding population. Abide by the law-prescribed working hours at the construction site within the limits (from 07h – 19 h), where the limit value of the noise level must not exceed the noise levels L_{day}, $L_{evening}$ for the intended zone of use of the space. Soundproof the casings of generators if located near residential facilities. Regularly maintain machinery and vehicles. Provide noise silencers for heavy machines. Plan the relocation of equipment at a time when there are not big daily traffic jams. Adhere to the measures defined by the Labour Management Procedure (LMP). Prepare and implement the Construction Site Organisation Plan that will include the measures of good construction practices given in Annex.	-	-	Contractor.	Contractor.	Problems will be regulated by the Works Execution Contract.
Construction.	Increased water turbidity as a consequence of the execution of works.	Works are executed in the dry weather. Prepare and implement the Construction Site Organisation Plan. Implement the Waste Management Plan given in Annex.			Contractor.	Contractor.	Problems will be regulated by the Works Execution Contract.

Phases	**Problem**	**Mitigation measure**	**Costs**		**Institutional responsibility**		**Comments**
			Planning	**Implement ation**	**Planning**	**Implementation**	

Construction.	Pollution of groundwater and surface waters with oils and lubrication due to bad maintenance and repairs of equipment, and fuelling at the construction site.	Avoid maintenance and fuelling at the site. In possible fuelling and maintenance of vehicles at the construction site, protective foils are to be used. Provide absorbing material in case of fuel spillage. Used oiled material and agents should be managed in line with the Waste Management Plan. Prepare and implement the Construction Site Organisation Plan that will include the measures of good construction practices given in Annex, measures from water management documents and measures from the Waste Management Plan given in Annex.	-	-	Contractor.	Contractor.	Problems will be regulated by the Works Execution Contract.
Construction.	Increased risk of invasive species of flora and fauna	Clean machinery and vehicles before use. In case of encountering a foreign invasive species, it is necessary to try to prevent its spread and remove it.	-	-	Contractor in cooperation with relevant offices	Contractor in cooperation with relevant offices	Problems will be regulated by the Works Execution Contract.
Construction.	Finding an archaeological or other material or immaterial culturalhistoric heritage	If, during the construction works, archaeological sites or archaeological finds are encountered, the contractor is obliged to immediately stop the work and notify the RS Supervising Engineer and the Institute for the Protection of Cultural, Historical and Natural Heritage, to take measures to protect the finds and to preserve them in place and the position in which they were discovered.	-	-	Contractor.	Contractor.	Problems will be regulated by the Works Execution Contract.

Phases	**Problem**	**Mitigation measure**	**Costs**		**Institutional responsibility**		**Comments**
			Planning	**Implement ation**	**Planning**	**Implementation**	

Construction.	Risk of worker exposure to exhaust gases, noise, dust and vibrations.	Implement all the mentioned measures related to mitigating the impact of exhaust gases, noise, dust and vibrations. Provide sanitary and hygienic facilities for workers. Prepare and implement the Site Organisation Plan and Worker Health and Safety Management Plan. Require all workers to comply with the Worker Health and Safety Management Plan. Provide workers with personal protective equipment (PPE) that meets the needs of performing work activities. Ensure that workers follow procedures on the mandatory use of personal protective equipment and that they have received training on occupational safety. Adhere to the measures defined by the Labour Management Procedure (LMP)	-	-	Contractor.	Contractor.	Problems will be regulated by the Works Execution Contract.

Phases	**Problem**	**Mitigation measure**	**Costs**		**Institutional responsibility**		**Comments**
			Planning	**Implement ation**	**Planning**	**Implementation**	

Construction.	Reduced passage through the area where the works are executed.	Inform the public about construction works through local media and notice boards in local communities. Plan the relocation of equipment when the daily traffic is not too jammed. Provide traffic assistants/ flaggers, traffic signs that help ensure the free and safe flow of traffic. Provide alternative passage for pedestrians and vehicles in cooperation with local authorities or assure safe passage through the construction site. Prepare and implement the Construction Site Organisation Plan that will include the measures of good construction practices given in Annex.	-	-	Contractor.	Contractor.	Problems will be regulated by the Works Execution Contract.
Construction.	Increased risks of traffic accidents and construction works.	Provide adequate warning signs, illumination, protective rails etc. Abide by traffic rules. Clean the construction site from construction phase both in the construction phase and upon the termination of works, when closing down the construction site. Provide medical material and medical aid at the construction site through institutional and administrative agreements with local hospitals Prepare and implement the Construction Site Organisation Plan Adhere to the measures defined by the Stakeholder Engagement Plan (SEP).	-	-	Contractor.	Contractor.	Problems will be regulated by the Works Execution Contract.

Phases	**Problem**	**Mitigation measure**	**Costs**		**Institutional responsibility**		**Comments**
			Planning	**Implement ation**	**Planning**	**Implementation**	

Construction.	Risk of injuries at work.	Request all workers to abide by protection at work measures Install warning signs along the route of the system construction Workers should be provided with sanitary and hygienic facilities Prepare and implement the Construction Site Organisation Plan and Protection at work measures plan. Provide workers with personal protective equipment (PPE) that matches the tasks. Ensure that workers follow procedures on the mandatory use of personal protective equipment and that they have received training on occupational safety. Provide regular training in occupational safety and health. Ensure that machines are operated only by qualified machine operators who have the skills and experience. Adhere to the measures defined by the Labour Management Procedure (LMP)			Contractor.	Contractor.	Problems will be regulated by the Works Execution Contract.
Construction.	Pollution of water and soil due to inadequate waste disposal. Short-term storage at designated locations	Short-term storage at certain locations. Takeover of waste and disposal by authorised institutions. Use earth and other inert material for „landscaping“. Re-usage and recycling of waste wherever possible. It is prohibited to incinerate waste in the open and at the location. Acting in line with the Waste Management Plan given in Annex.	-	-	Contractor.	Contractor.	Problems will be regulated by the Works Execution Contract.

Phases	**Problem**	**Mitigation measure**	**Costs**		**Institutional responsibility**		**Comments**
			Planning	**Implement ation**	**Planning**	**Implementation**	

Construction.	Risk of sexual exploitation and abuse and sexual harassment (GBV/SEA-SH)	Prepare and implement a Code of Conduct that reflects the contractor's core values and overall work culture and includes provisions related to GBV/SEA-SH. Conduct awareness raising on GBV/SEA-SH issues. Enable submission of appeals through the grievance mechanism. Adhere to the measures defined by the Labour Management Procedure (LMP)	-	-	Contractor.	Contractor.	Problems will be regulated by the Works Execution Contract.
Construction.	Indirect environmental impact by purchasing materials from unlicensed companies	For the supply of material, use existing quarries and concrete plants. Use licensed suppliers for other materials.	-	-	Contractor.	Contractor.	Problems will be regulated by the Works Execution Contract.
Construction	Restrictions on land exploitation that will affect access to property and livelihoods	Provide access to land and plots as well as cultivation of crops. Carry out work when there is no vegetation (late autumn - early spring), if it is not possible to compensate for the damage caused to the crops. Agree with the users of the plots on the project not to sow winter crops during the works.	-	-	Contractor.	Contractor.	Problems will be regulated by the Works Execution Contract.
Exploitation.	Gradual accumulation of hazardous substances in soil and plants due to unnoticed polluting substances in the water that is used for irrigation, which can result in low yield and represent possible hazards to consumers' health	Determine a required level of quality of water that is used for irrigation so that any future possible hazard to human and plant health could easily be determined. In case of quality aggravation, select some other source of water or implement the measures of sanitaryhygienic restoration.	-	-	System beneficiary	Authorised laboratory	-

Phases	Problem	Mitigation measure	Costs		Institutional responsibility		Comments

			Planning	Implement ation	Planning	Implementation	
Exploitation.	Noise from system equipment and agricultural machinery	Use equipment and machinery that emits a lower noise level and has less impact on the surrounding population and fauna Regularly maintain equipment and machinery			System beneficiary	System beneficiary	-
Exploitation.	Lack of irrigation water caused by excessive pumping	Give **zero priority** to the exploitation of potable water, so that if there is a shortage of potable water, exploit water for irrigation only when all the needs for potable water are met	-	-	System beneficiary	System beneficiary	In accordance with the terms of reference for the development of the Irrigation system project, designer will prepare an Irrigation system management and conduct education of irrigation system beneficiaries.
Exploitation.	Soil salinization, inundation, washing off the soil (erosion) and reduced yield due to excessive irrigation.	Define the water requirement of grown crops. Prepare an Irrigation system management plan and educate water users to use it. The Plan is to envisage regular calibration and maintenance of water management devices. Determine and appoint person/persons for regular monitoring and assessment of the irrigation system.	-	-	Designer.	Designer and system users.	-
Phases	**Problem**	**Mitigation measure**	**Costs**		**Institutional responsibility**		**Comments**
			Planning	**Implement ation**	**Planning**	**Implementation**	

Exploitation.	Impact on the environment and human health due to irregular application of phytopharmaceutical agents (pesticides) and natural and mineral fertilisers.	Controlled application of agrochemical agents based on the Integral pest control plan. Education of farmers about good agricultural practices that include proper selection, dosing, and timely usage of agro-chemical agents in order to assure maximal absorption by plants and soil. Use only agro-chemical agents that are allowed by the State Administration for plant protection. Using protective equipment during the application of phytopharmaceutical agents. Accomplish cooperation with beekeepers associations in order to prevent increases in bees' mortality.	-.	-	Project applicant.	Designer and system users.	-
Removal.	Negative environmental impact due to inadequate waste disposal generated during the removal of the irrigation system and/or during regular maintenance.	Adequately dispose of waste in line with the Waste Management Plan at authorised landfills. Recycle recyclable waste.	-	- waste.	System beneficiary.	Contractor.	-

5.2. Environmental monitoring plan

Table 17. Environmental monitoring plan for the irrigation project

Phases	Which parameter is to be monitored	Monitoring location	Monitoring method / type of monitoring equipment	Time of monitoring - frequency of measurement or permanent	Reason for monitoring	Costs		Responsibility	
						Planning	Implementation	Planning	Implementation
Planning/ Designing	Negative public reactions due to lack of information and coordination of activities	In the local community	By inspecting the registers of complaints as well as through regular interaction with the local population and land users	Monthly during the execution of works, in case of citizens' complaints	In order to timely prevent impact	-	-	APCU	APCU
Construction .	Number and species of planted plants. Area subjected to rehabilitation.	At the location of execution of construction works	Visual supervision and comparison with the Degraded Areas Rehabilitation Plan.	After the implementation of the Degraded Areas Rehabilitation Plan	For the need of restoring the land in its original condition		-	Supervision body.	Supervision body.
Construction .	Waste management during the execution of works. Separation of hazardous and non-hazardous waste	At the location of construction works	Visual monitoring and comparison with the waste management report	Continuously during the execution of works and removal of the construction site	To ensure proper waste management in accordance with local legislation	-	-	Supervision body.	Supervision body.

Phases	Which parameter is to be monitored	Monitoring location		Time of monitoring -	Reason for monitoring	Costs	Responsibility

			Monitoring method / type of monitoring equipment	frequency of measurement or permanent		Planning	Implementation	Planning	Implementation
Construction .	Occurrence of noise and air pollution	At the location of works execution	Standard equipment for measurement of air quality and noise level.	Upon received citizens' complaints	In order to establish the level of air pollution and noise, and compare it with law-prescribed limit values. In case of aberration, additional mitigation measures are to be applied.			Supervision body.	Contractor.
Construction .	Implementation of the Construction Site Organisation Plan Submitted citizens' complains due to reduced access, increased traffic and disorganisation of the construction site.	At the construction site	Visually and comparison with the Construction Site Organisation Plan.	Permanently during the execution of works and removal of the construction site.	In order to establish compliance with the Construction Site Organisation Plan and avoid negative impacts on population		Comprised by the supervision execution costs.	Contractor.	Supervision body.
Construction .	The presence of cultural / archaeological findings	At the location of works execution.	Supervision of excavations	During excavation	In order to preserve the cultural heritage, stop the work if archaeological finds are encountered	-	-	Contractor.	Supervision body.
Construction .	Emergence of foreign invasive species	At the project location	Visual identification	Daily	In order to determine the presence of foreign invasive species			Contractor.	Contractor.

Phases	Which parameter is to be monitored	Monitoring location	Monitoring method / type of monitoring equipment	Time of monitoring - frequency of measurement or permanent	Reason for monitoring	Costs		Responsibility	
						Planning	Implementation	Planning	Implementation
Construction	Control of working hours	At the location of works execution	Visually and comparison with the site organisation plan.	Permanently during the execution of works / daily	In order to determine compliance with working hours and limits on noise emission during daily working hours.	-		Supervision body	Supervision body
Construction .	Number of registered accidents Presence of hygienic conditions for workers, Application of protective equipment	At the construction site	Visually and insight in records	Permanently during the execution of works and removal of the construction site.	In order to establish the application of protection at work measures.	-	Comprised by the supervision execution costs.	Contractor.	Supervision body.
Construction .	Impact on population due to limited business activity and right to land usage	In the local community	Insight in records	Upon received citizens' complaints.	In order to timely prevent impact	-	Comprised by the supervision execution costs.	Project applicant.	Project applicant.
Construction .	Number of recorded traffic accidents of the local population due to construction works.	In the local community.	Insight in records.	Permanently during the execution of works and removal of the construction site.	In order to timely prevent impact.	-	Comprised by the supervision execution costs.	Contractor.	Supervision body.

Construction .	Number of recorded GBV/SEA-SH-related incidents	In the local community.	Insight in records.	Permanently during the execution of works and removal of the construction site.	In order to eliminate the impact in a timely manner.	-	Comprised by the supervision execution costs.	Contractor.	Supervision body.

Phases	**Which parameter is to be monitored**	**Monitoring location**	**Monitoring method / type of monitoring equipment**	**Time of monitoring - frequency of measurement or permanent**	**Reason for monitoring**	**Costs**		**Responsibility**	
						Planning	**Implementation**	**Planning**	**Implementation**
Construction .	Quality of executed works Quality of built-in material	At the construction site	Visual monitoring and insight into records	Permanently during the execution of works and closing down the construction site	Poor supervision and assessment of the quality of works execution can cause damages to the environment, structures of poor quality and usage of materials of poor quality, which can lead to damages to structures and expose irrigation system users to risks and possible accidents.		Comprised by the supervision execution costs.	Contractor.	Supervision body.
Exploitation.	Damage to the irrigation system due to improper management	At the project location	Visually and through records	Continuously	To ensure proper management of the irrigation system	Maintenance costs	Salary of the person in charge of system maintenance	System users	System users

Exploitation.	Quantity of taken water (l/s).	At the water intake structure/well.	Reading off water meters and keeping the records.	Daily.	In order to assure adequate water management in the system and compensate for deficits.	Included in construction costs.	Salary of the person in charge of system maintenance	System users	System users
Exploitation.	Piezometric level	On the piezometer tube in the well	On the piezometer tube in the well	Daily.	In order to prevent excessive pumping of groundwater.	Included in construction costs.	Salary of the person in charge of system maintenance	System users	System users

Phases	Which parameter is to be monitored	Monitoring location	Monitoring method / type of monitoring equipment	Time of monitoring - frequency of measurement or permanent	Reason for monitoring	Costs		Responsibility	
						Planning	Implementation	Planning	Implementation
Exploitation.	Precipitation (mm/day).	At the project location.	Reading off precipitation and keeping the records.	When necessary.	In order to establish quantities of precipitation and adjust quantities of water in the irrigation system.	-	Salary of the person in charge of system maintenance	System users	System users
Exploitation.	Speed and direction of the wind.	At the project location.	Reading off anemometer and keeping the records.	Daily.	In order to establish parameters that are significant to agriculture.	-	Salary of the person in charge of system maintenance	System users	System users
Exploitation	Air temperature.	At the project location	Reading off thermometers and keeping the records.	Daily.	In order to establish parameters that are significant to agriculture.	-	Salary of the person in charge of system maintenance	System users	System users
Exploitation.	Soil quality including: pH, Heavy metals Nitrogen and phosphorus Salts Pesticides.	On representative plots at the project location.	Soil sampling.	Once per year.	In order to establish impacts of agricultural activities on the quality of soil.		-	System users	Authorised laboratory.
Exploitation.	Water quality (chlorides, nitrates, coliform bacteria and pesticides).	At the well.	Sampling at the well.	Twice per year in characteristic hydrological situations.	In order to establish impacts of agricultural activities on the quality of groundwater.		-	System users	Authorised laboratory.

Exploitation.	Emergence of weeds and pests.	At the project location.	Visual identification and counting of individuals.	Daily	In order to determine the need for the use of phytopharmaceutical agents	-	-	System users	System users

Phases	Which parameter is to be monitored	Monitoring location	Monitoring method / type of monitoring equipment	Time of monitoring - frequency of measurement or permanent	Reason for monitoring	Costs		Responsibility	
						Planning	Implementation	Planning	Implementation
Exploitation.	Bees' mortality	Bee-keepers in the environment.	Counting the societies.	When necessary.	In order to establish impacts of unsuitable application of phytopharmaceutical agents.			System users	System users
Exploitation.	Occurrence of diseases that are related to irregular management of phytopharmaceutical agents.	At the project location.	Insight in records of hospitals.	Per year.	In order to establish impacts of unsuitable application of phytopharmaceutical agents on human health			System users	System users

6. STAKEHOLDER ENGAGEMENT METHODS

Within the ARPC, a SEP was prepared with the aim of establishing an effective platform for productive interaction with affected parties and other stakeholders during the project implementation.

The purpose of the Stakeholder Engagement Plan (SEP) is to present the target groups and methods of stakeholder engagement and responsibilities in the implementation of activities. In accordance with the World Bank's requirements, stakeholder engagement is an inclusive process that is carried out during the entire project life cycle, and is most effective if it is initiated at an early stage of project development.
Engagement should start as early as possible in the project preparation, because timely identification and consultation with stakeholders allows the views and opinions of those groups to be taken into account during the project development and implementation. The intention of SEP is to timely activate all stakeholders during the project preparation and implementation.
In particular, the SEP serves the following purposes:

a) stakeholder identification and analysis;
b) planning engagement modalities and effective communication tools for consultation and publication;
c) defining the role and responsibility of various actors in the Plan implementation;
d) defining the Grievance Mechanism (GM) and
e) providing stakeholders with feedback.

In order to adequately meet the needs of different groups, communication and information channels were created for all identified stakeholders in accordance with their needs. A participatory process will be used to obtain comments and suggestions for the Project design, which can help improve the Project design and bring greater benefits at the local level.

In order to comply with best practice approaches, the project will apply the following principles of stakeholder engagement:

- *Informed participation and feedback*: information will be provided and widely distributed among all stakeholders in an appropriate format; opportunities are provided for the submission of feedback from stakeholders, for analysis and resolution of comments and doubts;

- *Approach to openness and lifetime*: public consultations on the project will be organised during the entire lifetime, will be conducted in an open manner, without external manipulation, interference, coercion or intimidation;

- *Inclusiveness and sensitivity*: stakeholders are identified to support better communication and build effective relationships. The process of participation in projects is inclusive. All stakeholders are encouraged to be involved in the consultation process at all times. All interested parties are provided with equal access to information. Sensitivity to the stakeholders' needs is a key principle underlying the choice of engagement methods. Special attention is paid to vulnerable groups.

Significant stakeholder engagement throughout the project cycle is an important aspect of good project management and provides opportunities for the following:

- Clarification of project objectives, scope and management of expectations,
- Ensuring meaningful engagement of citizens,
- Seeking feedback to inform about project design, implementation, monitoring and evaluation,
- Assessment and mitigation of project risks,
- Better project results and benefits,
- Dissemination of information and materials about the project,
- Resolving grievances about the project.

6.1. Public consultations

The draft ESMP was published on the websites of the APCU and the Municipality of Modriča, in Serbian and English, together with invitations to public consultations. The invitation je indicated how to access the document on which the public was consulted, project details, date, time and place of the consultation and contact information for feedback and/or questions.

The public call was published in reputable print media with national coverage to enable a wide range of the public to be involved in the consultation process. The Public Consultation Notice was published in the daily newspaper "Glas Srpske" of 24 May 2024 and included details on the availability of the relevant documents for the public and stakeholders. In this way, the public was given an opportunity to express their views on the project's risks, impacts and mitigation measures and enable the project applicant (Municipality of Modriča) to consider and respond to them.

14 days as of the date of publication by the project applicant, the draft ESMP was subject to public consultation in accordance with the World Bank Guidelines. Public consultation and presentation of the Environmental and Social Management Plan (ESMP) for the irrigation project at the location "Jabuka" Garevac cadastral borough, Municipality of Modriča, as part of the ARCP Project for Republika Srpska, were organised by APCU within the RS MAFWM, on 07.06.2024 starting at 11 o'clock.

The interest of the participants of the public consultation was primarily related to questions about the expansion of the listing project or the opening of new similar projects. In addition, interest was also shown in obtaining the necessary permits for locating and using wells near their parcels. It is obvious that agricultural producers have taken seriously the problem of irrigation of agricultural crops both today and in the near future, seeing that serious farming is not possible without a irrigation system. Answers were given to the questions about the legal and financial restrictions related to the current project, as well as the address where concrete answers can be found for the use and construction of new wells. The hope was expressed that more such projects will be realized so that all interested farmers will receive quality irrigation systems. The complete record of the public hearing with the questions and answers is in attachment 5.

Final version of the ESMP for the irrigation project at the location "Jabuka" Garevac cadastral borough, Municipality of Modriča, will be published on the website of the APCU, Municipality of Modriča and will be visible throughout the project duration.

6.2. The grievance redress mechanism

The key objective of the grievance mechanism is to ensure an efficient way of handling complaints. The World Bank expects each project to establish such a mechanism in accordance with ESS10, at an early stage of project development, in order to be able to solve certain problems in an adequate and timely manner. The complaint includes complaints and proposals related to the project implementation.
The APCU will establish a grievance mechanism to deal with the acquisition of land and other property, as well as loss and damage caused by construction works, in accordance with ESS5. Therefore, the grievance mechanism will be established at the time when APCU in cooperation with municipal administrations starts negotiations with PPOs and will work until the completion of construction activities.
The GRM is available at no cost and it is important that it is easily accessible.

At the project level, APCU formed the Central Grievance Commission (CGC), which it will manage, and as part of the sub-project activities, Local Grievance Offices (LGO) will be formed, which will be formed and managed by local units of self-government-municipalities. APCU will ensure that the local offices of the municipalities involved have at least one officer who will deal with complaints (Local Grievance Officer-LGO). This officer will ensure that the receipt of the complaint is confirmed within 3 calendar days, that the appeals are assigned to the right person for review and proposed resolution, and that the decision/closure letter is sent to the person who filed the complaint in a timely manner and that receipt is confirmed. The local municipal grievance officer will be required to provide regular updates to the APCU on complaints received and on any extraordinary or urgent developments.

Any objections or concerns may be brought to the attention of the APCU or LGO orally or in writing (by post or email), or by filling in a grievance form, at no charge for grievances. Grievances can also be submitted anonymously.

The APCU will ensure that the participating municipalities designate at least one officer for the task of dealing with grievances. This officer will ensure that the receipt of the grievance is confirmed within 7 calendar days, and that the grievance is assigned to the right person for review and proposed resolution, and that the decision/closure letter is sent to the person who filed the grievance in a timely manner and that the receipt of the grievance is confirmed. The officer in charge at the municipal level will be required to regularly provide updates to the APCU on grievances received and on any extraordinary or urgent developments.

Any objections or concerns may be brought to the attention of the APCU or local municipal officer orally or in writing (by post or email), or by filling in a grievance form, at no charge for grievances. Grievances can also be submitted anonymously.

The Central Grievance Commission (CGC) was established to manage and respond appropriately to grievances at different stages, while the Local Grievance Commission (LGC) will be in place after a decision is made on each new sub-project. In addition to GRM, there are also legal remedies available under national legislation (courts, inspections, administrative authorities, etc.).

All grievances will be entered in the Register and assigned a number, and their receipt will be confirmed within 7 calendar days. Each grievance will be entered in the register with the following information: ▪ a description of the grievance, ▪ date of confirming the receipt returned to the complainant, ▪ a description of actions taken (investigation, corrective measures), and ▪ date of resolution and closure / delivery of feedback to the complainant.

APCU or LGC will make all reasonable efforts to resolve a grievance after confirming the receipt thereof. If the APCU or municipal officer is unable to address the issues through direct corrective action, long-term corrective action will be identified. The complainant will be informed about the proposed corrective action and the follow-up of the corrective action within 25 calendar days as of the day the grievance is confirmed.
If a particular issue raised through the grievance mechanism cannot be resolved or if no action is required, the complainant will be provided with a detailed explanation/justification as to why the issue was not resolved. The response will also include an explanation of how the person/organisation who filed the grievance can proceed with the grievance in the event that the outcome is not satisfactory.

If the complainant is not satisfied with the implemented corrective measure and/or a statement of reasons why the corrective measure is not needed, the grievance will be sent to the CGC. The CGC will include at least:

- one APCU member,
- one member of the competent municipality/city,
- two representatives of persons affected by the project.

The Board will re-evaluate the previously implemented corrective measure and/or the statement of reasons why the corrective measure is not required, and will reconsider alternatives for resolving the grievance in a satisfactory manner. The complainant will be informed about the proposed alternative corrective measure and control over the implementation of the alternative corrective measure within 3 months after confirming grievance receipt.

Applicants can at any time seek other legal remedies in accordance with the RS legal framework.

Contact details for inquiries and complaints: For
the attention of:
Zoran Kovačević, APCU Project Manager –RS Ministry of Agriculture, Forestry and Water Management
Address: Trg Republike Srpske 1,
78000 Banja Luka
Tel: +387 051/338-340
Email: to be published

7. ANALYSIS OF NEEDS FOR CAPACITIES STRENGTHENING AND TRAINING

The implementation of the Environmental Management Plan implementation is entrusted with:

- in the phase of planning and preparation: project applicant and designer,
- in the phase of construction: Contractor and supervision body, - in the phase of exploitation: irrigation system beneficiaries.

It is possible to assume that domestic stakeholders have the adequate level of knowledge and skills required designing, works execution and supervision execution and in this sense it is not necessary to implement special measure of training of personnel about the implementation of the Environmental and Social Management Plan in the phase of planning and construction.

Also, irrigation system users, long-term agricultural producers have satisfactory levels of education related to irrigation system management, as well as pest management, so it is not necessary to implement new training programs relating to:

1. elements of water dosing,
2. sustainable usage of the irrigation system in order to achieve maximal effects,
3. usage of good agricultural good agricultural practices among other these that are related to applying methods of integral pest prevention and supplemental soil feeding with natural and mineral fertilisers.

Therefore, the focus of the training program should be on future managers and users of the irrigation system.
When it comes to future managers, they need to be trained in sustainable management of the irrigation system. The core of knowledge on sustainable management of irrigation systems is found among hydraulic and/or mechanical engineering specialists who specialise in the maintenance of pumping systems and pipelines employed in higher education institutions or relevant institutions and consultant companies.

With regard to the first two points of training program, Manual/Guidelines for system operation and maintenance shall be prepared within the Project; this document shall help the client, users and municipal department in their future work on system operation and maintenance.

It is recommended to hold a seminar at the project location for agricultural estates, municipal bodies, and other interested local population, where the Manual/Guidelines for system operation and maintenance would be presented.

As for the remaining point 3 "Application of agricultural praxis", faculties of agriculture and their institutes possess the core knowledge of land management and application of phytopharmaceutical agents. In line with laws applicable to agriculture and application of phytopharmaceutical agents, farmers must attend corresponding trainings, whose continuity must be provided by faculties and their institutes. Training course must also comprise irrigation system users, as well as other interested population.

Training course must comprise issues such as:

- the most significant problems faced by farmers in terrain;
- methods for problem resolution;
- benefits and impacts related to application of fertilisers and pesticides,
- application of good agricultural praxis, amongst other those relating to the application of a method of integral pest control and soil feeding with natural and mineral fertilisers.

7.1. Procurement of equipment

Bearing in mind the proposed environmental impact monitoring, the future system manager will need to acquire impact monitoring equipment and undergo a training program for its use. The equipment specification is given in the following table.

Table 18. required equipment

Type	Quantity	Unit costs
Water meters for measuring water quantities	One for the locality in question	BAM 250
Thermometer for measuring air temperatures	One for the locality in question	BAM 15
Rain gauge for measuring precipitation	One for the locality in question	BAM 70
Anemometer for measuring wind speed and direction	One for the locality in question	BAM 200

Note: *equipment prices are not relevant because approximate prices were taken from the websites of agricultural distributors*

8. OVERVIEW OF NEEDS FOR PERMITS

Bodies in charge of the environmental impact assessment – Environmental assessment are under the jurisdiction of the RS Ministry of Spatial Planning, Civil Engineering and Ecology. Environmental impact assessments in the RS are done within the procedure of issuance of the environmental permit.

With the aim of acquiring the environmental permit for the irrigation construction system project at the location of Garevac cadastral borough, Municipality of Modriča, RS Ministry of Spatial Planning, Civil Engineering and Ecology must be addressed with the documentation set out in Article 64 of the Law on Environmental Protection (RS Official Gazette, 71/12, 79/15 and 70/20). This is necessary for a reason that subject project, according to the provisions of the Rulebook of projects for which Environmental Impact Assessment is done and criteria for making a decision on the needs for elaboration and scope of environmental impact assessment (RS Official Gazette, No. 124/12), falls in a category of projects for which the relevant Ministry makes a decision on the need to make environmental impact assessment on a case-by-case basis. If the Ministry decides that it is necessary to make an environmental impact assessment, the Ministry will issue a decision thereof, and order the project leader to submit a request with an authorised organisation for impact study elaboration, for activities determined in the Location requirements and that decision at the latest within six months as of the receipt of the decision. If there is no need to prepare an impact study, Evidence is made with the application for the issuance of an environmental permit and this documentation is attached to the issuance of the environmental permit.

Public institution Vode Srpske is competent to issue the water management permit whose requirements make integral part of the environmental permit.
In line with the regulations of RS relating to spatial planning and civil engineering, irrigation system construction projects require the acquisition of adequate acts in the field of construction, notably town planning permit, construction permit and usage permit. Irrigation system reconstruction projects require the acquisition of the construction and usage permits.

Also, this type of projects is subject to the procedure of issuing a concession for water pumping for the purpose of irrigation, which in the RS is regulated by the Law on Concessions (RS Official Gazette 59/13, 16/18).

According to the World Bank's ESF procedure, the concerned project is classified as moderately risky, in connection with the associated environmental and social risks.

The following table provides a summary of all required instruments for the proposed irrigation system construction project at the location of Garevac cadastral borough, Municipality of Modriča. It is important to stress that the applicant for water management documents, water intake concession and permits in line with civil engineering regulations is the future user of the system.

Table 19. Instruments required in line with procedures of WB and laws of RS

Sub-project	Category according to the WB	Environmental assessment instrument	Instrument in line with regulations on waters	Instrument in line with regulations on civil engineering
Construction of an irrigation system at the location of Garevac cadastral borough, Municipality of Modriča	Moderately risky	Preliminary environmental impact assessment was developed, Request for the issuance of the environmental permit	Water management documents Concession for the right to use waters for irrigation	Town planning permit Construction permit Usage permit

9. ANALYSIS OF INCIDENT RESPONSE OPTIONS

Incidents can be considered unfavourable events that occur during the system exploitation, either due to malfunction or force majeure. From the aspect of the planned system, especially significant is incidental spillage of oil derivatives that can occur in the phase of construction, due to malfunctioning construction mechanisation or during manipulation of these substances. For this reason, it is necessary to envisage and implement measures and procedures in the case of incidental situations during construction.

The release of hazardous substances (fuel, oil and lubricants) on the ground can also occur in the event of leakage of machinery used to cultivate agricultural land. There is little probability that environmental pollution may occur on a larger scale, but measures to prevent such occurrences must be taken, which is foreseen by the Plan. More significant environmental pollution can be caused by the irrational and uncontrolled application of various chemical and other means in agricultural production, which can lead to larger-scale accidents. Excessive use of inadequate agents, and accidents during their transport and storage, can have a harmful effect on the soil and indirectly on watercourses and groundwater by destroying animal life and poisoning people. There is a probability for their formation, but it is within the limits of the probability of such technological processes and there is no particularly prominent situation for the locality in question.
The causes of large-scale disasters can be natural such as earthquakes, hydrological conditions, and human factors such as fires, construction deficiencies, poor maintenance and management, and violent demolitions (war and terrorism).
The potential fire hazard is related to the occurrence of fires during the cleaning, clearing and management of agricultural plots. A fire that would arise as a result of ignition under the influence of external factors would be oriented to the place of origin, with the probability of spreading beyond the boundaries of the plots in the event that the fire is transferred to vegetation and the surrounding area. Due to carelessness, such fires often get out of control and can turn into fires with major consequences. The possibility of fire gases being carried to greater distances, under the influence of air currents, exists, but their emission would be of

such a scale that it would not endanger the environment. Considering the size of the fire as well as the material damage that can be caused, the application of appropriate technical and organisational measures will be necessary to prevent the possibility of their occurrence. In addition to the incidents caused by man, it is necessary to take into account the hazard of natural disasters in order to mitigate the hazardous effects that may arise under their influence. Natural disasters lead to minor or major changes in the environment, cause considerable material damage and can threaten human life and health. Major accidents and hazards can be caused by the following natural hazards:

- Earthquake,
- Large amounts of water - floods,
- Landslides,
- Atmospheric discharge.

Earthquake

The site is located in the area of seismic intensity 8° MC scale. In the Main design, the concerned irrigation system will be designed so that an earthquake of the specified intensity cannot cause harmful consequences.

Large amounts of water-floods

The area in question is not located near watercourses that could cause flooding. It is unlikely that this phenomenon will occur in the future, and the possibility of endangering people, technological equipment, and the environment of the surrounding area is ruled out.

Landslides

The project area is on flat ground, so the presence of landslides was not noticed.

Atmospheric discharge

According to the definition in technical regulations on lightning rods, lightning is a direct electric discharge or a series of such discharges caused by a difference between the electric potential of atmospheric electricity and the ground, i.e. objects on the ground, which are sufficient to damage objects and endanger people. Planned structures, considering their dimensions and technological characteristics, are threatened by this natural phenomenon, as a natural disaster, but with a low risk.

Prevention of major accidents

Prevention of major accidents is a set of measures and procedures at the level of plants, complexes and the wider community, which aim to prevent the occurrence of major accidents, reduce the probability of major accidents and minimise the consequences.

Preventive measures for major accidents include everything that is undertaken with the aim of:

- preventing the occurrence of a major accident,
- ensuring quick perception of a situation that differs from the expected one,
- an adequate reaction in the event of a major accident,
- as well as ensuring quick alerting of the relevant and responsible services and persons who organise the action of effective localisation and remediation of the consequences.

Procedure in the event of a major accident:

- Defining the method of alerting and engaging persons participating in the accident response (audio, telephone or other) as well as persons who are competent and responsible for alerting and engaging other persons.
- Development of a management and coordination scheme among the persons participating in the accident response. The diagram shows all the planned participants in the accident response. Information on organisations trained to respond to an accident and authorised to provide assistance (name of institution, address and telephone numbers) is provided for:
  - Firefighting assistance (local firefighting units and units of surrounding operators);
  - Medical assistance (health centres and specialised institutions for trauma, burns, poisoning control, etc.);
  - Detection (specialised laboratories for air, water and soil control);
  - Remediation (specialised teams from other operators and specialised teams for dealing with hazardous waste);
  - Specialised authorised laboratories for air, water and soil control (monitoring).
- The composition of accident response teams and the manner of engagement of accident response teams for:
  - Stopping the work process;
  - Extinguishing initial fires and stopping initial accidents;
  - Informing and alerting;
  - Transport and treatment of the injured;
  - Pollution detection and control;
  - Decontamination of people, equipment and space;
  - Information and contact with the public.
- Relief measures include:
  - Instructions on the behaviour of persons outside the complex (neighbouring operators or citizens);
  - Technical protection measures taken in the event of an accident; • Medical protection measures;
  - Evacuation measures.
- Measures to eliminate the consequences of the accident are aimed at defining the remediation of accidents as well as monitoring the post-accident situation.
- Defining accident recovery includes:
  - Objectives and scope of remediation depending on the type and scope of the accident;
  - Program of engagement of forces and resources by the operator and external professional services for rehabilitation;
  - Evidence of the method and success of the rehabilitation; • Rehabilitation costs.
- Defining post-accident monitoring includes:
  - Monitoring the state of people's health;
  - Air, water and soil monitoring

According to Article 63 of the Law on Protection and Rescue in Emergency Situations (Republika Srpska Official Gazette, 121/12), with the aim of protecting and saving people and material assets from the dangers caused by natural disasters and other accidents, jobs and tasks are carried out, among other things related to the protection of plants and plant products.

According to Article 65 of the mentioned Law, the protection and saving of plants and plant products includes: selection of the most optimal varieties of plants and proper cultivation; use of protective agents in accordance with standards and norms in the field of agriculture, industrial production of food and medicine, and animal husbandry; proper drying, silage and storage of seeds and finished products; fire protection and other measures to ensure the protection of plants and plant products from all types of plant diseases and pests; drying, canning and processing of fruits and vegetables; harvesting of edible and medicinal plants, fodder, livestock and other types of plants and plantations in case of danger from natural disasters and other accidents. The protection of plants and plant products is organised and carried out by: municipal or city services responsible for these tasks; business entities in the field of agriculture and forestry, agricultural holdings; individual agricultural producers; other professional agricultural institutions; plant breeders; food producers and competent protection and rescue authorities.
The Plant and Plant Products Protection Service carries out operational protection and rescue measures related to the protection of plants and other crops from plant diseases and pests in the affected area, notably:

- in the rescue phase:
  - suppresses and eradicates plant diseases and pests,
  - prohibits the cultivation of certain types and varieties of plants for a certain period of time and in a certain area, in order to prevent plant diseases and pests; destroys infected plants and packaging and conducts disinfection, disinsection and pest control of plant product warehouses; carries out decontamination of plants and plant products.
- in the phase of elimination of the consequences: engages experts and specialist teams for the protection of plants to eliminate the consequences that have occurred on the plants; determines the scope of consequences on plants caused by plant diseases and pests; participates in reseeding the soil with agricultural crops, with the aim of mitigating the consequences of plant diseases and pests in the affected area

According to Article 60 of the Law on Protection and Rescue in Emergency Situations (Republika Srpska Official Gazette, 121/12), civil protection measures and activities in the protection and rescue system are confirmed by protection and rescue plans adopted by business entities and other legal entities, the municipality, i.e. the city and the Government. Businesses and other legal entities are obliged to harmonise the Protection and Rescue Plan with the protection and rescue plan of the municipality, that is, the city.

10. ANNEXES

10.1. ANNEX 1: GOOD CONSTRUCTION PRACTICES

Requirements relating to good construction practices that shall be comprised in the contract on works execution are as follows:

General requirements:

- Contractors will be obliged to abide by practice of good environmental construction in all construction activities, and reduce as much as possible damages to vegetation, soil, groundwater, surface waters, landscape, as well as disturbance of settlements and local communications.
- Application of environment protection and mitigation measures, as well as monitoring, will be implemented parallel to construction activities. They will begin at the moment when workers, equipment and/or material are accommodated at the construction site, and end with termination of construction activities, when all workers, equipment and/or material leave the construction site and when environment is restored to its original state.
- The contractor is obliged to appoint a coordinator for protection at work and protection of environment, who will be responsible for assurance of conformity with the laws and objectives of environment protection, safety at work and protection from fire.
- The contractor is to assure order, discipline and professional responsibility of all employees at construction sites. Work and sojourn must be limited exclusively to the construction works zone; damages to private property, land and crops must be avoided. There should be insured regular contacts with representatives of local population (local communities) with purpose of information exchange or finding a solution to possible disputes (arisen by violation of right to property, damages during construction works etc.).

Provision and transport of material

- During the purchase of material for construction of dyke for protection from floods, the Contractor will select a producer/supplier who works in line with a valid environmental permit, if he needs it in accordance with the RS Law on Environmental Protection (RS Official Gazette, 71/12, 79/15 and 70/20), or other environmental standards that are acknowledged in BiH and/or EU.
- With the aim of preventing dust emission, the Contractor is obliged to transport asphalt, gravel, rock, earth and other material in trucks covered with tarpaulin. Transport of stone and gravel is done in moist condition. Vehicle velocity must not exceed 30 km/h. The contractor will avoid unnecessary drives.

Construction site development

- Construction should begin (if possible) in a part of year when advantages of dry soil can be taken, i.e. when compaction and degradation through usage are minimal.
- There will be used adequate machines and/or protective slabs that could prevent compaction during soil removal, e.g. usage of railway or low pressure tyres at spots that show a possibility of compaction. There will be used adequate procedures for separate removal, handling, storing and replacement of humus and subsoil.

- The contractor will establish a temporary disposal point for construction material, area for concrete pumps and mixers washing, and area for car tire washing with adequate cleaning agents. Temporary disposal points for excavation material (soil) will be reduced to maximum of 2 m in height in order to prevent compaction by soil weight and time of storing will be reduced to minimum.
- The contractor will insure that all construction equipment is licensed and approved in line with local regulations and if possible in line with the EU standards.
- The Contractor is obliged to use modern machines and vehicles that meet environmental standards with regard to was gases (complete combustion). Also, he will use filters for reduction of soot particles emission, and fuel with favourable chemical structure (low sulphur content) and efficient/safe decanting.
- The Contractor is obliged to use modern machines and vehicles that represent a source of noise (engine, exhaust system). This mainly implies provision of new machines or implementation of measures for installation of additional sound insulation, as well as its constant maintenance. Besides, it is recommended that machines only should work in the period 07-17 hours on all sections of the route whose distance from the closest residential house is less than 60 m.
- The Contractor is obliged to use biodegradable lubricants and oils for gear box. Maintenance, fuelling and cleaning of machines must be done outside the construction site and outside the area with surface water.
- The Contractor will determine and follow control measures for dust that is generated during equipment handling and/or during the works on reconstruction. The Contractor must deliver a plan that proposes roads for material transport and also, he should provide statements on proposed method for dust control at spots where transport through settlements cannot be avoided.
- Develop a project of construction site development with adequate solution to drainage and treatment of sanitary waste waters, as well as of storm water from the construction site zone. Drain used water from the construction site by adequate sewerage systems, upon need collect it in watertight containers in the prescribed way (either on the spot, or at a remote location), and before discharging into recipient or city sewerage system.
- The Contractor will insure that parking spaces for machines and vehicles and workers' accommodation containers are not within forest areas, that they do not make an impact on watercourses and do not influence endangered flora and fauna.
- The Contractor will insure the protection of the areas that are sensitive to erosion with stabilisation agents (temporary dams, fences, pits) and replanting after termination of construction works.

Execution of construction works

- In order not to jeopardise soil stability, in unstable or conditionally stable fields, construction works will be done in shorter intervals.
- During the earth works execution, humus layer will be disposed of in heaps that will not be higher than 2 m and will be protected from pollution in order to preserve its fertility.
- With aim of reducing negative impacts on the river and riverbanks to minimum, the activities of construction, which are done on or near surface water bodies, should be done in a small waters season, which is most frequently in the period from July to September. It is recommended to take this into account during preparation of activity schedule.

- All handling of petroleum and its derivatives in process of construction and provision of machines is done with maximal measure of protection in order to avoid spilling. All packaging for petroleum and other derivatives must be collected and removed to a controlled Contractor's landfill, whence it will be removed by an authorised utility company. In case of accidents, spilling of fuel or lubricants into environment, urgent interventions are necessary in line with procedures for discharge of fuel and lubricants.
- Machines and vehicles will not be washed in the zone of works.
- Waste waters from workers' lavatories will not be discharged into soil or watercourses.
- Waste shall be managed in line with the Waste Management plan (details are given in the continuation).
- Disposal of excavated material and any other solid waste into watercourses will be prohibited.
- The Contractor will implement adequate measures of traffic control in line with the law, during the contract and such measures must be primarily approved of by supervising engineer. Traffic safety management measures will include temporary lighting and adequate signalisation during excavation and works on rehabilitation.
- The Contractor should appoint permanent staff that will be hired on traffic safety issues and will be responsible for implementation of traffic safety measures and implementation of traffic measures that are prescribed in state laws, which shall include: (AND) review of condition and position of equipment for traffic control in usage, (II) review of drawings – a part that relates to equipment for traffic control, which is necessary for insurance of a safe and efficient traffic flow, (III) removal of all traffic lacks where applicable, (IV) control of work zones, equipment handling and storing, material handling and storing relating to safety in traffic.
- The Contractor must not leave excavated trenches without supervision, and must fence off and mark all open trenches in order to prevent possible accidents.

Construction site development after the termination of works

- The Contractor must remove all special objects and spots that are used as support to construction including temporary buildings and their foundations, temporary installations (electro, water and sewerage installations) and equipment (settlement basin), restoration of temporary roads into original state (especially in forest area and private property), and work areas, removal of fence, signs and notifications.
- The Contractor will remove all construction waste.
- All construction areas and other areas that were affected during construction will be restored into original state depending on future usage of soil.
- The activities of restoration into original state will start immediately after pipes are covered.
- Construction area must be planted with species preserved in peat and filled with adequate material if necessary.
- Agricultural areas must be restored into condition that is appropriate for land owner so that he could plant his own crops anew.

10.2. ANNEX 2: WASTE MANAGEMENT PLAN

Waste management in Republika Srpska is defined by the Law on Waste Management (Republika Srpska Official Gazette, 111/13, 106/15, 16/18, 70/20, 63/21 and 65/21), and implies the implementation of prescribed measures for dealing with waste within the scope of

waste collection, transport, storage, treatment and disposal, including the supervision of these activities and the care of waste management facilities after closure.

In order to fully understand this Plan, some articles of the Law on Waste Management (Republika Srpska Official Gazette, 111/13, 106/15, 16/18, 70/20, 63/21 and 65/21) are highlighted below, as well as clarifications of the basic terms used, which derive from the Law on Waste Management:

Article 4 points out that waste management is carried out in a way that ensures the least risk of endangering the lives and health of people and the environment, through control and measures of reducing:

- water, air and soil pollution,
- danger to flora and fauna,
- danger of accidents, explosions or fires,
- negative impacts on areas and natural assets of special value and
- levels of noise and unpleasant odours.

Article 7 defines the waste management principles:

- the principle of choosing the most suitable option for the environment,
- the principle of proximity and common approach to waste management,
- the principle of waste management hierarchy,
- the principle of responsibility and
- the "polluter pays" principle.

According to **Article 22**, the person in charge of the plant for which an environmental permit is required according to the Law on Environmental Protection must designate a person who will carry out the tasks of coordinating waste management - a waste coordinator. The person responsible for waste management is obliged:

- to organise the implementation and updating of the waste management plan
- To propose measures of prevention, reduction, reuse and recycling of waste and
- To monitor the implementation of laws and other regulations on waste management and reports to management authorities.

The waste management plan is updated every five years.

Basic terms

- “waste” means all substances of objects that a holder disposes of, intends to dispose of or must dispose of in line with one of the categories mentioned in the by-laws issued by the minister in charge of environment protection, and are found in the Waste Catalogue adopted in a special by-law; (RS Official Gazette, no. 111/13);
- "communal waste" – means domestic and other waste, which is similar to domestic waste by its nature or composition;
- "hazardous waste" - means waste that is established in a special regulation and that has one or several properties given in the by-laws issued by the minister in charge of environment protection, which causes danger to human health and environment, by its origin, composition or concentration, as well as the waste listed in the waste catalogue as hazardous waste and regulated by special regulations;

- "non-hazardous waste" - means waste that is not defined as "hazardous waste";
- "inert waste" - means waste that is not subject to significant physical, chemical or biological changes. Inert waste will not be generated, incinerated or in some other way physically or chemically processed, biologically degraded or unfavourably affect other substances with which it comes into contact in a way as to cause environment pollution or human health jeopardy;
- "holder" means every physical or legal entity, which owns the waste;
- "producer" je physical or legal entity whose activity produces waste or physical or legal entity who performs pre-treatment, sorting or other operations that lead to changes of physical properties or waste composition;
- "physical or legal entity" is a physical or legal entity responsible for any type of waste management activity;
- "waste management" – is a system of activities and actions, which imply the prevention of waste generation, waste quantity reduction and its hazardous properties, waste treatment. Planning and control of activity and process of waste management, waste transport, establishment, work, closing and maintaining waste treatment device after closing, monitoring, counselling and education relating to waste management activities.

1. WASTE MANAGEMENT IN THE PHASE OF CONSTRUCTION

Classification of waste that occurs during the construction and removal of the structure

Below is a classification list of all types of waste that may be generated during the preparation, development and closure of the construction site during construction and during the closing phase of the structure. For each category, guidelines are given for handling, that is, ways of waste collecting, transporting, processing and removing. Waste classification was carried out in accordance with the Rulebook on waste categories, testing and classification (Republika Srpska Official Gazette, 19/15, 79/18).

Table 1: Classification of waste occurring during the construction

Code	Waste
03	**WASTES FROM WOOD PROCESSING AND THE PRODUCTION OF PANELS AND FURNITURE, PULP, PAPER AND CARDBOARD**
03 02	**wastes from wood preservation**
03 02 04*	inorganic wood preservatives
08	**WASTES FORM THE MANUFACTURE, FORMULATION, SUPPLY AND USE (MFSU) OF COATINGS (PAINTS, VARNISHES AND VITREOUS ENAMELS,) ADHESIVES, SEALANTS AND PRINTING INKS**
08 01	**wastes from MFSU and removal of paint and varnish**
08 01 11*	waste paint and varnish containing organic solvents or other dangerous substances
12	**WASTES FROM SHAPING AND PHYSICAL AND MECHANICAL SURFACE TREATMENT OF METALS AND PLASTICS**
12 01	**wastes from shaping and physical and mechanical surface treatment of metals and plastics**
12 01 01	ferrous metal filings and turnings
12 01 03	non-ferrous metal filings and turnings

13	**OIL WASTES AND WASTES OF LIQUID FUELS (EXCEPT EDIBLE OILS, AND THOSE IN CHAPTERS 05, 12 AND 19)**
13 01	**waste hydraulic oils**
13 01 12*	readily biodegradable hydraulic oils
13 02	**waste engine, gear and lubricating oils**
13 02 06*	synthetic engine, gear and lubricating oils
13 02 07	readily biodegradable engine, gear and lubricating oils
15	**WASTE PACKAGING; ABSORBENTS, WIPING CLOTHS, FILTER MATERIALS AND PROTECTIVE CLOTHING NOT OTHERWISE SPECIFIED**
15 01	**packaging (including separately collected municipal packaging waste)**
15 01 10*	packaging containing residues of or contaminated by dangerous substances
15 02	**absorbents, filter materials, wiping cloths and protective clothing**
15 02 02*	absorbents, filter materials (including oil filters not otherwise specified), wiping cloths, protective clothing contaminated by dangerous substances
16	**WASTES NOT OTHERWISE SPECIFIED IN THE LIST**
16 01	**end-of-life vehicles from different means of transport (including off-road machinery) and wastes from dismantling of end-of-life vehicles and vehicle maintenance (except 13, 14, 16 06 and16 08)**
16 01 03	end-of-life tyres
16 06	**batteries and accumulators**
16 06 01*	lead batteries
17	**CONSTRUCTION AND DEMOLITION WASTES (INCLUDING EXCAVATED SOIL FROM CONTAMINATED SITES)**
17 01	**concrete, bricks, tiles and ceramics**
17 01 01	concrete
17 01 02	bricks
17 01 03	tiles and ceramics
17 01 07	mixture of concrete, bricks, tiles and ceramics other than those mentioned in 17 01 06
17 02	**wood, glass and plastic**
17 02 01	wood
17 02 03	plastic
17 03	**bituminous mixtures, coal tar and tarred products**
17 03 01*	bituminous mixtures, coal tar and tarred products
17 04	**metals including their alloys**
17 04 05	iron and steel
17 05	**soil (including excavated soil from contaminated sites), stones and dredging spoil**
17 05 04	soil and stones other than those mentioned in 17 05 03
17 05 06	dredging spoil other than those mentioned in 17 05 05
17 06	**insulation materials and asbestos-containing construction materials**
17 06 04	insulation materials other than those mentioned in 17 06 01 and 17 06 03
17 06 05*	construction materials containing asbestos
17 09	**other construction and demolition waste**
17 09 04	mixed construction and demolition wastes other than those mentioned in 17 09 01, 17 09 02 and 17 09 03

20	**MUNICIPAL WASTES (HOUSEHOLD WASTE AND SIMILAR COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL WASTES) INCLUDING SEPARATELY COLLECTED FRACTIONS**
20 01	**separately collected fractions (except 15 01)**
20 01 01	paper and cardboard
20 01 38	wood other than that mentioned in 20 01 37
20 01 39	plastics
20 03	**other municipal wastes**
20 03 01	mixed municipal waste

*Hazardous waste **Waste management plan during the structure construction and removal phase**

Methods of waste collection, storage and handling

The objective of selective waste collection, storing and handling is to prevent jeopardising of human health and environment, and especially discharging harmful substances in water and soil. Waste collection and storing will be organised in the area of the construction site, and it is based on basic waste management principles:

- Principle of separate collection,
- Prevention,
- Recycling

Waste generated in the construction site area will be collected selectively, i.e. in separate containers in accordance with the waste classification. Collected waste must not be incinerated on the spot in the open. Basic principle is the separation of hazardous from nonhazardous waste, then separation of construction waste from other categories, and specially separation of waste that can be recycled. Hazardous waste and its packaging must be marked in line with the regulations on hazardous substances marking. Hazardous waste should be collected and sorted by categories that are defined in the above table. Waste oils should be collected and kept separately.
It is prohibited to discharge waste oils into surface and underground rivers, sewerage or in the soil, which applies also to substances in which mineral or synthetic oils are found.

Storing or keeping separated waste is done at places specially envisaged therefore in adequate containers:

1 Container for hazardous waste - (03 02 04*, 08 01 11*, 15 02 02*, 15 01 10*, 16 06 01*, 17 06 05*)
2 Container for non-hazardous waste - mixed communal waste (20 03 01)
3 Container for non-hazardous waste - mixed recyclable packaging waste (20 01 01 , 38 and 39)
4 Container for non-hazardous waste – mixed recyclable metal waste (12 01 01 and 12 01 03 and 17 04 05)

Containers must be produced for the mentioned purposes, from which materials must not leak. Every container must be adequately marked.

Collected waste oils (13 02 06* and 07*) will be stored into barrels or other adequate dishes so that leaking cannot occur. Servicing of vehicles may be done only on the plateau that is at

a distance from a watercourse and sensitive areas, where barrels for waste oil barrels will be positioned.

For disposal of construction waste categories, the Contractor should envisage temporary and permanent locations for disposal along the route, in the zone of construction and at a special location.
Temporary landfills are necessary for disposal of humus, excavated materials, as well as for smaller quantities of tampon material and stone fractions. The contractor is obliged to identify locations for permanent and temporary disposal and acquire all necessary approvals.

Waste removal

A waste producer will transfer all selectively collected waste to authorised companies for collection, transport and processing of waste in line with the Law on Waste Management (RS Official Gazette 111/13, 106/15, 16/18, 70/20, 63/21 and 65/21). In the procedure of seeking the best offer for removal of (hazardous) waste, the producer will require from the offeror the evidence of registration for performance of waste management activities in line with relevant regulations.

The contractor will sign a contract with the selected company.

Keeping records

A waste producer will keep records of types and quantities of waste that he generates. The records imply the following data:

- Data on generated waste and causes of its generation; -
Storage of waste; - Waste removal.

For every shipment of waste, the producer will prepare a register sheet in two copies, out of which one copy he gives to the Operator and the other copy keeps in his own archives. Register sheets of the transferred waste should be kept in permanent office of the Contractor and a copy at temporary locations for the sake of inspections.

Responsibility

The Contractor is obliged to appoint a person who will be responsible for the activities of supervision over waste management at the construction site (waste coordinator).

2. WASTE MANAGEMENT IN THE PHASE OF EXPLOITATION

Classification of waste that is generated in the phase of exploitation

During the exploitation phase, waste occurs during the maintenance of the pumping station and possibly the tank, and in the case of the need to replace pipes due to malfunctions, cracks or the like. Also, in the exploitation phase we have waste from agricultural activities. The pumping stations are planned as unmanned automatic, so the only waste that can occur is from the maintenance of electric power equipment and water pumps.

Below are presented the types of waste that can be generated during the use of the planned irrigation system. Waste classification was carried out in accordance with the Rulebook on waste categories, testing and classification (Republika Srpska Official Gazette, 19/15, 79/18).

Table br.2: Classification of waste that occurs during the irrigation system exploitation

Code	Waste
02	**WASTES FROM AGRICULTURE, HORTICULTURE, AQUACULTURE, FORESTRY, HUNTING AND FISHING, FOOD PREPARATION AND PROCESSING**
02 01	**wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing**
02 01 04	waste plastics (except packaging)
02 01 08*	agrochemical waste containing dangerous substances
02 01 09	agrochemical waste other than those mentioned in 02 01 08
02 01 10	waste metal
02 01 99	wastes not otherwise specified
13	**OIL WASTES AND WASTES OF LIQUID FUELS (EXCEPT EDIBLE OILS, AND THOSE IN CHAPTERS 05, 12 AND 19)**
13 02	**waste engine, gear and lubricating oils**
13 02 06*	synthetic engine, gear and lubricating oils
13 02 07*	readily biodegradable engine, gear and lubricating oils
15	**WASTE PACKAGING; ABSORBENTS, WIPING CLOTHS, FILTER MATERIALS AND PROTECTIVE CLOTHING NOT OTHERWISE SPECIFIED**
15 01	**packaging (including separately collected municipal packaging waste)**
15 01 10*	packaging containing residues of or contaminated by dangerous substances
15 02	**absorbents, filter materials, wiping cloths and protective clothing**
15 02 02*	absorbents, filter materials (including oil filters not otherwise specified), wiping cloths, protective clothing contaminated by dangerous substances
17	**CONSTRUCTION AND DEMOLITION WASTES (INCLUDING EXCAVATED SOIL FROM CONTAMINATED SITES)**
17 02	**wood, glass and plastic**
17 02 03	plastic
17 05	soil (including excavated soil from contaminated sites), stones and dredging spoil
17 05 04	soil and stones other than those mentioned in 17 05 03
17 05 06	dredging spoil other than those mentioned in 17 05 05
19	**WASTES FROM WASTE MANAGEMENT FACILITIES, OFF-SITE WASTE WATER TREATMENT PLANTS AND THE PREPARATION OF WATER INTENDED FOR HUMAN CONSUMPTION AND WATER FOR INDUSTRIAL USE**
19 09	**wastes from the preparation of water intended for human consumption or water for industrial use**
19 09 02	sludges from water clarification
20	**MUNICIPAL WASTES (HOUSEHOLD WASTE AND SIMILAR COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL WASTES) INCLUDING SEPARATELY COLLECTED FRACTIONS**
20 03	**other municipal wastes**
20 03 01	other municipal wastes

*Hazardous waste

Waste management in the exploitation phase

Waste collection and storage will also be based on the principles of prevention and separate collection in this case.

Methods of waste collection, storage and handling

Waste producer, i.e. individual users will take care that waste management takes place according to the principle of good work practice and in accordance with legislation. The restriction can be set by the current way of waste management in the municipality in question, which does not favour separate collection of municipal waste.

During the system operation phase, during the regular maintenance of power equipment and water pumps in pumping stations, waste is generated in the form of greasy and oily rags, waste oil, and others, designated as 15 02 02*. This waste should be collected, sorted and temporarily disposed of at the location of the planned structures for the duration of maintenance. To store the collected waste oils (13 02 06* and 07*), which belong to hazardous waste, barrels or other suitable containers will be procured, properly marked, so that no environmental pollution can occur. The waste collected in this way will be distributed to companies dealing with the disposal of this type of waste, with which system users should enter into a contract before starting work. In the case of localised leakage of oil and grease, they should be removed with a cloth, and the oily cloths should be temporarily stored in metal barrels. Grease that is partially removed from the equipment, due to the appearance of mechanical particles or due to replacement, should be removed in the same way.

When protecting plants, chemicals are used whose packaging is considered hazardous waste (02 01 08*). Such packaging should be selected and collected separately in specially marked bags. The waste collected in this way should be handed over to a company dealing with the disposal of hazardous waste, with which a contract will be entered into before the system is put into operation.

Municipal waste marked 20 03 01, 17 02 03, 02 01 04, 02 01 10 and 02 01 99, generated by individual producers, can be generated at the irrigated location. In the event that a separate waste collection system has not been established in the municipality, such waste will be collected and temporarily stored in plastic bins or containers that the municipal utility company has installed in the municipality. This category also includes non-hazardous waste from chemicals used in agriculture (02 01 09). If there is no waste collection service, each manufacturer is obliged to organise collection and transportation to the nearest bin/container for disposal set up by the municipal utility company. Upon establishment of organised separate waste collection by municipal structures, recyclable waste (plastic, paper, glass and iron) will be separated and disposed of in special containers provided for that purpose.

When carrying out pipe replacement work, in case of malfunctions, pipe bursts or similar, deposit the soil layer (17 05 04 and 06) separately and return it after installing the pipe. Any excess material after rehabilitation must be deposited at predetermined locations, until it is taken to the landfill.

Waste removal

For removal and disposal of all generated types of waste, it is necessary to enter into contracts with companies who have all necessary permits for waste management. The waste producer will transfer (selectively) collected waste to the operator, i.e. authorised companies for waste collection, transport and processing. The operator undertakes the obligation of transport to the final waste processing, i.e. final disposal. Final disposal of communal waste shall be done regularly at a municipal/regional landfill with trucks of a municipal utility company in line with a contract which is to be entered into with them.

Hazardous waste will be transferred to authorised operators for hazardous waste. During transport it must be marked and packed in line with special regulations. The transport of hazardous waste must be harmonised with general requests for hazardous goods transport. Transport of hazardous waste shall be followed by adequate documentation

Keeping records

The user of the system shall keep register of generation of all types of waste at the location. It is necessary to keep records of types and quantities of waste. For every shipment of waste, the producer will prepare a register sheet in two copies, out of which one copy he gives to the authorised company and the other copy keeps in his own archives.
Based on saved documents, it is easy to establish accurate quantity of transferred hazardous and non-hazardous waste.

10.3. ANNEX 3. LEGAL FRAMEWORK

REGULATIONS IN THE FIELD OF ENVIRONMENTAL PROTECTION

Environmental impact assessment procedure

Environmental impact assessment (hereinafter referred to as EIA) is a procedure for evaluating the acceptability of interventions, with regard to the environment, as well as determining the necessary environmental protection measures, in order to minimise negative impacts and achieve a high level of environmental protection.

The Law on Environmental Protection (Republika Srpska Official Gazette, 71/12, 79/15 and 70/20) art. 60-79 prescribes the environmental impact assessment procedure. Additional clarifications can be found in the Rulebook on projects for which an environmental impact assessment is carried out and criteria for deciding on the need for implementation and the scope of environmental impact assessment (Republika Srpska Official Gazette, 124/12).

Art. 2, 3, 4 and 5 of the Rulebook on projects for which an environmental impact assessment is carried out and criteria for deciding on the need for implementation and the scope of environmental impact assessment, determine the projects that are subject to the environmental impact assessment procedure.

A preliminary environmental impact assessment is initiated by submitting a request for a preliminary environmental impact assessment, which the project applicant submits to the ministry responsible for environmental protection.

The application for the preliminary environmental impact assessment can be prepared by the applicant itself or by an institution authorised to perform activities in the field of environmental protection. Article 64 of the Law on Environmental Protection prescribes what must be attached to the Request for the preliminary environmental impact assessment, notably:
1. a description of the project, including data on its location, purpose and size,

2. a description of possible environmental impact of the project during its construction or execution and during its operation or exploitation,
3. a description of the planned measures to prevent, reduce or eliminate the hazardous environmental impact of the project,
4. a brief overview of the alternatives considered by the project applicant and the reasons for the chosen solution, considering the environmental impact,
5. an extract from the planning document,
6. information on possible difficulties encountered by the project applicant during data collection
7. a non-technical summary of information referred to in paragraph 2 of this article.

The competent administrative authority, which conducts the procedure for issuing Location Conditions, and it comes to projects that are in the Rulebook on projects for which an environmental impact assessment is done and criteria for deciding on the need for implementation and the scope of environmental impact assessment, if necessary, will notify in writing the Location Conditions applicant to submit a request to the Ministry responsible for environmental protection for the issuance of a decision on determining the obligation to conduct an impact assessment and the scope of impact assessment.

The request for a preliminary environmental impact assessment is submitted to the protocol of the RS Ministry of Spatial Planning, Civil Engineering and Ecology, or by mail.

When it is established that the request was prepared in accordance with Article 64 of the Law on Environmental Protection, it is taken into consideration and the procedure of the preliminary environmental impact assessment is initiated. In accordance with Article 65 of the Law on Environmental Protection, the Ministry is obliged to submit a copy of the request and provide access to the attached documentation to the entities specified in the same article, in order to obtain an opinion. The deadline for submitting opinions in writing is 30 days as of the day of receipt of documentation. On the request for a preliminary impact assessment, the Ministry decides in a Decision that establishes the applicant's obligation to conduct an environmental impact assessment of the project and obtain an environmental impact assessment study and determine the approximate scope and content of the study, or determines that the implementation of the impact assessment and obtaining the study it is not necessary. This Decision is made within 60 days as of the receipt of the request.

After a Decision on the obligation to carry out an impact assessment and the scope of the environmental impact assessment is issued, within six months of receiving this Decision, the project applicant is obliged to submit a request with the authorised organisation for the preparation of an impact study for the activities specified in the Location Conditions and the decision on determining the obligation conducting an impact assessment and obtaining an impact study.

The environmental impact study is submitted in two copies in hard form and four copies in electronic form with the Ministry responsible for environmental protection, along with a request for a decision on the approval of the impact study, within 30 days of receiving the study from the authorised institution.

In cooperation with the project applicant, the Ministry engages the public in the procedure. Within 15 days of submitting the request for approval of the study, the project applicant is obliged to inform the public and the interested public about the submitted request in one of the daily newspapers in Republika Srpska.

The project applicant is obliged to provide the interested public with a free insight into the application for the approval of the impact study and the impact study in the municipality where the location of the given project is situated from the day of publication of the notice until the expiration of the prescribed period of 30 days for giving an opinion.

The project applicant is obliged to organise a public debate no later than 60 days after submitting the request for approval of the impact study with the Ministry responsible for environmental protection. The invitation to the public debate must be published at least 15 days before the public debate.

The project applicant organises a public debate on the impact study in the municipality where the location of the given project is situated. The representative of the Ministry responsible for environmental protection must participate in the public debate, who conducts the public debate. The project applicant prepares and submits the minutes of the public debate with the Ministry responsible for environmental protection within 8 days thereafter

The interested public may, within 30 days as of the date of the public debate, submit objections with the project applicant regarding the request and the impact study, in writing. The project applicant is obliged to submit with the Ministry in charge of environmental protection, within the next 15 days, the comments received in connection with the request and the impact study, as well as its preliminary expert opinion on the received comments.

The Ministry responsible for environmental protection, within a deadline that it determines, but no longer than 15 days, forwards to the project applicant its assessment of the objections received from the interested public, about the preliminary expert stance of the project applicant and its stance on the received objections of the interested authorities, and orders the project applicant to make amendments to the impact study. The Ministry responsible for environmental protection sets a deadline for the project applicant, which cannot be longer than 30 days, to submit an amended study, including a special part of the impact study related to the possible environmental impact of the project on the other entity or Brčko District.

The Ministry entrusts the audit of the amended impact study with an authorised legal entity that meets the requirements for performing activities in the field of environmental protection (auditor). The impact study audit verifies the professional quality of the impact study.

The auditor submits an audit report wtih the Ministry, which contains an expert evaluation of the impact study, possible remarks on the quality and completeness of the study, and instructions for removing those deficiencies. The Ministry submits the audit report with the project applicant. The project applicant is obliged to submit the impact study with the Ministry in its final form in accordance with the remarks and instructions given by the audit report, within the deadline set by the Ministry, but not longer than 15 days. The decision on the approval of the study is issued by the Ministry within 60 days as of the receipt of the impact study in its final form.

The decision on the study approval determines in particular:

1. that the impact study was prepared in accordance with this law,
2. that the project applicant is obliged to take the measures for environmental protection that were determined in the impact study,
3. that the impact study is considered an integral part of the decision on the approval of the study.

In the statement of reasons of the decision approving the study, it is stated that the remarks of interested parties and the interested public, as well as remarks of another entity, Brčko District or another state, were taken into account. A decision to dismiss the study will be issued if:

- it determines that the project could cause a significant negative environmental impact, i.e. that the project could significantly endanger the environment,
- it determines that the project is not in accordance with the environmental protection plan at the inter-entity and entity level, or
- it establishes that the project is not in accordance with Bosnia and Herzegovina's international obligations regarding environmental protection.

The decision on the study approval ceases to be valid if the project applicant does not obtain a building permit or other decision within two years as of the date of receipt of the decision.

After receiving the Decision on the approval of the Environmental Impact Study, the Investor submits the Application for the Environmental Permit in accordance with Article 85 of the Law on Environmental Protection.

REGULATIONS IN THE FIELD OF CONSTRUCTION

RS Law on Spatial Planning and Civil Engineering (Republika Srpska Official Gazette, 40/13, 106/15, 13/16 and 84/19), regulates the system of spatial planning and regulation of space, preparation, drafting and adoption of spatial planning documents, location conditions, regulation of construction land, issuance of construction permits, types and content of technical documentation, construction of buildings and mutual relations between participants in construction, use and removal of buildings, legalisation of buildings, supervision over the application of this law, jurisdiction and work of the Chamber of Engineers, and other issues of importance for landscaping, building land and construction of buildings.

Procedure for obtaining a building permit

The procedure of obtaining permits in RS takes place through interaction with municipal services. In other words, when a request for a permit is submitted, the municipality determines whether or not it is within their jurisdiction to approve the project. If not, the municipality will officially submit the request with the RS Ministry of Spatial Planning, Civil Engineering and Ecology.

The procedure for issuing a building permit is defined by the Republika Srpska Law on Spatial Planning and Civil Engineering (Republika Srpska Official Gazette, 40/13, 106/15, 13/16 and 84/19). This law regulates the system of spatial planning and regulation of space, preparation, drafting and adoption of spatial planning documents, location conditions, regulation of construction land, issuance of building permits, types and content of technical documentation, construction of buildings and mutual relations between participants in construction, use and removal of buildings, legalisation of buildings, supervision over the application of this law, jurisdiction and work of the Chamber of Engineers, and other issues of importance for spatial planning, building land and construction of buildings.

Required documentation for obtaining a building permit:

- Location conditions, with urban planning and technical requirements.

- Proof of resolved property-legal relations.
- Main design in three copies.
- Report on the audit of technical documentation

In accordance with Article 127 of the Law, the issuance of a building permit is the responsibility of the administrative authority responsible for construction work in the local self-government unit in whose area sub-project activities are carried out.

WASTE MANAGEMENT REGULATIONS

In RS, in accordance with the Law on Waste Management (Republika Srpska Official Gazette, 111/13, 106/15, 16/18, 70/20, 63/21 and 65/21), a waste management plan is adopted for all facilities for which the environmental permit is prepared, which contains:

- documentation on waste produced by the company (origin, types of waste according to the waste list, composition, quantity),
- measures to be taken to prevent waste production, especially when it comes to hazardous waste,
- separation of waste, especially hazardous waste from other types of waste and from waste that will be reused,
- disposal of waste at the landfill,
- treatment and/or disposal methods.

The Rulebook on categories of waste with a catalogue (Republika Srpska Official Gazette, 19/15 and 79/18) determines the list of waste according to the activities in which it is generated. Waste from agricultural production, horticulture, aquatic crop production, food preparation and processing, hunting and fishing is specified as one of the subcategories in this List. This category includes waste animal tissue, other animal waste, waste from agricultural plants, waste plastic, forest waste and waste non-hazardous chemicals. Waste chemicals used in agriculture, including their packaging, unused or expired chemicals, are classified as hazardous waste that requires special treatment in accordance with the provisions of the Law on Waste Management.

WATER MANAGEMENT REGULATIONS

In RS, the Law on Water (Republika Srpska Official Gazette, 50/06, 92/09, 121/12) stipulates that the following water management documents must be obtained in the case of a project that includes e.g. construction of flood protection structures, as well as any other activities that could affect the quantity and quality of water:

- Water management guidelines, which prescribe the manner and conditions under which the relevant ministry will allow the use of water (they are issued at the stage of urban planning permission, that is, location conditions in the RS).
- Water management consent, which confirms that the documentation attached to the request for water management consent is in accordance with the preliminary water consent and water management guidelines in RS, regulations on water management and planning documents (they are issued before building permits in the RS) water management permit, which confirms that all the requirements specified in the water management permit (issued before the use permit in the RS) have been met.

- The water management permit determines the purpose, method and conditions of water utilisation, operation mode of facilities and plants, method and conditions of wastewater discharge, method and conditions of disposal of solid and liquid waste and other conditions. It also determines the applicant's obligations related to waste water measurement, frequency of measurement, quality control and keeping records of used water, as well as obligations related to the calculation and payment of water fees.
-

The Entity Law on Water stipulates that the environmental permit is issued on the basis of a previously obtained preliminary water management consent/water management guidelines.

The law stipulates that the environmental permit is issued on the basis of previously obtained preliminary water management consent, that is, water guidelines that decide on the applicant's right to water, as well as the way to exercise those rights. In this way, it is ensured that the relevant Ministry integrates recommendations and water protection measures from the preliminary water management consent into the environmental permit. According to legislation, the request for issuing a preliminary water management consent is submitted by the authority responsible for issuing permits and the environment.

It should be pointed out here that the practice is different from the prescribed one. Namely, the investor is required to initiate the procedure of obtaining the preliminary water management consent itself.

RS Law on Waters, Article 125 prescribes that for projects that are subject to the environmental impact assessment, it is necessary to attach the environmental impact study when submitting the Request for the issuance of a water management document. In this way, water protection measures recommended by the Study are integrated through water management documents. This ensures that the Ministry of the Environment can include all recommendations and measures related to water protection in the environmental permit. In RS, water management documentation is issued by the Public Institution "Vode Srpske" and local self-government units.

AGRICULTURAL REGULATIONS

Legal framework for the implementation of agricultural policy in Republika Srpska are laws and by-laws, as well as strategic documents related to the development of the entire sector or rural areas of this entity in BiH. The Law on Republic Administration (Republika Srpska Official Gazette, 115/18, 111/21, 15/22, 56/22, 132/22, 90/23) defines the role of the Republika Srpska Ministry of Internal Affairs and Communications as an institution responsible for performing administrative and professional tasks in the field of creation and implementation of agricultural policy.

The Republika Srpska Law on Agriculture (Republika Srpska Official Gazette, 70/06, 20/07, 86/07 and 71/09) establishes the goals and measures of the agricultural policy, as well as the methods of its implementation and monitoring. The Republika Srpska Law on Agriculture stipulates that agricultural policy is implemented on the basis of the Republika Srpska Agriculture Development Strategy, as a set of basic principles that determine the goals, measures and instruments of agricultural policy.

The Republika Srpska Strategic Plan for the Development of Agriculture and Rural Areas 2016-2020 simultaneously covers both areas - agriculture and rural development. The current

Strategic Plan for the Development of Agriculture and Rural Areas contains six strategic goals, 16 specific goals and 52 measures for their realisation. The implementation of this strategic document is expected to: increase the volume and productivity of agricultural production and ensure the stability of the income of agricultural producers, strengthen the competitiveness of the agricultural sector through increasing the level of investments, increasing the degree of marketability and finalisation of agricultural production, sustainable management of natural resources and mitigating the consequences of climate change, balanced integral rural development and systematic support for the development of the agricultural sector and rural areas.

This Plan envisages a partial reform of the current policy of incentives, which is on the line of approaching the monetary incentives policy in force in the EU, especially for countries that have recently joined the EU (transition to direct payments per unit of area and per head of livestock).

The basis for the continuous provision of funds is the Law on provision and direction of funds for encouraging the development of agriculture and villages (Republika Srpska Official Gazette, 43/02 and 106/09). This Law originally stipulated that the insured funds were primarily used for interventions in agriculture through the payment of premiums, rebates and cofinancing of various programs and projects, as well as investments in agriculture through interest rebates on loans granted to agricultural farms by banks.

WORKING CONDITIONS REGULATIONS

Labour legislation and occupational safety in RS are regulated by the following regulations:

- Law on Labour (Republika Srpska Official Gazette, 1/16 and 66/18): Regulates labour relations, rights, obligations and responsibilities pertaining to employment contracts, entering into employment contracts, working hours, breaks and rest, general protection of workers, salaries, benefits and other income, termination of employment contracts, protection of workers' rights, as well as organisation of workers and employers.
- RS Law on Occupational Safety (Republika Srpska Official Gazette, 1/08, 13/10), - Regulates occupational safety and health as an activity of general interest, responsibility for implementing and improving occupational safety and health, rights, obligations, responsibilities and preventive measures..
- Law on Protection from Harassment at Work (Republika Srpska Official Gazette, 90/21), This law defines that acts of harassment at work are considered physical attack or threat of physical attack, as well as verbal attack, i.e. shouting, threatening or insulting, as well as inappropriate public commenting on personal properties and characteristics of workers.

10.4. ANNEX 4 SCREENING QUESTIONNAIRE FOR ENVIRONMENTAL AND SOCIAL ISSUES

Table screening questionnaire for environmental and social issues

Name of the sub-project:	Main irrigation development project at the location of Miloševac cadastral borough (Kruševci location) and Garevac cadastral borough (Jabuka locality), Dobrinja cadastral borough (Pašinac locality), Municipality of Modriča
Project ID:	

Sub-project location:	Municipality of Modriča
Implementation Agency:	Agriculture Project Coordination Unit – APCU within the Republika Srpska Ministry of Agriculture, Forestry and Water Management
Sub-project beneficiaries:	Agricultural producers under land lease
Estimated duration of the construction period:	
Estimated duration of the operation and maintenance period (lifetime of the sub-project):	
Basic information about the proposed sub-project and activities:	
Project activity falls within the Subcomponent framework:	Pod-component 2.2 – Improvement of irrigation and drainage systems with the aim of adapting to climate change.

No.	**Questions for identification of environmental and social risk**	**YES**	**NO**	**Unknown**	**Notes**
1.	Does the project support activities that are on the elimination list of the World Bank?		No		
2.	Does the proposed activity belong to the list of projects for which a full environmental impact assessment is mandatory according to the RS Law on Environmental Protection?		No		
3.	Does the proposed activity require another type of environmental assessment according to RS legislation?	Yes			It is necessary to make a preliminary environmental impact assessment and Evidence with the request for the issuance of the environmental permit
4.	Does the proposed activity require special public consultations in accordance with RS legislation?		No		
5.	Does the proposed activity involve new construction and/or extension?	Yes			
6.	extension?		No		
7.	Will the project use natural resources such as land, water, materials or energy, especially any nonrenewable or scarce resources?	Yes			Irrigation water in a capacity that is defined on the basis of research works and that will not
					disturb the level of groundwater, which is proven by the Report
8.	Will project activities be carried out on or potentially affect archaeological or cultural heritage?		No		

9.	Will the project activities be sources of dust, pollutants or any hazardous, toxic or harmful substances in the air?		No		
10.	Will project activities be sources of greenhouse gases or substances that damage the ozone layer - ODS (halogens)?		No		
11.	Will the project be a source of noise and vibrations?		No		
12.	Will the project generate significant amounts of waste (hazardous, non-hazardous, inert waste)?		No		
13.	Will the project involve the use, storage, transport, handling, or production of substances or materials that may be harmful to human health or the environment, such as pesticides, or support concerns about actual or perceived risks to human health?		No		
14.	Will the project generate additional wastewater discharges?		No		
15.	Are there risks of surface water contamination?		No		
16.	Are there risks of groundwater contamination?	Yes			Only if the standards for the use of fertilisers and pesticides are not abided by. Defined measures of protection and use of pesticides and fertilisers, which will be applied (ESS3). The risk of contamination is low.
17.	Are there activities that will lead to physical changes in the water bod?		No		
18.	Will the project contribute to the pollution of international waters?		No		
19.	Are there risks of physical changes to the terrain, soil pollution, sediment load, erosion, etc.?	Yes			Only if the standards for the use of fertilisers and pesticides are not abided by. Defined measures of protection and use of pesticides and fertilisers, which will be applied (ESS3). The risk of contamination is low.
20.	Will the project involve the use of pesticides or fertilisers?	Yes			As determined for certain agricultural crops in

					accordance with the legislation
21.	Are there areas on or around the site that use protected, important or sensitive species of flora or fauna, e.g. for breeding, nesting, feeding, resting, wintering, migration, that could be affected by the project?		No		
22.	Will the project be located in or near a sensitive or protected area?		No		
23.	Are there areas or features of high landscape or scenic value on or around the site that could be affected by the project?		No		
24.	Will this project affect any critical habitats (forests, marshes, wetlands, aquatic ecosystems)?		No		
25.	Will this project affect any endangered plants or endangered animal species??		No		
26.	Is there a waste management facility near the subproject site?		No		
27.	Are there any routes or facilities on or around the site that the public uses to access recreation or other facilities that could be affected by the project?		No		
28.	Are there transportation routes on or around the site that are subject to congestion or that cause environmental problems that could be affected by the project?		No		
29.	Does the project location include a previously undeveloped area where there will be a loss of green areas?		No		
30.	Are there facilities within or around the project site that could be affected by the project such as: homes, gardens, other private property, industry, commerce, recreation, public open space, community facilities, agriculture, forestry, tourism, mining or extraction?		No		
31.	Are there areas within or around the site that are densely populated or built up that could be affected by the project?		No		
32.	Will the project implementation cause physical displacement of individuals, families or businesses?		No		
33.	Will the project require temporary or permanent land expropriation?		No		
34.	Is there a right of way issue?		No		
35.	Does the project affect community property?		No		
36.	Will the implementation of the project affect any vulnerable groups or individuals?		No		
37.	Does the project affect the health and safety of the community?		No		
38.	Is there a likelihood of harm to the health and safety of workers?		No		
39.	Are there indications that informal labour will be used for the purposes of the sub-project?		No		

RISK CATEGORISATION:

All positive responses marked in the red cell - indicate that the proposed project activity represents a high risk - such activity will not be financed.
All positive responses marked in the orange cell - indicate that the proposed project activity represents a significant risk - the proposed activity will be financed in accordance with World Bank ESS standards and relevant national legislation. The applicant should prepare an ESIA.

All positive responses marked in the yellow cell - indicate that the proposed project activity represents a moderate risk - the proposed activity will be financed in accordance with World Bank ESS standards and relevant national legislation. The applicant should prepare an ESMP.

All responses marked in the green cell - indicate that the proposed project activity represents a Low risk - the proposed activity will be financed in accordance with World Bank ESS standards and relevant national legislation. The applicant should prepare a generic ESMP.

The review process will take into account the cumulative number of risks and determine the overall category, but the highest risk, if listed, will prevail.

10.5. ANNEX 5: MINUTES OF THE PUBLIC DEBATE

Modriča, 7th June 2024

MINUTES

Minutes of the public hearing on the document Environmental and Social Management Plan (ESMP) for the irrigation development project at the locality of Miloševac cadastral borough (Krušici locality), Garevac cadastral borough (Jabuka locality) and Dobrinja cadastral borough (Pašinac locality), municipality of Modriča, held in the Modriča Municipality premises on 07.06.2024.

The public debate was conducted by the representative of the Republika Srpska Ministry of Agriculture, Forestry and Water Management, i.e. Agriculture Project Coordination Unit - APCU, Miss Nevena S., B.Sc. Agriculture.

After the opening speech and a brief introduction to the project, the representative of the relevant Ministry invited the consultant's representatives to present the Environmental and Social Management Plan of the project in question. Before the presentation, the head of the department for economy and social activities, Ms. Bojana K., addressed the audience, explaining how important the project is for the entire municipality, as well as for local communities and farmers. At the same time expecting the project to expand and include many more users than currently. After the department head, the audience was addressed by Ms. Sida T. - the irrigation project coordinator in front of the municipality of Modriča. She welcomed everyone and explained that this is a very important project, and that many more potential projects in the municipality depend on this project, if it were to develop in a positive direction. The subject document was presented by Mr. Siniša C. in front of the Civil Engineering Institute "IG" Banja Luka. During the presentation, the technical solution of the planned irrigation system at the locality of Garevac cadastral borough (Jabuka locality) its scope, identified and evaluated environmental and social impact of the project, planned measures for prevention/mitigation of impacts, monitoring plan, etc were presented. The subject presentation provided the attendees with enough information about the subject project and its impact, so that a high-quality discussion could be held afterwards, which was opened by Miss Nevena S., B.Sc. Agriculture.

The representative of the Modriča Municipality, Mrs. Sida T., took the floor. She pointed out that the choice of location for a specific project depended on many factors, among other things she emphasised that the municipality can only issue permits for projects up to 50 ha. That the project can be expanded in the future and how the municipality enters the procedures for several more projects of the similar type. Then there follows a joint discussion among Sida - Nevena - Bojana regarding the procedures for issuing permits for similar projects.

The representative of the IG Institute, Mr. Siniša C., asked the attendees to present their comments and questions on the presentation and the prepared document Environmental and Social Management Plan.

Those present actively participated in the conversation and asked several questions presenting their comments, where it is clear that they are very interested in this and future projects.

Question 1:
Participant no. 1– why was the plot he uses not included in the scope of the project?

Reply 1: The project location is limited to 50 ha and currently the project is based on an area that is compact and near a well that will be used for the irrigation system. The system will be able to expand and we can hope that his plot will also be covered by the Irrigation system in the future.

Question 2:
Participant no. 2– is it necessary to obtain permits for the construction of a well on the location of land presented in the document as location A2?

Reply 2: it is necessary to address the competent authorities in the municipality of Modriča, that will instruct him in detail in further procedures for issuing the necessary permits for the well.

Question 3:
Participant no. 3- does the well planned for irrigation have sufficient capacity to irrigate 50ha

Reply 3: during the preparation of the study, it was determined that the well has more than enough capacity for the area in question, as well as that it could be used for a larger area, however, as mentioned earlier, the area is limited to 50 ha for other reasons.

Question 4:
Participant no. 4–when will the other plot users, farmers, be included in such a project and how much is the participation in the project?

Reply 4: A lot is expected from this project, the hope is also expressed that there will be more such projects and that most farmers will be included in such projects. Currently, participation in this project is in the ratio: 85% of the World Bank to 15% of the municipality of Modriča, with the municipality having to prepare all the necessary documentation.

The head of the department for economy and social activities, Mrs. Bojana K., once again thanked all those present and pointed out that she expects a lot from this and similar projects in the municipality of Modriča.
Representative of the Republika Srpska Ministry of Agriculture, Forestry and Water Management, i.e. Agriculture Project Coordination Unit - APCU, Miss Nevena S., thanked the attendees and pointed out that all additional questions and remarks related to the presented document can be submitted to the municipality of Modriča in the next 7 days.

The stance of author of the Plan in question. We use the possibility of public inspection and the possibility of submitting comments on the prepared Plan to emphasise that all received remarks and suggestions on the prepared Environmental and Social Management Plan (ESMP) for the irrigation development project at the locality Miloševac cadastral borough

(Krušici locality), Garevac cadastral borough (Jabuka locality) and Dobrinja cadastral borough (Pašinac locality), Modriča municipality will be respected and will form an integral part of the final version of the Plan.

Below are photographs of the public presentation held in the municipality of Modriča, as well as a copy of the list of attendees.

Note: due to the protection of personal data, some information is hidden. They are known to the holder of the document as well as to the municipal superior bodies involved in the project.

EVIDENCIJA PRISUTNIH

JAVNE KONSULTACIJE

PLAN UPRAVLJANJA EKOLOŠKIM I DRUŠTVENIM PITANJIMA (ESMP)

za projekat razvoja navodnjavanja na lokalitetu
k.o. Miloševac (lokalitet „Krušici"), k.o. Garevac (lokalitet „Jabuka") i
k.o. Dobrinja (lokalitet „Pašinac")
OPŠTINA MODRIČA

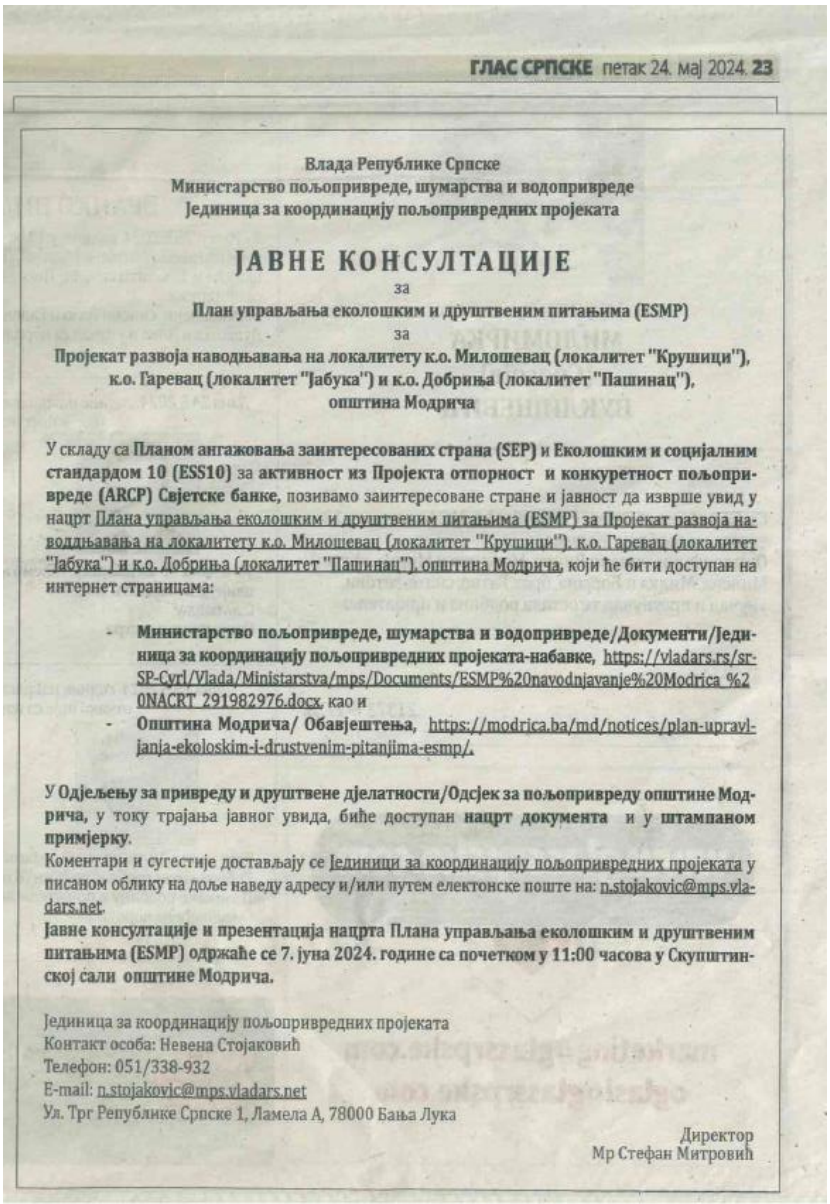
Datum: 07.06.2024. godine
Vrijeme početka: 11 časova
Opština Modriča

Redni broj	Ime i prezime	Organizacija	Telefon	e-mail adresa:	Potpis
1.	[redacted]	Institut za građevinarstvo „IG"	[redacted]	[redacted]	
2.		-11- -11-			
3.		-11- -11-			
4.		PZ „SAVSKI ČARDAK"			
5.		[illegible] DOO [illegible]			
6.		[illegible] J.P.			
7.		OPŠTINA MODRIČA			
8.		VODOVOD KARLOVAC			
9.		VODOVOD MODRIČA			
10.		OPŠTINA MODRIČA			
11.		OPŠTINA MODRIČA			
12.		-11-			
13.					

Redni broj	Ime i prezime	Organizacija	Telefon	e-mail adresa:	Potpis
14.	[redacted]	[illegible]	[redacted]	[redacted]	[signature]
15.	[redacted]	MIN. POLJOPRIV. [illegible]	[redacted]	[redacted]	[signature]
16.					
17.					
18.					
19.					
20.					
21.					
22.					
23.					
24.					
25.					
26.					
27.					
28.					
29.					
30.					

Publication of information on Public Consultations

The organisation of Public Consultations was conducted according to the World Bank guidelines and in accordance with the Environmental and Social Standard 10 (ESS10) of the Bank. The Public Consultation Notice was published in the daily newspaper "Glas Srpske" of 24 May 2024 and included details on the availability of the relevant documents for the public and stakeholders. The draft plan was on the website of Modriča municipality and the Republika Srpska Ministry of Agriculture, Forestry and Water Management, i.e. Agriculture Project Coordination Unit - APCU. Representatives of the municipality of Modriča informed interested farmers of the time and place of the presentation by telephone.



ГЛАС СРПСКЕ петак 24. мај 2024. 23

Влада Републике Српске
Министарство пољопривреде, шумарства и водопривреде
Јединица за координацију пољопривредних пројеката

ЈАВНЕ КОНСУЛТАЦИЈЕ

за

План управљања еколошким и друштвеним питањима (ESMP)

за

Пројекат развоја наводњавања на локалитету к.о. Милошевац (локалитет "Крушици"), к.о. Гаревац (локалитет "Јабука") и к.о. Добриња (локалитет "Пашинац"), општина Модрича

У складу са **Планом ангажовања заинтересованих страна (SEP) и Еколошким и социјалним стандардом 10 (ESS10)** за **активност из Пројекта отпорност и конкуретност пољопривреде (ARCP) Свјетске банке,** позивамо заинтересоване стране и јавност да изврше увид у нацрт Плана управљања еколошким и друштвеним питањима (ESMP) за Пројекат развоја наводњавања на локалитету к.о. Милошевац (локалитет "Крушици"), к.о. Гаревац (локалитет "Јабука") и к.о. Добриња (локалитет "Пашинац"), општина Модрича, који ће бити доступан на интернет страницама:

- **Министарство пољопривреде, шумарства и водопривреде/Документи/Јединица за координацију пољопривредних пројеката-набавке,** https://vladars.rs/sr-SP-Cyrl/Vlada/Ministarstva/mps/Documents/ESMP%20navodnjavanje%20Modrica_%20NACRT_291982976.docx, као и
- **Општина Модрича/ Обавјештења,** https://modrica.ba/md/notices/plan-upravljanja-ekoloskim-i-drustvenim-pitanjima-esmp/.

У Одјељењу за привреду и друштвене дјелатности/Одсјек за пољопривреду општине Модрича, у току трајања јавног увида, биће доступан **нацрт документа** и у **штампаном примјерку.**
Коментари и сугестије достављају се Јединици за координацију пољопривредних пројеката у писаном облику на доље наведу адресу и/или путем електонске поште на: n.stojakovic@mps.vladars.net.
Јавне консултације и презентација нацрта Плана управљања еколошким и друштвеним питањима (ESMP) одржаће се 7. јуна 2024. године са почетком у 11:00 часова у Скупштинској сали општине Модрича.

Јединица за координацију пољопривредних пројеката
Контакт особа: Невена Стојаковић
Телефон: 051/338-932
E-mail: n.stojakovic@mps.vladars.net
Ул. Трг Републике Српске 1, Ламела А, 78000 Бања Лука

Директор
Мр Стефан Митровић