DOI 10.20544/HORIZONS.B.03.1.16.P21
UDC 656.2.073:502/504(497.11)

THE ENVIRONMENTAL IMPACTS OF LOGISTICS CENTER[1]

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Abstract

Today, railroad is at the second place in terms of volume of cargo transportation (after the water traffic) and transportation of passengers (after the road traffic) and is considered that represents the "greenest" way for transportation of goods and passengers.

This paper analyses the effects of the planned logistics center in the industrial zone of city of Vršac and railway traffic, as part of the centre, on the environment. Subjects of research were the effects during the construction of a logistics centre and impact of the exploitation of the logistics centre on air quality, quality of surface and ground water, soil, impact on flora, fauna and population, as well as possible risk and accidents during the railway exploitation.

The conclusion is that the construction of logistics centre has a temporary negative impact on the environment but on the other hand all transhipment in transit traffic will be carried outside of the city and thus achieved significant positive effects in terms of reducing pollution in the centre of the city.

[1] Original scientific paper

Keywords–environment; freight transport; logistics centre; pollution; railway

INTRODUCTION

Railroad and operations carried out in logistic canter have unavoidable consequences for the environment, such as the disruption of the landscape, pollution of soil or exhaust emissions and noise.

Other effects such as emissions of pollutants in the workshops, pollution of ground and underground waters, pollution through accidents to a great extent depend on the equipment and care with which the work is performed.

This research analysed the environmental impact of the planned logistics centre and railway traffic which will be carried out at the proposed location in the city of Vršac, Republic of Serbia.

TEMPORARY EFECTS

Environmental impacts of logistic railway traffic can be direct, indirect and cumulative. According to their nature, these three impact categories can be further seen as temporary and permanent.

Temporary or current impacts are those impacts that cause temporary and at the same time reversible changes in the surrounding area, after a certain time period the changes just disappear. Temporary impacts on air quality can be seen as the increased quantities of fumes, dust and suspended matter in air during the construction of the structures which form a part of the logistics centre. Sedimentation of combustion products can temporarily have an effect on the quality of the surrounding soil and surface and groundwater in the vicinity of the centre. High levels of noise produced by machines can cause disturbance and changes in the paths of ornithoflora as well as other animal species that commonly inhabit this area. The increased activity of the construction machines within the logistics centre can have an impact on the life quality of the citizens of Vršac who live on the outskirts of the town, closest to the planned centre.

IMPACT OF THE EXPLOITATION OF THE LOGISTICS CENTRE ON AIR QUALITY

Building a logistics centre in the industrial zone of Vršac would enable reloading in transit traffic out of town and thus achieve significant positive effects when reducing air pollution in the city centre is concerned. Air quality in this area to a large extent depends on the traffic intensity since there are no other significant pollutants on the planned location. Due to the increased number of vehicles that will operate within the logistics centre and on the access roads, air pollution caused by traffic is limited to the area of

the logistics centre. Air pollution is likely to be caused by evaporating substances which are used for the railroad switch maintenance. For the estimation of air quality as a consequence of the increased traffic and the activities in the logistics centre, it is common to apply a model[1] where the input parameters are data on the average annual daily traffic for certain vehicle categories intended to be used within the logistics centre.

Combustion product analyses of the internal combustion engine showed that there are several hundreds of organic and inorganic compounds which occur during this process [2]. All these compounds are not ecotoxicologically significant. Therefore, several indicators are monitored with the aim of estimating aero contamination: carbon monoxide (CO), nitrogen oxide (NO, NO_2), sulphur oxide (SO_2), hydrocarbon (CxHy), lead (tetraethyl lead or Pb still present in the atmosphere although in our country it has not been added to gasoline since 2010) and soot particles (CC).

Meteorological conditions, in the first place wind speed, affect the concentrations of aerocontaminants. In accordance with the data on frequency, speed and direction of winds in the meteorological station Vršac, the most frequent wind is the southern wind with the velocity of 5 m/s [3]. By modelling the behaviour of air pollutants it is possible to predict the concentrations of pollutants at different distances from the pollutant source.

Bearing in mind the modernization of vehicle fleet in the future and significant restrictions when the quality of exhaust fumes is concerned, pollutant concentration decrease should be expected.

IMPACT OF LOGISTICS CENTRE ON GROUNDWATER AND SURFACE WATER

Permanent and temporary pollution of groundwater and negative impacts of the logistics centre on surface water (Mesić stream) and groundwater are likely to occur. These types of pollution are not permanent and after the construction works are finished and necessary protection measures are taken, the phenomena are reduced, i.e. they completely disappear after some time.

During the construction works on the location, there are activities that can cause negative impacts on the flow regime and water quality:

- Construction works (deep excavations, destroying and removing of natural surface layer and the like). In this way, disturbances of natural feeding directions are possible and at the same time by removing the surface layer and creating new drainage areas, cloudy or in some other way dirty water is easily drained into the ground as well as into surface water.
- Construction machines – a potential hazard from pouring or accidental leakages of oil and oil derivates, disposal of motor oil and similar waste.

- Uncontrolled depositing of dug material, placing bases for mechanization or asphalt bases in the vicinity of surface water.
- Usage of inadequate construction material.
- Uncontrolled drainage of sanitary water in the places where workers are staying, where smaller contaminations due to food preparation processes and sanitary blocks are possible.

Therefore, the need for this problem analysis arises taking into consideration real relationships relating to the spatial characteristics of the logistics centre, as well as the watercourse characteristics of possible recipients of atmospheric water and groundwater.

IMPACT OF LOGISTIC CENTRE ON SOIL CONTAMINATION

General problem in the relationship between the logistics centre and the environment is the most intensive when the impact on soil as a recipient of contaminating substances is concerned. Soil is a very complex system, very sensitive to different impacts since it reacts to minor changes which cause degradation of its basic characteristics.

The vicinity of the road and rail traffic can cause soil contamination[4]. Contaminating substances in road traffic are combustion products (polycyclic aromatic hydrocarbons) or lead which is formed from the presence of antidetonator- tetraethyl lead that was used as fuel additive until recently. The content of these contaminating substances decreases with the distance from the roads. Soil may also be contaminated by motor oil in places where road vehicle repair is performed. Rail traffic, besides combustion products, can be the source of polychlorinated biphenyl that were applied in transformers and condensers of electric locomotives and which can be found in higher concentrations in the soil near railroads.

Chemical suppression of weeds that is seasonally performed may be of a great significance as an impact on agricultural soil. In non-agricultural areas weed treating is performed once or twice a year depending on the situation on the field, that is, depending which part of the rail route can be cleaned from the present weed species and the quantity of vegetation that can be tolerated. Soil herbicides are applied in the period of intensive weed growth, from April to May, and foliar herbicides at the beginning of May and during June before the full blooming of weed. It is important to bear in mind that during the period from 2001 to 2006 railways were partially treated, mainly priority locations, in accordance with the economic possibilities of JP Železnice Srbije. Vegetation control on the railways is performed by rail treating with total herbicides. Dozes of these herbicides are usually very high which endangers groundwater as well. Depending on weed vegetation, the following herbicides are applied: flumioxazin, triclopyr, glyphosate,

flazasulfuron and combinations: flumioxazin + glyphosate, flazasulfuron + glyphosate, triclopyr + glyphosate[5].

As a consequence of traffic, solid particles, dust, soot, parts of asphalt, liquid substances (fuel, motor oil, liquid for glass washing, defrost liquid and the like) are commonly found in the soil. Emission of different types of salts for snow thawing (salts NaCl and KCl) also occurs which endanger the soil structure. Railway exploitation, that is, regular traffic has a minimum impact on the environment which is significant only in the first impact zone (next to the railroad). It comprises activities within the regular maintenance of infrastructure and regular rail traffic which involves the following: maintenance of metal parts, roads, signals, platforms, the remains of lubricant leakings, corrosion, toilets in carriages, friction between rails and wheels.

In the available documents about soil contamination in the vicinity of the objects relating to traffic, the presence of a wide range of harmful substances was found and in the concentrations that frequently exceed maximum allowable ones when soil exploitation is concerned (for growing certain agricultural cultures). Namely, it is about fuel components, such as hydrocarbons, organic and inorganic carbon. MTBE. nitrogen compounds (nitrates, nitrites and ammonium. A special group of elements comprises heavy metals, such as lead (fuel supplement that has not been used since 2010 except for old car models), cadmium, copper, zinc, mercury and nickel. These element traces can be detected at even longer distances from the emission site.

NOISE AND VIBRATION IMPACT OF LOGISTIC CENTRE

Generally speaking, noise represents a significant factor in environmental pollution. In accordance with regulations the maximum allowed outside noise levels in populated areas on the location of the logistics centre are 65 dB(A) per day, that is 55 dB(A) per night. Bearing in mind that the logistics centre is located on the outskirts of the town in the vicinity of Kormanterska forest, which can simultaneously play a part of the buffer zone for noise absorption, it can be concluded that a negative noise impact occurred due to the operations in the logistics centre is minimal.

Vibration impact, caused by the operations in the logistics centre during its construction and exploitation, on people and objects is analysed through the parameters for the projected solution and characteristic sections and is estimated on the basis of quantitative parameters which are characteristic for the nature of emission and transmission taking into account previously defined threshold values.

The construction phase, when vibrations are concerned, is characterised by mechanisation works and facilities located along the logistics centre that is being built. Construction organisation of an object such as the logistics centre is characterised by the arrangement of construction mechanisation on a relatively wide area which nevertheless, enables interventions on the environment from vibrations in this phase using noise barrier methods. Exposure to these impacts is time-limited, temporary and of smaller intensity.

In order to make an objective evaluation about negative vibration impacts occurred during the exploitation of the logistics centre and the traffic that will flow in the centre, it is necessary to reach the indicators which will enable the forming of such an evaluation based on concrete location characteristics. Vibration intensity depends on the characteristics of moving the large masses, flow, characteristics of moving surface, soil characteristics expressed through a muffling coefficient and other characteristic spatial relationships that occur during transmission from the source to the recipient. Bearing in mind the nature of the impact, negative consequences are seen in relation to people and objects on the location of the logistics centre, where there are objects that could be exposed to negative vibration impacts since the first residential objects are several hundred meters away and in the vicinity there is the zone of Kormanterska forest which can significantly lessen the effects of noise and vibration spread.

IMPACT ON FLORA, FAUNA AND POPULATION

Taking into consideration the presence of the structure and the arrangement of certain biocomplex categories within the logistics centre zone as well as the fact that the location is situated on agricultural soil, the construction will have a negative effect on agricultural biodiversity.

Impacts on agricultural vegetation and ruderal flora during the exploitation can be reflected as the increase of the combustion product quantities of transport vehicles within the logistics centre which can negatively affect the quality, habitus as well as fertility of agricultural and fruit and winegrowing products. Hydrotechnical objects may have a positive effect on habitus and ecological amplitude of plant species, and due to synergic activities and interactions on the relation pedosequences – waters – vegetation structure and floral composition of agricultural type. During the exploitation, agricultural and ruderal flora can be particularly affected by the higher intensity of traffic which results in the concentration increase of different exhaust fumes (SO, $C0_2$,$N0_2$) and heavy metals leading to dryness and leaf curls, as well as fruit itself, some types of corn, vegetable cultures and with the weakening of the root system, a decrease in oxygen production

and chlorophyll which can have adverse implications on the agricultural validity and biodiversity expressed through a decrease in yield as well as different negative phases in the reduction of permanent or temporary growth and advancement.

The logistics centre is intended to be located on the outskirts of the town of Vršac and it consists of two spatial units separated by a railway. Ecological corridors connect spatial units of isolated natural habitats. They enable seasonal migrations to be performed and genetic material exchange between partially isolated and/or spatially distant habitats and their passability ensures biodiversity preservation of the area.

Ecological corridors represent the habitats for amphibia, reptiles and birds, among which there are protected species as natural rarities, with the biggest number of individual animals in the period of seasonal migrations of birds and Amphibia. Busy asphalt roads are the barriers for the majority of animal species and thus the possibility of rare species extinction is increased and genetic diversity of game that is hunted is decreased. Since the logistics centre location represents an agricultural ecosystem during the construction and exploitation may have a negative impact on the area biodiversity.

The construction of the planned logistics centre will have positive socio-economic effects on the population in this area. Namely, it will provide new job opportunities for a certain number of people as well as a better logistics connection with the supplying centres, traffic communication and large-scale goods flow between settlements and the wider area.

Health impacts of the logistics centre on the population within the city zone of Vršac are essentially positive. These impacts comprise a decrease in noise level, vibrations and aero contamination (oil combustion and exhaust fumes).

POSSIBLE RISK AND ACCIDENTS DURING THE LOGISTICS CENTRE AND RAILWAY EXPLOITATION

Danger of accidents during the exploitation of the logistics centre on the outskirts of the town of Vršac is present and occurs as a consequence of traffic accidents and possible damages to freight vehicles which transport hazardous substances.

The most frequent accidents that occur on the roads relate to oil derivates that leak from reservoirs and cause soil contamination in the vicinity as well as groundwater and surface water pollution and the destruction of flora. Two types of accidental situations may occur – without burning of flammable materials and with their burning. If burning of transported substances happens to occur it causes soil contamination in the vicinity and through the soil groundwater and surface water pollution. By contaminating soil and

water, hazardous derivates occurred due to combustion processes have an impact on flora and fauna within the wider area of the logistics centre. Oil and its derivates represent highly flammable liquids and as such can be easily ignited by heat, sparks or open flames in the presence of oxygen. In conditions which enable the production of large quantities of energy, dispersed fuel and oil from vehicles heats and evaporates and explosive mixture is reached in contact with air, thus damages, fires and explosions are likely to occur. Fire and explosion occurrence on roads, except for material damage to vehicles and possible passenger injuries, can also cause the emission of a large quantity of chemical combustion products in the air, which are commonly dangerous for the environment.

There is a danger from the explosion due to evaporation from the inside, outside or in the sewage outlets, that is flammable liquids released into sewage can cause fire or explosion. It is a fact that most contaminating substances, especially oil derivates, when penetrate aquifiers and groundwater remain there for a longer period of time since there is no significant dilution when they come in contact with groundwater which could reduce their concentration. Bearing in mind that there is no biodegradation in groundwater polluted by oil derivates, filtration from the aquifers is a very slow process. In the aquifer layer there is delamination of oil phase to hydrocarbons lighter than water which are present in the upper layers and hydrocarbons heavier than water which settle in the lower layers of the endangered aquifer.

In case of road accidents caused by transport vehicles, carrying hazardous substances, soil, groundwater and surface water will be endangered in the first place. The scale of ecological consequences in case of accidents will depend on physical and chemical characteristics of the substances that are dispersed in the environment as well as on water conductivity of the terrain and filterability coefficient in the vicinity of the road section, the level of groundwater and the vicinity of watercourses.

CONCLUSION

Impact analysis on the environment when construction and later exploitation of the logistics centre on the outskirts of the town of Vršac are concerned shows that this centre will have a certain level of impact on the existing state of the environment on the proposed locality. Protection measures which would minimize negative consequences to acceptable limits comprise a range of activities for every noticed impact in the phases of both construction and exploitation of the centre.

Design and implementation of monitoring of environmental quality at the site of the logistics center on the outskirts of Vršac to obtain information that will initiate appropriate action of protection in order to prevent or minimize further degradation of environmental quality and established an early warning system.

Continuous control of relevant environmental parameters is performed in order to assess the quality status. The global objectives of the monitoring are collecting data for quality management of the environment and to maintain the state of the environment. Objectives of maintaining quality are promoted according to the needs in a given time period for a specific parameter of the environment. The ultimate goal of monitoring is to maintain environmental quality, and based on the information obtained to show you where it is necessary to take adequate measures to protect.

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