The highway reconstruction possible environmental impacts’ assessment in the steppe zone of Stavropol territory

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Abstract. This work is devoted to assessing the possible environmental impacts of the A-167 Kochubei – Neftekumsk – Zelenokumsk – Mineralnye Vody highway reconstruction (artificial lighting device) on the km 317 – km 323, Alexandriyskaya village. Administratively, the work site is located in Georgievsky municipal district in the southern part of the Stavropol Territory. Ecological condition in the Alexandriyskaya village area is relatively prosperous. As a result of road lighting, the main emissions of pollutants entering the environment have been studied. The background values and the pollutants concentration in MPC fractions have been given in the work. As it can be seen from the study, the pollutants concentration during lighting does not exceed 0.41 in MPC fractions, and during the road operation does not exceed 0.03 MPC.

1. Introduction
The construction of new and the reconstruction of old roads lead to an improvement in the living conditions of the population. However, roads, as engineering structures affect natural landscapes, causing various forms of pollution, changing the flow regime of surface and ground waters, are able to significantly change the conditions of flora and fauna habitats, migration routes of animals. The sources of pollutant emissions into the atmosphere during the construction and repair of the road are the working construction equipment, dusty surfaces of the subgrade, road vehicles involved in the building structures’ transportation, as well as the subgrade filling sections, sites of ground construction materials, pipe construction sites, etc. [12].

The purpose of this work is to study the state of the environment during the highway reconstruction.

The Alexandriyskaya village is located 14 km northwest of the center of Georgievsk on the left bank of the river Kumy, between the Mineralnye Vody - Georgievsk railway (Vinogradnaya station) and the Mineralnye Vody - Budennovsk highway. The village is stretched for 7 km along the Kuma Valley, about 1100 hectares are built up, has semi-quarterly and perimeter quarterly buildings.

During the A-167 highway Kochubey - Neftekumsk - Zelenokumsk - Mineralnye Vody reconstruction, artificial lighting devices were installed on the section km 317 - km 323 (Figure 1). In terms of ensuring the power supply reliability, the outdoor lighting line belongs to category III.
Figure 1. A space photograph of the A-167 Kochubey – Neftekumsk – Zelenokumsk – Mineralnye Vody highway section km 317 – km 323 (Alexandriyskaya village) in the Stavropol Territory

The main factors determining the climatic conditions of the study area are the terrain, the direction of the prevailing winds and the features of atmospheric circulation. Background concentrations of pollutants in the air before the road reconstruction are shown in Table 1.

| Substance                           | Background concentration |
|-------------------------------------|--------------------------|
| Suspended substances, [mg/m³]       | 0.2                      |
| sulphur dioxide, [mg/m³]            | 0.007                    |
| Carbon monoxide, [mg/m³]            | 2                        |
| Nitrogen dioxide, [mg/m³]           | 0.037                    |
| Nitric oxide, [mg/m³]               | 0.024                    |

Exceeding the maximum permissible concentration (MPC) of substances is not observed.

2. Research methods

When lighting, the main sources of environmental pollution are dismantling, road machinery, welding stations, painting of metal structures, loading and unloading, transit vehicles. The calculation of pollutants emissions was carried out according to the methodological manuals for the calculation, regulation and control of pollutants emissions into the air [3-10].

3. Research results

Ecological condition in the area of Alexandriyskaya village is relatively prosperous. The results of the study. Background values and concentration of pollutants in the MPC shares are given in Table 2.

| Substance code | Substance name | Concentration in MPC shares in the residential area | Concentration in shares of MPC at the border of SPZ |
|----------------|----------------|-----------------------------------------------------|--------------------------------------------------|
| 0123           | Iron oxide     | 0.00007                                             | 0.0011                                           |
| Code   | Substance                                      | Concentration 1 | Concentration 2 |
|--------|-----------------------------------------------|----------------|-----------------|
| 0143   | Manganese and its compounds                   | 0.00017        | 0.0026          |
| 0203   | Chromium oxide                                | 0.0015         | 0.0023          |
| 0301   | Nitrogen dioxide                              | 0.24           | 0.27            |
| 0304   | Nitric oxide                                  | 0.06           | 0.07            |
| 0328   | Carbon black                                  | 0.0098         | 0.01            |
| 0330   | Sulfur dioxide                                | 0.02           | 0.02            |
| 0337   | Carbon oxide                                  | 0.41           | 0.41            |
| 0344   | Inorganic fluorides, poorly soluble            | 0.00016        | 0.00024         |
| 0616   | Xylene                                        | 0.0086         | 0.01            |
| 1042   | Butanol                                       | 0.0057         | 0.0087          |
| 1048   | Isobutyl alcohol                              | 0.0057         | 0.0087          |
| 2704   | Petrol                                        | 0.0013         | 0.002           |
| 2732   | Kerosene                                      | 0.0028         | 0.0043          |
| 2752   | White Spirit                                  | 0.0001         | 0.00016         |
| 2902   | Suspended matter                              | 0.4            | 0.4             |
| 2907   | Inorganic dust >70% SiO₂                      | 0.0013         | 0.002           |
| 2908   | Inorganic dust 70-20% SiO₂                    | 0.0002         | 0.00031         |

### When operating the road

| Code   | Substance                                      | Concentration 1 | Concentration 2 |
|--------|-----------------------------------------------|----------------|-----------------|
| 0301   | Nitrogen dioxide                              | 0.03           | 0.04            |
| 0304   | Nitric oxide                                  | 0.0024         | 0.0036          |
| 0328   | Carbon (Soot)                                 | 0.0025         | 0.0039          |
| 0330   | Sulfur dioxide                                | 0.0019         | 0.0029          |
| 0337   | Carbon oxide                                  | 0.0068         | 0.01            |
| 2704   | Petrol                                        | 0.0010         | 0.0016          |
| 2732   | Kerosene                                      | 0.0013         | 0.0059          |
| 6204   | Summation group (nitrogen dioxide + sulfur dioxide) | 0.02           | 0.03            |

As it can be seen from the Table 2, the pollutants concentration during lighting does not exceed 0.41 in MPC fractions, during the road operation does not exceed 0.03 MPC. The calculation of the pollutants dispersion (nitrogen dioxide) when illuminating the road is shown in Figure 1, and during the road operation - in Figure 2.
Figure 2. The calculation of the dispersion of nitrogen dioxide during the lighting of the road.
4. Summary.

Thus, it was found that the pollutants concentration during lighting does not exceed 0.41 in MPC fractions, and during the road operation does not exceed 0.03 MPC. Consequently, the impact on the air of the enterprise is negligible.

Overhaul of the road sections was designed with the maximum possible use of the permanent right-of-way strip of the existing road, preserving the landscape, which made it possible to preserve and not violate the prevailing conditions of plant growth and animal habitat in the area.

**Figure 3.** The calculation of the nitrogen dioxide dispersion during the road operation
The nearest water body is the Kuma River. It is located at a distance of more than 500 m from the projected object “Artificial lighting on the A-167 Kochubey - Neftekumsk - Zelenokumsk - Mineralnye Vody section km 317 - km 323 (Alexandriyskaya village) in the Stavropol Territory”. The object is located in a non-water protection zone. Water protection measures are not required.

References
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