Plan van Aanpak / Approach

for measures and project-oriented investigations against potential risks from former hard coal mining in South Limburg along the planned construction “Eurekarail: Heerlen - grens”

by

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This report consists of 9 pages and 4 plans

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1 Objectives

The railway connection between Heerlen (Netherlands) and Herzogenrath (Germany) is to be extended. The extension comprises a two-track expansion as well as technical adjustments in the western section between Heerlen Station and Landgraaf. For the eastern section only the frequency of the train runs will be increased. At present, the project is in the planning phase. In this context, a Milieu Effect Rapport (MER) was elaborated by HASKONINGDHV NEDERLAND B.V. Since the railway line is running through the South Limburg mining district, the potential effects from mining have to be considered as well.

The consulting engineers Heitfeld-Schetelig GmbH, D - Aachen (named IHS in the following) were commissioned by HASKONINGDHV NEDERLAND B.V. to investigate and evaluate the potential risks of the former mining activities in detail. As a result of step 1 of these investigations the “Report about the investigation of potential risks from former hard coal mining in South Limburg related to the planned construction “Eurekarail: Heerlen - grens”” (IHS, 22.01.2019) was worked out.

In step 2 of these investigations a more detailed view on the actually identified risks is required. Therefore the Plan van Aanpak in hand delivers for the relevant identified risks a project-oriented program on measures or investigations or monitoring.

2 State of knowledge

The "Report about the investigation of potential risks from former hard coal mining in South Limburg related to the planned construction "Eurekarail: Heerlen - grens"" (IHS, 22.01.2019) came to the following main conclusions about the potential effects from former hard coal mining:

1. **Near surface mining:**
   Risk is very low (EK 3) to low/medium (EK 2) in a small area;
   Need for further consideration and/or action
2. **Mine shafts:**
   Not relevant
3. **Other mining legacies:**
   Risk is low to very low;
   Need for further consideration and/or action
4. **Ground movements:**
   Risk is low;
   Need for further consideration and/or action
5. **Groundwater quality and groundwater quantity:**
   Not relevant
6. **Mine gas:**
   Not relevant
7. **Small earthquakes:**
   Not relevant

In Plan 1 to Plan 4 the relevant mining relicts and mining issues are shown with respect to the actual conceptual planning of the railway. This map is the base for the following description of the Plan van Aanpak, as measures or further investigations are restricted to areas in which actually construction work will take place, while for other areas monitoring will be sufficient.

3 Plan van Aanpak / Approach

The extension of the railway connection between Heerlen (Netherlands) and Herzogenrath (Germany) comprises a two-track expansion as well as technical adjustments in the western section between Heerlen Station and Landgraaf, while for the eastern section only the frequency of the train runs will be increased. Therefore in the western part a detailed assessment of the planned constructions in the identified areas with mining risks is necessary. From Plan 1 to Plan 4 the actual conceptual planning along the western part of the railway track is shown together with the identified mining relicts, which might induce risks for the ground surface or the soil stability.

From west to east the following mining relicts/mining risks are encountered by the planned two-track expansion.

Downward drilling between chainage 19.4 and 19.5 (Plan 1)

Between the chainage 19.4 and 19.5 on the northern side of the railway track at the Limaweg/Heerlen a Downward drilling is documented. Plan 1 shows the most likely position and a circle for the position accuracy of ±20 m. It is evident that the southern part of the position accuracy is overlapping with the planned alignment. No signal posts or posts for overhead lines are planned in this specific area.

According to the available data this drilling was sunken in the year 1891 as exploration drilling, presumably on hard coal. The final depth of the drilling was 188,8 m below the rotary table of the drill rig which corresponds to a level of approx. -74 mNAP. In a depth of 127 m (approx. -13 mNAP) the top of the Carbon-

iferous bedrock was reached. According to the documented mining maps the drilling was placed in an area in which afterwards no mining activities took place. Therefore the borehole represents a link between the ground surface and the Carboniferous bedrock but without any connection to mine voids. If this Downward drilling was not re-filled properly it might be a "geotechnical zone of weakness". This means that a foundation exactly in the position of a former drillhole might lead to geotechnical problems like irregular settlement.

Therefore it should be checked if the Downward drilling is definitely outside of the planned railway track. In the following a way of action is proposed; the estimated costs are listed in Tab. 1.

1. **Mining expert:** On-site inspection to check the situation and the accessibility.
2. **Mining expert:** Performance of 10 small diameter hammer drivings (Kleinrammbohrungen) with short spacing (0,5 m) down to a depth of approximately 2 m at the most probable location of the former borehole with the intention to detect and check the former borehole.
3. **Mining expert:** If (2) is not successful, continuation with estimated 40 small diameter hammer drivings (Kleinrammbohrungen) with short spacing (0,5 m) down to a depth of approximately 2 m along the line where the northern new alignment intersects with the position of accuracy or alternatively the excavation of a trench along this line. For this work a safety staff member from the railway company will be needed.

Drempels between chainage 20.3 and 20.4 (Plan 2)

Between the chainage 20.3 and 20.4 three lines of "Drempels" are documented, which intersect the existing as well as the planned northern extension of the railway line (see Plan 2). No signal posts or posts for overhead lines are planned in this specific area.

This area should be included into the On-site inspections. As no specific construction planning is covering this area, no more action is required, but the area should be included into a monitoring program (see below). In the following a way of action is proposed; the estimated costs are listed in Tab. 1.

4. **Mining expert:** On-site inspection to check the situation.

Drempels between chainage 20.6 and 20.8 (Plan 3)

Between the chainage 20.6 and 20.8 a cluster of "Drempels" is documented, which intersects the existing and the planned northern extension of the railway line (see Plan 3). In this area some signal posts and posts for overhead lines are planned and furthermore at the northern outer face of the alignment a "kunststof damwand" is planned. This area should also be included into the On-site inspections.

Furthermore along the whole area of these "Drempels" each single foundation of posts and the "kunststof damwand" should be checked on the geotechnical properties by Soundings (Rammsondierungen/Slagsonderingen) or Cone Penetration Tests. These investigations can be included into the general geotechnical subsoil

investigations which may be performed along the railway track. In the following a way of action is proposed; the estimated costs are listed in Tab. 1.

5. **Mining expert:** On-site inspection to check the situation.
6. **Geotechnical expert:** Subsoil investigations at each planned foundation.

Industrial near surface mining from chainage 20.8 to 21.4 (Plan 3 and Plan 4)

From chainage 20.9 to a few meters east of chainage 21.4, an impact area from industrial near surface mining of impact category EK 3 (low estimated relative probability for future sinkholes and/or subsidence, “blue”) is intersected by the railway line. In addition, the central part of this impact area features a cluster of Upward drillings. In this area some signal posts and posts for overhead lines are planned and furthermore at the eastern part of the section a “kunststof damwand” is planned. The situation is shown in Plan 3 and Plan 4.

For dealing with both the potential impact from industrial near surface mining and the cluster of Upward drillings, the report “Na-ijlende gevolgen steenkolenwinning Zuid-Limburg, GS-ZL” lists several measures. Adapted to the site-specific conditions, in the following a way of action is proposed; the estimated costs are listed in Tab. 1.

7. **Geotechnical expert:** Subsoil investigations at each planned foundation in the planning phase.
8. **Mining expert:** On-site inspection of each foundation pit in the construction phase.

9. **Mining expert:** The results and the information on the location of both the impact areas and the Upward drillings should be shared with the "Railway line management" in an informational meeting (cf. "Regional development planning" and "Awareness-raising").

Industrial near surface mining from chainage 21.6 to the east

Starting about 70 m east of chainage 21.6, the part of the railway line with planned constructions intersects an impact area from industrial near surface mining of impact category EK 3 (low estimated relative probability for future sinkholes and/or subsidence, "blue"). In addition, in the area of chainage 21.8 a "Drempel" crosses the railway line (see Plan 4).

In this area not only signal posts and posts for overhead lines are planned but also a new construction of station platforms. For dealing with these potential risks, in the following a way of action is proposed; the estimated costs are listed in Tab. 1.

10. **Geotechnical expert:** Subsoil investigations at each planned foundation in the planning phase.
11. **Mining expert:** On-site inspection of each foundation pit in the construction phase.
12. **Mining expert:** The results and the information on the location of the impact area should be shared with the "Railway line management" in an informational meeting (cf. "Regional development planning" and "Awareness-raising").

In a first rough estimation, the costs for the above mentioned actions and recommendations are listed below in Tab. 1.

Tab. 1: Cost estimation

„Eurekarail „Heerlen – Grens“		
	Investigation € [excl. VAT/BTW]	**Engineering € [excl. VAT/BTW]**
1. Mining expert: On-site inspection	-	1000,-
2. Mining expert: 10 small diameter hammer drivings	1000,-	1000,-
3. Mining expert (without safety staff member): 40 small diameter hammer drivings	4000,-	1000,-
4. Mining expert: On-site inspection	-	(incl. in 1.)
5. Mining expert: On-site inspection	-	(incl. in 1.)
6. Geotechnical expert: Subsoil investigations in the planning phase (estimated 20 relevant foundations)	4000,-	2500,-
7. Geotechnical expert: Subsoil investigations in the planning phase (estimated 40 relevant foundations)	8000,-	4000,-
8. Mining expert: On-site inspections of excavation pits in the construction phase (estimated 30 inspections)	-	10500,-
9. Mining expert: Informational meeting	-	2000,-
10. Geotechnical expert: Subsoil investigations in the planning phase (estimated 40 relevant foundations)	8000,-	4000,-
11. Mining expert: On-site inspections of excavation pits in the construction phase (estimated 30 inspections)	-	10500,-
12. Mining expert: Informational meeting	-	(incl. in 9.)
Total	**25000,-**	**36500,-**

Eastern part of the railway line without construction planning

For the eastern section of the railway line only the frequency of the train runs will be increased. As no constructions are planned there is no need for subsoil investigations and/or for the inspection of excavation pits. Nevertheless, as this part of the railway line is intersecting areas of impact category EK 3 ("blue") and in one small segment even of impact category EK 2 ("yellow"), there should be a monitoring on potential changes in ground surface. From the theoretical point of view these ground deformations might be downward movements, induced by subsidence, or might be upward movements, induced by the rising mine water.

The monitoring should be done directly on the railway track by levelling with a "Track Geometry Car" by the railway company. An interval for levelling each six months will be sufficient.

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