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LLC Center for Ecotoxicological Research Podgorica**



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**SECTOR FOR LABORATORY DIAGNOSTIC AND RADIATION PROTECTION**

**Report No.: 00-1659/1**

**REPORT OF ANALYSES OF SOIL, CONCRETE,  
UNDERGROUND WATER, AIR AND WIPE TEST OF WALLS  
IN AREA OF KAP TEMPORARY PCB STORAGE**



**PODGORICA, NOVEMBER 2019.**

|                            |                                                                                                                         |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------|
| <b>Project</b>             | <b>“Comprehensive Environmentally Sound Management of PCBs in Montenegro”.</b>                                          |
| <b>Project number</b>      | <b>100313</b>                                                                                                           |
| <b>Task of the project</b> | <b>PCB analysis (site investigation) at the UNIPROM - KAP<br/>PCB storage</b>                                           |
| <b>Client</b>              | <b>UNDP - United Nations Development Programme</b>                                                                      |
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## CONTENTS

|                                                                                                                | Page |
|----------------------------------------------------------------------------------------------------------------|------|
| Introduction                                                                                                   | 6    |
| Project realization                                                                                            | 6    |
| 1. Preliminary Site Assessment/preliminary investigation                                                       | 7    |
| 1.1. History of the Aluminum Plant                                                                             | 7    |
| 1.2. Location of KAP                                                                                           | 7    |
| 1.3. Metrological characteristics                                                                              | 8    |
| 1.4. Geological characteristics of soil                                                                        | 8    |
| 1.5. Hydrological characteristics of Podgorica, KAP and its surroundings                                       | 8    |
| 1.6. History of the subjected location-PCB storage                                                             | 9    |
| 1.7. Spatial distribution of polychlorinated biphenyls in groundwater of the Zeta plain in the 1992-1993 study | 13   |
| 2. Site Assessment/main site investigation                                                                     | 14   |
| 2.1. Soil sampling                                                                                             | 14   |
| 2.2. Water sampling                                                                                            | 19   |
| 2.3. Concrete sampling                                                                                         | 23   |
| 2.4. Wall samples (wipe)-sampling                                                                              | 24   |
| 2.5. Air sampling                                                                                              | 25   |
| 3.0 Laboratory analysis                                                                                        | 26   |
| 4.0 Results of analysis                                                                                        | 28   |
| 4.1 Results of soil analysis                                                                                   | 29   |
| 4.1.1 Results of analysis of soil/solid material sampled at 0-20 cm depth                                      | 30   |
| Data interpretation (soil sampled at a depth of 0-20 cm)                                                       | 34   |

**REPORT No. 00-1659/1**

|       |                                                                                                                               |     |
|-------|-------------------------------------------------------------------------------------------------------------------------------|-----|
| 4.1.2 | Results of analysis of soil/solid material sampled at 20-40 cm depth                                                          | 40  |
|       | Data interpretation (soil sampled at a depth of 20-40 cm)                                                                     | 44  |
| 4.1.3 | Review of the results of PCB analysis in soil samples by zones                                                                | 48  |
| 4.1.4 | Review of the results analysis of Dioxin-like PCBs congeners in soil/solid material samples with highest concentration of PCB | 50  |
| 4.1.5 | Results of analysis of soil samples sampled in the boreholes with data interpretation                                         | 51  |
| 4.1.6 | Results of soil analysis-PAH, TPH, Metals, bulk density, combustible sulphur and determination of particle size distribution  | 78  |
| 4.2   | Results of underground water analysis with data interpretation                                                                | 81  |
| 4.3   | Results of wipe test with data interpretation                                                                                 | 83  |
| 4.4   | Results of concrete analysis                                                                                                  | 87  |
| 4.5   | Results of air analysis with data interpretation                                                                              | 91  |
| 5.0   | Conclusion                                                                                                                    | 95  |
|       | Annex 1 Photo documentation of soil sampling                                                                                  | 103 |
|       | Annex 2 Photo documentation of water sampling                                                                                 | 122 |
|       | Annex 3 Photo documentation of concrete sampling                                                                              | 126 |
|       | Annex 4 Photo documentation of wall (wipe) sampling                                                                           | 138 |
|       | Annex 5 Photo documentation of air sampling                                                                                   | 149 |
|       | Annex 6 result of analysis of halogens, total organic halogens and total sulphur                                              | 151 |

## **Introduction**

In accordance with the signed agreement between the United Nations Development Program and the Center for Ecotoxicological Research Podgorica (CETI) (No. 00-1659), CETI implemented the activities set out in the Terms of Reference for providing services on the site investigation at Aluminum Factory Podgorica within the UNDP / GEF project (number: 100313) “Comprehensive Environmentally Sound Management of PCBs in Montenegro”.

Scope of work given by the project task included the realization of the activities on site investigation related to the determination of the PCB contamination of the area surrounding the KAP, temporary storage and the storage itself. It was done by collecting and analyzing samples of soil, concrete platform in front of the storage, than the ambient air and the groundwater, as well as the walls and the floor of the temporary storage.

Based on the information obtained from the above activities, risk assessment study, which involves identification of potential human exposure scenarios and characterization and quantification of related risks to the human health and environment will be carried out.

## **Project realization**

In order to obtain relevant data for human and environmental risk assessment caused by contamination of subject location (KAP temporary Storage) with PCBs, especially given the complexity of this process, quantification and risk assessment activities were implemented in phases. Each phase had a specific goal to be achieved. The goal revision were a continuous process at every stage.

The principal investigation phases were:

1. Preliminary Site Assessment/preliminary investigation,
2. Site Assessment/main site investigation
3. Assessment of results of investigation.

## 1. Preliminary Site Assessment/preliminary investigation

First phase of investigation was carried out using historical records and other sources to obtain information on the past and present usage of the site together with information about local soil properties, geology, pedology, hydrogeology and environmental setting. This phase has been completed in certain segments. Specifically, tests have shown that there is an indication of pollution in this area. However, there were no information on the contamination of the concrete part inside and outside the warehouse, the hydrogeological characteristics of the terrain, the amount of soil contaminated, the distribution of pollution, etc. The objectives of the preliminary investigation were set out formally before the **main site investigation** has started, to ensure that the scope (e.g. sources of information searched) is appropriate.

### 1.1. History of the Aluminum Plant

The Montenegrin Development Program, adopted in 1952, envisages the construction of the aluminum plant in the Titograd area. The approval for the location of the future Aluminum plant Titograd (KAT) was issued in 1965. KAT was founded in 1969, and began operating in 1971 when Phase I was built and put into operation by electrolysis cells, with the anode factory in Foundry previously completed. Other production facilities are released according to the finishing work. In 1972, the Aluminum plant started operating with a capacity of 200,000t / year. The same year, groundwater pollution was observed in the villages around KAT as the red sludge pool began to leak. This was the reason that KAT did not receive the operating permit, because it was only in 1975 that it obtained provisional sanitary approval, which it has not finally obtained to this day. In 1973, a capacity of 50,000t / year of primary aluminum were achieved. Phase II KAT-and began the construction in 1977 and was played back into operation successively, the anode, foundry, PCR and started in 1979 with the production of 102000t / year of primary aluminum and 280,000t of alumina. Electrolysis is put into operation in thirds, the reason was a lack of energy. Foundry alloy plant - Foundry "Silumin" started operating in 1983. Factory forgings Al-Forge, was put into operation in 1984. Al conductors factory in Kolasin was put into operation in 1985 and in 1999 the aluminum processing plant in Podgorica. The privatization process started in 2004 and since 2005 KAT is no longer state-owned.

### 1.2. Location of KAP

The industrial facilities of the aluminum plant are located southwest of Podgorica in the barren part of Ćemovsko Polje. The geographical location of this area is determined by 42°26 North latitude and 19°17 East longitude, with an altitude of 33 m. The area covered by all KAP facilities in Podgorica is 825000m<sup>2</sup> and has a rectangular shape. The KAP orientation is northwest-southeast.

In the area of Zeta plain, in addition to Podgorica as the capital city, there are 37 smaller and larger settlements, and in the immediate vicinity of the KAP are: Dajbabe, Zelenika, Botun, Velji Brijeg, Srpska, Cijevna, Baliače, Mojanovići, Mahala, Ljajkovići and Golubovci. On the other side of the highway to the east, there are grape plantations of Agrocombinat “13. Jul-Plantaže”.

Otherwise, the Zeta plain is the largest agricultural complex in Montenegro with exceptional climatic characteristics.

### **1.3. Metrological characteristics**

The dominant wind rose is with velocity intervals of 0.1 to 4m / sec in the NNI and N and S directions, SSW respectively north and northeast and south, southwest. Winds of magnitudes of 4.1-6m / sec occur much less in the north-south direction, and even less frequent are winds of greater intensity than 6m / sec, blowing in the north-east direction from north-east.

### **1.4. Geological characteristics of soil**

Geological profile of the terrain on which KAP was built is: 0.2 m humus mixed with red earth, 0.7 m the sandy-gravel materials from the dusty red soil and 35 m sandy gravel materials, gravel materials with layers of conglomerate (Civil Engineering Faculty, University in Belgrade).

### **1.5. Hydrological characteristics of Podgorica, KAP and its surroundings**

The Zeta plain, including the area where KAP is located, is the largest natural drinking water reservoir in Europe. Namely, in the area of the Zeta plain, a compact aquifer within the quaternary complex of glaciofluvial sediments was formed. Within the sandy-gravel deposits, 30-90 m thick, a mostly unique compact aquifer was formed, with a free surface level of over 200 km<sup>2</sup>. This underground aquifer is fed by the underground flows of the Morača River and the Cijevna River, with an average of 6.34 m<sup>3</sup> / sec, respectively the amount of about 200x106 m<sup>3</sup> / year.

On the part of the terrain between Srpska and Dajbabe in the dry season of the year, at the minimum level of aquifer (when Cijevna in this part dries up), the general direction of movement of groundwater is from north and northwest to south and southeast. At other times of the year, the general direction is from north to south. The first aquifer is at -11.5m below ground level and is about three kilometers wide, with a constant groundwater level at 12.5m from ground level.

The total amount of water sediment in the average dry year in this area is 172m<sup>3</sup>/sec, or 5,421,000,000m<sup>3</sup>/year.

The main water course of Morača River passes by the KAP at 300 m distance, where the main water supply system of the KAP with 2083 m<sup>3</sup>/ h of water was made. Downstream 300 m from the water intake is the main wastewater collector of KAP, which is discharged in Morača River.

The minimum, mean and maximum flow of the Morača River is: Qmin: 5,5m<sup>3</sup>/sek, Qmean: 132,0 m<sup>3</sup>/sek and Qmax : 900,0 m<sup>3</sup>/sek.

This clearly indicates what changes in groundwater levels occur and their impact on pollutant transport.

### **1.6. History of the subjected location- PCB storage**

- After the disclosure of the news that old stocked barrels of Pyralen waste transformer oil were leaking and spilling around the environment, the Investigative Prosecutor in Podgorica in June 1990 issued an Order to determine the actual state and evaluate the impact of this accident on the ecosystem. After a thorough examination of the content of PCBs in soil, groundwater and biological material, a "Report on the Pollution Level of the Zeta Plain Ecosystem by Pyralen", which was produced in 1991 and 1992, and completed in July 1992. At the same time, the special commission of the Ministry of the Interior Affairs ascertained that 1.5 tons of PCB (pyralene) had leaked from the stocked barrels and that there was no documentation of the fate for 9.5 tons of it. The report on the degree of pollution indicated a serious threat to groundwater, soil and foodstuffs of animal origin in the vicinity of KAP. This led to a detailed study on the environmental impact of KAP.
- After informing the competent authorities about the situation, the Ministry of Environmental Protection has contracted the preparation of the "Environmental Quality Assessment Study" with the Institute for Technical Research - Podgorica and the Institute for Health Protection - Podgorica to determine the quality of groundwater throughout the Zeta plain, air quality and soil. Due to the lack of funding for the entire study, it is divided into several phases. In the first phase, groundwater was tested in 178 wells and 20 KAP piezometers, with 22 wells examined in 2 time periods (dry and rainy). The study identified a serious threat to groundwater in the KAP environment with alkali, fluoride, phenols, polycyclic aromatic hydrocarbons (PAH-s), polychlorinated biphenyls (PCB-s), alkali metal salts, mineral oils and heavy metals. In order to undertake remediation measures, the President of the Republic has formed a "State Commission" with the task of determining: the state of technological environment protection of KAP, the state of technological discipline, emissions of harmful substances and the state and deposition of waste materials from the process of production of KAP and in accordance with that to propose to the Government appropriate measures to reduce and stop pollution in order to protect the health of the population. The report, which contained 54 measures, was adopted by the Government and obliged the holders to implement them in accordance with the given deadlines. An overview of the examined objects in Phase I of the Study is given in Figure 1. In Figure 2 is given the spatial distributions of PCBs by sector to which the Zeta plain is separated.

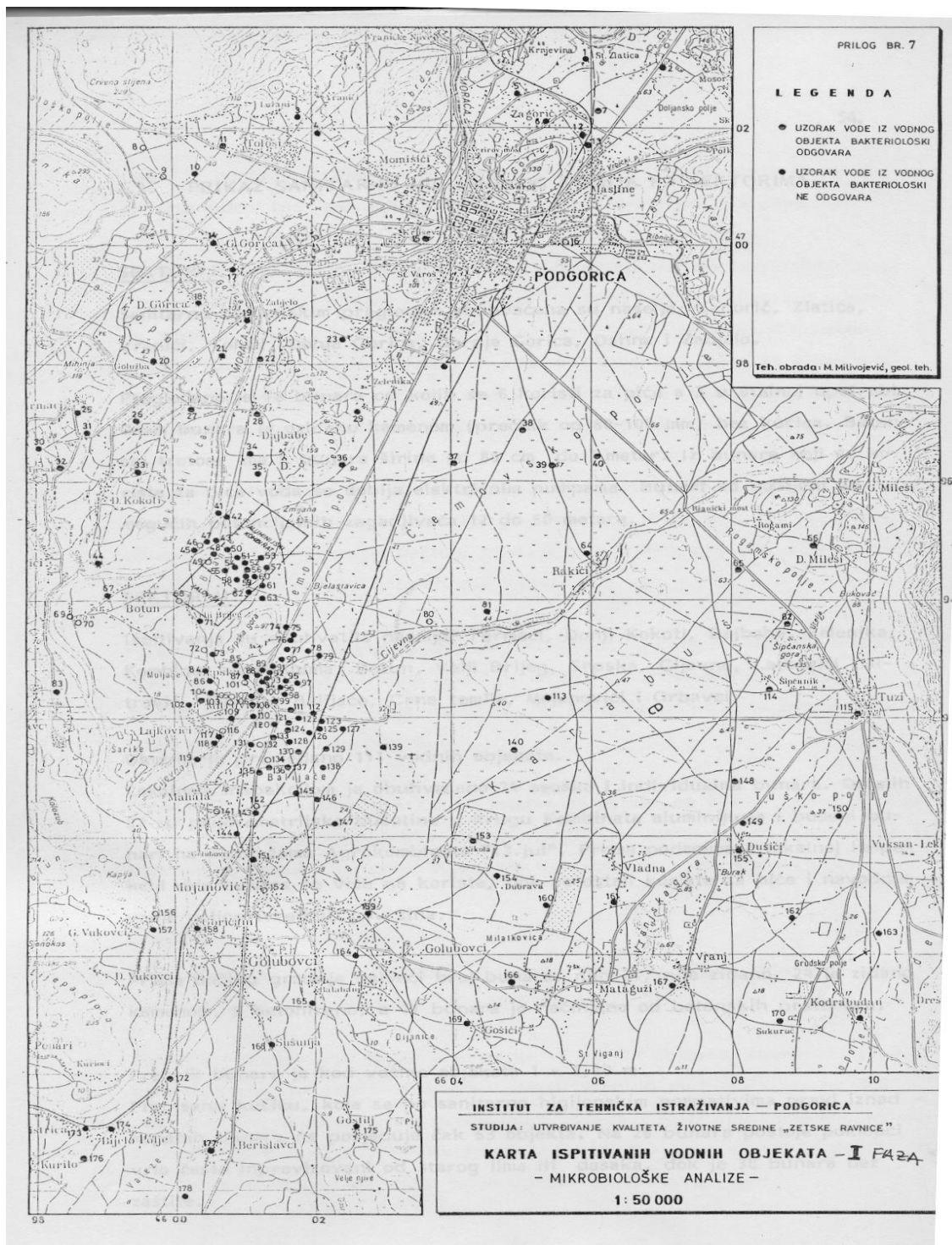
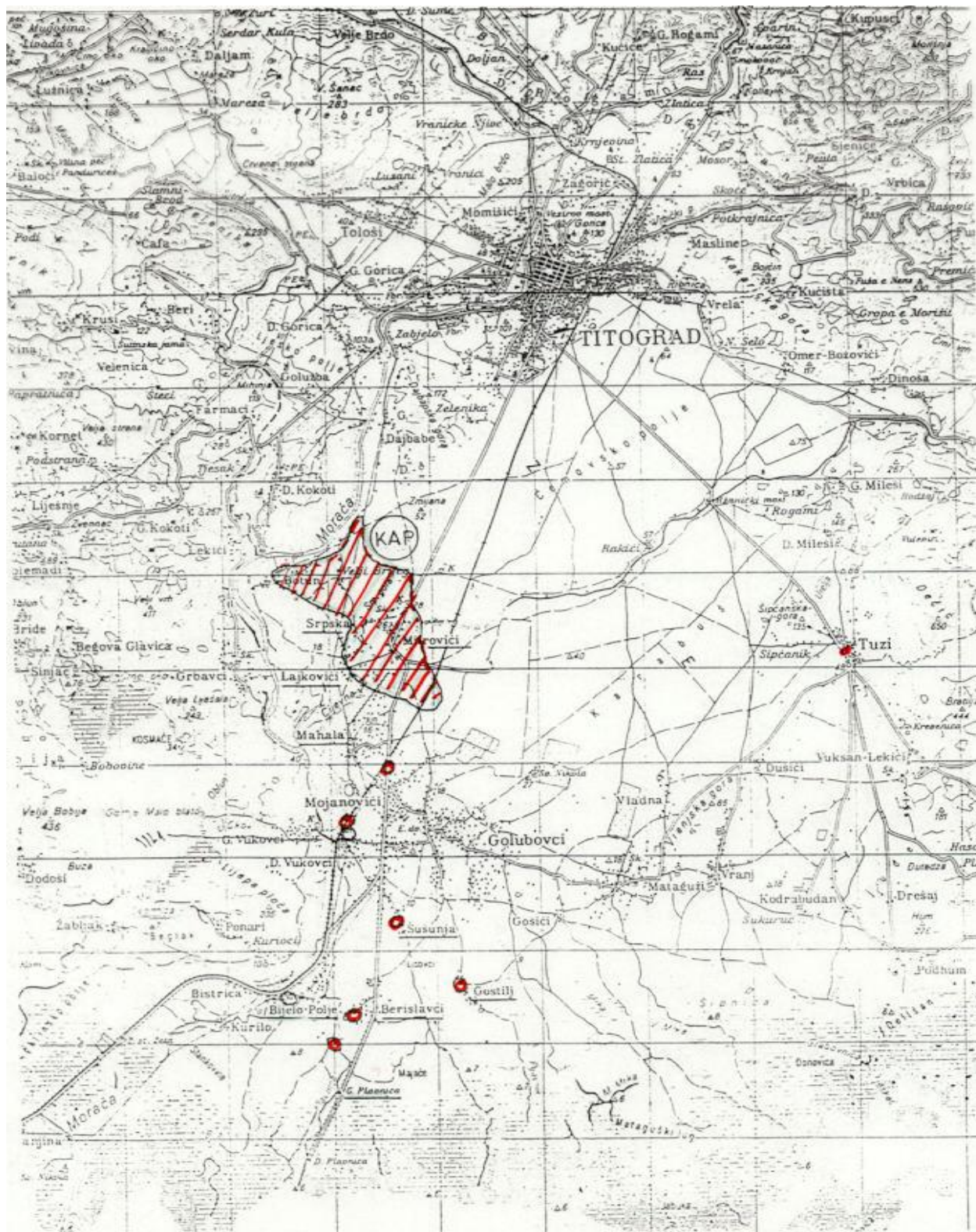


Figure 1. Examined objects in phase I of the study



**Figure 2.** The distribution of the contaminated area around KAP

Boreholes BA17 i BH 109 were located at the site of the barrel crash with used pyralene in 1990s. Along side of the BA17 borehole, a 3m manhole was excavated, in which, in 1990, the contents of the PCBs in the soil were examined in depth, depending on the soil quality, when it was found that about 90% of the PCBs was retained in the first layer of reddish, and in sandy and gravelly soil much less. After the adoption of the measures of the State Commission, the most contaminated layer of land was removed at this site and stored together with all barrels and containers in a concrete sarcophagus built at this site. Data for the content of PCBs in wells BA17 and BH 109 from 2005 show that the values are lower than those from 2004, which represents a positive trend of decrease of PCBs compounds in the ecosystem. Due to the property of PCBs compounds to remain in the soil for a very long time, the obtained results can be interpreted as poor absorption properties of sandy-gravel substrate, which does not have the ability to permanently bind liposoluble PCBs. Namely, due to such characteristics of the substrate and the extremely high amount of rainfall in Podgorica, it has apparently been washed away and diluted in the ecosystem over the past 15 years. This conclusion is confirmed by the content of PCBs in individual wells in the Zeta plain, Skadar Lake and fish, which also showed a significant decrease in concentrations. However, at the site, BA18, on which the transformer crash occurred, and with a deeper surface layer of red soil that had not been removed, the content of PCBs was still significantly high, although the crash happened in the 1980s.

This facility also includes the machine shop and service for vehicle maintenance, which certainly contribute significantly to the pollution of soil and groundwater, but they were not subject of examination.

Beside PCBs, in both wells an increased content of Cd and PAHs was found, and in BA17 a high mercury content also. Table 1 provides an overview of the contents of PCBs for these two wells by year.

**Table 1.** Review of the contents of polychlorinated biphenyls in the facility for maintenance of operation funds – PCR per years

| YEAR                  | BOREHOLE BA-17 |      |       | BOREHOLE BA-109 ( AS-1) |      |       |
|-----------------------|----------------|------|-------|-------------------------|------|-------|
|                       | 1990           | 1994 | 2005  | 1990                    | 1994 | 2005  |
| pH                    | 7,74           | 7,74 | 7,63  | 9.17                    | 8.15 | 7,56  |
| Conductivity<br>μS/cm | 400            | 300  | 353   | 390                     | 380  | 355   |
| Fluorides- mg/l       | 0,36           | 1,71 | 2,159 | 0,30                    | 1.11 | 1,41  |
| Arsenic-mg/l          | -              | -    | <0,01 | -                       | -    | <0,01 |

|                  |                   |                      |        |                      |                      |         |
|------------------|-------------------|----------------------|--------|----------------------|----------------------|---------|
| Cadmium-mg/l     | -                 | 0,002                | 0,0027 | -                    | <0,001               | 0,0027  |
| Mercury- mg/l    | -                 | <0,0005              | 0,0109 | -                    | 0,000                | <0,0005 |
| Phenols-mg/l     | 0,000             | <0,001               | 0,0011 | 0,001                | <0,001               | 0,0011  |
| PAH-s µg/l       | 0,00              | 0,00                 | 0,52   | 0,00                 | 0,00                 | 0,53    |
| PCB-s µg/l       | 10,20-381,1*      | 123,1                | 67,3   | 245,5                | 3,48                 | 0,69    |
| Mineral oil mg/l | Heavy fractions** | 5,49 Heavy fractions | 0,166  | 0,82 Heavy fractions | 0,12 Heavy fractions | 0,0106  |

\* depends on depth.

\*\* Heavy fractions - oil fuel

### 1.7. Spatial distribution of polychlorinated biphenyls in groundwater of the Zeta plain in the 1992-1993 study

The image of the contaminated area in the Zeta plain with alkali hydroxides, PCBs and fluorides after the tests conducted in Phase I of the Study is shown in Figure 3.

During the Phase I of the Study the need to expand the network for observation of wells was noted, so that in the second phase, which lasted during 2004 and 2005, 400 individual wells were included, of which 25 are tested four times a year.

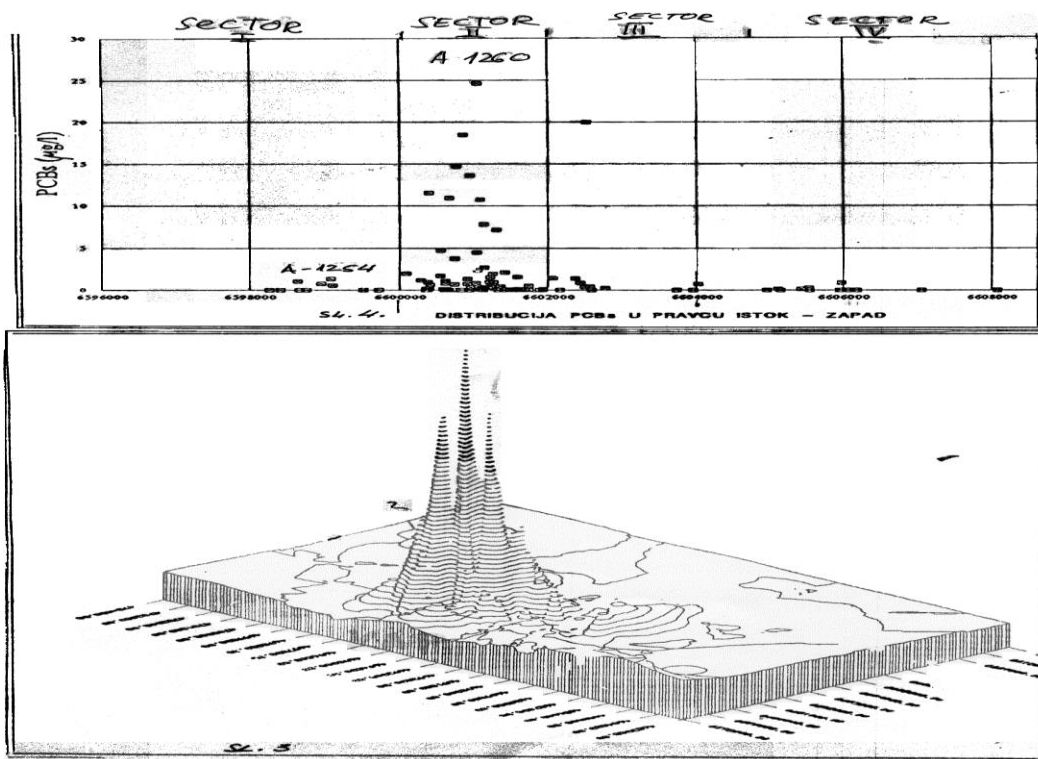


Figure 3 . Spatial distribution of PCBs in phase I of the study

## 2. Site Assessment/main site investigation

The main site investigation served for the quantitative determination of the amount and spatial distribution of contaminants, their mobile fractions and possibilities of spreading in the environment. It required the sampling and analysis of soil, surface water and groundwater in order to obtain the information necessary to enable a full assessment of the risks presented by the contamination to humans and other potential receptors.

The methodological approach was such that, in addition to the general principles that could be applied to all contaminated sites, the CETI knowledge and experience gained primarily in KAP and the resulting knowledge gained at the contaminated sites that were previously subject to CETI testing have been applied.

Namely, all activities for which there is a standard method were implemented following the rules established by the standard.

### 2.1. Soil sampling

Center for Ecotoxicological Research Podgorica carried out activities related to soil and concrete sampling in the area surrounding the PCB temporary storage. Also sampling of wall and concrete floor in storage itself in UNIPROM – KAP, Podgorica was done. All activities were realized for the purpose of realization PCB analyses in collected samples.

In accordance with the project requirements, a sampling plan was prepared first. This involves the formation of zones and sampling of composite samples in them, which are consist of an adequate number of subsamples. Soil sampling area is shown on figure 4.



**Figure 4.** Soil sampling area

In order to form the most appropriate sampling strategy, the guidelines described in the following documents have been taken into account:

1. ISO 18400-104:2018 Soil quality — Sampling — Part 104: Strategies
2. ISO 18400-203:2018 Soil quality — Sampling — Part 203: Investigation of potentially contaminated sites
3. ISO 18400-202:2018 Soil quality -- Sampling -- Part 202: Preliminary investigations
4. ISO 18400-101:2017 Soil quality -- Sampling -- Part 101: Framework for the preparation and application of a sampling plan
5. ISO 18400-102:2017 Soil quality -- Sampling -- Part 102: Selection and application of sampling techniques

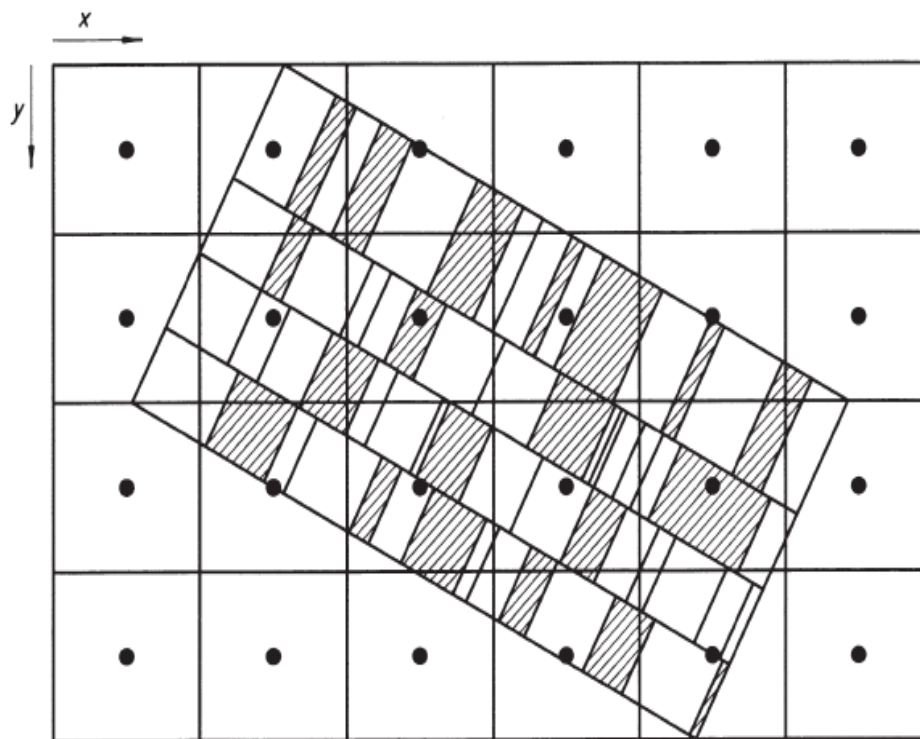
In accordance with standard method requirements and situation on site location sampling area was divided into 28 zones (figure 5).



***Figure 5.*** Soil sampling zones

Each zone is represented by a composite sample which consists of 6 subsamples. Sampling method (figure 6) used for soil sampling have a good relationship between the distance of sampling points and the areas they cover.

Sampling was carried out using Auger soil sampler that allows sampling from the surface to deeper layers of soil. Soil samples collected from surface layer of soil 0-20 cm and from deeper soil layer 20-40 cm.



**Figure 6.** Soil sampling method-scheme

After sampling, all samples were packed in sealed inert containers which are properly marked with indelible label on the outside to obtain safe transportation to the laboratory. Table 2 shows the sampling zones, the depths at which the sampling was performed as well as coordinates of zones

**Table 2.** Representative sample, zone and coordinates

| No. | Zone | Depth of sampling | Coordinates                |
|-----|------|-------------------|----------------------------|
| 1.  | 1    | 0-20 cm           | 42° 23.468'<br>19° 13.721' |
| 2.  | 2    | 0-20 cm           | 42° 23.464'<br>19° 13.729' |
| 3.  | 3    | 0-20 cm           | 42° 23.461'<br>19° 13.736' |
| 4.  | 4    | 0-20 cm           | 42° 23.459'<br>19° 13.742' |
| 5.  | 5    | 0-20 cm           | 42° 23.457'<br>19° 13.744' |
| 6.  |      | 20-40 cm          |                            |

REPORT No. 00-1659/1

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|-----|----|----------|----------------------------|
| 7.  | 6  | 0-20 cm  | 42° 23.456'                |
| 8.  |    | 20-40 cm | 19° 13.747'                |
| 9.  | 7  | 0-20 cm  | 42° 23.454'                |
| 10. |    | 20-40 cm | 19° 13.750'                |
| 11. | 8  | 0-20 cm  | 42° 23.451'                |
| 12. |    | 20-40 cm | 19° 13.754'                |
| 13. | 9  | 0-20 cm  | 42° 23.449'                |
| 14. |    | 20-40 cm | 19° 13.758'                |
| 15. | 10 | 0-20 cm  | 42° 23.446'                |
| 16. |    | 20-40 cm | 19° 13.762'                |
| 17. | 11 | 0-20 cm  | 42° 23.457'                |
| 18. |    | 20-40 cm | 19° 13.762'                |
| 19. | 12 | 0-20 cm  | 42° 23.454'                |
| 20. |    | 20-40 cm | 19° 13.769'                |
| 21. | 13 | 0-20 cm  | 42° 23.440'                |
| 22. |    | 20-40 cm | 19° 13.768'                |
| 23. | 14 | 0-20 cm  | 42° 23.444'                |
| 24. |    | 20-40 cm | 19° 13.772'                |
| 25. | 15 | 0-20 cm  | 42° 23.447'                |
| 26. |    | 20-40 cm | 19° 13.776'                |
| 27. | 16 | 0-20 cm  | 42° 23.450'                |
| 28. |    | 20-40 cm | 19° 13.780'                |
| 29. | 17 | 0-20 cm  | 42° 23.456'                |
| 30. |    | 20-40 cm | 19° 13.782'                |
| 31. | 18 | 0-20 cm  | 42° 23.462'                |
| 32. |    | 20-40 cm | 19° 13.789'                |
| 33. | 19 | 0-20 cm  | 42° 23.458'                |
| 34. |    | 20-40 cm | 19° 13.797'                |
| 35. | 20 | 0-20 cm  | 42° 23.452'                |
| 36. |    | 20-40 cm | 19° 13.788'                |
| 37. | 21 | 0-20 cm  | 42° 23.463'<br>19° 13.773' |
| 38. | 22 | 0-20 cm  | 42° 23.465'<br>19° 13.782' |
| 39. | 23 | 0-20 cm  | 42° 23.459'<br>19° 13.759' |
| 40. | 24 | 0-20 cm  | 42° 23.459'<br>19° 13.752' |

|     |    |         |                            |
|-----|----|---------|----------------------------|
| 41. | 25 | 0-20 cm | 42° 23.463'<br>19° 13.745' |
| 42. | 26 | 0-20 cm | 42° 23.468'<br>19° 13.740' |
| 43. | 27 | 0-20 cm | 42° 23.470'<br>19° 13.734' |
| 44. | 28 | 0-20 cm | 42° 23.475'<br>19° 13.726' |

In order to obtain a clear picture of the distribution of PCBs into the ecosystem, three boreholes were drilled at the zones with the highest pollution was determined (Figure 7 and Table 3 )



**Figure 7.** Boreholes sampling points

**Table 3.** List of boreholes with coordinates

| No. | Borehole | Zone | Coordinates                |
|-----|----------|------|----------------------------|
| 1.  | BH21     | 21   | 42° 23.463'<br>19° 13.771' |
| 2.  | BH27     | 27   | 42° 23.470'<br>19° 13.738' |
| 3.  | BH16     | 16   | 42° 23.451'<br>19° 13.774' |

Sampling of soil/solid material from boreholes was done on each meter of depth. Analysis were performed in total of 67 soil samples from boreholes.

After soil/solid material sampling from boreholes, subsamples were taken from each meter of depth for preparation of representative sample for that depth.

In accordance with the sampling methodology, soil sampling and sampling of a material from boreholes were accompanied by the photo documentation provided in Annex I.

## 2.2. Water sampling

In order to provide a more accurate picture of the site, all piezometers were visited, the altitude at which they were located and the water level were measured, and in accordance with the direction of groundwater flow, sampling was carried out in those wells where possible contamination through the distribution of PCBs was expected. Regarding this, table 4 gives an overview of piezometers and wells and precise water levels. Figure 8 shows a map of the locations of piezometers and wells.

**Table 4.** Coordinates of piezometers and wells

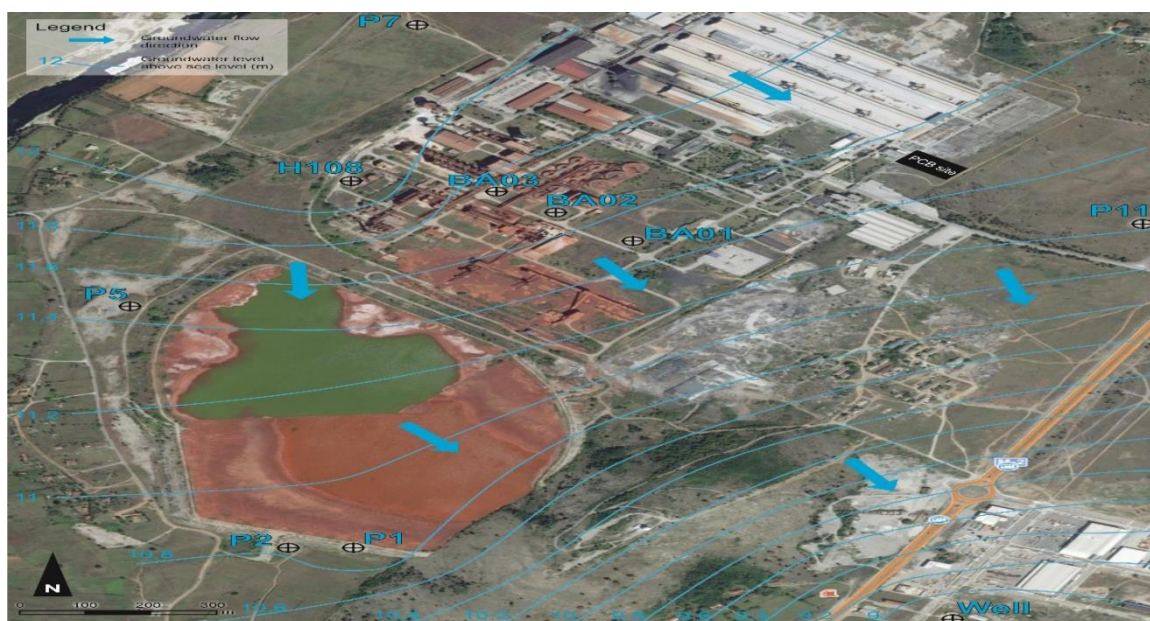
| Identification of the measuring point | Geodetic coordinates |             |        |                 |
|---------------------------------------|----------------------|-------------|--------|-----------------|
|                                       | x                    | y           | z      | Water level (m) |
| BA01                                  | 6601160.888          | 4694551.326 | 30.110 | 18,60           |
| BA02                                  | 6601048.241          | 4694643.871 | 30.275 | 18,55           |
| BA03                                  | 6600955.915          | 4694721.217 | 30.411 | 18,76           |
| BH 108                                | 6600743.803          | 4694737.114 | 29.183 | 17,00           |
| BH 109                                | 6601603.910          | 4694815.201 | 31.573 | not active      |
| BH 105                                | 6600735.694          | 4694428.623 | 28.638 | not active      |
| P1                                    | 6600746.505          | 4693442.090 | 26.305 | 15,30           |
| P2                                    | 6600638.278          | 4693446.732 | 27.052 | 16,25           |
| P4                                    | 6600416.491          | 4693907.951 | 26.279 | not active      |
| P5                                    | 6600400.635          | 4694295.731 | 26.829 | 15,40           |
| P7                                    | 6600841.372          | 4695310.059 | 30.318 | 18,20           |
| P11                                   | 6601974.043          | 4694597.324 | 32.432 | 21,20           |
| P12                                   | 6601565.151          | 4694265.770 | 29.449 | not active      |
| Well                                  | 6601665.402          | 4693170.522 | 26.437 | 17,70           |



**Figure 8.** Map of the locations of piezometers and wells

In spite of certain information on the direction of groundwater movement, these have been verified having in mind aforementioned, that it is possible to change the direction of groundwater during different periods of the year (it is a dry period in the period of realization of measurement and sampling activities for the project).

The result of the check is given on the map shown in figure 9.



**Figure 9.** Map of groundwater movement

According to all information, piezometers and wells for which were thought to provide the most complete information on PCB distribution were selected. Sampling locations of selected piezometers and wells are shown in Figure 10, while sampling points and its coordinates are given in table 5.



**Figure 10.** Sampling points of piezometers and wells

**Table 5.** Sampling points of piezometers and wells, with correspondiv coordinates

| N <sub>0</sub> | Sampling point                       | Coordinates                |
|----------------|--------------------------------------|----------------------------|
| 1.             | Piezometer-P11                       | 42° 23.331'<br>19° 14.013' |
| 2.             | Piezometer-P7                        | 42° 23.723'<br>19° 13.197' |
| 3.             | Piezometer-BA 01                     | 42° 23.312'<br>19° 13.424' |
| 4.             | Well (Krstović Vukašin)<br>Cijevna   | 42° 22.558'<br>19° 13.775' |
| 5.             | Well (Savo Stijepović)<br>Ljajkovići | 42° 22.173'<br>19° 13.262' |

|     |                                 |                            |
|-----|---------------------------------|----------------------------|
| 6.  | Well (Đorđe Vulević)<br>Cijevna | 42° 22.361'<br>19° 13.673' |
| 7.  | Well (Šefketi Faik) Cijevna     | 42° 22.480'<br>19° 13.857' |
| 8.  | Well (Miljković Božo)           | 42° 22.134'<br>19° 13.864' |
| 9.  | Well (Bezarević)                | 42° 21.903'<br>19° 14.311' |
| 10. | Piezometer-P1                   | 42° 22.717'<br>19° 13.105' |

In accordance with the sampling methodology, water sampling was accompanied by the photo documentation provided in Annex II.

### 2.3. Concrete sampling

In order to investigate possible contamination of the concrete base with the PCB, CETI sampled concrete floor samples on the plateau in front of the PCB warehouse as well as in the warehouse itself.

An electric drill was used to take concrete samples by drilling 1.5 cm holes. The collected concrete dust after drilling represented the sample for analysis. The drill dust was collected by using a poly spoon into the sample container.

A total of 30 concrete dust samples were taken. Figure 11 shows the sampling locations of concrete dust in warehouse and on the plateau in front of the warehouse.



**Figure 11.** Concrete dust sampling locations

Concrete sampling in accordance with sampling methodology, was accompanied by the photo documentation provided in Annex III.

## 2.4. Wall samples (wipe)-sampling

Storage of waste transformer oil and equipment which contained PCB, was tested for possible PCB contamination by sampling from the storage wall itself.

Standard wipe test uses a 10 cm x 10 cm pattern to display the sampling area. Glass wool which was soaked in hexane was used to collect the sample. The space inside the 100 cm<sup>2</sup> template was thoroughly overwritten with glass wool and then analyzed for PCB presence. A total of 30 samples were taken inside the warehouse with two different heights (1 m and 2m). Figure 12 shows the sampling locations.



**Figure 12.** Wall (wipe) sampling location

Wall (wipe) sampling was accompanied by the photo documentation provided in Annex IV.

## 2.5. Air sampling

One of the tasks of the project was to determine the levels of PCBs and PAHs in ambient air at the UNIPROM PCR warehouse in KAP. Air sampling was carried on one sampling point (Figure 13) and in accordance with the recommendations given in the project as follows:

- first sample was 24h sampling before the start of soil sapling on subjected location,
- second sample was 24h sampling on the day of the soil sampling
- third sample was taken after the completion of soil sampling at the PCR site.

Ambient air sampling was performed in accordance with following standard methods:

1. Method TO-4A (Determination of Pesticides and Polychlorinated Biphenyls in Ambient Air Using High Volume Polyurethane Foam (PUF) Sampling Followed by Gas Chromatographic/Multi-Detector Detection (GC/MD),
2. Method TO-13A (Polycyclic Aromatic Hydrocarbons (PAHs) in Ambient Air Using Gas Chromatography/Mass Spectrometry (GC/MS).

For the active sampling method high-volume sampling device, Echo Hi Vol (TCR-Tecora, Milan, Italy) was used. This instrument is designed to perform requests of standard methods. Instruments flowrate was electronically controlled and PUF sampling module with filter holder of 102 mm and adsorbing cartridge (for PUF) of 58 x 125 mm was used allowing simultaneous sampling of particulate and gas fractions. Particle phase was retained by using a 102 mm diameter quartz fiber filter (QFF), whereas the gas phase was trapped with a polyurethane foam (PUF) plug of 65 mm diameter, 75 mm length and 0.22 g/cm<sup>3</sup> in density. An average flow of 200 ± 2 L/min was achieved during the sampling interval. Quality assurance / quality control (QA/QC) protocol was followed during the sampling and analysis. Air flow through the sampling system was checked with Tecora Flow Cal Air calibrator before sample collection period.

After sampling the QFF and the glass PUF cartridge were removed from the sampler, wrapped with the original aluminum foil and placed in a sealed, labeled container for transport, back to the laboratory.



**Figure 13.** Air sampling location

Photo documentation of air sampling is provided in Annex V.

### 3.0 Laboratory analysis

Samples taken from the subjected location were analyzed using following *standard methods* for each parameter:

1. EPA 8270 C-Determination of semivolatile organic compounds by gas chromatography/mass spectrometry (GC/MS)
2. EPA 8080A-Organochlorine pesticides and polychlorinated biphenyls by gas chromatography
3. ISO 16703:2004-Determination of content of hydrocarbon in the range C10 to C40 by gas chromatography
4. BS EN 13656:2002-Microwave assisted digestion with hydrofluoric (HF), nitric (HNO<sub>3</sub>), and hydrochloric (HCl) acid mixture for subsequent determination of elements
5. AMA-112-- Determination of Mercury in Soils and Geological Samples, Form No. 203-821-112, LECO Corporation
6. EN 12880-Determination of dry residue and water content
7. USEPA Method TO-4A (Determination of Pesticides and Polychlorinated Biphenyls in Ambient Air Using High Volume Polyurethane Foam (PUF) Sampling Followed by Gas Chromatographic/Multi-Detector Detection (GC/MD)
8. USEPA Method TO-13A (Polycyclic Aromatic Hydrocarbons (PAHs) in Ambient Air Using Gas Chromatography/Mass Spectrometry (GC/MS).

For all above mentioned analysis following equipment was used:

#### ***Equipment for analysis of PCBs, PAHs, TPH***

1. Gas chromatograph–mass spectrometer, GCMS QP 2010 plus, Shimadzu
2. Gas chromatograph–mass spectrometer, GCMS QP 2020 plus, Shimadzu
3. Gas chromatograph with ECD detector 2010 plus, Shimadzu
4. Speed Extractor E-914 , Buchi

#### ***Equipment for analysis of chemical elements***

1. Atomic Absorption Spectrophotometer, AA6800, Shimadzu
2. Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES), iCAP6300, Thermo
3. Advanced Mercury Analyzer, AMA 254, Altec Ltd.
4. Microwave Digestion, Speedwave Xpert, Berghof

***Equipment for determination of water content***

1. Moisture balance, MA40, Sartorius

***Equipment for sampling of air quality***

1. Echo Hi Vol -TCR-Tecora, Milan, Italy

***Equipment for preparation of soil/solid material samples***

1. Ball Mills, RETSCH S100, Retsch

2. Analytical Sieve Shaker, Analysen SIEB-AS 200, Retsch

#### 4.0 Results of Analysis

According to scope of work given by the project task, CETI realized the analyses shown in Table 5a

**Table 5a.** Overview of the analysis done within the project

| No. | Parameter                                                                                                                 | Number of analyses |
|-----|---------------------------------------------------------------------------------------------------------------------------|--------------------|
| 1.  | <b>Analyses – soil/concrete</b>                                                                                           |                    |
|     | PCBs, PCBs congeners-soil (0-20cm)                                                                                        | 28                 |
|     | PCBs, PCBs congeners-soil (20-40cm)                                                                                       | 16                 |
|     | Dioxin like PCBs congeners - soil                                                                                         | 11                 |
|     | PCB-soil (3 borehole)                                                                                                     | 67                 |
|     | PCB-concrete                                                                                                              | 30                 |
|     | Metals (As, Hg, Cd, Zn, Pb, Cu, Ba, Ni, V, Cr, Sn, Co)-soil                                                               | 2                  |
|     | Total petroleum hydrocarbons (TPH) - soil                                                                                 | 2                  |
|     | Polycyclic aromatic hydrocarbons (PAH) - soil                                                                             | 2                  |
|     | Total organic halogens (TOX) - soil                                                                                       | 2                  |
|     | Total halogens (TX) - soil                                                                                                | 2                  |
|     | Total sulphur content - soil                                                                                              | 2                  |
|     | Combustible sulphur - soil                                                                                                | 2                  |
|     | Bulk density - soil                                                                                                       | 2                  |
|     | Particle size distribution                                                                                                | 2                  |
| 2.  | <b>Analyses – wall samples (wipe)</b>                                                                                     |                    |
|     | PCBs                                                                                                                      | 30                 |
| 3.  | <b>Analyses – groundwater</b>                                                                                             |                    |
|     | PCBs                                                                                                                      | 10                 |
| 4.  | <b>Analyses – ambient air</b>                                                                                             |                    |
|     | dl-PCB - coplanar, PCB-indicator + selected set of polycyclic aromatic hydrocarbons (PAHs - set of 16 by US EPA standard) | 3                  |

#### 4.1 Results of Soil Analysis

In accordance with project ToR for results interpretation followed documents were used:

- Dutch soil intervention values (Dutch Ministry of Housing, Land Planning and Environment, 2009)
- Limits set in UNIDO “POPs Contaminated Site Investigation and Management Toolkit”

In addition to the documents mentioned, we also used the following document for results interpretation:

- Dutch Target and Intervention Values, 2000 (the New Dutch List)

The results of the analysis are presented in Tables 6-17:

- Tables 6 and 7 provides a results of soil analysis sampled at a depth of 0-20 cm;
- Tables 8 and 9 shows the results of the analysis of soil sampled at a depth of 20-40 cm;
- Table 10 provides a review of the results of PCB analysis in soil samples by zones;
- Soil samples with highest concentration of PCB, were analyzed on dioxin-like PCBs congeners and obtained results are given in Table 11;
- Tables 12-17 shows the results of analysis of soil samples sampled in the boreholes.

The table also shows target values, intervention values and permissible values for an industrial site. All values for target and intervention levels for soil are corrected on the organic matter content<sup>1</sup>.

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<sup>1</sup> **Note:**

According to Dutch soil legislation target values and intervention values levels for serious contamination for organic compounds, depend on the organic matter content. For the conversion for organic compounds, with the exception of PAH, the following soil type correction formula can be used:

$$(SW,IW)_b = (SW,IW)_{sb} \times (\% \text{ organic matter}/10)$$

in which:

$(SW,IW)_b$  = target value or intervention value for the soil to be assessed

$(SW,IW)_{sb}$  = target value or intervention value for standard soil

% organic matter = measured percentage organic matter in the soil to be assessed. For soils with measured organic matter content of more than 30% or less than 2% contents of 30% and 2% are adhered to respectively.

For each result, comments are given on the relationship between the result obtained and the target values, intervention values and permissible values for an industrial site.

#### 4.1.1 Results of Analysis of soil/solid material sampled at 0-20 cm depth

**Table 6.** Results of analysis of Total PCB and sum of congeners in soil/solid material sampled at 0-20 cm depth

| RESULTS OF SOIL/SOLID MATERIAL ANALYSIS |              |      |                    |                     |                           |                                     |                                                            |
|-----------------------------------------|--------------|------|--------------------|---------------------|---------------------------|-------------------------------------|------------------------------------------------------------|
| Date of sampling                        |              |      | 01-02.10.2019.     |                     | Target level**<br>(mg/kg) | Intervention<br>Level***<br>(mg/kg) | Permissible<br>level for<br>industrial area<br>(mg/kg)**** |
| Depth of sampling                       |              |      | 0-20 cm            |                     |                           |                                     |                                                            |
| Parameter                               |              |      | Total PCB          | Σ7PCB<br>congeners* |                           |                                     |                                                            |
| N <sub>0</sub>                          | Sample<br>ID | Zone | Results<br>(mg/kg) | Results<br>(mg/kg)  |                           |                                     |                                                            |
| 1.                                      | 407/11       | 1    | 94±9               | 22±3                | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 2.                                      | 408/11       | 2    | 147±14             | 32±4                | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 3.                                      | 409/11       | 3    | 212±21             | 48±5                | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 4.                                      | 410/11       | 4    | 70±7               | 17±2                | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 5.                                      | 411/11       | 5    | 66±6               | 14±2                | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 6.                                      | 413/11       | 6    | 81±8               | 18±2                | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 7.                                      | 415/11       | 7    | 97±10              | 19±2                | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 8.                                      | 417/11       | 8    | 26±3               | 4.9±0.5             | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 9.                                      | 419/11       | 9    | 85.0±8.4           | 19±2                | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 10.                                     | 421/11       | 10   | 39±4               | 6.8±0.6             | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 11.                                     | 423/11       | 11   | 127±12             | 23±3                | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 12.                                     | 425/11       | 12   | 665±65             | 150±21              | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 13.                                     | 427/11       | 13   | 10±1               | 2.2±0.3             | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 14.                                     | 429/11       | 14   | 70±7               | 14±2                | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |

|     |        |    |              |          |                   |                  |    |
|-----|--------|----|--------------|----------|-------------------|------------------|----|
| 15. | 431/11 | 15 | 1432.0±140.8 | 397±57   | 0.04 <sup>a</sup> | 2.1 <sup>a</sup> | 33 |
| 16. | 433/11 | 16 | 1216±120     | 256±37   | 0.04 <sup>a</sup> | 2.1 <sup>a</sup> | 33 |
| 17. | 435/11 | 17 | 377±37       | 54±8     | 0.04 <sup>a</sup> | 2.1 <sup>a</sup> | 33 |
| 18. | 437/11 | 18 | 687±68       | 128±18   | 0.04 <sup>a</sup> | 2.1 <sup>a</sup> | 33 |
| 19. | 439/11 | 19 | 5.7±0.6      | 0.9±0.1  | 0.04 <sup>a</sup> | 2.1 <sup>a</sup> | 33 |
| 20. | 441/11 | 20 | 404±40       | 58±8     | 0.04 <sup>a</sup> | 2.1 <sup>a</sup> | 33 |
| 21. | 443/11 | 21 | 6155±605     | 1234±176 | 0.04 <sup>a</sup> | 2.1 <sup>a</sup> | 33 |
| 22. | 444/11 | 22 | 2992±294     | 628±90   | 0.04 <sup>a</sup> | 2.1 <sup>a</sup> | 33 |
| 23. | 445/11 | 23 | 2857±281     | 586±84   | 0.04 <sup>a</sup> | 2.1 <sup>a</sup> | 33 |
| 24. | 446/11 | 24 | 2244±221     | 495±71   | 0.04 <sup>a</sup> | 2.1 <sup>a</sup> | 33 |
| 25. | 447/11 | 25 | 4809±473     | 1014±145 | 0.04 <sup>a</sup> | 2.1 <sup>a</sup> | 33 |
| 26. | 448/11 | 26 | 4245±417     | 919±131  | 0.04 <sup>a</sup> | 2.1 <sup>a</sup> | 33 |
| 27. | 449/11 | 27 | 4213±414     | 850±122  | 0.04 <sup>a</sup> | 2.1 <sup>a</sup> | 33 |
| 28. | 505/11 | 28 | 1507±148     | 335±48   | 0.04 <sup>a</sup> | 2.1 <sup>a</sup> | 33 |

\*Σ7PCB= 28, 52, 101, 118, 138, 153 and 180

\*\*Dutch Target and Intervention Values, 2000 (the New Dutch List)

\*\*\*Dutch Ministry of Housing, Land Planning and Environment, 2009

\*\*\*\*UNIDO "POPs Contaminated Site Investigation and Management Toolkit"

<sup>a</sup>-Intervention and target level corrected on average content of organic matter (21%) in soil

**Table 7.** Results of analysis of single PCB congeners in soil/solid material sampled at 0-20 cm depth

| RESULTS OF SOIL/SOLID MATERIAL ANALYSIS |           |      |                       |             |           |             |           |           |           |           |           |           |           |
|-----------------------------------------|-----------|------|-----------------------|-------------|-----------|-------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Date of sampling                        |           |      | 01-02.10.2019.        |             |           |             |           |           |           |           |           |           |           |
| Depth of sampling                       |           |      | 0-20 cm               |             |           |             |           |           |           |           |           |           |           |
| Parameter                               |           |      | PCB congeners (mg/kg) |             |           |             |           |           |           |           |           |           |           |
| N <sub>0</sub>                          | Sample ID | Zone | PCB 18                | PCB 28 & 31 | PCB 52    | PCB 44      | PCB 101   | PCB 149   | PCB 118   | PCB 153   | PCB 138   | PCB 180   | PCB 194   |
| 1.                                      | 407/11    | 1    | <0.002                | <0.002      | 0.25±0.03 | 0.13±0.02   | 3.0±0.3   | 2.9±0.3   | 3.9±0.4   | 5.5±0.5   | 6.2±0.6   | 3.3±0.5   | 0.76±0.11 |
| 2.                                      | 408/11    | 2    | <0.002                | <0.002      | 0.43±0.05 | 0.35±0.04   | 4.8±0.5   | 4.7±0.5   | 5.6±0.6   | 8.0±0.8   | 8.7±0.8   | 4.7±0.7   | 0.94±0.13 |
| 3.                                      | 409/11    | 3    | <0.002                | <0.002      | 0.78±0.10 | 0.56±0.07   | 7.5±0.8   | 6.0±0.6   | 9.1±0.9   | 12±1      | 13±1      | 6.6±1.0   | 1.5±0.2   |
| 4.                                      | 410/11    | 4    | <0.002                | <0.002      | 0.23±0.03 | 0.17±0.02   | 2.5±0.3   | 2.2±0.2   | 3.2±0.3   | 4.0±0.4   | 4.5±0.4   | 2.3±0.4   | 0.52±0.07 |
| 5.                                      | 411/11    | 5    | <0.002                | <0.002      | 0.16±0.02 | 0.17±0.02   | 2.3±0.2   | 2.4±0.2   | 2.4±0.2   | 3.6±0.4   | 4.0±0.4   | 2.0±0.3   | 0.46±0.07 |
| 6.                                      | 413/11    | 6    | <0.002                | <0.002      | 0.48±0.06 | 0.29±0.03   | 3.2±0.3   | 2.8±0.3   | 3.1±0.3   | 4.3±0.4   | 4.8±0.4   | 2.4±0.4   | 0.53±0.08 |
| 7.                                      | 415/11    | 7    | 0.010±0.001           | 0.08±0.01   | 0.74±0.09 | 0.43±0.05   | 3.3±0.4   | 2.6±0.3   | 3.2±0.3   | 4.3±0.4   | 4.7±0.4   | 2.4±0.4   | 0.52±0.07 |
| 8.                                      | 417/11    | 8    | <0.002                | <0.002      | 0.14±0.02 | 0.09±0.01   | 0.80±0.09 | 0.61±0.06 | 0.89±0.09 | 1.2±0.1   | 1.3±0.1   | 0.68±0.10 | 0.15±0.02 |
| 9.                                      | 419/11    | 9    | <0.002                | 0.70±0.08   | 0.64±0.08 | 0.49±0.06   | 3.1±0.3   | 2.6±0.3   | 3.0±0.3   | 4.3±0.4   | 4.8±0.4   | 2.5±0.4   | 0.54±0.08 |
| 10.                                     | 421/11    | 10   | <0.002                | 0.24±0.03   | 0.23±0.03 | 0.14±0.02   | 1.1±0.1   | 0.91±0.09 | 1.1±0.1   | 1.6±0.2   | 1.7±0.2   | 1.0±0.1   | 0.21±0.03 |
| 11.                                     | 423/11    | 11   | 0.08±0.01             | 0.90±0.10   | 0.77±0.09 | 0.50±0.06   | 3.8±0.4   | 2.8±0.3   | 3.5±0.3   | 5.1±0.5   | 5.7±0.5   | 3.1±0.5   | 0.67±0.10 |
| 12.                                     | 425/11    | 12   | 3.1±0.4               | 6.2±0.7     | 7.0±0.9   | 5.1±0.6     | 26±3      | 18±2      | 22±2      | 35±3      | 34±3      | 19±3      | 3.7±0.5   |
| 13.                                     | 427/11    | 13   | 0.020±0.002           | 0.08±0.01   | 0.07±0.01 | 0.040±0.005 | 0.31±0.03 | 0.35±0.04 | 0.27±0.03 | 0.82±0.08 | 0.54±0.05 | 0.11±0.02 | 0.06±0.01 |
| 14.                                     | 429/11    | 14   | 0.09±0.01             | 0.50±0.06   | 0.65±0.08 | 0.39±0.05   | 2.6±0.3   | 2.2±0.2   | 2.3±0.2   | 3.2±0.3   | 3.5±0.3   | 1.8±0.3   | 0.35±0.05 |

|     |        |    |           |         |           |           |           |           |           |           |           |           |             |
|-----|--------|----|-----------|---------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-------------|
| 15. | 431/11 | 15 | <0.002    | 31±3    | 23±3      | 14±2      | 79±9      | 56±6      | 57±6      | 85±8      | 91±8      | 41±6      | 7.9±1.1     |
| 16. | 433/11 | 16 | 1.5±0.2   | 7.5±0.9 | 12±1      | 7.4±0.9   | 53±6      | 38±4      | 40±4      | 57±6      | 61±6      | 27±4      | 5.0±0.7     |
| 17. | 435/11 | 17 | <0.002    | 1.1±0.1 | 3.3±0.4   | 2.2±0.3   | 10±1      | 7.5±0.8   | 7.8±0.8   | 12±1      | 13±1      | 7.1±1.1   | 1.6±0.2     |
| 18. | 437/11 | 18 | <0.002    | 1.4±0.2 | 9.8±1.2   | 4.9±0.6   | 24±3      | 19±2      | 15±2      | 29±3      | 31±3      | 18±3      | 3.5±0.5     |
| 19. | 439/11 | 19 | <0.002    | <0.002  | 0.05±0.01 | 0.09±0.01 | 0.17±0.02 | 0.16±0.02 | 0.13±0.01 | 0.22±0.02 | 0.24±0.02 | 0.10±0.02 | 0.010±0.001 |
| 20. | 441/11 | 20 | 0.07±0.01 | 1.2±0.1 | 3.5±0.4   | 2.0±0.2   | 11±1      | 6.4±0.6   | 9.1±0.9   | 13±1      | 13±1      | 7.5±1.1   | 1.7±0.2     |
| 21. | 443/11 | 21 | 0.35±0.04 | 6.3±0.7 | 134±16    | 72±8      | 287±31    | 145±15    | 222±22    | 239±24    | 254±23    | 93±14     | 17±2        |
| 22. | 444/11 | 22 | 0.89±0.11 | 3.6±0.4 | 66±8      | 29±3      | 152±17    | 88±9      | 95±9      | 125±12    | 131±12    | 55±8      | 10±1        |
| 23. | 445/11 | 23 | 0.12±0.01 | 2.2±0.3 | 43±5      | 27±3      | 133±14    | 85±9      | 98±10     | 119±12    | 132±12    | 57±9      | 11±2        |
| 24. | 446/11 | 24 | 0.12±0.01 | 4.6±0.5 | 34±4      | 18±2      | 109±12    | 61±6      | 85±8      | 102±10    | 108±10    | 53±8      | 11±2        |
| 25. | 447/11 | 25 | 0.20±0.02 | 6.4±0.7 | 82±10     | 41±5      | 236±26    | 127±13    | 163±16    | 202±20    | 225±21    | 99±15     | 20±3        |
| 26. | 448/11 | 26 | 0.14±0.02 | 3.0±0.3 | 60±7      | 33±4      | 197±21    | 142±14    | 138±14    | 201±20    | 211±19    | 109±16    | 22±3        |
| 27. | 449/11 | 27 | 0.26±0.03 | 5.4±0.6 | 69±8      | 37±4      | 198±22    | 121±12    | 143±14    | 168±17    | 188±17    | 80±12     | 16±2        |
| 28. | 505/11 | 28 | <0.002    | <0.002  | 21±3      | 9.4±1.1   | 70±8      | 63±6      | 38±4      | 77±8      | 78±7      | 51±8      | 10±1        |

**DATA INTERPRETATION**  
(soil sampled at a depth of 0-20 cm)

Result of chemical analysis for soil sample (sample ID 407/11) sampled from 0-20 cm depth in Zone 1 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma 7$ PCB congeners is above of target and intervention level.

Result of chemical analysis for soil sample (sample ID 407/11) sampled from 0-20 cm depth in Zone 1 observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil sample (sample ID 408/11) sampled from 0-20 cm depth in Zone 2 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma 7$ PCB congeners is above of target and intervention level.

Result of chemical analysis for soil sample (sample ID 408/11) sampled from 0-20 cm depth in Zone 2 observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil sample (sample ID 409/11) sampled from 0-20 cm depth in Zone 3 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma 7$ PCB congeners is above of target and intervention level.

Result of chemical analysis for soil sample (sample ID 409/11) sampled from 0-20 cm depth in Zone 3 observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil sample (sample ID 410/11) sampled from 0-20 cm depth in Zone 4 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma 7$ PCB congeners is above of target and intervention level.

Result of chemical analysis for soil sample (sample ID 410/11) sampled from 0-20 cm depth in Zone 4 observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil sample (sample ID 411/11) sampled from 0-20 cm depth in Zone 5 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma 7$ PCB congeners is above of target and intervention level.

Result of chemical analysis for soil sample (sample ID 411/11) sampled from 0-20 cm depth in Zone 5 observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil sample (sample ID 413/11) sampled from 0-20 cm depth in Zone 6 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil sample (sample ID 413/11) sampled from 0-20 cm depth in Zone 6 observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil sample (sample ID 415/11) sampled from 0-20 cm depth in Zone 7 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil sample (sample ID 415/11) sampled from 0-20 cm depth in Zone 7 observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil sample (sample ID 417/11) sampled from 0-20 cm depth in Zone 8 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil sample (sample ID 417/11) sampled from 0-20 cm depth in Zone 8 observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil sample (sample ID 419/11) sampled from 0-20 cm depth in Zone 9 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil sample (sample ID 419/11) sampled from 0-20 cm depth in Zone 9 observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil sample (sample ID 421/11) sampled from 0-20 cm depth in Zone 10 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil sample (sample ID 421/11) sampled from 0-20 cm depth in Zone 10 observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil sample (sample ID 423/11) sampled from 0-20 cm depth in Zone 11 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil sample (sample ID 423/11) sampled from 0-20 cm depth in Zone 11 observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil sample (sample ID 425/11) sampled from 0-20 cm depth in Zone 12 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil sample (sample ID 425/11) sampled from 0-20 cm depth in Zone 12 observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil sample (sample ID 427/11) sampled from 0-20 cm depth in Zone 13 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma$ 7PCB congeners is below of target and intervention level.

Result of chemical analysis for soil sample (sample ID 427/11) sampled from 0-20 cm depth in Zone 13 observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil sample (sample ID 429/11) sampled from 0-20 cm depth in Zone 14 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil sample (sample ID 429/11) sampled from 0-20 cm depth in Zone 14 observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil sample (sample ID 431/11) sampled from 0-20 cm depth in Zone 15 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil sample (sample ID 431/11) sampled from 0-20 cm depth in Zone 15 observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil sample (sample ID 433/11) sampled from 0-20 cm depth in Zone 16 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil sample (sample ID 433/11) sampled from 0-20 cm depth in Zone 16 observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil sample (sample ID 435/11) sampled from 0-20 cm depth in Zone 17 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil sample (sample ID 435/11) sampled from 0-20 cm depth in Zone 17 observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 437/11) sampled from 0-20 cm depth in Zone 18 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 437/11) sampled from 0-20 cm depth in Zone 18 observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil sample (sample ID 439/11) sampled from 0-20 cm depth in Zone 19 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma$ 7PCB congeners is below of target and intervention level.

Result of chemical analysis for soil sample (sample ID 439/11) sampled from 0-20 cm depth in Zone 19 observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil sample (sample ID 441/11) sampled from 0-20 cm depth in Zone 20 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil sample (sample ID 441/11) sampled from 0-20 cm depth in Zone 20 observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 443/11) sampled from 0-20 cm depth in Zone 21 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 443/11) sampled from 0-20 cm depth in Zone 21 observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 444/11) sampled from 0-20 cm depth in Zone 22 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 444/11) sampled from 0-20 cm depth in Zone 22 observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 445/11) sampled from 0-20 cm depth in Zone 23 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 445/11) sampled from 0-20 cm depth in Zone 23 observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 446/11) sampled from 0-20 cm depth in Zone 24 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 446/11) sampled from 0-20 cm depth in Zone 24 observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 447/11) sampled from 0-20 cm depth in Zone 25 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 447/11) sampled from 0-20 cm depth in Zone 25 observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 448/11) sampled from 0-20 cm depth in Zone 26 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma 7\text{PCB}$  congeners is above of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 448/11) sampled from 0-20 cm depth in Zone 26 observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 449/11) sampled from 0-20 cm depth in Zone 27 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma 7\text{PCB}$  congeners is above of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 449/11) sampled from 0-20 cm depth in Zone 27 observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 505/11) sampled from 0-20 cm depth in Zone 28 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma 7\text{PCB}$  congeners is above of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 505/11) sampled from 0-20 cm depth in Zone 28 observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is above of permissible level for industrial area.

#### 4.1.2 Results of Analysis of soil/solid material sampled at 20-40 cm depth

**Table 8.** Results of analysis of Total PCB and sum of congeners in soil sampled at 20-40 cm depth

| RESULTS OF SOIL ANALYSIS |              |      |                    |                     |                           |                                     |                                                            |
|--------------------------|--------------|------|--------------------|---------------------|---------------------------|-------------------------------------|------------------------------------------------------------|
| Date of sampling         |              |      | 01-02.10.2019.     |                     | Target level**<br>(mg/kg) | Intervention<br>Level***<br>(mg/kg) | Permissible<br>level for<br>industrial area<br>(mg/kg)**** |
| Depth of sampling        |              |      | 20-40 cm           |                     |                           |                                     |                                                            |
| Parameter                |              |      | Total PCB          | Σ7PCB<br>congeners* |                           |                                     |                                                            |
| N <sub>0</sub>           | Sample<br>ID | Zone | Results<br>(mg/kg) | Results<br>(mg/kg)  |                           |                                     |                                                            |
| 1.                       | 412/11       | 5    | 12±1               | 2.3±0.3             | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 2.                       | 414/11       | 6    | 47±5               | 6.0±0.7             | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 3.                       | 416/11       | 7    | 79±8               | 19±2                | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 4.                       | 418/11       | 8    | 31±3               | 6.4±0.8             | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 5.                       | 420/11       | 9    | 25±2               | 5.2±0.6             | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 6.                       | 422/11       | 10   | 24±2               | 5.7±0.6             | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 7.                       | 424/11       | 11   | 53±5               | 9.9±1.0             | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 8.                       | 426/11       | 12   | 259±25             | 33±3                | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 9.                       | 428/11       | 13   | 2.9±0.3            | 0.6±0.1             | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 10.                      | 430/11       | 14   | 30±3               | 6.4±0.6             | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 11.                      | 432/11       | 15   | 402±40             | 85±13               | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 12.                      | 434/11       | 16   | 1338±132           | 314±45              | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 13.                      | 436/11       | 17   | 78±8               | 16±2                | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 14.                      | 438/11       | 18   | 1238±122           | 279±40              | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 15.                      | 440/11       | 19   | 1.0±0.1            | 0.20±0.03           | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 16.                      | 442/11       | 20   | 74±7               | 11±2                | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |

\*Σ7PCB= 28, 52, 101, 118, 138, 153 and 180

\*\*Dutch Target and Intervention Values, 2000 (the New Dutch List)

\*\*\*Dutch Ministry of Housing, Land Planning and Environment, 2009

\*\*\*\*UNIDO “POPs Contaminated Site Investigation and Management Toolkit”

<sup>a</sup>-Intervention and target level corrected on average content of organic matter (21%) in soil

**Table 9.** Results of analysis of single PCB congeners in soil sampled at 20-40cm depth

| RESULTS OF SOIL ANALYSIS |           |      |                       |            |             |             |           |           |           |           |           |           |             |
|--------------------------|-----------|------|-----------------------|------------|-------------|-------------|-----------|-----------|-----------|-----------|-----------|-----------|-------------|
| Date of sampling         |           |      | 01.10.2019.           |            |             |             |           |           |           |           |           |           |             |
| Depth of sampling        |           |      | 20-40 cm              |            |             |             |           |           |           |           |           |           |             |
| Parameter                |           |      | PCB congeners (mg/kg) |            |             |             |           |           |           |           |           |           |             |
| N <sub>0</sub>           | Sample ID | Zone | PCB 18                | PCB 28 &31 | PCB 52      | PCB 44      | PCB 101   | PCB 149   | PCB 118   | PCB 153   | PCB 138   | PCB 180   | PCB 194     |
| 1.                       | 412/11    | 5    | <0.002                | <0.002     | 0.040±0.005 | 0.030±0.004 | 0.36±0.04 | 0.28±0.03 | 0.45±0.04 | 0.55±0.05 | 0.62±0.06 | 0.32±0.05 | 0.070±0.010 |
| 2.                       | 414/11    | 6    | <0.002                | 0.08±0.01  | 0.19±0.02   | 0.09±0.01   | 1.1±0.1   | 0.9±0.1   | 0.9±0.1   | 1.4±0.1   | 1.5±0.1   | 0.8±0.1   | 0.17±0.02   |
| 3.                       | 416/11    | 7    | 0.020±0.002           | 0.20±0.02  | 0.74±0.09   | 0.25±0.03   | 3.3±0.4   | 2.5±0.3   | 3.1±0.3   | 4.4±0.4   | 4.7±0.4   | 2.3±0.3   | 0.53±0.08   |
| 4.                       | 418/11    | 8    | <0.002                | 0.24±0.03  | 0.20±0.02   | 0.12±0.01   | 1.1±0.1   | 0.71±0.07 | 1.1±0.1   | 1.4±0.1   | 1.6±0.1   | 0.81±0.12 | 0.18±0.03   |
| 5.                       | 420/11    | 9    | <0.002                | 0.18±0.02  | 0.18±0.02   | 0.11±0.01   | 0.87±0.09 | 0.72±0.07 | 0.82±0.08 | 1.2±0.1   | 1.3±0.1   | 0.71±0.11 | 0.15±0.02   |
| 6.                       | 422/11    | 10   | <0.002                | 0.20±0.02  | 0.19±0.02   | 0.12±0.01   | 0.91±0.10 | 0.68±0.07 | 0.89±0.09 | 1.3±0.1   | 1.4±0.1   | 0.79±0.12 | 0.17±0.02   |
| 7.                       | 424/11    | 11   | 0.040±0.005           | 0.32±0.04  | 0.29±0.04   | 0.21±0.02   | 1.5±0.2   | 1.3±0.1   | 1.5±0.2   | 2.3±0.2   | 2.5±0.2   | 1.5±0.2   | 0.33±0.05   |
| 8.                       | 426/11    | 12   | 0.19±0.02             | 1.3±0.1    | 1.4±0.2     | 0.96±0.11   | 5.1±0.6   | 4.7±0.5   | 3.8±0.4   | 7.9±0.8   | 7.9±0.7   | 5.2±0.8   | 1.2±0.2     |
| 9.                       | 428/11    | 13   | <0.002                | <0.002     | 0.030±0.004 | 0.010±0.001 | 0.10±0.01 | 0.08±0.01 | 0.10±0.01 | 0.15±0.01 | 0.16±0.01 | 0.09±0.01 | 0.020±0.003 |
| 10.                      | 430/11    | 14   | 0.040±0.005           | 0.22±0.02  | 0.26±0.03   | 0.16±0.02   | 1.1±0.1   | 0.90±0.09 | 0.91±0.09 | 1.5±0.1   | 1.6±0.1   | 0.86±0.13 | 0.18±0.03   |
| 11.                      | 432/11    | 15   | <0.002                | 2.5±0.3    | 3.6±0.4     | 2.5±0.3     | 15.1±1.6  | 12±1      | 13±1      | 20±2      | 20±2      | 11±2      | 2.1±0.3     |
| 12.                      | 434/11    | 16   | 0.80±0.10             | 9.7±1.1    | 22±3        | 12±1        | 62±7      | 39±4      | 44±4      | 64±6      | 67±6      | 49±7      | 6.9±1.0     |

|     |        |    |             |           |             |             |             |             |             |             |             |             |             |
|-----|--------|----|-------------|-----------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| 13. | 436/11 | 17 | 0.020±0.002 | 0.12±0.01 | 0.84±0.10   | 0.55±0.06   | 3.3±0.4     | 2.1±0.2     | 2.6±0.3     | 3.7±0.4     | 3.9±0.4     | 1.9±0.3     | 0.39±0.06   |
| 14. | 438/11 | 18 | 0.09±0.01   | 0.74±0.08 | 20.7±2.5    | 12.2±1.4    | 59.0±6.4    | 42.0±4.2    | 39.3±3.9    | 62.1±6.1    | 63.0±5.7    | 34.0±5.1    | 6.6±0.9     |
| 15. | 440/11 | 19 | <0.002      | <0.002    | 0.020±0.002 | 0.010±0.001 | 0.040±0.004 | 0.030±0.003 | 0.030±0.003 | 0.050±0.005 | 0.060±0.005 | 0.030±0.005 | 0.010±0.001 |
| 16. | 442/11 | 20 | 0.030±0.004 | 0.16±0.02 | 0.58±0.07   | 0.31±0.04   | 2.1±0.2     | 1.4±0.1     | 1.7±0.2     | 2.4±0.2     | 2.6±0.2     | 1.3±0.2     | 0.29±0.04   |

**DATA INTERPRETATION**  
(soil sampled at a depth of 20-40 cm)

Result of chemical analysis for soil sample (sample ID 412/11) sampled from 20-40 cm depth in Zone 5 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma 7$ PCB congeners is below of target and intervention level.

Result of chemical analysis for soil sample (sample ID 412/11) sampled from 20-40 cm depth in Zone 5 observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil sample (sample ID 414/11) sampled from 20-40 cm depth in Zone 6 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma 7$ PCB congeners is above of target and intervention level.

Result of chemical analysis for soil sample (sample ID 414/11) sampled from 20-40 cm depth in Zone 6 observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil sample (sample ID 416/11) sampled from 20-40 cm depth in Zone 7 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma 7$ PCB congeners is above of target and intervention level.

Result of chemical analysis for soil sample (sample ID 416/11) sampled from 20-40 cm depth in Zone 7 observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil sample (sample ID 418/11) sampled from 20-40 cm depth in Zone 8 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma 7$ PCB congeners is above of target and intervention level.

Result of chemical analysis for soil sample (sample ID 418/11) sampled from 20-40 cm depth in Zone 8 observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil sample (sample ID 420/11) sampled from 20-40 cm depth in Zone 9 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma 7$ PCB congeners is above of target and intervention level.

Result of chemical analysis for soil sample (sample ID 420/11) sampled from 20-40 cm depth in Zone 9 observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil sample (sample ID 422/11) sampled from 20-40 cm depth in Zone 10 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil sample (sample ID 422/11) sampled from 20-40 cm depth in Zone 10 observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil sample (sample ID 424/11) sampled from 20-40 cm depth in Zone 11 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil sample (sample ID 424/11) sampled from 20-40 cm depth in Zone 11 observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil sample (sample ID 426/11) sampled from 20-40 cm depth in Zone 12 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil sample (sample ID 426/11) sampled from 20-40 cm depth in Zone 12 observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil sample (sample ID 428/11) sampled from 20-40 cm depth in Zone 13 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma$ 7PCB congeners is below of target and intervention level.

Result of chemical analysis for soil sample (sample ID 428/11) sampled from 20-40 cm depth in Zone 13 observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil sample (sample ID 430/11) sampled from 20-40 cm depth in Zone 14 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil sample (sample ID 430/11) sampled from 20-40 cm depth in Zone 14 observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil sample (sample ID 432/11) sampled from 20-40 cm depth in Zone 15 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma 7$ PCB congeners is above of target and intervention level.

Result of chemical analysis for soil sample (sample ID 432/11) sampled from 20-40 cm depth in Zone 15 observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil sample (sample ID 434/11) sampled from 20-40 cm depth in Zone 16 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma 7$ PCB congeners is above of target and intervention level.

Result of chemical analysis for soil sample (sample ID 434/11) sampled from 20-40 cm depth in Zone 16 observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil sample (sample ID 436/11) sampled from 20-40 cm depth in Zone 17 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma 7$ PCB congeners is above of target and intervention level.

Result of chemical analysis for soil sample (sample ID 436/11) sampled from 20-40 cm depth in Zone 17 observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil sample (sample ID 438/11) sampled from 20-40 cm depth in Zone 18 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma 7$ PCB congeners is above of target and intervention level.

Result of chemical analysis for soil sample (sample ID 438/11) sampled from 20-40 cm depth in Zone 18 observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil sample (sample ID 440/11) sampled from 20-40 cm depth in Zone 19 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma 7$ PCB congeners is below of target and intervention level.

Result of chemical analysis for soil sample (sample ID 440/11) sampled from 20-40 cm depth in Zone 19 observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil sample (sample ID 442/11) sampled from 20-40 cm depth in Zone 20 observed in relation to the Dutch soil standard, indicate that the content of  $\Sigma 7$ PCB congeners is above of target and intervention level.

Result of chemical analysis for soil sample (sample ID 442/11) sampled from 20-40 cm depth in Zone 20 observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is above of permissible level for industrial area.

#### 4.1.3 Review of the results of PCB analysis in soil samples by zones

**Table 10.** Review of the results of PCB analysis in soil/solid material samples by zones

| No. | Zone | Depth of sampling | Sample ID | Total PCB (mg/kg) | $\Sigma$ 7PCB congeners* (mg/kg) |
|-----|------|-------------------|-----------|-------------------|----------------------------------|
| 1.  | 1    | 0-20 cm           | 407/11    | 94                | 22                               |
| 2.  | 2    | 0-20 cm           | 408/11    | 147               | 32                               |
| 3.  | 3    | 0-20 cm           | 409/11    | 212               | 48                               |
| 4.  | 4    | 0-20 cm           | 410/11    | 70                | 17                               |
| 5.  | 5    | 0-20 cm           | 411/11    | 66                | 14                               |
| 6.  |      | 20-40 cm          | 412/11    | 12                | 2.3                              |
| 7.  | 6    | 0-20 cm           | 413/11    | 81                | 18                               |
| 8.  |      | 20-40 cm          | 414/11    | 47                | 6.0                              |
| 9.  | 7    | 0-20 cm           | 415/11    | 97                | 19                               |
| 10. |      | 20-40 cm          | 416/11    | 79                | 19                               |
| 11. | 8    | 0-20 cm           | 417/11    | 26                | 4.9                              |
| 12. |      | 20-40 cm          | 418/11    | 31                | 6.4                              |
| 13. | 9    | 0-20 cm           | 419/11    | 85                | 19                               |
| 14. |      | 20-40 cm          | 420/11    | 25                | 5.2                              |
| 15. | 10   | 0-20 cm           | 421/11    | 39                | 6.8                              |
| 16. |      | 20-40 cm          | 422/11    | 24                | 5.7                              |
| 17. | 11   | 0-20 cm           | 423/11    | 127               | 23                               |
| 18. |      | 20-40 cm          | 424/11    | 53                | 9.9                              |
| 19. | 12   | 0-20 cm           | 425/11    | 665               | 150                              |
| 20. |      | 20-40 cm          | 426/11    | 259               | 33                               |
| 21. | 13   | 0-20 cm           | 427/11    | 10                | 2.2                              |
| 22. |      | 20-40 cm          | 428/11    | 2,9               | 0.6                              |
| 23. | 14   | 0-20 cm           | 429/11    | 70                | 14.5                             |
| 24. |      | 20-40 cm          | 430/11    | 30                | 6.4                              |
| 25. | 15   | 0-20 cm           | 431/11    | 1432              | 397                              |
| 26. |      | 20-40 cm          | 432/11    | 402               | 85                               |

REPORT No. 00-1659/1

|     |    |          |        |      |      |
|-----|----|----------|--------|------|------|
| 27. | 16 | 0-20 cm  | 433/11 | 1216 | 256  |
| 28. |    | 20-40 cm | 434/11 | 1338 | 314  |
| 29. | 17 | 0-20 cm  | 435/11 | 377  | 54   |
| 30. |    | 20-40 cm | 436/11 | 78   | 16   |
| 31. | 18 | 0-20 cm  | 437/11 | 687  | 128  |
| 32. |    | 20-40 cm | 438/11 | 1298 | 279  |
| 33. | 19 | 0-20 cm  | 439/11 | 5,7  | 0.9  |
| 34. |    | 20-40 cm | 440/11 | 1,0  | 0.2  |
| 35. | 20 | 0-20 cm  | 441/11 | 404  | 58   |
| 36. |    | 20-40 cm | 442/11 | 74   | 11   |
| 37. | 21 | 0-20 cm  | 443/11 | 6155 | 1234 |
| 38. | 22 | 0-20 cm  | 444/11 | 2992 | 628  |
| 39. | 23 | 0-20 cm  | 445/11 | 2857 | 586  |
| 40. | 24 | 0-20 cm  | 446/11 | 2244 | 495  |
| 41. | 25 | 0-20 cm  | 447/11 | 4809 | 1014 |
| 42. | 26 | 0-20 cm  | 448/11 | 4245 | 919  |
| 43. | 27 | 0-20 cm  | 449/11 | 4213 | 850  |
| 44. | 28 | 0-20 cm  | 505/11 | 1507 | 335  |

\*Σ7PCB= 28, 52, 101, 118, 138, 153 and 180

**4.1.4 Review of the results analysis of Dioxin-like PCBs congeners in soil/solid material samples with highest concentration of PCB**

**Table 11.** Review of the results analysis of Dioxin-like PCBs congeners in soil/solid material samples with highest concentration of PCB

| RESULTS OF SOIL/SOLID MATERIAL ANALYSIS |           |      |                   |                                   |        |         |         |         |         |         |         |         |
|-----------------------------------------|-----------|------|-------------------|-----------------------------------|--------|---------|---------|---------|---------|---------|---------|---------|
| Date of sampling                        |           |      |                   | 01.10.2019.                       |        |         |         |         |         |         |         |         |
| Parameter                               |           |      |                   | Dioxin-like PCB congeners (mg/kg) |        |         |         |         |         |         |         |         |
| N <sub>0</sub>                          | Sample ID | Zone | Depth of sampling | PCB 81                            | PCB 77 | PCB 123 | PCB 105 | PCB 126 | PCB 167 | PCB 157 | PCB 169 | PCB 189 |
| 1.                                      | 431/11    | 15   | 0-20 cm           | 1.6                               | 8.0    | 9.6     | 28      | 1.5     | 6.6     | 3.1     | 0.10    | 36      |
| 2.                                      | 433/11    | 16   | 0-20 cm           | 0.94                              | 4.9    | 5.9     | 16      | 1.1     | 3.9     | 1.7     | 0.07    | 20      |
| 3.                                      | 434/11    | 16   | 20-40 cm          | 1.0                               | 0.92   | 4.7     | 15      | 0.21    | 2.4     | 1.3     | 0.01    | 26      |
| 4.                                      | 438/11    | 18   | 20-40 cm          | 0.10                              | 0.09   | 0.55    | 1.8     | 0.24    | 0.31    | 0.13    | <0.002  | 3.1     |
| 5.                                      | 443/11    | 21   | 0-20 cm           | 6.3                               | 3.8    | 28      | 93      | 1.3     | 14      | 6.8     | 0.03    | 84      |
| 6.                                      | 444/11    | 22   | 0-20 cm           | 1.8                               | 2.9    | 10      | 24      | 0.88    | 4.5     | 2.6     | 0.06    | 32      |
| 7.                                      | 445/11    | 23   | 0-20 cm           | 2.0                               | 1.4    | 7.9     | 27      | 0.50    | 4.7     | 2.1     | 0.02    | 30      |
| 8.                                      | 446/11    | 24   | 0-20 cm           | 1.3                               | 1.3    | 5.5     | 18      | 0.35    | 3.8     | 1.4     | 0.01    | 22      |
| 9.                                      | 447/11    | 25   | 0-20 cm           | 3.0                               | 1.5    | 13      | 44      | 0.80    | 6.5     | 3.7     | 0.03    | 49      |
| 10.                                     | 448/11    | 26   | 0-20 cm           | 2.7                               | 2.9    | 12      | 37      | 1.3     | 7.8     | 3.3     | 0.04    | 50      |
| 11.                                     | 449/11    | 27   | 0-20 cm           | 2.4                               | 2.4    | 11      | 37      | 1.2     | 6.5     | 2.9     | 0.04    | 36      |

#### 4.1.5 Results of analysis of soil samples sampled in the boreholes with data interpretation

**Table 12.** Results of analysis of Total PCB and sum of congeners in soil/solid material sampled in a borehole drilled in zone 21

| RESULTS OF SOIL/SOLID MATERIAL ANALYSIS IN BOREHOLE |              |                      |                    |                      |                           |                                     |                                                            |
|-----------------------------------------------------|--------------|----------------------|--------------------|----------------------|---------------------------|-------------------------------------|------------------------------------------------------------|
| Date of sampling                                    |              |                      | 15-18.10.2019.     |                      | Target level**<br>(mg/kg) | Intervention<br>Level***<br>(mg/kg) | Permissible<br>level for<br>industrial area<br>(mg/kg)**** |
| Zone                                                |              |                      | 21                 |                      |                           |                                     |                                                            |
| Parameter                                           |              |                      | Total PCB          | Σ 7PCB<br>congeners* |                           |                                     |                                                            |
| N <sub>0</sub>                                      | Sample<br>ID | Depth of<br>sampling | Results<br>(mg/kg) | Results<br>(mg/kg)   |                           |                                     |                                                            |
| 1.                                                  | 500/11       | 0-1m                 | 2643±260           | 575±86               | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 2.                                                  | 501/11       | 1-2m                 | 196±19             | 34±5                 | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 3.                                                  | 502/11       | 2-3m                 | 24±2               | 5.1±0.8              | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 4.                                                  | 503/11       | 3-4m                 | 17±2               | 3.9±0.6              | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 5.                                                  | 504/11       | 4-5m                 | 23±2               | 5.0±0.8              | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 6.                                                  | 506/11       | 5-6m                 | 86±8               | 15±2                 | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 7.                                                  | 507/11       | 6-7m                 | 42±4               | 9.8±1.5              | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 8.                                                  | 543/11       | 7-8m                 | 37±4               | 5.4±0.8              | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 9.                                                  | 544/11       | 8-9m                 | 12.0±1.2           | 2.6±0.4              | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 10.                                                 | 545/11       | 9-10m                | 18±2               | 3.2±0.5              | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 11.                                                 | 546/11       | 10-11m               | 10±1               | 2.1±0.3              | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 12.                                                 | 547/11       | 11-12m               | 22±2               | 3.9±0.6              | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 13.                                                 | 548/11       | 12-13m               | 17±2               | 3.1±0.5              | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 14.                                                 | 549/11       | 13-14m               | 4.2±0.6            | 0.98±0.15            | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 15.                                                 | 550/11       | 14-15m               | 2.8±0.4            | 0.64±0.10            | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 16.                                                 | 551/11       | 15-16m               | 2.7±0.4            | 0.64±0.10            | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |

|     |        |        |         |           |                   |                  |    |
|-----|--------|--------|---------|-----------|-------------------|------------------|----|
| 17. | 552/11 | 16-17m | 2.6±0.4 | 0.61±0.09 | 0.04 <sup>a</sup> | 2.1 <sup>a</sup> | 33 |
| 18. | 553/11 | 17-18m | 1.0±0.1 | 0.22±0.03 | 0.04 <sup>a</sup> | 2.1 <sup>a</sup> | 33 |
| 19. | 554/11 | 18-19m | 11±2    | 2.0±0.3   | 0.04 <sup>a</sup> | 2.1 <sup>a</sup> | 33 |
| 20. | 555/11 | 19-20m | 33±5    | 5.1±0.8   | 0.04 <sup>a</sup> | 2.1 <sup>a</sup> | 33 |
| 21. | 556/11 | 20-21m | 10±1    | 1.8±0.3   | 0.04 <sup>a</sup> | 2.1 <sup>a</sup> | 33 |
| 22. | 557/11 | 21-22m | 8.1±1.2 | 1.5±0.2   | 0.04 <sup>a</sup> | 2.1 <sup>a</sup> | 33 |
| 23. | 558/11 | 22-23m | 12±1    | 2.3±0.4   | 0.04 <sup>a</sup> | 2.1 <sup>a</sup> | 33 |

\*Σ7PCB= 28, 52, 101, 118, 138, 153 and 180

\*\*Dutch Target and Intervention Values, 2000 (the New Dutch List)

\*\*\*Dutch Ministry of Housing, Land Planning and Environment, 2009

\*\*\*\*UNIDO "POPs Contaminated Site Investigation and Management Toolkit"

<sup>a</sup>-Intervention and target level corrected on average content of organic matter (21%) in soil

**Table 13.** Results of analysis of single congeners in soil/solid material sampled in a borehole drilled in zone 21

| RESULTS OF SOIL/SOLID MATERIAL ANALYSIS IN BOREHOLE |           |                   |                       |             |           |           |           |           |           |           |           |           |             |
|-----------------------------------------------------|-----------|-------------------|-----------------------|-------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-------------|
| Date of sampling                                    |           |                   | 15-18.10.2019.        |             |           |           |           |           |           |           |           |           |             |
| Zone                                                |           |                   | 21                    |             |           |           |           |           |           |           |           |           |             |
| Parameter                                           |           |                   | PCB congeners (mg/kg) |             |           |           |           |           |           |           |           |           |             |
| N <sub>0</sub>                                      | Sample ID | Depth of sampling | PCB 18                | PCB 28 & 31 | PCB 52    | PCB 44    | PCB 101   | PCB 149   | PCB 118   | PCB 153   | PCB 138   | PCB 180   | PCB 194     |
| 1.                                                  | 500/11    | 0-1m              | 0.11±0.01             | 7.1±0.8     | 49±6      | 28±3      | 129±14    | 76±8      | 86±9      | 118±12    | 125±11    | 61±9      | 13±2        |
| 2.                                                  | 501/11    | 1-2m              | <0.002                | 0.6±0.1     | 2.5±0.3   | 1.2±0.1   | 5.9±0.6   | 3.7±0.4   | 4.2±0.4   | 11±1      | 6.5±0.6   | 3.6±0.5   | 0.8±0.1     |
| 3.                                                  | 502/11    | 2-3m              | <0.002                | <0.002      | 0.36±0.04 | 0.24±0.03 | 1.0±0.1   | 0.73±0.07 | 0.77±0.08 | 1.2±0.1   | 1.2±0.1   | 0.68±0.10 | 0.13±0.02   |
| 4.                                                  | 503/11    | 3-4m              | <0.002                | 0.12±0.01   | 0.41±0.05 | 0.21±0.02 | 0.73±0.08 | 0.57±0.06 | 0.43±0.04 | 0.88±0.09 | 0.83±0.08 | 0.50±0.08 | 0.09±0.01   |
| 5.                                                  | 504/11    | 4-5m              | <0.002                | 0.10±0.01   | 0.39±0.05 | 0.24±0.03 | 1.0±0.1   | 0.83±0.08 | 0.67±0.07 | 1.1±0.1   | 1.1±0.1   | 0.62±0.09 | 0.12±0.02   |
| 6.                                                  | 506/11    | 5-6m              | <0.002                | 0.32±0.04   | 1.2±0.1   | 0.65±0.08 | 3.2±0.3   | 1.8±0.2   | 2.3±0.2   | 3.1±0.3   | 3.3±0.3   | 1.8±0.3   | 0.37±0.05   |
| 7.                                                  | 507/11    | 6-7m              | <0.002                | 0.19±0.02   | 0.64±0.08 | 0.38±0.04 | 2.1±0.2   | 1.3±0.1   | 1.4±0.1   | 2.1±0.2   | 2.2±0.2   | 1.3±0.2   | 0.22±0.03   |
| 8.                                                  | 543/11    | 7-8m              | <0.002                | 0.14±0.02   | 0.41±0.05 | 0.29±0.03 | 1.1±0.1   | 0.72±0.07 | 0.81±0.08 | 1.1±0.1   | 1.2±0.1   | 0.66±0.10 | 0.14±0.02   |
| 9.                                                  | 544/11    | 8-9m              | <0.002                | 0.060±0.007 | 0.22±0.03 | 0.12±0.01 | 0.58±0.06 | 0.41±0.04 | 0.33±0.03 | 0.54±0.05 | 0.57±0.05 | 0.31±0.05 | 0.060±0.009 |
| 10.                                                 | 545/11    | 9-10m             | <0.002                | 0.060±0.007 | 0.27±0.03 | 0.17±0.02 | 0.72±0.08 | 0.48±0.05 | 0.44±0.04 | 0.67±0.07 | 0.70±0.06 | 0.38±0.06 | 0.08±0.01   |
| 11.                                                 | 546/11    | 10-11m            | <0.002                | 0.040±0.005 | 0.16±0.02 | 0.09±0.01 | 0.44±0.05 | 0.26±0.03 | 0.31±0.03 | 0.44±0.04 | 0.46±0.04 | 0.25±0.04 | 0.050±0.007 |
| 12.                                                 | 547/11    | 11-12m            | <0.002                | 0.070±0.008 | 0.28±0.03 | 0.15±0.02 | 0.81±0.09 | 0.58±0.06 | 0.50±0.05 | 0.84±0.08 | 0.88±0.08 | 0.50±0.08 | 0.11±0.02   |

|     |        |        |             |             |             |             |             |             |             |             |             |             |             |
|-----|--------|--------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| 13. | 548/11 | 12-13m | <0.002      | 0.050±0.006 | 0.22±0.03   | 0.10±0.01   | 0.52±0.06   | 0.46±0.05   | 0.36±0.04   | 0.75±0.07   | 0.72±0.07   | 0.47±0.07   | 0.09±0.01   |
| 14. | 549/11 | 13-14m | <0.002      | 0.020±0.002 | 0.060±0.007 | 0.030±0.004 | 0.18±0.02   | 0.16±0.02   | 0.11±0.01   | 0.24±0.02   | 0.23±0.02   | 0.15±0.02   | 0.030±0.004 |
| 15. | 550/11 | 14-15m | <0.002      | 0.010±0.001 | 0.040±0.005 | 0.020±0.002 | 0.14±0.02   | 0.11±0.01   | 0.080±0.008 | 0.14±0.01   | 0.15±0.01   | 0.08±0.01   | 0.010±0.001 |
| 16. | 551/11 | 15-16m | <0.002      | 0.010±0.001 | 0.050±0.006 | 0.030±0.004 | 0.13±0.01   | 0.080±0.008 | 0.090±0.009 | 0.14±0.01   | 0.14±0.01   | 0.08±0.01   | 0.010±0.001 |
| 17. | 552/11 | 16-17m | 0.020±0.002 | 0.010±0.001 | 0.050±0.006 | 0.020±0.002 | 0.13±0.01   | 0.090±0.009 | 0.080±0.008 | 0.13±0.01   | 0.13±0.01   | 0.07±0.01   | 0.010±0.001 |
| 18. | 553/11 | 17-18m | <0.002      | 0.006±0.001 | 0.020±0.002 | 0.010±0.001 | 0.040±0.004 | 0.040±0.004 | 0.030±0.003 | 0.050±0.005 | 0.050±0.005 | 0.030±0.005 | 0.005±0.001 |
| 19. | 554/11 | 18-19m | <0.002      | 0.030±0.003 | 0.11±0.01   | 0.060±0.007 | 0.38±0.04   | 0.28±0.03   | 0.31±0.03   | 0.43±0.04   | 0.46±0.04   | 0.27±0.04   | 0.050±0.007 |
| 20. | 555/11 | 19-20m | <0.002      | 0.09±0.01   | 0.33±0.04   | 0.19±0.02   | 0.99±0.11   | 0.71±0.07   | 0.70±0.07   | 1.1±0.1     | 1.2±0.1     | 0.69±0.10   | 0.15±0.02   |
| 21. | 556/11 | 20-21m | 0.020±0.002 | 0.030±0.003 | 0.11±0.01   | 0.060±0.007 | 0.34±0.04   | 0.30±0.03   | 0.23±0.02   | 0.42±0.04   | 0.45±0.04   | 0.26±0.04   | 0.060±0.009 |
| 22. | 557/11 | 21-22m | 0.020±0.002 | 0.030±0.003 | 0.09±0.01   | 0.050±0.006 | 0.28±0.03   | 0.27±0.03   | 0.17±0.02   | 0.37±0.04   | 0.38±0.03   | 0.23±0.03   | 0.050±0.007 |
| 23. | 558/11 | 22-23m | 0.030±0.004 | 0.040±0.005 | 0.14±0.02   | 0.09±0.01   | 0.41±0.04   | 0.39±0.04   | 0.28±0.03   | 0.53±0.05   | 0.54±0.05   | 0.35±0.05   | 0.07±0.01   |

**DATA INTERPRETATION**

(soil/solid material sampled in a borehole drilled in zone 21)

Result of chemical analysis for soil sample (sample ID 500/11), sampled from borehole (0-1m depth) in Zone 21, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil sample (sample ID 500/11), sampled from borehole (0-1m depth) in Zone 21, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil sample (sample ID 501/11), sampled from borehole (1-2m depth) in Zone 21, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil sample (sample ID 501/11), sampled from borehole (1-2m depth) in Zone 21, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 502/11), sampled from borehole (2-3m depth) in Zone 21, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 502/11), sampled from borehole (2-3m depth) in Zone 21, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 503/11), sampled from borehole (3-4m depth) in Zone 21, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 503/11), sampled from borehole (3-4m depth) in Zone 21, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 504/11), sampled from borehole (4-5m depth) in Zone 21, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 504/11), sampled from borehole (4-5m depth) in Zone 21, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 506/11), sampled from borehole (5-6m depth) in Zone 21, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma 7$ PCB congeners is above of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 506/11), sampled from borehole (5-6m depth) in Zone 21, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 507/11), sampled from borehole (6-7m depth) in Zone 21, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma 7$ PCB congeners is above of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 507/11), sampled from borehole (6-7m depth) in Zone 21, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 543/11), sampled from borehole (7-8m depth) in Zone 21, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma 7$ PCB congeners is above of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 543/11), sampled from borehole (7-8m depth) in Zone 21, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 544/11), sampled from borehole (8-9m depth) in Zone 21, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma 7$ PCB congeners is above of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 544/11), sampled from borehole (8-9m depth) in Zone 21, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 545/11), sampled from borehole (9-10m depth) in Zone 21, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma 7$ PCB congeners is above of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 545/11), sampled from borehole (9-10m depth) in Zone 21, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 546/11), sampled from borehole (10-11m depth) in Zone 21, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma 7$ PCB congeners is below of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 546/11), sampled from borehole (10-11m depth) in Zone 21, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 547/11), sampled from borehole (11-12m depth) in Zone 21, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma 7$ PCB congeners is above of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 547/11), sampled from borehole (11-12m depth) in Zone 21, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 548/11), sampled from borehole (12-13m depth) in Zone 21, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma 7$ PCB congeners is above of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 548/11), sampled from borehole (12-13m depth) in Zone 21, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 549/11), sampled from borehole (13-14m depth) in Zone 21, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma 7$ PCB congeners is below of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 549/11), sampled from borehole (13-14m depth) in Zone 21, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 550/11), sampled from borehole (14-15m depth) in Zone 21, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma 7$ PCB congeners is below of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 550/11), sampled from borehole (14-15m depth) in Zone 21, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 551/11), sampled from borehole (15-16m depth) in Zone 21, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma 7$ PCB congeners is below of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 551/11), sampled from borehole (15-16m depth) in Zone 21, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 552/11), sampled from borehole (16-17m depth) in Zone 21, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma 7$ PCB congeners is below of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 552/11), sampled from borehole (16-17m depth) in Zone 21, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 553/11), sampled from borehole (17-18m depth) in Zone 21, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma 7$ PCB congeners is below of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 553/11), sampled from borehole (17-18m depth) in Zone 21, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 554/11), sampled from borehole (18-19m depth) in Zone 21, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma 7$ PCB congeners is below of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 554/11), sampled from borehole (18-19m depth) in Zone 21, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 555/11), sampled from borehole (19-20m depth) in Zone 21, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma 7$ PCB congeners is above of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 555/11), sampled from borehole (19-20m depth) in Zone 21, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 556/11), sampled from borehole (20-21m depth) in Zone 21, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma$ 7PCB congeners is below of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 556/11), sampled from borehole (20-21m depth) in Zone 21, observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 557/11), sampled from borehole (21-22m depth) in Zone 21, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma$ 7PCB congeners is below of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 557/11), sampled from borehole (21-22m depth) in Zone 21, observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 558/11), sampled from borehole (22-23m depth) in Zone 21, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma$ 7PCB congeners is below of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 558/11), sampled from borehole (22-23m depth) in Zone 21, observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is below of permissible level for industrial area.

**Table 14.** Results of analysis of Total PCB and sum of congeners in soil/solid material sampled in a borehole drilled in zone 27

| RESULTS OF SOIL/SOLID MATERIAL ANALYSIS IN BOREHOLE |              |                      |                    |                      |                           |                                     |                                                            |
|-----------------------------------------------------|--------------|----------------------|--------------------|----------------------|---------------------------|-------------------------------------|------------------------------------------------------------|
| Date of sampling                                    |              |                      | 18-19.10.2019.     |                      | Target level**<br>(mg/kg) | Intervention<br>Level***<br>(mg/kg) | Permissible<br>level for<br>industrial area<br>(mg/kg)**** |
| Zone                                                |              |                      | 27                 |                      |                           |                                     |                                                            |
| Parameter                                           |              |                      | Total PCB          | Σ 7PCB<br>congeners* |                           |                                     |                                                            |
| N <sub>0</sub>                                      | Sample<br>ID | Depth of<br>sampling | Results<br>(mg/kg) | Results<br>(mg/kg)   |                           |                                     |                                                            |
| 1.                                                  | 564/11       | 0-1m                 | 10868±1068         | 1904±286             | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 2.                                                  | 565/11       | 1-2m                 | 344±34             | 62±9                 | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 3.                                                  | 566/11       | 2-3m                 | 652±64             | 118±18               | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 4.                                                  | 567/11       | 3-4m                 | 430±42             | 63±10                | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 5.                                                  | 568/11       | 4-5m                 | 374±37             | 71±11                | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 6.                                                  | 569/11       | 5-6m                 | 196±19             | 39±5                 | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 7.                                                  | 570/11       | 6-7m                 | 95±9               | 19±3                 | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 8.                                                  | 571/11       | 7-8m                 | 46±5               | 9.2±1.3              | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 9.                                                  | 572/11       | 8-9m                 | 42±4               | 9.1±1.3              | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 10.                                                 | 573/11       | 9-10m                | 26±3               | 5.2±0.7              | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 11.                                                 | 574/11       | 10-11m               | 13±1               | 2.5±0.4              | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 12.                                                 | 575/11       | 11-12m               | 17±2               | 3.6±0.5              | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 13.                                                 | 576/11       | 12-13m               | 9.3±0.9            | 1.8±0.3              | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 14.                                                 | 577/11       | 13-14m               | 5.7±0.6            | 1.1±0.2              | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 15.                                                 | 578/11       | 14-15m               | 2.7±0.3            | 0.54±0.08            | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 16.                                                 | 579/11       | 15-16m               | 4.3±0.4            | 0.88±0.12            | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 17.                                                 | 580/11       | 16-17m               | 2.4±0.2            | 0.49±0.07            | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |

REPORT No. 00-1659/1

|     |        |        |         |           |                   |                  |    |
|-----|--------|--------|---------|-----------|-------------------|------------------|----|
| 18. | 581/11 | 17-18m | 2.2±0.2 | 0.46±0.06 | 0.04 <sup>a</sup> | 2.1 <sup>a</sup> | 33 |
| 19. | 582/11 | 18-19m | 1.9±0.2 | 0.37±0.05 | 0.04 <sup>a</sup> | 2.1 <sup>a</sup> | 33 |
| 20. | 583/11 | 19-20m | 3.1±0.3 | 0.59±0.08 | 0.04 <sup>a</sup> | 2.1 <sup>a</sup> | 33 |
| 21. | 584/11 | 20-21m | 2.6±0.3 | 0.51±0.07 | 0.04 <sup>a</sup> | 2.1 <sup>a</sup> | 33 |
| 22. | 585/11 | 21-22m | 1.4±0.1 | 0.28±0.04 | 0.04 <sup>a</sup> | 2.1 <sup>a</sup> | 33 |
| 23. | 586/11 | 22-23m | 1.8±0.2 | 0.41±0.06 | 0.04 <sup>a</sup> | 2.1 <sup>a</sup> | 33 |

\*Σ7PCB= 28, 52, 101, 118, 138, 153 and 180

\*\*Dutch Target and Intervention Values, 2000 (the New Dutch List)

\*\*\*Dutch Ministry of Housing, Land Planning and Environment, 2009

\*\*\*\*UNIDO "POPs Contaminated Site Investigation and Management Toolkit"

<sup>a</sup>-Intervention and target level corrected on average content of organic matter (21%) in soil

**Table 15.** Results of analysis of single congeners in soil/solid material sampled in a borehole drilled in zone 27

| RESULTS OF SOIL/SOLID MATERIAL ANALYSIS IN BOREHOLE |           |                   |                       |             |             |             |           |           |           |           |           |           |           |
|-----------------------------------------------------|-----------|-------------------|-----------------------|-------------|-------------|-------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| Date of sampling                                    |           |                   | 19-20.10.2019.        |             |             |             |           |           |           |           |           |           |           |
| Zone                                                |           |                   | 27                    |             |             |             |           |           |           |           |           |           |           |
| Parameter                                           |           |                   | PCB congeners (mg/kg) |             |             |             |           |           |           |           |           |           |           |
| N <sub>0</sub>                                      | Sample ID | Depth of sampling | PCB 18                | PCB 28 & 31 | PCB 52      | PCB 44      | PCB 101   | PCB 149   | PCB 118   | PCB 153   | PCB 138   | PCB 180   | PCB 194   |
| 1.                                                  | 564/11    | 0-1m              | <0.002                | 18±2        | 193±24      | 85±10       | 472±51    | 302±30    | 301±30    | 345±34    | 411±38    | 165±25    | 30±4      |
| 2.                                                  | 565/11    | 1-2m              | 0.14±0.02             | 0.53±0.06   | 5.7±0.7     | 2.6±0.3     | 15.2±1.7  | 11.1±1.1  | 9.6±0.9   | 11.8±1.2  | 14.1±1.3  | 5.5±0.8   | 0.99±0.14 |
| 3.                                                  | 566/11    | 2-3m              | 0.27±0.03             | 1.1±0.1     | 11±1        | 6.0±0.7     | 26±3      | 15±2      | 21±2      | 22±2      | 26±2      | 11±2      | 2.1±0.3   |
| 4.                                                  | 567/11    | 3-4m              | <0.002                | 0.56±0.06   | 6.2±0.8     | 2.8±0.3     | 14±2      | 8.2±0.8   | 11±1      | 12±1      | 14±1      | 5.6±0.8   | 1.1±0.2   |
| 5.                                                  | 568/11    | 4-5m              | <0.002                | 0.71±0.08   | 6.7±0.8     | 3.0±0.4     | 17±2      | 8.8±0.9   | 12±1      | 13±1      | 15±1      | 6.4±1.0   | 1.2±0.2   |
| 6.                                                  | 569/11    | 5-6m              | <0.002                | 0.16±0.02   | 0.78±0.10   | 0.50±0.06   | 6.2±0.7   | 5.6±0.6   | 6.9±0.7   | 9.5±0.9   | 11±1      | 5.4±0.8   | 1.2±0.2   |
| 7.                                                  | 570/11    | 6-7m              | <0.002                | 0.08±0.01   | 0.38±0.05   | 0.24±0.03   | 3.0±0.3   | 2.7±0.3   | 3.4±0.3   | 4.6±0.5   | 5.1±0.5   | 2.6±0.4   | 0.59±0.08 |
| 8.                                                  | 571/11    | 7-8m              | <0.002                | 0.037±0.004 | 0.012±0.001 | 0.12±0.01   | 1.5±0.2   | 1.3±0.1   | 1.6±0.2   | 2.2±0.2   | 2.5±0.2   | 1.3±0.2   | 0.28±0.04 |
| 9.                                                  | 572/11    | 8-9m              | <0.002                | 0.041±0.004 | 0.013±0.001 | 0.13±0.01   | 1.2±0.2   | 1.4±0.1   | 1.6±0.2   | 2.4±0.2   | 2.7±0.3   | 1.2±0.2   | 0.32±0.04 |
| 10.                                                 | 573/11    | 9-10m             | <0.002                | 0.021±0.002 | 0.010±0.001 | 0.07±0.01   | 0.82±0.09 | 0.74±0.07 | 0.93±0.09 | 1.27±0.13 | 1.40±0.13 | 0.72±0.11 | 0.16±0.02 |
| 11.                                                 | 574/11    | 10-11m            | <0.002                | 0.011±0.001 | 0.013±0.001 | 0.034±0.003 | 0.40±0.04 | 0.36±0.04 | 0.44±0.04 | 0.61±0.06 | 0.67±0.06 | 0.35±0.05 | 0.08±0.01 |
| 12.                                                 | 575/11    | 11-12m            | <0.002                | 0.019±0.002 | 0.010±0.001 | 0.05±0.01   | 0.57±0.06 | 0.51±0.05 | 0.64±0.06 | 0.88±0.09 | 0.97±0.09 | 0.50±0.08 | 0.11±0.02 |
| 13.                                                 | 576/11    | 12-13m            | <0.002                | 0.014±0.001 | 0.014±0.001 | 0.022±0.002 | 0.29±0.03 | 0.26±0.03 | 0.32±0.03 | 0.44±0.04 | 0.48±0.04 | 0.25±0.04 | 0.06±0.01 |

|     |        |        |        |             |             |             |           |           |           |           |           |           |             |
|-----|--------|--------|--------|-------------|-------------|-------------|-----------|-----------|-----------|-----------|-----------|-----------|-------------|
| 14. | 577/11 | 13-14m | <0.002 | 0.015±0.001 | 0.012±0.001 | 0.015±0.001 | 0.17±0.02 | 0.16±0.02 | 0.20±0.02 | 0.27±0.03 | 0.30±0.03 | 0.15±0.02 | 0.034±0.003 |
| 15. | 578/11 | 14-15m | <0.002 | 0.010±0.001 | 0.011±0.001 | 0.011±0.001 | 0.09±0.01 | 0.08±0.01 | 0.10±0.01 | 0.13±0.01 | 0.15±0.01 | 0.08±0.01 | 0.016±0.002 |
| 16. | 579/11 | 15-16m | <0.002 | 0.012±0.001 | 0.013±0.001 | 0.010±0.001 | 0.14±0.02 | 0.13±0.01 | 0.16±0.02 | 0.21±0.02 | 0.24±0.02 | 0.12±0.02 | 0.028±0.003 |
| 17. | 580/11 | 16-17m | <0.002 | 0.015±0.001 | 0.012±0.001 | 0.014±0.001 | 0.08±0.01 | 0.07±0.01 | 0.09±0.01 | 0.12±0.01 | 0.13±0.01 | 0.07±0.01 | 0.019±0.002 |
| 18. | 581/11 | 17-18m | <0.002 | 0.015±0.001 | 0.011±0.001 | 0.011±0.001 | 0.07±0.01 | 0.07±0.01 | 0.08±0.01 | 0.11±0.01 | 0.12±0.01 | 0.06±0.01 | 0.012±0.001 |
| 19. | 582/11 | 18-19m | <0.002 | 0.013±0.001 | 0.010±0.001 | 0.014±0.001 | 0.06±0.01 | 0.05±0.01 | 0.07±0.01 | 0.09±0.01 | 0.10±0.01 | 0.05±0.01 | 0.014±0.001 |
| 20. | 583/11 | 19-20m | <0.002 | 0.013±0.001 | 0.011±0.001 | 0.010±0.001 | 0.09±0.01 | 0.08±0.01 | 0.10±0.01 | 0.14±0.01 | 0.16±0.01 | 0.08±0.01 | 0.021±0.002 |
| 21. | 584/11 | 20-21m | <0.002 | 0.010±0.001 | 0.011±0.001 | 0.011±0.001 | 0.08±0.01 | 0.07±0.01 | 0.09±0.01 | 0.12±0.01 | 0.14±0.01 | 0.07±0.01 | 0.018±0.001 |
| 22. | 585/11 | 21-22m | <0.002 | <0.002      | <0.002      | <0.002      | 0.04±0.01 | 0.04±0.01 | 0.05±0.01 | 0.07±0.01 | 0.08±0.01 | 0.04±0.01 | 0.010±0.001 |
| 23. | 586/11 | 22-23m | <0.002 | <0.002      | <0.002      | 0.010±0.001 | 0.06±0.01 | 0.06±0.01 | 0.07±0.01 | 0.10±0.01 | 0.11±0.01 | 0.06±0.01 | 0.010±0.001 |

**DATA INTERPRETATION**

(soil/solid material sampled in a borehole drilled in zone 27)

Result of chemical analysis for soil sample (sample ID 564/11), sampled from borehole (0-1m depth) in Zone 27, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil sample (sample ID 564/11), sampled from borehole (0-1m depth) in Zone 27, observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil sample (sample ID 565/11), sampled from borehole (1-2m depth) in Zone 27, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil sample (sample ID 565/11), sampled from borehole (1-2m depth) in Zone 27, observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 566/11), sampled from borehole (2-3m depth) in Zone 27, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 566/11), sampled from borehole (2-3m depth) in Zone 27, observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 567/11), sampled from borehole (3-4m depth) in Zone 27, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 567/11), sampled from borehole (3-4m depth) in Zone 27, observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 568/11), sampled from borehole (4-5m depth) in Zone 27, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 568/11), sampled from borehole (4-5m depth) in Zone 27, observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 569/11), sampled from borehole (5-6m depth) in Zone 27, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 569/11), sampled from borehole (5-6m depth) in Zone 27, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 570/11), sampled from borehole (6-7m depth) in Zone 27, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 570/11), sampled from borehole (6-7m depth) in Zone 27, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 571/11), sampled from borehole (7-8m depth) in Zone 27, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 571/11), sampled from borehole (7-8m depth) in Zone 27, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 572/11), sampled from borehole (8-9m depth) in Zone 27, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 572/11), sampled from borehole (8-9m depth) in Zone 27, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 573/11), sampled from borehole (9-10m depth) in Zone 27, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 573/11), sampled from borehole (9-10m depth) in Zone 27, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 574/11), sampled from borehole (10-11m depth) in Zone 27, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma$ 7PCB congeners is below of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 574/11), sampled from borehole (10-11m depth) in Zone 27, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 575/11), sampled from borehole (11-12m depth) in Zone 27, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 575/11), sampled from borehole (11-12m depth) in Zone 27, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 576/11), sampled from borehole (12-13m depth) in Zone 27, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma$ 7PCB congeners is below of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 576/11), sampled from borehole (12-13m depth) in Zone 27, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 577/11), sampled from borehole (13-14m depth) in Zone 27, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma$ 7PCB congeners is below of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 577/11), sampled from borehole (13-14m depth) in Zone 27, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 578/11), sampled from borehole (14-15m depth) in Zone 27, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma$ 7PCB congeners is below of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 578/11), sampled from borehole (14-15m depth) in Zone 27, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 579/11), sampled from borehole (15-16m depth) in Zone 27, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma 7$ PCB congeners is below of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 579/11), sampled from borehole (15-16m depth) in Zone 27, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 580/11), sampled from borehole (16-17m depth) in Zone 27, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma 7$ PCB congeners is below of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 580/11), sampled from borehole (16-17m depth) in Zone 27, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 581/11), sampled from borehole (17-18m depth) in Zone 27, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma 7$ PCB congeners is below of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 581/11), sampled from borehole (17-18m depth) in Zone 27, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 582/11), sampled from borehole (18-19m depth) in Zone 27, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma 7$ PCB congeners is below of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 582/11), sampled from borehole (18-19m depth) in Zone 27, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 583/11), sampled from borehole (19-20m depth) in Zone 27, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma 7$ PCB congeners is below of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 583/11), sampled from borehole (19-20m depth) in Zone 27, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 584/11), sampled from borehole (20-21m depth) in Zone 27, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma$ 7PCB congeners is below of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 584/11), sampled from borehole (20-21m depth) in Zone 27, observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 585/11), sampled from borehole (21-22m depth) in Zone 27, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma$ 7PCB congeners is below of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 585/11), sampled from borehole (21-22m depth) in Zone 27, observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 586/11), sampled from borehole (22-23m depth) in Zone 27, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma$ 7PCB congeners is below of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 586/11), sampled from borehole (22-23m depth) in Zone 27, observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is below of permissible level for industrial area.

**Table 16.** Results of analysis of Total PCB and sum of congeners in soil/solid material sampled in a borehole drilled in zone 16

| RESULTS OF SOIL/SOLID MATERIAL ANALYSIS IN BOREHOLE |              |                      |                    |                      |                           |                                     |                                                            |
|-----------------------------------------------------|--------------|----------------------|--------------------|----------------------|---------------------------|-------------------------------------|------------------------------------------------------------|
| Date of sampling                                    |              |                      | 19-20.10.2019.     |                      | Target level**<br>(mg/kg) | Intervention<br>Level***<br>(mg/kg) | Permissible<br>level for<br>industrial area<br>(mg/kg)**** |
| Zone                                                |              |                      | 16                 |                      |                           |                                     |                                                            |
| Parameter                                           |              |                      | Total PCB          | Σ 7PCB<br>congeners* |                           |                                     |                                                            |
| N <sub>0</sub>                                      | Sample<br>ID | Depth of<br>sampling | Results<br>(mg/kg) | Results<br>(mg/kg)   |                           |                                     |                                                            |
| 1.                                                  | 559/11       | 0-1m                 | 716±87             | 135 ±20              | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 2.                                                  | 560/11       | 1-2m                 | 36±4               | 8.9±1.3              | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 3.                                                  | 561/11       | 2-3m                 | 32±4               | 4.9±0.7              | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 4.                                                  | 562/11       | 3-4m                 | 19±2               | 2.9±0.4              | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 5.                                                  | 563/11       | 4-5m                 | 16±2               | 2.8±0.4              | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 6.                                                  | 587/11       | 5-6m                 | 14±1               | 2.9±0.4              | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 7.                                                  | 588/11       | 6-7m                 | 11±1               | 2.2±0.3              | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 8.                                                  | 589/11       | 7-8m                 | 8.4±0.8            | 1.8±0.3              | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 9.                                                  | 590/11       | 8-9m                 | 5.2±0.5            | 1.2±0.2              | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 10.                                                 | 591/11       | 9-10m                | 5.7±0.6            | 1.2±0.2              | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 11.                                                 | 592/11       | 10-11m               | 4.2±0.4            | 0.86±0.13            | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 12.                                                 | 593/11       | 11-12m               | 2.8±0.3            | 0.54±0.08            | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 13.                                                 | 594/11       | 12-13m               | 3.2±0.3            | 0.64±0.10            | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 14.                                                 | 595/11       | 13-14m               | 1.9±0.2            | 0.38±0.06            | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 15.                                                 | 596/11       | 14-15m               | 1.1±0.1            | 0.21±0.03            | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 16.                                                 | 597/11       | 15-16m               | 1.6±0.2            | 0.34±0.05            | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |
| 17.                                                 | 598/11       | 16-17m               | 1.8±0.2            | 0.35±0.05            | 0.04 <sup>a</sup>         | 2.1 <sup>a</sup>                    | 33                                                         |

|     |        |        |           |           |                   |                  |    |
|-----|--------|--------|-----------|-----------|-------------------|------------------|----|
| 18. | 599/11 | 17-18m | 1.1±0.1   | 0.23±0.03 | 0.04 <sup>a</sup> | 2.1 <sup>a</sup> | 33 |
| 19. | 600/11 | 18-19m | 0.94±0.09 | 0.20±0.03 | 0.04 <sup>a</sup> | 2.1 <sup>a</sup> | 33 |
| 20. | 601/11 | 19-20m | 0.68±0.07 | 0.14±0.02 | 0.04 <sup>a</sup> | 2.1 <sup>a</sup> | 33 |
| 21. | 602/11 | 20-21m | 0.81±0.08 | 0.16±0.02 | 0.04 <sup>a</sup> | 2.1 <sup>a</sup> | 33 |

\*Σ7PCB= 28, 52, 101, 118, 138, 153 and 180

\*\*Dutch Target and Intervention Values, 2000 (the New Dutch List)

\*\*\*Dutch Ministry of Housing, Land Planning and Environment, 2009

\*\*\*\*UNIDO "POPs Contaminated Site Investigation and Management Toolkit"

<sup>a</sup>-Intervention and target level corrected on average content of organic matter (21%) in soil

**Table 17.** Results of analysis of single congeners in soil/solid material sampled in a borehole drilled in zone 16

| RESULTS OF SOIL/SOLID MATERIAL ANALYSIS IN BOREHOLE |           |                   |                       |             |             |             |           |           |           |           |           |           |             |
|-----------------------------------------------------|-----------|-------------------|-----------------------|-------------|-------------|-------------|-----------|-----------|-----------|-----------|-----------|-----------|-------------|
| Date of sampling                                    |           |                   | 19-20.10.2019.        |             |             |             |           |           |           |           |           |           |             |
| Zone                                                |           |                   | 16                    |             |             |             |           |           |           |           |           |           |             |
| Parameter                                           |           |                   | PCB congeners (mg/kg) |             |             |             |           |           |           |           |           |           |             |
| N <sub>0</sub>                                      | Sample ID | Depth of sampling | PCB 18                | PCB 28 & 31 | PCB 52      | PCB 44      | PCB 101   | PCB 149   | PCB 118   | PCB 153   | PCB 138   | PCB 180   | PCB 194     |
| 1.                                                  | 559/11    | 0-1m              | 0.26±0.03             | 3.1±0.4     | 5.4±0.7     | 3.9±0.5     | 25±3      | 24±2      | 17±2      | 32±3      | 36±3      | 18±3      | 3.6±0.5     |
| 2.                                                  | 560/11    | 1-2m              | <0.002                | 0.12±0.01   | 0.31±0.04   | 0.18±0.02   | 1.6±0.2   | 1.1±0.1   | 1.4±0.1   | 2.0±0.2   | 2.1±0.2   | 1.0±0.1   | 0.17±0.02   |
| 3.                                                  | 561/11    | 2-3m              | <0.002                | 0.10±0.01   | 0.19±0.02   | 0.11±0.01   | 0.88±0.10 | 0.73±0.07 | 0.69±0.07 | 1.2±0.1   | 1.2±0.1   | 0.66±0.10 | 0.13±0.02   |
| 4.                                                  | 562/11    | 3-4m              | <0.002                | 0.05±0.01   | 0.10±0.01   | 0.06±0.01   | 0.52±0.06 | 0.47±0.05 | 0.35±0.03 | 0.71±0.07 | 0.76±0.07 | 0.41±0.06 | 0.08±0.01   |
| 5.                                                  | 563/11    | 4-5m              | 0.038±0.005           | 0.060±0.007 | 0.10±0.01   | 0.08±0.01   | 0.52±0.06 | 0.48±0.05 | 0.38±0.04 | 0.69±0.07 | 0.73±0.07 | 0.36±0.05 | 0.07±0.01   |
| 6.                                                  | 587/11    | 5-6m              | <0.002                | 0.012±0.001 | 0.06±0.01   | 0.04±0.00   | 0.46±0.05 | 0.41±0.04 | 0.52±0.05 | 0.71±0.07 | 0.78±0.07 | 0.40±0.06 | 0.09±0.01   |
| 7.                                                  | 588/11    | 6-7m              | <0.002                | 0.013±0.001 | 0.04±0.01   | 0.03±0.00   | 0.35±0.04 | 0.31±0.03 | 0.39±0.04 | 0.54±0.05 | 0.59±0.05 | 0.31±0.05 | 0.07±0.01   |
| 8.                                                  | 589/11    | 7-8m              | <0.002                | 0.014±0.001 | 0.043±0.003 | 0.021±0.002 | 0.29±0.03 | 0.26±0.03 | 0.32±0.03 | 0.44±0.04 | 0.48±0.04 | 0.25±0.04 | 0.06±0.01   |
| 9.                                                  | 590/11    | 8-9m              | <0.002                | 0.011±0.001 | 0.018±0.002 | 0.022±0.002 | 0.19±0.02 | 0.17±0.02 | 0.21±0.02 | 0.29±0.03 | 0.32±0.03 | 0.17±0.03 | 0.04±0.01   |
| 10.                                                 | 591/11    | 9-10m             | <0.002                | 0.010±0.001 | 0.022±0.002 | 0.019±0.002 | 0.19±0.02 | 0.17±0.02 | 0.21±0.02 | 0.29±0.03 | 0.32±0.03 | 0.17±0.03 | 0.04±0.01   |
| 11.                                                 | 592/11    | 10-11m            | <0.002                | <0.002      | 0.019±0.002 | 0.012±0.001 | 0.14±0.01 | 0.12±0.01 | 0.15±0.02 | 0.21±0.02 | 0.23±0.02 | 0.12±0.02 | 0.032±0.003 |
| 12.                                                 | 593/11    | 11-12m            | <0.002                | <0.002      | 0.012±0.001 | 0.011±0.001 | 0.09±0.01 | 0.08±0.01 | 0.10±0.01 | 0.13±0.01 | 0.15±0.01 | 0.08±0.01 | 0.022±0.002 |

|     |        |        |        |        |             |             |             |             |             |             |             |             |             |
|-----|--------|--------|--------|--------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| 13. | 594/11 | 12-13m | <0.002 | <0.002 | 0.013±0.001 | 0.014±0.001 | 0.10±0.01   | 0.09±0.01   | 0.11±0.01   | 0.16±0.02   | 0.17±0.02   | 0.09±0.01   | 0.024±0.002 |
| 14. | 595/11 | 13-14m | <0.002 | <0.002 | 0.014±0.001 | <0.002      | 0.06±0.01   | 0.05±0.01   | 0.07±0.01   | 0.09±0.01   | 0.10±0.01   | 0.05±0.01   | 0.011±0.001 |
| 15. | 596/11 | 14-15m | <0.002 | <0.002 | <0.002      | <0.002      | 0.032±0.003 | 0.028±0.003 | 0.043±0.004 | 0.05±0.01   | 0.06±0.01   | 0.03±0.00   | 0.013±0.001 |
| 16. | 597/11 | 15-16m | <0.002 | <0.002 | 0.011±0.001 | <0.002      | 0.05±0.01   | 0.05±0.001  | 0.06±0.01   | 0.08±0.01   | 0.09±0.01   | 0.05±0.01   | 0.011±0.001 |
| 17. | 598/11 | 16-17m | <0.002 | <0.002 | 0.013±0.001 | <0.002      | 0.06±0.01   | 0.05±0.01   | 0.06±0.01   | 0.09±0.01   | 0.09±0.01   | 0.05±0.01   | 0.014±0.001 |
| 18. | 599/11 | 17-18m | <0.002 | <0.002 | <0.002      | <0.002      | 0.038±0.004 | 0.027±0.003 | 0.042±0.004 | 0.06±0.01   | 0.06±0.01   | 0.032±0.003 | 0.011±0.001 |
| 19. | 600/11 | 18-19m | <0.002 | <0.002 | <0.002      | <0.002      | 0.032±0.003 | 0.034±0.003 | 0.039±0.004 | 0.05±0.01   | 0.05±0.01   | 0.028±0.003 | 0.013±0.001 |
| 20. | 601/11 | 19-20m | <0.002 | <0.002 | <0.002      | <0.002      | 0.024±0.002 | 0.021±0.002 | 0.019±0.002 | 0.033±0.003 | 0.044±0.004 | 0.021±0.002 | <0.002      |
| 21. | 602/11 | 20-21m | <0.002 | <0.002 | <0.002      | <0.002      | 0.03±0.00   | 0.02±0.00   | 0.028±0.003 | 0.04±0.00   | 0.037±0.004 | 0.023±0.002 | <0.002      |

**DATA INTERPRETATION**

(soil/solid material sampled in a borehole drilled in zone 16)

Result of chemical analysis for soil sample (sample ID 559/11), sampled from borehole (0-1m depth) in Zone 16, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma 7$ PCB congeners is above of target and intervention level.

Result of chemical analysis for soil sample (sample ID 559/11), sampled from borehole (0-1m depth) in Zone 16, observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is above of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 560/11), sampled from borehole (1-2m depth) in Zone 16, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma 7$ PCB congeners is above of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 560/11), sampled from borehole (1-2m depth) in Zone 16, observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 561/11), sampled from borehole (2-3m depth) in Zone 16, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma 7$ PCB congeners is above of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 561/11), sampled from borehole (2-3m depth) in Zone 16, observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 562/11), sampled from borehole (3-4m depth) in Zone 16, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma 7$ PCB congeners is above of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 562/11), sampled from borehole (3-4m depth) in Zone 16, observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 563/11), sampled from borehole (4-5m depth) in Zone 16, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma 7$ PCB congeners is above of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 563/11), sampled from borehole (4-5m depth) in Zone 16, observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 587/11), sampled from borehole (5-6m depth) in Zone 16, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma$ 7PCB congeners is above of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 587/11), sampled from borehole (5-6m depth) in Zone 16, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 588/11), sampled from borehole (6-7m depth) in Zone 16, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma$ 7PCB congeners is below of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 588/11), sampled from borehole (6-7m depth) in Zone 16, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 589/11), sampled from borehole (7-8m depth) in Zone 16, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma$ 7PCB congeners is below of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 589/11), sampled from borehole (7-8m depth) in Zone 16, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 590/11), sampled from borehole (8-9m depth) in Zone 16, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma$ 7PCB congeners is below of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 590/11), sampled from borehole (8-9m depth) in Zone 16, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 591/11), sampled from borehole (9-10m depth) in Zone 16, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma$ 7PCB congeners is below of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 591/11), sampled from borehole (9-10m depth) in Zone 16, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 592/11), sampled from borehole (10-11m depth) in Zone 16, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma 7$ PCB congeners is below of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 592/11), sampled from borehole (10-11m depth) in Zone 16, observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 593/11), sampled from borehole (11-12m depth) in Zone 16, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma 7$ PCB congeners is below of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 593/11), sampled from borehole (11-12m depth) in Zone 16, observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 594/11), sampled from borehole (12-13m depth) in Zone 16, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma 7$ PCB congeners is below of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 594/11), sampled from borehole (12-13m depth) in Zone 16, observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 595/11), sampled from borehole (13-14m depth) in Zone 16, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma 7$ PCB congeners is below of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 595/11), sampled from borehole (13-14m depth) in Zone 16, observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 596/11), sampled from borehole (14-15m depth) in Zone 16, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma 7$ PCB congeners is below of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 596/11), sampled from borehole (14-15m depth) in Zone 16, observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 597/11), sampled from borehole (15-16m depth) in Zone 16, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma 7$ PCB congeners is below of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 597/11), sampled from borehole (15-16m depth) in Zone 16, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 598/11), sampled from borehole (16-17m depth) in Zone 16, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma 7$ PCB congeners is below of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 598/11), sampled from borehole (16-17m depth) in Zone 16, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 599/11), sampled from borehole (17-18m depth) in Zone 16, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma 7$ PCB congeners is below of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 599/11), sampled from borehole (17-18m depth) in Zone 16, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 560/11), sampled from borehole (18-19m depth) in Zone 16, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma 7$ PCB congeners is below of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 560/11), sampled from borehole (18-19m depth) in Zone 16, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 561/11), sampled from borehole (19-20m depth) in Zone 16, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma 7$ PCB congeners is below of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 561/11), sampled from borehole (19-20m depth) in Zone 16, observed in relation to UNIDO "POPs Contaminated Site Investigation and Management Toolkit" indicate that the content of total PCB is below of permissible level for industrial area.

Result of chemical analysis for soil/solid material sample (sample ID 562/11), sampled from borehole (20-21m depth) in Zone 16, observed in relation to the Dutch soil standard indicate that the content of  $\Sigma 7$ PCB congeners is below of target and intervention level.

Result of chemical analysis for soil/solid material sample (sample ID 562/11), sampled from borehole (20-21m depth) in Zone 16, observed in relation to UNIDO “POPs Contaminated Site Investigation and Management Toolkit” indicate that the content of total PCB is below of permissible level for industrial area.

#### 4.1.6 Results of soil analysis-PAH, TPH, metals, bulk density and combustible sulphur and determination of particle size distribution

In accordance with the requirements of the project, a composite sample was formed of samples from the surface layer (0-40 cm) and a layer depth (1-4m) with the aim of analyzing them on the content of PAH, TPH, metals, bulk density and combustible sulphur. Also, in accordance with project requirements total halogens, total organic halogens and total sulphur were analyzed. The results of the analysis PAH, TPH, metals, bulk density and combustible sulphur in composite soil sample at 0-40 cm and 1-4 m depth are presented in Tables 18 and 19. The results of the analysis of total halogens, total organic halogens and total sulphur are given in Annex VI.

**Table 18.** Results of analysis of PAH, TPH and metals in composite soil sample at 0-40 cm and 1-4 m depth

| RESULTS OF SOIL ANALYSIS |                                  |       |                       |                       |
|--------------------------|----------------------------------|-------|-----------------------|-----------------------|
| Sample                   |                                  |       | Composite soil sample | Composite soil sample |
| Depth                    |                                  |       | 0-40 cm               | 1-4 m                 |
| Zone                     |                                  |       | 1-28                  | 16,21,27              |
| Date of sampling         |                                  |       | 01-02.10.2019.        | 15-19.10.2019.        |
| Sample ID                |                                  |       | 603/11                | 604/11                |
| No.                      | Parameter                        | Unit  | Results               | Results               |
| 1.                       | Polycyclic Aromatic Hydrocarbons |       |                       |                       |
|                          | Naphtalene                       | mg/kg | 0.012±0.003           | 0.005±0.001           |
|                          | 2-Methylnaphtalene               | mg/kg | 0.010±0.003           | <0.005                |
|                          | 1-Methylnaphtalene               | mg/kg | 0.007±0.002           | <0.005                |
|                          | Acenaphtylene                    | mg/kg | <0.005                | <0.005                |
|                          | Acenaphtene                      | mg/kg | 0.030±0.005           | 0.005±0.001           |
|                          | Fluorene                         | mg/kg | 0.012±0.002           | <0.005                |
|                          | Phenanthrene                     | mg/kg | 0.18±0.03             | 0.026±0.004           |
|                          | Anthracene                       | mg/kg | 0.046±0.006           | <0.005                |
|                          | Fluoranthene                     | mg/kg | 0.62±0.09             | 0.035±0.005           |
|                          | Pyrene                           | mg/kg | 0.52±0.08             | 0.027±0.004           |
|                          | Benzo(a)anthracene               | mg/kg | 0.34±0.05             | 0.010±0.001           |
|                          | Chrysene                         | mg/kg | 0.66±0.10             | 0.025±0.004           |

|    |                        |       |             |             |
|----|------------------------|-------|-------------|-------------|
|    | Benzo(b)fluoranthene   | mg/kg | 1.17±0.18   | 0.030±0.005 |
|    | Benzo(k)fluoranthene   | mg/kg | 0.39±0.10   | 0.021±0.005 |
|    | Benzo(a)pyrene         | mg/kg | 0.45±0.06   | 0.013±0.002 |
|    | Indeno(1.2.3-cd)pyrene | mg/kg | 0.45±0.07   | 0.015±0.002 |
|    | Dibenzo(a,h)anthracene | mg/kg | 0.11±0.03   | <0.005      |
|    | Benzo(g,h,i)perylene   | mg/kg | 0.44±0.08   | 0.012±0.002 |
|    | ΣPAHs                  | mg/kg | 5.5±0.9     | 0.22±0.04   |
| 2. | TPH (C10-C40)          | mg/kg | 259         | 39          |
| 3. | Metals                 |       |             |             |
|    | As                     | mg/kg | 13±1        | 3.0±0.3     |
|    | Hg                     | mg/kg | 0.040±0.005 | 0.019±0.002 |
|    | Cd                     | mg/kg | 1.1±0.1     | 0.48±0.05   |
|    | Zn                     | mg/kg | 202±20      | 32±3        |
|    | Pb                     | mg/kg | 80±8        | 15±1        |
|    | Cu                     | mg/kg | 83±8        | 22±2        |
|    | Ba                     | mg/kg | 92±9        | 30±3        |
|    | Ni                     | mg/kg | 125±13      | 34±3        |
|    | V                      | mg/kg | 109         | 27          |
|    | Cr                     | mg/kg | 112±11      | 55±5        |
|    | Sn                     | mg/kg | 3.5         | 1.1         |
|    | Co                     | mg/kg | 14±2        | 4.6±0.7     |
| 4. | Bulk density           | g/l   | 954         | 1328        |
| 5. | Combustible sulphur    | %     | <0.1        | <0.1        |

*Table 18a.* Particle size distribution

| PARTICLE SIZE DISTRIBUTION |                       |                       |
|----------------------------|-----------------------|-----------------------|
| Sample                     | Composite soil sample | Composite soil sample |
| Depth                      | 0-40 cm               | 1-4 m                 |
| Zone                       | 1-28                  | 16,21,27              |
| Sample ID                  | 603/11                | 604/11                |
| Sieves (mm)                | Results (%)           | Results (%)           |
| 14                         | 22.0                  | 19.9                  |
| 10                         | 15.3                  | 16.7                  |
| 4                          | 16.2                  | 20.4                  |
| 3.15                       | 4.6                   | 5.9                   |
| 2                          | 8.5                   | 7.2                   |
| <2                         | 33.4                  | 29.8                  |

## 4.2 Results of underground water analysis with data interpretation

In accordance with project ToR for results interpretation Dutch groundwater target values (Dutch Ministry of Housing, Land Planning and Environment, 2009) were used.

The results of the analysis are presented in Tables 19. For each result, a comment is given on the relationship between the result obtained and the target values and intervention values.

**Table 19.** Review of the results of underground water analysis

| RESULTS OF UNDERGROUND WATER ANALYSIS |           |                                      |                            |                |                  |                          |                                |
|---------------------------------------|-----------|--------------------------------------|----------------------------|----------------|------------------|--------------------------|--------------------------------|
| Date of sampling                      |           |                                      |                            | 18.10.2019.    |                  | Target level**<br>(µg/l) | Intervention level**<br>(µg/l) |
| Parameter                             |           |                                      |                            | Total PCB      | Σ7PCB congeners* |                          |                                |
| N <sub>0</sub>                        | Sample ID | Sampling point                       | Coordinates                | Results (µg/l) | Results (µg/l)   |                          |                                |
| 1.                                    | 797/04    | Piezometer-P11                       | 42° 23.331'<br>19° 14.013' | <0.002         | <0.002           | 0.01                     | 0.01                           |
| 2.                                    | 798/04    | Piezometer-P7                        | 42° 23.723'<br>19° 13.197' | <0.002         | <0.002           | 0.01                     | 0.01                           |
| 3.                                    | 799/04    | Piezometer-BA 01                     | 42° 23.312'<br>19° 13.424' | <0.002         | <0.002           | 0.01                     | 0.01                           |
| 4.                                    | 800/04    | Well (Krstović Vukašin)<br>Cijevna   | 42° 22.558'<br>19° 13.775' | <0.002         | <0.002           | 0.01                     | 0.01                           |
| 5.                                    | 801/04    | Well (Savo Stijepović)<br>Ljajkovići | 42° 22.173'<br>19° 13.262' | <0.002         | <0.002           | 0.01                     | 0.01                           |
| 6.                                    | 802/04    | Well (Đorđe Vulević)<br>Cijevna      | 42° 22.361'<br>19° 13.673' | <0.002         | <0.002           | 0.01                     | 0.01                           |
| 7.                                    | 803/04    | Well (Šefketi Faik)<br>Cijevna       | 42° 22.480'<br>19° 13.857' | <0.002         | <0.002           | 0.01                     | 0.01                           |
| 8.                                    | 804/04    | Well (Miljković Božo)                | 42° 22.134'<br>19° 13.864' | <0.002         | <0.002           | 0.01                     | 0.01                           |
| 9.                                    | 805/04    | Well (Bezarević)                     | 42° 21.903'<br>19° 14.311' | <0.002         | <0.002           | 0.01                     | 0.01                           |
| 10.                                   | 806/04    | Piezometer-P1                        | 42° 22.717'<br>19° 13.105' | <0.002         | <0.002           | 0.01                     | 0.01                           |

\*Σ7PCB= 28, 52, 101, 118, 138, 153 and 180

\*\* Dutch Ministry of Housing, Land Planning and Environment, 2009

**DATA INTERPRETATION**

Result of chemical analysis for water sample (sample ID 797/04), sampled from Piezometer-P11, observed in relation to the Dutch legislation indicate that the content of  $\Sigma$ 7PCB congeners is below of target and intervention level.

Result of chemical analysis for water sample (sample ID 798/04), sampled from Piezometer-P7, observed in relation to the Dutch legislation indicate that the content of  $\Sigma$ 7PCB congeners is below of target and intervention level.

Result of chemical analysis for water sample (sample ID 799/04), sampled from Piezometer-BA 01, observed in relation to the Dutch legislation indicate that the content of  $\Sigma$ 7PCB congeners is below of target and intervention level.

Result of chemical analysis for water sample (sample ID 800/04), sampled from Well (Krstović Vukašin) Cijevna, observed in relation to the Dutch legislation indicate that the content of  $\Sigma$ 7PCB congeners is below of target and intervention level.

Result of chemical analysis for water sample (sample ID 801/04), sampled from Well (Savo Stijepović) Ljajkovići, observed in relation to the Dutch legislation indicate that the content of  $\Sigma$ 7PCB congeners is below of target and intervention level.

Result of chemical analysis for water sample (sample ID 802/04), sampled from Well (Đorđe Vulević) Cijevna, observed in relation to the Dutch legislation indicate that the content of  $\Sigma$ 7PCB congeners is below of target and intervention level.

Result of chemical analysis for water sample (sample ID 803/04), sampled from Well (Šefketi Faik) Cijevna, observed in relation to the Dutch legislation indicate that the content of  $\Sigma$ 7PCB congeners is below of target and intervention level.

Result of chemical analysis for water sample (sample ID 804/04), sampled from Well (Miljković Božo), observed in relation to the Dutch legislation indicate that the content of  $\Sigma$ 7PCB congeners is below of target and intervention level.

Result of chemical analysis for water sample (sample ID 805/04), sampled from Well (Bezarević), observed in relation to the Dutch legislation indicate that the content of  $\Sigma$ 7PCB congeners is below of target and intervention level.

Result of chemical analysis for water sample (sample ID 806/04), sampled from Piezometer-P1, observed in relation to the Dutch legislation indicate that the content of  $\Sigma$ 7PCB congeners is below of target and intervention level.

### 4.3 Results of Wipe Test with data interpretation

As there is no EU regulation that prescribes PCB content on the wall of industrial buildings, we used the limits prescribed by the US Environmental Protection Agency („Wipe Sampling and Double Wash/Rinse Cleanup as recommended by the Environmental Protection Agency PCB Spill Cleanup Policy, USEPA, June 23, 1987 (revised and clarified on April 18, 1991)“). According to the US EPA, the PCB limit value for indoor surfaces is 10 µg/100cm<sup>2</sup>.

The results of wall analysis in PCB storage, using wipe test are presented in Tables 20 and 21.

**Table 20.** Results of wall analysis of Total PCB and sum of congeners sampled by wipe test

| RESULTS OF ANALYSIS – WALL OF TEMPORARY STORAGE<br>(WIPE) |           |                    |                                  |                                  |
|-----------------------------------------------------------|-----------|--------------------|----------------------------------|----------------------------------|
| Date of sampling                                          |           |                    | 04.10.2019.                      |                                  |
| Parameter                                                 |           |                    | Total PCB                        | Σ7PCB congeners*                 |
| N <sub>0</sub>                                            | Sample ID | Height of sampling | Results (µg/100cm <sup>2</sup> ) | Results (µg/100cm <sup>2</sup> ) |
| 1.                                                        | 450/11    | 1m                 | 0.32                             | 0.07                             |
| 2.                                                        | 451/11    | 2m                 | 0.38                             | 0.08                             |
| 3.                                                        | 452/11    | 1m                 | 0.40                             | 0.08                             |
| 4.                                                        | 453/11    | 2m                 | 3.9                              | 0.36                             |
| 5.                                                        | 454/11    | 1m                 | 0.38                             | 0.07                             |
| 6.                                                        | 455/11    | 2m                 | 0.75                             | 0.14                             |
| 7.                                                        | 456/11    | 1m                 | 0.57                             | 0.11                             |
| 8.                                                        | 457/11    | 2m                 | 2.3                              | 0.32                             |
| 9.                                                        | 458/11    | 1m                 | 0.56                             | 0.12                             |
| 10.                                                       | 459/11    | 2m                 | 0.54                             | 0.12                             |
| 11.                                                       | 460/11    | 1m                 | 1.5                              | 0.23                             |
| 12.                                                       | 461/11    | 2m                 | 2.6                              | 0.37                             |
| 13.                                                       | 462/11    | 1m                 | 1.4                              | 0.21                             |
| 14.                                                       | 463/11    | 2m                 | 1.3                              | 0.20                             |
| 15.                                                       | 464/11    | 1m                 | 7.8                              | 1.5                              |
| 16.                                                       | 465/11    | 2m                 | 9.2                              | 1.8                              |

REPORT No. 00-1659/1

|     |        |    |      |      |
|-----|--------|----|------|------|
| 17. | 466/11 | 1m | 9.7  | 3.1  |
| 18. | 467/11 | 2m | 9.5  | 2.7  |
| 19. | 468/11 | 1m | 1.6  | 0.24 |
| 20. | 469/11 | 2m | 0.57 | 0.12 |
| 21. | 470/11 | 1m | 1.2  | 0.19 |
| 22. | 471/11 | 2m | 4.9  | 0.97 |
| 23. | 472/11 | 1m | 3.4  | 0.75 |
| 24. | 473/11 | 2m | 2.3  | 0.31 |
| 25. | 474/11 | 1m | 0.86 | 0.13 |
| 26. | 475/11 | 2m | 0.45 | 0.08 |
| 27. | 476/11 | 1m | 0.47 | 0.10 |
| 28. | 477/11 | 2m | 0.60 | 0.12 |
| 29. | 478/11 | 1m | 0.47 | 0.10 |
| 30. | 479/11 | 2m | 0.26 | 0.06 |

\*Σ7PCB= 28, 52, 101, 118, 138, 153 and 180

### DATA INTERPRETATION

Results of chemical analysis of inside PCB storage walls show that PCB concentrations in all tested parts of storage are below the limits prescribed by the US Environmental Protection Agency.

**Table 21.** Results of wall analysis of single congeners sampled by wipe test

| RESULTS OF ANALYSIS – WALL OF TEMPORARY STORAGE (WIPE) |           |                    |                                        |             |        |        |         |         |         |         |         |         |         |
|--------------------------------------------------------|-----------|--------------------|----------------------------------------|-------------|--------|--------|---------|---------|---------|---------|---------|---------|---------|
| Date of sampling                                       |           |                    | 04.10.2019.                            |             |        |        |         |         |         |         |         |         |         |
| Parameter                                              |           |                    | PCB congeners (µg/100cm <sup>2</sup> ) |             |        |        |         |         |         |         |         |         |         |
| N <sub>0</sub>                                         | Sample ID | Height of sampling | PCB 18                                 | PCB 28 & 31 | PCB 52 | PCB 44 | PCB 101 | PCB 149 | PCB 118 | PCB 153 | PCB 138 | PCB 180 | PCB 194 |
| 1.                                                     | 450/11    | 1m                 | 0.007                                  | 0.02        | 0.006  | 0.005  | 0.01    | 0.008   | 0.01    | 0.01    | 0.01    | 0.007   | <0.002  |
| 2.                                                     | 451/11    | 2m                 | 0.009                                  | 0.03        | 0.008  | 0.007  | 0.01    | 0.007   | 0.01    | 0.01    | 0.01    | 0.006   | 0.004   |
| 3.                                                     | 452/11    | 1m                 | 0.01                                   | 0.03        | 0.005  | 0.007  | 0.01    | 0.009   | 0.01    | 0.01    | 0.02    | 0.007   | <0.002  |
| 4.                                                     | 453/11    | 2m                 | 0.04                                   | 0.09        | 0.03   | 0.03   | 0.06    | 0.04    | 0.06    | 0.06    | 0.08    | 0.03    | 0.008   |
| 5.                                                     | 454/11    | 1m                 | 0.01                                   | 0.03        | 0.006  | 0.007  | 0.01    | 0.008   | 0.01    | 0.01    | 0.02    | 0.006   | <0.002  |
| 6.                                                     | 455/11    | 2m                 | 0.01                                   | 0.04        | 0.01   | 0.01   | 0.02    | 0.02    | 0.02    | 0.02    | 0.03    | 0.01    | 0.003   |
| 7.                                                     | 456/11    | 1m                 | 0.01                                   | 0.04        | 0.01   | 0.01   | 0.02    | 0.02    | 0.01    | 0.02    | 0.02    | 0.009   | 0.002   |
| 8.                                                     | 457/11    | 2m                 | 0.03                                   | 0.12        | 0.03   | 0.03   | 0.05    | 0.04    | 0.05    | 0.05    | 0.06    | 0.03    | 0.008   |
| 9.                                                     | 458/11    | 1m                 | 0.01                                   | 0.04        | 0.03   | 0.01   | 0.01    | 0.009   | 0.02    | 0.01    | 0.02    | 0.009   | 0.002   |
| 10.                                                    | 459/11    | 2m                 | 0.02                                   | 0.04        | 0.01   | 0.009  | 0.02    | 0.02    | 0.02    | 0.02    | 0.02    | 0.01    | 0.003   |
| 11.                                                    | 460/11    | 1m                 | 0.03                                   | 0.10        | 0.03   | 0.03   | 0.04    | 0.03    | 0.03    | 0.03    | 0.04    | 0.02    | 0.005   |
| 12.                                                    | 461/11    | 2m                 | 0.04                                   | 0.13        | 0.04   | 0.04   | 0.06    | 0.03    | 0.06    | 0.05    | 0.07    | 0.03    | 0.009   |
| 13.                                                    | 462/11    | 1m                 | 0.03                                   | 0.08        | 0.02   | 0.02   | 0.03    | 0.02    | 0.03    | 0.03    | 0.04    | 0.02    | 0.004   |

|     |        |    |       |      |       |       |       |       |      |       |      |        |        |
|-----|--------|----|-------|------|-------|-------|-------|-------|------|-------|------|--------|--------|
| 14. | 463/11 | 2m | 0.02  | 0.06 | 0.02  | 0.02  | 0.03  | 0.03  | 0.03 | 0.03  | 0.04 | 0.02   | 0.005  |
| 15. | 464/11 | 1m | 0.22  | 0.37 | 0.15  | 0.16  | 0.22  | 0.26  | 0.19 | 0.25  | 0.32 | 0.14   | 0.04   |
| 16. | 465/11 | 2m | 0.20  | 0.52 | 0.16  | 0.20  | 0.31  | 0.19  | 0.28 | 0.26  | 0.37 | 0.16   | 0.04   |
| 17. | 466/11 | 1m | 0.24  | 0.65 | 0.24  | 0.21  | 0.55  | 0.36  | 0.48 | 0.52  | 0.66 | 0.35   | 0.10   |
| 18. | 467/11 | 2m | 0.26  | 0.66 | 0.22  | 0.26  | 0.43  | 0.32  | 0.43 | 0.41  | 0.59 | 0.27   | 0.06   |
| 19. | 468/11 | 1m | 0.03  | 0.08 | 0.02  | 0.02  | 0.04  | 0.03  | 0.04 | 0.03  | 0.05 | 0.02   | 0.003  |
| 20. | 469/11 | 2m | 0.01  | 0.03 | 0.01  | 0.01  | 0.02  | 0.01  | 0.02 | 0.02  | 0.02 | 0.01   | 0.002  |
| 21. | 470/11 | 1m | 0.02  | 0.05 | 0.02  | 0.01  | 0.03  | 0.02  | 0.03 | 0.03  | 0.04 | 0.02   | 0.005  |
| 22. | 471/11 | 2m | 0.08  | 0.20 | 0.07  | 0.09  | 0.17  | 0.11  | 0.16 | 0.16  | 0.21 | 0.10   | 0.03   |
| 23. | 472/11 | 1m | 0.06  | 0.14 | 0.05  | 0.06  | 0.14  | 0.11  | 0.11 | 0.13  | 0.17 | 0.09   | 0.03   |
| 24. | 473/11 | 2m | 0.02  | 0.06 | 0.02  | 0.02  | 0.06  | 0.04  | 0.04 | 0.05  | 0.07 | 0.03   | 0.01   |
| 25. | 474/11 | 1m | 0.01  | 0.03 | 0.01  | 0.01  | 0.02  | 0.02  | 0.02 | 0.02  | 0.03 | 0.01   | 0.003  |
| 26. | 475/11 | 2m | 0.007 | 0.02 | 0.006 | 0.006 | 0.01  | 0.008 | 0.01 | 0.01  | 0.02 | 0.007  | <0.002 |
| 27. | 476/11 | 1m | 0.01  | 0.03 | 0.009 | 0.007 | 0.02  | 0.01  | 0.02 | 0.01  | 0.02 | 0.009  | 0.002  |
| 28. | 477/11 | 2m | 0.01  | 0.03 | 0.009 | 0.009 | 0.02  | 0.01  | 0.02 | 0.02  | 0.03 | 0.01   | 0.003  |
| 29. | 478/11 | 1m | 0.01  | 0.03 | 0.008 | 0.008 | 0.02  | 0.01  | 0.02 | 0.02  | 0.02 | 0.009  | <0.002 |
| 30. | 479/11 | 2m | 0.009 | 0.02 | 0.005 | 0.003 | 0.008 | 0.005 | 0.01 | 0.005 | 0.01 | <0.002 | <0.002 |

#### 4.4 Results of Concrete Analysis

The results of concrete analysis are presented in Tables 22 and 23.

**Table 22.** Results of concrete analysis of total PCB and sum of congeners

| RESULTS OF ANALYSIS - CONCRETE |           |                 |                          |
|--------------------------------|-----------|-----------------|--------------------------|
| Date of sampling               |           | 16.10.2019.     |                          |
| Parameter                      |           | Total PCB       | $\Sigma$ 7PCB congeners* |
| N <sub>0</sub>                 | Sample ID | Results (mg/kg) | Results (mg/kg)          |
| 1.                             | 508/11    | 172             | 23                       |
| 2.                             | 509/11    | 921             | 194                      |
| 3.                             | 510/11    | 602             | 88                       |
| 4.                             | 511/11    | 123             | 23                       |
| 5.                             | 512/11    | 15              | 2.5                      |
| 6.                             | 513/11    | 19              | 4.0                      |
| 7.                             | 514/11    | 102             | 9.8                      |
| 8.                             | 515/11    | <2              | <0.01                    |
| 9.                             | 516/11    | 98              | 17                       |
| 10.                            | 517/11    | 17              | 3.1                      |
| 11.                            | 518/11    | 25593           | 2135                     |
| 12.                            | 519/11    | 253             | 44                       |
| 13.                            | 520/11    | 306             | 50                       |
| 14.                            | 521/11    | 157             | 29                       |
| 15.                            | 522/11    | 21              | 4.6                      |
| 16.                            | 523/11    | 20              | 4.1                      |
| 17.                            | 524/11    | 2.4             | 0.15                     |
| 18.                            | 525/11    | 31              | 6.1                      |
| 19.                            | 526/11    | <2              | <0.01                    |
| 20.                            | 527/11    | <2              | <0.01                    |
| 21.                            | 528/11    | 103             | 15                       |

REPORT No. 00-1659/1

|     |        |       |      |
|-----|--------|-------|------|
| 22. | 529/11 | 6.3   | 1.7  |
| 23. | 530/11 | 19    | 4.2  |
| 24. | 531/11 | 236   | 14   |
| 25. | 532/11 | <2    | 0.20 |
| 26. | 533/11 | 2.2   | 0.57 |
| 27. | 534/11 | 5.1   | 0.56 |
| 28. | 535/11 | 796   | 108  |
| 29. | 536/11 | 1165  | 179  |
| 30. | 537/11 | 17473 | 3557 |

\*Σ7PCB= 28, 52, 101, 118, 138, 153 and 180

**Table 23.** Results of concrete analysis of single congeners

| RESULTS OF ANALYSIS - CONCRETE |           |                       |            |        |        |         |         |         |         |         |         |         |
|--------------------------------|-----------|-----------------------|------------|--------|--------|---------|---------|---------|---------|---------|---------|---------|
| Date of sampling               |           | 16.10.2019.           |            |        |        |         |         |         |         |         |         |         |
| Parameter                      |           | PCB congeners (mg/kg) |            |        |        |         |         |         |         |         |         |         |
| N <sub>0</sub>                 | Sample ID | PCB 18                | PCB 28 &31 | PCB 52 | PCB 44 | PCB 101 | PCB 149 | PCB 118 | PCB 153 | PCB 138 | PCB 180 | PCB 194 |
| 1.                             | 508/11    | 2.8                   | 8.7        | 2.9    | 3.3    | 4.0     | 2.3     | 3.3     | 3.4     | 3.6     | 1.7     | 0.29    |
| 2.                             | 509/11    | 8.9                   | 22         | 15     | 13     | 40      | 39      | 26      | 39      | 43      | 20      | 3.5     |
| 3.                             | 510/11    | 16                    | 40         | 11     | 11     | 15      | 6.5     | 13      | 11      | 13      | 5.5     | 1.1     |
| 4.                             | 511/11    | 1.2                   | 3.6        | 1.5    | 1.3    | 4.6     | 3.5     | 3.6     | 4.4     | 5.1     | 2.3     | 0.47    |
| 5.                             | 512/11    | 0.32                  | 0.75       | 0.23   | 0.24   | 0.49    | 0.27    | 0.43    | 0.37    | 0.42    | 0.15    | 0.02    |
| 6.                             | 513/11    | 0.19                  | 0.57       | 0.20   | 0.18   | 0.59    | 0.48    | 0.75    | 0.79    | 1.0     | 0.40    | 0.07    |
| 7.                             | 514/11    | 2.9                   | 6.9        | 1.9    | 2.2    | 1.4     | 0.65    | 0.83    | 0.86    | 0.91    | 0.49    | 0.11    |
| 8.                             | 515/11    | <0.002                | <0.002     | <0.002 | <0.002 | <0.002  | <0.002  | <0.002  | <0.002  | <0.002  | <0.002  | <0.002  |
| 9.                             | 516/11    | 0.56                  | 1.5        | 1.3    | 0.82   | 3.9     | 3.2     | 2.7     | 3.1     | 4.0     | 1.2     | 0.21    |
| 10.                            | 517/11    | 0.31                  | 0.87       | 0.26   | 0.25   | 0.58    | 0.27    | 0.57    | 0.48    | 0.57    | 0.23    | 0.04    |
| 11.                            | 518/11    | 1191                  | 2160       | 439    | 445    | 215     | 125     | 104     | 118     | 131     | 48      | 8.5     |
| 12.                            | 519/11    | 0.39                  | 0.66       | 2.3    | 1.1    | 9.1     | 6.2     | 6.5     | 8.9     | 12.8    | 4.2     | 0.84    |
| 13.                            | 520/11    | 0.10                  | 0.43       | 2.0    | 0.91   | 8.9     | 3.5     | 10.0    | 10.4    | 13.9    | 4.2     | 0.74    |

|     |        |        |        |        |        |        |        |        |        |        |        |        |
|-----|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 14. | 521/11 | 0.17   | 0.48   | 1.6    | 0.79   | 6.3    | 4.4    | 5.2    | 6.1    | 7.4    | 2.3    | 0.46   |
| 15. | 522/11 | 0.08   | 0.16   | 0.20   | 0.11   | 1.1    | 0.70   | 0.85   | 0.98   | 1.17   | 0.31   | 0.04   |
| 16. | 523/11 | 0.13   | 0.37   | 0.21   | 0.15   | 0.65   | 0.61   | 0.49   | 0.90   | 0.95   | 0.76   | 0.21   |
| 17. | 524/11 | 0.02   | 0.07   | 0.01   | 0.01   | 0.02   | 0.02   | 0.02   | 0.02   | 0.03   | 0.02   | 0.006  |
| 18. | 525/11 | <0.002 | 0.14   | 0.25   | 0.26   | 1.2    | 0.97   | 1.2    | 1.4    | 1.6    | 0.50   | 0.10   |
| 19. | 526/11 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 |
| 20. | 527/11 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 |
| 21. | 528/11 | 0.11   | 0.37   | 2.0    | 0.77   | 4.4    | 1.7    | 2.9    | 2.4    | 2.9    | 0.65   | 0.08   |
| 22. | 529/11 | 0.05   | 0.10   | 0.04   | 0.04   | 0.20   | 0.23   | 0.16   | 0.43   | 0.44   | 0.35   | 0.07   |
| 23. | 530/11 | 0.005  | 0.02   | 0.14   | 0.09   | 0.77   | 0.52   | 0.69   | 0.98   | 1.1    | 0.53   | 0.10   |
| 24. | 531/11 | 7.0    | 16     | 3.5    | 3.9    | 0.86   | 0.25   | 0.65   | 0.24   | 0.31   | 0.17   | <0.002 |
| 25. | 532/11 | 0.008  | 0.02   | 0.007  | 0.005  | 0.03   | 0.03   | 0.03   | 0.05   | 0.05   | 0.03   | 0.006  |
| 26. | 533/11 | <0.002 | 0.07   | 0.02   | 0.02   | 0.08   | 0.07   | 0.08   | 0.12   | 0.14   | 0.09   | 0.02   |
| 27. | 534/11 | 0.006  | 0.01   | 0.01   | 0.01   | 0.07   | 0.08   | 0.09   | 0.14   | 0.18   | 0.07   | 0.01   |
| 28. | 535/11 | 0.04   | 0.17   | 6.7    | 3.4    | 23     | 15     | 19     | 22     | 26     | 12     | 2.5    |
| 29. | 536/11 | 0.18   | 0.55   | 6.9    | 3.8    | 32     | 24     | 28     | 41     | 44     | 28     | 6.6    |
| 30. | 537/11 | 3.3    | 8.0    | 456    | 217    | 939    | 537    | 596    | 615    | 794    | 154    | 6.8    |

#### 4.5 Results of Air Analysis with data interpretation

Review of the results obtained during air analysis is given in tables 24, 25 and 27.

**Table 24.** Concentration of Dioxin like PCB congeners in air samples

| Parameter                 | Measurement period                       |                                   |                                      |
|---------------------------|------------------------------------------|-----------------------------------|--------------------------------------|
|                           | Air sample before soil sample collection | Air sample during soil collection | Air sample after the soil collection |
|                           | Mean daily values (ng/m <sup>3</sup> )   |                                   |                                      |
| PCB 81                    | 0.29                                     | 0.42                              | 0.70                                 |
| PCB 77                    | 0.17                                     | 0.46                              | 0.73                                 |
| PCB 123                   | 3.30                                     | 4.9                               | 8.8                                  |
| PCB 105                   | 0.83                                     | 1.3                               | 2.6                                  |
| PCB 126                   | 0.06                                     | 0.10                              | 0.06                                 |
| PCB 167                   | 0.07                                     | 0.42                              | 0.27                                 |
| PCB 157                   | 0.08                                     | 0.16                              | 0.11                                 |
| PCB 169                   | 0.02                                     | 0.02                              | 0.03                                 |
| PCB 189                   | 0.40                                     | 0.64                              | 0.80                                 |
| PCB 170                   | 0.009                                    | 0.01                              | 0.03                                 |
| <b>Σ DL PCB congeners</b> | <b>5.20</b>                              | <b>8.5</b>                        | <b>14.1</b>                          |

**Table 25.** Concentration of total PCB and sum of congeners in air samples

| Parameter                | Measurement period                       |                                   |                                      |
|--------------------------|------------------------------------------|-----------------------------------|--------------------------------------|
|                          | Air sample before soil sample collection | Air sample during soil collection | Air sample after the soil collection |
|                          | Mean daily values (ng/m <sup>3</sup> )   |                                   |                                      |
| PCB 18                   | 11.3                                     | 11.6                              | 7.3                                  |
| PCB 28&31                | 20.2                                     | 21.9                              | 16.5                                 |
| PCB 52                   | 27.5                                     | 37.7                              | 40.8                                 |
| PCB 44                   | 11.9                                     | 16.5                              | 15.4                                 |
| PCB 101                  | 29.5                                     | 41.8                              | 43.6                                 |
| PCB 149                  | 10.3                                     | 10.8                              | 16.1                                 |
| PCB 118                  | 6.4                                      | 12.2                              | 9.2                                  |
| PCB 153                  | 7.2                                      | 8.6                               | 10.2                                 |
| PCB 138                  | 6.4                                      | 8.9                               | 11.1                                 |
| PCB 180                  | 0.60                                     | 0.75                              | 2.1                                  |
| PCB 194                  | 0.38                                     | 0.28                              | 0.35                                 |
| <b>Σ 12PCB congeners</b> | 132                                      | 171                               | 173                                  |
| <b>Total PCB</b>         | <b>470</b>                               | <b>620</b>                        | <b>608</b>                           |

### DATA INTERPRETATION

European Union legislation on air pollution does not prescribe norms for PCBs. Globally, PCBs are found in air concentrations of 0.002 up to 15 ng/m<sup>3</sup>. In industrial areas, levels are higher (up to µg/m<sup>3</sup>) (table 26). Few studies have been conducted to measure ambient air levels of PCBs, but concentrations appear to differ markedly between locations. Owing to variations in the analytical procedures used, concentrations measured in independent studies must be evaluated with caution. The lowest levels, from 0.002 ng/m<sup>3</sup>, are found in non-industrialized and non-contaminated areas, whereas levels of 3.3 ng/m<sup>3</sup> have been measured in the Ruhr area in Germany <sup>2</sup>. Near a waste

<sup>2</sup> Polychlorinated biphenyls and terphenyls, 2nd ed. Geneva, World Health Organization, 1993 (Environmental Health Criteria, No. 140).

landfill in Yugoslavia and close to industrial plants in Japan, levels of up to 45 and 650  $\mu\text{g}/\text{m}^3$ , respectively were found<sup>3</sup>.

**Table 26.** PCB levels in air in several countries

| PCB levels in air in several countries |                                                                   |                                   |                                                         |
|----------------------------------------|-------------------------------------------------------------------|-----------------------------------|---------------------------------------------------------|
| Country                                | Location and/or type of sample                                    | PCB levels (average and/or range) | References                                              |
| Canada                                 | Northwestern territories                                          | 0.002-0.07 $\text{ng}/\text{m}^3$ | Bidleman et al. (1978)                                  |
| Germany                                | Industrial area (Ruhr area)                                       | 3.3 $\text{ng}/\text{m}^3$        | DFG (1988)                                              |
|                                        | Non-contaminated area                                             | 0.003 $\text{ng}/\text{m}^3$      |                                                         |
| Japan                                  | Within industrial plants: - PCB vapours                           | 13-540 $\mu\text{g}/\text{m}^3$   | Tatsukawa & Watanabe(1972)                              |
|                                        | - PCBs on airborne particulates                                   | 4-650 $\mu\text{g}/\text{m}^3$    |                                                         |
|                                        | North Pacific, South Pacific, Indian,                             | 0.1-0.3 $\text{ng}/\text{m}^3$    | Tatsukawa & Tanabe (1983)                               |
|                                        | North Atlantic Ocean                                              | 0.5 $\text{ng}/\text{m}^3$        | Tatsukawa & Tanabe (1983)                               |
| USA                                    | Near the North-East Coast                                         | 5 $\text{ng}/\text{m}^3$          | Harvey & Steinhauer (1974)                              |
|                                        | Over the Atlantic Ocean, 2000 km away from the industrial complex | 0.05 $\text{ng}/\text{m}^3$       |                                                         |
|                                        | several locations                                                 | 1-50 $\text{ng}/\text{m}^3$       | Panel on Hazardous Substances (1972) cf WHO/EURO (1988) |
| Yugoslavia                             | Bela Krajina: - 300 m from an industrial plant                    | 4-7 $\mu\text{g}/\text{m}^3$      | Jan et al. (1988b)                                      |
|                                        | - air near a waste landfill                                       | 45 $\mu\text{g}/\text{m}^3$       |                                                         |
|                                        | Over the river Kruga                                              | 2-5 $\mu\text{g}/\text{m}^3$      |                                                         |

<sup>3</sup> Polychlorinated biphenyls and terphenyls, 2nd ed. Geneva, World Health Organization, 1993 (Environmental Health Criteria, No. 140).

**Table 27.** Concentration of PAHs in air samples

| Parameter                | Measurement period                       |                                   |                                      |
|--------------------------|------------------------------------------|-----------------------------------|--------------------------------------|
|                          | Air sample before soil sample collection | Air sample during soil collection | Air sample after the soil collection |
|                          | Mean daily values (ng/m <sup>3</sup> )   |                                   |                                      |
| Naphtalene               | 0.33                                     | 0.12                              | 1.2                                  |
| 2-Methylnaphtalene       | 0.42                                     | 0.08                              | 1.1                                  |
| 1-Methylnaphtalene       | 0.24                                     | 0.03                              | 0.68                                 |
| Acenaphthylene           | 0.41                                     | 0.11                              | 0.43                                 |
| Acenaphthene             | 7.9                                      | 0.85                              | 1.8                                  |
| Fluorene                 | 9.5                                      | 3.5                               | 5.4                                  |
| Phenanthrene             | 37.5                                     | 31.8                              | 51.4                                 |
| Anthracene               | 3.5                                      | 3.5                               | 2.0                                  |
| Fluoranthene             | 32.7                                     | 29.7                              | 20.8                                 |
| Pyrene                   | 19.9                                     | 19.2                              | 12.2                                 |
| Benzo (a) anthracene     | 4.5                                      | 5.1                               | 2.2                                  |
| Chrysene                 | 4.7                                      | 5.1                               | 4.7                                  |
| Benzo (b) fluoranthene   | 5.3                                      | 6.3                               | 5.7                                  |
| Benzo (k) fluoranthene   | 1.6                                      | 2.1                               | 1.2                                  |
| Benzo (a) pyrene         | 3.0                                      | 3.8                               | 1.6                                  |
| Indeno (123-cd ) pyrene  | 2.1                                      | 2.7                               | 1.2                                  |
| Dibenzo (a,h) anthracene | 0.45                                     | 0.5                               | 0.35                                 |
| Benzo (g,h,i) perylene   | 1.9                                      | 2.5                               | 1.3                                  |
| <b>Sum PAH</b>           | <b>136</b>                               | <b>117</b>                        | <b>115</b>                           |

#### DATA INTERPRETATION

There are no prescribed limit values for total polycyclic hydrocarbons in ambient air, nor any recommendations in the legislation of EU countries. Directive 2004/107/EC sets a target value of 1 ng/m<sup>3</sup> for the mean annual value of benzo (a) pyrene in suspended PM<sub>10</sub> particles.

## 5.0 CONCLUSION

### SOIL

#### SOIL (0-20 cm and 20-40 cm)

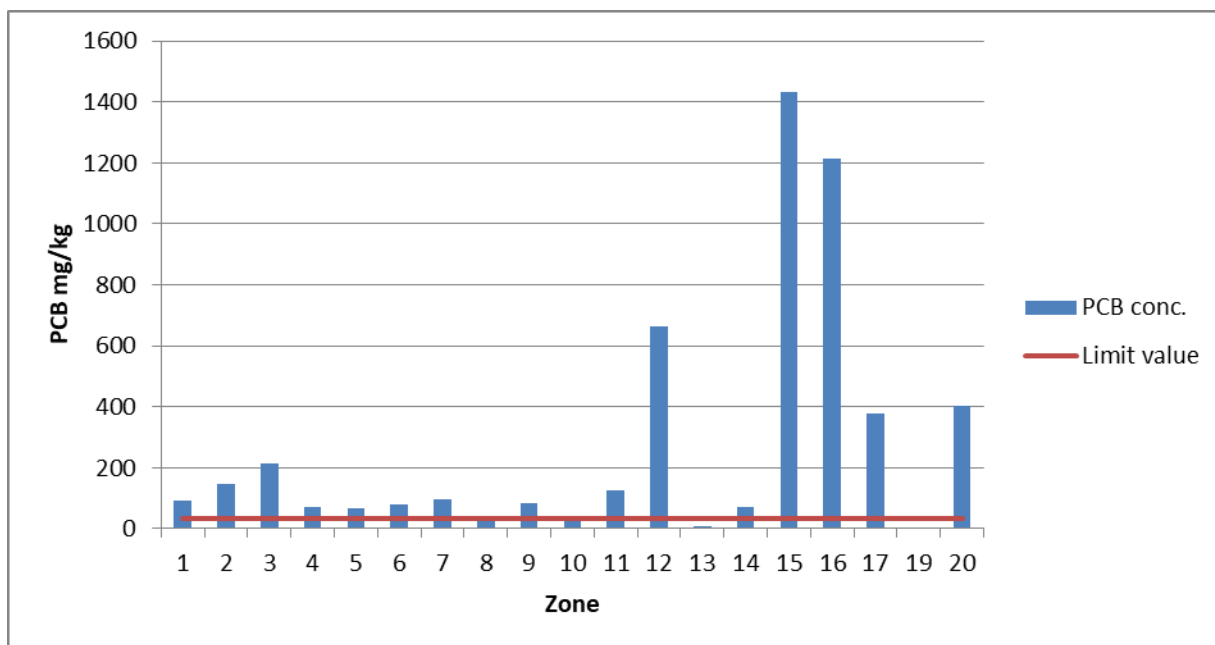
In the vicinity of the PCB warehouse, a total of 44 soil samples were analyzed, of which 28 were sampled from a depth of 0-20 cm and 16 samples from a depth of 20-40 cm.

The results of PCB analysis observed in relation to the Dutch Soil Intervention Values (Dutch Ministry of Housing, Land Planning and Environment, 2009) show that most of the analyzed samples greatly exceed the PCB intervention value given by this standard. Only soil samples in zones 13 and 19, at both depths tested (0-20cm and 20-40cm), as well as soil samples in zone 5 (20-40cm), have PCB concentrations below soil intervention value.

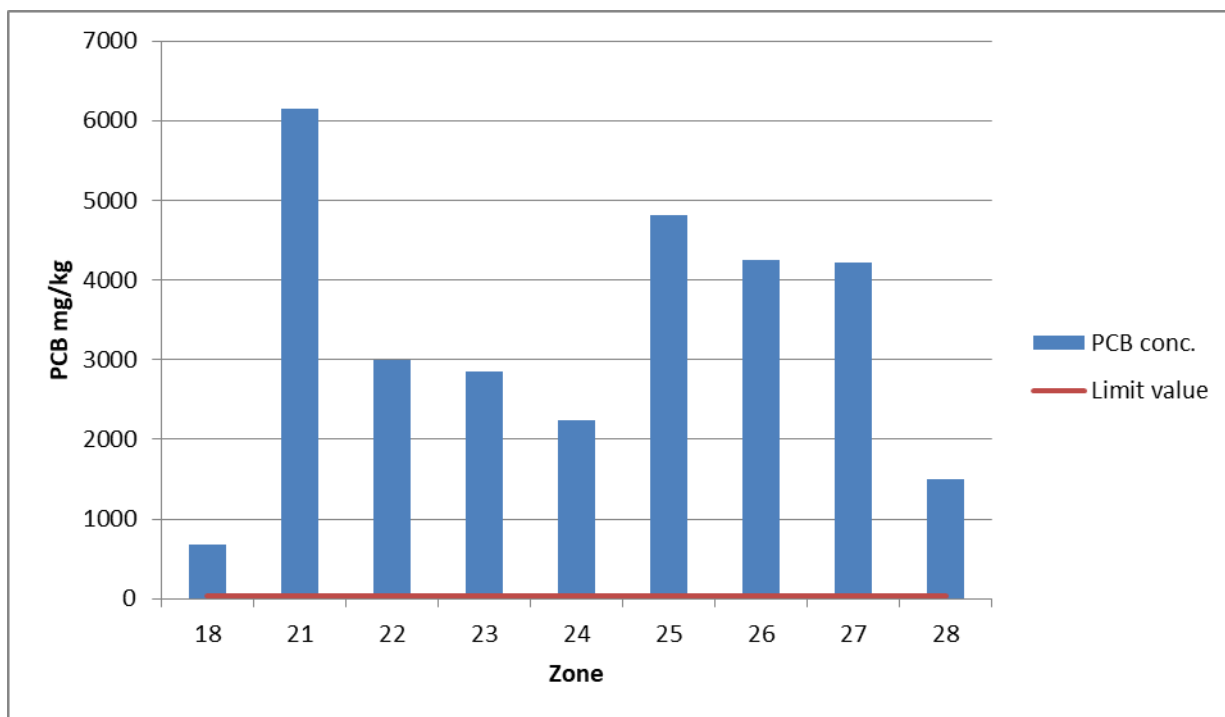
In addition to the Dutch soil quality standard, the limits set in UNIDO's "POPs Contaminated Site Investigation and Management Toolkit" were used for interpretation of results. According to UNIDO guidelines, the acceptable limit of PCB concentration in soil in commercial and industrial areas is 33 mg/kg.

The results of PCB analysis observed in relation to the UNIDO limit value show that of the 28 samples analyzed, taken from a depth of 0-20 cm, in 25 samples PCB concentrations significantly exceed the acceptable limit.

Obtained values of PCB by test zones compared to the UNIDO acceptable limit are shown in figure 14 and 15.



**Figure 14.** PCB concentration in zones 1-20 compared to the UNIDO acceptable limit



**Figure 15.** PCB concentration in zones 18 and 21-28 compared to the UNIDO acceptable limit

As can be seen from the plots, particularly high concentrations of PCBs were found in zones 18 and zones 21-28 located next to and around the storage area itself. These zones are 1 m higher in relation to the other analyzed zones and the surface layer of them consists of a mixture of soil, sand and gravel.

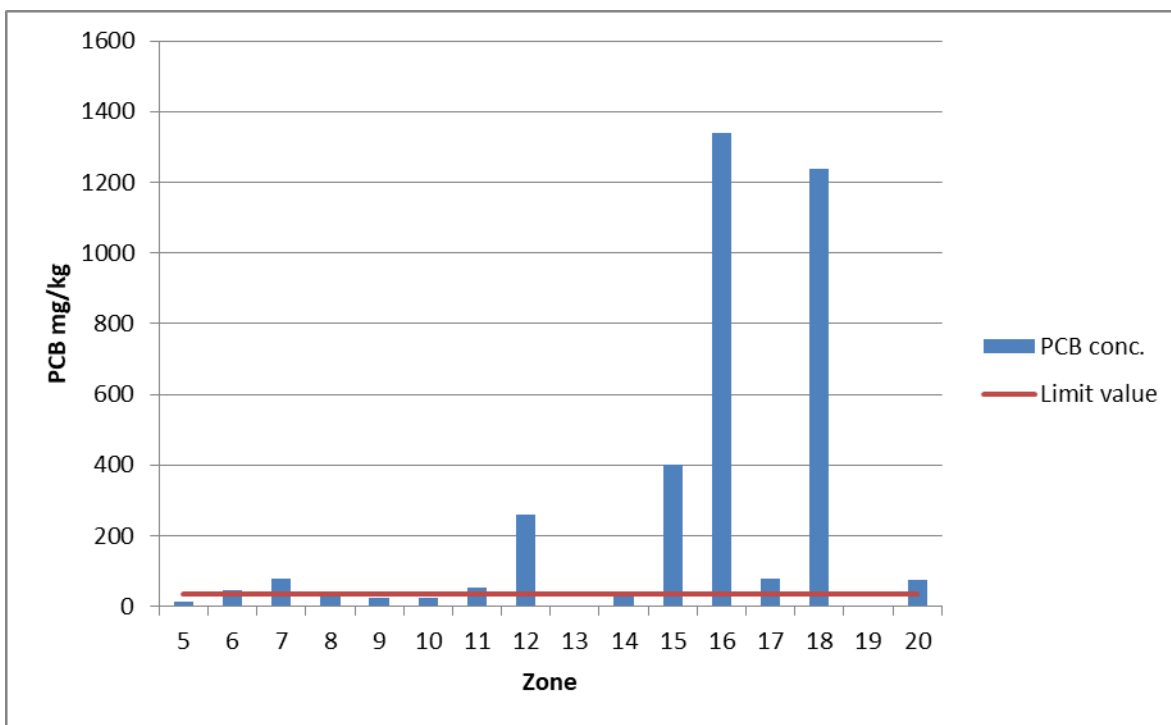
The zones that also have a high PCB content are zones 12, 15, 16, 17 and 20, which represent the area around the drainage of transformer oil collection pit, which is located at the end of the concrete platform in the area of zone 22.

Samples from zones (13 and 19) located at the boundary parts of subjected area have the lowest PCB content in the surface layer of soil, which is expected since they are farthest from the warehouse and the platform in front of the warehouse where PCB equipment and tanks with waste PCB transformer oil were stored.

The content of PCBs in these zones is both according to the UNIDO guide and to the Dutch standard below the limits which indicate significant soil contamination with PCBs.

The results of PCB analysis in soil samples from a depth of 20-40 cm observed with respect to the UNIDO limit value show that in 9 of the 16 analyzed samples, concentration of PCBs exceeds the acceptable limit of 33 mg/kg.

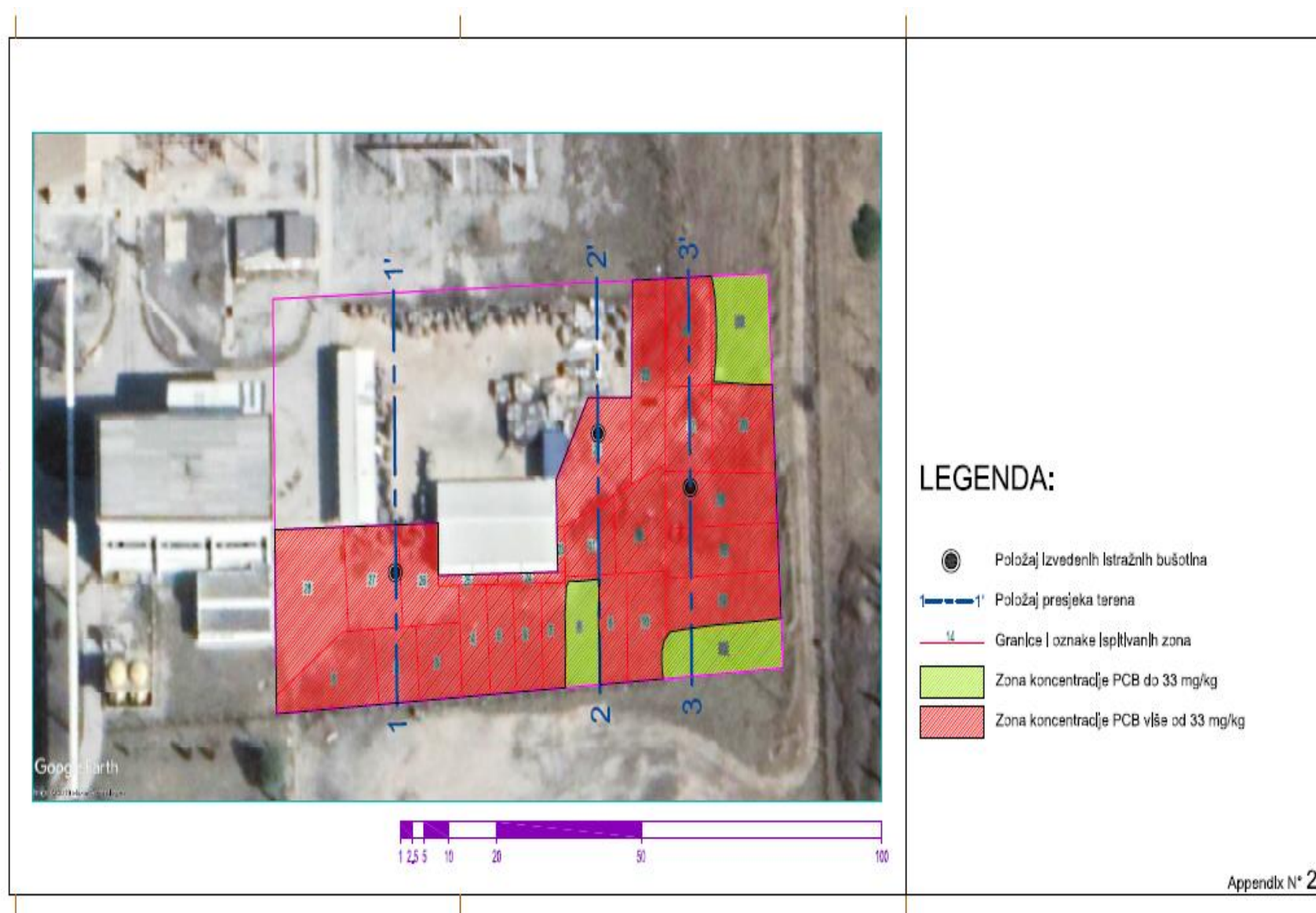
Obtained PCB concentrations (20-40 cm) compared to the UNIDO acceptable limit are shown in figure 16.



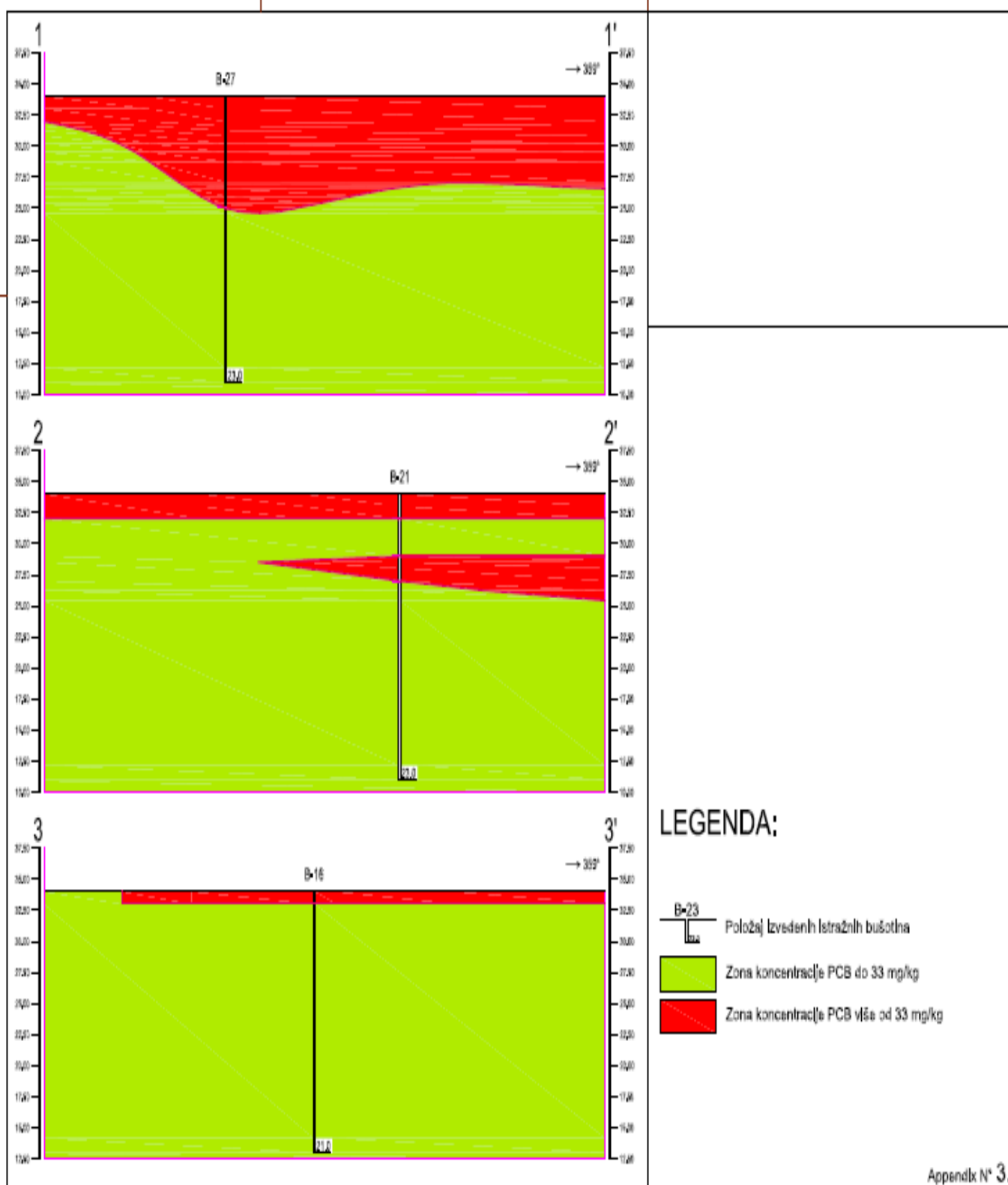
**Figure 16.** PCB concentration in zones 5-20 compared to the UNIDO acceptable limit

The results of the analysis show that the content of PCBs at depths of 20-40 cm is still highest in zones 12, 15, 16, 17, 18 and 20 which were probably directly exposed by the leakage of PCB transformer oil from both the platform in front of the PCB storage and the transformer oil collection pit.

The horizontal and vertical distribution of PCBs in the soil is shown in Figures 17 and 18. The estimated volume of contaminated soil (above MPL) up to a depth of 2m is 6300 m<sup>3</sup>.



**Figure 17.** The horizontal distribution of PCBs



**Figure 18.** The vertical distribution of PCBs

## BOREHOLES

After testing the surface layer of soil, three boreholes were drilled in the areas where the PCB content was highest, in order to determine the vertical distribution of the PCBs.

The results of soil/solid analysis from boreholes show that the highest concentrations of PCBs are in the first meter (0-1m) in all of them and significantly exceed the acceptable limit for PCBs in soil for commercial and industrial use given in UNIDO "POPs Contaminated Site Investigation and Management Toolkit" as well as the Dutch Soil Intervention Value (Dutch Ministry of Housing, Land Planning and Environment, 2009).

The vertical distribution of PCBs is largest in the borehole located in zone 27 where the PCB concentration up to 9 meters exceeds the limit given by UNIDO guides, or up to 10 m exceeds the soil intervention value given by the Dutch soil quality standard.

In the borehole located in zone 16, PCB concentrations are already after first meter within the permitted limit values given by the UNIDO guidelines for soil for commercial and industrial use, while the PCB distribution up to 6 m exceeds the soil by Dutch standard intervention value.

In the borehole located in zone 21, the content of PCBs in the first two meters significantly exceeds the UNIDO limit value for PCBs for industrial use as well as at a depth of 5-6m, while at a depth of 6-7m it slightly exceeds the UNIDO limit value for PCBs. Compared to the Dutch soil intervention value, the PCB concentration exceeds the limit up to 13 m except in depth 10-11m and significantly exceeding the intervention value in the first meter. Table 28 shows the vertical distribution of PCBs in boreholes compared to the UNIDO limit value for industrial soil and Dutch soil intervention value.

**Table 28.** Review of vertical distribution of PCBs in boreholes compared to UNIDO limit value for industrial soil and Dutch soil intervention value

| UNIDO limit value for industrial soil |                    |                    | Depth | Dutch soil intervention value |                      |                      |
|---------------------------------------|--------------------|--------------------|-------|-------------------------------|----------------------|----------------------|
| Borhole 21                            | Borhole 27         | Borhole 16         |       | Borhole 21                    | Borhole 27           | Borhole 16           |
| Total PCB<br>mg/kg                    | Total PCB<br>mg/kg | Total PCB<br>mg/kg |       | Σ 7PCB<br>congeners*          | Σ 7PCB<br>congeners* | Σ 7PCB<br>congeners* |
| 2643±260                              | 10868±1068         | 716±87             | 0-1m  | 575±86                        | 1904±286             | 135 ±20              |
| 196±19                                | 344±34             | 36±4               | 1-2m  | 34±5                          | 62±9                 | 8.9±1.3              |
| 24±2                                  | 652±64             | 32±4               | 2-3m  | 5.1±0.8                       | 118±18               | 4.9±0.7              |
| 17±2                                  | 430±42             | 19±2               | 3-4m  | 3.9±0.6                       | 63±10                | 2.9±0.4              |
| 23±2                                  | 374±37             | 16±2               | 4-5m  | 5.0±0.8                       | 71±11                | 2.8±0.4              |
| 86±8                                  | 196±19             | 14±1               | 5-6m  | 15±2                          | 39±5                 | 2.9±0.4              |
| 42±4                                  | 95±9               | 11±1               | 6-7m  | 9.8±1.5                       | 19±3                 | 2.2±0.3              |

|          |         |           |        |           |           |           |
|----------|---------|-----------|--------|-----------|-----------|-----------|
| 37±4     | 46±5    | 8.4±0.8   | 7-8m   | 5.4±0.8   | 9.2±1.3   | 1.8±0.3   |
| 12.0±1.2 | 42±4    | 5.2±0.5   | 8-9m   | 2.6±0.4   | 9.1±1.3   | 1.2±0.2   |
| 18±2     | 26±3    | 5.7±0.6   | 9-10m  | 3.2±0.5   | 5.2±0.7   | 1.2±0.2   |
| 10±1     | 13±1    | 4.2±0.4   | 10-11m | 2.1±0.3   | 2.5±0.4   | 0.86±0.13 |
| 22±2     | 17±2    | 2.8±0.3   | 11-12m | 3.9±0.6   | 3.6±0.5   | 0.54±0.08 |
| 17±2     | 9.3±0.9 | 3.2±0.3   | 12-13m | 3.1±0.5   | 1.8±0.3   | 0.64±0.10 |
| 4.2±0.6  | 5.7±0.6 | 1.9±0.2   | 13-14m | 0.98±0.15 | 1.1±0.2   | 0.38±0.06 |
| 2.8±0.4  | 2.7±0.3 | 1.1±0.1   | 14-15m | 0.64±0.10 | 0.54±0.08 | 0.21±0.03 |
| 2.7±0.4  | 4.3±0.4 | 1.6±0.2   | 15-16m | 0.64±0.10 | 0.88±0.12 | 0.34±0.05 |
| 2.6±0.4  | 2.4±0.2 | 1.8±0.2   | 16-17m | 0.61±0.09 | 0.49±0.07 | 0.35±0.05 |
| 1.0±0.1  | 2.2±0.2 | 1.1±0.1   | 17-18m | 0.22±0.03 | 0.46±0.06 | 0.23±0.03 |
| 11±2     | 1.9±0.2 | 0.94±0.09 | 18-19m | 2.0±0.3   | 0.37±0.05 | 0.20±0.03 |
| 33±5     | 3.1±0.3 | 0.68±0.07 | 19-20m | 5.1±0.8   | 0.59±0.08 | 0.14±0.02 |
| 10±1     | 2.6±0.3 | 0.81±0.08 | 20-21m | 1.8±0.3   | 0.51±0.07 | 0.16±0.02 |
| 8.1±1.2  | 1.4±0.1 | /         | 21-22m | 1.5±0.2   | 0.28±0.04 | /         |
| 12±1     | 1.8±0.2 | /         | 22-23m | 2.3±0.4   | 0.41±0.06 | /         |

\*Σ7PCB= 28, 52, 101, 118, 138, 153 and 180

## UNDERGROUND WATER

Analysis of underground water for the presence of PCBs was carried out in piezometers and wells located upstream and downstream of the flow relative to the test area where the PCB storage is located.

The results of the analysis show that on all tested location content of PCB is below groundwater target values (Dutch Ministry of Housing, Land Planning and Environment, 2009), which indicates that there is no influence of contaminated PCB soil on groundwater in the the environment of KAP PCB storage.

## WALL-WIPE TEST

Results from wipe testing of inside PCB storage walls show that PCB concentrations are in range from 0.26 to 9.7 µg/100cm<sup>2</sup>.

According to the US EPA, the PCB limit value for indoor surfaces is 10 µg/100cm<sup>2</sup>. Given that all the found concentrations of wipe test of indoor walls in KAP PCB storage are below a concentration of 10 µg/100cm<sup>2</sup>, we can conclude that the walls of the warehouse as a low-contact industrial surface do not pose a risk for dermal contact.

## **CONCRETE**

The results of the analysis of concrete platform in front of the storage as well as concrete floor in the storage itself show increased concentration of PCBs in certain test areas, both in the PCB warehouse itself and on the platform in front of the warehouse. The increased concentration of PCB in analyzed concrete is due to the leakage of oil from stored equipment containing PCB transformer oil as well as from stored tanks with waste PCB transformer oil, which is especially noticeable on the locations marked as points 2, 3, 11, 12, 13, 28, 29 on Figure 11.

## **AIR**

The results of the ambient air analysis at the investigated site show that the measured PCB concentrations are in the range of 470-620 ng/m<sup>3</sup> in the case of total Aroclors and 132-173 ng/m<sup>3</sup> in the case of the sum of individual congeners. The results indicate a significant presence of PCBs in ambient air near the storage, which is in a way expected given the site specificity (PCB transformer storage)

The results of ambient air analysis on the presence of polycyclic aromatic hydrocarbons show extremely high measured values in all three measurement cycles. Such high measured PAH values are certainly due to the proximity of the Anode plant, which uses electrolytic resin, coke and ground anode residue (the rest of the anodes used) in its production.

## **ANNEX I**

### **PHOTO DOCUMENTATION OF SOIL SAMPLING**



***Figure 1. Soil sampling in Zone 1***



***Figure 2. Soil sampling in Zone 2***



***Figure 3. Soil sampling in Zone 3***



***Figure 4. Soil sampling in Zone 4***



***Figure 5. Soil sampling in Zone 5***



***Figure 6. Soil sampling in Zone 6***



***Figure 7. Soil sampling in Zone 7***



***Figure 8. Soil sampling in Zone 8***



***Figure 9. Soil sampling in Zone 9***



***Figure 10. Soil sampling in Zone 10***



***Figure 11. Soil sampling in Zone 11***



***Figure 12. Soil sampling in Zone 12***



***Figure 13. Soil sampling in Zone 13***



***Figure 14. Soil sampling in Zone 14***



***Figure 15. Soil sampling in Zone 15***



***Figure 16. Soil sampling in Zone 16***



***Figure 17. Soil sampling in Zone 17***



***Figure 18. Soil sampling in Zone 18***



***Figure 19. Soil sampling in Zone 19***



***Figure 20. Soil sampling in Zone 20***



***Figure 21. Soil sampling in Zone 21***



***Figure 22. Soil sampling in Zone 22***



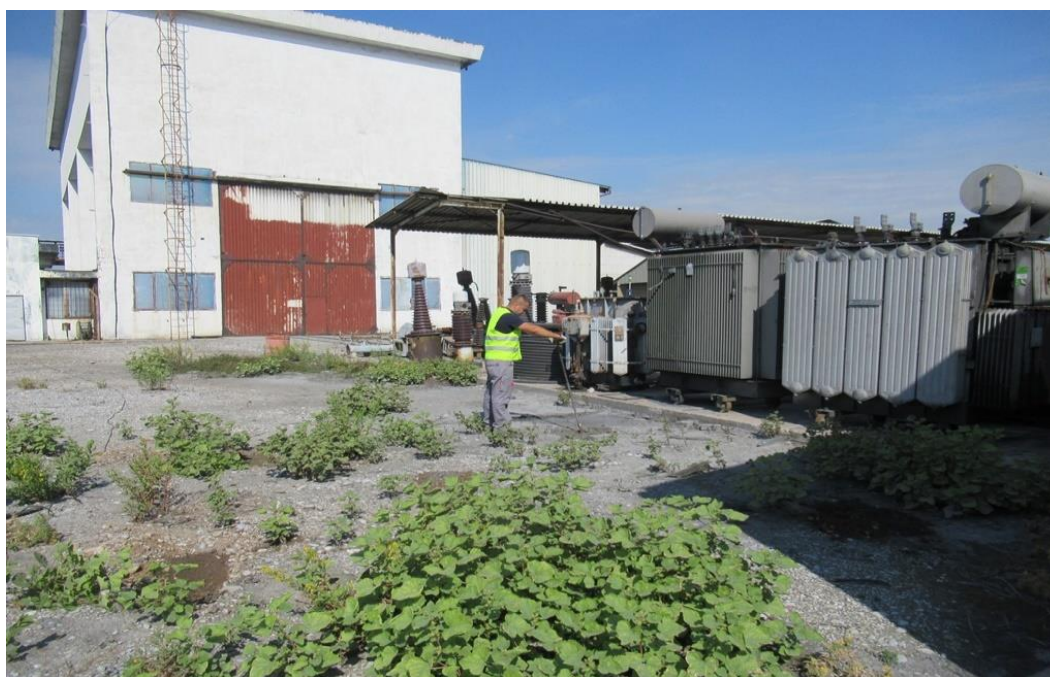
*Figure 23. Soil sampling in Zone 23*



*Figure 24. Soil sampling in Zone 24*



***Figure 25. Soil sampling in Zone 25***



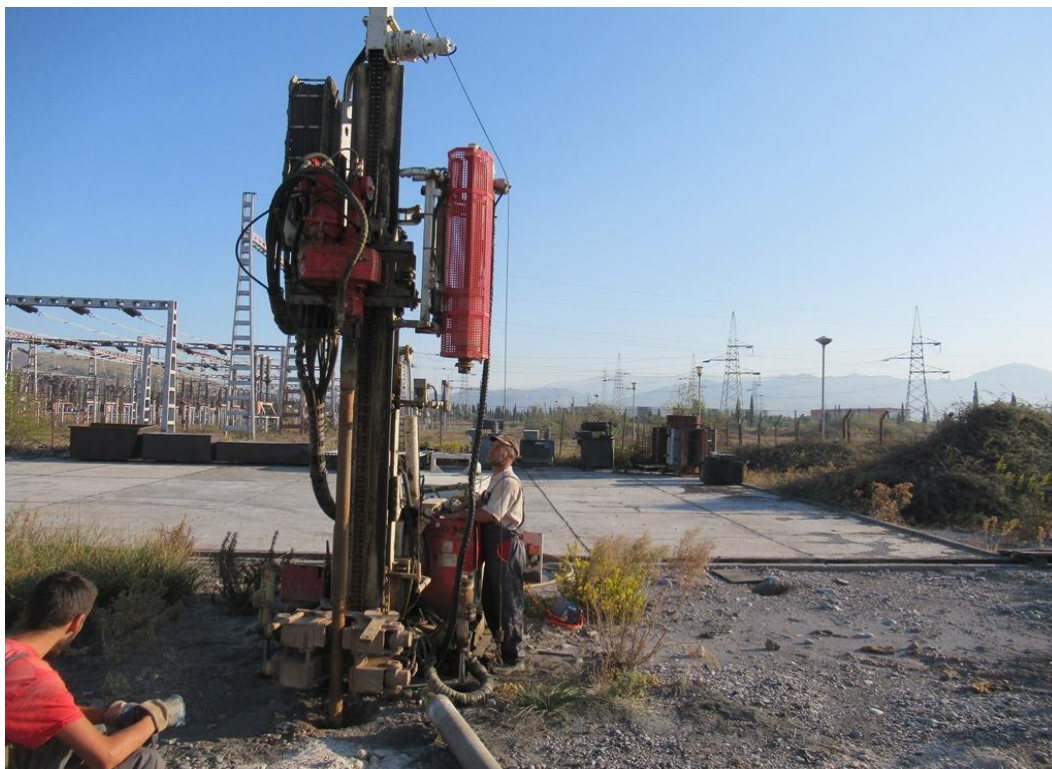
***Figure 26. Soil sampling in Zone 26***



***Figure 27. Soil sampling in Zone 27***



***Figure 28. Soil sampling in Zone 28***



***Figure 29. Borehole drilling***



***Figure 30. Borehole drilling***



**Figure 31. Borehole drilling**



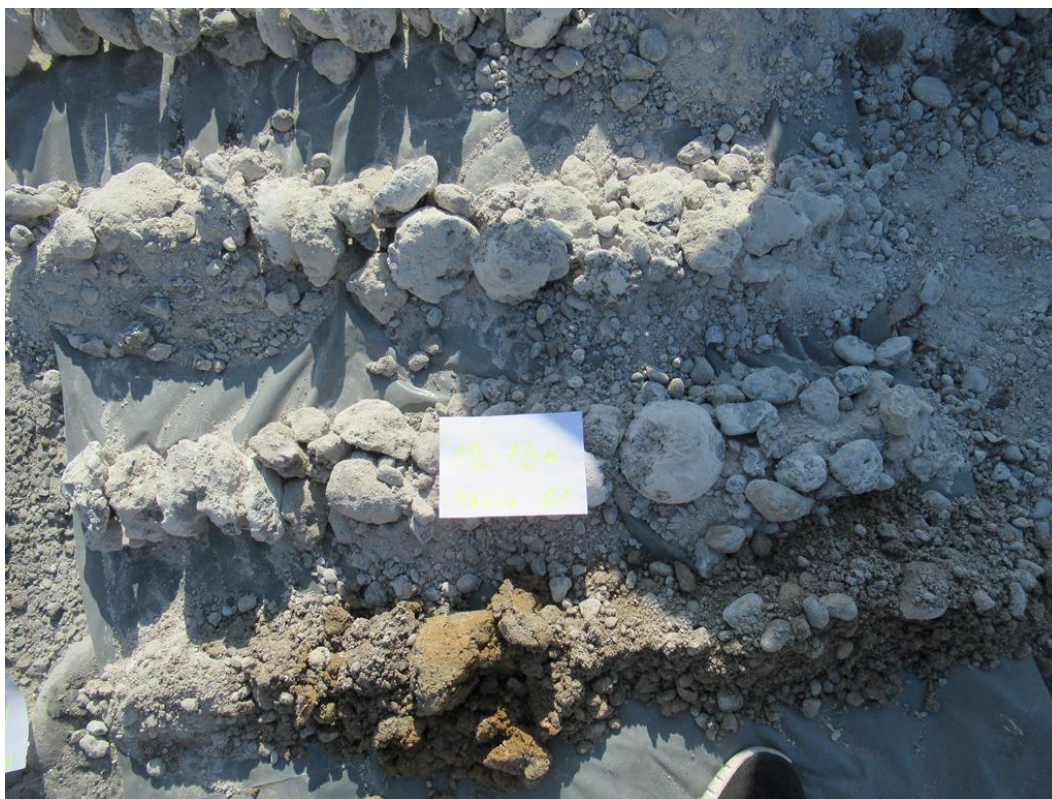
**Figure 32. Soil samples from borehole**



**Figure 33. Soil samples from borehole**



**Figure 34. Soil samples from borehole**



**Figure 35. Soil samples from borehole**



**Figure 36. Soil samples from borehole**

## **ANNEX II**

### **PHOTO DOCUMENTATION OF WATER SAMPLING**



***Figure 1. Site of underground water sampling***



***Figure 2. Site of underground water sampling***



**Figure 3.** Site of underground water sampling



**Figure 4.** Site of underground water sampling



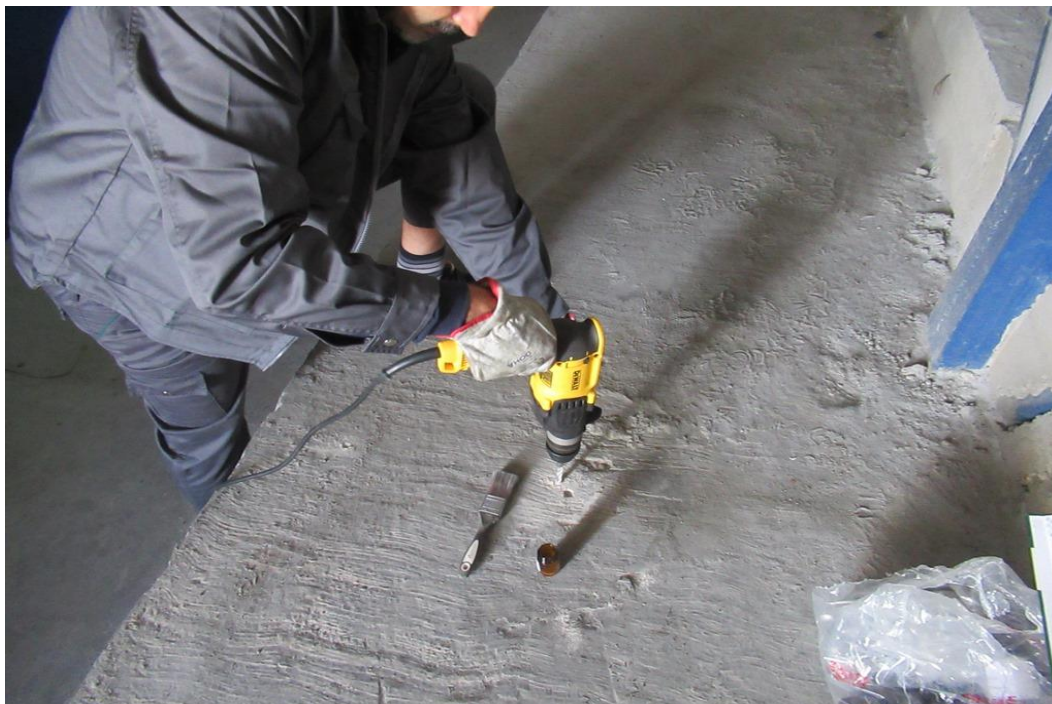
***Figure 5. Site of underground water sampling***



***Figure 6. Site of underground water sampling***

## **ANNEX III**

### **PHOTO DOCUMENTATION OF CONCRETE SAMPLING**



***Figure 1. Concrete sampling***



***Figure 2. Concrete sampling***



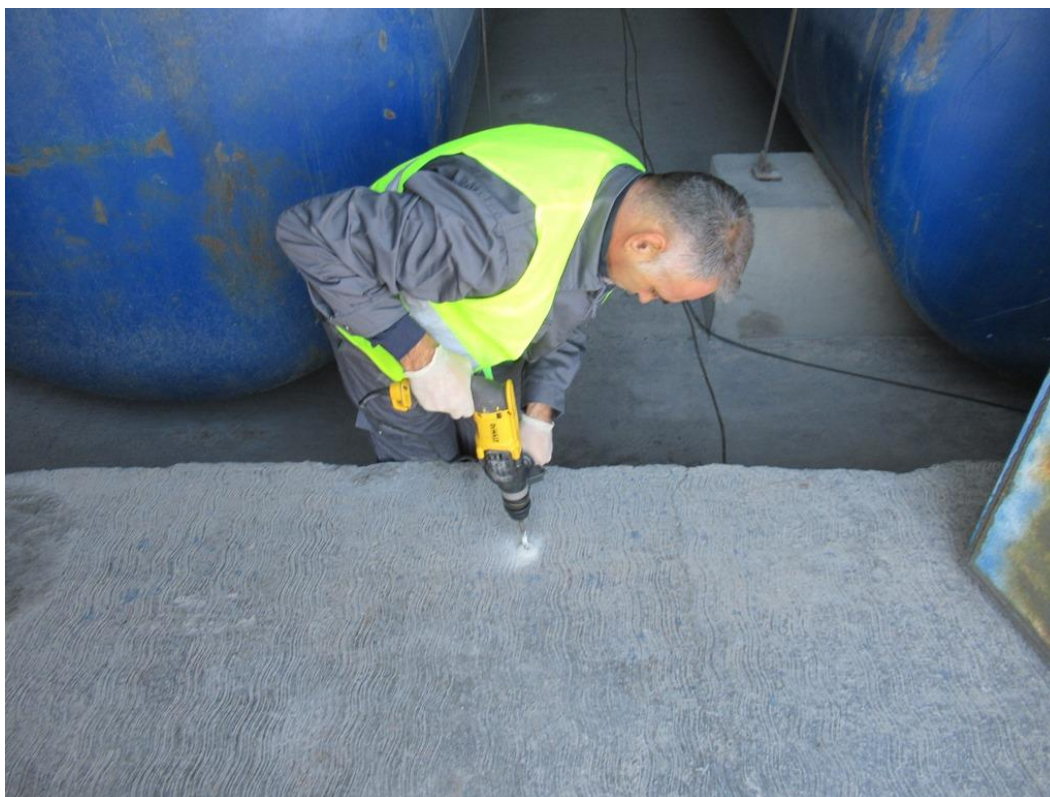
***Figure 3. Concrete sampling***



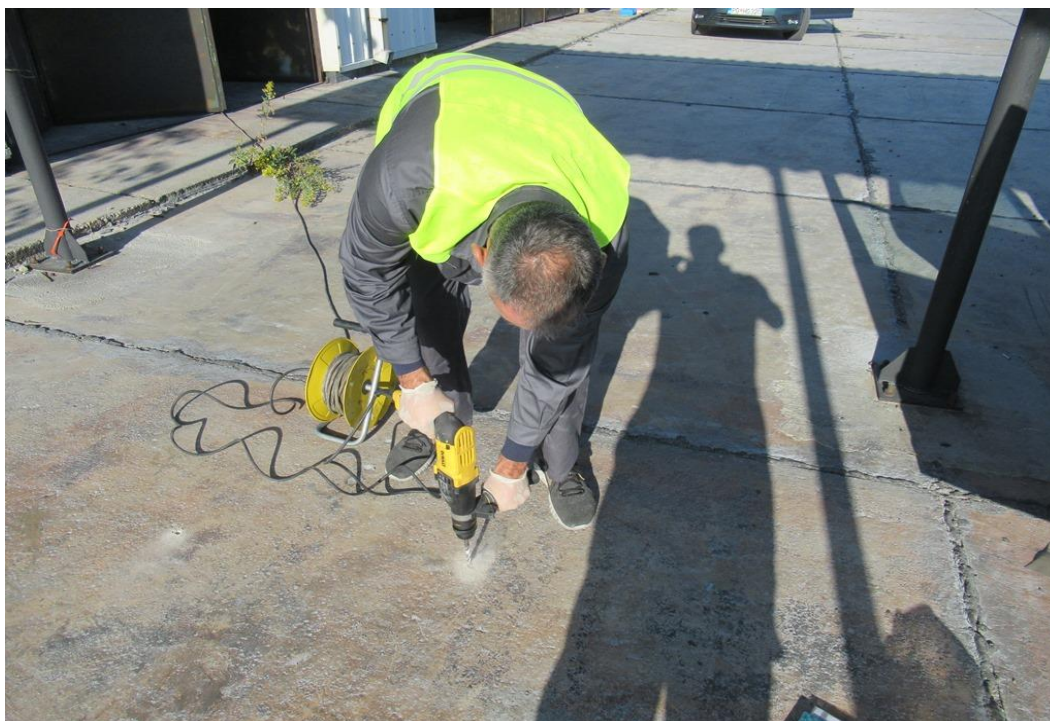
***Figure 4. Concrete sampling***



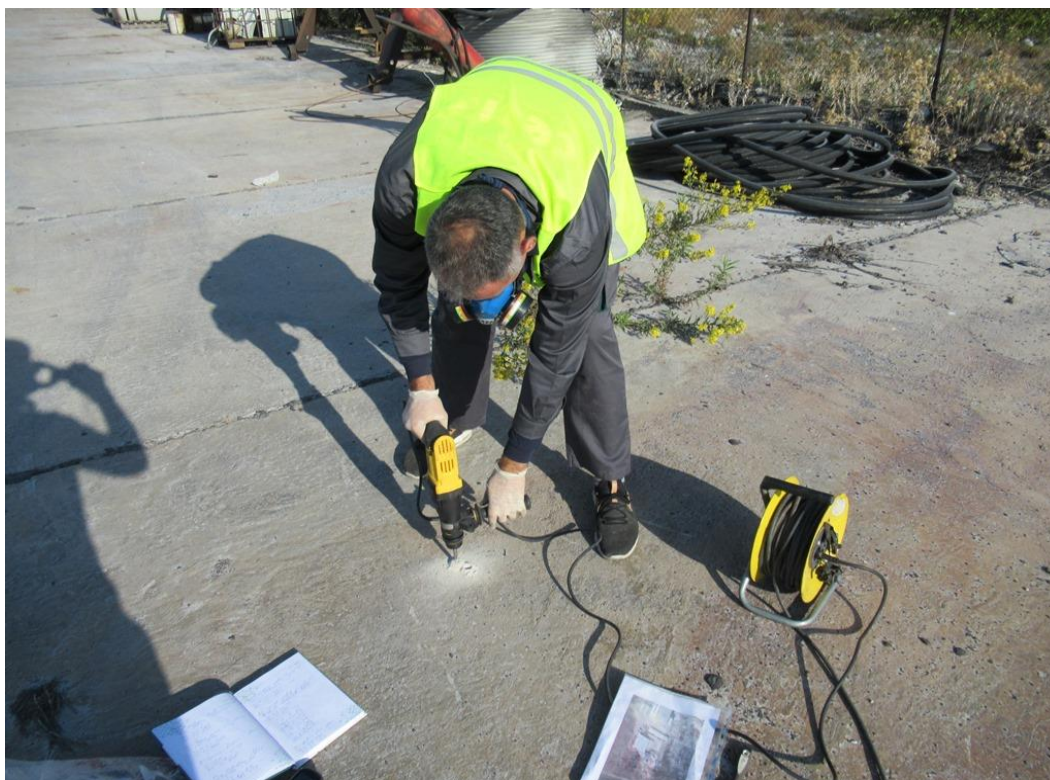
***Figure 5. Concrete sampling***



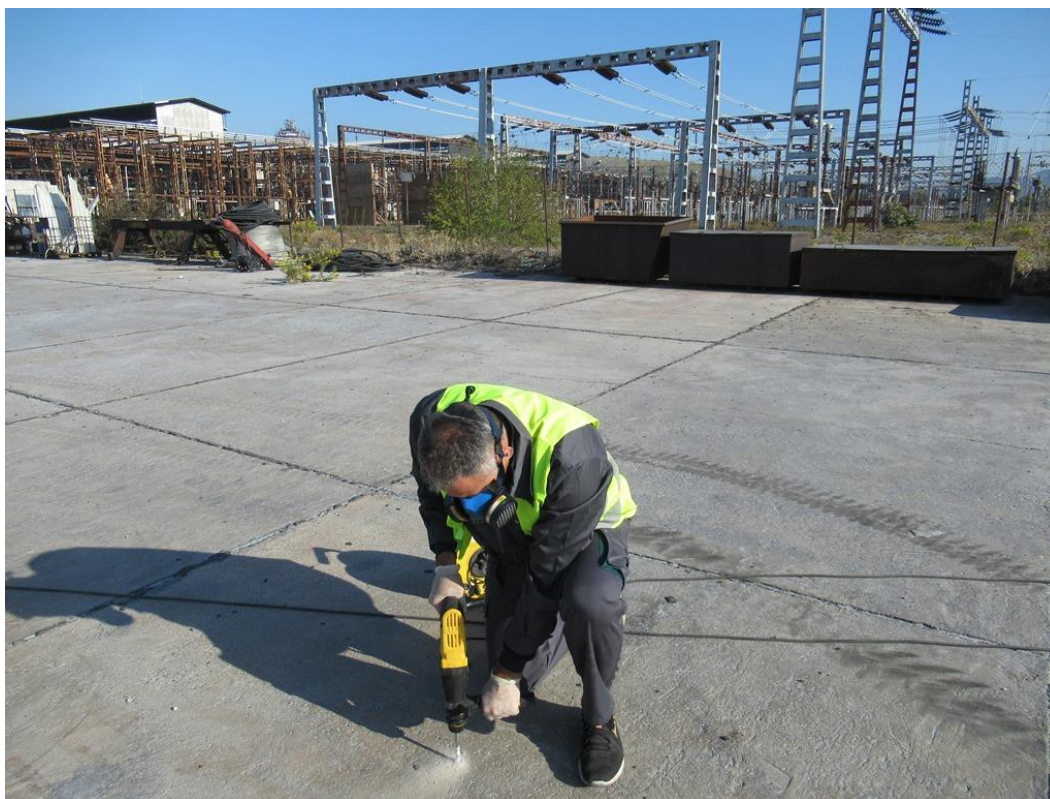
***Figure 6. Concrete sampling***



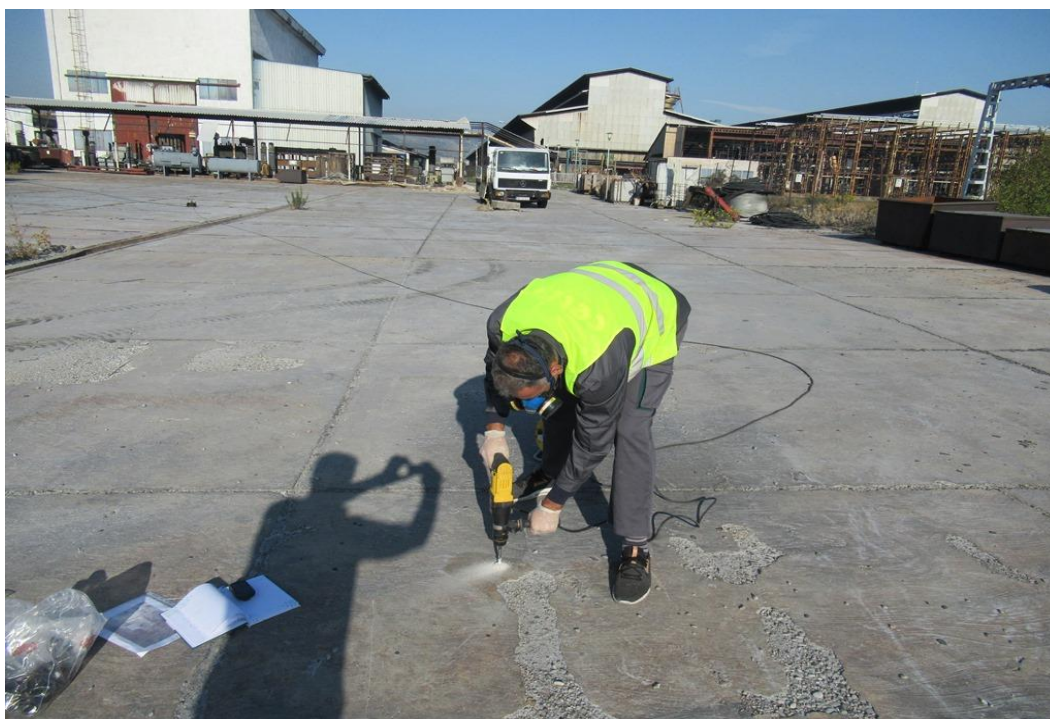
***Figure 7. Concrete sampling***



***Figure 8. Concrete sampling***



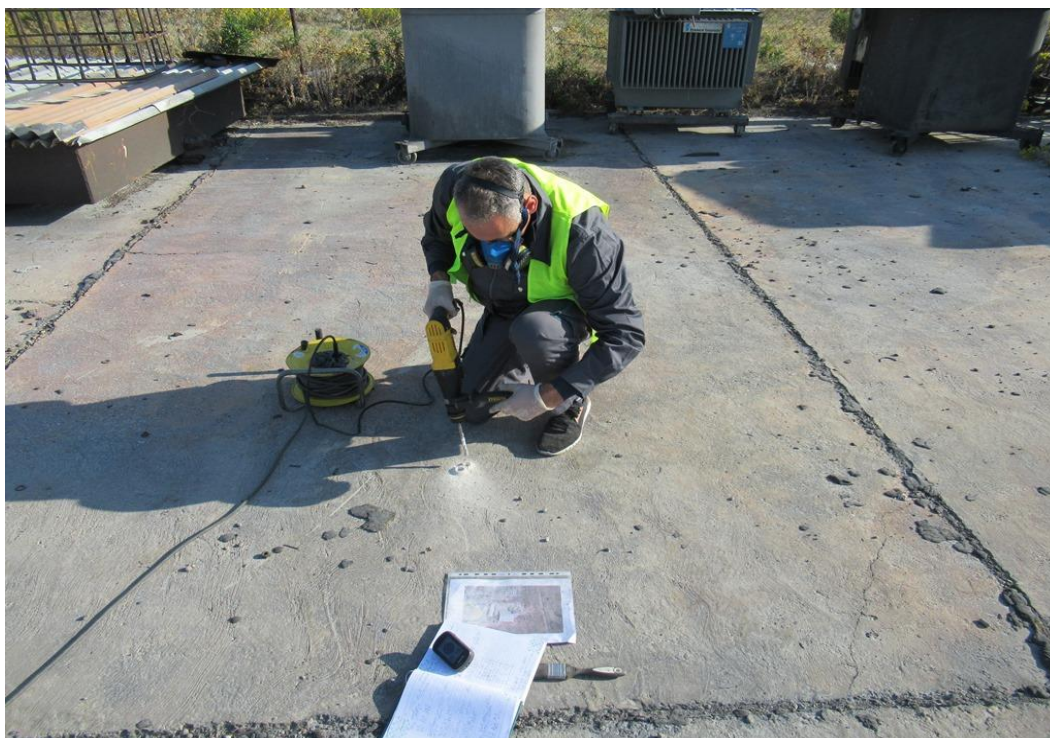
***Figure 9. Concrete sampling***



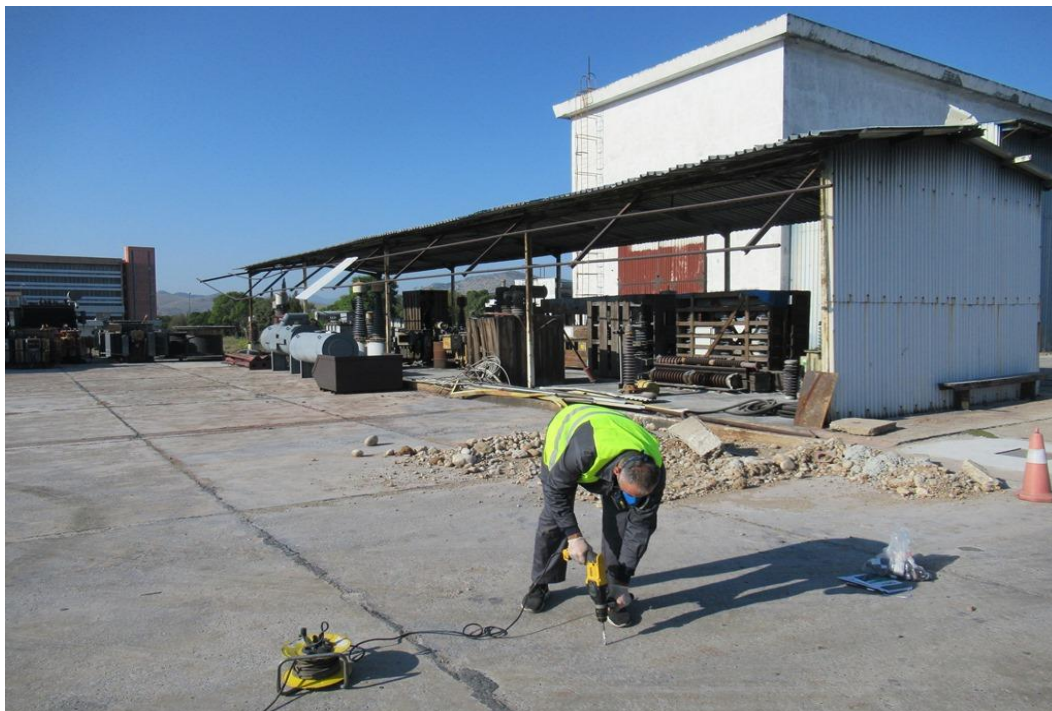
***Figure 10. Concrete sampling***



***Figure 11. Concrete sampling***



***Figure 12. Concrete sampling***



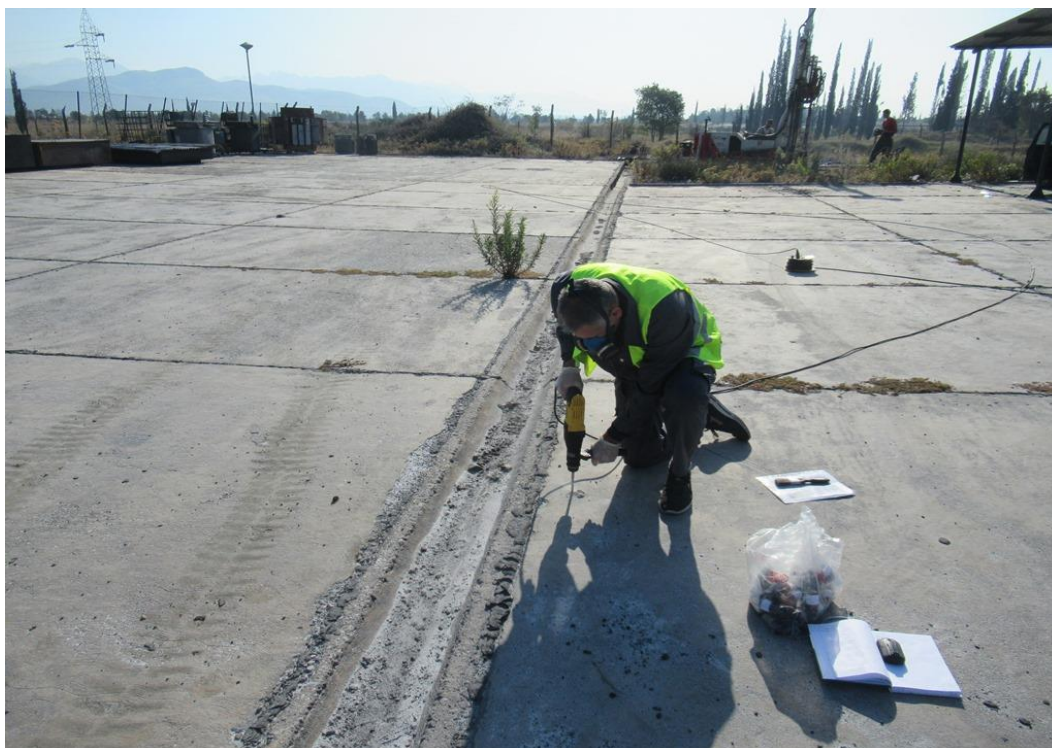
***Figure 13. Concrete sampling***



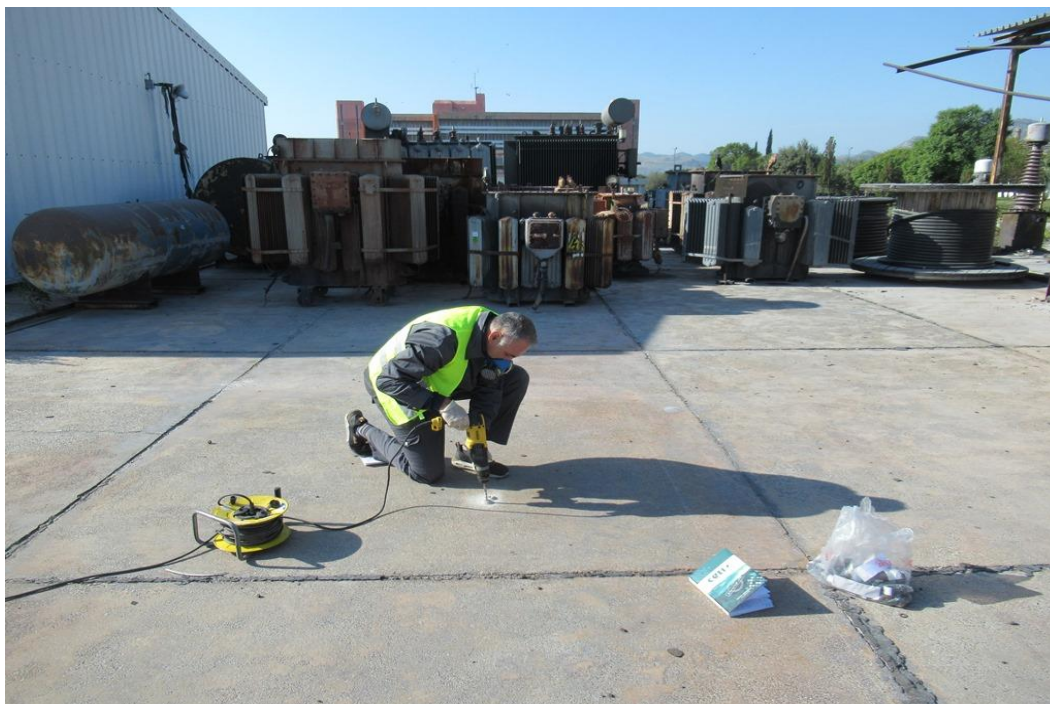
***Figure 14. Concrete sampling***



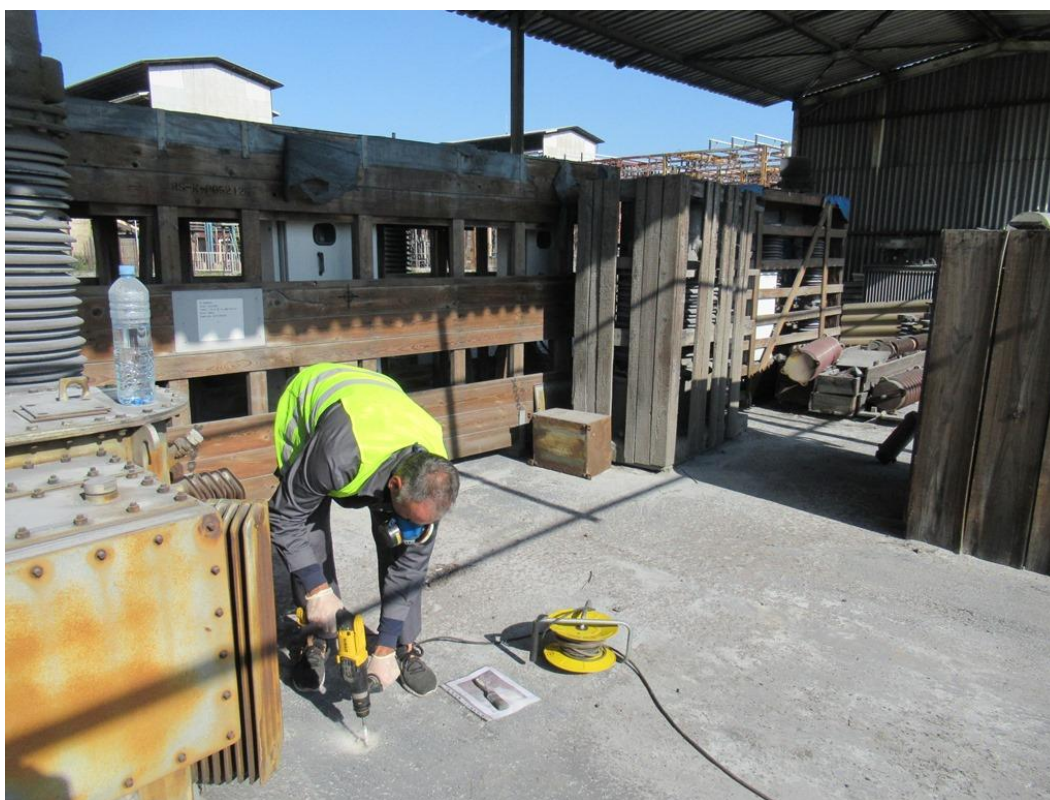
***Figure 15. Concrete sampling***



***Figure 16. Concrete sampling***



***Figure 17. Concrete sampling***



***Figure 18. Concrete sampling***



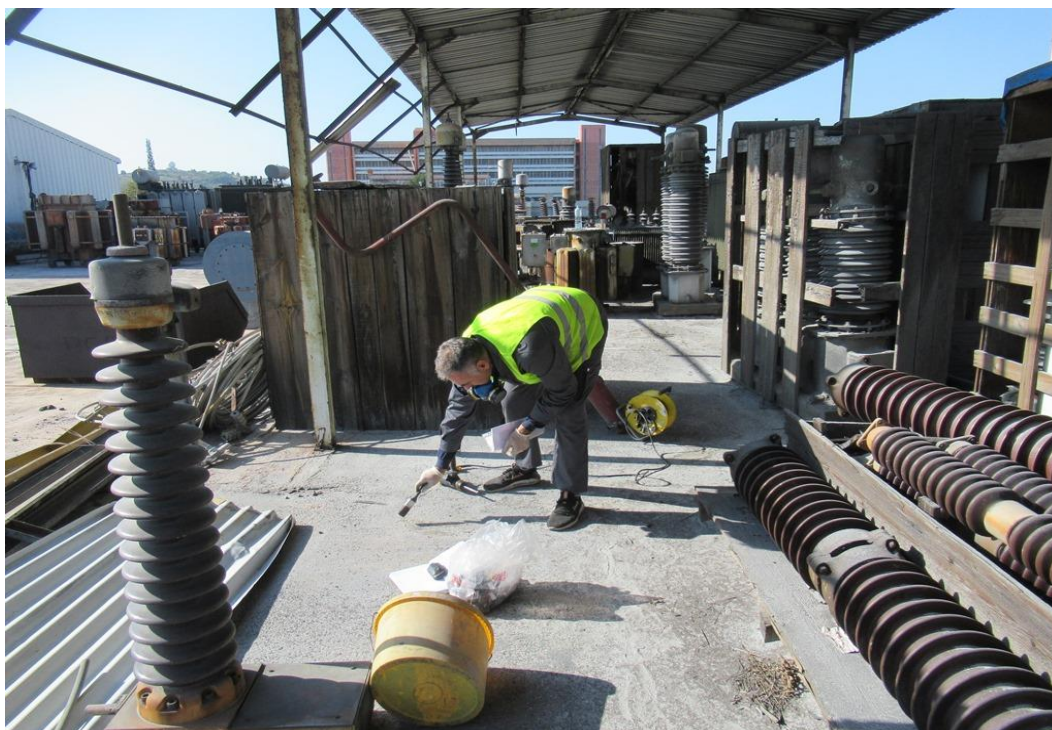
*Figure 19. Concrete sampling*



*Figure 20. Concrete sampling*



*Figure 21. Concrete sampling*



*Figure 22. Concrete sampling*

## **ANNEX IV**

### **PHOTO DOCUMENTATION OF WALL (WIPE) SAMPLING**



*Figure 1. Wall (wipe) sampling*



*Figure 2. Wall (wipe) sampling*



*Figure 3. Wall (wipe) sampling*



*Figure 4. Wall (wipe) sampling*



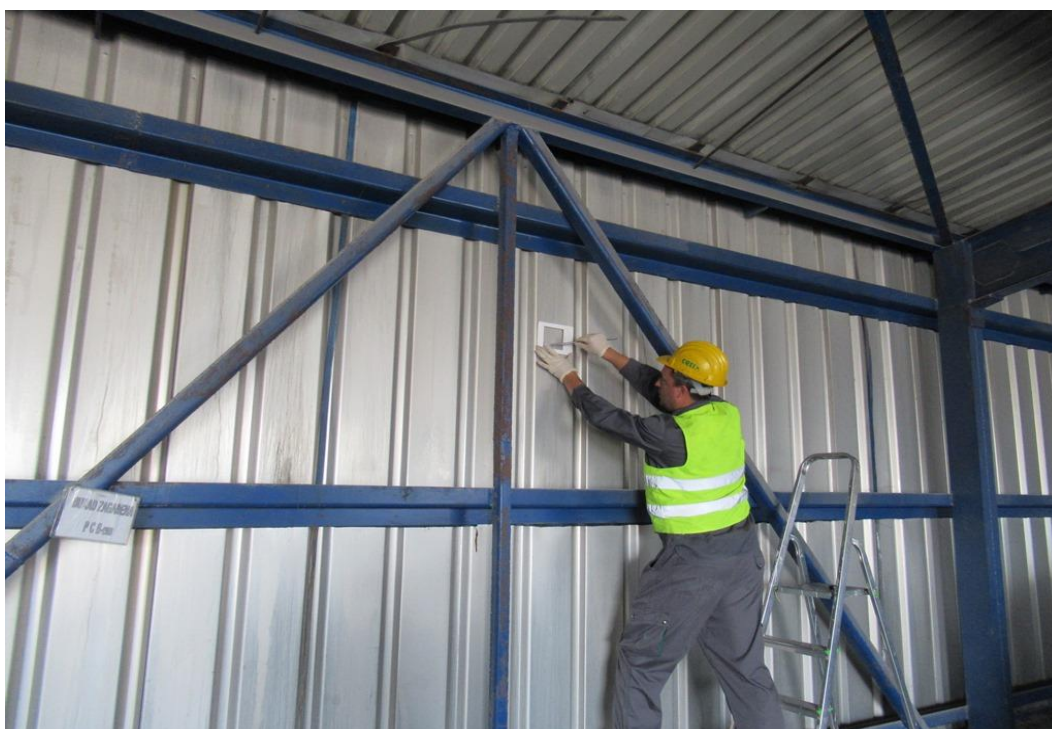
*Figure 5. Wall (wipe) sampling*



*Figure 6. Wall (wipe) sampling*



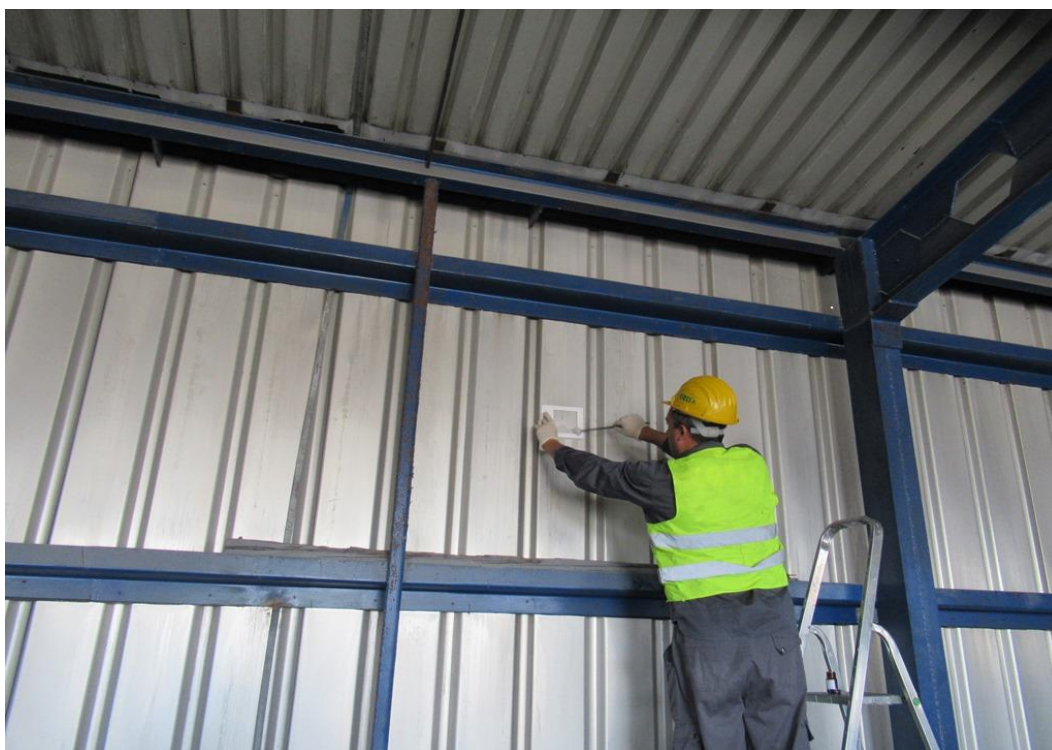
*Figure 7. Wall (wipe) sampling*



*Figure 8. Wall (wipe) sampling*



*Figure 9. Wall (wipe) sampling*



*Figure 10. Wall (wipe) sampling*



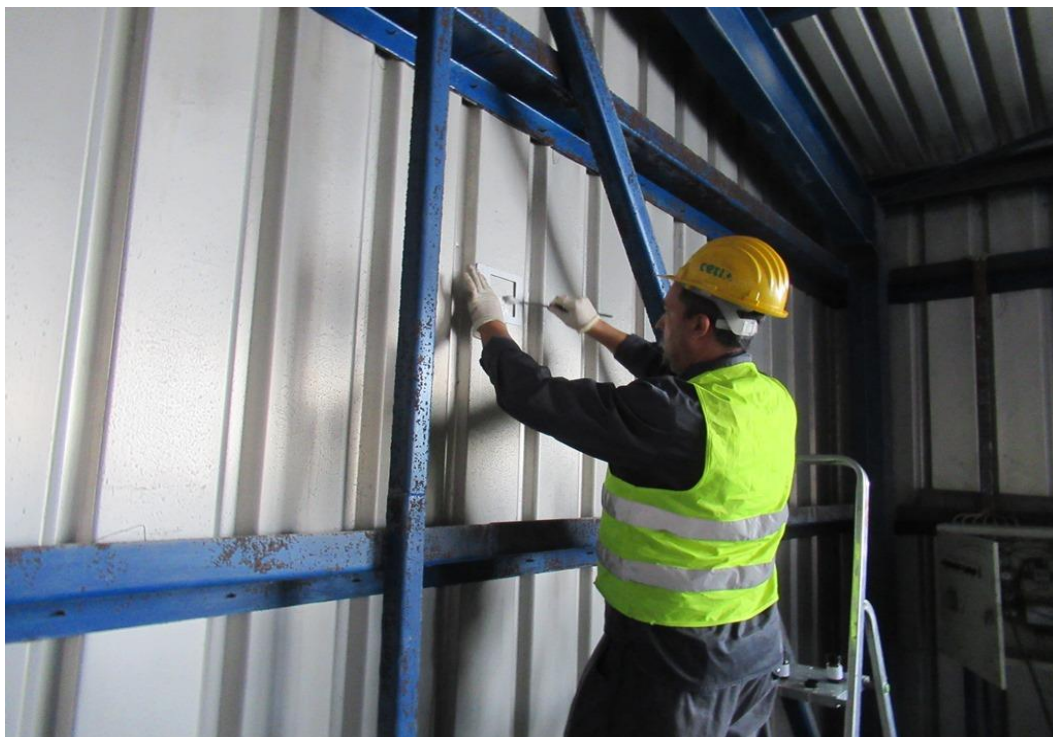
*Figure 11. Wall (wipe) sampling*



*Figure 12. Wall (wipe) sampling*



*Figure 13. Wall (wipe) sampling*



*Figure 14. Wall (wipe) sampling*



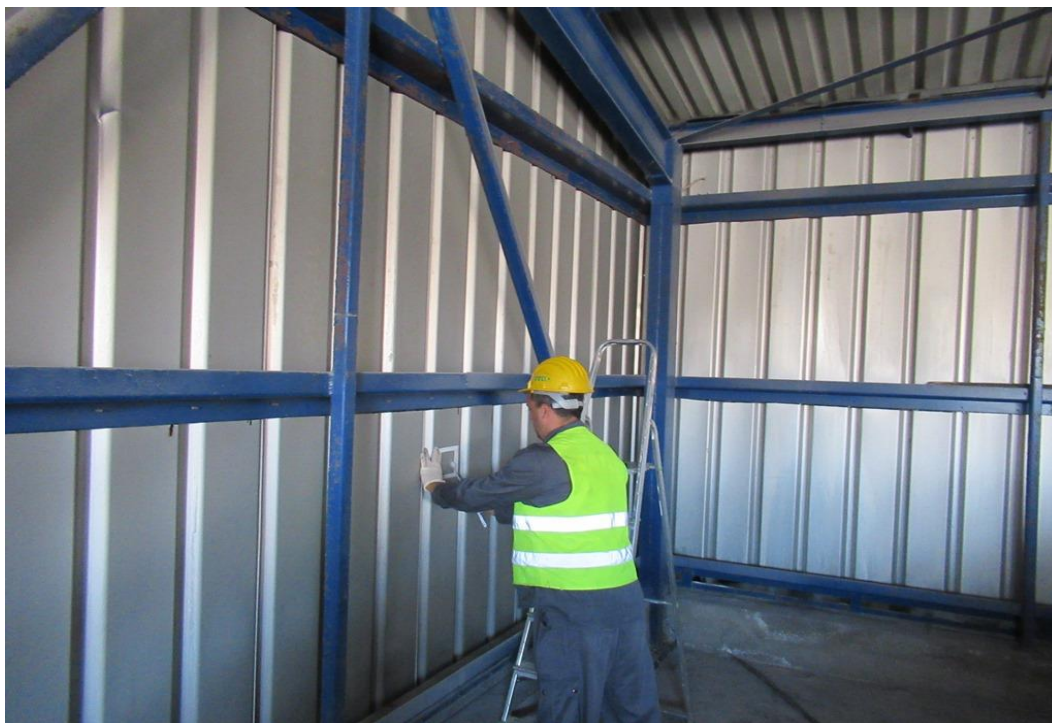
*Figure 15. Wall (wipe) sampling*



*Figure 16. Wall (wipe) sampling*



*Figure 17. Wall (wipe) sampling*



*Figure 18. Wall (wipe) sampling*



*Figure 19. Wall (wipe) sampling*



*Figure 20. Wall (wipe) sampling*

## **ANNEX V**

### **PHOTO DOCUMENTATION OF AIR SAMPLING**



***Figure 1. Installation of an air sampling instrument***



***Figure 2. Installation of an air sampling instrument***

## **ANNEX VI**

### **RESULT OF ANALYSIS OF HALOGENS, TOTAL ORGANIC HALOGENS AND TOTAL SULPHUR**



## CERTIFICATE OF ANALYSIS

|              |                                                        |                          |                                                               |
|--------------|--------------------------------------------------------|--------------------------|---------------------------------------------------------------|
| Work Order   | : PR19B6568                                            | Issue Date               | : 07-Nov-2019                                                 |
| Customer     | : Centre for ecotoxicological research<br>Podorica LLC | Laboratory               | : ALS Czech Republic, s.r.o.                                  |
| Contact      | : Vladimir Zivkovic                                    | Contact                  | : Client Service                                              |
| Address      | : Bulevar Sarla de Gola 2<br>81000 Podgorica           | Address                  | : Na Harfe 336/9 Prague 9 - Vysocany<br>190 00 Czech Republic |
| E-mail       | : vladimir.zivkovic@ceti.co.me                         | E-mail                   | : customer.support@alsglobal.com                              |
| Telephone    | : ----                                                 | Telephone                | : +420 226 226 228                                            |
| Project      | : ----                                                 | Page                     | : 1 of 2                                                      |
| Order number | : ----                                                 | Date Samples<br>Received | : 29-Oct-2019                                                 |
|              |                                                        | Quote number             | : PR2019CFERP-ME0001<br>(CZ-200-19-0673)                      |
| Site         | : ----                                                 | Date of test             | : 31-Oct-2019 - 07-Nov-2019                                   |
| Sampled by   | : client                                               | QC Level                 | : ALS CR Standard Quality Control<br>Schedule                 |

### General Comments

This report shall not be reproduced except in full, without prior written approval from the laboratory.

The laboratory declares that the test results relate only to the listed samples. If the section "Sampled by" of the Certificate of analysis states: "Sampled by Customer" then the results relate to the sample as received.

### Responsible for accuracy

Signatories  
Zdeněk Jiráček

Position  
Environmental Business Unit  
Manager

Testing Laboratory No. 1163  
Accredited by CAI according to  
CSN EN ISO/IEC 17025:2018



Issue Date : 07-Nov-2019  
 Page : 2 of 2  
 Work Order : PR19B6568  
 Customer : Centre for ecotoxicological research Podgorica LLC



## Analytical Results

Sub-Matrix: SOIL

Client sample ID  
 Laboratory sample ID  
 Client sampling date / time

|                                         |           |      |       | 603/11            |         | 604/11            |         | ----   |      |
|-----------------------------------------|-----------|------|-------|-------------------|---------|-------------------|---------|--------|------|
|                                         |           |      |       | PR19B6568-001     |         | PR19B6568-002     |         | ----   |      |
|                                         |           |      |       | 01-Oct-2019 00:00 |         | 15-Oct-2019 00:00 |         | ----   |      |
| Parameter                               | Method    | LOR  | Unit  | Result            | MU      | Result            | MU      | Result | MU   |
| <b>Physical Parameters</b>              |           |      |       |                   |         |                   |         |        |      |
| Water Analytical M(ad)                  | I-WA-GR   | 0.50 | %     | 0.84              | ± 44.4% | <0.50             | ----    | ----   | ---- |
| Water Gross M(ex)                       | I-WG-GR   | 0.50 | %     | 9.07              | ± 20.3% | 1.55              | ± 20.4% | ----   | ---- |
| Water Total M(ar)                       | I-WT-CC   | 0.50 | %     | 9.83              | ----    | 1.55              | ----    | ----   | ---- |
| <b>Aggregate Parameters</b>             |           |      |       |                   |         |                   |         |        |      |
| Total Halogens (TX)                     | S-TX-COU  | 1.0  | mg/kg | 95.6              | ± 20.0% | 70.6              | ± 20.0% | ----   | ---- |
| <b>Nonmetallic Inorganic Parameters</b> |           |      |       |                   |         |                   |         |        |      |
| Sulfur Total in Dry Matter S(d)         | I-ST-TCDS | 0.10 | % DW  | <0.10             | ----    | <0.10             | ----    | ----   | ---- |
| Sulfur Total Original S(ar)             | I-ST-TCDS | 0.10 | %     | <0.10             | ----    | <0.10             | ----    | ----   | ---- |
| Total Organic Halogens (TOX)            | S-TOX     | 10   | mg/kg | <10               | ----    | <10               | ----    | ----   | ---- |

If no sampling time is provided, the sampling time will default 00:00 on the date of sampling. If no sampling date is provided, delivery date in brackets without a time component will be displayed instead. Measurement uncertainty is expressed as expanded measurement uncertainty with coverage factor k = 2, representing 95% confidence level.

Key: LOR = Limit of reporting; MU = Measurement Uncertainty. The MU does not include sampling uncertainty.

## The end of result part of the certificate of analysis

### Brief Method Summaries

| Analytical Methods                                                             | Method Descriptions                                                                                                                                                                                                                                                                                                                                                                  |
|--------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Location of test performance: Bendlova 1687/7 Ceska Lipa Czech Republic 470 01 |                                                                                                                                                                                                                                                                                                                                                                                      |
| I-ST-TCDS                                                                      | CZ_SOP_D06_07_121.A (methodology of LECO Company, CSN ISO 29541, CSN EN ISO 16994, CSN EN ISO 16948, CSN EN 15407, CSN ISO 19579, CSN EN 15408, CSN ISO 10694) Determination of total carbon, total sulphur and hydrogen by combustion method with IR detection, determination of total nitrogen by combustion method with TCD detection and determination of oxygen by calculation. |
| I-WA-GR                                                                        | CZ_SOP_D06_07_041 (CSN 44 1377, CSN EN ISO 18134-1, CSN EN ISO 18134-2, CSN EN ISO 18134-3, CSN P CEN/TS 15414-1, CSN P CEN/TS 15414-2, CSN EN 15414-3, CSN EN12880, CSN EN14346, CSN EN 15002) Determination of analytical water and gross water by gravimetry and determination of total water by calculation from measured values.                                                |
| I-WG-GR                                                                        | CZ_SOP_D06_07_041 (CSN 44 1377, CSN EN ISO 18134-1, CSN EN ISO 18134-2, CSN EN ISO 18134-3, CSN P CEN/TS 15414-1, CSN P CEN/TS 15414-2, CSN EN 15414-3, CSN EN12880, CSN EN14346, CSN EN 15002) Determination of analytical water and gross water by gravimetry and determination of total water by calculation from measured values.                                                |
| I-WT-CC                                                                        | CZ_SOP_D06_07_041 (CSN 44 1377, CSN EN ISO 18134-1, CSN EN ISO 18134-2, CSN EN ISO 18134-3, CSN P CEN/TS 15414-1, CSN P CEN/TS 15414-2, CSN EN 15414-3, CSN EN12880, CSN EN14346, CSN EN 15002) Determination of analytical water and gross water by gravimetry and determination of total water by calculation from measured values.                                                |
| * S-TOX                                                                        | Determination of total organic halogens (TOX) according to the internal instruction.                                                                                                                                                                                                                                                                                                 |
| S-TX-COU                                                                       | CZ_SOP_D06_07_027 (US EPA 9076) Determination of total halogens (TX).                                                                                                                                                                                                                                                                                                                |
| Preparation Methods                                                            |                                                                                                                                                                                                                                                                                                                                                                                      |
| Location of test performance: Bendlova 1687/7 Ceska Lipa Czech Republic 470 01 |                                                                                                                                                                                                                                                                                                                                                                                      |
| * S-PPHOM.07                                                                   | CZ_SOP_D06_07_P01 Preparation of solid samples for analysis (crushing, milling and pulverizing).                                                                                                                                                                                                                                                                                     |
| * S-PPHOM.0.3                                                                  | CZ_SOP_D06_07_P01 Preparation of solid samples for analysis (crushing, milling and pulverizing).                                                                                                                                                                                                                                                                                     |

A \*\* symbol preceding any method indicates laboratory or subcontractor non-accredited test. In the case when a procedure belonging to an accredited method was used for non-accredited matrix, would apply that the reported results are non-accredited. Please refer to General Comment section on front page for information. If the report contains subcontracted analysis, those are made in a subcontracted laboratory outside the laboratories ALS Czech Republic, s.r.o.

The calculation methods of summation parameters are available on request in the client service.