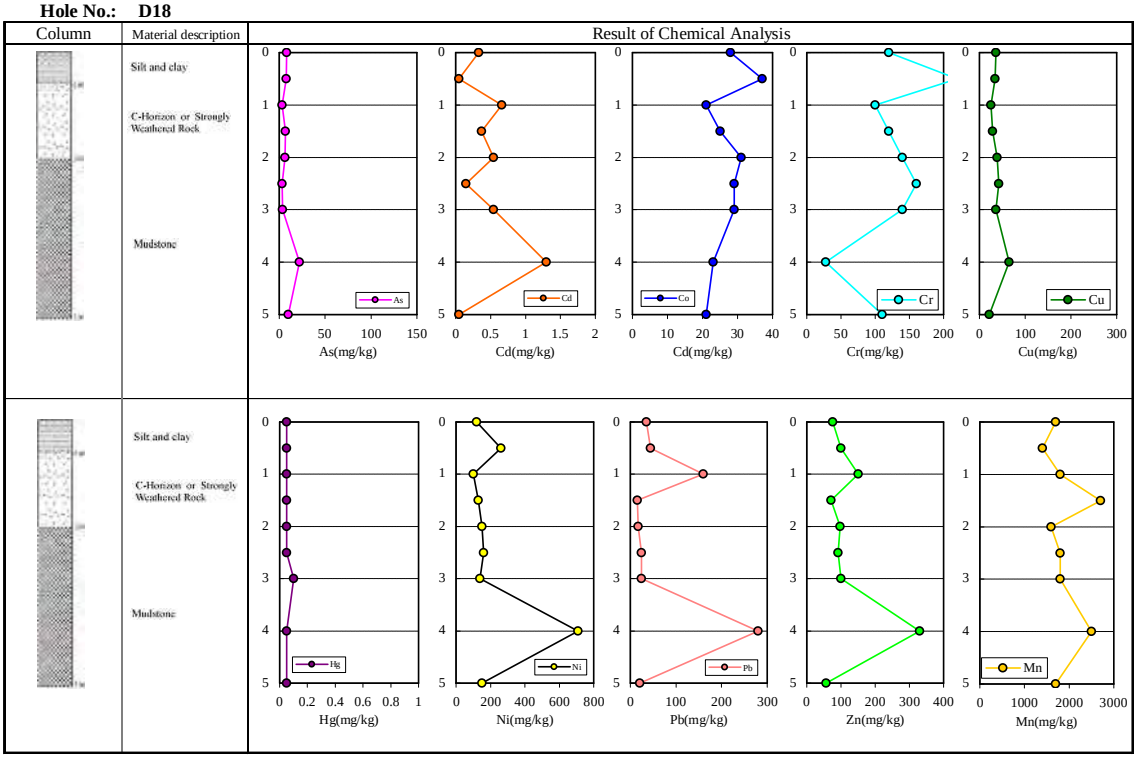
# Appendix 8

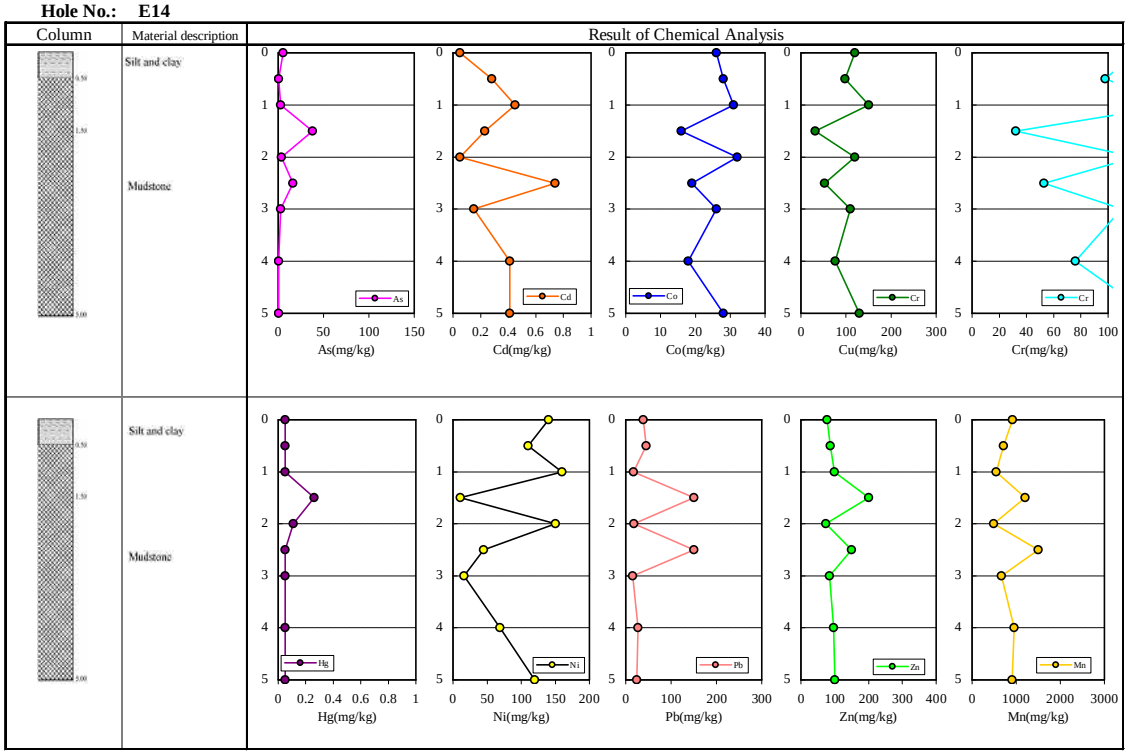
# Vertical Chemical Variation of Drill Hole

**Hole No.: D18**




**Content analysis result of 5m drilling core samples**

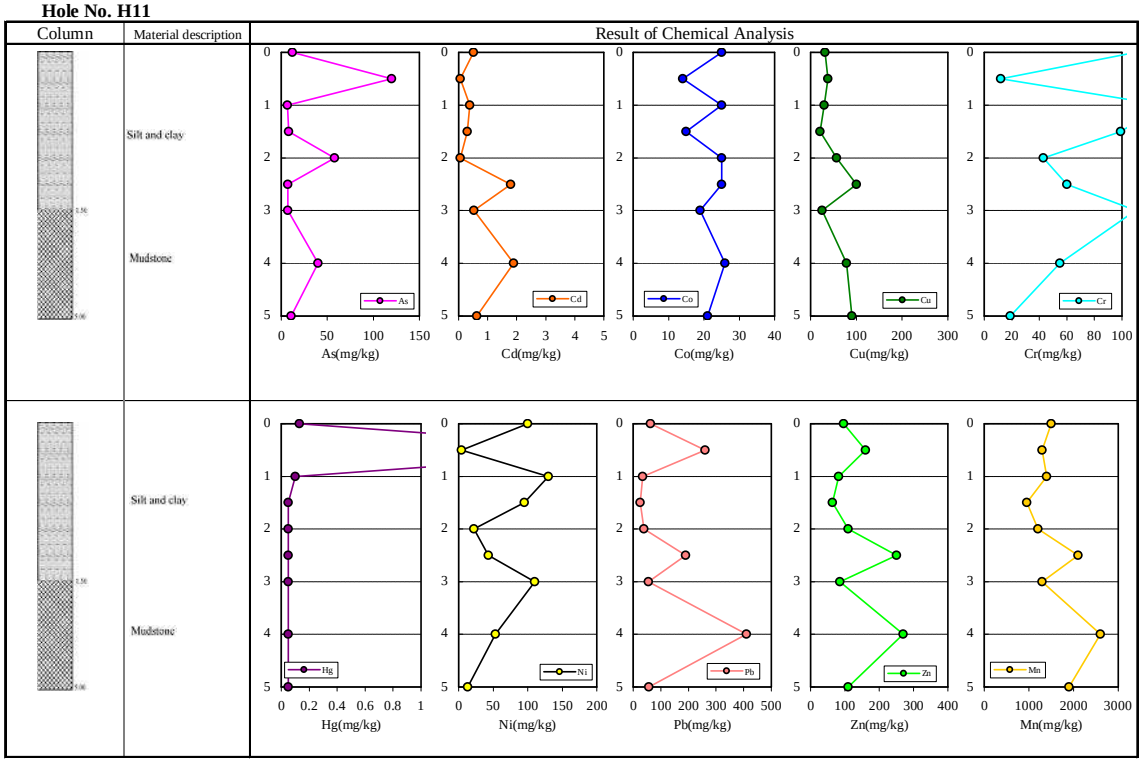
**Hole No.: E14**




**Variations of Heavy Metals (E14)**

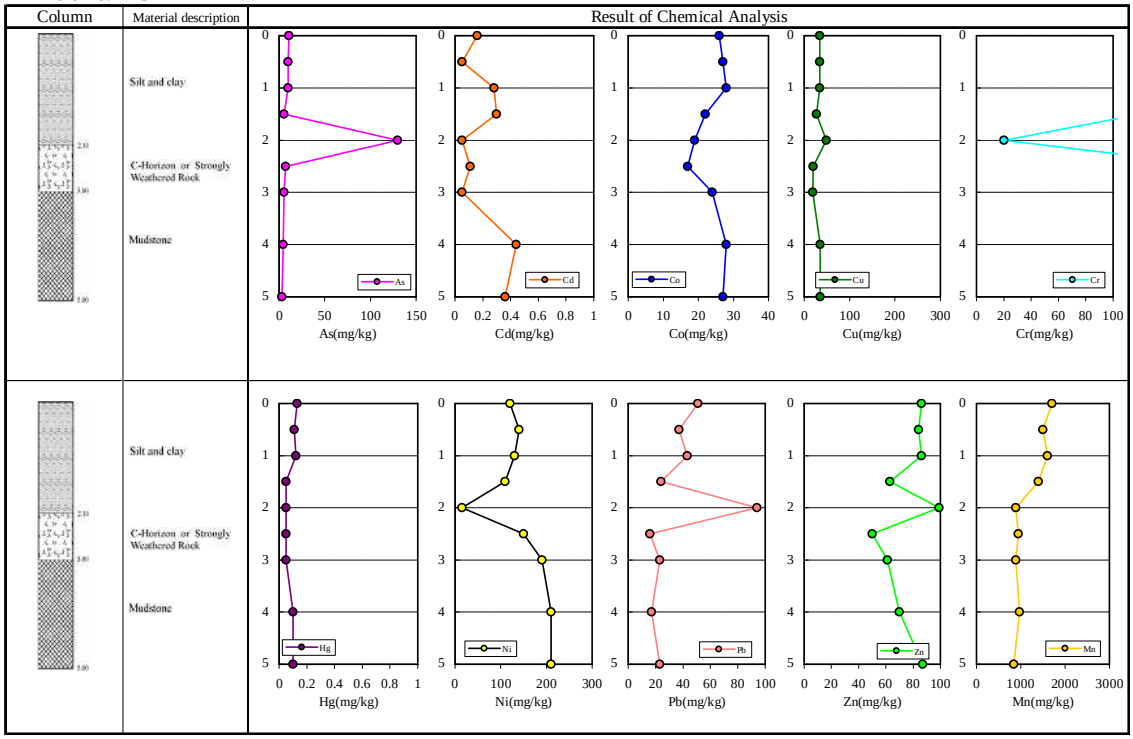
# Vertical Chemical Variations of the Drill Holes (1)

**Hole No. H11**




**Variations of Heavy Metals (H11)**

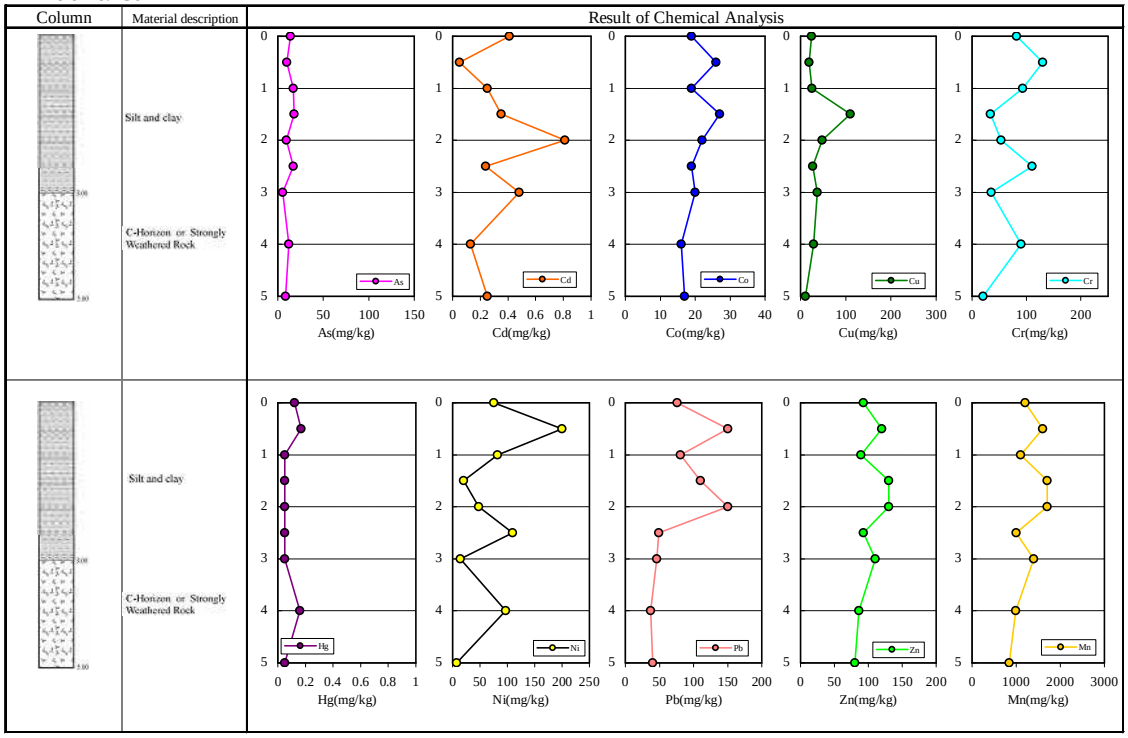
**Hole No. H15**




**Variations of Heavy Metals (H15)**

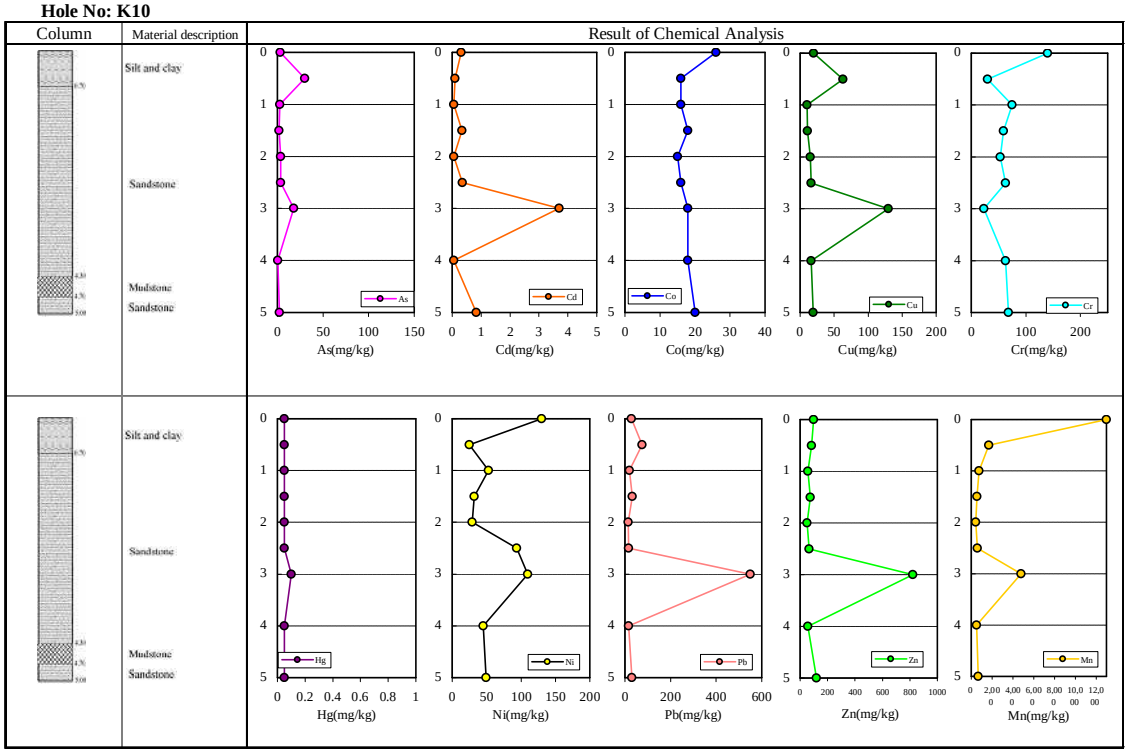
# Vertical Chemical Variations of the Drill Holes (2)

**Hole No. I36**




**Variations of Heavy Metals (I36)**

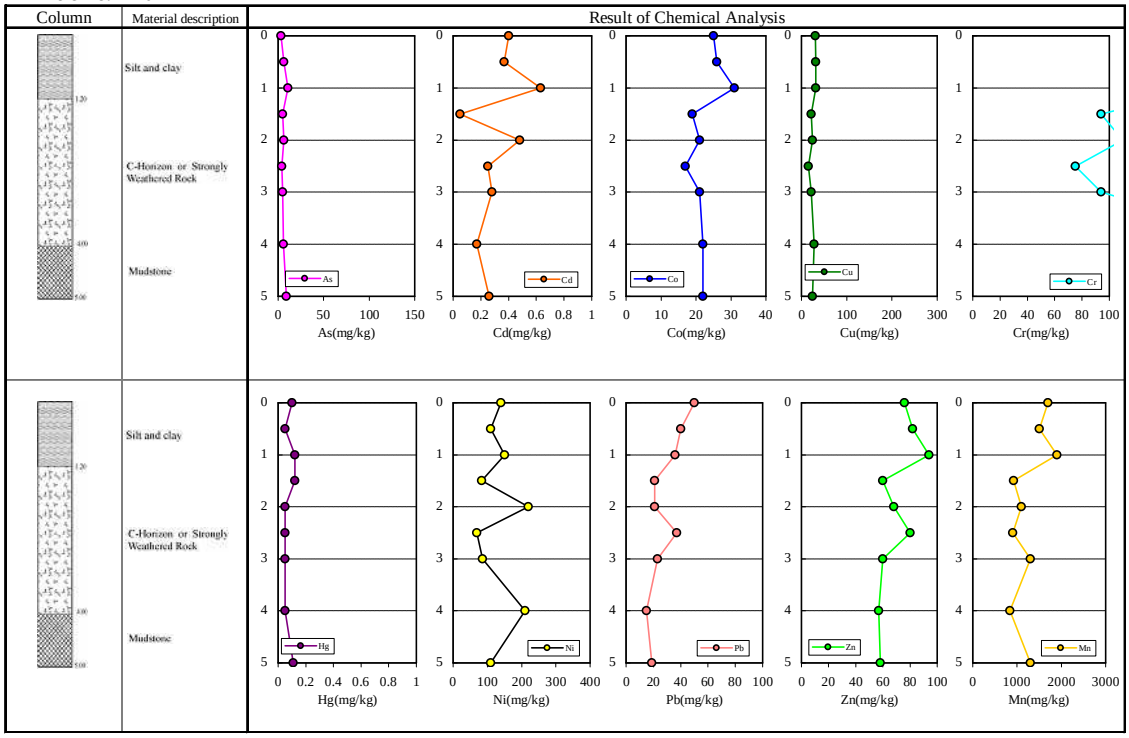
**Hole No: K10**




**Variations of Heavy Metals (K10)**

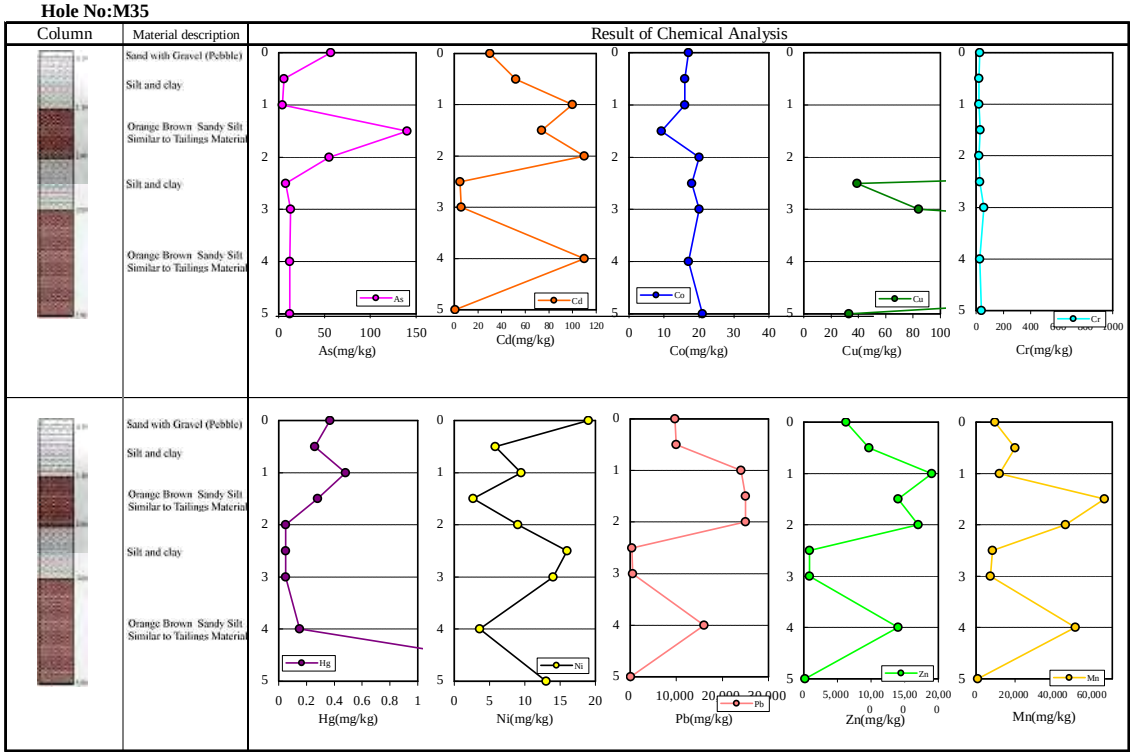
# Vertical Chemical Variations of the Drill Holes (3)

**Hole No: M10**




**Variations of Heavy Metals (M10)**

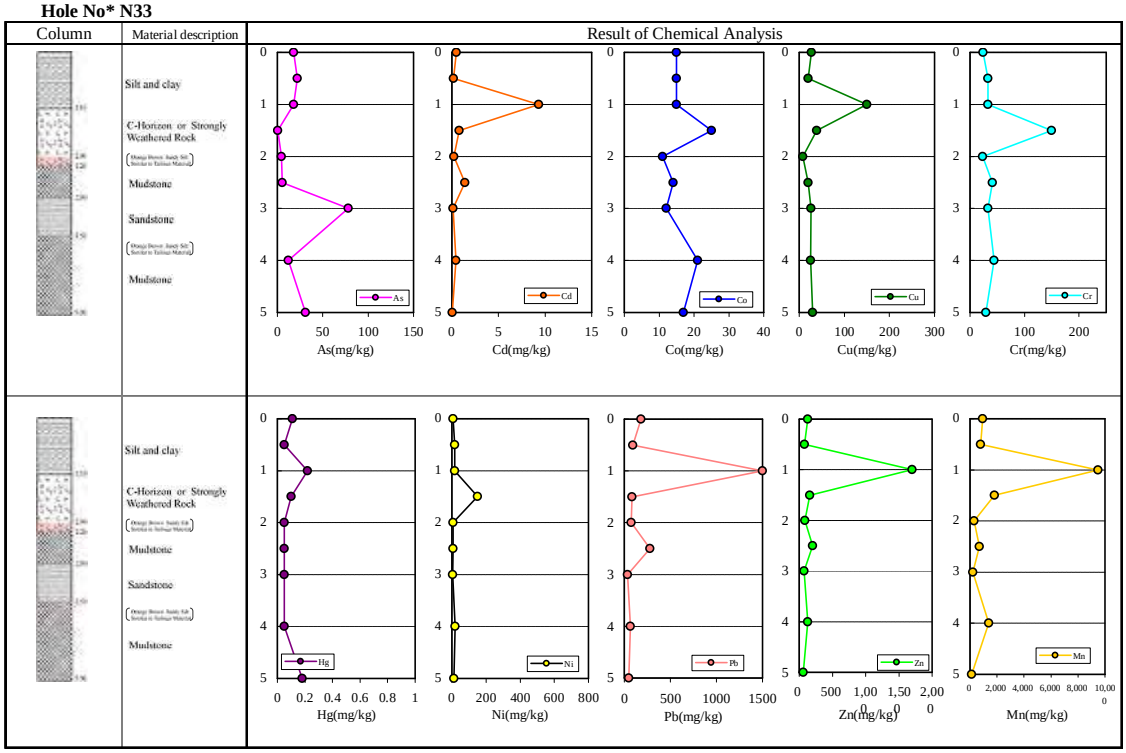
**Hole No:M35**




**Variations of Heavy Metals (M35)**

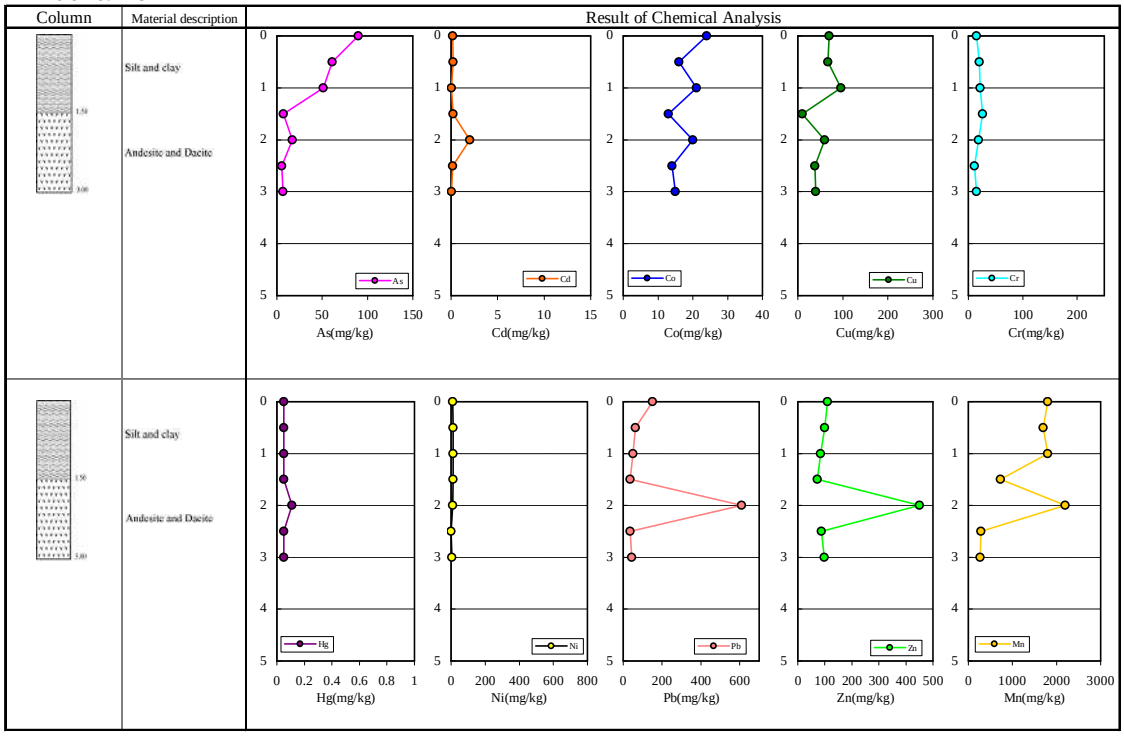
# Vertical Chemical Variations of the Drill Holes (4)

**Hole No* N33**




**Variations of Heavy Metals (N33)**

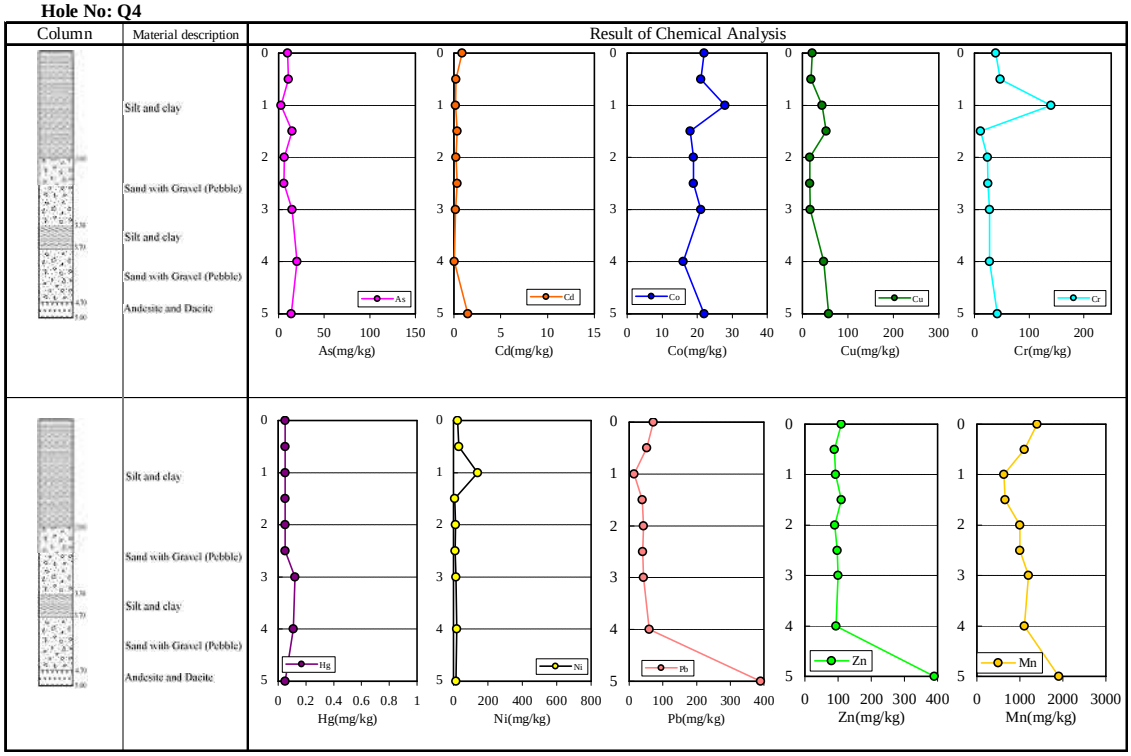
**Hole No: P28**




**Variations of Heavy Metals (P28)**

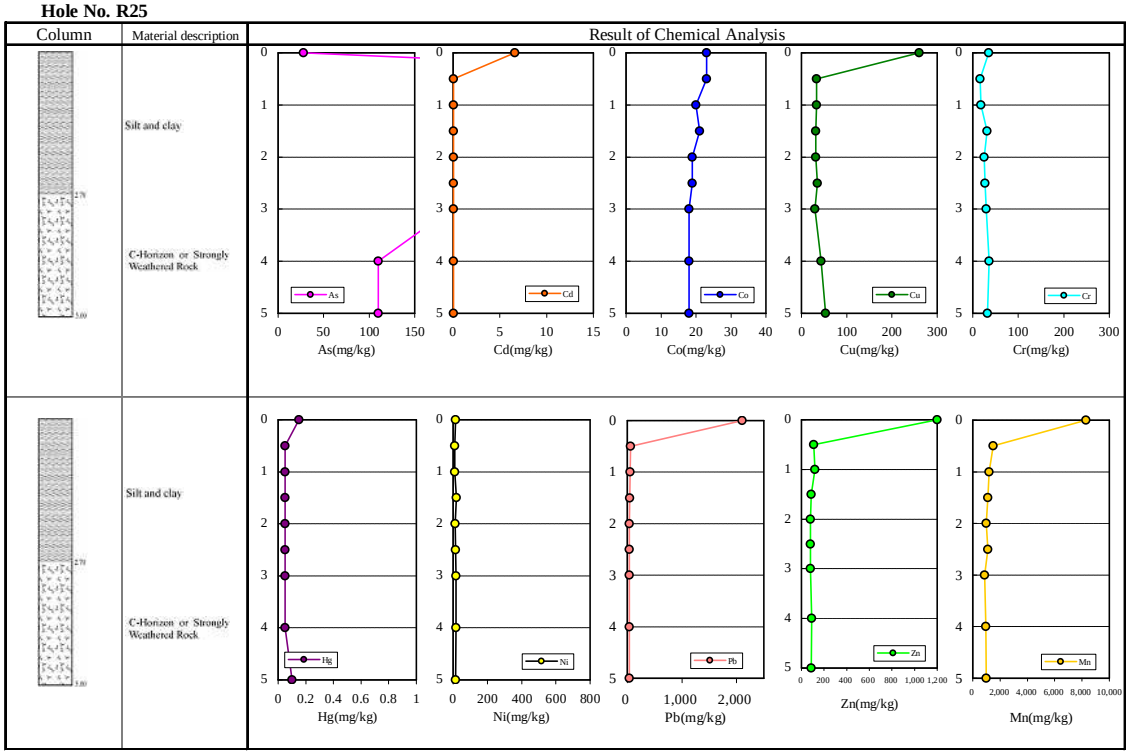
# Vertical Chemical Variations of the Drill Holes (5)

**Hole No: Q4**




**Variations of Heavy Metals (Q4)**

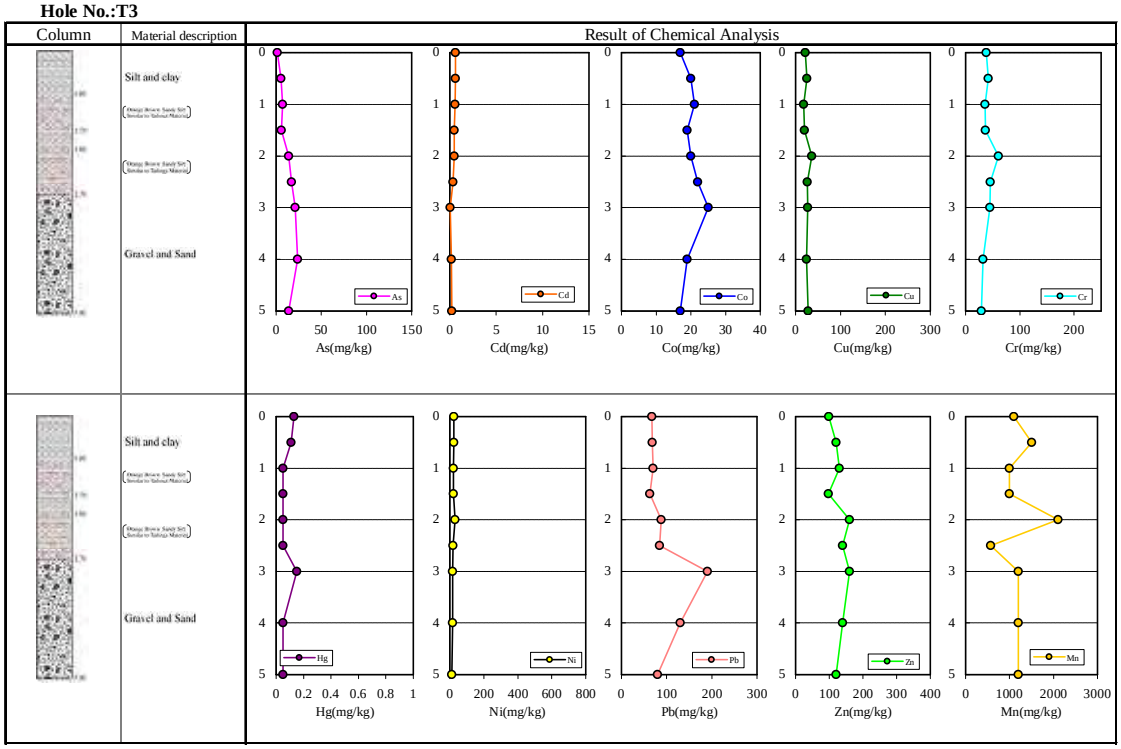
**Hole No. R25**




**Variations of Heavy Metals (R25)**

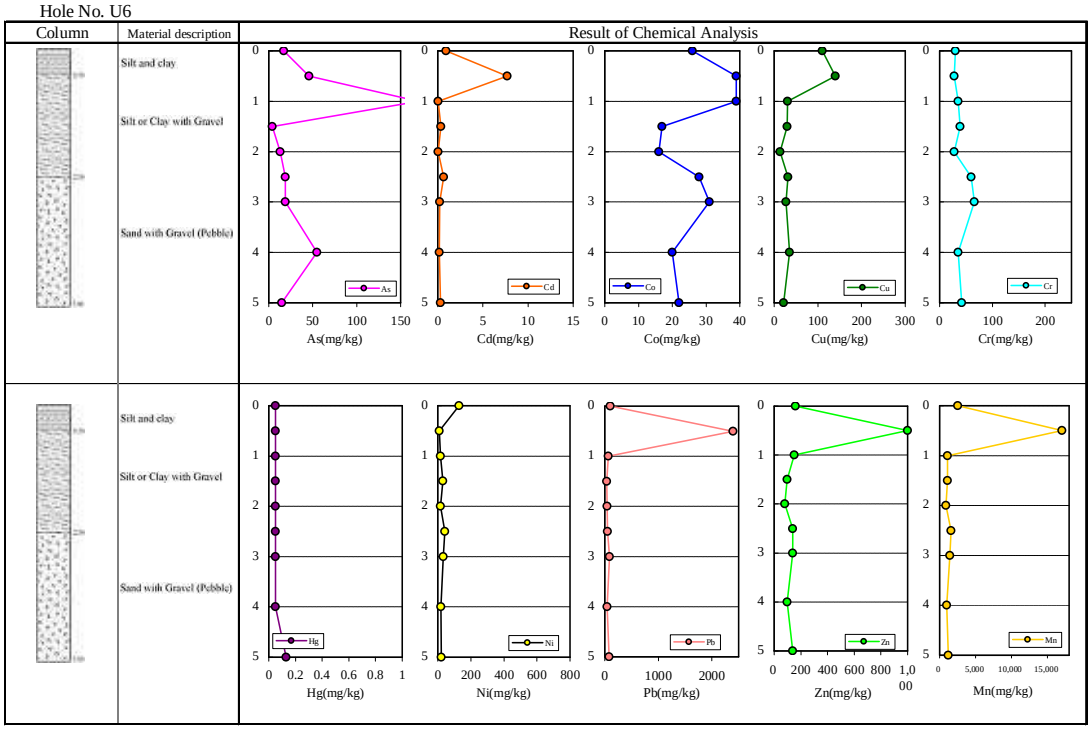
# Vertical Chemical Variations of the Drill Holes (6)

**Hole No.:T3**




**Variations of Heavy Metals (T3)**

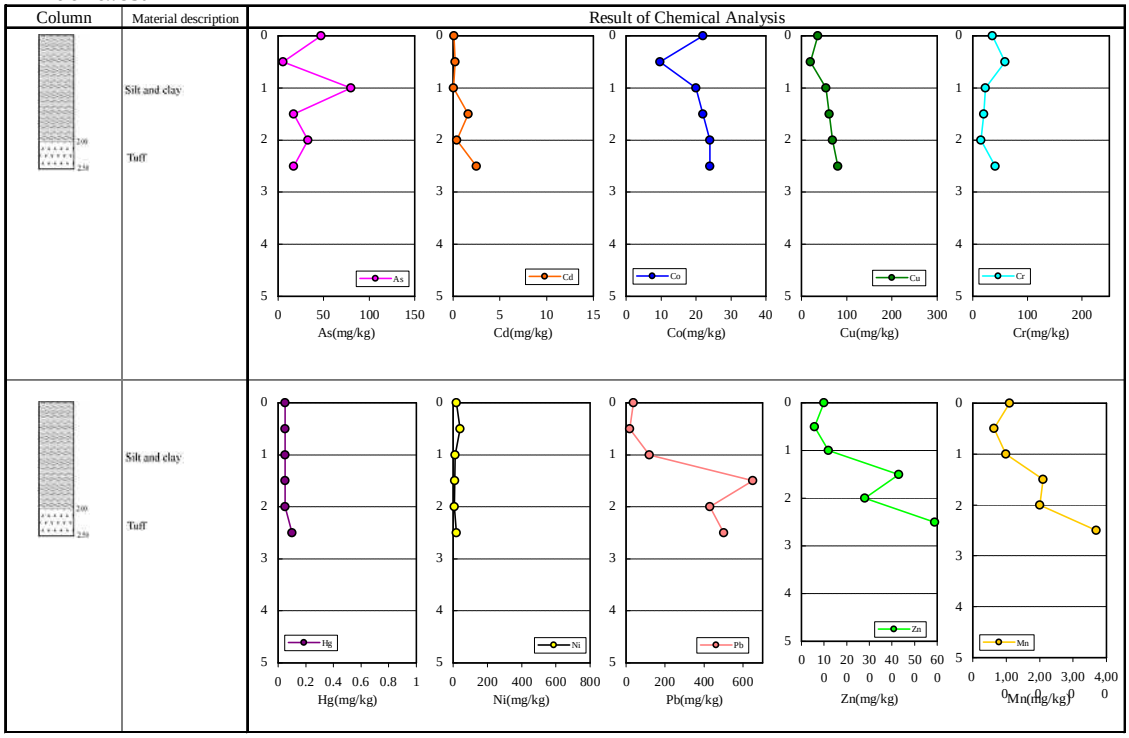
Hole No. U6




**Variations of Heavy Metals (U6)**

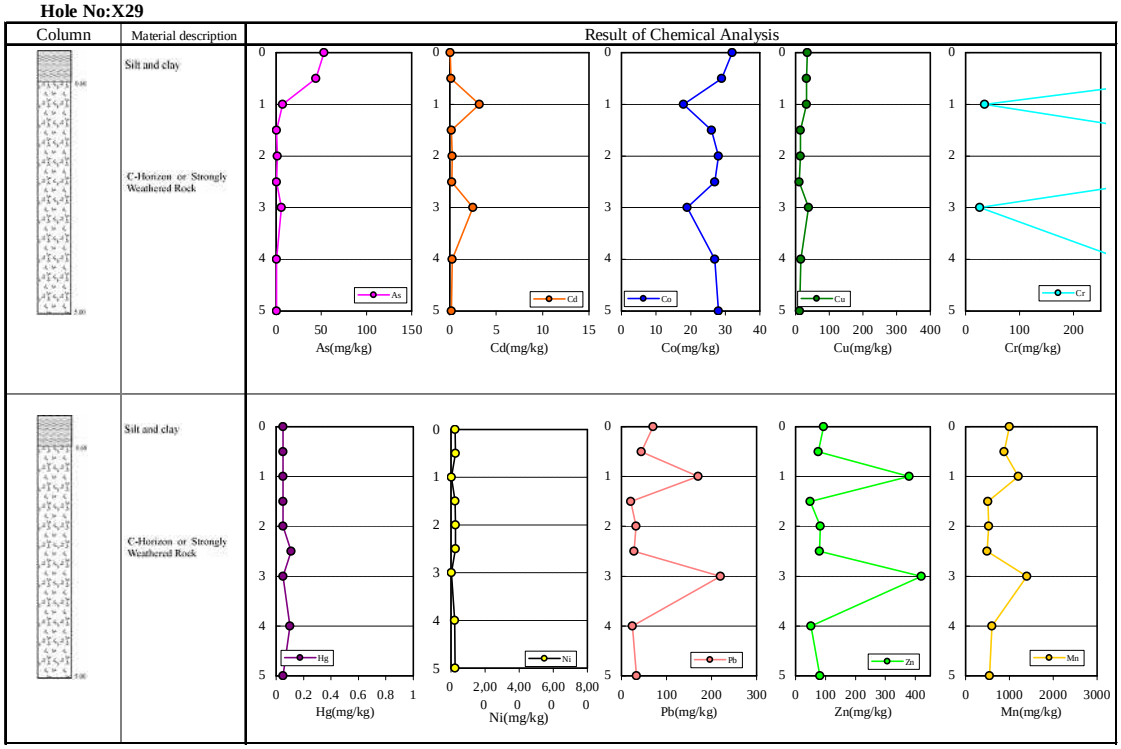
# Vertical Chemical Variations of the Drill Holes (7)

**Hole No.:U30**




**Variations of Heavy Metals (U30)**

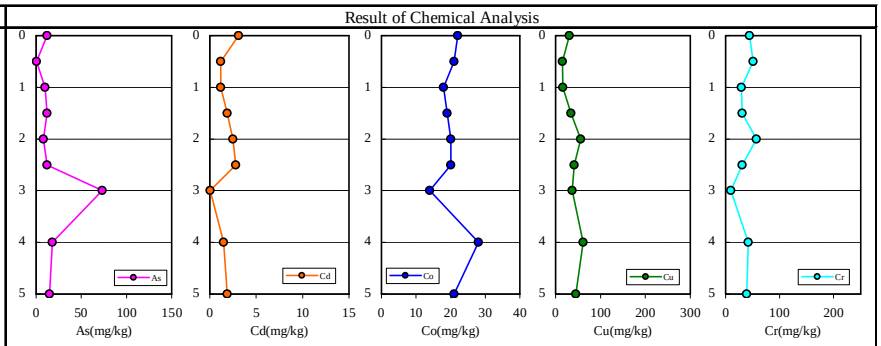
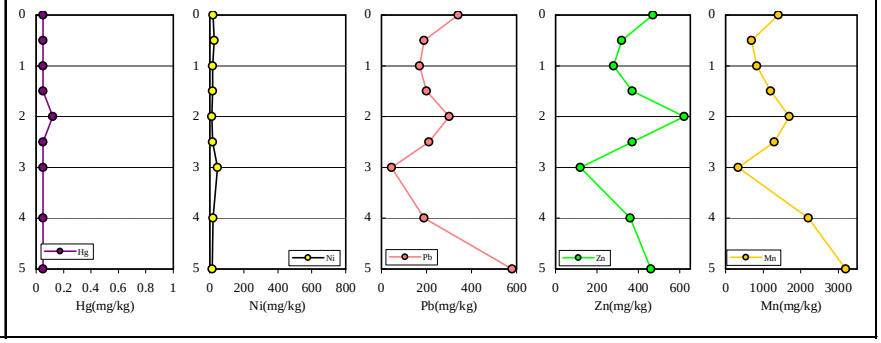
**Hole No:X29**




**Variations of Heavy Metals (X29)**

# Vertical Chemical Variations of the Drill Holes (8)

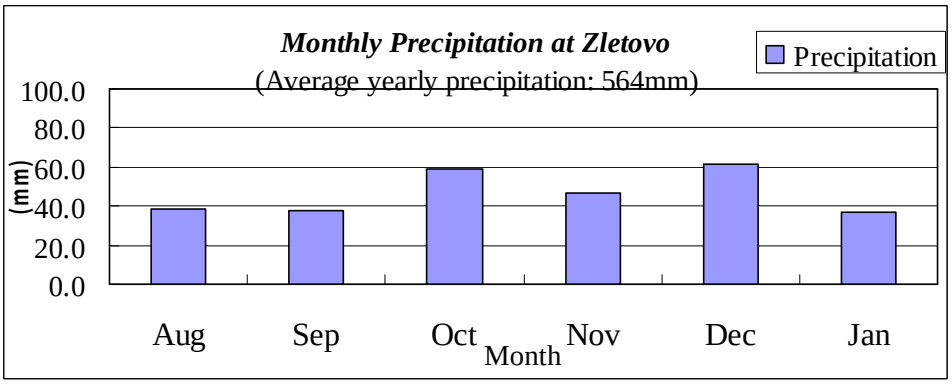
Hole **No.: a30**

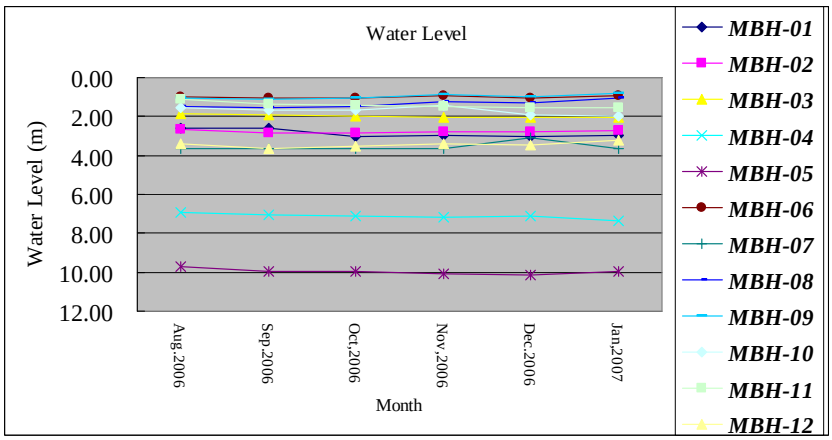
| Column | Material description | Result of Chemical Analysis |
|---|---|---|
|  | Silt and clay<br>C-Horizon or Strongly Weathered Rock<br>Tuff |  |
|  | Silt and clay<br>C-Horizon or Strongly Weathered Rock<br>Tuff |  |

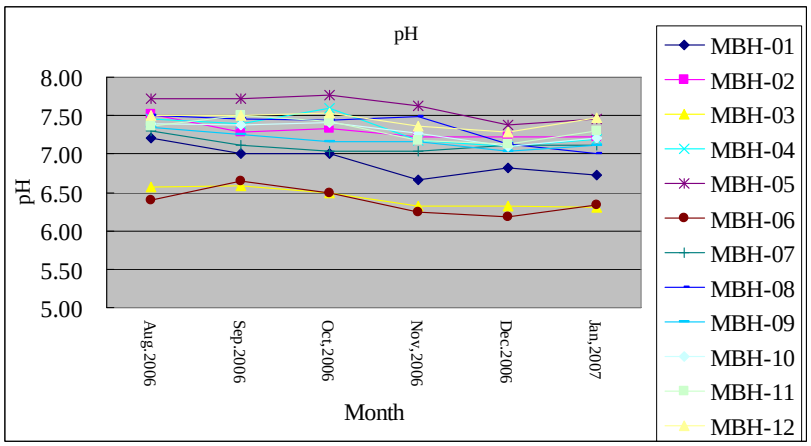
**Variations of Heavy Metals (a30)**

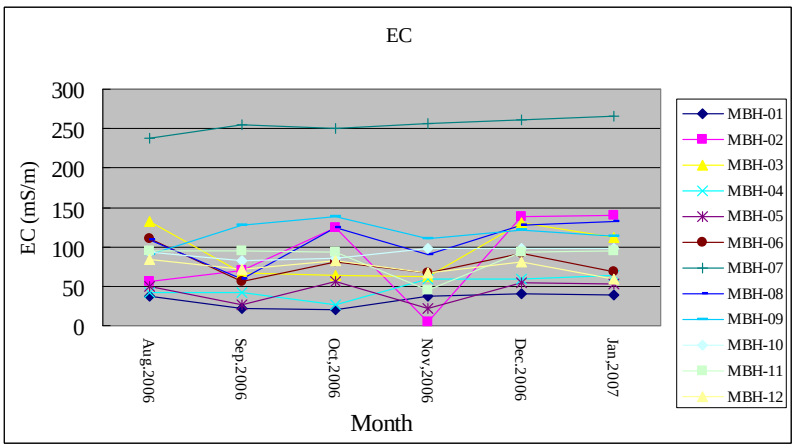
# Vertical Chemical Variations of the Drill Holes (9)

# Appendix 9
# Results of Monitoring Bore Holes

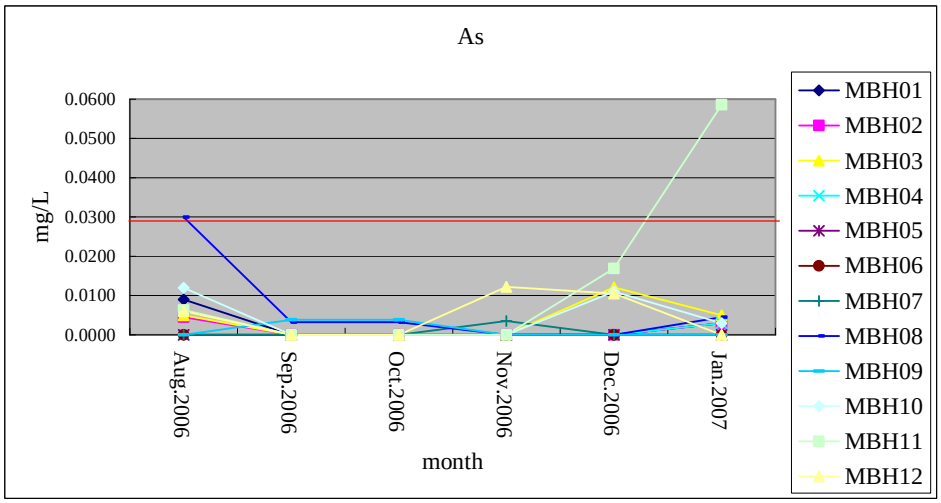


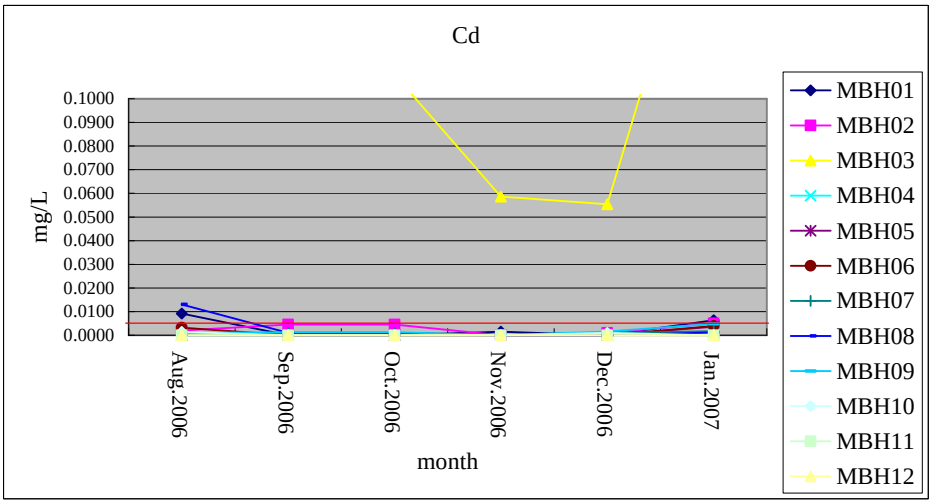



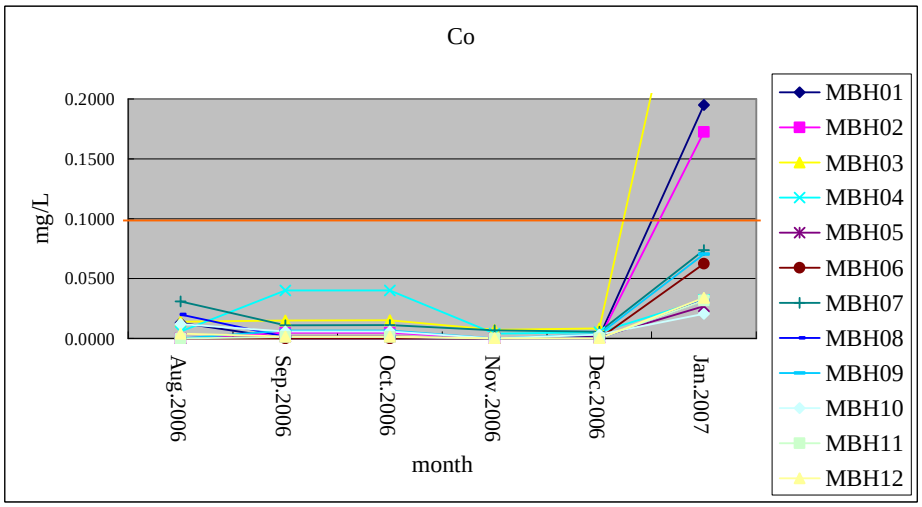



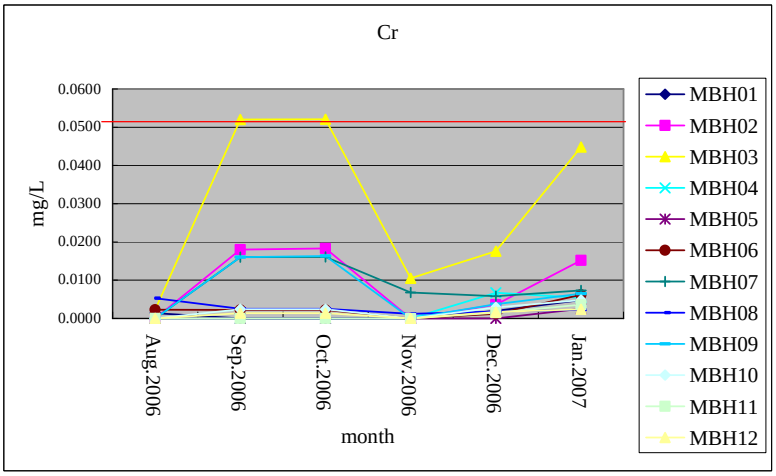

**Water Level, pH and EC of the Monitoring Borehole**

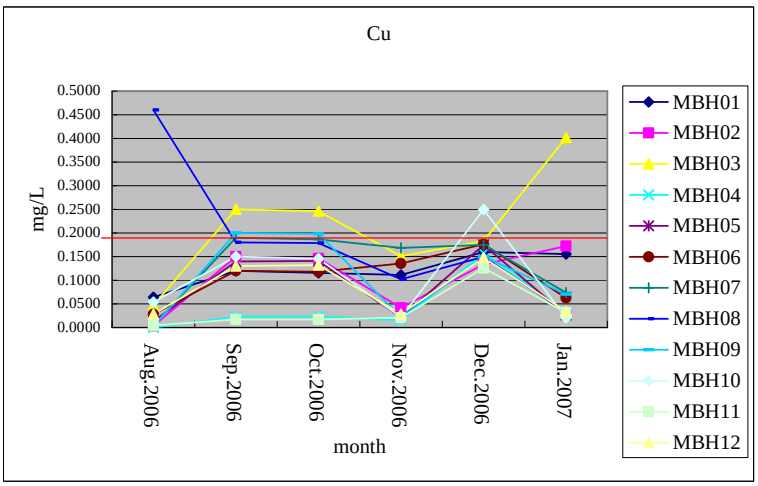


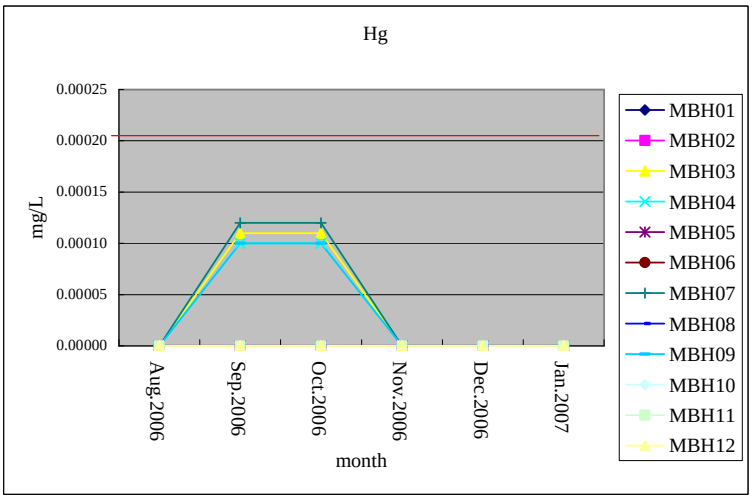



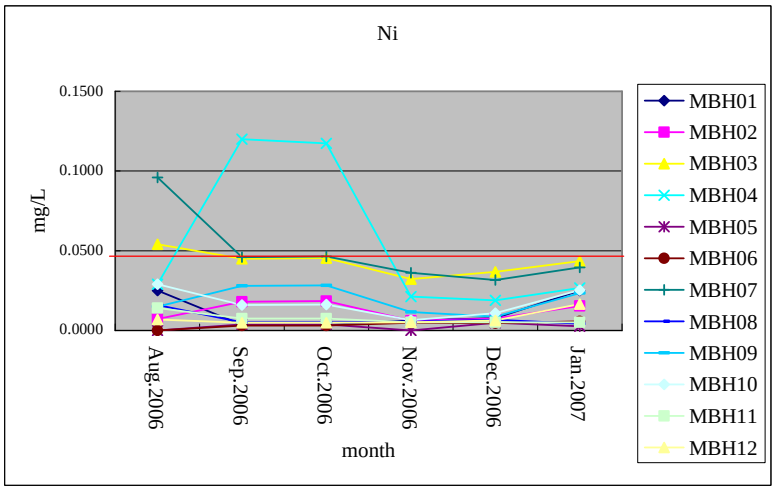

**Heavy Metal Concentration of Groundwater (1)**

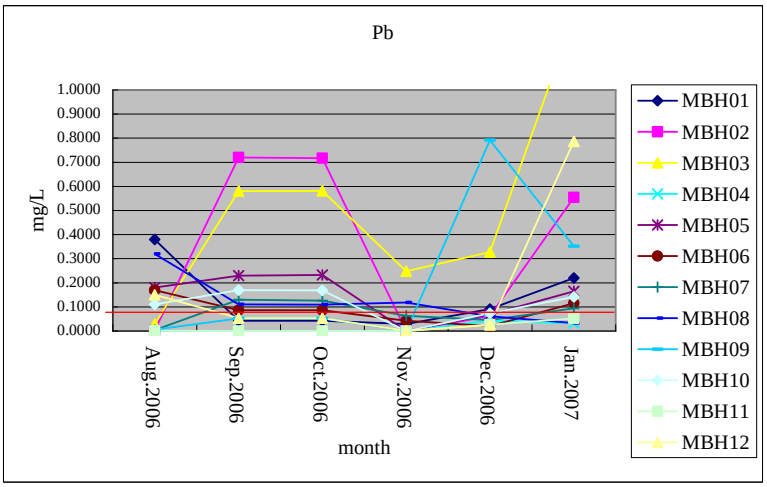


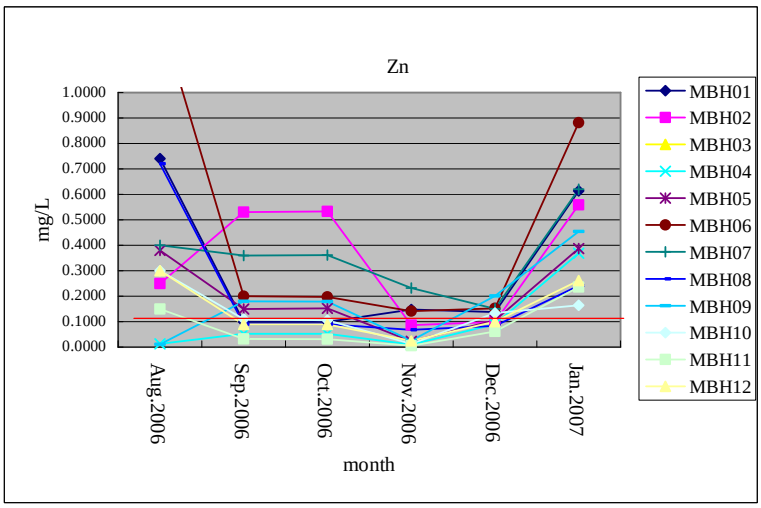



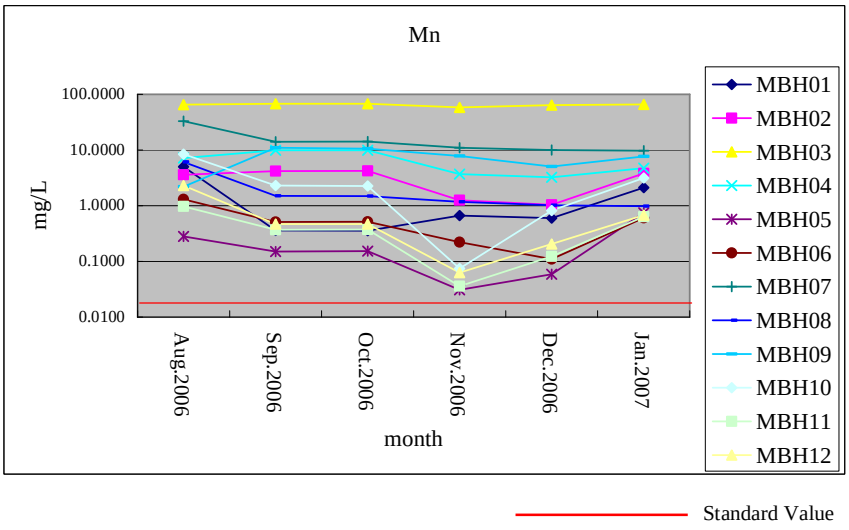

**Heavy Metal Concentration of Groundwater (2)**



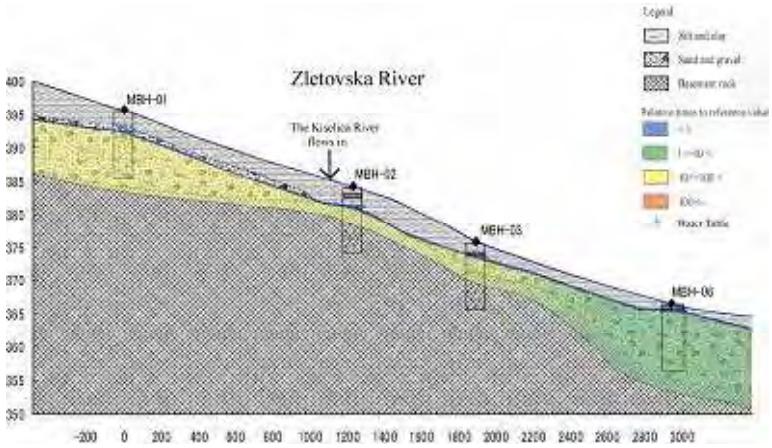



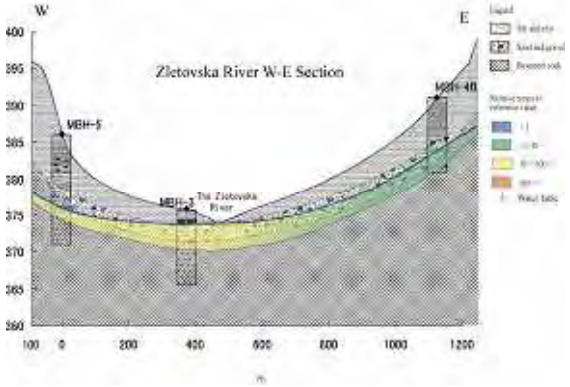

**Heavy Metal Concentration of Groundwater (3)**

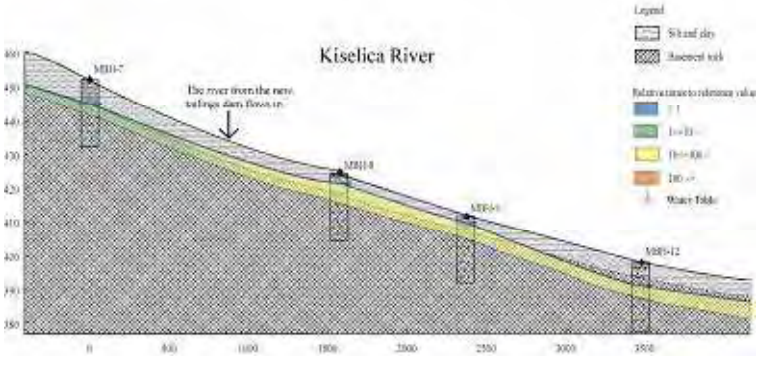


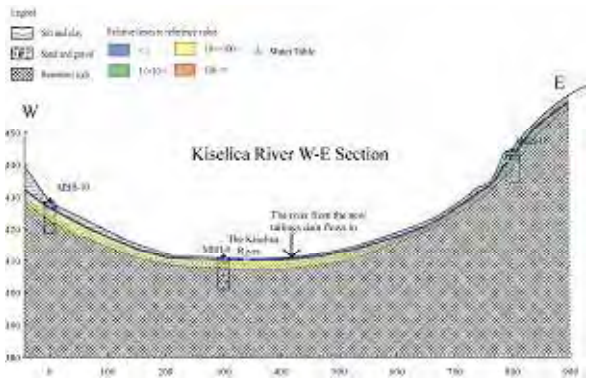

**Heavy Metal Concentration of Groundwater (4)**

# Appendix 10
# Cross Sections of Groundwater Profiles

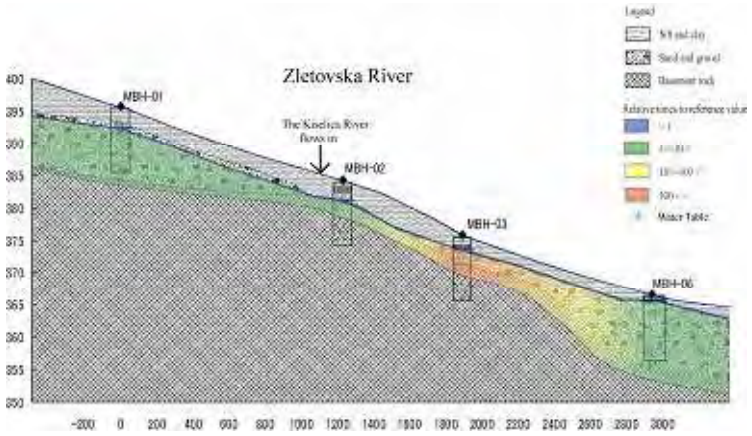


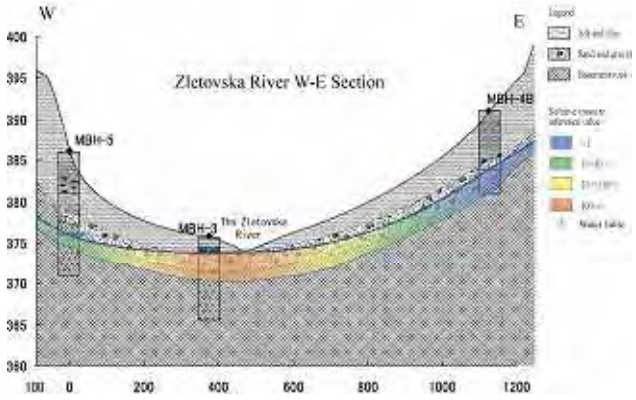



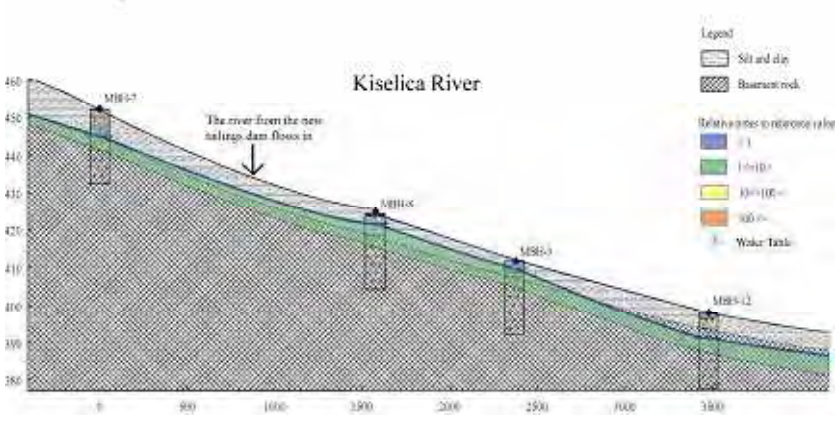



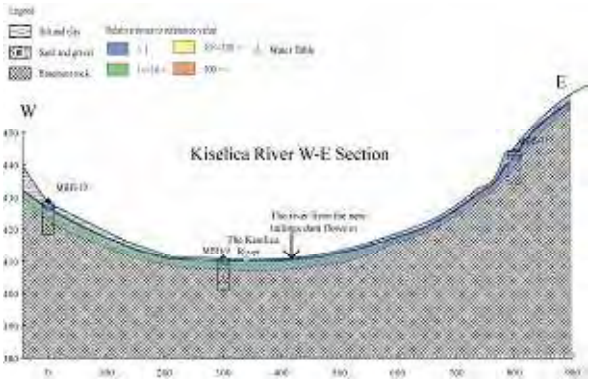




Cross Sections of Groundwater Profile (1) Pb

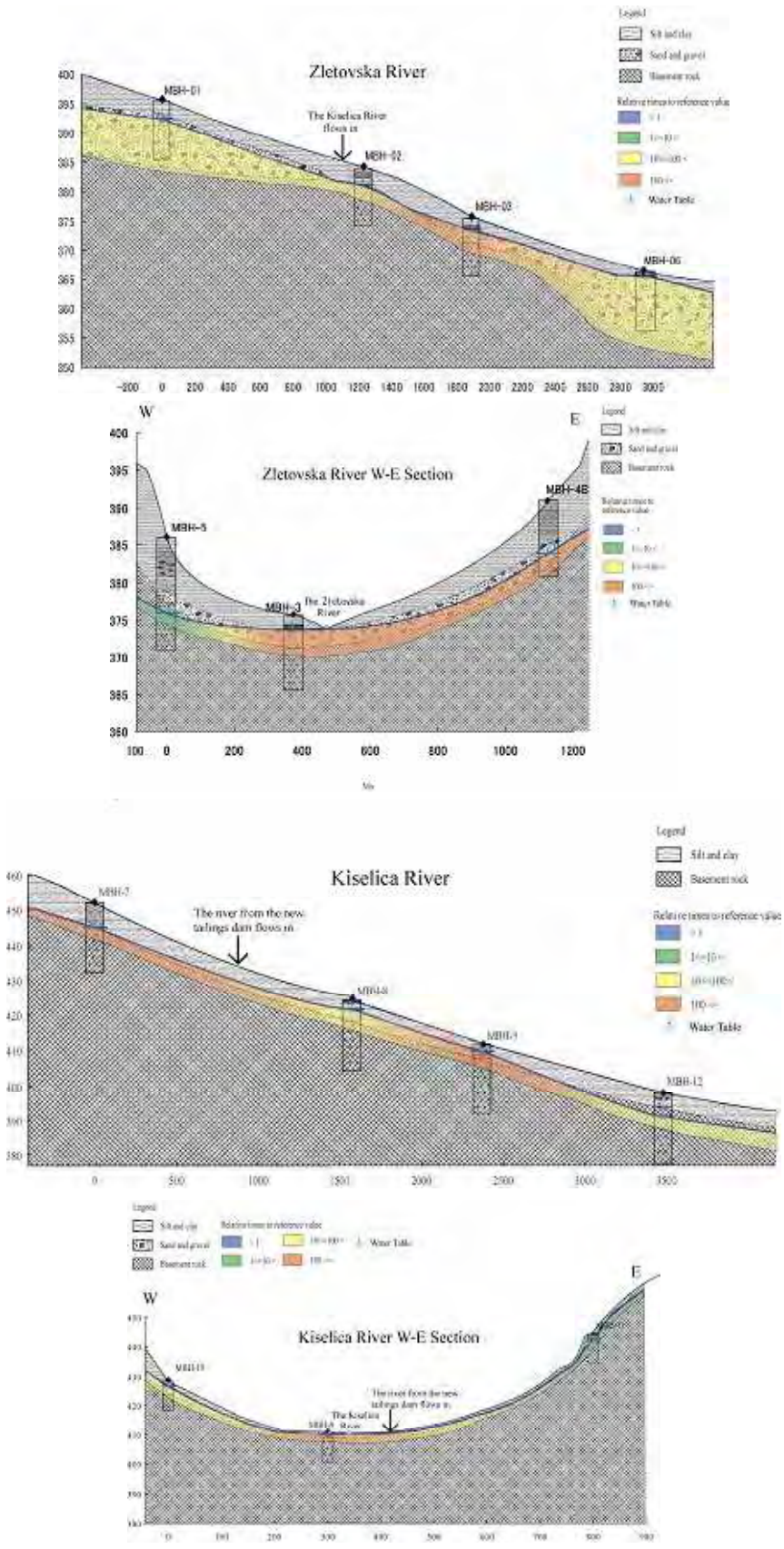



Cross Sections of Groundwater Profile (2) Zn




Cross Sections of Groundwater Profile (3) Mn

# Appendix 11
# Sample List of Additional Groundwater Survey

# Sample List of Groundwater and River Water (Additional Survey) (1)

| # | Vil | Sample No. | Village/Town Name | Type of Water Source | Drinkable (Y/N) | Filter the water (Y/N) | Other Purpose | pH | EC (mS/m) | Temperature (˚C) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | BT 1 | Buciste | well | yes | Yes | no | 7.11 | 131.0 | 12.6 |
| 2 | | BT 2 | Buciste | well | no | no | no | 7.02 | 205.0 | 13.4 |
| 3 | | BT 3 | Buciste | well | no | no | livestock drinking | 7.09 | 89.3 | 13.7 |
| 4 | | BT 4 | Buciste | well | no | no | irrigation | 6.97 | 87.2 | 13.7 |
| Average | | | Buciste | | | | | 7.05 | 128.1 | 13.4 |
| 5 | 2 | CT 1 | Strmos | well | no | No | No | 7.11 | 303.0 | 14.0 |
| 6 | | CT 2 | Strmos | well | no | No | irrigation | 7.15 | 460.0 | 12.9 |
| 7 | | CT 3 | Strmos | well | no | No | for washing | 6.95 | 382.0 | 14.1 |
| Average | | | Strmos | | | | | 7.07 | 381.7 | 13.7 |
| 8 | 3 | DB 1 | Dobrevo | well pumping | yes | No | No | 7.12 | 77.6 | 13.3 |
| 9 | | DB 2 | Dobrevo | Spring | yes | No | livestock drinking | 7.31 | 79.7 | 13.4 |
| 10 | | DB 3 | Dobrevo | well pumping | yes | Yes | No | 7.28 | 83.3 | 12.4 |
| Average | | | Dobrevo | | | | | 7.24 | 80.2 | 13.0 |
| 11 | 4 | DL 1 | Drenok | spring | yes | No | livestock drinking | 7.20 | 117.7 | 14.3 |
| 12 | | DL 2 | Drenok | well | no | No | livestock drinking | 7.27 | 580.0 | 13.6 |
| 13 | | DL 3 | Drenok | well | yes | No | No | 7.02 | 208.0 | 14.1 |
| Average | | | Drenok | | | | | 7.16 | 301.9 | 14.0 |
| 14 | 5 | DR 1 | Dreveno | well | yes | Yes | No | 7.27 | 111.4 | 14.4 |
| 15 | | DR 2 | Dreveno | well | yes | No | irrigation | 7.42 | 165.5 | 15.0 |
| 16 | | DR 3 | Dreveno | well | yes | No | livestock drinking, irrigation | 7.10 | 105.2 | 13.9 |
| 17 | | DR 4 | Dreveno | well | no | No | irrigation | 7.38 | 168.2 | 12.3 |
| Average | | | Dreveno | | | | | 7.29 | 137.6 | 13.9 |
| 18 | 6 | DS 1 | D. Stubol | well | no | no | irrigation | 6.97 | 186.2 | 12.7 |
| 19 | | DS 2 | D. Stubol | well | yes | No | livestock drinking, cooking | 6.95 | 191.0 | 13.2 |
| 20 | | DS 3 | D. Stubol | well | yes before | | livestock drinking, irrigation | 7.27 | 366.0 | 12.9 |
| Average | | | D. Stubol | | | | | 7.06 | 247.7 | 12.9 |
| 21 | 7 | GN 1 | Gujnovci | well pumping | yes | yes | irrigation | 7.33 | 154.7 | 14.9 |
| 22 | | GN 2 | Gujnovci | well pumping | yes | No | livestock drinking, irrigation | 7.24 | 163.2 | 16.3 |
| 23 | | GN 3 | Gujnovci | well pumping | yes | No | irrigation | 7.29 | 137.3 | 15.6 |
| 24 | | GN 4 | Gujnovci | well | yes | yes | No | 7.13 | 175.8 | 14.3 |
| Average | | | Gujnovci | | | | | 7.25 | 157.8 | 15.3 |
| 25 | 8 | GR 1 | Garjanci | well pumping | no | No | washing | 7.18 | 418.0 | 14.9 |
| 26 | | GR 2 | Garjanci | well | no | No | irrigation | 7.33 | 262.0 | 13.7 |
| 27 | | GR 3 | Garjanci | well | no | No | No | 7.41 | 165.6 | 13.0 |
| 28 | | GR 4 | Garjanci | well pumping | no | No | irrigation | 8.09 | 97.5 | 13.8 |
| Average | | | Garjanci | | | | | 7.50 | 235.8 | 13.9 |
| 29 | 9 | GS 1 | G. Stubol | surface spring | no | no | for cooking | 6.10 | 22.3 | 14.7 |
| 30 | | GS 2 | G. Stubol | well | no | no | no | 7.16 | 98.3 | 12.9 |
| 31 | | GS 3 | G. Stubol | well pumping | yes | No | livestock drinking | 7.44 | 103.6 | 16.0 |
| Average | | | G. Stubol | | | | | 6.90 | 74.7 | 14.5 |
| 32 | 10 | GZ 1 | Grizilevci | well | no | No | livestock drinking, irrigation | 7.45 | 221.0 | 13.9 |
| 33 | | GZ 2 | Grizilevci | well | no | No | livestock drinking | 6.89 | 96.1 | 12.4 |
| 34 | | GZ 3 | Grizilevci | well | yes | No | No | 7.72 | 57.1 | 11.5 |
| Average | | | Grizilevci | | | | | 7.35 | 124.7 | 12.6 |
| 35 | 11 | JG 1 | Jiganci | well pumping | yes | No | No | 7.27 | 152.9 | 15.6 |
| 36 | | JG 2 | Jiganci | well pumping | no | no | livestock drinking, irrigation | 7.55 | 548.0 | 13.8 |
| 37 | | JG 3 | Jiganci | well pumping | yes | no | irrigation | 6.99 | 100.5 | 14.9 |
| Average | | | Jiganci | | | | | 7.27 | 267.1 | 14.8 |
| 38 | 12 | KD 1 | Kundino | well | no | No | irrigation | 7.36 | 22.0 | 23.1 |
| 39 | | KD 2 | Kundino | well | yes | yes | livestock drinking, irrigation | 7.75 | 150.4 | 12.3 |
| 40 | | KD 3 | Kundino-Pr | well | yes | No | No | 6.69 | 37.4 | 12.6 |
| Average | | | Kundino | | | | | 7.27 | 69.9 | 16.0 |
| 41 | 13 | KK 1 | Kukovo | spring | yes | No | livestock drinking | 7.23 | 60.3 | 15.3 |
| 42 | | KK 2 | Kukovo | spring | yes | No | livestock drinking | 7.28 | 28.8 | 16.0 |
| Average | | | Kukovo | | | | | 7.26 | 44.6 | 15.7 |
| 43 | 14 | LS 1 | Lesnovo | spring | yes | No | livestock drinking | 7.13 | 40.4 | 11.1 |
| 44 | | LS 2 | Lesnovo | well | yes | No | irrigation | 6.84 | 67.0 | 12.4 |
| 45 | | LS 3 | Lesnovo | spring | yes | No | livestock drinking | 7.12 | 39.0 | 12.8 |
| Average | | | Lesnovo | | | | | 7.03 | 48.8 | 12.1 |

# Sample List of Groundwater and River Water (Additional Survey) (2)

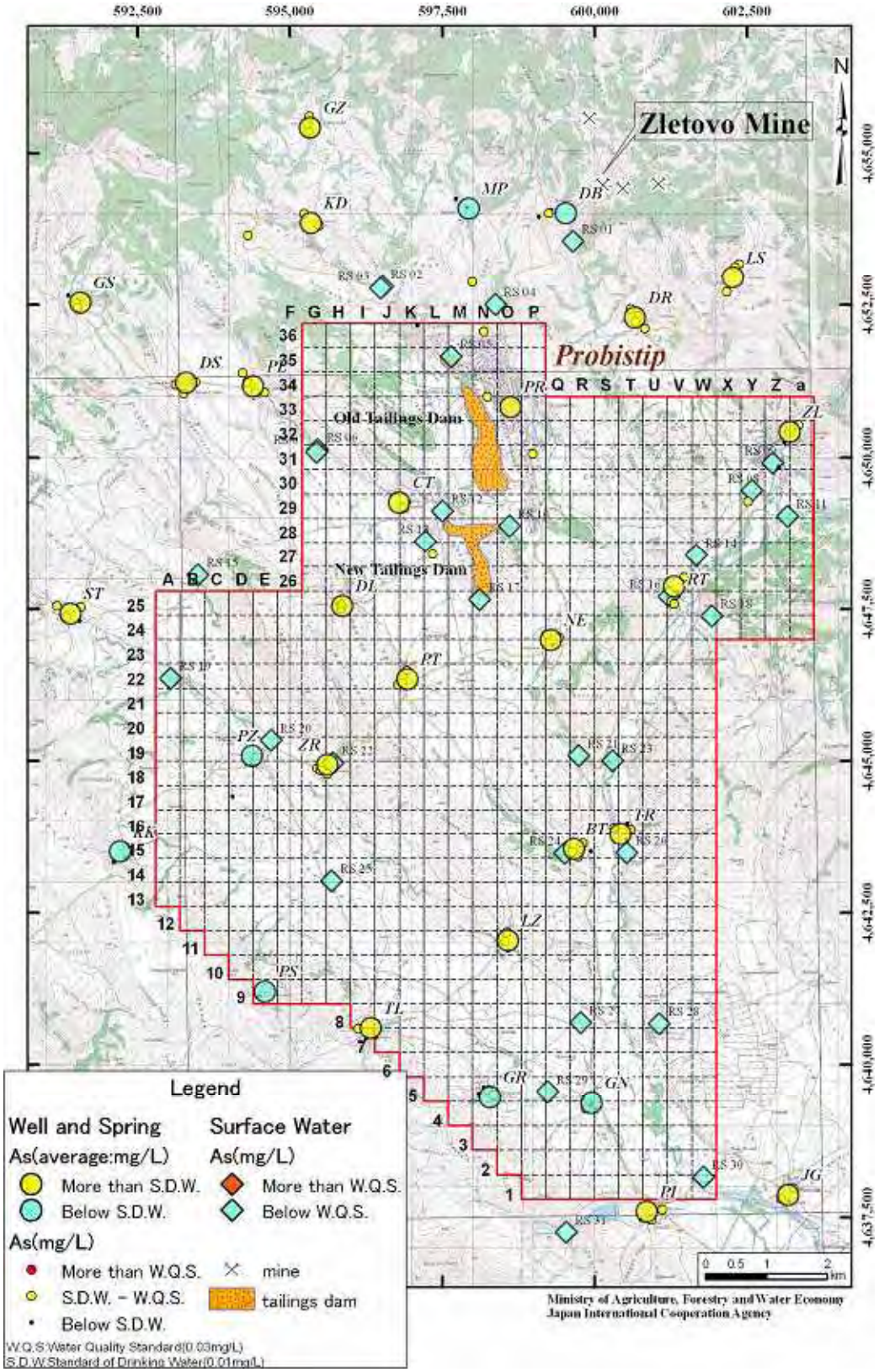
| # | Vil | Sample No. | Village/Town Name | Type of Water Source | Drinkable (Y/N) | Filter the water (Y/N) | Other Purpose | pH | EC (mS/m) | Temperature (˚C) |
|---|---|---|---|---|---|---|---|---|---|---|
| 46 | 15 | LZ 1 | Lezovo | well | yes | Yes | livestock drinking | 7.06 | 118.5 | 14.7 |
| 47 | | LZ 2 | Lezovo | well | no | No | livestock drinking | 7.25 | 114.8 | 13.0 |
| 48 | | LZ 3 | Lezovo | spring | no | No | livestock drinking | 7.08 | 89.4 | 16.6 |
| Average | | | Lezovo | | | | | 7.13 | 107.6 | 14.8 |
| 49 | 16 | MP 1 | Marcino | spring | yes | No | livestock drinking | 7.49 | 66.4 | 12.3 |
| 50 | | MP 2 | Marcino | spring | yes | no | livestock drinking | 7.66 | 61.2 | 12.0 |
| 51 | | MP 3 | Marcino-Pr | well | no | no | irrigation, cooking | 8.12 | 43.6 | 12.5 |
| Average | | | Marcino | | | | | 7.76 | 57.1 | 12.3 |
| 52 | 17 | NE 1 | Neokazi | well | no | No | No | 7.10 | 159.3 | 14.6 |
| 53 | | NE 2 | Neokazi | spring | yes | No | livestock drinking | 7.06 | 116.1 | 14.3 |
| 54 | | NE 3 | Neokazi | well pumping | yes | No | No | 7.06 | 163.9 | 13.5 |
| Average | | | Neokazi | | | | | 7.07 | 146.4 | 14.1 |
| 55 | 18 | PI 1 | Pisica | well pumping | yes | no | irrigation | 6.92 | 179.8 | 14.5 |
| 56 | | PI 2 | Pisica | well | no | No | irrigation | 7.20 | 148.8 | 13.5 |
| 57 | | PI 3 | Pisica | spring | yes | no | livestock drinking | 7.08 | 118.1 | 13.5 |
| Average | | | Pisica | | | | | 7.07 | 148.9 | 13.8 |
| 58 | 19 | PL 1 | Plesinci | well | no | No | irrigation, washing | 7.00 | 72.7 | 14.1 |
| 59 | | PL 2 | Plesinci | well | yes | No | livestock drinking, irrigation | 6.66 | 143.6 | 13.2 |
| 60 | | PL 3 | Plesinci | well | no | No | livestock drinking, irrigation | 6.50 | 81.2 | 15.8 |
| 61 | | PL 4 | Plesinci | well | yes | No | irrigation | 7.14 | 405.0 | 13.0 |
| Average | | | Plesinci | | | | | 6.83 | 175.6 | 14.0 |
| 62 | 20 | PR 1 | Probistip | well | no | no | irrigation | 8.17 | 146.3 | 14.3 |
| 63 | | PR 2 | Probistip | well | no | No | irrigation | 7.77 | 58.5 | 12.6 |
| 64 | | PR 3 | Probistip | well pumping | yes | No | No | 7.18 | 277.0 | 13.1 |
| 65 | | PR 4 | Probistip | well | no | No | irrigation | 7.90 | 86.4 | 17.2 |
| Average | | | Probistip | | | | | 7.76 | 142.1 | 14.3 |
| 66 | 21 | PS 1 | Pestrisino | spring | yes | No | livestock drinking | 7.33 | 53.2 | 15.3 |
| Average | | | Pestrisino | | | | | 7.33 | 53.2 | 15.3 |
| 67 | 22 | PT 1 | Petrsino | spring | yes | No | livestock drinking | 7.12 | 68.5 | 16.3 |
| 68 | | PT 2 | Petrsino | well pumping | yes | No | irrigation | 7.30 | 89.4 | 16.0 |
| 69 | | PT 3 | Petrsino | well | yes | No | irrigation | 7.56 | 270.0 | 13.4 |
| Average | | | Petrsino | | | | | 7.33 | 142.6 | 15.2 |
| 70 | 23 | PZ 1 | Puzderci | spring | yes | No | livestock drinking | 7.11 | 99.9 | 14.3 |
| 71 | | PZ 2 | Puzderci | spring | no | No | livestock drinking | | | |
| 72 | | PZ 3 | Puzderci | well | no | No | irrigation | 7.91 | 63.4 | 17.1 |
| 73 | | PZ 4 | Puzderci | well | No, Yes before | No | No | 7.11 | 100.4 | 12.8 |
| Average | | | Puzderci | | | | | 7.38 | 87.9 | 14.7 |
| 74 | 24 | RT 1 | Ratavica | well | no | No | irrigation | 7.22 | 108.4 | 14.0 |
| 75 | | RT 2 | Ratavica | well | no | No | irrigation | 7.30 | 163.5 | 14.3 |
| 76 | | RT 3 | Ratavica | well | no | no | irrigation | 7.37 | 233.0 | 15.4 |
| 77 | | RT 4 | Ratavica | well pumping | no | No | No | 7.02 | 214.0 | 15.0 |
| Average | | | Ratavica | | | | | 7.23 | 179.7 | 14.7 |
| 78 | 25 | ST 1 | Strisovci | well | no | no | livestock drinking, irrigation | 7.05 | 225.0 | 13.1 |
| 79 | | ST 2 | Strisovci | well pumping | yes | Yes | livestock drinking, irrigation | 7.17 | 114.1 | 14.9 |
| 80 | | ST 3 | Strisovci | well | yes | Yes | livestock drinking, irrigation | 7.32 | 121.6 | 13.1 |
| 81 | | ST 4 | Strisovci | well | yes | No | irrigation | 7.16 | 100.2 | 13.4 |
| Average | | | Strisovci | | | | | 7.18 | 140.2 | 13.6 |
| 82 | 26 | TL 1 | Troolo | well | no | No | irrigation | 7.57 | 171.5 | 14.8 |
| 83 | | TL 2 | Troolo | spring | yes | No | livestock drinking | 7.47 | 67.4 | 18.9 |
| 84 | | TL 3 | Troolo | well pumping | yes | No | livestock drinking, irrigation | 7.35 | 77.6 | 21.7 |
| Average | | | Troolo | | | | | 7.46 | 105.5 | 18.5 |
| 85 | 27 | TR 1 | Tripatanci | well | no | no | irrigation | 6.95 | 295.0 | 13.3 |
| 86 | | TR 2 | Tripatanci | well | no | No | no | 7.03 | 116.5 | 12.6 |
| 87 | | TR 3 | Tripatanci | well | no | no | irrigation | 7.66 | 185.8 | 12.7 |
| 88 | | TR 4 | Tripatanci | well | no | No | irrigation | 6.74 | 42.0 | 14.1 |
| Average | | | Tripatanci | | | | | 7.10 | 159.8 | 13.2 |
| 89 | 28 | ZL 1 | Zletovo | well pumping | yes | No | No | 6.92 | 25.7 | 13.4 |
| 90 | | ZL 2 | Zletovo | well pumping | Yes,sometimes | No | No | 6.78 | 24.5 | 11.9 |
| 91 | | ZL 3 | Zletovo | well pumping | yes | Yes | irrigation | 7.09 | 43.9 | 16.2 |
| 92 | | ZL 4 | Zletovo | well pumping | no | No | irrigation | 7.16 | 119.5 | 14.7 |
| Average | | | Zletovo | | | | | 6.99 | 53.4 | 14.1 |
| 93 | 29 | ZR 1 | Zarapinci | well | yes | Yes | No | 7.74 | 113.8 | 13.3 |
| 94 | | ZR 2 | Zarapinci | well | yes | No | irrigation | 6.35 | 65.3 | 12.5 |
| 95 | | ZR 3 | Zarapinci | spring | yes | No | livestock drinking | 5.98 | 132.4 | 11.9 |
| Average | | | Zarapinci | | | | | 6.69 | 103.8 | 12.6 |

# Sample List of Groundwater and River Water (Additional Survey) (3)

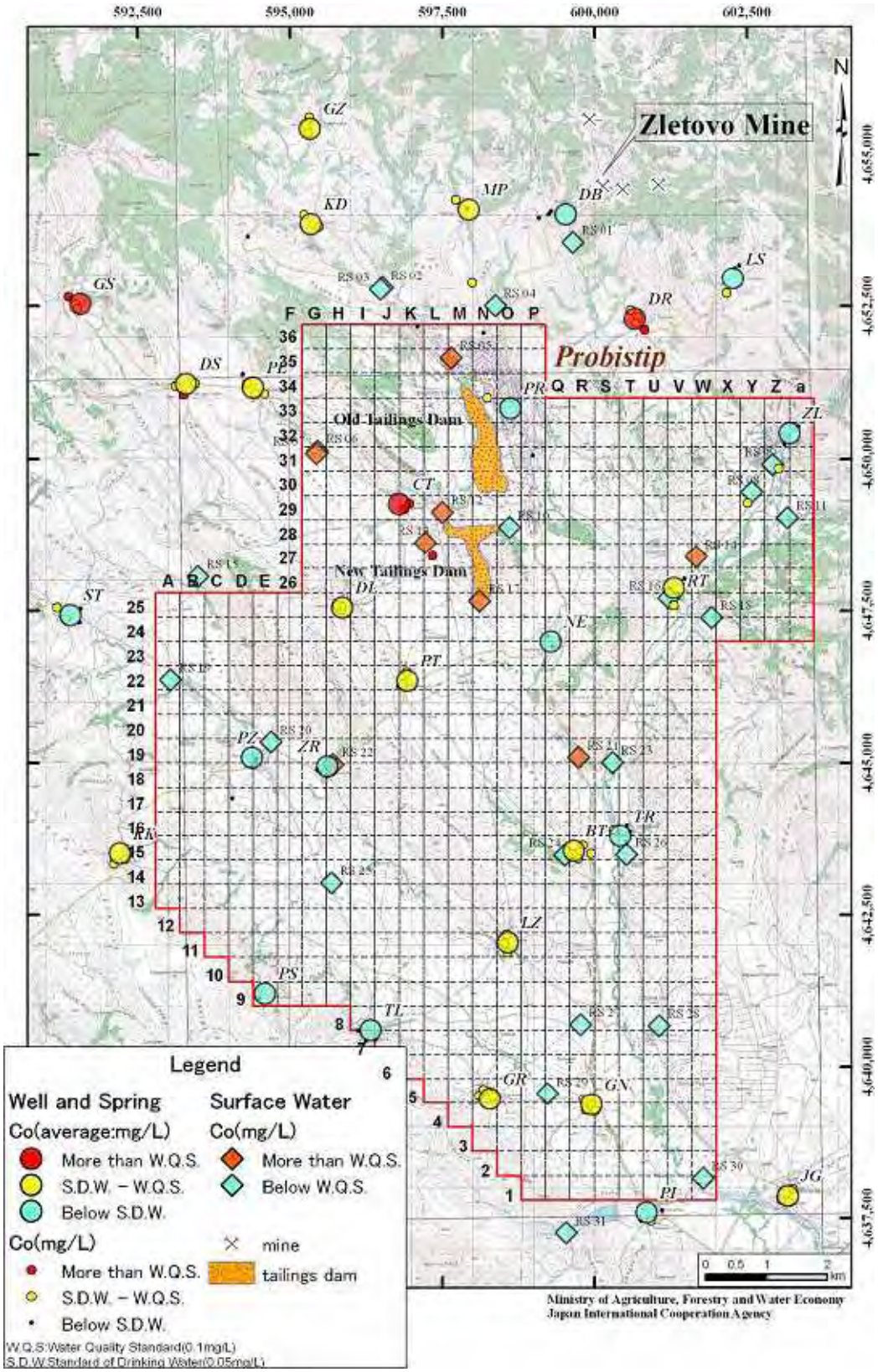
River samples

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 96 | | RS 01 | | river | | | | 7.53 | 86.1 | 16.2 |
| 97 | | RS 02 | | river | | | | 5.20 | 80.3 | 21.8 |
| 98 | | RS 03 | | river | | | | 7.26 | 92.3 | 17.0 |
| 99 | | RS 04 | | river | | | | 8.46 | 76.7 | 13.7 |
| 100 | | RS 05 | | seepage water | | | | 6.55 | 182.3 | 25.7 |
| 101 | | RS 06 | | river | | | | 3.38 | 153.3 | 21.2 |
| 102 | | RS 07 | | river | | | | 6.86 | 115.0 | 22.1 |
| 103 | | RS 08 | | river | | | | 7.95 | 63.9 | 16.6 |
| 104 | | RS 09 | | river | | | | 8.07 | 11.46 | 15.5 |
| 105 | | RS 10 | | seepage water | | | | 7.41 | 101.6 | 18.6 |
| 106 | | RS 11 | | river | | | | 7.95 | 32.3 | 16.0 |
| 107 | | RS 12 | | river | | | | 8.10 | 170.2 | 18.8 |
| 108 | | RS 13 | | river | | | | 6.84 | 133.1 | 21.0 |
| 109 | | RS 14 | | river | | | | 8.30 | 103.1 | 21.1 |
| 110 | | RS 15 | | river | | | | 8.38 | 87.5 | 24.6 |
| 111 | | RS 16 | | river | | | | 8.00 | 126.9 | 19.0 |
| 112 | | RS 17 | | river | | | | 7.18 | 142.3 | 15.0 |
| 113 | | RS 18 | | river | | | | 8.15 | 96.4 | 19.8 |
| 114 | | RS 19 | | river | | | | 8.25 | 137.0 | 25.0 |
| 115 | | RS 20 | | river | | | | 8.34 | 107.1 | 28.4 |
| 116 | | RS 21 | | river | | | | 7.94 | 148.7 | 18.3 |
| 117 | | RS 22 | | river | | | | 4.53 | 120.1 | 20.7 |
| 118 | | RS 23 | | river | | | | 8.06 | 24.6 | 19.3 |
| 119 | | RS 24 | | river | | | | 7.19 | 121.2 | 15.8 |
| 120 | | RS 25 | | river | | | | 7.56 | 154.4 | 16.1 |
| 121 | | RS 26 | | river | | | | 7.93 | 101.4 | 25.8 |
| 122 | | RS 27 | | river | | | | 8.46 | 118.6 | 26.8 |
| 123 | | RS 28 | | river | | | | 7.29 | 120.5 | 16.6 |
| 124 | | RS 29 | | river | | | | 7.30 | 178.5 | 16.8 |
| 125 | | RS 30 | | river | | | | 7.72 | 23.9 | 21.7 |
| 126 | | RS 31 | | river | | | | 8.46 | 59.5 | 23.4 |
| | | | | | | | River Water Maximum | 8.46 | 182.30 | 28.40 |
| | | | | | | | River Water Minimum | 3.38 | 11.46 | 13.70 |
| | | | | | | | River Water Average | 7.44 | 105.49 | 19.95 |

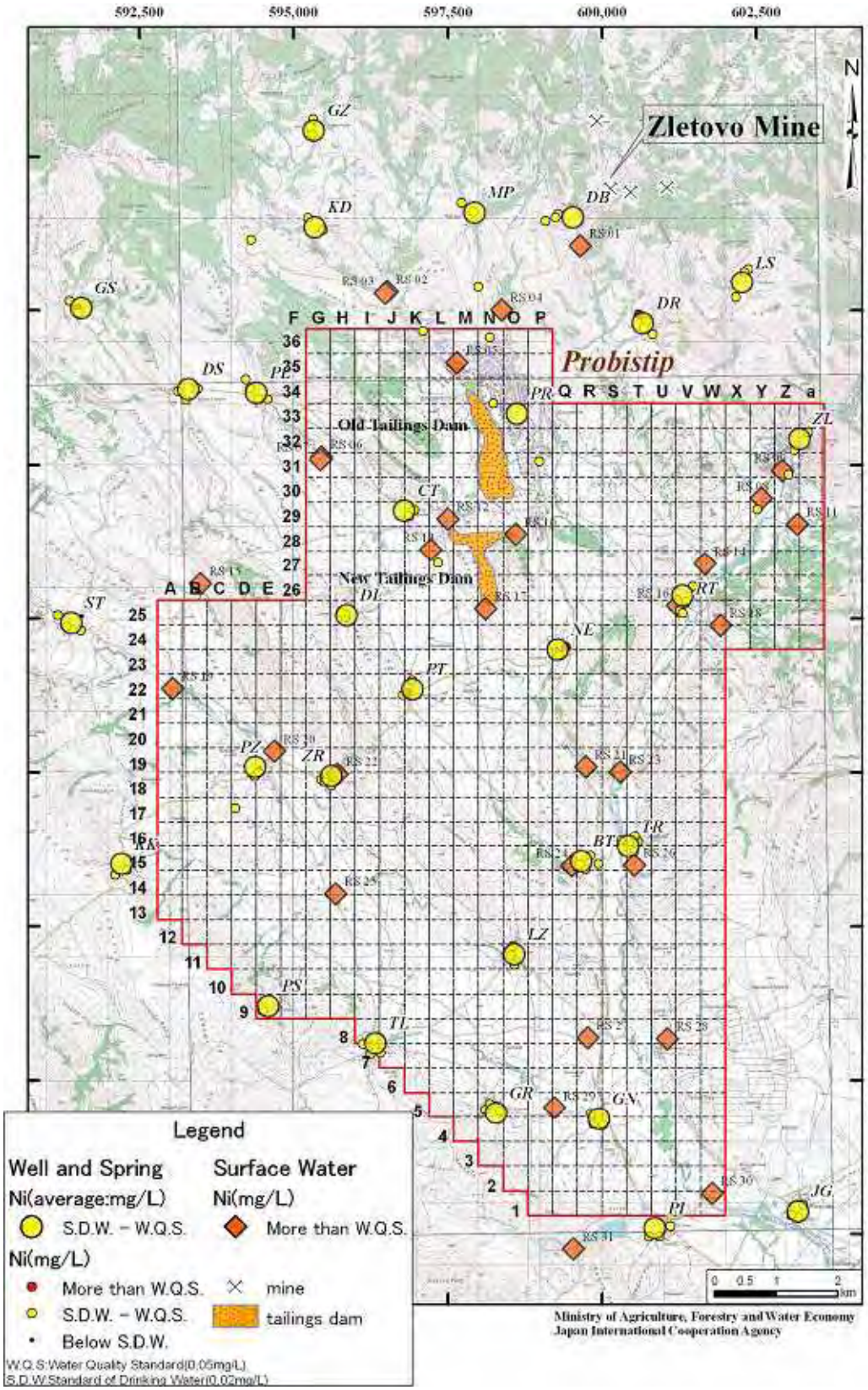
# Appendix 12
# Heavy Metal Concentration in Groundwater and River Water (Additional Survey)



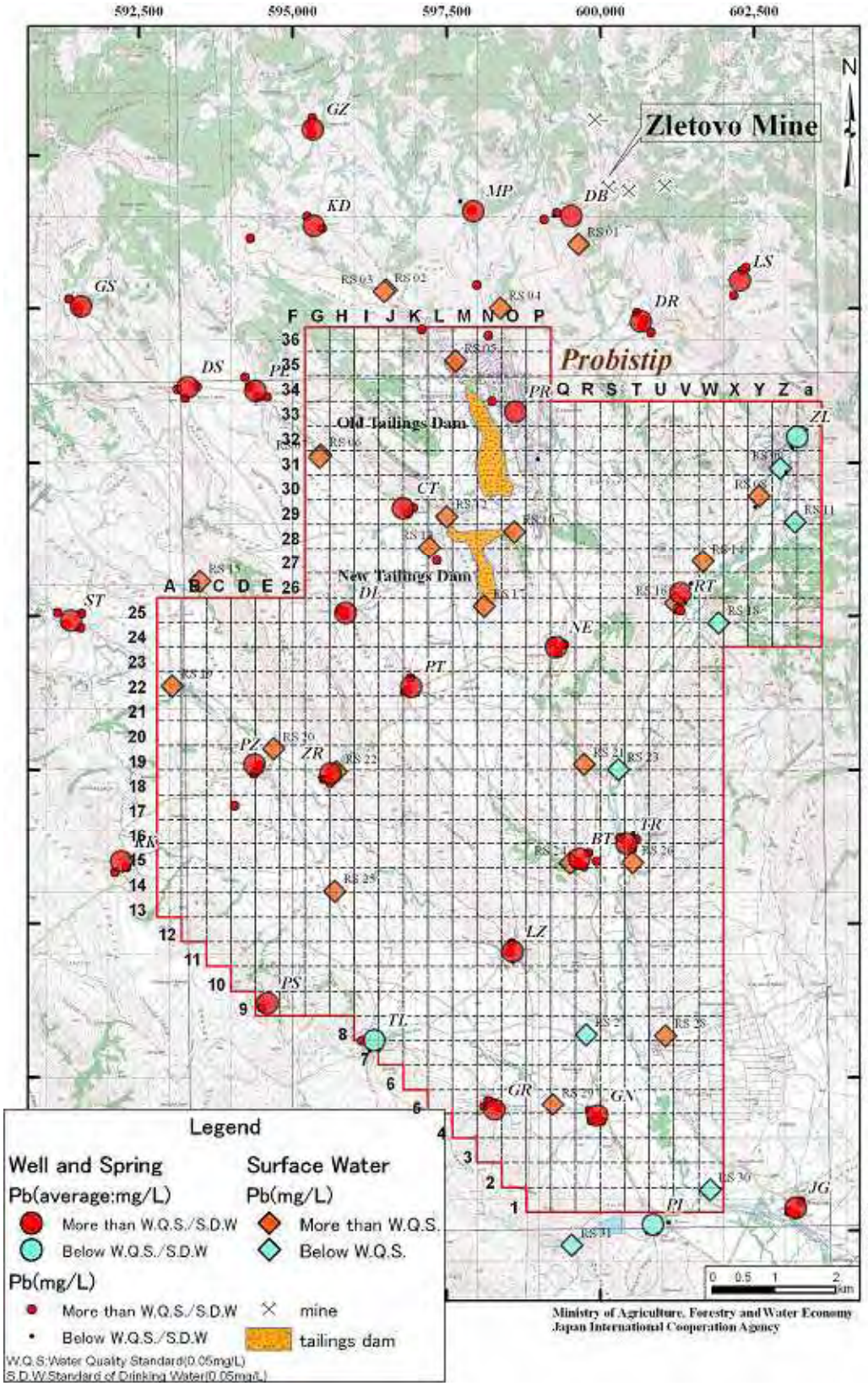

As Concentration in Groundwater and River Water (Additional Survey)



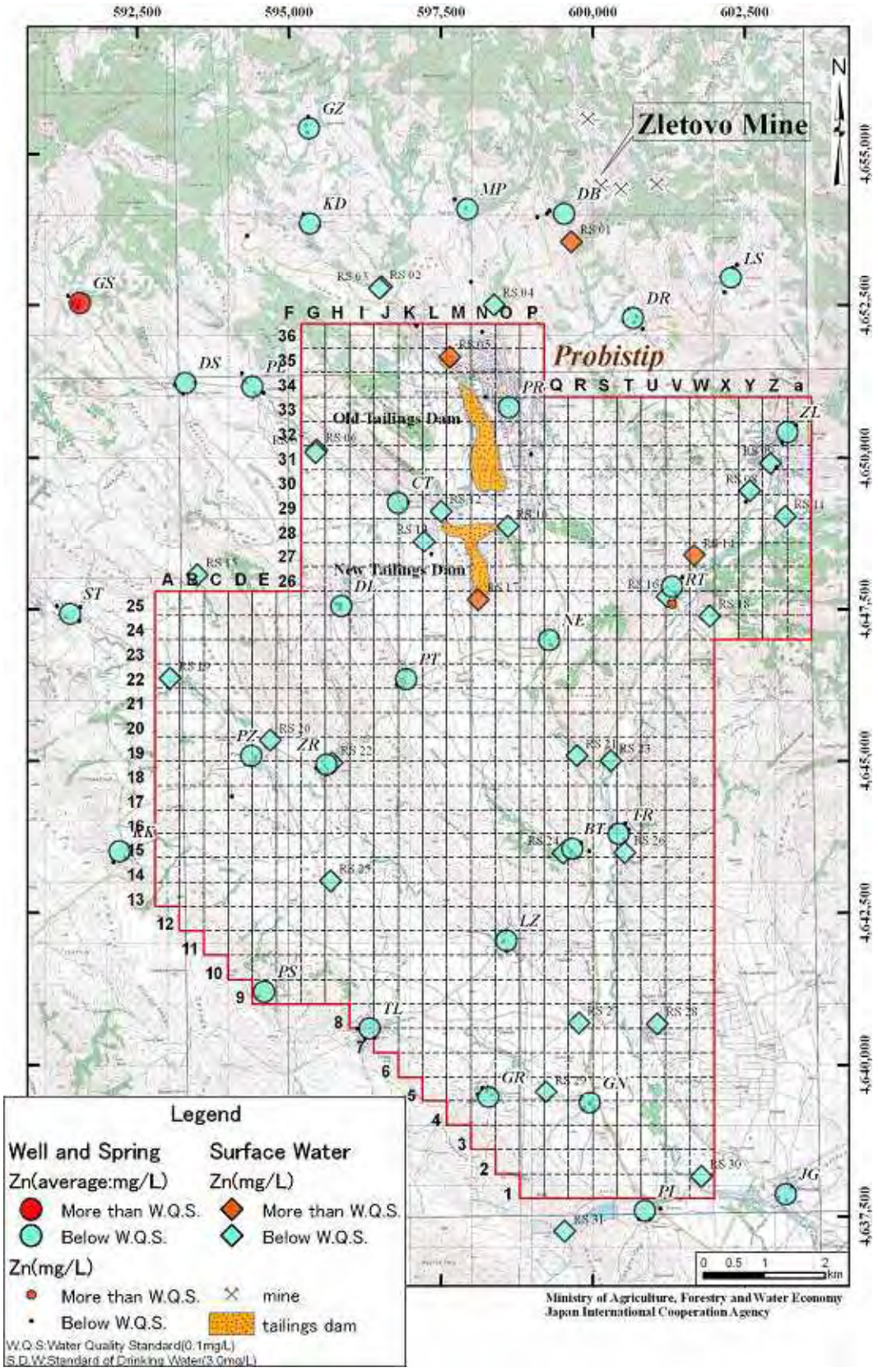

Co Concentration in Groundwater and River Water (Additional Survey)



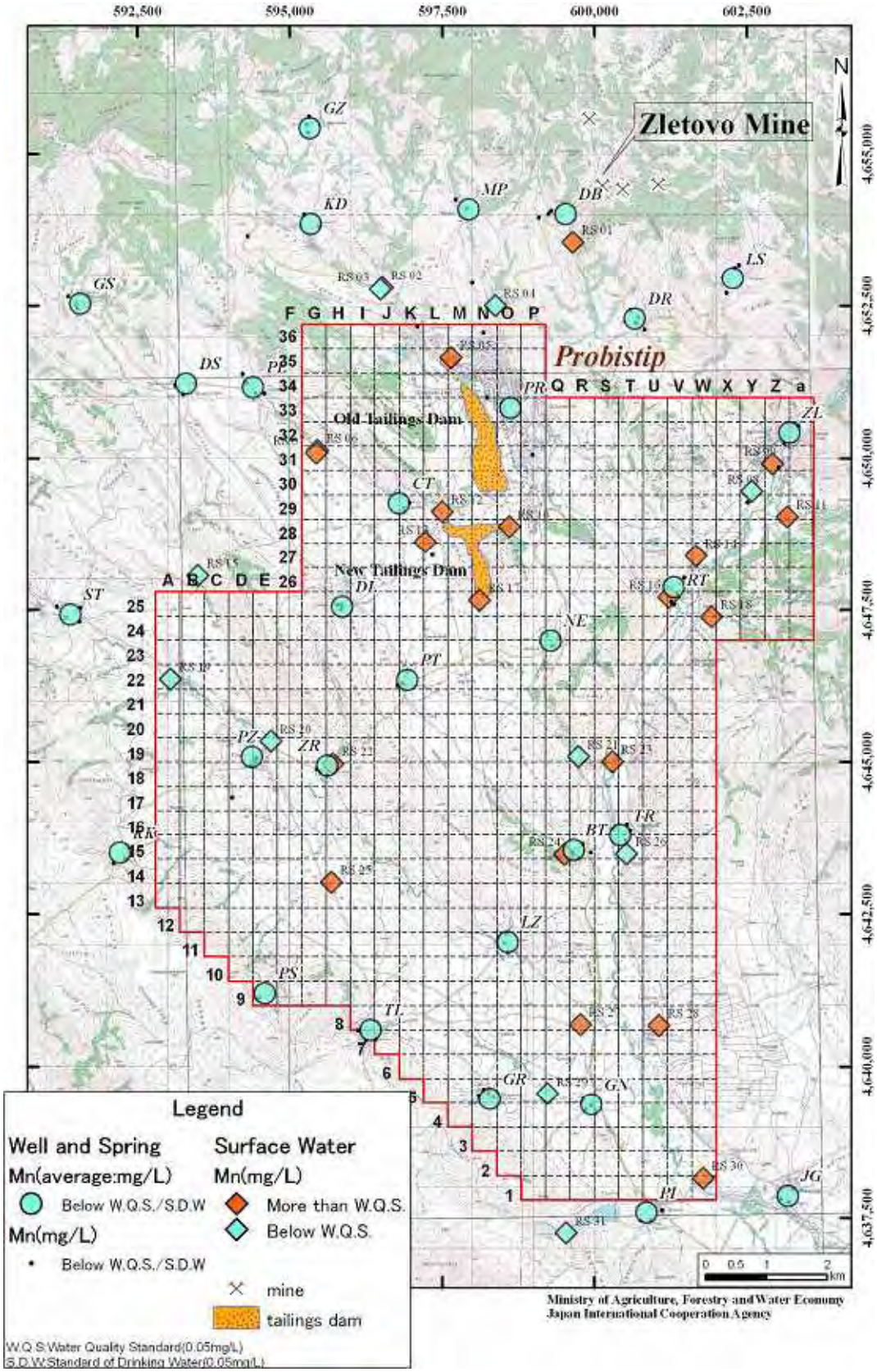

Ni Concentration in Groundwater and River Water (Additional Survey)




Pb Concentration in Groundwater and River Water (Additional Survey)



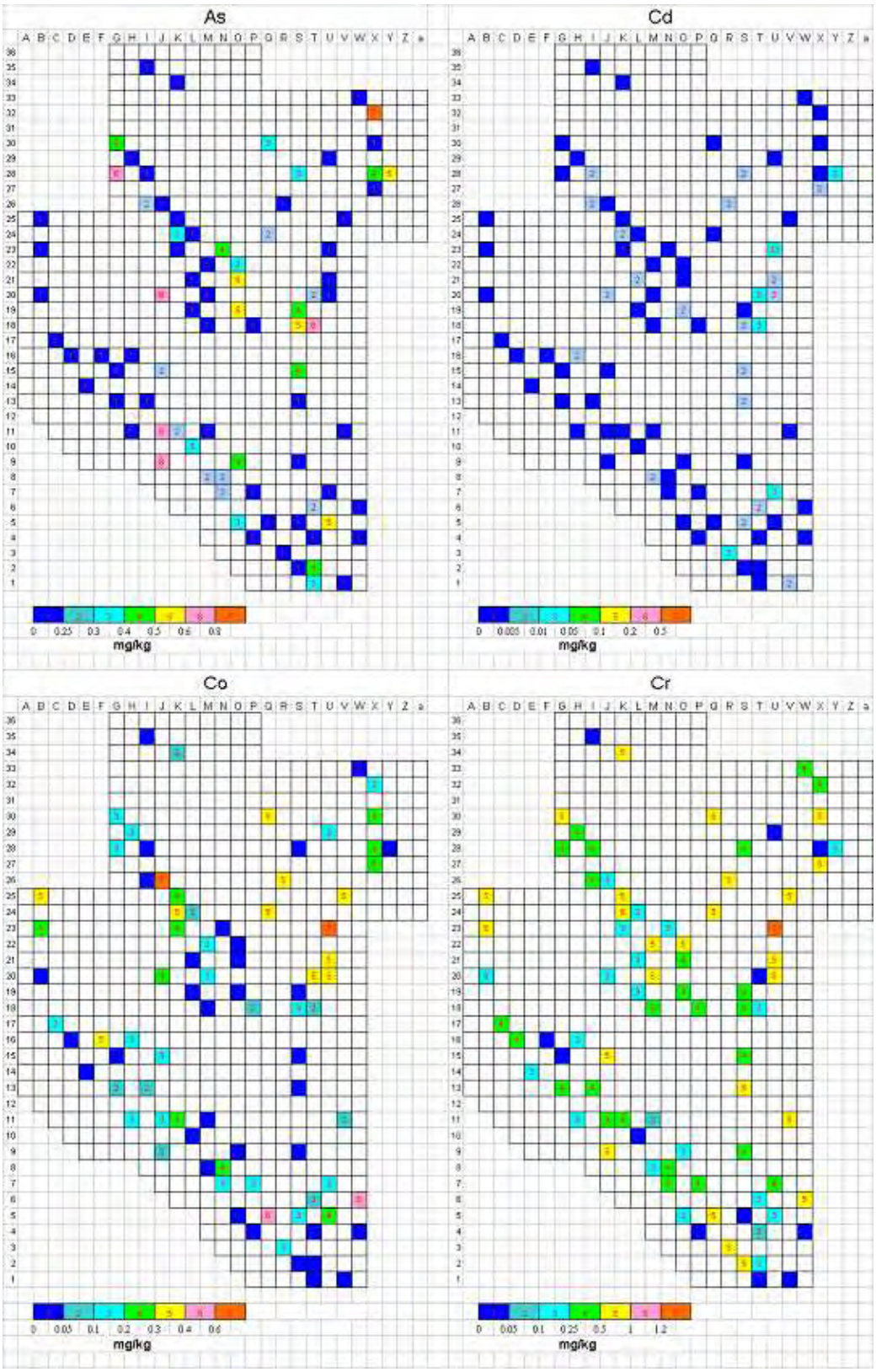

Zn Concentration in Groundwater and River Water (Additional Survey)




Mn Concentration in Groundwater and River Water (Additional Survey)

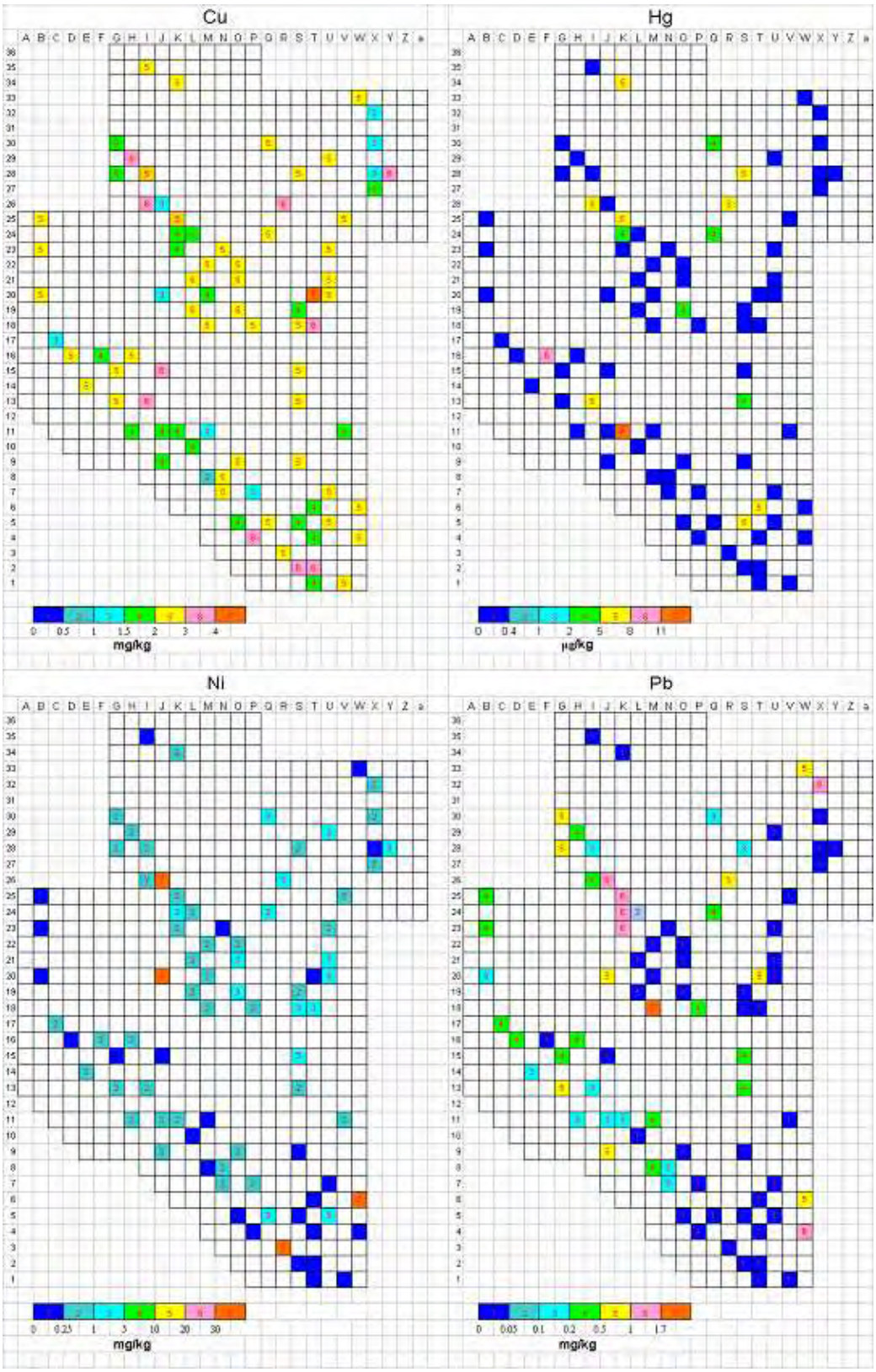
# Appendix 13
# Distribution of Heavy Metals in Crops

**Wheat**



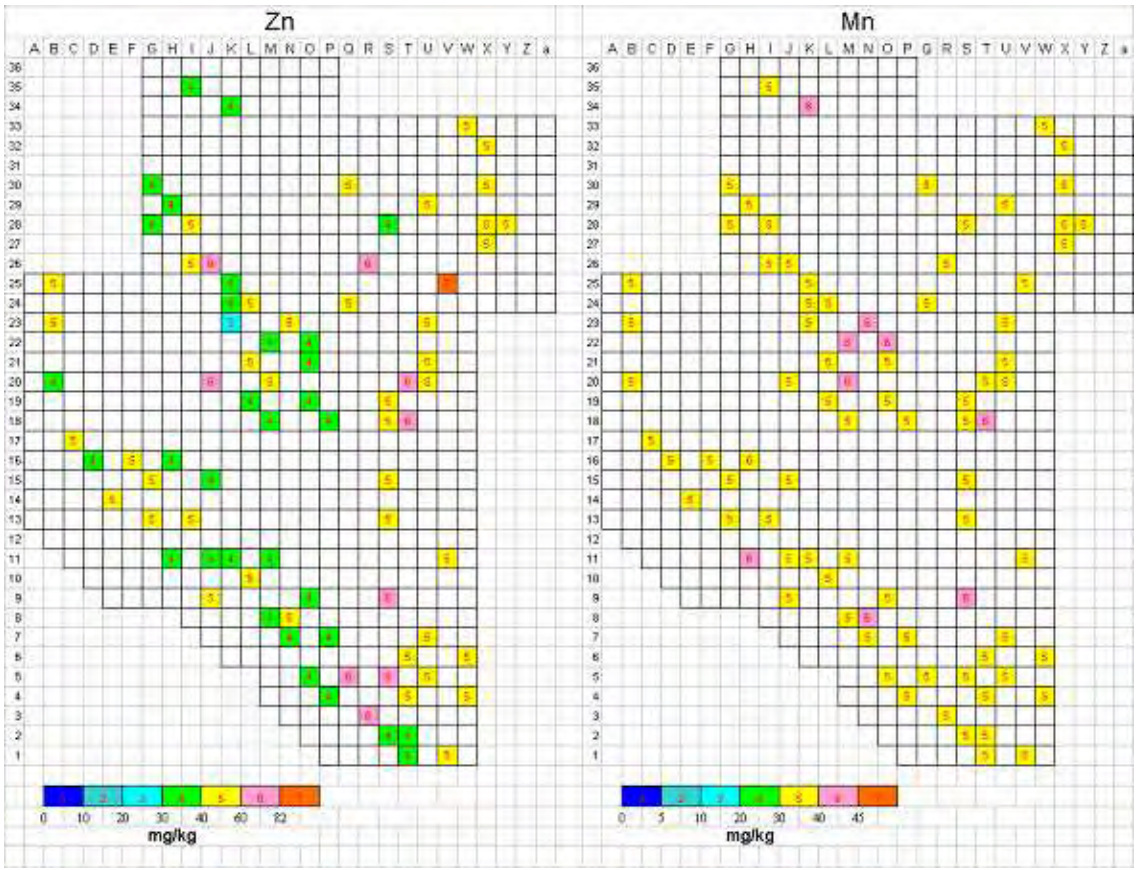

Heavy Metals Concentration of Wheat in the Pilot Project Area (1)

**Wheat**



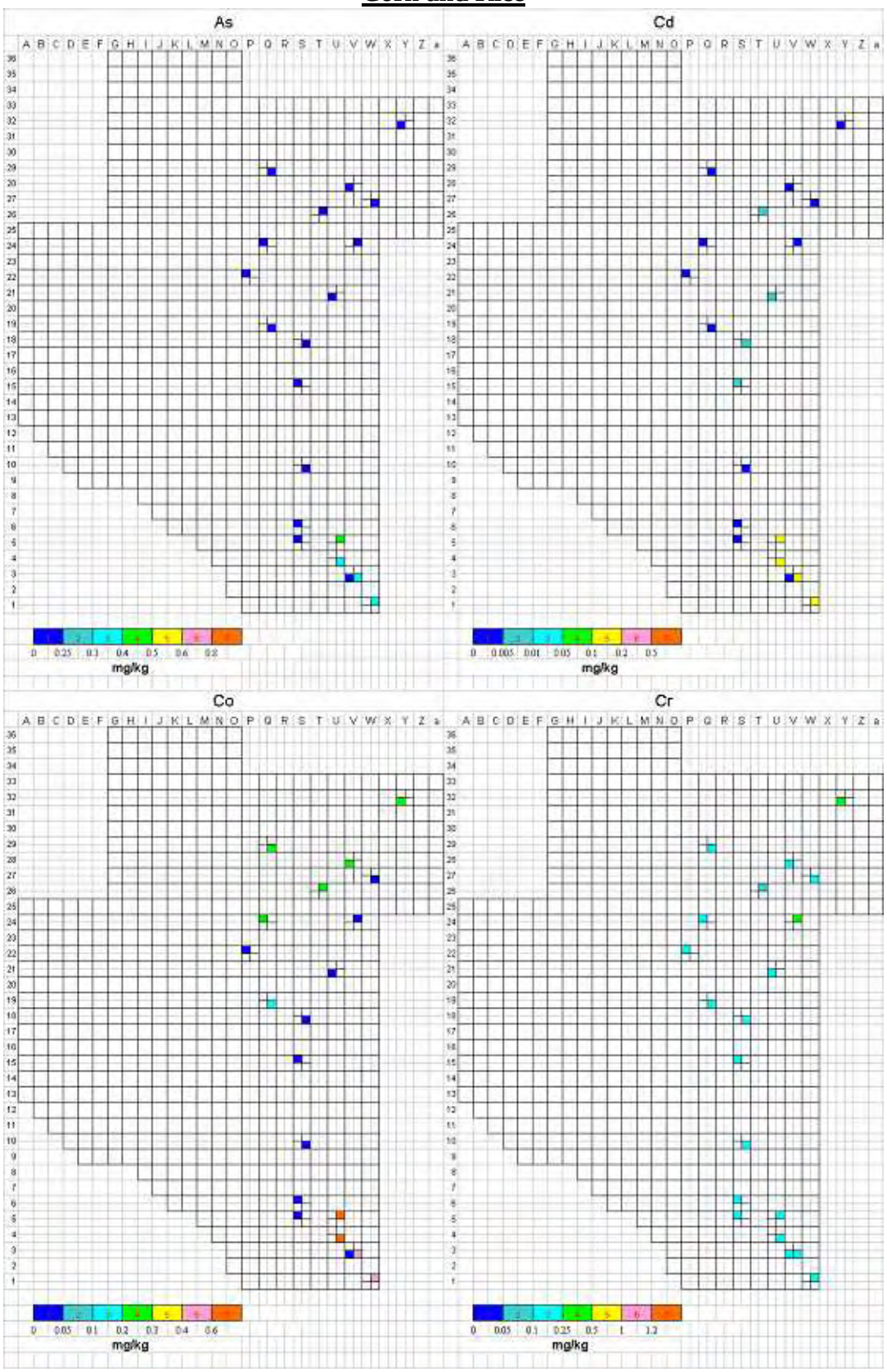

Heavy Metals Concentration of Wheat in the Pilot Project Area (2)

## Wheat



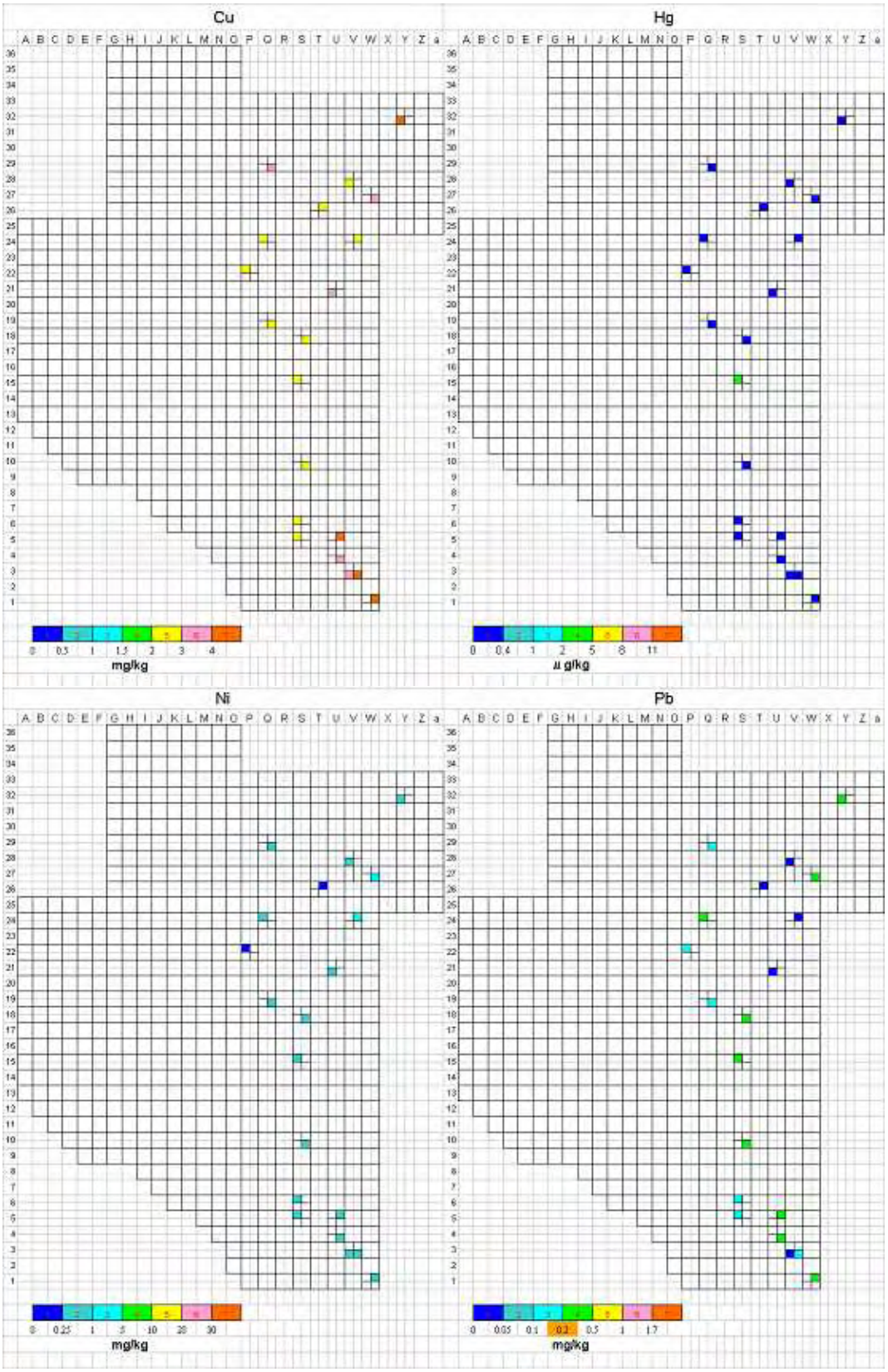

**Heavy Metals Concentration of Wheat in the Pilot Project Area (3)**

## Corn and Rice



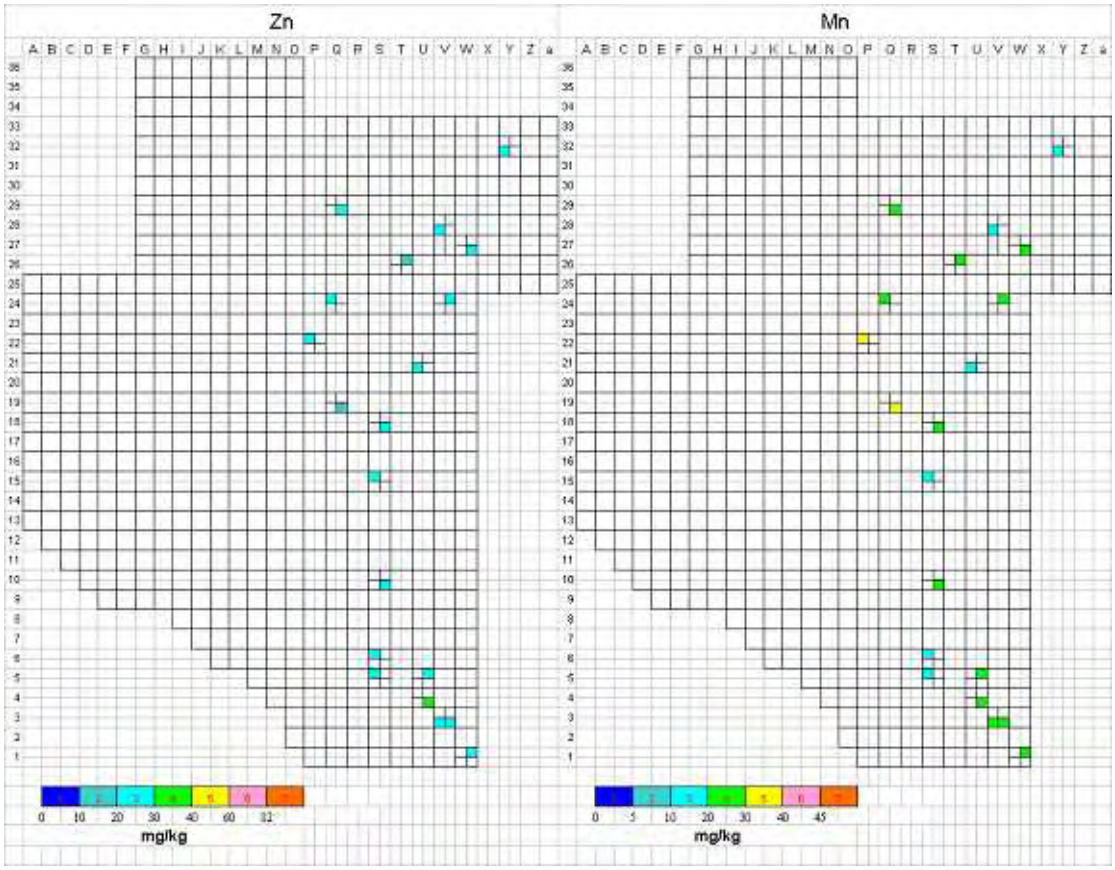

**Heavy Metals Concentration of Corn and Rice in the Pilot Project Area (1)**

## Corn and Rice




**Heavy Metals Concentration of Corn and Rice in the Pilot Project Area (2)**

## Corn and Rice




**Heavy Metals Concentration of Corn and Rice in the Pilot Project Area (3)**

# Appendix 14
# Cost Estimation of Counter Measure

Cost Estimation of the Counter-measures (1)

| Priority sites | Location and area | Methods of Actions and Alternatives (**A**) | Content | Unit Price (Euro) | Price (Euro) | Total (Euro) |
|---|---|---|---|---|---|---|
| 1. Priority No.1 | - Tailings Dams TD-I and TD-II | **A-1:**<br>- TD-1: Removing tailings to New Tailings Dam after dressing again, after that need to reclaim by fresh soil, 0.52m thick.<br>**- Volume of tailings of TD-1: 150,000 $m^3$**<br>**- Area of tailings of TD-I: 1.25ha**<br>**- Area of slope of TD-I: 0.5ha** | 1. Excavation of tailings: 150,000$m^3$<br>2. Transportation : 4km<br>3. Backfilling by fresh soil: 0.5m<br>: 6,000 $m^3$<br>4. Planting : 1.25ha | 2<br>2<br>2<br>10,000 | 300,000<br>300,000<br>300,000<br>12,500 | **912,500** |
| | | - TD-2: Retaining wall located at western side of dam, ditches/ culverts for collecting seeped water from tailings, and water treatment.<br>**- Volume of tailings of TD-II: 100,000$m^3$**<br>**- Area of tailings of TD-II: 7.2ha**<br>**- Area of slope of TD-II: 1.6ha** | 1. Earth work for smoothing of slope<br>: 1.6ha<br>2. Retaining wall : 450m long<br>x 4m high<br>3. Ditches/culverts : 450m | 10,000<br>300<br>100 | 16,000<br>135,000<br>45,000 | **196,000** |
| | | **A-2:**<br>- TD-1: Retaining wall located at northern side of dam, culvert for seepage water, ditches/culverts for collecting seeped water from tailings, and water treatment. | 1. Earth work for smoothing of slope<br>: 0.5ha<br>2. Retaining wall : 150m long x 2<br>x 4m high<br>3. Ditches/culverts : 300m | 10,000<br>300<br>100 | 5,000<br>90,000<br>30,000 | **125,000** |
| | | - TD-2: Retaining wall located at western side of dam, ditches/culverts for collecting seeped water from tailings, and water treatment. | 1. Earth work for smoothing of slope<br>: 1.6ha<br>2. Retaining wall : 450m long,<br>x 4m high<br>3. Ditches/culverts : 450m | 10,000<br>300<br>100 | 16,000<br>135,000<br>45,000 | **196,000** |

Cost Estimation of the Counter-measures for the Action Plan (2)

| Priority sites | Location and area | Methods of Actions and Alternatives (**A**) | Content | Unit Price (Euro) | Price (Euro) | Total (Euro) |
|---|---|---|---|---|---|---|
| 2-1. Priority No.2 | - Tailings Dams TD-III, IV and TD-V | **A-1:**<br>- Covering of surface and slope<br>- Vegetation/forestation: Surface of dams.<br>- Slope: Steps and ditches in each 5m, **covering by stones** for protection against erosion.<br>- Retaining walls: 1900m long x 10m high, reinforced concrete.<br>- Drainage ditches: Collecting seepage and surface water, etc.<br>**TD-III:**<br>**- Volume of tailings : 750,000m$^3$**<br>**- Area of tailings : 10.5ha**<br>**- Area of slope : 2.8ha**<br>**TD-IV:**<br>**- Volume of tailings: 900,000m$^3$**<br>**- Area of tailings: 7.5ha**<br>**- Area of slope: 4.0ha**<br>**TD-V:**<br>**- Volume of tailings: 1,100,000m$^3$**<br>**- Area of tailings: 17.5ha**<br>**- Area of slope: 5.0ha** | **TD-IV~V**<br>1. Covering of top : 25ha x 1.5m thick 375,000 m$^3$<br>2. Slope protection (covering of slope by stone : 9.0ha, 135,000 m$^3$<br>3. Planting x: 25ha<br>4. Earth work for smoothing of slope : 9.0ha<br>5. Retaining wall : 1,000m long, x 4m high<br>6. Ditches/culverts : 1,000m | 2<br>1<br>10,000<br>10,000<br>300<br>100 | 750,000<br>135,000<br>250,000<br>90,000<br>300,000<br>100,000 | **1,625,000** |
| | | | **TD-III**<br>6. Earth work for smoothing of slope : 2.80ha<br>7. Retaining wall : 400m long, x 4m high<br>8. Ditches/culverts : 400m | 10,000<br>300<br>100 | 28,000<br>120,000<br>40,000 | **188,000** |
| | | | **Total** | | | **1,813,000** |
| | | **A-2:**<br>**- Covering surface and slope by uncontaminated soil**, thickness: 1.5m<br>- Vegetation/forestation: Surface of dams.<br>- Slope: Steps and ditches in each 5m, **covering by stones** for protection of erosion. | **TD-III, IV and V**<br>1. Covering of top : 25ha x 1.5m thick 375,000 m$^3$<br>2. Planting : 25ha<br>3. Earth work for smoothing of slope : 11.8ha<br>4. Slope protection by stone : 9.0ha<br>5. Ditches/culverts : 1,400m | 1<br>10,000<br>10,000<br>20,000<br>100 | 375,000<br>250,000<br>118,000<br>180,000<br>140,000 | **1,063,000** |

Cost Estimation of the Counter-measures for the Action Plan (3)

| Priority sites | Location and area | Methods of Actions and Alternatives (**A**) | Content | Unit Price (Euro) | Price (Euro) | Total (Euro) |
|---|---|---|---|---|---|---|
| 2-2. Priority No.2 | - Tailings Dams TD-III, IV and TD-V | **A-3:**<br>- Slope: Steps and ditches in each 5m, covering by uncontaminated soil.<br>- **Covering of surface by uncontaminated construction debris**, thickness: 2m.<br>- Vegetation/forestation, after covered. | **TD-III, IV and V**<br>1. Covering of top : 25ha x 1.5m thick 375,000 $m^3$<br>2. Planting : 25ha<br>3. Earth work for smoothing of slope : 11.8ha<br>4. Slope protection by stone : 9.0ha | <br>1<br>10,000<br>10,000<br>20,000 | <br>375,000<br>250,000<br>118,000<br>180,000 | **923,000** |
| | | **A-4:**<br>- **Covering slope by gravels** after smoothing of slope surface.<br>- **Covering of surface by uncontaminated construction debris**, thickness: 2m.<br>- Vegetation/forestation, after covered. | **TD-III, IV and V**<br>1. Covering of top : 25ha x 1.5m thick 375,000 $m^3$<br>2. Planting : 12.5ha<br>3. Earth work for smoothing of slope : 11.8ha<br>4. Slope protection by stone : 9.0ha | <br>1<br>10,000<br>10,000<br>5,000 | <br>375,000<br>125,000<br>118,00<br>45,000 | **663,000** |

Cost Estimation of the Counter-measures for the Action Plan (4)

| Priority sites | Location and area | Methods of Actions and Alternatives (**A**) | Content | Unit Price (Euro) | Price (Euro) | Total (Euro) |
|---|---|---|---|---|---|---|
| 3. Priority No.3 | - Middle stream of the Zletovska River (Area: 60ha) | **A-1:** Removing tailings, tailings should be returned to the New Tailings Dam: 5km for transportation from site to New Tailings Dam. Average: thickness of tailings: 0.5m. | 1. Excavation of tailings: 300,000m$^3$<br>2. Transportation : 8km | 1.5<br>3 | 450,000<br>900,000 | **1,350,000** |
| | | **A-2:** Same as A-1, half size of excavation area. | 1. Excavation of tailings: 150,000m$^3$<br>2. Transportation : 8km | 1.5<br>3 | 225,000<br>900,000 | **1,125,000** |
| | | **A-3:** Phyto-remediation/bio-diesel. | 1. Seeds (unknown) | - | - | - |
| | | **A-4:** Management measures to restrict use of land near the river for agricultural purposes. | | - | - | - |
| 4. Priority No.4 | Lower stream of the Koritnica River | **A-1:**<br>- Sand control dam to stop the contaminated fragment and gravels, installed culverts and water treatment. Scale of dam: 15m high, 50m wide, 2 dams. | 1. Sand control dams : 2 sets<br>2. Culverts : 30m | 750,000<br>1,000 | 1,500,000<br>30,000 | **1,530,000** |
| | | **A-2:** Same as A-1. | | | | **1,530,000** |
| | | **A-3:** Management measures to restrict use of land near the river for agricultural purposes. | | - | - | - |

Cost Estimation of the Counter-measures for the Action Plan (5)

| Priority sites | Location and area | Methods of Actions and Alternatives | Content | Unit Price (Euro) | Price (Euro) | Total (Euro) |
|---|---|---|---|---|---|---|
| 5. Priority No.5 | Lower stream of the Kiselica River (Area: 32ha) | **A-1:**<br>- Removing tailings, tailings should be returned to the New Tailings Dam. | 1. Excavation of tailings: 160,000m$^3$<br>2. Transportation : 3km | 1.5<br>2 | 240,000<br>320,000 | **560,000** |
| | | **A-2:** Phyto-remediation/bio-diesel | 1. Seeds (unknown) | - | - | - |
| | | **A-3:** Management measures to restrict use of land near the river for agricultural purposes. | | - | - | - |
| 6. Other sites | 1) Mine site: water | **A-1:** Control and water treatment, monitoring | (Mining company should take care waste water from mining sites.) | | | |
| | 2) New Tailings Dam | **A-1:** Covering slope of dike, monitoring | (Mining company should take care concerning tailings dam.) | | | |
| | 3) Lowermost stream of Zletovska River | **A-1:** Phyto-remediation/bio-diesel | 1. Seeds (unknown) | - | - | - |
| | | **A-2:** Management measures to restrict use of land near the river for agricultural purposes. | | - | - | - |
| | 4) South of Probistip | **A-1:** Phyto-remediation/bio-diesel | 1. Seeds (unknown) | - | - | - |
| | | **A-2:** Management measures to restrict use of land near the river for agricultural purposes. | | - | - | - |

# Appendix 15
# Soil Contamination Survey Method

***Soil Contamination Survey Method (Draft)***

**(1) Existing Data Analysis**: Collection and analysis of data and information concerning usage of harmful substances in the site.

1. Planning of soil contamination survey in the site
2. Official reporting the contents and implementation plan of soil contamination survey to the Administrative Office.

**(2) General Survey:** Surface soil survey and Groundwater survey using existing water wells.

1. Soil and water sampling and analyses of content and elution tests.
2. Confirmation of contaminated soil area of surface dimension.
3. Official chemical analysis method.

**General Survey : see Box 15-1 in Appendix -15.**

**(3) Detailed Survey:** Drilling survey.

1. Drilling sampling and analyses of content and elution tests.
2. Confirmation of contaminated soil area of 3 dimensions.
3. Official chemical analysis method

**Detailed Survey : see Box 15-2 in Appendix - 15.**

**(4) Crop Survey:** Sampling and chemical analysis of Crops.

1. Official sampling method.
2. Official chemical analysis method

**Crop Survey : see Box15-3 in Appendix - 15**

**(5) Risk Assessment:** Risk analysis and assessment based on the land-use.

**(6) Reporting of Soil Contamination Survey:** Evaluation and Registration.

1. The results of soil contamination survey are reported to the Administrative Office.

**Reporting: Summary Report: see Table 10.2.**

**(7) Designation of Soil Contamination Site:** Instruction (order) of counter-measures of soil contamination.

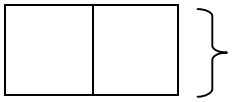
## Box 15-1

***Outline of General Survey for Soil Contamination***

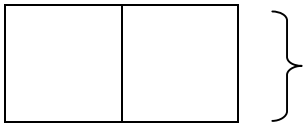
The General Survey is for soil contamination due to heavy metals, including As, Cd, Cr, Hg, Pb, etc., and the survey consists of surface soil survey described as below.

**(1) Surface Soil Survey: Grid survey**

a. Urban, industrial and commercial areas : 30m Grid
It is possible to reduce width of grid up to 10m grid depend on the site condition.

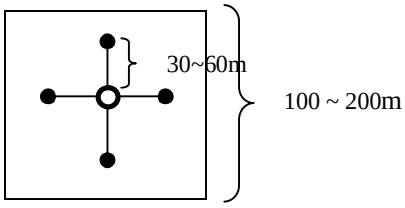



b. Agricultural land and mining area : 100 ~ 200m Grid
It is possible to reduce width of grid up to 100m grid depend on the site condition and in order to reduce contaminated area by narrow-down method.




(**2) Soil Sampling Method: 5 points sampling method**

5 points sampling method is assured to be highly reliability more than one point sampling method.




In case of 100m Grid survey, the distance between centre and each point extends to 33m of 100m Grid and 66m of 200m Grid.

**(3) Sampling Depth:**

a. Urban, industrial and commercial areas : 0 ~ 30cm deep
b. Agricultural land and mining area : 0 ~ 30cm deep

**(4) Soil Sample:**

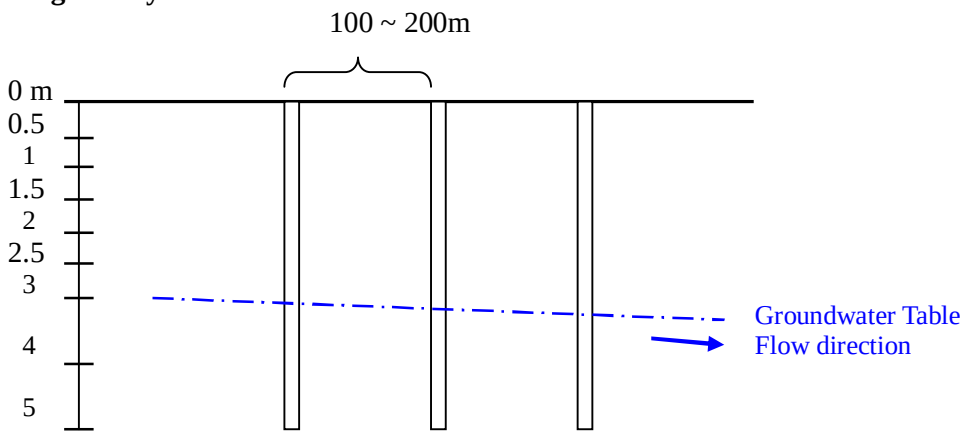
a. Weight of each soil sample : 500g of soil
b. Soil sample: Soil sample should take out gravels, approximately bigger than 2mm in diameter, roots of plant, etc.

## Box 15-2

***Outline of Detailed Survey for Soil Contamination***

The Detailed Survey is for soil contamination due to heavy metals, including As, Cd, Cr, Hg, Pb, etc., and the survey consists of drilling survey described as below.

**(1) Drilling Survey**

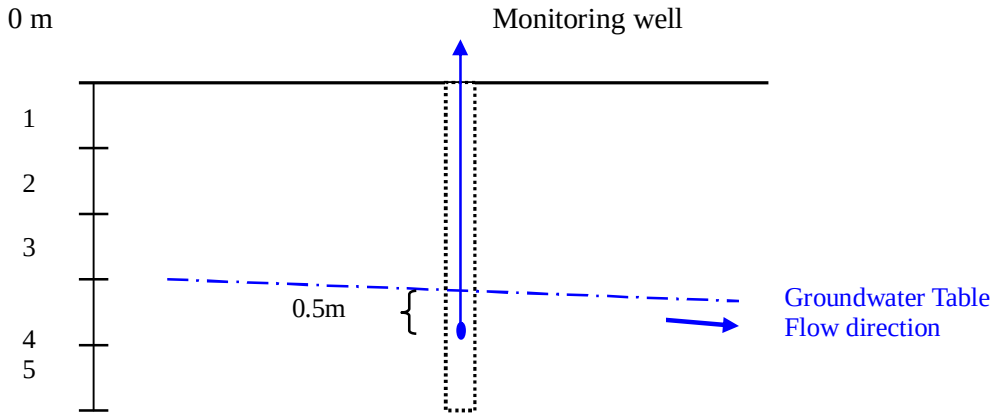



- Sampling depth : 0.5m, 1.0m, 1.5m, 2.0m, 3.0m, 4.0m and 5.0m
- Total samples : 8 samples

**(2) Groundwater Survey**

- Groundwater Sampling :

| | |
|---|---|
| by open bailer | : 0 ~ 0.5m deep from groundwater table |
| by closed bailer | : 0.5m deep from groundwater table |
| by submergible pump | : 0.5m deep from groundwater table |



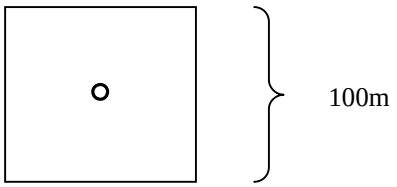
## Box 15-3

***Outline of Crop Survey***

The Crop Survey is for crop contamination due to heavy metals, including As, Cd, Cr, Hg, Pb, etc., and the survey consists of sampling and pre-treatment of samples described as below.

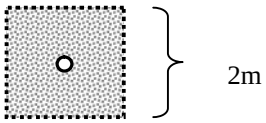
**(1) Crop Survey: Grid survey**

Agricultural land : 100m Grid
Sampling point : Centre of grid




**(2) Crop Sampling Method**

Sampling area : 2m grid
Sample weight : 2kg




○ Soil sampling point

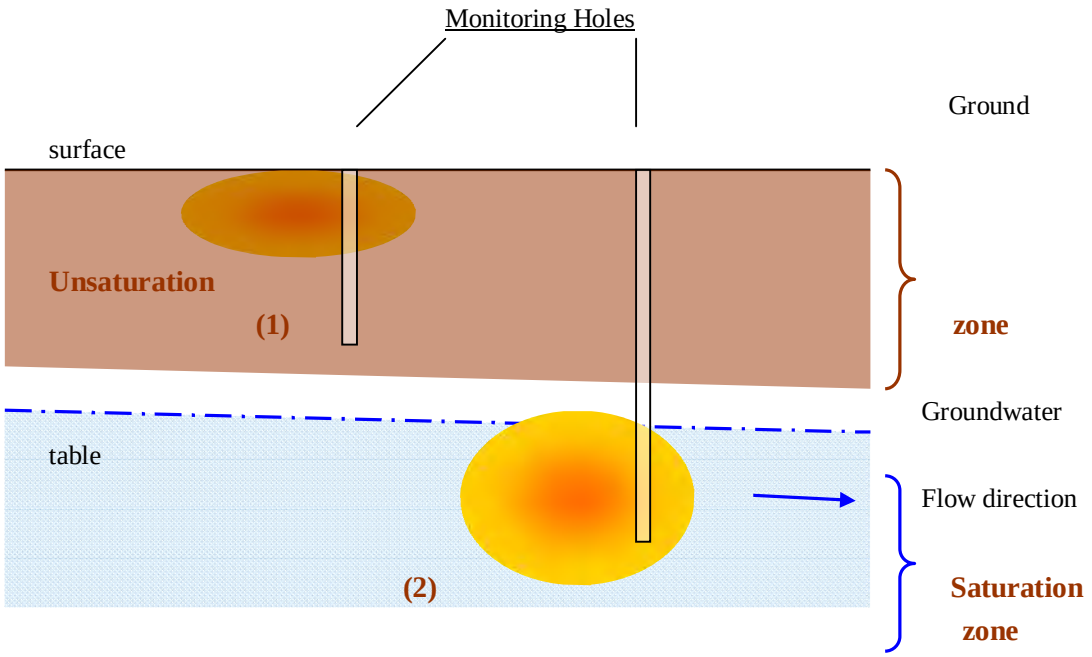
Remarks: 1) Crops should be carefully sampled without artificial contamination by contaminated soil, instruments, etc.
2) Soil sampling and analysis need to carry out at the same point of crop.

**(3) Pre-treatment of crop sample:**

Crops with husks : Any husks (wheat, rice, etc.) should be taken before analysis.

**Box 15-4**

***Monitoring Method of Soil Contamination***



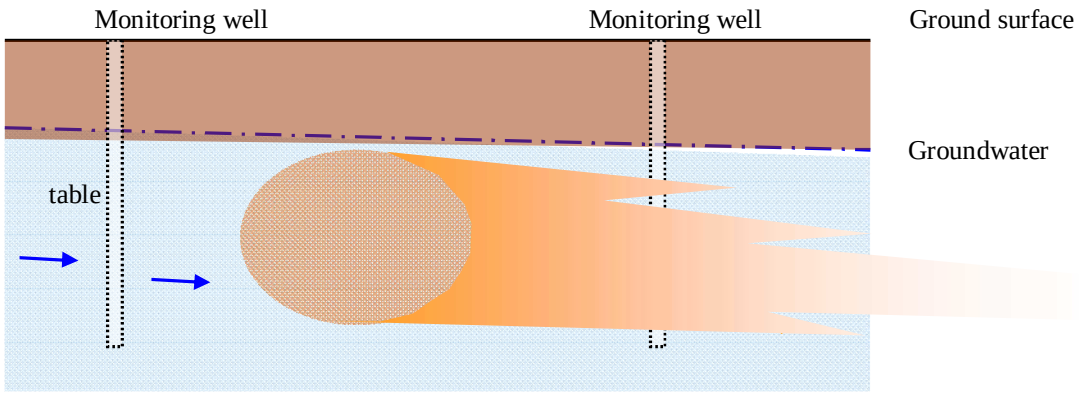

(1) Soil contamination in unsaturation zone over the groundwater table

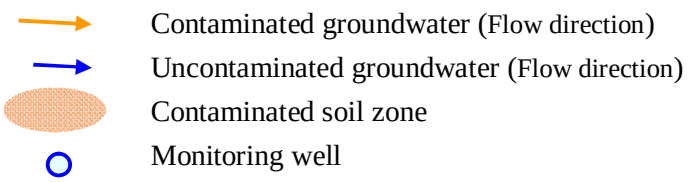
(2) Soil contamination in saturation zone on and under the groundwater table

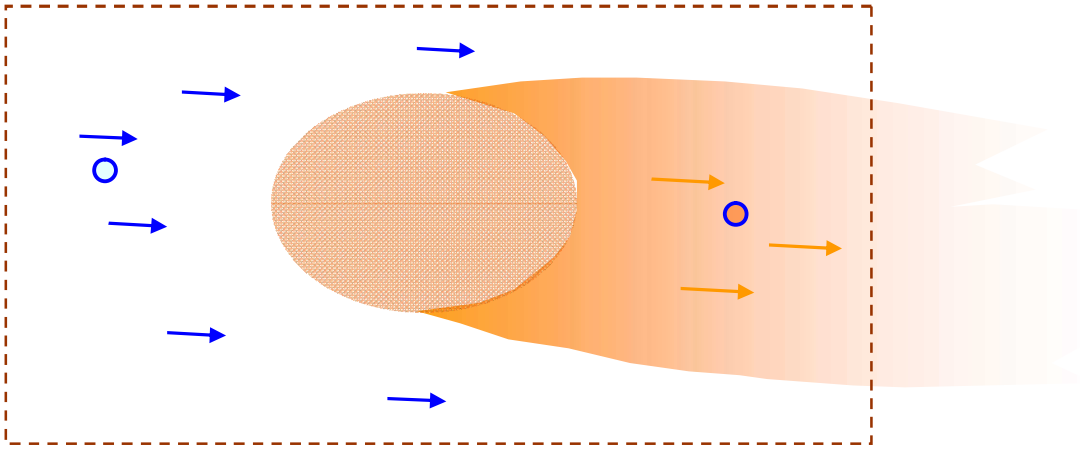
Location of Soil Contamination

**Box 15-5**

***Monitoring Method of Soil Contamination***



Location of Monitoring wells in Contaminated Soil Site