

Table 1: Analytical results for water samples from Metro Manila, collected between 26 and 30 May, 2006

| I.D.   | Altitude<br>m, a.m.s.l | Well depth<br>m | pH  | Cond<br>μS/cm | Temp<br>°C | Na <sup>+</sup><br>mg/L | K <sup>+</sup><br>mg/L | Ca <sup>2+</sup><br>mg/L | Mg <sup>2+</sup><br>mg/L | Cl <sup>-</sup><br>mg/L | SO <sub>4</sub> <sup>2-</sup><br>mg/L | NO <sub>3</sub> <sup>-</sup><br>mg/L | As<br>μg/L  | Cd<br>μg/L  | Pb<br>μg/L  | δD-H <sub>2</sub> O<br>‰ | δ <sup>18</sup> O-H <sub>2</sub> O<br>‰ | δ <sup>34</sup> S-SO <sub>4</sub> <sup>2-</sup><br>‰ | δ <sup>18</sup> O-SO <sub>4</sub> <sup>2-</sup><br>‰ | <sup>87</sup> Sr/ <sup>86</sup> Sr |
|--|------------------------|-----------------|-----|---------------|------------|-------------------------|------------------------|--------------------------|--------------------------|-------------------------|---------------------------------------|--------------------------------------|-------------|-------------|-------------|--------------------------|---|--|--|------------------------------------|
| <b><u>Rainwater</u></b>  |                        |                 |     |               |            |                         |                        |                          |                          |                         |                                       |                                      |             |             |             |                          |   |  |  |                                    |
| M15  | 3                      |                 | 5.3 | 25            | 25         | 0.9                     | 0.4                    | 0.8                      | 0.1                      | 1.9                     | 3.0                                   | 1.2                                  | 0.4         | <i>u.d.</i> | 2.0         | -34.4                    | -6.0                                    | <i>n.d.</i>  | <i>n.d.</i>  | <i>n.d.</i>                        |
| <b><u>River water (Pasig River and its tributary)</u></b>                        |                        |                 |     |               |            |                         |                        |                          |                          |                         |                                       |                                      |             |             |             |                          |   |  |  |                                    |
| M11  | 80                     |                 | 8.2 | 318           | 32         | 14.1                    | 7.4                    | 36.1                     | 8.0                      | 8.7                     | 12.8                                  | 10.7                                 | 4.2         | <i>u.d.</i> | <i>u.d.</i> | -42.6                    | -6.5                                    | 5.3  | 6.0  | 0.70566                            |
| M12  | 9                      |                 | 7.4 | 561           | 33         | 26.1                    | 7.8                    | 39.2                     | 10.1                     | 25.8                    | 12.8                                  | 1.1                                  | 4.4         | <i>u.d.</i> | 0.3         | -37.7                    | -5.9                                    | 9.6  | 7.4  | 0.70544                            |
| M13  | 9                      |                 | 7.8 | 3760          | 33         | 601.2                   | 26.5                   | 31.7                     | 79.8                     | 1082.6                  | 144.8                                 | 21.0                                 | 2.7         | <i>u.d.</i> | <i>u.d.</i> | -17.9                    | -2.8                                    | 20.7   | 8.7  | 0.70790                            |
| M14  | 5                      |                 | 7.9 | 14860         | 32         | 2760.6                  | 101.2                  | 86.2                     | 346.6                    | 5187.0                  | 676.8                                 | 70.0                                 | <i>n.d.</i> | <i>u.d.</i> | 0.2         | -19.4                    | -3.3                                    | 21.7   | 10.0   | 0.70895                            |
| <b><u>Shallow groundwater (2-122 m in depth: dug and hand pumping wells)</u></b> |                        |                 |     |               |            |                         |                        |                          |                          |                         |                                       |                                      |             |             |             |                          |   |  |  |                                    |
| M2   | 6                      | 122             | 7.8 | 582           | 32         | 44.1                    | 12.5                   | 47.0                     | 18.2                     | 10.6                    | 8.9                                   | 1.0                                  | 8.5         | <i>u.d.</i> | 0.2         | -52.0                    | -7.9                                    | 4.6  | 7.2  | 0.70464                            |
| M4   | 3                      | 122             | 7.8 | 4200          | 31         | 426.8                   | 53.0                   | 225.7                    | 91.3                     | 1023.1                  | 116.4                                 | 6.9                                  | 13.7        | <i>u.d.</i> | 0.1         | -46.7                    | -7.2                                    | 23.9   | 12.9   | 0.70543                            |
| M6   | 6                      | 70              | 8.1 | 633           | 31         | 82.6                    | 28.9                   | 28.0                     | 8.9                      | 22.4                    | 20.0                                  | 1.0                                  | 22.5        | <i>u.d.</i> | 0.1         | -48.8                    | -7.5                                    | 11.7   | 12.9   | 0.70645                            |
| M8   | 2                      | 43              | 7.8 | 856           | 29         | 107.1                   | 13.8                   | 45.1                     | 19.3                     | 49.9                    | 35.4                                  | 1.0                                  | 7.1         | <i>u.d.</i> | 0.6         | -42.8                    | -6.4                                    | 12.2   | 14.4   | 0.70528                            |
| M10  | 7                      | 46              | 7.7 | 764           | 34         | 51.7                    | 15.3                   | 62.2                     | 25.8                     | 37.4                    | 56.2                                  | 1.1                                  | 6.1         | <i>u.d.</i> | <i>u.d.</i> | -50.1                    | -7.6                                    | -1.8   | 5.5  | 0.70490                            |
| M16  | 4                      | 5               | 7.5 | 4610          | 30         | 485.7                   | 56.5                   | 282.4                    | 159.0                    | 1098.1                  | 317.5                                 | 145.3                                | 7.0         | 0.1         | 0.5         | -34.0                    | -6.0                                    | <i>n.d.</i>  | <i>n.d.</i>  | <i>n.d.</i>                        |
| M17  | 6                      | 2               | 7.4 | 1950          | 30         | 271.4                   | 43.7                   | 71.6                     | 45.7                     | 181.7                   | 59.2                                  | 39.8                                 | 7.4         | 0.1         | 0.1         | -44.2                    | -6.8                                    | <i>n.d.</i>  | <i>n.d.</i>  | <i>n.d.</i>                        |
| M18  | 11                     | 10              | 7.5 | 1910          | 33         | 305.7                   | 24.5                   | 54.9                     | 42.2                     | 175.1                   | 97.1                                  | 2.7                                  | 12.2        | 0.1         | <i>u.d.</i> | -38.1                    | -6.4                                    | <i>n.d.</i>  | <i>n.d.</i>  | <i>n.d.</i>                        |
| M19  | 4                      | 43              | 7.7 | 2440          | 31         | 127.9                   | 21.5                   | 180.2                    | 97.2                     | 479.6                   | 85.3                                  | 6.8                                  | 5.1         | <i>u.d.</i> | 0.7         | -40.8                    | -6.4                                    | <i>n.d.</i>  | <i>n.d.</i>  | <i>n.d.</i>                        |
| M22  | 18                     | 55              | 7.4 | 622           | 29         | 46.0                    | 10.3                   | 52.1                     | 17.7                     | 30.6                    | 11.5                                  | 2.6                                  | 10.8        | <i>u.d.</i> | 0.1         | -46.4                    | -6.8                                    | 21.9   | <i>u.d.</i>  | 0.70577                            |
| M23  | 28                     | <i>l.d.</i>     | 7.3 | 500           | 31         | 40.1                    | 7.0                    | 33.5                     | 14.6                     | 20.5                    | 22.0                                  | 6.6                                  | 10.9        | <i>u.d.</i> | <i>u.d.</i> | -46.7                    | -6.8                                    | 3.8  | 13.7   | 0.70448                            |
| M24  | 23                     | <i>l.d.</i>     | 7.2 | 662           | 30         | 48.0                    | 13.2                   | 51.9                     | 18.4                     | 40.7                    | 16.6                                  | 1.1                                  | 3.5         | <i>u.d.</i> | <i>u.d.</i> | -47.1                    | -7.0                                    | 19.9   | 12.1   | 0.70449                            |
| M25  | 17                     | 37              | 7.1 | 406           | 29         | 27.2                    | 9.7                    | 27.3                     | 9.8                      | 15.2                    | 5.7                                   | 0.7                                  | 2.4         | <i>u.d.</i> | <i>u.d.</i> | -44.9                    | -6.7                                    | 21.4   | 16.6   | 0.70450                            |
| M26  | 1                      | 12              | 7.2 | 5600          | 30         | 848.1                   | 23.1                   | 94.2                     | 74.7                     | 1338.5                  | 278.0                                 | 13.8                                 | 10.2        | <i>u.d.</i> | 1.4         | -40.9                    | -6.4                                    | 22.0   | 15.0   | 0.70622                            |
| M27  | 20                     | 24              | 7.6 | 491           | 29         | 77.7                    | 9.6                    | 48.7                     | 15.6                     | 24.8                    | 38.4                                  | 15.7                                 | 9.7         | <i>u.d.</i> | 0.4         | -36.7                    | -6.0                                    | 1.8  | 7.5  | 0.70638                            |
| M32  | 14                     | 12              | 7.3 | 1416          | 30         | 158.5                   | 7.9                    | 97.8                     | 48.6                     | 155.2                   | 29.6                                  | 3.9                                  | 4.4         | 0.1         | <i>u.d.</i> | <i>n.d.</i>              | <i>n.d.</i>                             | 14.9   | 12.0   | 0.70612                            |
| M33  | 21                     | 122             | 7.3 | 690           | 30         | 63.8                    | 5.7                    | 63.5                     | 16.3                     | 28.5                    | 8.4                                   | 1.0                                  | 4.3         | <i>u.d.</i> | <i>u.d.</i> | <i>n.d.</i>              | <i>n.d.</i>                             | 14.8   | 12.6   | 0.70748                            |
| M34  | 14                     | 73              | 7.1 | 500           | 29         | 34.1                    | 11.7                   | 34.7                     | 16.3                     | 33.7                    | 20.8                                  | 1.1                                  | 10.1        | <i>u.d.</i> | 0.3         | <i>n.d.</i>              | <i>n.d.</i>                             | 8.1  | 7.3  | 0.70447                            |
| <b><u>Deep groundwater (183-269 m in depth: production wells)</u></b>            |                        |                 |     |               |            |                         |                        |                          |                          |                         |                                       |                                      |             |             |             |                          |   |  |  |                                    |
| M1   | 6                      | <i>l.d.</i>     | 8.2 | 538           | 34         | 100.8                   | 14.3                   | 8.3                      | 2.5                      | 13.5                    | 12.8                                  | 1.2                                  | 7.1         | <i>u.d.</i> | 0.4         | -48.1                    | -7.3                                    | 15.9   | 15.2   | 0.70448                            |
| M3   | 3                      | 223             | 8.5 | 613           | 35         | 126.8                   | 13.4                   | 2.9                      | 0.4                      | 51.7                    | 22.9                                  | 1.6                                  | 8.1         | 0.1         | 0.1         | -50.3                    | -7.8                                    | 20.6   | 15.4   | 0.70490                            |
| M5   | 4                      | 190             | 8.6 | 609           | 35         | 122.3                   | 12.6                   | 1.5                      | 0.3                      | 31.9                    | 28.7                                  | 1.1                                  | 9.2         | 0.1         | 0.2         | -51.3                    | -7.9                                    | 21.2   | 15.0   | 0.70493                            |
| M7   | 4                      | 269             | 8.0 | 591           | 32         | 79.4                    | 27.3                   | 25.6                     | 8.8                      | 10.1                    | 19.6                                  | 0.5                                  | 19.8        | <i>u.d.</i> | 0.2         | -48.9                    | -7.7                                    | 11.4   | 11.3   | 0.70631                            |
| M9   | 7                      | <i>l.d.</i>     | 7.7 | 542           | 30         | 46.5                    | 12.5                   | 40.3                     | 18.9                     | 11.7                    | 8.5                                   | 1.0                                  | 9.1         | <i>u.d.</i> | 0.3         | -51.9                    | -7.9                                    | 8.7  | 8.5  | 0.70474                            |
| M20  | 14                     | <i>l.d.</i>     | 8.3 | 853           | 33         | 167.9                   | 23.3                   | 9.8                      | 1.7                      | 63.6                    | 14.3                                  | 1.4                                  | 4.7         | <i>u.d.</i> | 0.4         | -39.2                    | -6.2                                    | <i>u.d.</i>  | 7.1  | <i>n.d.</i>                        |
| M28  | 18                     | 183             | 8.1 | 746           | 32         | 151.9                   | 17.1                   | 8.9                      | 3.1                      | 43.8                    | 14.2                                  | 1.0                                  | 2.6         | 0.1         | <i>u.d.</i> | -45.3                    | -6.7                                    | 22.9   | 13.4   | 0.70476                            |
| M29  | 30                     | 195             | 8.5 | 657           | 31         | 145.5                   | 12.7                   | 6.2                      | 0.7                      | 12.7                    | 18.7                                  | 1.1                                  | 1.7         | <i>u.d.</i> | 0.2         | <i>n.d.</i>              | <i>n.d.</i>                             | 4.5  | 8.0  | 0.70448                            |
| M30  | 25                     | 183             | 8.4 | 708           | 34         | 154.7                   | 13.1                   | 7.2                      | 1.0                      | 12.3                    | 10.5                                  | 1.0                                  | 1.3         | <i>u.d.</i> | 0.4         | <i>n.d.</i>              | <i>n.d.</i>                             | 17.8   | 14.3   | 0.70447                            |
| M31  | 9                      | <i>l.d.</i>     | 8.3 | 1346          | 32         | 277.7                   | 15.9                   | 7.7                      | 1.8                      | 227.2                   | 38.1                                  | 3.4                                  | 1.1         | <i>u.d.</i> | <i>u.d.</i> | <i>n.d.</i>              | <i>n.d.</i>                             | 19.5   | 14.2   | 0.70487                            |

*l.d.* = lack of detailed data*n.d.* = not determined*u.d.* = under the detection limit

Table 2: Analytical results for water samples reacted with fertilizers and detergents commonly used in Metro Manila

| Name   | Material         | Na <sup>+</sup><br>mg/L | K <sup>+</sup><br>mg/L | Ca <sup>2+</sup><br>mg/L | Mg <sup>2+</sup><br>mg/L | Cl <sup>-</sup><br>mg/L | SO <sub>4</sub> <sup>2-</sup><br>mg/L | NO <sub>3</sub> <sup>-</sup><br>mg/L | As<br>μg/L | Cd<br>μg/L | Pb<br>μg/L | δ <sup>34</sup> S-SO <sub>4</sub> <sup>2-</sup><br>‰ | δ <sup>18</sup> O-SO <sub>4</sub> <sup>2-</sup><br>‰ | <sup>87</sup> Sr/ <sup>86</sup> Sr |
|--|------------------|-------------------------|------------------------|--------------------------|--------------------------|-------------------------|---------------------------------------|--------------------------------------|------------|------------|------------|--|--|------------------------------------|
| <b><u>Water reacted with fertilizers</u></b> |                  |                         |                        |                          |                          |                         |                                       |                                      |            |            |            |  |  |                                    |
| MNLF2  | ammonium sulfate | <i>u.d.</i>             | 0.4                    | 21                       | 0.2                      | 0.7                     | 773                                   | <i>u.d.</i>                          | 0.3        | 0.2        | 0.6        | 0.8  | 10.1   | <i>n.d.</i>                        |
| MNLF3  | NPK fertilizer   | 2.0                     | 101.0                  | 24                       | 1.0                      | 94.8                    | 384                                   | 3.2                                  | 5.2        | 1.0        | 0.3        | -0.2   | 9.9  | 0.70589                            |
| MNLF4  | NPK fertilizer   | 1.3                     | 6.4                    | 22                       | 2.2                      | 6.7                     | 469                                   | 1.1                                  | 7.2        | 2.6        | 0.4        | 0.1  | 10.4   | 0.70697                            |
| <b>average (n = 3)</b>                       |                  | <b>1.6</b>              | <b>35.9</b>            | <b>22</b>                | <b>1.1</b>               | <b>34.1</b>             | <b>542</b>                            | <b>2.2</b>                           | <b>4.2</b> | <b>1.3</b> | <b>0.4</b> | <b>0.2</b>   | <b>10.1</b>  | <b>0.70643</b>                     |
| <b><u>Water reacted with detergents</u></b>  |                  |                         |                        |                          |                          |                         |                                       |                                      |            |            |            |  |  |                                    |
| MNLD1  | powder detergent | 278                     | 0.6                    | 22                       | 0.4                      | 2.3                     | 150                                   | <i>u.d.</i>                          | 4.2        | 1.7        | 3.2        | 13.5   | 14.0   | <i>n.d.</i>                        |
| MNLD2  | powder detergent | 256                     | 0.7                    | 22                       | 0.3                      | 1.9                     | 267                                   | <i>u.d.</i>                          | 2.3        | 0.3        | 0.6        | 22.0   | 16.1   | <i>n.d.</i>                        |
| MNLD3  | powder detergent | 286                     | 0.3                    | 22                       | 0.4                      | 2.0                     | 303                                   | <i>u.d.</i>                          | 0.3        | 0.2        | 0.3        | 24.9   | 12.4   | <i>n.d.</i>                        |
| MNLD4  | powder detergent | 293                     | 0.5                    | 22                       | 0.2                      | 1.7                     | 330                                   | <i>u.d.</i>                          | 0.6        | 0.3        | 0.4        | 16.3   | 17.8   | <i>n.d.</i>                        |
| <b>average (n = 4)</b>                       |                  | <b>278</b>              | <b>0.5</b>             | <b>22</b>                | <b>0.3</b>               | <b>2.0</b>              | <b>263</b>                            |                                      | <b>1.9</b> | <b>0.6</b> | <b>1.1</b> | <b>19.2</b>  | <b>15.1</b>  |                                    |

*u.d.* = under the detection limit*n.d.* = could not determined