

## **ANNEX 3.6:**

### **SET OF AVAILABLE LESKOVAC WASTEWATER QUALITY AND QUANTITY DATA, 1990 - 2007**



## WATER QUALITY IN SEWER SYSTEM

**Table** Error! No text of specified style in document.-1 Analysis of wastewater quality in Leskovac in 1990

| No  | Analysed parameter                               | Unit                              | Results of analysis |            |            |            | Average value |
|-----|--|-----------------------------------|---------------------|------------|------------|------------|---------------|
|     |  |                                   | Winter              | Spring     | Summer     | Autumn     | Caverage      |
| 1.  | Water/air temperature                            | °C                                | 8/0                 | 14/15      | 20/28      | 16/18      |               |
| 2.  | pH   |                                   | 7,8                 | 8          | 7,6        | 6,8        | 7,56          |
| 3.  | Settled matter after 2h                          | sm <sup>3</sup> /dm <sup>3</sup>  | 1,5                 | 2          | 4          | 5          | 3,12          |
| 4.  | <b>Suspended matter</b>                          | <b>mg/dm<sup>3</sup></b>          | <b>350</b>          | <b>276</b> | <b>276</b> | <b>502</b> | <b>351</b>    |
| 5.  | Dry residue – SS                                 | mg/dm <sup>3</sup>                | 184                 | 80         | 187        | 152        | 151           |
| 6.  | Total dry residue                                | mg/dm <sup>3</sup>                | 1140                | 1108       | 1208       | 1470       | 1231          |
| 7.  | Total residue (after incineration)               | mg/dm <sup>3</sup>                | 326                 | 640        | 890        | 798        | 663           |
| 8.  | Dry residue of dissolved matter                  | mg/dm <sup>3</sup>                | 790                 | 832        | 932        | 968        | 880           |
| 9.  | Residue of dissolved matter (after incineration) | mg/dm <sup>3</sup>                | 142                 | 560        | 703        | 646        | 513           |
| 10. | COD  | mgO <sub>2</sub> /dm <sup>3</sup> | 760                 | 768        | 1180       | 1413       | 1030          |
| 11. | BOD <sub>5</sub>                                 | mgO <sub>2</sub> /dm <sup>3</sup> | 306                 | 318        | 540        | 680        | 461           |
| 12. | Phenols  | mg/dm <sup>3</sup>                | 0,08                | 0,129      | 0,022      | 0,082      | 0,078         |
| 13. | Detergents                                       | mg/dm <sup>3</sup>                | 1,4                 | 1,043      | 2,8        | 3,52       | 2,191         |
| 14. | Oils and fats                                    | mg/dm <sup>3</sup>                | 36                  | 64         | 48         | 122        | 68            |
| 15. | Nitrates   | mg/dm <sup>3</sup>                | 18                  | 1,4        | 3,8        | 0,6        | 5,95          |
| 16. | Nitrites   | mg/dm <sup>3</sup>                | 0,5                 | 0,15       | 0          | 0          | 0,16          |
| 17. | Sulphates  | mg/dm <sup>3</sup>                | 180                 | 94         | 105        | 172        | 138           |
| 18. | Cyanides   | mg/dm <sup>3</sup>                | 0                   | 0          | 0          | 0          | 0             |
| 19. | Cr   | mg/dm <sup>3</sup>                | 0                   | 0          | 0          | 0          | 0             |
| 20. | Fe   | mg/dm <sup>3</sup>                | 0                   | 0          | 0          | 0          | 0             |
| 21. | Cu   | mg/dm <sup>3</sup>                | 0                   | 0          | 0          | 0          | 0             |
| 22. | Zn   | mg/dm <sup>3</sup>                | 0                   | 0          | 0          | 0          | 0             |
| 23. | Phosphates                                       | mg/dm <sup>3</sup>                | 1,4                 | 0,49       | 12         | 0          | 4,63          |
| 24. | Ammonia  | mg/dm <sup>3</sup>                | 3                   | 5,2        | 3,8        | 10,3       | 5,57          |
| 25. | BOD <sub>5</sub> /COD ratio                      | %                                 | 40                  | 41         | 55         | 78         | 53            |

**Q = 873 m<sup>3</sup>/h = 242 l/s**

**Table Error! No text of specified style in document.-2** Communal wastewater quality in Leskovac based

on 29 samples taken between 1997 and 2004

| Parameter          | Unit | Average | St. dev. |
|--------------------|------|---------|----------|
| COD                | mg/l | 404     | 202      |
| BOD                | mg/l | 162     | 110      |
| NH <sub>4</sub> -N | mg/l | 23.0    | 26.7     |
| Nitrate-N          | mg/l | 3.96    | 3.93     |
| Total P            | mg/l | 2.36    | 0.96     |
| TSS                | mg/l | 446     | 303      |

**Table Error! No text of specified style in document.-3** Communal wastewater quality in Leskovac in 2004

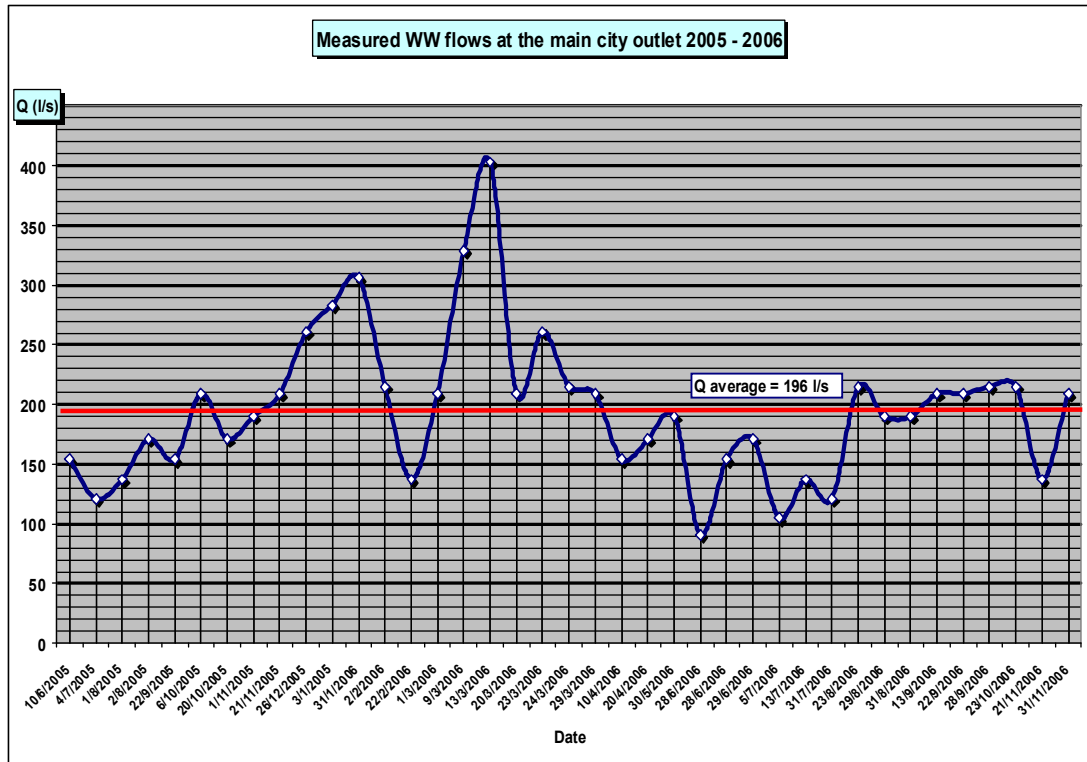
– Institute for Public Health Leskovac

| Parameter        | Unit | Range     |
|------------------|------|-----------|
| pH               |      | 7,7 – 7,8 |
| SS               | mg/l | 50 – 550  |
| BOD <sub>5</sub> | mg/l | 57 – 137  |
| COD              | mg/l | 181 - 311 |

### Wastewater Quantity

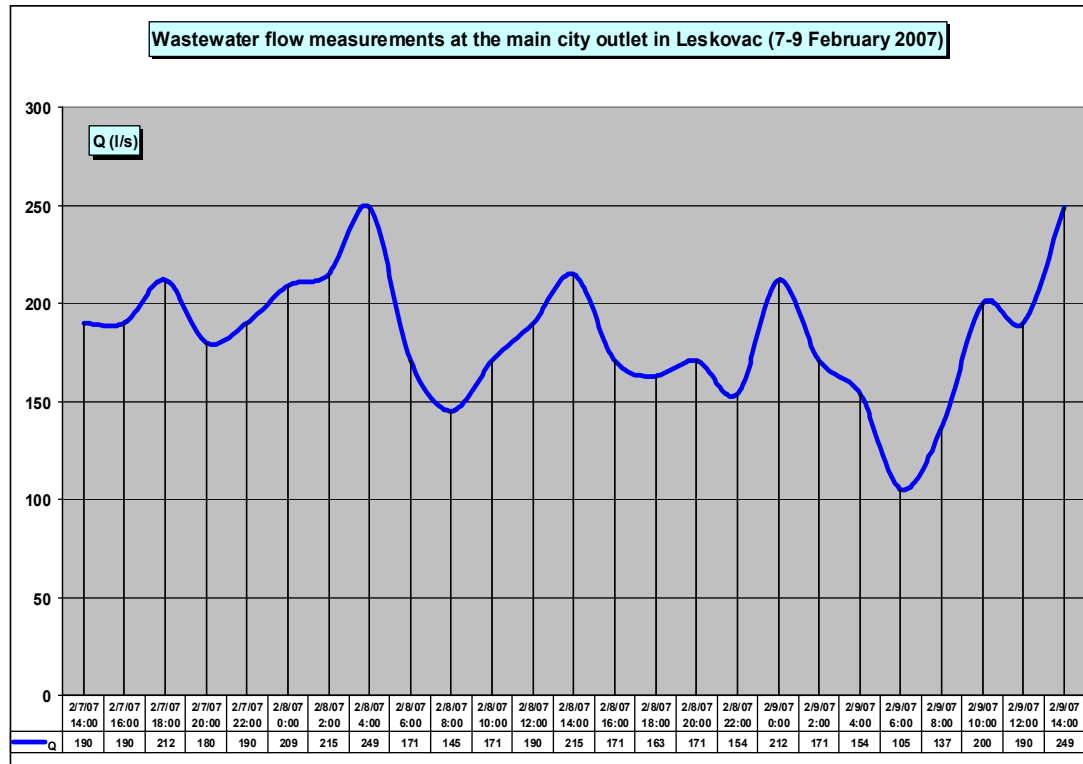
Since 2005 regularly intermittent measurements of the flow have been conducted (source – GP report 2007) and based on these a new series was carried out in the period June 2005 – November 2006 (39 individual measurements in total), resulting in an average flow of 196 l/s, somewhat higher than earlier results, see Figure below.

**Figure** Error! No text of specified style in document.-1 Intermittent flow measurements at the main outlet 2005 and 2006



Although the measurements shown in the GP 2007 cover much longer period and can be considered as more representative for assessment of the average annual discharge, with regard to the average flows recorded, the results appear to be comparable, and the average discharge of approximately 180 l/s can be adopted for further analysis in this study.

**Figure Error! No text of specified style in document.-2 Short-term WW flow measurements in February 2007**



A limited number of flow measurements of wastewater collected and discharged has been conducted and recorded, but on rather random basis, and therefore these measurements should be also cross-checked with the water consumption data in order to establish/confirm a correlation.

Therefore, current wastewater flows shall be estimated in relation to the recorded water supply consumption for consumers connected to the water supply, and at the same time to the sanitary sewerage system.

**Table Error! No text of specified style in document.-4** Results of wastewater quality analysis carried out by the Institute “Jaroslav Černí“ concurrent with flow measurement

| PARAMETER  | UNIT                | 1                | 2                | 3                | 4                | 5                | 6                | 7                | 8                | 9                | 10               | 11               | 12               | 13               | 14      | 15    | 16              | 17             |
|--|---------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|---------|-------|-----------------|----------------|
|  |                     | 07.02.07.<br>14h | 07.02.07.<br>18h | 07.02.07.<br>22h | 08.02.07.<br>02h | 08.02.07.<br>06h | 08.02.07.<br>10h | 08.02.07.<br>14h | 08.02.07.<br>18h | 08.02.07.<br>22h | 09.02.07.<br>02h | 09.02.07.<br>06h | 09.02.07.<br>10h | 09.02.07.<br>14h | Max.    | Min.  | Ave.<br>weighed | Stand.<br>Dev. |
| KMnO <sub>4</sub> consump.                           | mg/l                | 230,1            | 235,2            | 253,8            | 132,8            | 85,7             | 202,6            | 283,4            | 180,9            | 228,9            | 174,8            | 98,9             | 204,2            | 1093,7           | 1.093,7 | 85,7  | 284,3           | 256,7          |
| COD (K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> ) | mgO <sub>2</sub> /l | 350              | 380              | 440              | 160              | 110              | 390              | 460              | 360              | 350              | 280              | 130              | 410              | 840              | 840,0   | 110,0 | 372,1           | 185,4          |
| BOD <sub>5</sub>                                     | mgO <sub>2</sub> /l | 159,8            | 148              | 154              | 57,7             | 28,5             | 130,6            | 159              | 129,8            | 140,6            | 110,2            | 32,9             | 89,1             | 751,2            | 751,2   | 28,5  | 175,9           | 183,3          |
| Suspended matter                                     | mg/l                | 510,0            | 405,0            | 360,0            | 156,0            | 70,0             | 277,0            | 530,0            | 400,0            | 277,0            | 140,0            | 60,0             | 255,0            | 1588,0           | 1.588,0 | 60    | 421,5           | 391,9          |
| Settleable matter                                    | ml/l                | 3,0              | 3,0              | 6,0              | 1,0              | 1,0              | 4,0              | 4,0              | 2,0              | 2,0              | 1,5              | 0,5              | 2,0              | 12,0             | 12,0    | 0,5   | 3,5             | 3,0            |
| Cl   | mg/l                | 86,49            | 124,25           | 82,32            | 39,71            | 45,43            | 90,6             | 75,6             | 91,9             | 72,8             | 59,3             | 39,6             | 68,6             | 94,8             | 124,3   | 39,6  | 75,4            | 24,5           |
| SO <sub>4</sub>                                      | mg/l                | 112,5            | 125,0            | 115,0            | 111,2            | 88,8             | 76,2             | 77,5             | 82,5             | 100,0            | 100,0            | 71,2             | 72,5             | 112,5            | 125,0   | 71,2  | 96,5            | 18,6           |
| S-   | mg/l                | 3,1              | 2,6              | 2,9              | 0,5              | 0,26             | 3,6              | 4,1              | 2,6              | 2,6              | 2,6              | 1,2              | 3,1              | 4,1              | 4,1     | 0,3   | 2,6             | 1,2            |
| PO <sub>4</sub> total                                | mgP/l               | 6,4              | 5,9              | 6,4              | 4,0              | 2,4              | 7,4              | 7,7              | 6,4              | 7,0              | 7,8              | 5,0              | 7,9              | 11,4             | 11,4    | 2,4   | 6,7             | 2,2            |
| Nkjeldal   | mgN/l               | 53,2             | 58,8             | 53,2             | 33,6             | 28,0             | 75,6             | 58,8             | 44,8             | 49               | 50,4             | 30,1             | 70               | 75,6             | 75,6    | 28,0  | 53,1            | 15,8           |
| NH <sub>4</sub> <sup>+</sup>                         | mgN/l               | 36,4             | 42,0             | 33,6             | 19,6             | 14,0             | 47,6             | 33,6             | 37,8             | 30,8             | 30,8             | 25,2             | 47,6             | 30,8             | 47,6    | 14,0  | 33,0            | 9,8            |
| NO <sub>2</sub>                                      | mgN/l               | 0,010            | 0,011            | 0,010            | 0,035            | 0,015            | 0,010            | 0,014            | 0,012            | 0,012            | 0,011            | 0,030            | 0,012            | 0,027            | 0,035   | 0,010 | 0,017           | 0,009          |
| NO <sub>3</sub>                                      | mgN/l               | 1,00             | 1,10             | 0,30             | 0,60             | 0,40             | 0,86             | 0,34             | 0,18             | 0,20             | 0,20             | 0,15             | 1,38             | 0,26             | 1,38    | 0,15  | 0,55            | 0,41           |
| Mineral oils   | mg/l                | 0,68             | 3,31             |                  | 1,38             |                  | 6,94             |                  | 4,89             |                  | 5,05             |                  | 12,61            |                  | 12,6    | 0,7   | 5,5             | 4,0            |
| Detergents   | mg/l                | 0,7              | 0,8              |                  | 0,3              |                  | 0,8              |                  | 0,6              |                  | 0,4              |                  | 0,6              |                  | 0,8     | 0,3   | 0,6             | 0,2            |
| Phenols  | µg/l                | 20               | 32               |                  | 15               |                  | 18               |                  | 26               |                  | 14               |                  | 42               |                  | 42,0    | 14,0  | 24,8            | 10,2           |
| Fe   | mg/l                | 0,54             | 0,53             | 0,88             | 0,40             | 0,36             | 0,30             | 0,30             | 0,22             | 0,26             | 0,22             | 0,28             | 0,39             | 1,40             | 1,40    | 0,22  | 0,50            | 0,33           |
| Mn   | mg/l                | 0,18             | 0,14             | 0,13             | 0,20             | 0,16             | 0,14             | 0,13             | 0,11             | 0,12             | 0,09             | 0,10             | 0,12             | 0,18             | 0,20    | 0,09  | 0,14            | 0,03           |
| Zn   | mg/l                | 0,17             | 0,10             | 0,10             | 0,03             | 0,01             | 0,01             | 0,04             | 0,03             | 0,04             | 0,03             | 0,02             | 0,08             | 0,16             | 0,17    | 0,01  | 0,07            | 0,05           |
| Cu   | mg/l                | 0,03             | 0,02             | 0,01             | <0,01            | <0,01            | <0,01            | <0,01            | <0,01            | <0,01            | <0,01            | <0,01            | <0,01            | 0,04             | 0,04    | <0,01 | n/a             | n/a            |
| Cr   | µg/l                | 7,0              | 4,0              | 2,2              | <1,0             | <1,0             | <1,0             | <1,0             | 4,0              | 6,2              | <1,0             | 6,5              | 6,2              | 44,0             | 44,0    | <1,0  | n/a             | n/a            |
| Cd   | µg/l                | <0,5             | <0,5             | <0,5             | <0,5             | <0,5             | <0,5             | <0,5             | <0,5             | <0,5             | <0,5             | <0,5             | <0,5             | 0,80             | 0,8     | <0,5  | n/a             | n/a            |
| As   | µg/l                | <10,0            | <10,0            | <10,0            | <10,0            | <10,0            | <10,0            | <10,0            | <10,0            | <10,0            | <10,0            | <10,0            | <10,0            | <10,0            | <10,0   | <10,0 | n/a             | n/a            |
| <b>Q</b>   | <b>l/s</b>          | <b>190</b>       | <b>212</b>       | <b>190</b>       | <b>215</b>       | <b>171</b>       | <b>171</b>       | <b>215</b>       | <b>163</b>       | <b>154</b>       | <b>171</b>       | <b>105</b>       | <b>200</b>       | <b>249</b>       |         |       | <b>190</b>      |                |

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