# Urban Planning & Noise Rating Systems

## Embedded parks in Q-Zones (WP 1.2)

### Objectives:

Identify boundary conditions and maximum noise gains for parks embedded in Q-Zones (zones in inner city where only quiet low emission vehicles are tolerated)

### Technical Tasks:

- Evaluating the existing noise levels in different parks of European cities

- Determination of the influence of local parameters
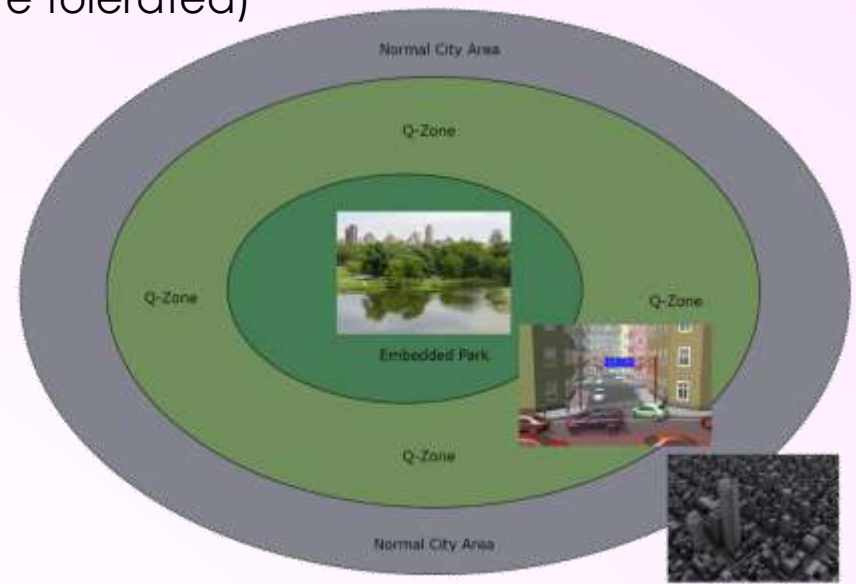
# Identify Boundary Conditions

## Determination of the influence of local parameters

**Type A: Local source related parameters:**

- size of park areas

- range of noise sources

- size of the projected surrounding Q-Zone

**Type B: Local area related parameters (considered at a later stage):**

- nature of the surrounding areas

- methods of accessing the area

CityHush

# Identify Boundary Conditions

**Investigation of different traffic scenarios for evaluation of source related parameters**

| Local parameters | Variation | | | |
|---|---|---|---|---|
| Zone size | Small | large | | |
| Fees (€) | 0 | 1 | 2 | ban |
| Percentage LNV ownership inside Q-zone | 1 % | 20 % | 100 % | |
| Percentage LNV ownership external (countrywide) | 1 % | 5 % | 20 % | |

# How to demonstrate effects on noise situation

Considered parameters for evaluation of the existing noise levels in **parks**:
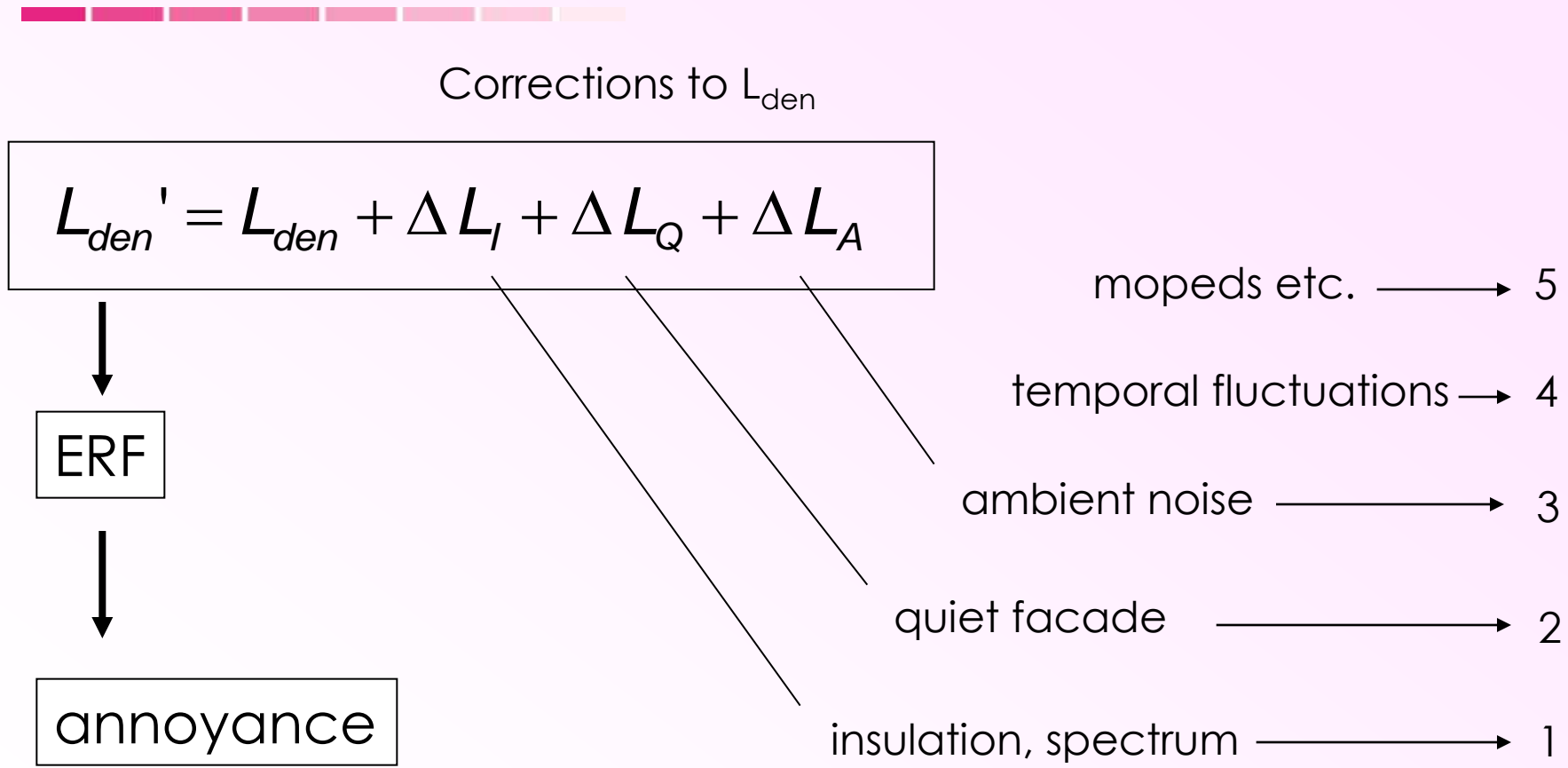
- Average day/evening-time noise level ($L_{de}$) in the park, based on grid calculations (10 x 10 m²)

- Noise distribution within a park (area [m²] affected by noise [1 dB-classes])

- "Capacity" of embedded park ("capacity" is defined as size of area with av. $L_{DE}$ 10 dB lower as surrounding (defined as area, which residents can reach within 5 min walk/400 m distance)

# How to demonstrate effects on noise situation

Considered parameters for evaluation of the existing noise levels within the **Q-zone** and **test site**:

- Number "highly annoyed people (HAP)" per building and HAP for each scenario (single number value for Q-zone and test site) based on "Improved noise score model for indoors" published in Deliverable D2.2.2 (WP 2.2) and therefore

- $L_{den}$´ based on:

- $L_{den}$ at the most exposed facade of each residential building

- $L_{den}$ at the "quietest" facade of each residential building

- "Ambient noise" for $L_{den}$ corrections

# Excursion: Refined method for annoyance at home

Corrections to $L_{den}$

$$L_{den}' = L_{den} + \Delta L_I + \Delta L_Q + \Delta L_A$$

ERF

↓

annoyance

mopeds etc. ——→ 5

temporal fluctuations —→ 4

ambient noise ———→ 3

quiet facade ———→ 2

insulation, spectrum ———→ 1

ERF = exposure-response function by Miedema and Oudshoorn (2001)

CityHush

$$L_{den}' = L_{den} + \Delta L_I + \Delta L_Q + \Delta L_A$$

### Annoyance at home

$$\Delta L_I = a \, (I - I_{av}) \, L_{den} + b \, (I - I_{av})$$

For easy explanation the following values for the parameters will be used in the instruction

$a = -0.0222 \quad I = 30$ (Example City)

$b = 1 \quad I_{av} = 28$

(av. Average)

### Facade insulation

Influence of the façade insulation of a building

$I \rightarrow$ Façade insulation

Values from Norwegian facade insulation study

$$\Delta L_Q = a \, (Q - Q_{av}) \, L_{den} + b \, (Q - Q_{av})$$

For easy explanation the following values for the parameters will be used in the instruction

$a = -0.0156 \quad Q = L_{max} - L_{min}$

$b = 0.7 \quad Q_{av} = 10$

(av. Average)

### Quiet facade

Influence of the Difference between the most exposed and quietest façade of a building

$Q \rightarrow$ maximum and minimum Levels ($L_{den}$)

Values from various studies (Gothenburg, TNO)

$$\Delta L_A = a \, (A - A_{av}) \, L_{den} + b \, (A - A_{av})$$

For easy explanation the following values for the parameters will be used in the instruction

$a = -0.0039 \quad A = 25$ Percentile

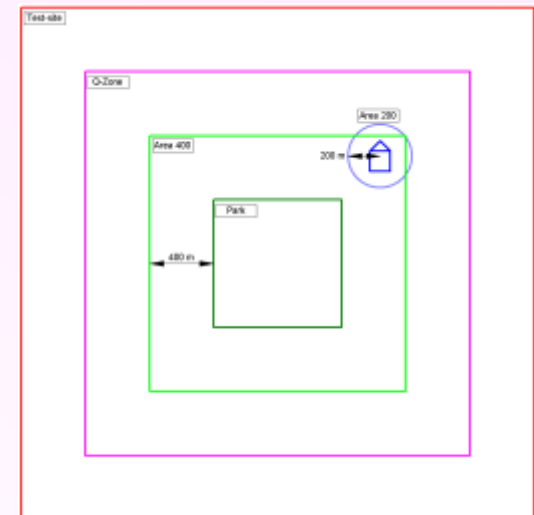$b = 0.175 \quad A_{av} = 50$ Percentile

(av. Average)

### Ambient noise

Influence of the ambient noise in a radius of 200m around a building

25 / 50 Percentile $\rightarrow$ defines the area with ambient noise below that level

Values from various studies (Gothenburg, TNO, Gent)

Corrections to $L_{den}$ implemented into software

# Example: Location test site Bratislava

# Noise situation within test site Bratislava (status quo)



| dB(A) | Park | Q-zone | Test site |
|---|---|---|---|
| $L_{de(av)}$ | 63,2 | 69,7 | 70,4 |

### Area affected (Test site Bratislava)

| Noise level [5 dB - Classes] | Park area [m²] | Q-zone (small) area [m²] | Test site area [m²] |
|---|---|---|---|
| 40 - 45 | 0 | 1000 | 144200 |
| 45 - 50 | 0 | 147000 | 319500 |
| 50 - 55 | 5900 | 62900 | 528000 |
| 55 - 60 | 9400 | 35900 | 959300 |
| 60 - 65 | 6700 | 51800 | 1714900 |
| 65 - 70 | 5700 | 61700 | 1076500 |
| > 70 | 1000 | 99300 | 1068900 |

Park

small Quiet Zone

CityHush

# Noise situation within the **Park** for different traffic scenarios



| | | S1 | S2 | S3 | S4 | S5 | S6 | S7 | S8 | S9 | S10 | S11 | S12 | S13 | S14 | S15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $L_{deav}$ (Park) | [dB(A)] | 60,0 | 58,9 | 58,9 | 59,0 | 58,8 | 59,0 | 59,0 | 59,9 | 58,5 | 58,6 | 58,6 | 59,2 | 56,5 | 56,7 | 56,8 |
| Change $L_{deav}$ (Park) | [dB(A)] | - | -1,1 | -1,1 | -1,0 | -1,2 | -1,0 | -1,0 | -0,2 | -1,6 | -1,4 | -1,4 | -0,8 | -3,5 | -3,3 | -3,2 |
| $L_{deav}$ (Surrounding) | [dB(A)] | 62,5 | 61,5 | 61,5 | 61,5 | 61,9 | 61,9 | 61,9 | 62,3 | 61,3 | 61,3 | 61,3 | 61,7 | 60,3 | 60,3 | 60,3 |
| Change $L_{deav}$ (Surrounding) | [dB(A)] | - | -1,0 | -1,0 | -1,0 | -0,6 | -0,6 | -0,6 | -0,2 | -1,2 | -1,2 | -1,2 | -0,8 | -2,2 | -2,2 | -2,2 |
| Capacity of embedded park or quiet area | [m²] | 1091 | 2411 | 2411 | 2210 | 2497 | 2411 | 2210 | 1205 | 3014 | 2927 | 2956 | 1894 | 9270 | 8696 | 8294 |
| increase of "Capacity" | [m²] | - | 1320 | 1320 | 1119 | 1406 | 1320 | 1119 | 115 | 1923 | 1837 | 1866 | 804 | 8180 | 7606 | 7204 |

# Noise situation within the **Q-zone** and **test site** for different traffic scenarios
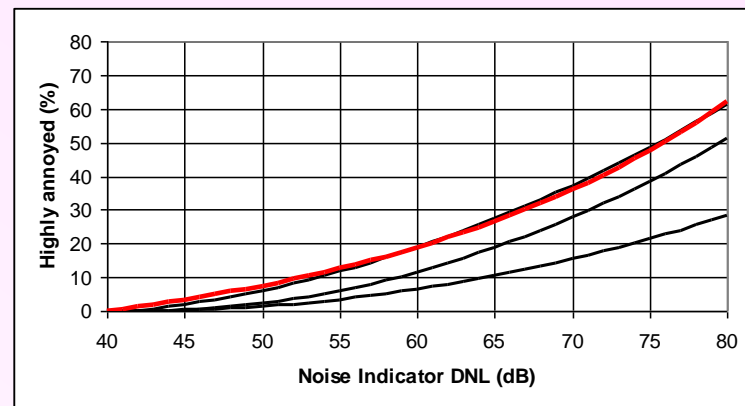


| Evaluation Criteria | | S1 | S2 | S3 | S4 | S5 | S6 | S7 | S8 | S9 | S10 | S11 | S12 | S13 | S14 | S15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HAP (residents) Q-Zone | # | 412 | 363 | 363 | 362 | 363 | 363 | 362 | 408 | 357 | 357 | 356 | 386 | 318 | 322 | 321 |
| HAP (residents) Test-site | # | 1957 | 1982 | 1963 | 1965 | 1989 | 1976 | 1978 | 1932 | 1940 | 1935 | 1936 | 1837 | 1827 | 1823 | 1822 |
| Noise costs (based on CBA, D2.3) | [€] | 3432474 | 3397751 | 3356248 | 3358771 | 3402427 | 3382230 | 3383292 | 3392761 | 3316220 | 3304927 | 3306689 | 3192917 | 3085923 | 3087131 | 3084550 |
| Change of Total Noise costs | [€] | - | -34723 | -76227 | -73703 | -30047 | -50244 | -49182 | -39713 | -116254 | -127547 | -125785 | -239557 | -346551 | -345343 | -347924 |

# Excursion: Number of people highly annoyed

| $L_{den}$ Road | | Highly Annoyed People | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| dB(A) | % | S16 | S17 | S18 | S19 | S20 | S21 | S22 | S23 | S24 | S25 | S26 | S27 | S28 | S29 | S30 |
| ≥44 | 0.8 | 20 | 19 | 19 | 19 | 19 | 19 | 19 | 20 | 19 | 19 | 19 | 20 | 20 | 20 | 20 |
| ≥45 | 1.1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 9 | 9 | 9 |
| ≥46 | 1.5 | 3 | 11 | 12 | 12 | 2 | 2 | 2 | 13 | 13 | 13 | 13 | 18 | 7 | 8 | 8 |
| ≥47 | 1.9 | 24 | 9 | 9 | 8 | 21 | 21 | 21 | 12 | 8 | 9 | 9 | 10 | 9 | 7 | 7 |
| ≥48 | 2.2 | 10 | 7 | 7 | 7 | 6 | 8 | 8 | 10 | 8 | 9 | 9 | 6 | 14 | 13 | 13 |
| ≥49 | 2.6 | 12 | 21 | 22 | 21 | 22 | 22 | 21 | 12 | 19 | 17 | 17 | 25 | 19 | 19 | 19 |
| ≥50 | 2.9 | 34 | 21 | 21 | 22 | 23 | 21 | 21 | 32 | 21 | 23 | 23 | 16 | 6 | 19 | 18 |
| ≥51 | 3.3 | 5 | 6 | 8 | 8 | 7 | 8 | 6 | 6 | 8 | 10 | 10 | 7 | 25 | 12 | 13 |
| ≥52 | 3.7 | 9 | 12 | 24 | 10 | 9 | 24 | 26 | 11 | 28 | 25 | 25 | 12 | 13 | 8 | 8 |
| ≥53 | 4.2 | 12 | 27 | 12 | 29 | 29 | 11 | 13 | 9 | 6 | 8 | 8 | 29 | 6 | 8 | 8 |
| ≥54 | 4.6 | 53 | 36 | 33 | 31 | 34 | 34 | 32 | 52 | 36 | 31 | 31 | 32 | 58 | 60 | 60 |
| ≥55 | 5.1 | 13 | 28 | 63 | 65 | 28 | 29 | 31 | 13 | 65 | 71 | 68 | 72 | 75 | 68 | 71 |
| ≥56 | 5.6 | 130 | 80 | 74 | 70 | 136 | 137 | 134 | 130 | 101 | 99 | 102 | 115 | 81 | 80 | 80 |
| ≥57 | 6.2 | 72 | 207 | 173 | 177 | 78 | 84 | 85 | 74 | 155 | 155 | 156 | 91 | 160 | 164 | 161 |
| ≥58 | 6.8 | 113 | 42 | 105 | 98 | 128 | 122 | 122 | 199 | 88 | 84 | 84 | 173 | 189 | 192 | 188 |
| ≥59 | 7.5 | 201 | 225 | 153 | 154 | 194 | 204 | 204 | 104 | 165 | 157 | 156 | 98 | 26 | 32 | 39 |
| ≥60 | 8.3 | 93 | 70 | 63 | 64 | 77 | 60 | 57 | 99 | 58 | 55 | 56 | 129 | 166 | 165 | 161 |
| ≥61 | 9 | 154 | 155 | 156 | 164 | 157 | 161 | 166 | 183 | 178 | 175 | 174 | 133 | 181 | 174 | 174 |
| ≥62 | 9.9 | 156 | 185 | 213 | 205 | 190 | 193 | 198 | 127 | 176 | 210 | 210 | 137 | 90 | 101 | 99 |
| ≥63 | 10.8 | 135 | 132 | 101 | 101 | 141 | 123 | 115 | 144 | 131 | 120 | 120 | 132 | 163 | 151 | 152 |
| ≥64 | 11.9 | 157 | 138 | 167 | 167 | 136 | 167 | 167 | 149 | 143 | 135 | 135 | 108 | 72 | 79 | 87 |
| ≥65 | 12.9 | 98 | 88 | 69 | 69 | 88 | 69 | 69 | 88 | 87 | 96 | 90 | 130 | 150 | 149 | 146 |
| ≥66 | 14.1 | 213 | 170 | 175 | 175 | 167 | 175 | 175 | 243 | 147 | 136 | 143 | 171 | 91 | 94 | 90 |
| ≥67 | 15.4 | 75 | 83 | 83 | 83 | 86 | 83 | 83 | 41 | 129 | 130 | 130 | 81 | 189 | 187 | 187 |
| ≥68 | 16.8 | 156 | 257 | 249 | 249 | 242 | 252 | 253 | 147 | 215 | 215 | 215 | 169 | 52 | 52 | 52 |
| ≥69 | 18.2 | 124 | 28 | 28 | 28 | 45 | 25 | 24 | 124 | 13 | 14 | 14 | 32 | 49 | 48 | 48 |
| ≥70 | 19.8 | 16 | 55 | 55 | 55 | 54 | 53 | 54 | 16 | 52 | 50 | 50 | 65 | 26 | 21 | 24 |
| ≥71 | 21.5 | 62 | 34 | 34 | 34 | 34 | 35 | 35 | 64 | 32 | 33 | 33 | 20 | 19 | 22 | 19 |
| ≥72 | 23.3 | 27 | 11 | 11 | 11 | 13 | 11 | 11 | 31 | 9 | 8 | 8 | 45 | 5 | 7 | 7 |
| ≥73 | 25.2 | 44 | 4 | 0 | 0 | 4 | 33 | 5 | 38 | 33 | 33 | 33 | 13 | 40 | 44 | 44 |
| ≥74 | 27.2 | 13 | 51 | 55 | 55 | 51 | 20 | 50 | 16 | 20 | 24 | 24 | 36 | 22 | 17 | 17 |
| ≥75 | 29.4 | 49 | 16 | 21 | 21 | 21 | 21 | 21 | 46 | 24 | 16 | 16 | 23 | 35 | 35 | 35 |
| ≥76 | 31.7 | 13 | 39 | 30 | 30 | 33 | 30 | 30 | 14 | 30 | 30 | 33 | 4 | 9 | 9 | 9 |
| ≥77 | 34.1 | 4 | 4 | 15 | 15 | 4 | 15 | 15 | 4 | 12 | 15 | 12 | 5 | 1 | 1 | 1 |
| ≥78 | 36.7 | 5 | 9 | 4 | 4 | 9 | 4 | 4 | 5 | 5 | 5 | 4 | 4 | 32 | 32 | 32 |
| ≥79 | 39.4 | 4 | 35 | 32 | 32 | 35 | 32 | 32 | 24 | 30 | 31 | 31 | 20 | 0 | 0 | 0 |
| ≥80 | 42.3 | 90 | 60 | 60 | 60 | 60 | 60 | 60 | 68 | 60 | 60 | 60 | 68 | 60 | 60 | 60 |
| Sum | | 2400 | 2378 | 2357 | 2358 | 2384 | 2370 | 2372 | 2370 | 2328 | 2323 | 2323 | 2251 | 2170 | 2170 | 2169 |

CityHush

# Excursion: Noise costs based on CBA

## Recommended calculation procedure:

**Step 1**   Quantification of the number of persons exposed to certain noise levels (for each scenario)
*Remark: We use refined $L_{den}´$ according refined noise score model*

**Step 2**   Preparation of the cost factor table by increasing the cost factor according to the assumed country-specific GDP per capita growth for each year of the analysis
*Remark:* In order to ensure a uniformity of approach across the selected test sites a single country factor will be used

**Step 3**   Calculation of impacts (multiply percentage of highly annoyed persons by number of persons exposed) and costs (multiply cost per person by number of persons exposed) for all scenarios

**Step 4**   Subtraction of total costs for the Do-Something cases from Do-Minimum case (base case)

**Step 5**   Reporting of costs and impacts (change in number of people highly annoyed)

# Excursion: Noise costs based on CBA

| $L_{den}$ | Germany 2002 | Germany 2010 | Slovakia 2002 | Slovakia 2010 | Sweden 2002 | Sweden 2010 | UK 2002 | UK 2010 | Total Average | Ger, Swe & UK Average 2002 | Ger, Swe & UK Average 2010 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 51 | 10 | 13 | 2 | Not known | 11 | 14 | 11 | 14 | 10 | 11 | **14** |
| 52 | 19 | 24 | 4 | Not known | 22 | 28 | 21 | 26 | 20 | 21 | **26** |
| 53 | 29 | 37 | 5 | Not known | 33 | 43 | 32 | 40 | 30 | 31 | **40** |
| 54 | 39 | 50 | 7 | Not known | 44 | 57 | 43 | 54 | 40 | 42 | **53** |
| 55 | 49 | 63 | 9 | Not known | 55 | 71 | 53 | 66 | 50 | 52 | **66** |
| 56 | 58 | 74 | 11 | Not known | 66 | 85 | 64 | 80 | 60 | 63 | **80** |
| 57 | 68 | 87 | 13 | Not known | 77 | 99 | 75 | 94 | 70 | 73 | **93** |
| 58 | 78 | 100 | 14 | Not known | 88 | 114 | 85 | 106 | 80 | 84 | **106** |
| 59 | 88 | 113 | 16 | Not known | 99 | 128 | 96 | 120 | 90 | 94 | **120** |
| 60 | 97 | 124 | 18 | Not known | 110 | 142 | 107 | 134 | 100 | 105 | **133** |
| 61 | 107 | 137 | 20 | Not known | 120 | 155 | 117 | 146 | 109 | 115 | **146** |
| 62 | 117 | 150 | 22 | Not known | 131 | 169 | 128 | 160 | 119 | 125 | **159** |
| 63 | 127 | 163 | 23 | Not known | 142 | 183 | 139 | 174 | 129 | 136 | **173** |
| 64 | 136 | 174 | 25 | Not known | 153 | 197 | 149 | 186 | 139 | 146 | **185** |
| 65 | 146 | 187 | 27 | Not known | 164 | 212 | 160 | 200 | 149 | 157 | **199** |
| 66 | 156 | 200 | 29 | Not known | 175 | 226 | 171 | 214 | 159 | 167 | **213** |
| 67 | 166 | 212 | 31 | Not known | 186 | 240 | 181 | 226 | 169 | 178 | **226** |
| 68 | 175 | 224 | 32 | Not known | 197 | 254 | 192 | 240 | 179 | 188 | **239** |
| 69 | 185 | 237 | 34 | Not known | 208 | 268 | 203 | 254 | 189 | 199 | **252** |
| 70 | 195 | 250 | 36 | Not known | 219 | 283 | 213 | 266 | 199 | 209 | **265** |
| 71 | 259 | 332 | 48 | Not known | 291 | 375 | 283 | 354 | 265 | 278 | **353** |
| 72 | 275 | 352 | 51 | Not known | 309 | 399 | 301 | 376 | 281 | 295 | **375** |
| 73 | 291 | 372 | 54 | Not known | 327 | 422 | 319 | 399 | 298 | 312 | **397** |
| 74 | 307 | 393 | 57 | Not known | 346 | 446 | 337 | 421 | 314 | 330 | **419** |
| 75 | 324 | 415 | 60 | Not known | 364 | 470 | 355 | 444 | 331 | 348 | **442** |
| 76 | 340 | 435 | 63 | Not known | 382 | 493 | 372 | 465 | 347 | 365 | **463** |
| 77 | 356 | 456 | 66 | Not known | 401 | 517 | 390 | 488 | 364 | 382 | **486** |
| 78 | 373 | 477 | 69 | Not known | 419 | 541 | 408 | 510 | 381 | 400 | **508** |
| 79 | 389 | 498 | 72 | Not known | 437 | 564 | 426 | 533 | 398 | 417 | **530** |
| 80 | 405 | 518 | 75 | Not known | 456 | 588 | 444 | 555 | 414 | 435 | **552** |
| 81 | 422 | 540 | 78 | Not known | 474 | 611 | 462 | 578 | 431 | 453 | **575** |

Central values for noise exposure in Euros (2010) „factor costs per person exposed"

# Excursion: Noise costs based on CBA

| $L_{den}$ | Cost factors | Noise Costs - Costs per Year | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| dB(A) | € | S16 | S17 | S18 | S19 | S20 | S21 | S22 | S23 | S24 | S25 | S26 | S27 | S28 | S29 | S30 |
| ≥51 | 14 | 1924 | 2642 | 3129 | 3265 | 2669 | 3129 | 2330 | 2628 | 3373 | 4186 | 4186 | 2845 | 10336 | 5026 | 5392 |
| ≥52 | 26 | 6457 | 8714 | 17244 | 7428 | 6719 | 17192 | 18740 | 7585 | 20000 | 17874 | 17874 | 8189 | 8976 | 5879 | 5879 |
| ≥53 | 40 | 11819 | 26025 | 10903 | 27855 | 27338 | 10028 | 11938 | 8755 | 5929 | 7919 | 7919 | 27378 | 5889 | 7998 | 7998 |
| ≥54 | 53 | 61501 | 41285 | 38405 | 35631 | 39898 | 39845 | 37338 | 60861 | 41925 | 36271 | 35791 | 37445 | 67795 | 69982 | 70035 |
| ≥55 | 66 | 16682 | 35957 | 81883 | 85272 | 36422 | 37153 | 40343 | 17546 | 85140 | 92783 | 89260 | 93647 | 97435 | 88662 | 92052 |
| ≥56 | 80 | 184959 | 113411 | 104577 | 99643 | 193236 | 195385 | 190690 | 184164 | 143176 | 141107 | 144848 | 163312 | 115799 | 113968 | 113172 |
| ≥57 | 93 | 108873 | 310786 | 259656 | 266548 | 116975 | 126103 | 127220 | 110642 | 232740 | 232740 | 234137 | 136440 | 240750 | 246245 | 242333 |
| ≥58 | 106 | 175855 | 65029 | 163423 | 153860 | 199231 | 190943 | 190731 | 311226 | 138134 | 131546 | 131971 | 270742 | 295500 | 300069 | 294225 |
| ≥59 | 120 | 320594 | 359769 | 243920 | 245357 | 309093 | 326584 | 326584 | 166646 | 264286 | 250988 | 249431 | 155744 | 40973 | 50317 | 62178 |
| ≥60 | 133 | 149144 | 112456 | 100891 | 103284 | 123223 | 95973 | 91055 | 158449 | 92916 | 87333 | 89726 | 206169 | 265853 | 263461 | 257612 |
| ≥61 | 146 | 249022 | 250623 | 252954 | 265041 | 253682 | 259798 | 268390 | 295477 | 288341 | 282516 | 281205 | 215673 | 293438 | 281351 | 281351 |
| ≥62 | 159 | 250380 | 297177 | 343019 | 329330 | 305931 | 310706 | 318665 | 204538 | 283169 | 337925 | 337925 | 219978 | 144689 | 162516 | 158377 |
| ≥63 | 173 | 216418 | 211237 | 161148 | 161148 | 226090 | 196728 | 184292 | 230581 | 209855 | 191719 | 191719 | 211755 | 261325 | 241463 | 243190 |
| ≥64 | 185 | 245125 | 215458 | 259773 | 259773 | 212491 | 259773 | 259773 | 232888 | 222504 | 209710 | 209710 | 168176 | 112550 | 123304 | 135913 |
| ≥65 | 199 | 151215 | 135297 | 107044 | 106845 | 135297 | 106845 | 106845 | 136491 | 134501 | 148429 | 138481 | 200160 | 231199 | 229807 | 225230 |
| ≥66 | 213 | 321533 | 256504 | 263942 | 264154 | 252253 | 263517 | 263517 | 366586 | 221014 | 205288 | 215914 | 258416 | 137496 | 141321 | 135158 |
| ≥67 | 226 | 110562 | 121844 | 121618 | 121618 | 126357 | 122295 | 122295 | 60696 | 189535 | 189760 | 189760 | 119136 | 276405 | 274149 | 274149 |
| ≥68 | 239 | 221331 | 365064 | 353842 | 353842 | 344053 | 358618 | 359811 | 208915 | 305613 | 305374 | 305374 | 239476 | 74493 | 74493 | 74493 |
| ≥69 | 252 | 171316 | 38855 | 38855 | 38855 | 62320 | 35071 | 33809 | 171316 | 17914 | 19175 | 19175 | 44154 | 67366 | 67114 | 67114 |
| ≥70 | 265 | 20969 | 74320 | 74320 | 74320 | 71932 | 71666 | 71932 | 20969 | 69277 | 66888 | 66888 | 87592 | 34771 | 28401 | 32382 |
| ≥71 | 353 | 101559 | 55364 | 55364 | 55364 | 55011 | 57480 | 57127 | 105086 | 53248 | 53601 | 53601 | 33500 | 31032 | 36322 | 31032 |
| ≥72 | 375 | 43459 | 18358 | 18358 | 18358 | 20606 | 18358 | 18358 | 49079 | 14611 | 13113 | 13113 | 72682 | 7868 | 11614 | 11614 |
| ≥73 | 397 | 69416 | 6743 | 0 | 0 | 6743 | 51963 | 8330 | 59500 | 51963 | 51963 | 51963 | 20626 | 62673 | 68623 | 68623 |
| ≥74 | 419 | 19698 | 78791 | 85496 | 85496 | 78372 | 30594 | 76695 | 23889 | 31013 | 37300 | 37300 | 55740 | 33528 | 26822 | 26822 |
| ≥75 | 442 | 74178 | 23401 | 31791 | 31791 | 31791 | 31791 | 31791 | 69763 | 35764 | 24726 | 24726 | 33998 | 52543 | 52984 | 52984 |
| ≥76 | 463 | 19451 | 56965 | 43997 | 43997 | 48628 | 43997 | 43997 | 19914 | 43997 | 43997 | 48628 | 5558 | 12504 | 12504 | 12504 |
| ≥77 | 486 | 6312 | 5341 | 20879 | 20879 | 5341 | 20879 | 20879 | 5827 | 16509 | 20879 | 16509 | 7283 | 1942 | 1942 | 1942 |
| ≥78 | 508 | 7112 | 12192 | 6096 | 6096 | 12192 | 6096 | 6096 | 7112 | 7112 | 6604 | 6096 | 5080 | 44196 | 44196 | 44196 |
| ≥79 | 530 | 5300 | 47701 | 42401 | 42401 | 47701 | 42401 | 42401 | 32331 | 40811 | 41871 | 41871 | 27031 | 0 | 0 | 0 |
| ≥80 | 552 | 117119 | 79000 | 79000 | 79000 | 79000 | 79000 | 79000 | 88944 | 79000 | 79000 | 79000 | 88944 | 79000 | 79000 | 79000 |
| Sum | | 3459282 | 3426309 | 3383928 | 3386452 | 3430597 | 3409911 | 3410972 | 3418402 | 3343372 | 3332586 | 3334101 | 3216871 | 3108325 | 3109533 | 3106952 |

# Comparison of Scenarios



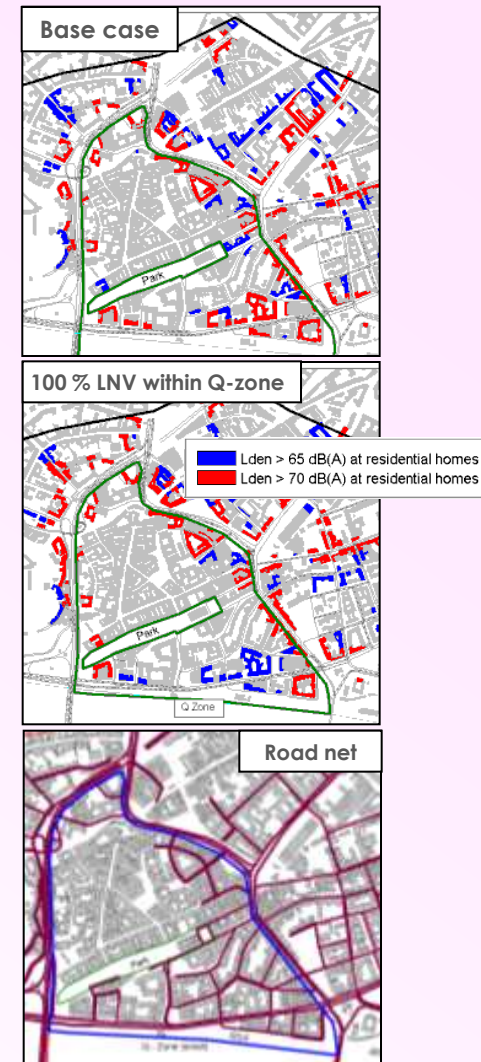Highly Annoyed People
Noise Costs
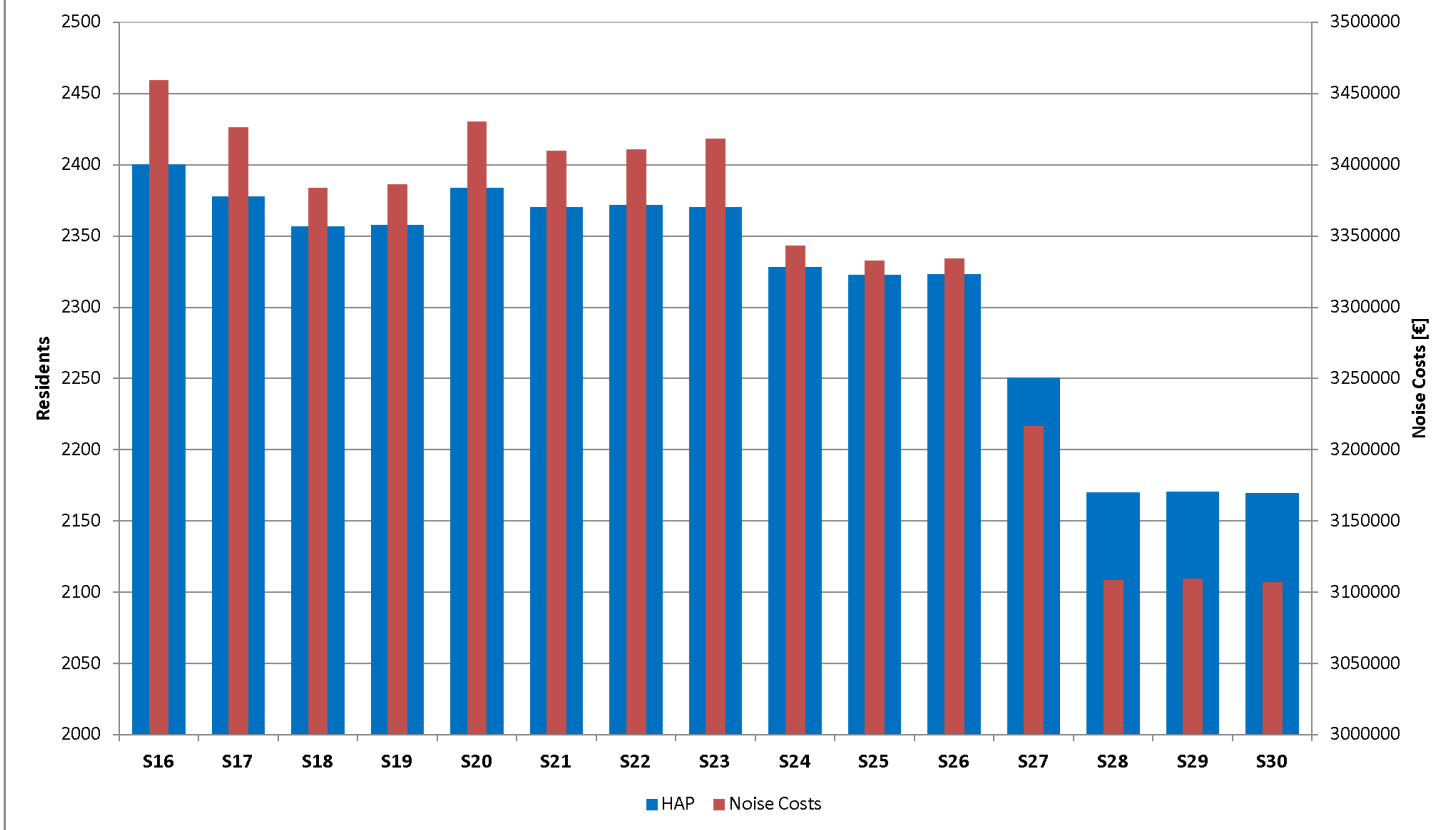
| CBA | S16 base case | S17 | S18 | S19 | S20 | S21 | S22 | S23 | S24 | S25 | S26 | S27 | S28 | S29 | S30 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Q Zone | none | large | | | small | | | none | large | | | none | large | | |
| Fee [€] | none | ban | 1 | 2 | ban | 1 | 2 | none | ban | 1 | 2 | none | ban | 1 | 2 |
| Inside LNVO | | | | 0,01 | | | | 0,05 | | 0,2 | | | | 1 | |
| External LNVO | | | | 0,01 | | | | | 0,05 | | | | 0,2 | | |

# Conclusions for Bratislava

- Average day/evening-time noise level ($L_{de}$) in the park could be reduced by maximum 3 dB(A)

- "Capacity" of the embedded park could increase from 3 % to maximum 30 % of the park area.

- The maximum reduction of HAP can be expected by 226 or 10 %

- In total: limited improvements compared to the strict measure

CityHush

# Reasons for limited improvements

- The analysis of highly affected residential homes shows, that most of the buildings were affected by roads outside the Q-zone; therefore the decrease of HAP is limited

- The $L_{de}$ within the park is strongly influenced by a main road outside the Q-zone, therefore the background noise from the surrounding road network inhibits further improvements

- The average $L_{de}$ of the Q-zone without any traffic inside the Q-zone is approx. 54 dB(A) and thereby only 5 dB lower than the base case.

- Considering the fact, that in all scenarios only traffic work from passenger cars were replaced by low emission car traffic (no improvements on trucks), the noise reduction is limited by approx. 3 dB.



Base case

100 % LNV within Q-zone

Lden > 65 dB(A) at residential homes
Lden > 70 dB(A) at residential homes

Road net

CityHush

# Results from test site Essen



| Test site Essen | Base case noise level Ldeav | Background noise level Ldeav | Potential of noise reduction (based on Ldeav) |
|---|---|---|---|
| park area | 63.3 dB | 59.9 dB | 3.4 dB |
| small Q-zone area incl. park | 63.0 dB | 57.5 dB | 5.5 dB |
| large Q-zone area incl. park | 62.7 dB | 58.3 dB | 4.4 dB |

- Average day/evening-time noise level ($L_{de}$) in the park could be reduced by maximum 2.8 dB(A)

- "Capacity" of the embedded park could increase from 0 m² for the base case to maximum 7700 m² (7 % of the park area).

- The maximum reduction of HAP can be expected by 469 or 6 %

- In total: limited improvements compared to the strict measure
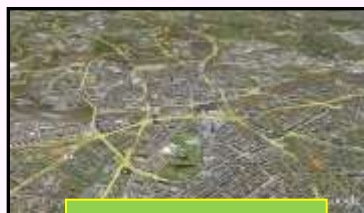
CityHush

# Results from test site Essen
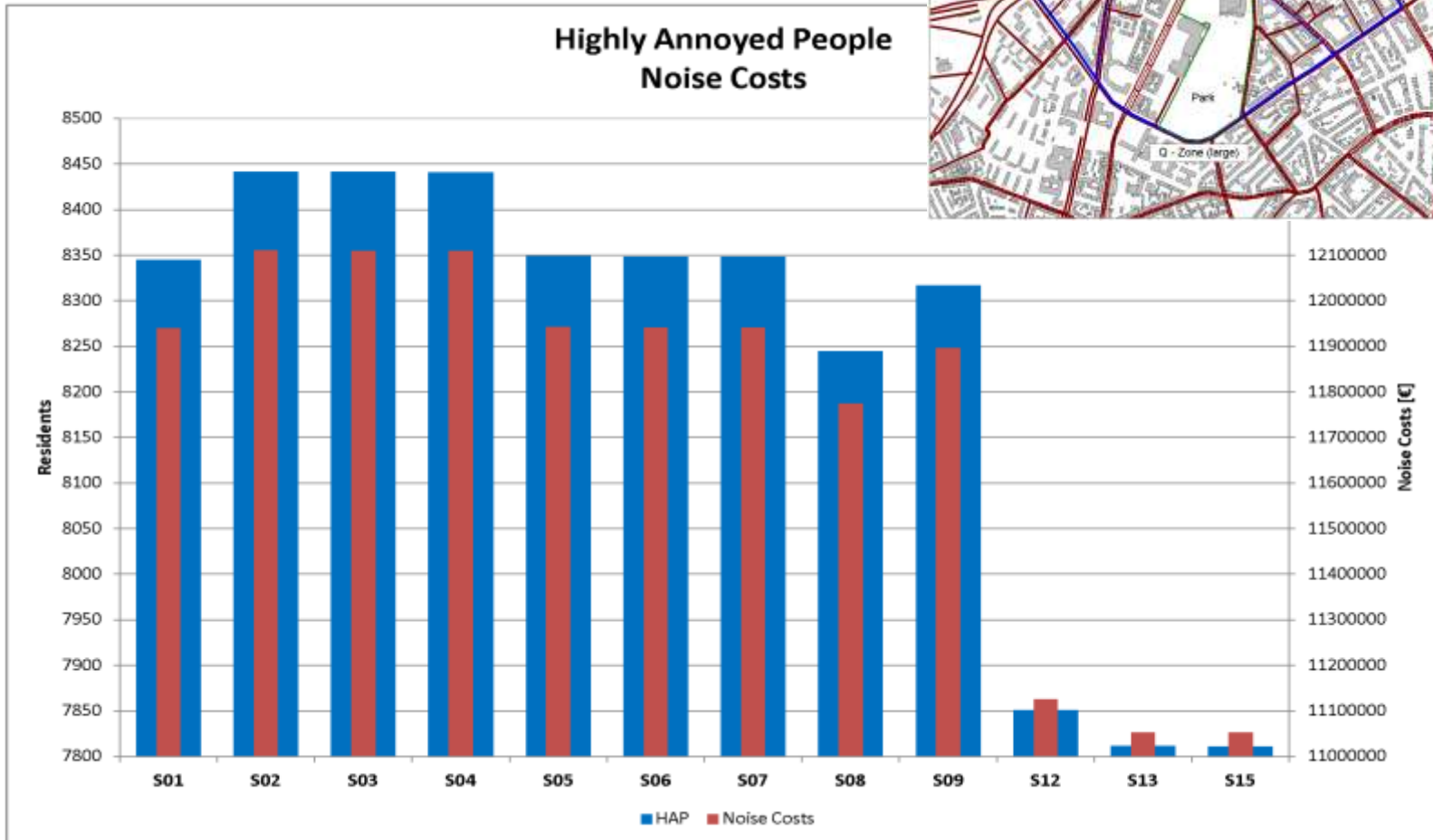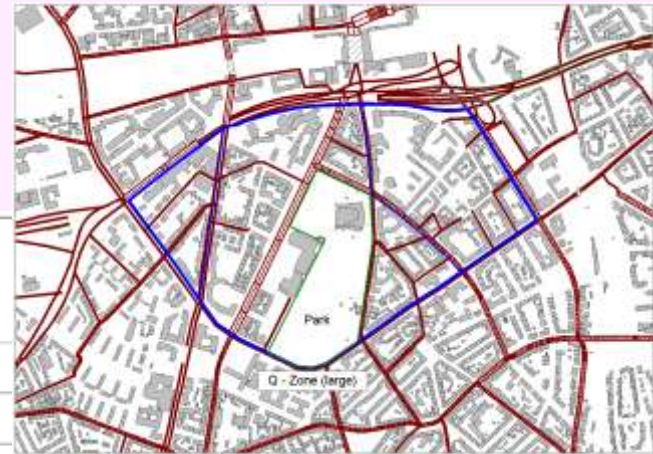
# Final recommendations will follow ☺
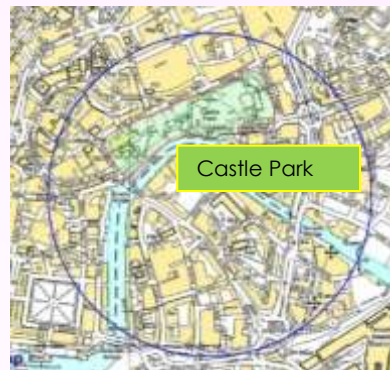
**City of Stockholm**
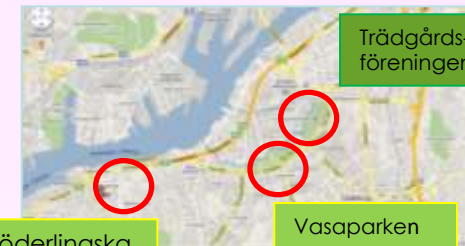


**City of Essen**



Park Stadtgarten

**City of Bristol**



Castle Park

**City of Gothenburg**



Trädgårds-föreningen

Söderlingska Trädgården

Vasaparken

CityHush

# Thank you for your attention

**Contact:**    Markus Petz

ACCON GmbH
Gewerbering 5
86926 Greifenberg / Germany

Phone: +49 8192 99 60-12

markus.petz@accon.de
www.accon.de

CityHush