Embedded Parks to reduce transport noise

Stockholm Workshop, December 11th, 2012

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Embedded parks in Q-Zones

Aim:

Noise reduction by surrounding a park with a quiet buffer zone

Objectives:

Identification of boundary conditions and maximum noise gains for parks embedded in Q-Zones

Technical Tasks:

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

- Determination of the influence of local parameters on noise levels

Determination of the influence of local parameters on noise situation

Local parameters which influence the noise situation

- size of park areas

- range of noise sources (e.g. roads, rail, types of vehicle)

- rate of low noise vehicles (LNV*) within the car fleet and the ratio of ownership (O) in the population

- size of the projected surrounding Q-Zone

- nature of the surrounding areas

- methods of accessing the surrounding Q-Zone (e.g. fees, bans)

*LNV is assumed to provide a total (drive system + tyre noise) 10 dB(A) reduction in emissions

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Identification of boundary conditions

- Investigation of different traffic scenarios for the evaluation of source related parameters (based on traffic model simulations)

- Definition and evaluation of various parameter combinations (~ 15) for each test site

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

Investigated test sites

City of Bratislava

City of Bristol

Castle Park

City of Essen

Park Stadtgarten

City of Gothenburg

Trädgårds-föreningen

Söderlingska Trädgården

Vasaparken
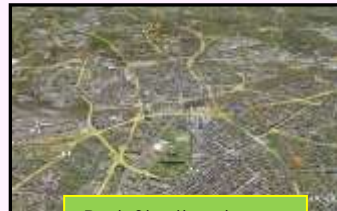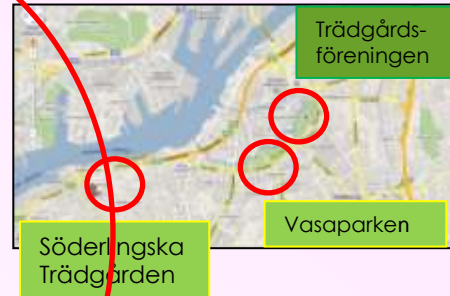
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Today's focus

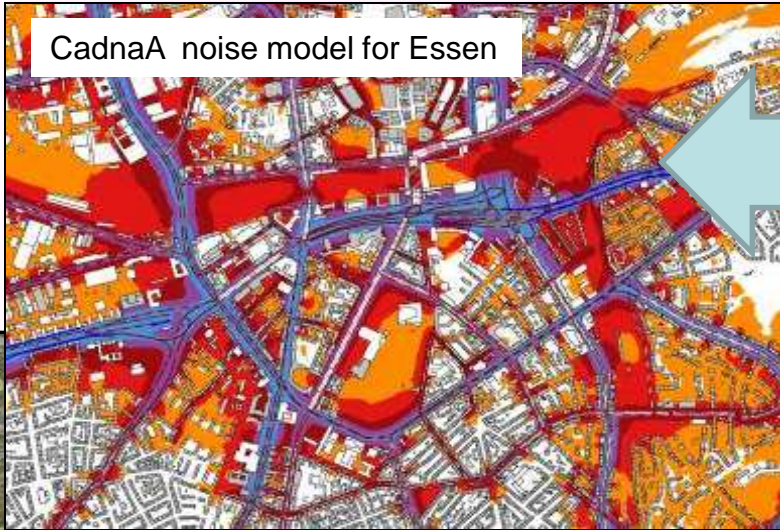CityHush

Traffic Simulation

➤ Simulation of traveller behaviour
  ➤ Route choice
  ➤ (Destination choice)
  ➤ (Mode choice)
➤ Resulting in link flows/speeds
  ➤ Congestion effects
➤ Using available traffic simulation model databases
  ➤ Regard to distribution of value of time

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Example: Location test site Essen
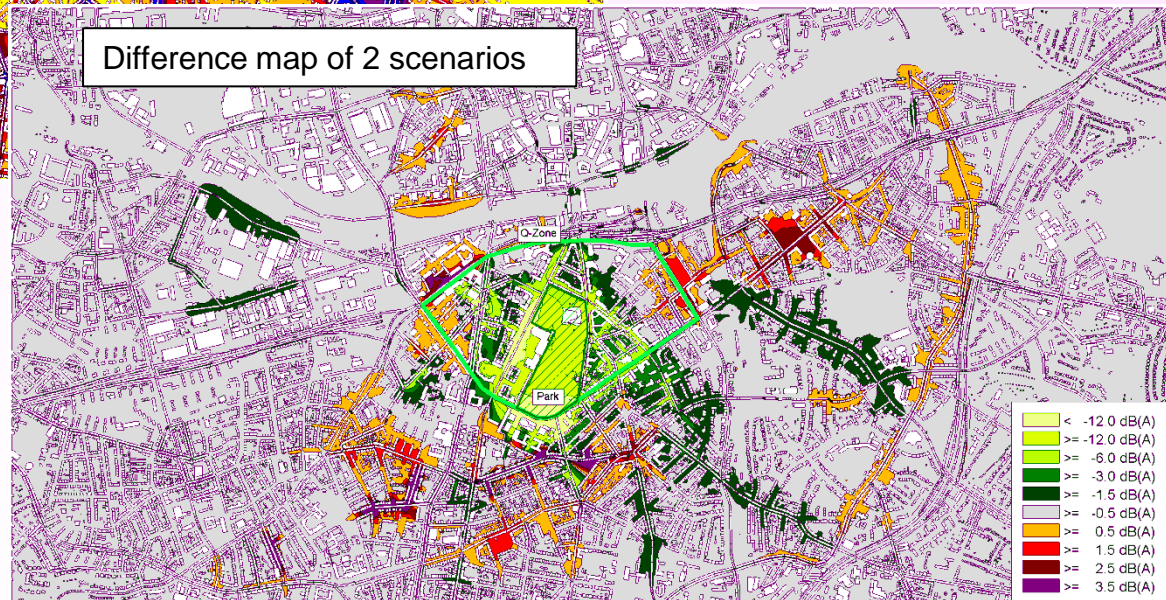

CadnaA noise model for Essen

Traffic simulation for Essen

Example: Location test site Essen

Different Q-Zones

	Q-Zone	Fee [€]	Inside LNVO	External LNVO
S1	none	none	0.01	0.01
S2	large	ban	0.01	0.01
S3	large	1	0.01	0.01
S4	large	0.5	0.01	0.01
S5	small	Ban	0.01	0.01
S6	small	1	0.01	0.01
S7	small	0.5	0.01	0.01
S8	none	none	0.05	0.05
S9	large	ban	0.2	0.05
S10	XL	ban	0.01	0.01
S11	XXL	ban	0.01	0.01
S12	none	none	0.2	0.2
S13	large	ban	1	0.2
S14	XXL	ban	1	0.2
S15	large	0.5	1	0.2

How to demonstrate effects on noise situation

Noise map based on grid calculation

Difference map of 2 scenarios

	< -12.0 dB(A)
	>= -12.0 dB(A)
	>= -6.0 dB(A)
	>= -3.0 dB(A)
	>= -1.5 dB(A)
	>= -0.5 dB(A)
	>= 0.5 dB(A)
	>= 1.5 dB(A)
	>= 2.5 dB(A)
	>= 3.5 dB(A)
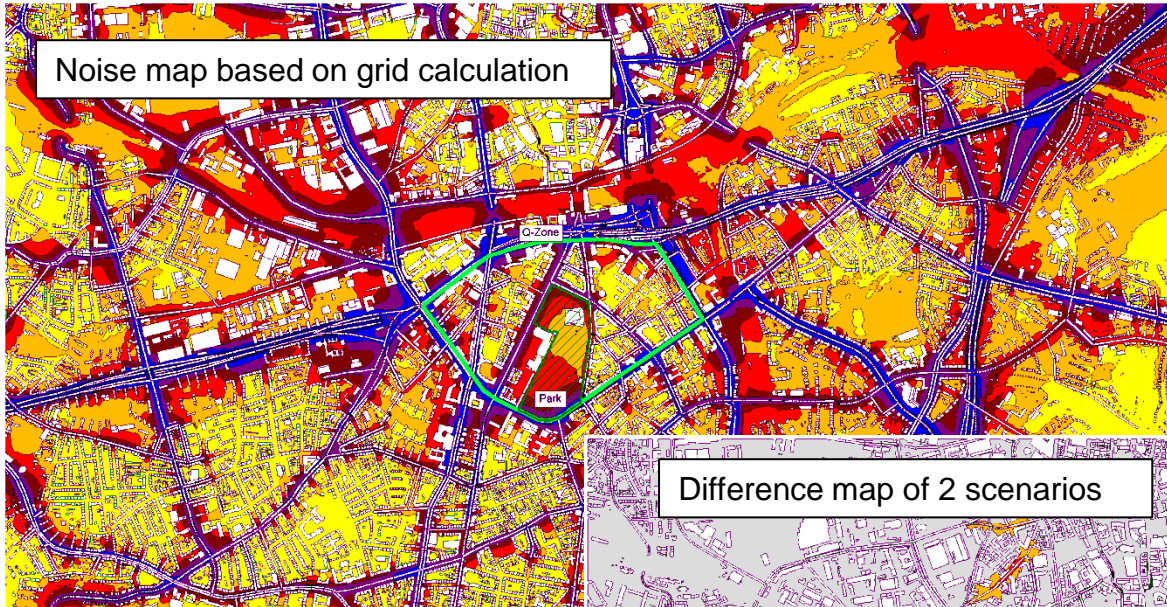
How to demonstrate effects on noise situation

Noise level [5 dB classes]	Park area [m²]	Q-Zone S area [m²]	Q-Zone L area [m²]	Q-Zone XL area [m²]	Q-Zone XXL area [m²]	Test site (S Q-Zone) area [m²]	Test site (L Q-Zone) area [m²]	Test site (XL Q-Zone) area [m²]	Test site (XXL Q-Zone) area [m²]
< 40	0	0	0	0	0	32 800	32 800	32 800	32 800
40 - 45	0	0	0	0	0	49 700	49 700	49 700	49 700
45 - 50	0	140 300	21 800	22 800	36 600	1 016 600	1 009 100	1 008 100	994 300
50 - 55	2600	64 200	116 600	118 800	140 500	2 393 700	2 341 300	2 339100	2 317 400
55 - 60	45 900	44 800	92 500	94 700	109 100	3 225 100	3 177 400	3 175 200	3 160 800
60 - 65	28 000	41 400	74 300	80 300	88 700	2 138 700	2 105 800	2 099 800	2 091 400
65 - 70	17 700	29 200	54 300	60 000	65 200	1 380 600	1 355 500	1 349 800	1 344 600
70 - 75	7 500	47 500	71 700	83 000	86 800	1 098 000	1 073 800	1 062 500	1 058 700
> 75	2 600	28 000	55 800	64 400	66 500	1 294 000	1 266 200	1 257 600	1 255 500
Total area size	104 300	269 400	487 000	524 000	593 400	12 629 200	12 411 600	12 374 600	12 305 200

Noise distributions for the various areas defined. Noise levels (based on the L_{de}) are given in 5 dB classes for each of the Q-Zone configurations and for the test sites in the base case scenario.

Defined "single number values" for comparison of different scenarios

Considered parameters for evaluation of the existing noise levels in **parks**:

- Average day/evening-time noise level ($L_{de,av}$) in the park, based on grid calculations (10 x 10 m²)

- "**Capacity**" of embedded park

capacity = size of the park area in which the average noise indicator $L_{de,av}$ is 10 dB lower as that of the *park-surrounding*

park-surrounding = area whose residents can reach the park within a 5 minute walk (walking distance of 400 meters to the park)

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Defined "single number values" for comparison of different scenarios

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

- Average day/evening-time noise level ($L_{de,av}$) in the Q-zone and test site (without Q-zone area), based on grid calculations (10 x 10 m²)

- Number "highly annoyed people (HAP)" per building and **HAP** for each scenario (single number value for Q-Zone and test site)

Noise situation on Essen test site
Status quo, $L_{de,av}$ in the various zones

Different Q-Zones

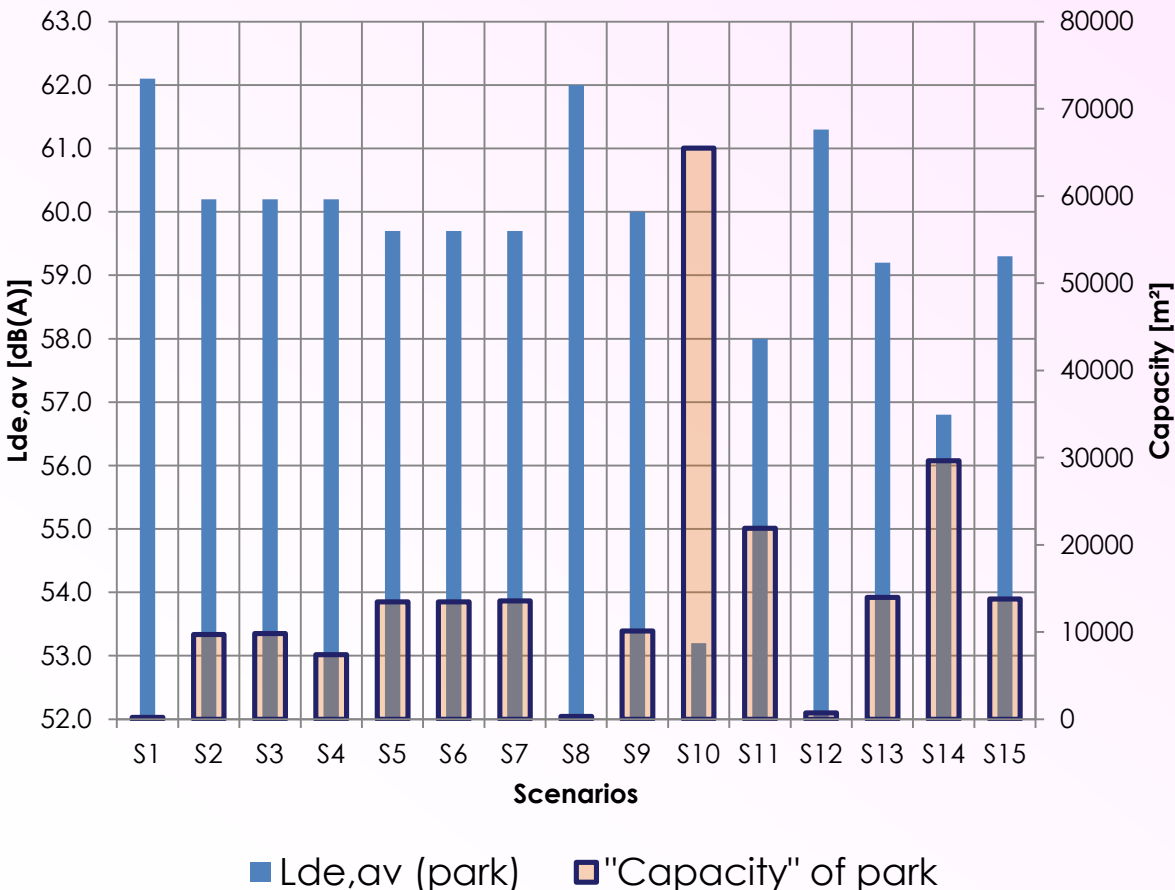| Scenario	S1 small	S1 large	S1 XL	S1 XXL
$L_{de,av}$ [dB(A)] park	62.1	62.1	62.1	62.1
$L_{de,av}$ [dB(A)] Q-Zone area	62.3	62.3	62.7	62.0
$L_{de,av}$ [dB(A)] Testsite area (without Q-Zone)	61.0	61.0	61.0	61.0

Base case values

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Noise and capacity situation within the **park** for different traffic scenarios

Characteristic values for the embedded park - Essen

Legend: ■ Lde,av (park) □ "Capacity" of park

	Q-Zone	Fee [€]	Inside LNVO*	External LNVO
S1	none	none	0.01	0.01
S2	large	ban	0.01	0.01
S3	large	1	0.01	0.01
S4	large	0.5	0.01	0.01
S5	small	Ban	0.01	0.01
S6	small	1	0.01	0.01
S7	small	0.5	0.01	0.01
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S15	large	0.5	1	0.2

Best noise reduction scenario

Best HAP scenario

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Results of all scenarios - overwiew

Scenario	Change $L_{de,av}$ (park) [dB(A)]	Change $L_{de,av}$ (surround.) [dB(A)]	Change of "Capacity"	Change of no.HAP within Q-Zone	Change of no. HAP outside Q-Zone within affected area	Change of no. HAP (Test-site including Q-Zone)
S1						
S2	-1.9	-1	9 491	-39	135	96
S3	-1.9	-1	9 595	-40	135	95
S4	-1.9	-1	7 196	-40	135	95
S5	-2.4	-0.7	13 246	-7	9	2
S6	-2.4	-0.7	13 246	-7	9	2
S7	-2.4	-0.7	13 350	-7	9	2
S8	-0.1	-0.1	104	-6	-93	-99
S9	-2.1	-1.2	9 908	-42	12	-30
S10	-8.9	-1.7	65 291	-70	102	32
S11	-4.1	-1.3	21 694	-53	108	55
S12	-0.8	-0.8	521	-27	-467	-494
S13	-2.9	-2	13 767	-68	-467	-535
S14	-5.3	-2.4	29 412	-101	-539	-639
S15	-2.8	-2	13 559	-68	-467	-536

	Q-Zone	Fee [€]	Inside LNVO*	External LNVO
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Best noise reduction scenario

Best HAP scenario

Scenarios with „softer" restrictions (speed limit and low noise asphalt at the main road within the Q-Zone instead of traffic ban)

Example: Difference map
Base case (S1) – Best case (S10)

	< -12.0 dB(A)
	>= -12.0 dB(A)
	>= -6.0 dB(A)
	>= -3.0 dB(A)
	>= -1.5 dB(A)
	>= -0.5 dB(A)
	>= 0.5 dB(A)
	>= 1.5 dB(A)
	>= 2.5 dB(A)
	>= 3.5 dB(A)

Q-Zone

Park

Significant parts of the embedded park with noise reduction of 12 dB(A) and more (coloured in light green)

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Results from the test site in Essen

- By implementing a Q-Zone the $L_{de,av}$ in the embedded park can be reduced up to 8.9 dB(A) (average value)

- Noise reduction of 12 dB(A) and more within significant parts of the embedded park can be expected

- "Capacity" of the embedded park could be increased from 0 m² in the base case to a maximum 65 291 m² (59.4 % of the park area)

- Maximum reduction of HAP 639 (or 7 %) on the complete test site

- Negative consequences in other regions of the city

    - caused by traffic re-distribution effects

    - revealed by a rise in the number of HAP in the affected regions

- Implementation of a Q-Zone demands additional mitigation measures for compensation of (temporary) negative effects

Conclusions for test site in Essen

- Individual mitigation measures need to be developed and applied in negatively affected areas

- **Q-Zones need to be carefully designed to reduce negative implications on HAP from the beginning**

- With rising rate of LNVO a considerable reduction of HAP can be expected

General conclusions

➢ Noise in parks can be reduced significantly, (> -10 dB(A)), by embedment in Quiet Zones
➢ Effects differ widely with local conditions
  ➢ Traffic zoning
➢ The Quiet Zone may be difficult to establish
  ➢ Redistribution effects may offset park gains
  ➢ Additional mitigation measures may have to be applied
➢ Critical parameters:
  ➢ Low Noise Vehicle Ownership in QZ
  ➢ Spare road capacity

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Find more on www.cityhush.eu

Thank you for your attention!

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