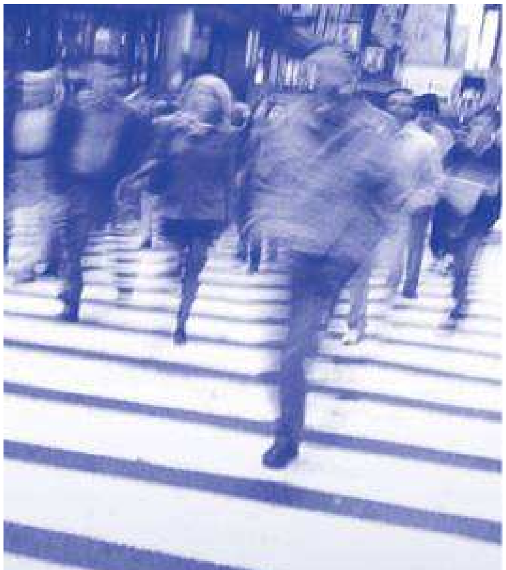

CIVITAS
Cleaner and better transport in cities

ARCHIMEDES
AALBORG • BRIGHTON & HOVE • DONOSTIA-SAN SEBASTIÁN • IAŞI • MONZA • ÚSTÍ NAD LABEM

Ústí nad Labem

R28.1 – Study of Noise Reduction in Ústí nad Labem

THE CIVITAS INITIATIVE
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Contents

1. Introduction

1.1 Background CIVITAS

CIVITAS - cleaner and better transport in cities - stands for CIty-VITAlity-Sustainability. With the CIVITAS Initiative, the EC aims to generate a decisive breakthrough by supporting and evaluating the implementation of ambitious integrated sustainable urban transport strategies that should make a real difference for the welfare of the European citizen.

CIVITAS I started in early 2002 (within the 5th Framework Research Programme);
CIVITAS II started in early 2005 (within the 6th Framework Research Programme) and
CIVITAS PLUS started in late 2008 (within the 7th Framework Research Programme).

The objective of CIVITAS-Plus is to test and increase the understanding of the frameworks, processes and packaging required to successfully introduce bold, integrated and innovative strategies for clean and sustainable urban transport that address concerns related to energy-efficiency, transport policy and road safety, alternative fuels and the environment.

Within CIVITAS I (2002-2006) there were 19 cities clustered in 4 demonstration projects, within CIVITAS II (2005-2009) 17 cities in 4 demonstration projects, whilst within CIVITAS PLUS (2008-2012) 25 cities in 5 demonstration projects are taking part. These demonstration cities all over Europe are funded by the European Commission.

Objectives:

- to promote and implement sustainable, clean and (energy) efficient urban transport measures
- to implement integrated packages of technology and policy measures in the field of energy and transport in 8 categories of measures
- to build up critical mass and markets for innovation

Horizontal projects support the CIVITAS demonstration projects & cities by:

- Cross-site evaluation and Europe wide dissemination in co-operation with the demonstration projects
- The organisation of the annual meeting of CIVITAS Forum members
- Providing the Secretariat for the Political Advisory Committee (PAC)
- Development of policy recommendations for a long-term multiplier effect of CIVITAS

Key elements of CIVITAS

- CIVITAS is co-ordinated by cities: it is a programme “of cities for cities”
- Cities are in the heart of local public private partnerships
- Political commitment is a basic requirement
- Cities are living ‘Laboratories' for learning and evaluating

1.2 Background ARCHIMEDES

ARCHIMEDES is an integrating project, bringing together 6 European cities to address problems and opportunities for creating environmentally sustainable, safe and energy efficient transport systems in medium sized urban areas.

The objective of ARCHIMEDES is to introduce innovative, integrated and ambitious strategies for clean, energy-efficient, sustainable urban transport to achieve significant impacts in the policy fields of energy, transport, and environmental sustainability. An ambitious blend of policy tools and measures will increase energy-efficiency in transport, provide safer and more convenient travel for all, using a higher share of clean engine technology and fuels, resulting in an enhanced urban environment (including reduced noise and air pollution). Visible and measurable impacts will result from significantly sized measures in specific innovation areas. Demonstrations of innovative transport technologies, policy measures and partnership working, combined with targeted research, will verify the best frameworks, processes and packaging required to successfully transfer the strategies to other cities.

1.3 Participant Cities

The ARCHIMEDES project focuses on activities in specific innovation areas of each city, known as the ARCHIMEDES corridor or zone (depending on shape and geography). These innovation areas extend to the peri-urban fringe and the administrative boundaries of regional authorities and neighbouring administrations.

The two Learning cities, to which experience and best-practice will be transferred, are Monza (Italy) and Ústí nad Labem (Czech Republic). The strategy for the project is to ensure that the tools and measures developed have the widest application throughout Europe, tested via the Learning Cities' activities and interaction with the Lead City partners.

1.3.1 Leading City Innovation Areas

The four Leading cities in the ARCHIMEDES project are:

- Aalborg (Denmark);
- Brighton & Hove (UK);
- Donostia-San Sebastián (Spain); and
- Iasi (Romania).

Together the Lead Cities in ARCHIMEDES cover different geographic parts of Europe. They have the full support of the relevant political representatives for the project, and are well able to implement the innovative range of demonstration activities.

The Lead Cities are joined in their local projects by a small number of key partners that show a high level of commitment to the project objectives of energy-efficient urban transportation. In all cases the public transport company features as a partner in the proposed project.

2. Ústí nad Labem

Ústí nad Labem is situated in the north of the Czech Republic, about 20 km from the German border. Thanks to its location in the beautiful valley of the largest Czech river Labe (Elbe) and the surrounding Central Bohemian Massive, it is sometimes called 'the Gateway to Bohemia'. Ústí is an industrial, business and cultural centre of the Ústí region.

Ústí nad Labem is an important industrial centre of north-west Bohemia. The city's population is 93,859, living in an area of 93.95km2. The city is also home to the Jan Evangelista Purkyně University with eight faculties and large student population. The city used to be a base for a large range of heavy industry, causing damage to the natural environment. This is now a major focus for improvement and care.

The Transport Master Plan, initiated in 2007, will be the basic transport document for the development of a new urban plan in 2011. This document will characterise the development of transport in the city for the next 15 years. Therefore, the opportunity to integrate Sustainable Urban Transport Planning best practices into the Master Plan of Ústí nad Labem within the project represents an ideal match between city policy framework and the ARCHIMEDES project.

The ARCHIMEDES project's main objective in Ústí nad Labem is to address transport organisation of the city, depending on the urban form, transport intensity, development of public transport, and access needs. The process, running until 2011, will include improving the digital model of city transport that Ústí currently has at its disposal. The plan will have to deal with the fact (and mitigate against unwanted effects that could otherwise arise), that from 2010, the city will be fully connected to the D8 motorway, running from Prague to Dresden.

3. Background to the Deliverable

Ústí nad Labem has a target to reduce the proportion of residential areas that are located in areas exposed to traffic noise levels above 65 dB by the year 2012. It was proposed that studies would be undertaken to gain a better understanding in the impact measures for reducing noise and to develop a noise map so that problem areas can be targeted as part of the Ústí nad Labem Sustainable Urban Transport Plan. This measure is closely related to the measure 67, task 7.6 Noise Reduction, where the findings of the measure 28 will be further elaborated.

3.1 Summary Description of the Task

The task was aimed at linking noise emissions with road map to provide a noise map for the city as well as modelling some proposed solutions to reduce the noise and to evaluate the effectiveness of individual proposed scenarios.

The study has following goals:

– to develop the emission noise map from noise generated by the current traffic in the city and identify the problematic areas

– to identify roads with the highest level of noise emitted by the local traffic

– to develop the emission noise map from noise generated by the traffic predicted in the city for the year 2012

– to propose measures reducing the noise emitted by cars for the most affected areas with regard to organization and regulation of local traffic, targeted to year 2012

– to apply the traffic model and subsequently the noise model on the proposed solutions and include assessment of the proposals for effective distribution of goods in Ústí nad Labem within the measure 67, task 7.6 Noise Reduction

4. Noise Reduction in Ústí nad Labem

4.1 The Traffic Model

The traffic planning software PTV-VISION ® from the company PTV Karlsruhe was used for the development of the traffic model to calculate the traffic load for various scenarios. The software VISEM ® 8.10 is part of PTV-VISION ® and is used for modelling the transport demand. The input data are: division of the area into individual zones, demographic and activity information for each zone, transport behaviour patterns of homogeneous groups of inhabitants, decision-making algorithms, the offer of the transport network and the offer of transport services. The output data are matrixes of traffic volumes divided into three categories: personal vehicles, light trucks (less than 3.5 tonnes) and other freight vehicles (above 3.5 tonnes).

The software VISUM ® is another part of the package PTV-VISION ®, which matches transport demand matrixes to the appropriate parameterised transport network. The matching is dependent on load capacity, iterative steps, defined network nodes and lines, length, category, capacity, initial speed, intersections, allowed movements and length of delay. VISUM ® allows tracking the differences in the burden of road network for different scenarios and different time periods. The final output is an annual average daily traffic intensity on the network (AADT).

The traffic model was based on following documents:
• National traffic census (2005)
• Directional survey on border crossings (2005)
• Timetable for construction work on highways and expressways in the Czech Republic
• Statistical lexicon of Municipalities in the Czech Republic (2005)
• Results of the traffic survey conducted by the processor
• The Regulatory plan of Ústí nad Labem (2005)

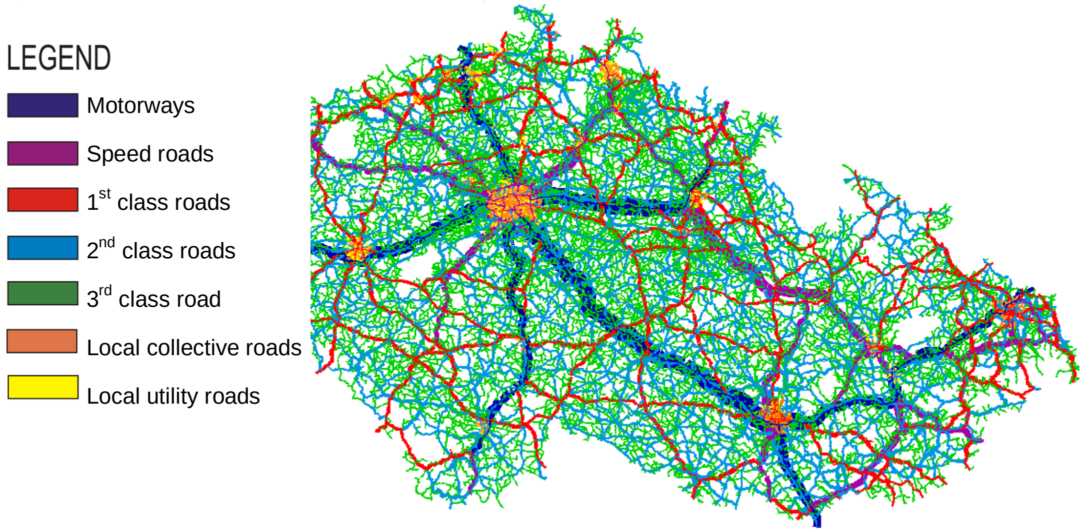
The road network model was based on the model of private vehicles in the Czech Republic calculated to the level of 3rd class roads, including roads of European importance abroad. It was elaborated as a research project for the Ministry of Transport in the Czech Republic. This model is continuously updated and used for the needs of local authorities.

When processing the traffic model of Ústí nad Labem, the nationwide model of road network system served as a basic material. It was resized within the borders between the roads I/7, I/16, I/9 and the state border. Further calculations and analysis are based on the local model.

The traffic model was used to simulate the current state of transport and the foreseen future state of the traffic load in 2012. The input data correspond with the Regulatory plan of the city from the year 2005.

Road network is in the traffic model divided according to the type into:
• Motorways
• Expressways
• 1st class roads (rural)
• 2nd class roads (rural)
• 3rd class roads (rural)
• Local speed roads (urban arterials)
• Local collective roads (urban)
• Local utility roads (urban)

Figure 1 - The traffic model of the Czech Republic



4.1.1 Transport demand

Ústí nad Labem is divided into 158 zones according to the residential units and shopping centres. Outside the city, each outskirt represents individual zone. Transport demand is calculated by linking the zones and calibrating the transport relations' matrixes.

Transport demand model includes matrixes of transport links for domestic traffic and separate matrixes for foreign traffic (external and transit relationships).

Methodology:
Matrixes for domestic traffic within the Czech Republic are calculated by VISEM ® 8.10. The input data consist of the total amount of population, economically active population, population under 14 years of age, number of job opportunities, attractiveness of the area, shopping centres, etc. The matrixes of transport relations are based on the chain activities, such as home - work - shopping - home, home - school - home, etc. Matrixes

are divided by type of vehicles to personal, light trucks (less than 3.5 tonnes) and other freight vehicles (above 3.5 tonnes) without the public transport vehicles.

Matrixes for foreign traffic were calculated from the data of the directional survey on border crossings in 2005. Matrixes are divided by type of vehicles to personal, light trucks (less than 3.5 tonnes) and other freight vehicles (above 3.5 tonnes) without the public transport vehicles.

After calculating the matrixes of transport relations, the values were calibrated for values of the national traffic census made in the year 2005 and for values resulting from the surveys carried out by traffic loops or cameras. Matrixes for the foreseen horizon in 2012 were obtained by multiplying the calibrated matrixes by the traffic growth ratio.

4.1.2 Transport supply

The model of the transport supply was based on principles of network analysis. The network consists of nodes and links, representing the road network. The following parameters are considered:
• Type of the road: highway, expressway, 1^{st}, 2^{nd} or 3^{rd} class road
• Function of the road: speed road (arterials), collective road, utility road, according to the standard CSN 73 6110
• Maximum speed
• Capacity for 24 hours
• Number of lanes

Nodes represent intersections or links between zones. They have the following parameters:
• Type of intersection (traffic light controlled, uncontrolled, with or without priority, with elevated crossing)
• Restricted movements on intersections
• Delays caused by transiting the intersection

4.2 Noise Emissions

The noise emissions are calculated on a model using the software VISUM ® and the module Environment. Calculations are based on the German standard RLS-90 (Richtlinien für den Lärmschutz an Straßen). The average noise level Lm25 is defined as follows:

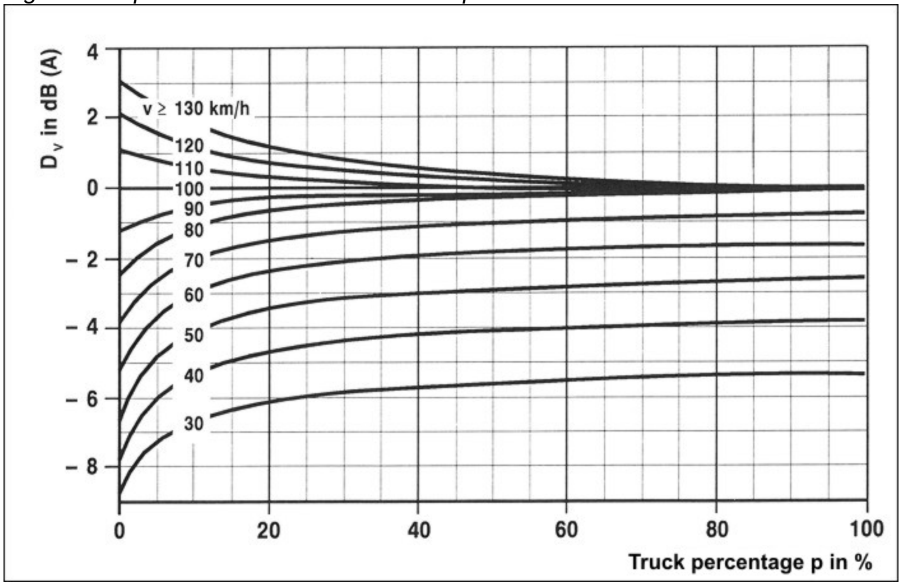
Lm25 = 37,5 + 10 * log [M* (1 + 0.082*p)]

Lm – emission level
M - standard hourly traffic volume (6% for day-time traffic, 1.1% for night-time traffic according to RLS-90)
p - the relevant percentage of trucks in the total volume of vehicles (over 2.8 tons of total weight permitted)

Calculations are determined by following factors:
• DStrO: correction for varying road surface (mastic asphalt, concrete, even pavement, other pavement)
• Dv: correction for different speeds

Speed corrections Dv for various speed limits dependent on the percentage of trucks over 2,8 tonnes are demonstrated in the following diagram:

Figure 2 - Speed corrections for various speed limits



• DStg – a slope of the road: correction for upward and downward gradients

DStg = 0.6 | g | -3 for | g | > 5%
DStg = 0 for | g | ≤ 5%
g - a longitudinal gradient of the road

Final noise level Lm, E is calculated:
Lm, E = Lm + Dv + + DStrO + DStg

The correction factor DE for absorption characteristics of the area is not taken into account in the calculation. The calculations of the noise level are presented in the graphic annex.

The input data are:

1) The standard hourly traffic volume counted as a percentage of 24-hour model volume:
The day-time traffic is 6% out of 24-hour traffic volume
The night-time traffic is dependent on the type of road as follows:

Table 1 - Calculations of the standard hourly traffic volume according to the type of road

	Standard hourly traffic volume [veh/h]	
	Day-time (6:00 - 22:00)	Night-time (22:00 - 6:00)
Motorway	0,06 * AADT	0,014 * AADT
1st class road	0,06 * AADT	0,011 * AADT
2nd and 3rd class road	0,06 * AADT	0,008 * AADT
Local road	0,06 * AADT	0,011 * AADT

AADT - annual average number of vehicles in the daily traffic volumes [veh/24h].

Road sections with the traffic volume below 10 veh/h are not included in the noise calculations.

2) The proportion of trucks:
It is calculated from the model volumes of vehicles according to their category. The traffic model divides trucks into trucks under 3,5 tonnes and over 3,5 tonnes, while the classification system RLS-90 considers trucks under 2.8 tonnes and over 2.8 tonnes. For the noise calculation, an assumption was adopted that the division of trucks is conform.

3) Type of road surface:
Asphalt concrete is considered as a uniform surface for the whole road network.

4) Speed of traffic flow:
The speed is defined with respect to the applicable traffic regulations.

5) The longitudinal gradient of the road:
The digital model of the terrain with resolution of 10 meters was created from the contour lines and elevation points of the ZABAGED database using the software ArcGIS Desktop. The road network was converted into 3D, the relevant gradient was calculated and the data were used in the traffic model transferred by the software VISUM.

4.3 Results of the Noise Study

The primary result of the noise study of the current state is an emission noise map for the existent motor-vehicle traffic. The map for day-time and night-time period is attached in the annex.

Roads with the highest noise emissions:
The highest noise emissions are produced on roads with the highest traffic volumes and the highest percentage of trucks. These roads are listed in the following table according to their noise emissions in the existing situation.

Table 2 - Roads with the highest level of noise emissions

no.	Road	Noise emissions [dB]			
		Day-time		Night-time	
		od	do	od	do
1	motorway D8	70,0	72,2	63,6	65,8
2	silnice II/613 (Žižkova, Střelecká)	68,4	70,4	59,7	61,7
3	silnice I/30	67,6	68,0	60,2	60,6
4	silnice II/258 (Hrbovická, Chabarovická)	65,3	65,9	56,6	57,1
5	silnice I/62	64,9	68,1	57,5	60,6
6	Všebořická, Havířská	64,4	66,1	57,1	58,8
7	Panská, U Trati	64,4	66,0	56,8	58,6
8	Sociální péče, Božtěšická	63,0	65,6	55,7	58,3
9	Petrovická (II/528)	62,8	63,1	54,1	54,3
10	Masarykova	62,7	65,7	55,4	58,4
11	Důlce, Hoření	62,6	66,2	55,3	58,9
12	Tovární	61,4	64,2	53,7	57,0
13	Štěfánikova	61,4	61,7	54,0	54,6
14	Roosveltova	61,2	61,2	53,9	53,9
15	Malátova , Na Návsi, Výstupní	61,0	64,1	53,6	55,3
16	Majakovského, Tyršova	61,0	63,2	52,2	54,2
17	Drážďanská	60,9	63,5	53,9	55,7
18	Podmokelská, Opletalova	60,9	66,3	53,4	59,0
19	Děčínská, Vítězná	60,6	60,9	51,9	52,3
20	Nová	60,3	61,7	53,3	54,4
21	Klíšská	59,3	62,2	52,0	55,3
22	Bělehradská	51,9	63,0	44,5	55,7

4.4 Identified problems

The motorway, as the strongest source of noise emissions on the road network, does not have to have a negative impact on the citizens if it is situated in a proper distance from the residential areas if the noise is properly prevented. (See the chapter 4.7 Organisational & Technical Solutions for Noise Protection)

More problematic are local roads leading directly through the residential areas or in the close distance to them. The traffic is realised partially by the vehicles of residents themselves and its volume is difficult to reduce. More potential appears to be in reducing the transit traffic and the freight traffic.

The noise reducing measures should be realised by technical and organisational solutions, such as speed reduction, implementation of one-way roads, improvements to a road surface etc. (See the chapter 4.7 Organisational & Technical Solutions for Noise Protection)

The local roads in the city centre are concentrated mainly around the transport destinations and points of interest (offices, businesses, institutions, shopping centres, industrial zones etc).

The noise maps developed for day-time and night-time period are attached in the annex, as well as the graphic demonstration of the density of inhabitants in individual city zones. (Please see the list of maps attached in the Annex)

4.5 Noise reducing model solutions for the year 2012

Zero Scenario – The current state of the infrastructure is preserved, no changes towards the noise reduction are made. This scenario serves as a basis for comparison with other options. (Please see Maps 1.1, 2.1, 2.2, 4.1, 5.1, and 5.2, in the Annex attached)

Scenario A – considering implementation of the southeast bypass between the 2nd class road number 261 (Litoměřická) and the 1st class road number 62 (Vodařská). (Please see Maps 4.2, 5.3, 5.4 and 6.1 in the Annex attached)

Scenario B - considering implementation of the southwest bypass between the 2nd class road number 261 (Litoměřická) and Jateční Street. (Please see Maps 4.3, 5.5, 5.6, and 6.2 in the Annex attached)

Scenario C - considering implementation of the northeast bypass between the 2nd class road number 528 (Petrovická) and the 1st class road number 62 (Vodařská). (Please see Maps 4.4, 5.7, 5.8 and 6.3 in the Annex attached)

Scenario D - considering implementation of the northwest bypass between the streets and Jateční and Božtěšická. (Please see Maps 4.5, 5.9, 5.10, 6.4, in the Annex attached)

Scenario E – all the bypasses from previous scenarios are implemented. (Please see Maps 4.6, 5.11, 5.12, and 6.5 in the Annex attached)

Scenario F – considering the decrease of the traffic speed by 10%. (Please see Maps 5.13, 5.14, 6.6 in the Annex attached),

Scenario G - excluding all the freight vehicles with the weight above 3,5 tonnes to determine the roads appropriate for such solution. (Please see Maps 5.15, 5.16 and 6.7 in the Annex attached)

4.6 Results

The study results are presented in various noise emission maps representing different scenarios for the noise reducing measures compared to the Zero scenario. The maps are attached in the annex for day-time and night-time period. (Please see the List of maps attached in Annex) Several sections of the planned bypasses will lead through tunnels and therefore, they will emit less noise emissions than considered in to the survey. Nevertheless, the emissions are in the map calculated for all the sections.

The change of noise emissions for scenario A to D compared to the Zero scenario is in the selected areas very small, generally in tenths of dB. The noise reduction is dependent on the importance of the road and on its location. Several areas are positively influenced in the scenario E.

In scenario F, the reduction of noise emissions is more significant in all areas except the motorway D8.

Maximum decrease is reached in the scenario G, but the freight vehicles cannot be eliminated from all the sections. Furthermore, such elimination can have negative impact on other roads on which the vehicles would be diverted. This solution is rather hypothetic and serves as a source of information to identify the areas suitable for implementation of such measure.

The difference between the Zero scenario and any other scenarios were presented in the maps attached in the annex.

Scenario A:
The most significant improvement in the level of noise emissions appears on the 1st class road number 62. The decrease is about 2 to 5 dB due to the transfer of the traffic to the southeast bypass. In other areas, the decrease is very low, up to 1 dB. (Please see Maps 5.3 and 5.4 in Annex)

Scenario B:
The impact of the southwest bypass on the noise emission level in Ústí is very low, mostly up to 1 dB. (Please see Maps 5.5 and 5.6 in Annex)

Scenario C:
The noise emission level is influenced mainly outside the city on the 3rd class road, where the level is decreased by 10 dB. In the city, the change of the noise level is small, up to 1 dB. (Please see Maps 5.7 and 5.8 in Annex)

Scenario D:
The northwest bypass is quite short with rather local impact on the noise level. It is decreasing the level by 1 to 2 dB on the northwest part of the city, including residential areas. In other areas, the noise emissions are decreased up to 1 Db. (Please see Maps 5.9 and 5.10 in Annex)

Scenario E:
Decrease of noise emissions is particularly evident on the 1st class road number 62 and the 2nd class road 261, where the improvement is about 4 dB. Similar situation is on the streets Nové and Žukov. The noise level is decreased less on the 2nd class road number 613 and the streets Jateční, Klíšská, Štefánikova, Výstupní, Neštěmická and Krčinova. Noise emissions on all the other roads are decreased up to 1 dB. Significant improvement is realised outside the city on the northeast 3rd class roads. (Please see Maps 5.11 and 5.12 in Annex)

Scenario F:
The noise level is decreased on the majority of local roads, but only to a small extent up to 1 dB. More affected are the outskirts and areas outside the city, where the traffic volume is low and even a small improvement has significant impact. The speed reduction by 10% for all roads is not sufficient noise reducing measure. In case the speed limit was applied on selected roads only, diversion of the traffic to more time and speed efficient routes for drivers can bring greater emission reducing effect. (Please see Maps 5.13 and 5.14 in Annex)

Scenario G:
This scenario describes the major potential of reducing the noise level on various roads. Decrease of noise emissions is significant on almost all sections, which is on average over 5 dB. However, an absolute exclusion of vehicles over 3.5 tonnes from the traffic load is purely hypothetical. These vehicles would have to be replaced by other vehicles (under 3.5 tonnes) to ensure goods supply and functions of the city. (Please see Maps, 5.15 and 5.16 in Annex)

All maps of noise emissions for different scenarios for day and night are attached in the annex. The values are presented in the following summary sheet. The differences in emissions are shown compared to the Zero scenario:

Table 3 - The differences in noise emissions for various scenarios compared to the Zero scenario for the year 2012 (day-time)

		Noise emissions in 2012 [dB] – day-time							
Road		**Zero**	**A**	**B**	**C**	**D**	**E**	**F**	**G**
1	Motorway D8	76,1	76,1	76,2	76,1	76	75,8	76,3	71,6
2	Žižkova (2nd class/613)	69,4	69,4	68,7	69,3	69,3	67,8	68,9	63,1
3	Sociální péče	68,3	68,2	68,1	68,3	68,4	68,3	67,5	62,1
4	Všebořická	68,2	68,2	68,2	68,4	68,1	68	67,5	62,1
5	Hrbovická (2nd class /258)	67,9	67,8	67,8	67,8	67,9	67,8	67,2	58,8
6	Přístavní	67,4	63,3	67,6	66,9	67,5	62,7	66,8	60,7
7	Opletalova (1st class/62)	67,3	62,8	67,4	66,5	67,4	61,2	66,6	59,5
8	Majakovského	66,5	66,5	66,7	66,4	66,8	66,9	65,8	61
9	Panská	66,1	66	66,1	65,9	65,9	66,2	65,4	62,3
10	Drážďanská	65,4	64,9	65,3	64,3	65,4	63,8	64,7	59,2
11	Hoření	65,3	65,2	65,1	65,3	65,3	64,9	64,5	59,5
12	Pražská (1st class /30)	65,3	65,4	64,6	65,3	65,3	65,5	64,4	57
13	Výstupní	65	64,5	65	63,7	64,9	63,5	64,3	59,7
14	Masarykova	64,8	64,8	65	65,1	64,7	64,8	64,5	59,6
15	Petrovická (2nd class /538)	64,5	64,5	64,6	64,8	64,6	64,6	63,8	57,6
16	Štěfánikova	64,4	64,4	64,3	64,7	62,8	62,6	63,6	58,8
17	Vítězná (2nd class /261)	64,2	66,5	64,3	64,3	64,3	59,9	63,6	57,7
18	Tovární	64,2	64,2	63,8	63,9	64,1	63,4	63,4	58,4
19	Bělehradská	63,9	63,9	64,2	64	64,3	64,2	63,3	57
20	Klíšská	62,7	62,9	62,8	62,7	61,5	61,6	62	56,5
21	Nová	62,7	62,4	59,7	62,8	62,8	58,7	61,9	56,2
22	Rooseveltova	62,2	62,2	62,3	62,2	62,5	62,4	61,5	57,5

Table 4 - The differences in noise emissions for various scenarios compared to the Zero scenario for the year 2012 (night-time)

		Noise emissions in 2012 [dB] – night-time							
Road		**nulová**	A	B	C	D	E	F	G
1	Motorway D8	**69,8**	69,8	69,9	69,8	69,7	69,5	69,9	65,3
2	Žižkova (2nd class /613)	**60,6**	60,7	59,9	60,5	60,6	59	60,2	54,4
3	Sociální péče	**61**	60,7	60,7	60,8	61	60,9	60,2	54,7
4	Všebořická	**60,9**	60,9	60,8	61	60,7	60,6	60,2	54,7
5	Hrbovická (2nd class /258)	**59**	59	59,1	59	59,1	59,1	58,5	50,1
6	Přístavní	**60,1**	55,7	60,2	59,5	60,2	55,2	59,4	53,4
7	Opletalova (1st class /62)	**60**	55,4	60	59,2	60	53,8	59,3	52,1
8	Majakovského	**57,7**	57,7	58	57,5	58	58,2	57,1	52,3
9	Panská	**58,6**	58,5	58,7	58,5	58,5	58,8	57,9	55
10	Drážďanská	**57,9**	57,4	58	56,8	57,9	56,6	57,3	51,8
11	Hoření	**57,8**	57,8	57,8	57,9	58	57,5	57,2	52,1
12	Pražská (1st class /30)	**58**	58	57,3	58	58	58,1	57	49,7
13	Výstupní	**57,7**	57,4	57,7	56,3	57,5	56,1	56,9	52,3
14	Masarykova	**57,5**	57,5	57,6	57,8	57,2	57,5	57,1	52,2
15	Petrovická (2nd class /538)	**55,6**	55,9	55,9	55,9	55,5	55,6	54,9	48,8
16	Štěfánikova	**57,1**	57,1	56,9	57,3	55,4	55	56,2	51,5
17	Vítězná (2nd class /261)	**55,4**	57,9	55,7	55,3	55,7	50,5	54,7	49
18	Tovární	**56,9**	56,9	56,4	56,4	56,8	56,1	56,1	51,1
19	Bělehradská	**56,4**	56,3	57	56,4	56,8	56,7	55,9	49,7
20	Klíšská	**55,4**	55,4	55,1	55,4	54,3	53,8	54,4	49,1
21	Nová	**55,3**	55	52,4	55,6	55,3	51,6	54,7	48,9
22	Rooseveltova	**54,8**	54,8	55,1	54,8	55,1	55	53,9	50,2

4.7 Organisational & Technical Solutions for Noise Protection

Measures suitable for Ústí nad Labem, which can help to reduce the traffic noise, are following:

Greenery - If there is enough space available, greenery is a suitable noise reducing measure with great acoustic characteristics - three metres wide green belt can reduce noise by a quarter. Furthermore, it improves the aesthetic level of the surroundings. The best type of greenery is a combination of wild trees and bushes growing on grassy areas. To reach the desired effect, at least 20 metres long continuous green belt should be implemented. Smaller area covered by the greenery has rather psychological effect.

Noise walls – Noise walls are suitable only for areas with enough space available. Walls have to be designed to absorb the noise, not only to send it elsewhere. Important is also their appearance, which should be suitable for the particular area. Noise walls, as a spatial barrier, have to be applied carefully with regard to the surroundings.

Speed reduction – Speed reduction should be implemented on properly assessed areas suitable for such measure. On some roads, reducing the speed can have opposite effect, when driving in a lower gear produces more noise. If applying speed reduction, it is essential to ensure the reduction is not only formal, but is realised in practise, which can be achieved by recording vehicles crossing the maximum speed by radars placed on critical areas.

Constructional changes on roads - Reducing the number of driving lanes, narrowing roads, implementing speed bumps and any other traffic calming measure have a positive impact on the level of produced noise. If possible, partial or complete coverings (tunnels) would reduce the noise significantly.

Suitable road surface – The road surface plays a significant role in resulting noise pollutions. To minimize the negative impact, the road surface should be regularly profiled, with high quality solid construction of the road to avoid inequalities, stairs, waves or distortions. Joints and coverings should be placed outside the tyre tracks. Two-layer porous road surfaces (such as surface manufactured from recycled tyres) can reduce noise by up to 12 dB. Degree of noise is determined by the structure of the road and the structure of tyres in contact with the road. Noise preventing road surface can reduce such noise by half up to three quarters compared to the standard asphalt surface. However, the road surface also needs to meet the demands of cost, safety and durability. The required effect of the noise reducing road surface is evident on roads, where the vehicles travel at the speed higher than 50 km / hour. At lower speeds, the engine noise is predominant. Quiet road surface is more expensive, but provides savings where it allows avoiding constructions of noise barriers and insulations for buildings. It should be implemented on all busy roads in close distance to buildings.

Road profile - While designing new roads, noise has to be taken into account. The best solution is to lead the roads in sufficient distance from buildings. When doubling the distance between a road and a building, the noise decreases by 4 dB. Another noise reduction can be achieved by utilizing the natural terrain barriers (elevations, hills, pits, trees, etc.) or artificial barriers. It is also necessary to determine which areas have the highest priority for noise protection and which solutions will cause the lowest noise burden. If an additional source of noise is necessary, it should be ideally placed to already existing noise centres, so the noise controlling measures can be applied all together lowering the costs. Other aspects of the road profile should be considered, such as topography, altitude, position on the ground level or above.

Renewal of the vehicle fleet - It is desirable to renew the fleet of old and noisy vehicles, to lower the level of accepted noise produced by tyres and to increase the use of alternative fuels (hybrid and electric) reducing the noise emissions generated by engines.

Avoiding crossroads where possible - Sudden and repeated breaking and accelerating of vehicles generates significant noise burden. A road without any crossroad enables more fluent traffic and therefore less noise emissions. For elevated crossings, it is necessary to determine which floor level is appropriate for the strongest traffic flows to cause the lowest noise burden. In addition, proper leading of the weakest traffic flow can serve as a noise barrier for the stronger ones.

Noise protection for buildings – Buildings exposed to the traffic noise should be constructed as closed structures alongside the roads. Noise preventing technical solutions should be applied, such as insulation and noise resistant windows.

Traffic-management – Noise from traffic can be limited by reducing the driving speed on roads in close distance to residential areas, especially where the speed limit is higher than 50 km/hour.
If the driving speed is bellow 30 km/hour for personal vehicles and 50 km/hour for fright vehicles, the main source of traffic noise is from the engines. For higher speeds, the noise from tyres and road surface is predominant. Another solution is limiting or banning completely the access to selected city parts during certain periods, for specific types of vehicles or for specific vehicle users and establishing residential zones. However, in areas with restricted access for freight vehicles, the positive impact is lowered by presence of public transport vehicles.

Improving the flow of traffic – The traffic flow can be influenced by telematic systems. Green Wave method limits the time of breaking and iterative acceleration to minimum. Permanent red light signal is suitable for roads with low traffic intensity, where the signal can immediately change after detecting the vehicle. Permanent green light signal should be implemented on busy roads, where there is low traffic intensity on side roads. The green light changes after detecting the vehicle on a side road.

Modifying the transport demand – The aim is to initiate the change of the modal split in favour of non-motorized transport by supporting public transport, which should be cheap, convenient, fast, and have a priority of way in the city traffic. Charged access to the city centre for cars, with parking places implemented conveniently enough outside the city centre would help this solution. Additionally, support for pedestrians and for cycle transport is necessary.

4.8 Conclusions & Recommendations

The target to reduce the noise level in the city exceeding 65 dB is expensive and demands radical measures. Even smaller reduction by 3 dB requires significant decrease of the traffic intensity (about 50 %), which is difficult in an urban environment and must be accompanied by other technical solutions preventing noise.

Significant reduction in the traffic volume can be achieved by building bypasses and transferring the traffic from sensitive zones. Although, such measure can result in only temporary improvement, when the released traffic capacity on roads in the city may cause iterative increase of individual transport and therefore traffic saturation.

Scenarios A – D are solutions considering the construction of bypasses between selected roads. Such measures have only a local effect manifested mainly in the relevant city quadrants decreasing the noise level by 2 – 5 dB. In other parts of the city, the changes are only small. The solution realized by decrease of traffic intensity is inefficient and is not sufficient for significant noise reduction.

In scenario E, the complex system of bypasses results in slight decrease in noise emissions on several areas.

Scenario F shows improvements on all the roads, but is decreasing the noise level only by 1 dB on average. The speed reduction has a potential to reduce noise emissions if implemented in more than 10%.

Results of the scenario G are most visible. The decrease of noise emissions is achieved on almost all the roads in the city by more than 5 dB on average. Exclusion of freight vehicles is an effective measure, but it is necessary to determine on which roads it is appropriate to implement it and what effect this will have on the outside zones.

The foreseen absolute difference in noise emissions in each individual scenario compared to the
Zero scenario for the year 2012 is presented in the following sheet.

Table 5 - The absolute difference in noise emissions for each scenario compared to the Zero scenario for the year 2012

		The absolute difference [dB] – day-time						
Road		A	B	C	D	E	F	G
1	Motorway D8	0	0,1	0	-0,1	-0,3	0,2	-4,5
2	Žižkova (II/613)	0	-0,7	-0,1	-0,1	-1,6	-0,5	-6,3
3	Sociální péče	-0,1	-0,2	0	0,1	0	-0,8	-6,2
4	Všebořická	0	0	0,2	-0,1	-0,2	-0,7	-6,1
5	Hrbovická (II/258)	-0,1	-0,1	-0,1	0	-0,1	-0,7	-9,1
6	Přístavní	-4,1	0,2	-0,5	0,1	-4,7	-0,6	-6,7
7	Opletalova (I/62)	-4,5	0,1	-0,8	0,1	-6,1	-0,7	-7,8
8	Majakovského	0	0,2	-0,1	0,3	0,4	-0,7	-5,5
9	Panská	-0,1	0	-0,2	-0,2	0,1	-0,7	-3,8
10	Drážďanská	-0,5	-0,1	-1,1	0	-1,6	-0,7	-6,2
11	Hoření	-0,1	-0,2	0	0	-0,4	-0,8	-5,8
12	Pražská (I/30)	0,1	-0,7	0	0	0,2	-0,9	-8,3
13	Výstupní	-0,5	0	-1,3	-0,1	-1,5	-0,7	-5,3
14	Masarykova	0	0,2	0,3	-0,1	0	-0,3	-5,2
15	Petrovická (II/538)	0	0,1	0,3	0,1	0,1	-0,7	-6,9
16	Štěfánikova	0	-0,1	0,3	-1,6	-1,8	-0,8	-5,6
17	Vítězná (II/261)	2,3	0,1	0,1	0,1	-4,3	-0,6	-6,5
18	Tovární	0	-0,4	-0,3	-0,1	-0,8	-0,8	-5,8
19	Bělehradská	0	0,3	0,1	0,4	0,3	-0,6	-6,9
20	Klíšská	0,2	0,1	0	-1,2	-1,1	-0,7	-6,2
21	Nová	-0,3	-3	0,1	0,1	-4	-0,8	-6,5
22	Rooseveltova	0	0,1	0	0,3	0,2	-0,7	-4,7

In order to reduce the noise emissions in the city, it is recommended to apply other technical solutions, such as noise barriers, use of innovative materials preventing noise, tunnel solutions, etc. (See the chapter 4.7 Organisational & Technical Solutions for Noise Protection)

The measure should be supported by suitable demand management strategies for individual transport aimed at reducing number of vehicles by shortening the number of parking lots available in the city centre, introducing the paid entrance to the central zones, etc.

5. The List of Maps Attached in the Annex:

1.1 Present state road network in Ústí nad Labem (2009)

2.1 Level of noise emissions on current road network in Ústí nad Labem (2009) – day-time (6 a.m. - 10 p.m.)

2.2 Level of noise emissions on current road network in Ústí nad Labem (2009) – night-time (10 p.m. - 6 a.m.)

3.1 Density of population in Ústí nad Labem region (2005)

3.2 Density of population in Ústí nad Labem region with road network (2009)

4.1 Road network – Zero scenario for the year 2012

4.2 Road network – Scenario A for the year 2012

4.3 Road network – Scenario B for the year 2012

4.4 Road network – Scenario C for the year 2012

4.5 Road network – Scenario D for the year 2012

4.6 Road network – Scenario E for the year 2012

5.1 Traffic noise emissions – Zero scenario for the year 2012 – day-time (6 a.m. - 10 p.m.)

5.2 Traffic noise emissions – Zero scenario for the year 2012 – night-time (10 p.m. - 6 a.m.)

5.3 Traffic noise emissions – Scenario A for the year 2012 – day-time (6 a.m. - 10 p.m.)

5.4 Traffic noise emissions – Scenario A for the year 2012 – night-time (10 p.m. - 6 a.m.)

5.5 Traffic noise emissions – Scenario B for the year 2012 – day-time (6 a.m. - 10 p.m.)

5.6 Traffic noise emissions – Scenario B for the year 2012 – night-time (10 p.m. - 6 a.m.)

5.7 Traffic noise emissions – Scenario C for the year 2012 – day-time (6 a.m. - 10 p.m.)

5.8 Traffic noise emissions – Scenario C for the year 2012 – night-time (10 p.m. - 6 a.m.)