ROYAL HASKONING

HASKONING NEDERLAND B.V. WATER
IHS INSTITUTE FOR HOUSING AND URBAN DEVELOPMENT STUDIES
DELOITTE&TOUCHE CENTRAL EUROPE

# Feasibility Study

## Duboko Solid Waste Management Project

European Agency for Reconstruction (EAR)
European Bank for Reconstruction and Development (EBRD)

05 March 2007

Final Report

9R5927/CvS/R2006_17/R002

Municipal Infrastructure Agency Support Programme
An EU-funded project managed by the European Agency for reconstruction

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**DELOITTE&TOUCHE CENTRAL EUROPE**

Maršala Birjuzova 16/4
11000 Belgrade
Serbia
+381-11-185 999 Telephone
+381-11-185 946 Fax
office@miasp.com E-mail
www.royalhaskoning.com Internet
Arnhem 09122561 CoC

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| | | |
|---|---|---|
| Drafted by | Herrie Heckman<br>Henk Oosterdijk<br>Michel Leushuis<br>Saar Bijman | |
| Checked by | Michel Leushuis | |
| Date/initials check | ……. | ……. |
| Approved by | Cok van Schooten | |
| Date/initials approval | ……. | ……. |

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# EXECUTIVE SUMMARY

## Introduction

This Feasibility Study for the Duboko Solid Waste Management Project was requested by the EAR and the EBRD in July 2006 in order to be enabled to consider the possibility to provide grant funds and/or a loan towards the financing of the Project. The region, consisting of 9 municipalities (Užice, Čajetina, Požega, Čačak, Kosjerić, Lučani, Arilje, Ivanjica and Bajina Bašta), is located in the central/western part of the Republic of Serbia and is one of the strongest industrial areas in the country.

A site for the landfill has been selected nearby Užice (in Duboko) and the PUC Duboko has been established to be in charge of the construction and operation of the regional scheme.

The objective of the project is to improve the standards of service and operational efficiency. The solid waste management scheme has to be in compliance with Serbia's and EU's legal, regulatory and environmental legislation and standards.

The feasibility study supported defining the project and the operational and institutional arrangements required to secure financing. The study supported the full preparation of the project to the level at which financing can be extended for its implementation.

**Scope of the Feasibility Study**

1. A basis for financial project appraisal;
2. A financial and operational performance plan for the PUC Duboko on a commercial basis;
3. A plan for the construction and operation of transfer stations and the new solid waste landfill;
4. Closure plans for the 9 existing landfills;

**Scope of the regional solid waste management project**

1. Transfer stations and recycling lines;
2. Transport from the transfer stations and/or the recycling lines to the landfill;
3. The Duboko landfill;
4. The closure of the 9 existing landfills.

This project is designed for municipal communal waste, and does not include special waste streams such as: abattoir waste, industrial waste, hazardous waste, medical waste, used cars, coal ash, used tyres, construction waste, bulky communal waste and car accumulators.

## Conclusions and Recommendations

General

1. The project was originally designed to serve the municipality of Užice alone. The transformation into a regional project and the later inclusion of Čačak in the project required updates and redesigns.
2. The project is in line with the Serbian legislation and regulation, in particular the National Solid Waste Management Strategy.

3. It is strongly recommended to develop within the coming 12 months a Regional Solid Waste Management Strategy in order to establish a policy framework. This regional SWM plan shall ensure a comprehensive approach of waste management and address the issues as tariff policies, policies for non-municipal waste, collection upstream, recycling, industrial and hazardous waste, etc. This regional strategy has to be supported and ratified by the participating municipalities.

Existing landfills

1. All existing dumpsites can be categorized as K4 "Public deposit sites that do not fulfil any minimal protection measures". The National Waste Management Strategy prescribes ''immediate closure, restoration and re-cultivation.
2. Užice and Čačak have developed plans for the environmentally safe closure of their landfills. This feasibility study gives general guidelines for the closure and re-cultivation of all 9 sites.
3. For the existing landfills in Užice and Čačak extraction of landfill gas is technically suitable. Financial feasibility is only established with additional carbon credit income (N.B. Kyoto protocol not ratified by Serbia).
4. The assessed costs for the closure of the existing sites vary from 100 k€ for the smallest sites to more than 5 M€ for the largest sites.
5. Detailed tailor made closure plans need to be developed for each site;
6. It is recommended to secure financing of the closure and re-cultivation of the sites within this project by a combination of grants, Ecofund and tariff setting. This should be worked out in the Regional Solid Waste Management Plan.

Permits and approvals

1. All required permits and approvals required to start tendering and construction are in place.
2. All of the required land for the landfill has been acquired. Some land acquisition may still be necessary for the planned access road extension.

Landfill Duboko

1. The design of the landfill in general lines follows the national and EU regulations. A number of design adoptions are required to fully comply with the requirements (a.o. soil and ground water protection measures, treatment of the leachate);
2. Landfill gas can be utilized for electricity production within 4 to 5 years after start of operations.
3. Based on the recent calculations of (increasing) waste production, and taking into account future waste separation, recycling and re-use it is concluded that the lifetime of the Duboko landfill is 12-15 years, instead of the originally calculated 20-22 years.

Recycle lines, transport and transfer stations

1. The number of waste separation lines was originally put on 1 (in Duboko only). Based on the actual available recycle equipment in Čačak and taking into account transport costs and efficiency calculations it was considered to increase the number of recycle lines to 2. It is finally recommended that only one separation plant in Duboko should be constructed within the scheme. The waste separation plant in Čačak has been already partly established, and the plans have been devised in order to rehabilitate it and put it in operation. The local PUC Čačak will develop and operate local separation plant, but unlike in other participating municipalities, waste shall be handed over to the PUC Duboko only after waste separation is carried out in Čačak. The PUC Čačak and PUC Duboko could then decide on corresponding

differential tariff effects, i.e. how to compensate the fact that Čačak would carry out waste separation on its own territory. This issue should be subject to negotiations amongst the participating municipalities.

2. It is recommended to adapt the current design of the recycle line into a less complex, reliable and state of the art system.
3. Each municipality (apart from Užice) is allocated a single environmental yard (or simplified transfer station) in order to get all communal waste collected in a particular municipality to that location. In such a way individual PUC's collecting waste in the municipalities would generally carry out waste collection services unchanged – delivering waste to a single location in their municipality and would not incur additional transportation expenses. This alternative was adopted by the municipalities as the preferred option and also accepted by the EAR and EBRD.

SPV Company: PUC Duboko

1. In the municipalities limited management capacity is available to operate the PUC. Active enhancement of these capacities is strongly recommended starting in the implementation phase of the project. It is suggested to attract an expert manager as Advisor to the management of the PUC Duboko (e.g. Dutch PUM-program);
2. The Service Level Agreement (SLA) has to be developed during the project implementation phase and agreed upon by all major players before the system start to operate.
3. Tariffs should be based on an agreed formula based on full costs, including depreciation and debt service, and the approved budget for the coming year.
4. Decision processes should be standardized and the corresponding time limits have to be determined.
5. Municipalities have to guarantee the payments of their individual PUC's to the PUC Duboko in due time.
6. It is recommended to implement a Financial and Operational Performance Enhancement Programme designed to prepare the PUC Duboko for the exploitation of the scheme and to create the proper conditions. The measures shall include as a minimum a policy framework, the SLA, decision making, information systems, outsourcing, organising, the business plan and the concept of regionalisation.
7. Identify the most appropriate legal set-up of a regional PUC considering issues as borrowing, ownership, and corporate decision-making.
8. A total maximum number of approximately 91 staff is foreseen to operate the scheme.

Financial analysis of the SPV, Affordability and Creditworthiness, municipal budgets

1. A 13 year base case scenario financial analysis shows that with the introduction of a tipping fee of CSD 2,350 (€ 21)/ton in 2008, with no further real tipping fee increases, a nominal IRR of 10% can be achieved and a NPV of € 1,094K at a nominal discount rate of 8%. Full cost recovery will have been achieved by the second operational year (2009).The analysis takes into account substantial replacement investments in mobile equipment, and additional landfill capacity.
2. Full unit cost prices per municipality vary widely, as a result of transport distances and forecasted quantities of waste collected.
3. Since Užice municipality transports its waste directly to the Regional Landfill and therefore does not have costs related to transfer station of transportation via long haul vehicle, it's full unit cost price during 2008 is 52% lower than average.
4. The investment in the recycling activity contributes positively to the project (IRR of 20%; NPV of € 2,454K at 8% nominal discount rate).

5. Impact on final domestic consumer tariff is a real increase of almost 108% cumulative for the first 13 years, which however remains well within affordability constraints (max tariff burden achieved in 2008: 0,9% of average household income). The calculated rate is based on the actual production of waste per customer group; i.e. the additional rate is not cross subsidized. Also, it is assumed that the PUC's from the municipalities manage to improve their collection rates.
6. Apart from the years 2013 and 2014 the SPV Company achieves a positive cash flow. It operates profitably from the second operational year (2008) and onwards. Debt service coverage is below 1.3 in the years 2013 (-0.31) and 2014 (0.88), as a result of investment in the extension of the landfill and of substantial replacement investments. However, accumulated cash is sufficient to finance these investments and service the debt.
7. Investment in a Landfill gas to electricity project is financially feasible, even without a carbon credit scheme. Investments can be financed from internally generated funds. The IRR for the 30 year period (2007 – 2036) in case of LFG with carbon credit income is 49%. The IRR for the same period of a LFG scheme without carbon credit income is 23%.
8. Budget projections show that both Čačak and Užice municipality could absorb the EBRD debt service obligations from the EBRD loan from operational surpluses. However, this would consume a large part of the budget surplus of Užice municipality and the municipality would have utilised the maximum affordable loan amount in accordance with national law.
9. Liabilities resulting from a pay-or-deliver contract can be absorbed by both municipalities during the loan repayment period.

Supervision and enforcement

1. It is strongly recommended to prepare Inter-municipal Agreement which defines terms and conditions of arranging communal solid waste services where no other but regional landfill may be used; define penalties, grounds for legal proceedings and authorities of inspection; subsequently amend and harmonize municipal Decisions on Communal Arrangements.
2. Illegal dumpsites emerge mostly in areas with no coverage with solid waste services thus gradual increase in coverage of rural areas is recommended as well as environmental awareness public campaign.

Environmental Impact Assessment

1. The existing 'EIA 2005' has been approved by the Serbian authorities. A number of non compliances with the EAR/EBRD requirements have been identified. Part of the non-compliances has been covered in this Feasibility Study.
2. It is recommended to quantify emissions for both the existing situation and the planned scheme, taking into account the total transport and landfill gas emissions.
3. A full Management plan, a modified Mitigation Plan and a modified Monitoring Plan have to be composed.
4. Alternative sites have been studied in Užice (10) and Čačak (3). Potential sites in other municipalities were not evaluated.
5. Since the start of the project initiative in 1991 the public in Užice has been informed through public consultations, TV interviews, news papers etc. It is nevertheless recommended that a full public consultation process should be prepared and executed according the EAR/EBRD guidelines. The public consultation should cover all components of the project and should be set up within all nine municipalities.

6. To enhance the public acceptance of the Duboko Regional Landfill site, it could be considered to levy a specific tax (eco-tax) in all municipalities of the solid waste management scheme. The proceeds should be used for infrastructural and environmental improvements of the people most affected by the new Land fill.

Investment plan

1. It is recommended to include phase II of the original landfill design in the first short term investment project, because of the expected shorter duration of the landfill.
2. Investments for Phase II, as well as replacement investments in mobile equipment, are proposed to be financed entirely from internally generated funds.
3. The costs for the closure of the existing landfills vary from 100 k€ for the smallest sites to 5 M€ for the largest sites, which adds up to total investment costs of approximately 12,6 M€ and annual monitoring costs of approx. 50 k€ per year for all sites.

**Table ES-1 Overview of investment costs for SWMP Duboko**

| | **Phase 1 (former I and II) in 1000x€** | **Phase 2 (former III, IV and V) in 1000x€** |
|---|---|---|
| Access road | 379 | |
| Landfill Duboko | 4.682 | 2.166 |
| Separation plant in Duboko | 3.048 | |
| Separation plant in Čačak | - | |
| Transfer stations (Čačak, Požega, Ivanjica, Lučani, Arilje, Čajetina, Bajina Bašta, Kosjerić) | 2.150 | |
| Trucks | 690 | |
| Engineering, contingencies (4+7,5%) | 1.259 | 249 |
| TOTAL in 1000x€ (ex. VAT) | 12.209 | 2.415 |
| VAT (18%) not applicable for EAR grant and EBRD loan | - | - |
| **TOTAL in 1000x€** | **12.209** | **2.415** |
| **TOTAL in 1000x€** | **14.624** | |

**Table ES-2 Identified TA elements**

| | |
|---|---|
| Regional Solid waste management strategy. | 200 |
| Master Plan for the closure of 9 abandoned landfills.<br>Site investigations and closure plans of 9 abandoned land fills. | 200 |
| Public Consultation Process. (might be considered as done) | 100 |
| Financial Operation and Performance Enhancement Program (FOPEP) | 300 |

**Table ES-3 Proposed financing scheme Phase I**

| | |
|---|---|
| EAR grant | 3.000 |
| EBRD loan | 5.000 |
| Municipal contribution<br>(including 350 working capital) | 3.059 |
| Ecofund | 1.500 |
| **TOTAL in 1000x€** | **12.559** |

## Risks

1. The acquisition of the remaining land for the access road appears to be unsuccessful. Changes are moderate, but adverse effects are serious because delay in the construction could arise;
2. A guarantee for the loan can not be issued by the municipalities. Without the (EBRD) loan the project is not feasible. Risk that EBRD does not accept a contractual obligation only from the two municipalities (pay or deliver contract).
3. In case the management capacity in the municipalities is not enhanced in a timely manner, the scheme might face insurmountable operational problems;
4. The appearance of uncontrolled waste streams (industrial, mining, agricultural, construction, hazardous, medical, slaughter, bulky, cars, etc) and/or illegal dumping of communal waste will undercut the success and acceptance of the scheme. Collateral policies (a.o. through a regional solid waste management strategy) have to be developed to mitigate these effects.
5. Inadequate tariff policies might endanger the financial position of the PUC Duboko. Close and independent directing and an accepted a regional solid waste management strategy is recommended.

# 1 INTRODUCTION

## 1.1 Preliminary

This document describes the Feasibility Study for the Duboko Solid Waste Management Project, according to both EBRD requirements and MIA/EAR standards for Bankable Project Documentation.

In July 2006 it was concluded that a final design, an EIA and a feasibility study have been prepared. These cover the regional landfill and waste separation line and are exclusive of the impact of the involvement of Čačak on the project, and ***exclusive of the transfer stations***. The design and the feasibility study have been updated by the municipal project team.

## 1.2 The region (Užice, Čajetina, Požega, Čačak, Kosjerić, Lučani, Arilje, Ivanjica and Bajina Bašta)

The region is located in the central/western part of the Republic of Serbia and is one of the strongest industrial areas in the county. Čačak and Užice (the "Cities") have requested assistance from the European Bank for Reconstruction and Development (the "Bank"), the European Agency for Reconstruction (EAR) and the Swedish International Development Agency (SIDA) in the development and financing of a regional sanitary solid waste landfill (the "Project").
Depending on the findings of this Feasibility Study (this report) the EAR will consider the possibility to provide grant funds towards the financing of the Project, whilst the EBRD would contribute through the extension of a loan.
The Project would be the first EBRD's transaction in the solid waste sector in Serbia. Non adequate solid waste treatment presents one of the biggest ecologic problems in Serbia. Aware of these problems, the government of the Republic of Serbia (GoS) adopted the conclusion that formulating a solution to the current state of waste disposal, collection and treatment is a priority within the environmental protection policy in Serbia. Consistently with this conclusion, in 2003 the GoS adopted the National Strategy on Solid Waste Management and defined improved solid waste management as one of the priorities of environmental policy. As it would be the first time that regional solid waste management schemes will be set up in Serbia, in which various Municipalities will co-operate, the program is expected to serve as a demonstration project for other parts of Serbia, where appropriate steps and directions can be learnt and successes replicated.

The Cities have identified a site for the regional sanitary landfill in Duboko and have created a special purpose company (the "SPV", PUC Duboko) to be in charge of the construction and operation of the regional scheme. The regional scheme is designed to serve the whole surrounding region. Čačak and Užice will jointly be majority stakeholders (at least 51%), while the seven other municipalities are to be served by the new landfill (Bajina Basta, Požega, Arilje, Čajetina, Kosjerić, Lučani, Ivanjica). They are expected to participate as minority stakeholders.

It is intended that the SPV will operate the landfill on a commercial basis at arms-length from the existing municipal solid waste collection companies. It has been studied whether the Cities and the SPV would enter into a Deliver-or-Pay undertaking with each of the participating municipalities which would undertake to deliver a guaranteed amount of waste to the landfill or to pay and amount equivalent the tipping fees to the SPV. The tipping fees will be set to provide at least full cost recovery.

There are several landfills existing in the area. The closure of the existing landfills and recultivation and rehabilitation of the area on which it insists are part of the current study. The overall cost for environmental protection of the existing landfills has been clarified under stated later in this document.

## 1.3 Project Development Plan and Technical Assistance

It is envisaged that the Project will be developed and prepared in two phases. The first phase is this Feasibility Study, and the second phase will be subject to the findings and results of the first phase.

- Phase 1: Feasibility study. An assessment of the project has been made, a detailed project structure has been developed and the ToR for the second phase has been prepared. Based on this study the project will be presented to the Cities and the financiers.
- Phase 2: Implementation Support. This will be a separate follow-up assignment and financing for this support will be agreed upon during Phase 1. Technical co-operation required during this phase will likely include preparation of the majority of design work, tender documents and assistance in the tender process.

## 1.4 Objective

The overall objective of this Project is to improve the standards of service, operational efficiency and environmental compliance of solid waste management system in the mentioned region. The feasibility study will help define the Project and the operational and institutional arrangements required to secure financing. In particular, it is intended to fully prepare the project to the level at which financing can be extended for its implementation.

## 1.5 Scope of Work of the Feasibility Study

1. A basis upon which the financiers can appraise and take a decision regarding financing the Project;
2. A plan for the financial and operational performance of the SPV (the “Borrower”) on a commercial basis, including the transport from transfer stations to the landfill;
3. A plan for the construction and operation of transfer stations and the new solid waste landfill in compliance with Serbia’s and EU’s legal, regulatory and environmental legislation; and
4. A plan for the closure of the existing dumpsite located in the City of Užice in compliance with Serbia’s and EU’

# 2 BASELINE STUDY

## 2.1 Introduction

In this chapter the overall legal framework for waste management in the Republic of Serbia has been outlined and assessed. The rights and responsibilities of local, regional and national governments have been defined. A description is given and assessment has been made of the institutional framework in the Cities including: (i) What are the roles and responsibilities of each of the City and State authorities involved in the waste management sector; (ii) How is supervision and enforcement of waste management regulations (in practical terms) carried out in the Cities; and (iii) description of how waste fees are determined and approved (for various generators).

## 2.2 Regulatory Framework

### 2.2.1 Legislative framework

General background
Serbia has launched in 2004 an ambitious programme to modernise its environmental management and harmonise its environmental legislation with EU Directives.

The body of environmental legislation in Serbia consists of a large number of laws and regulations (more than 100). Legislative, executive and judicial powers are mostly practiced through the legally prescribed scope of competencies of the Authorities of the Republic. According to the law, certain competences are delegated to the Autonomous Province and Local Government.

Environmental legislation includes laws and regulations on planning and construction, mining, geological survey, water, soil and forest protection, flora and fauna, national parks, fishery, hunting, waste management, production and trade of chemicals, trade and transport of explosive and hazardous materials, protection of ionizing and non-ionizing radiation, nuclear safety etc. A list of relevant legislation is given in Annex 2.1.

Harmonised legislation
The new legal framework for environmental protection was introduced in 2004 in the Republic of Serbia by:
1. the Law on Environmental Protection;
2. Law on Strategic Environmental Assessment;
3. Law on Environmental Impact Assessment, and
4. Law on Integrated Prevention and Pollution Control.

The most significant issues addressed by the Law on Environmental Protection include:
- main principles of environmental protection;
- management and protection of natural resources;
- measures and conditions of environmental protection;
- environmental programs and plans;
- industrial accidents;
- public participation;
- monitoring and information system;
- clearly identified competences of the Environmental Protection Agency;
- reporting;

- financing of environmental protection;
- inspection services, and
- fines.

This Law also foresaw the creation of Ecological Funds for environmental investments. The new laws are harmonised with the EU Directives on Environmental Impact Assessment (85/337/EEC), Strategic Impact Assessment (2001/43/EC), IPPC (96/61/EC) and Public Participation (2003/35/EC). A number of EU Directives have been prioritised for transposition into Serbian Law. Relevant for Waste Management are the EU Directive on Packaging (2005/20/EC) and the Landfill Directive (1999/31/EC).

Draft Solid Waste Law

The framework for Solid Waste Management (SWM) will be provided by the Solid Waste Law. A modern Law harmonised with the relevant EU Directives has been drafted by the Government and is currently in the latest stages of approval. The specific objectives of this piece of legislation are:

- to ensure compliance with EU Directives;
- to promote efficient implementation of waste legislation;
- to define the responsibilities at three governmental levels, viz. national, regional, and local level;
- to facilitate private sector involvement in this sector.

Important features of this Law are:

*Planning*

The Government is obliged to develop a national strategy in combination with an action plan. Regional Waste Management Plans shall be prepared by two or more Municipalities while local Waste Management Plan shall be developed by a Municipality. The planning horizon of all these plans shall be 10 years with a mid-term review/update.

*Actors*

The Law distinguishes between the Parties that are obliged to set the conditions for SWM and the Parties involved in SWM. The first category included the Republic, the autonomous province, municipality or city, the Agency for Environmental Protection and the authorised professional organisation for waste testing and other organisation in line with the law while the second category comprises Producers, Owners, Waste Transporters as well as the Waste Treatment Facility and Landfill Operators.

*Permitting and public information*

Waste management permits are required for the

- collection;
- transportation;
- storage;
- treatment, and
- disposal of waste.

Permits for activities in the territory of several municipalities are issued by the Ministry. The Operator submits request for permits and the Ministry has to inform the public within 15 days of the receipt of the request.

*Reporting*
Municipalities which have adopted a Regional Waste Management Plan shall report on its realisation every two years to the Ministry. The Ministry submits an annual environmental report to the Parliament.
Producers and owners of waste shall maintain daily records on waste and report every six months to the Agency for Environmental Protection on waste delivered to the solid waste management facility, recyclable materials and waste and other materials transported from the facility. The Agency reports on its turn to the Ministry. The Ministry shall maintain a database on SWM. This database shall contain data on the quality, quantity and type of waste, facilities, storage, treatment and disposal of waste, permits issued for facilities operations and permits for import, export and transit of waste.

*Supervision and inspection*
The Ministry supervises the Agency for Environmental Protection, Municipalities and authorised legal entities. Inspection is carried out by the environmental protection inspectors of the Ministry. The Municipalities are charged with the inspection of collection, transport and temporary storage of non-hazardous waste. Inspectors are authorised to monitor implementation of solid waste plans, permits etc prescribed by this law. Inspectors can order rehabilitation of the dumpsite/landfill after its closure and supervision of it 30 years after the closure. Inspectors can forbid storing, treatment or disposal of waste out of the waste management facility for which the permit was issued.

Communal services
Solid waste is defined as a communal activity (Law on Local Government) which belongs in the realm of the Municipality. The Municipality may create to this purpose either a Public Utility Company (PUC) or entrust the activity to another enterprise. If the establishment of a PUC would not be rational considering the scope of activities and the number of users, the Municipality can delegate these activities to a third party. Delegation of public utility activities is set on a period of up to five years but in case that delegation is combined with the obligation to provide capital, the duration may last as long as the repayment period but not longer than 25 years.

Exploitation and development of public utility activities are financed from the sales of the products and services of the public utility. Other possibilities include compensations for the development and utilisation of construction land, voluntary local taxes, and other legally possible sources (grants and subsidies).

Public utility activities may be organised for two or more municipalities. In this case the municipalities will regulate their internal rights and commitments in a separate agreement.

Public Companies
The set-up of a PUC is regulated in the Law on Public Companies and Activities of Common Interest ("Official Gazette of the RS", no. 25/2000, 25/02, 107/05). The Law deals with the establishment, the internal organisation, and the operation of Public Companies. A Company shall be established by a Founding Act and duly registered with the Court Registry. Company regulations shall be defined in the Statues and any other documents required by Law.

Management is assured by a Manager who reports to the Management Board, which is the highest decision making body in the Company. The Management Board is supervised by a Supervisory Board who monitors the functioning of the Company, in

particular the financial documents such as annual report and proposals for the allocation of profits, and advises the Founders (the Municipality) accordingly.

The Law contains a numbers of provisions In order to protect the general interest in a Public Utility Company. The Municipality, in practice the People's Assembly, must approve the statute (and eventual changes) and major policy issues, i.e. tariffs, disposal of company assets, capital investments, etc, and nominates the Management of the PUC, i.e. Supervisory Board, Management Board, and the Manager.

The Ministry of Finance may send instructions to limit the annual increase in salary mass and tariffs. For 2006 the allowed increase has been set at 9.3%. This obviously is not the case for new activities but the salaries for the newly recruited staff must not exceed the average salary levels for the Municipality. The annual accounts are annually audited by the National Bank of Serbia and submitted to the Ministry of Finance.

### 2.2.2 Policy framework

The National Waste Management Strategy (NWMS), approved in 2004, provides a comprehensive policy framework for the rational and sustainable waste management in the Republic of Serbia. It contains general and sector specific goals and objectives and determines principles of waste management implementation and planning.

Waste is generally classified as controlled and uncontrolled waste. Controlled waste includes domestic, commercial, and industrial waste, including medical waste. All the mentioned waste may be inert, hazardous or not. Uncontrolled waste includes agricultural waste, and waste from mining and quarry industry.

An important element of the Strategy is the waste management policy analysis, which addresses the following issues:

- waste volume development in the Republic of Serbia;
- waste collection and the main problems in this area;
- waste treatment and the lacking capacities in this field;
- current use of disposal sites and the developments in the near future.

The current waste deposit sites (landfills) in Serbia have been classified in the following manner:

**Table 2-1 Classification of Waste Deposits**

| Class | Characteristics |
|---|---|
| **K1** | Big sanitary deposit-sites with complete equipment (draining systems and bottom sealing, systems for filtrate and gas monitoring and control on the site) |
| **K2** | Official disposal sites which may be used during long periods, provided they are reclaimed and reorganized in compliance with EU standards |
| **K3** | Official disposal sites – dumps which may still be used up to 5 years, provided renovation is done with minimal prevention measures |
| **K4** | Public disposal sites – landfills not fulfilling minimal protection measures, completely full, which should be immediately restored, closed and re-cultivated. |

The Strategy aims to close all K4 disposal sites, to allow temporarily K3 sites and to move into full development of the K2 and K1 disposal sites. This implies scale enlargement in waste management as the K1 sites should cater for areas with at least

200,000 inhabitants. It also implies a need for Municipalities to cooperate in this field. It is recognised that disposal sites can only closed down in case of viable alternative.

The Strategy identified regional clusters of different types of environmental infrastructure mainly based on technical and economic criteria:

- a network of **regional landfills**: 29 regional clusters for 160 municipalities;
- a network of **transfer stations**: 44 regional clusters for 63 municipalities;
- a network of **recycling centres**: 17 regional clusters for 160 municipalities;
- a network of **composting centres**: 7 regional clusters for 146 municipalities;
- a network of **incinerators for communal waste**: 4 incinerators for 160 municipalities.

The orientations of the National Waste Management Strategy is again confirmed in the draft National Environmental Strategy (NES) and the corresponding National Environmental Action Plan (NEAP).

The NES describes a coherent comprehensive strategy on Environmental Management and attaches a high priority to waste management. The most relevant elements of the NES which bear on the Duboko Landfill Project (DLP) comprise a.o.

- **Legislative**: harmonisation of national waste legislation with the EU Environmental Acquis;
- **Regulatory**: environmental quality standards, a.o. revision of the technical requirements for sanitary landfill sites following the Landfill Directive 99/31/EC;
- **Economic instruments**: introduction of economic instruments, a.o. apply volumetric waste charges (Polluter Pays Principle), application of full cost recovery and the introduction of a landfill and methane tax;
- **Monitoring**: improvement of monitoring and information systems, a.o monitoring of waste volume, composition, and physic-chemical characteristics;
- **Financing**: ear-mark environmental revenues for environmental investments and channel by preference through the Environmental Protection Fund and harmonise it with other earmarked environmental funds;
- **Institutional**: strengthening of the Environmental Monitoring System, the Environmental Inspectorate, and Environmental Protection Fund. Establishment of Inter-municipal Waste Management Councils;
- **Infrastructure**: extend the existing infrastructure (vehicles and containers) for collection and transportation, build transfer stations to serve the regional landfills, building of regional landfills for at least 50% of the population and controlled.

The NEAP component dealing with Waste Management for the period 2005 – 2009 identifies 12 policy objectives and 58 actions. The policy objectives which are most relevant for the Duboko Landfill Project comprise:

- To harmonise national waste legislation with the EU Environmental Acquis – i.e. packaging;
- To develop integrated waste management plans for all regions following the Waste Framework Directive 75/443/EEC by 2009;
- To extend municipal waste collection to cover 80% of the Serbian population by 2008;
- To establish sanitary landfill in each region by 2014 according to the technical and operational requirements of the Landfill Directive 99/31/EC (10 in the coming 5 years);

- To (safely close and) recultivate dumpsites that pose the greatest environmental risks;
- To increase recovery and recycling of packaging waste (glass, paper, cardboard, metal and plastics) to 25 % of their volume.

### 2.2.3 Institutional Framework

National Level

The Ministry of Science and Environmental Protection – **Directorate for Environmental Protection** (DEP) - has the key responsibility in the field of environmental protection. The Directorate for Environmental Protection (DEP) has a wide range of responsibilities identified in the Law on Ministries (The Official Gazette R Serbia Nr 19/04 and 84/04). This Directorate is a.o. responsible for Waste Management except for radioactive waste and environmental and sustainable development related inspection. The Sector for Inspection comprises three departments; the Inspectorate of Environmental Protection disposes of 45 inspectors and deals with the Inspectorates for Environmental Protection at municipal level. There is no clear separation of responsibilities between these two levels.

The Law on Environmental Protection provides for establishment of the **Environmental Protection Fund**, sets out the sources of financing for the Fund, management of these funds, the supervisory bodies of the Fund etc. The Law provides for setting up environmental funds at the state, provincial and local government levels. The revenues of the Fund include: part of the revenues from nature and resource use, pollution charges, a portion of funds resulting from privatization, funds from multilateral and bilateral international cooperation such as programmes, projects and other activities in the field of environmental protection and energy efficiency, reinvested income and revenues of the Fund, contributions, donations, grants and assistance, and other sources.

**Environmental Protection Fund**

The Environmental Protection Fund was established in accordance with the Law on Environmental Protection in 2005. The Fund is designed to finance the preparation, development and implementation of environmental and energy efficiency projects but may also act as mediator in providing external financing for environmental projects.

The Fund is replenished by earmarked budgetary funds resulting from environmental charges, privatisation funds, and revenues realized from international cooperation, own funds and grants. 40% of the charges imposed on polluters go into the Republican budget while the balance is intended for the budget of the Local Self-Governance Unit. These Units may also introduce environmental charges and establish Environmental Protection Funds at municipal or regional level.

The Fund may grant funds through loans, guarantees and other forms of collateral, subsidies, assistance and donations. The Annual Plan budgets 8.3 M€ investment of which 76% is planned for regional sanitary landfills and 16% for the rehabilitation of existing dumpsites. Applicants will have to follow a public selection procedure.

The Government passed a Decision (352-3744/2005-001 of 7 July 2005) that defined regional landfills and rehabilitation of existing dumpsites as the first priority. It is the intention to provide 70-80% of the total funds in form of grants at the beginning but to

decrease to 50% with an increase of loan components to 30% by 2009.

The Fund already allocated 3 million Dinar for the controlled closure of the existing dumpsite in Užice.

The Public Companies and State Aid Sector of the Treasury Department (Ministry of Finance) monitors the performance of the PUCs. The PUCs are monitored for salary levels and are given instructions on their annual plans.

Investments could be provided through the Ministry of Science of and Environmental Protection and its Environmental Protection Fund, while other Ministries may provide funds for the sectors in which they have line responsibility: the Ministry of Capital Investment for access roads, the Ministry of Agriculture, Forestry and Water Management with their Directorate for Waters for waste waters. In 2006, the Ministry of Finance launched the National Investment Fund that is coordinated by line Ministries and the Ministry of Local Governments with its Municipal Infrastructure Agency in sector of municipal infrastructure.

The Standing Conference on Towns and Municipalities (SCTM) serves as a Professional Association for all municipalities in the country. The members pay an annual fee related to their size and budget. The SCTM acts as a platform for exchange of best practices and advocacy. It has established a Working Group for Solid Waste Management and is currently promoting a manual for the developing Regional Waste Management Plans. Municipal Waste Operators are united in KOMDEL.

Regional level

The role of Government at Regional Level is mainly coordinative and very limited. The NWMS has defined regional clusters for 29 regional landfills and 44 regional transfer stations. Please be noted that these regions are not prescribed but only serve as a guideline for a possible division in suitable regions. The region under consideration for the Duboko scheme differs from the regions identified in the NWMS as well as the formally recognised regions. This will not pose a problem.

Local level

Local Government is assured by the Municipalities. Municipalities are headed by elected Mayors and controlled by an elected Municipal Council. The Municipality is responsible for communal services and usually handles this by one Public Utility Company (PUC), regrouping all the various services concerned. The PUC usually is able to cover its costs of O&M but has to refer to the Municipality for investments. The Council will need to ratify the major decisions of the PUC, most notably tariffs.

### 2.2.4 The roles and responsibilities of Public Administration in Solid Waste Management

Solid Waste Management is a complex field which touches on every economic activity in the country. We will try to characterise in the following section the division of tasks and responsibilities between the different Governmental levels. Public Administration in Serbia focuses on the national and local level but allows certain activities at regional level. The NWMS, however, recognises that solid waste management cannot be solved alone at local level and that regional and in some cases national solutions are required. This realisation will require that more activities have to be carried out at regional level.

Planning
Policy development by its very nature is the prerogative of the National Government. This applies for legislative and regulatory activities. Strategic planning for waste management on the other hand is foreseen at national, regional and local level. The first Regional Waste Management Plans are being approved but this is not the case yet for the project area. Čačak is working at a Local Environmental Action Plan (LEAP) on EAR-financing, which will without doubt address waste. National Authorities play a dominant role in planning as most (environmental) investments are provided by them. Important players in this respect are the National Investment Plan (NIP, implemented by the Municipal Infrastructure Agency –MIA-) and the Environmental Fund (Ecofund, implemented by the Directorate for Environmental Protection).

Operations
Solid waste management is the responsibility of the Municipality which have established PUCs for this purpose. Waste collection and separation of 2ndary raw materials is typically still a governmental activity and no private operators have been signalled in this field yet. Some initiatives of Private Sector Participation are developed but no real experience on the ground is available. Waste collection is mostly concentrated on urban areas and effective. This is not the case for rural areas.

Supervision and enforcement
Supervision of environmental issues and larger polluters is carried out either by the Ministry of Science and Environmental Protection (Environmental Inspection comprising 45 inspectors) or by the environmental inspectors of the Municipalities. No clear-cut division of responsibilities has been defined between these services. The Inspectorates will issue the environmental license and monitor its application. In reality no waste disposal site complies with the environmental regulations but cannot be closed down in absence of a viable alternative. It is the intention of the Directorate of Environmental Protection to close down all irregular waste disposal sites once a sanitary landfill is available in the region. The inspectors subsequently operate reactive and act upon complaints or upon the observed irregularities. The same also applies to industrial and hospital waste.

While environmental inspectors are focused on large polluters, dumpsites and large companies, Municipalities also dispose of communal inspection which supervises hygiene in public space and is focused on small commercial companies, public utility companies and the population. This inspectorate also monitors collection and transportation of solid waste.

The municipalities reported cases of illegal dumping in their territory. The illegal dumpsites emerge where there is no coverage with public solid waste services but also for the reason of poor level of environmental awareness among population. The municipalities take actions to clean and close illegal dumpsites which is financed either from municipal budget or as is the case with Čačak in an EU co-funded project Local Ecological Action Plan (LEAP). Difficulties to close illegal dumpsites are reported in areas with no coverage with solid waste collection. There are no reports of illegal dumping by legal entities. Use of legal instruments such as lawsuits is found to be inappropriate as proofs that specific individuals performed illegal dumping are required by courts.

Scope, method and responsibilities in performing communal activities as well authorities in enforcement and penalties are defined by Municipal Decisions on Communal

Arrangements. These Decisions are in line with national legislation and are legally binding documents in municipalities in which they are endorsed.

## 2.3 Waste Generation and source separation

The main categories of waste are described and an estimate of the current and future quantities is given. A description of the existing experience with waste separation at source (household and business/industries) in the Cities is given as well as the market for extracted materials.

All available and relevant project documents have been studied, in particular:

- Feasibility study, Consortium 'EKOINDUSTRIJA' of April 2006 (update version with the city of Čačak included);
- EIA, Consortium 'EKOINDUSTRIJA', 2005.

Reviewing the available documents we conclude the following (main findings):

- The collected waste is not weighed. Only the collection truck capacity in m3 is counted. As different types of trucks are used, a/o compactors, this results in different specific weights of the collected wastes. The consequence is an amount of tonnage collected waste that is not useable;
- The 2005 waste amounts are based upon the population census of 2002 and specific waste productions of 0.75 kg/person/day in urban areas and 0.3 kg/person/day in rural areas. The specific waste production quantities are not based upon research carried out in the project area;
- The used waste composition is based on waste analysis carried out in the municipality of Užice prior to 2005 (year(s) not known);
- The waste scenarios applied are:
  - The specific waste production in rural area will drop to 0.1 kg/person/day (organic waste will be used, more than today, for cattle feeding. No justification is given);
  - An annual waste quantity growth of 2.0% due to a growth of GDP of 3.0% up to 2010 and 2.0% after 2010;
  - An increase of collection coverage in the villages. For 2005 this is assumed to be 25%, increasing every 5 years with of 25%-point up to 100% in 2025;
- Reduction of disposable waste of 35% (weight) due to the recycle activities in particular planned at Duboko site;
- Very high recycle rates for certain fractions have assumed. This will directly affect the feasibility.

It was noted that the feasibility study (April 2006) used slightly other waste amounts figures, most likely due to more recent information.

As the waste amounts and compositions affect the designs of the technical installations/equipments and the life-time of a landfill cell, and therefore determine the financial/economical impact of the project, it is of importance to work with as accurate data as possible.

Based on questionnaires, prepared by MIASP and filled in by the PUC's of the municipalities and our visits to the PUC's/municipalities we have composed more accurate waste amount and composition figure, as presented hereafter.

By developing scenarios the waste amounts and compositions for the project period are forecasted.

### 2.3.1 The waste amounts and composition

2005 waste data

All municipalities have been requested to provide their 2005 data on waste collection (Table 2-2). Since the collected waste is not weighted, only the cubic meters are (more or less) known (volume of collection truck).

**Table 2-2 2005 waste data (collected waste)**

| Municipality | m3 (2005) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Organic | Plastik | Paper/carton | Metal | Glass | Other | Total | % of total |
| Uzice | 9,240 | 13,274 | 15,763 | 280 | 4,563 | 14,000 | **57,120** | 28% |
| Arilje | 5,906 | 576 | 6,482 | 72 | 72 | 1,296 | **14,404** | 7% |
| Lučani | | | | | | | **4,320** | 2% |
| Kosjerić | 500 | 400 | 500 | 100 | 200 | 300 | **2,000** | 1% |
| Požega | 3,960 | 2,640 | 4,752 | 3,960 | 2,376 | 8,712 | **26,400** | 13% |
| Bajina Bašta | | | | | | | **7,870** | 4% |
| Čajetina | | | | | | | **10,075** | 5% |
| Ivanjica | 2,860 | 715 | 2,145 | 286 | 429 | 7,865 | **14,300** | 7% |
| Čačak | 11,620 | 15,000 | 19,350 | 5,320 | 3,710 | 15,000 | **70,000** | 34% |
| | | | | | | | **206,489** | |

Based on waste analysis in Užice in recent years the following waste composition has been determined (Table 2-3).

**Table 2-3 Waste composition (on weight)**

| Fraction | Waste composition % weight /1 |
|---|---|
| Paper | 15.0% |
| Metal | 2.0% |
| Glass | 6.9% |
| Plastic | 9.8% |
| PET bottles | 1.3% |
| Wood | 6.6% |
| Rubber | 1.6% |
| Textile | 2.5% |
| Biomass | 15.9% |
| Other | 38.6% |
| **Total** | **100.0%** |

/1 source: Table 1.3.3, page 12 FS Ekoindustrija april 2006

The waste composition of Table 2-3 was used in all studies carried out in this project so far (a/o feasibility study and EIA).

The municipality of Užice performed in 2005 again a composition analysis. Three analyses were carried out on 1.1 waste collection containers and also three analyses on 80 l bins. The average composition from this composition analysis is given in Table 2-4.

**Table 2-4 Average waste composition in Užice (2005)**

| | All containers and rubbish bins | | | |
|---|---|---|---|---|
| **Material** | **W(kg)** | ***Share(%)*** | **V($m^3$)** | **Share(%)** |
| **Paper** | 243.5 | *18.02* | 1.650 | *25.25* |
| **Metal** | 20.0 | *1.48* | 0.034 | *0.52* |
| **Glass** | 121.5 | *8.99* | 0.487 | *7.45* |
| **Plastics** | 141.5 | *10.47* | 1.105 | *16.91* |
| **PET bottles** | 18.1 | *1.34* | 0.365 | *5.59* |
| **Wood** | 76.5 | *5.66* | 0.133 | *2.04* |
| **Rubber** | 11.5 | *0.85* | 0.029 | *0.44* |
| **Textile** | 32.5 | *2.40* | 0.135 | *2.07* |
| **Bio-mass** | 248.0 | *18.35* | 1.227 | *18.78* |
| **Other** | 438.3 | *32.43* | 1.370 | *20.96* |
| **Total** | **1351.4** | ***100.0*** | **6.535** | ***100.0*** |

| | | |
|---|---|---|
| **Plastic + PET bottles** | 159.6 | 1.470 |
| **Wood, Rubber, Textile, Others** | 578.8 | 1.701 |

The figures from Table 2-3 and Table 2-4 differ slightly. This might be due to the definition of the category “Others”. The average figures of these tables will be used for the calculation presented in the reporting of this Feasibility Study (Table 2-5).

**Table 2-5 Average waste composition on weight of past and 2005 analysis**

| | Waste composition |
|---|---|
| **Fraction** | **% weight** |
| Paper | 16.49% |
| Metal | 1.71% |
| Glass | 7.92% |
| Plastic | 10.11% |
| PET bottles | 1.31% |
| Wood | 6.14% |
| Rubber | 1.23% |
| Textile | 2.43% |
| Biomass | 17.12% |
| Other | 35.54% |
| **Total** | **100.00%** |

The waste composition of Table 2-5 is in fact based on waste analysis from urban areas. The waste composition in rural areas will differ. In particular much less organics will be present. As the amount of waste produced per capita and the collection rates in rural areas is much lower, the effect on the overall waste composition will be minimal.

Based on the Užice analysis the following specific weights for the different fraction are calculated.

**Table 2-6 Specific weight of waste fraction (from 2005 waste analysis Užice)**

| Spec. weight kg/m$^3$ | |
|---|---|
| 147.6 | Paper |
| 588.2 | Metal |
| 249.5 | Glass |
| 128.1 | Plastics |
| 49.6 | PET bottles |
| 575.2 | Wood |
| 396.6 | Rubber |
| 240.7 | Textile |
| 202.1 | Bio-mass |
| 319.9 | Other |
| **206.8** | **Avrg. Total** |

| | |
|---|---|
| 108.6 | average of plastic + PET |
| 340.3 | Average of Wood, Rubber, Textile, Others |

The average weight of a 1m$^3$ of non-compacted collected waste weighs 207kg. This is lower than used in the studies (250 kg/m$^3$). This difference is explained by the fact that compactor trucks were in use that results in higher specific weights.

Recently more compactor trucks came into use for the collection of the municipal waste. Almost all collected waste in Čačak and Užice was in 2005 collected by compactor trucks. By the PUC of Čačak it is reported that the specific weight of the collected waste in these compactor trucks is 323 kg/m$^3$.

Based on the Čačak information and our international experiences a specific weight of 320 kg/m$^3$ is used in our calculations. This result in the following amounts of waste produced in 2005.

**Table 2-7 Waste amounts in tons per municipality in 2005**

| Municipality | ton 2005 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Paper/carton | Metal | Glass | Plastic | PET Bottles | Wood | Rubber | Textile | Biomass | Other | Total |
| Uzice | 3,014 | 313 | 1,448 | 1,848 | 239 | 1,121 | 225 | 445 | 3,129 | 6,496 | **18,278** |
| Arilje | 760 | 79 | 365 | 466 | 60 | 283 | 57 | 112 | 789 | 1,638 | **4,609** |
| Lučani | 228 | 24 | 109 | 140 | 18 | 85 | 17 | 34 | 237 | 491 | **1,382** |
| Kosjerić | 106 | 11 | 51 | 65 | 8 | 39 | 8 | 16 | 110 | 227 | **640** |
| Požega | 1,393 | 145 | 669 | 854 | 110 | 518 | 104 | 205 | 1,446 | 3,002 | **8,448** |
| Bajina Bašta | 415 | 43 | 199 | 255 | 33 | 155 | 31 | 61 | 431 | 895 | **2,518** |
| Čajetina | 532 | 55 | 255 | 326 | 42 | 198 | 40 | 78 | 552 | 1,146 | **3,224** |
| Ivanjica | 755 | 78 | 362 | 463 | 60 | 281 | 56 | 111 | 783 | 1,626 | **4,576** |
| Čačak | 3,694 | 384 | 1,774 | 2,265 | 293 | 1,374 | 276 | 545 | 3,835 | 7,961 | **22,400** |
| | | | | | | | | | | | **66,076** |

A total of 66.000 ton is collected and dumped in 2005 by the municipalities concerned. This is slightly more than forecasted in the updated feasibility study dated April 2006 (63,000 ton forecasted in 2005, chapter 3, table 5).

Scenarios

The following parameters have impact on the waste amount and composition scenario:

1. Population growth;
2. Economic growth;
3. Increase collection coverage;
4. Waste reduction due to separate collection at source

*1. Population growth*

In the last few years there was a slight decline of the population. Over the period 1991 – 2002 the decline in the municipalities was on average -0.09%. Over the period 1999 - 2004 it was -0.37%. A 0% scenario over the whole project period is applied in our calculations.

*2. Economic growth (GDP)*

The Base Case scenario of EBRD is applied being a growth of 3 – 4% per year (see paragraph 5.7). Based on historic data in Western Europe it is assumed that the waste production increases with the same figures.

*3. Increase in collection coverage*

Based on our investigation the collection coverage differs per municipality as presented in Table 2-8. Based on their targets the following collection coverage scenario is applied.

**Table 2-8 Scenario for collection coverage**

**Scenario for the urban areas**

| Municipality | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Uzice | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Arilje | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Lučani | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Kosjerić | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Požega | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Bajina Bašta | 77% | 80% | 90% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Čajetina | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Ivanjica | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |
| Čačak | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% | 100% |

**Scenario for the rural areas**

| Municipality | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Uzice | 37% | 40% | 50% | 60% | 70% | 80% | 80% | 80% | 80% | 80% | 80% | 80% | 80% | 80% | 80% | 80% | 80% | 80% | 80% | 80% | 80% |
| Arilje | 16% | 16% | 20% | 25% | 30% | 35% | 40% | 45% | 50% | 50% | 50% | 50% | 50% | 50% | 50% | 50% | 50% | 50% | 50% | 50% | 50% |
| Lučani | 6% | 10% | 15% | 20% | 25% | 30% | 35% | 40% | 45% | 50% | 50% | 50% | 50% | 50% | 50% | 50% | 50% | 50% | 50% | 50% | 50% |
| Kosjerić | 14% | 15% | 16% | 17% | 18% | 19% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% | 20% |
| Požega | 8% | 10% | 15% | 20% | 25% | 30% | 35% | 40% | 45% | 50% | 50% | 50% | 50% | 50% | 50% | 50% | 50% | 50% | 50% | 50% | 50% |
| Bajina Bašta | 14% | 15% | 20% | 25% | 30% | 35% | 40% | 45% | 50% | 50% | 50% | 50% | 50% | 50% | 50% | 50% | 50% | 50% | 50% | 50% | 50% |
| Čajetina | 21% | 25% | 30% | 35% | 40% | 40% | 40% | 40% | 40% | 40% | 40% | 40% | 40% | 40% | 40% | 40% | 40% | 40% | 40% | 40% | 40% |
| Ivanjica | 16% | 20% | 25% | 30% | 35% | 40% | 45% | 50% | 50% | 50% | 50% | 50% | 50% | 50% | 50% | 50% | 50% | 50% | 50% | 50% | 50% |
| Čačak | 27% | 30% | 40% | 50% | 60% | 70% | 80% | 80% | 80% | 80% | 80% | 80% | 80% | 80% | 80% | 80% | 80% | 80% | 80% | 80% | 80% |

As around 50% of the collection increase is in the rural areas, an average waste production amount of 0.45 kg/person/day is applied.

*4. Waste separation at source*

In line with the National Waste Management Strategy (2003) it can be expected that the separation at the source will be introduced. At present only the city of Čačak has plans developed for the separate collection of its waste. However implementation lacks so far. We do not expect that separation at source will be developed before 2008.

The following scenarios have been applied for the paper/carton and PET fractions (Table 2-9). No separation at source for the other fractions is assumed.

**Table 2-9 Scenario for separate collection of paper/carton and PET (% is the amount taken out)**

| Scenario for paper/carton | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Municipality** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| Užice | 0% | 0% | 0% | 5% | 10% | 15% | 20% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% |
| Arilje | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Lučani | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Kosjerić | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Požega | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Bajina Bašta | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Čajetina | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Ivanjica | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Čačak | 0% | 0% | 0% | 5% | 10% | 15% | 20% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% |
| | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | |
| **Scenario for PET** | | | | | | | | | | | | | | | | | | | | | |
| **Municipality** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | **2021** | **2022** | **2023** | **2024** | **2025** |
| Užice | 0% | 0% | 0% | 5% | 10% | 15% | 20% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% |
| Arilje | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Lučani | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Kosjerić | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Požega | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Bajina Bašta | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Čajetina | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Ivanjica | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| Čačak | 0% | 0% | 0% | 5% | 10% | 15% | 20% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% | 25% |

Waste prognosis

Based on the scenarios the following waste amounts and composition is predicted (Figure 2-1).

**Figure 2-1 Development of the total amount of collected waste**

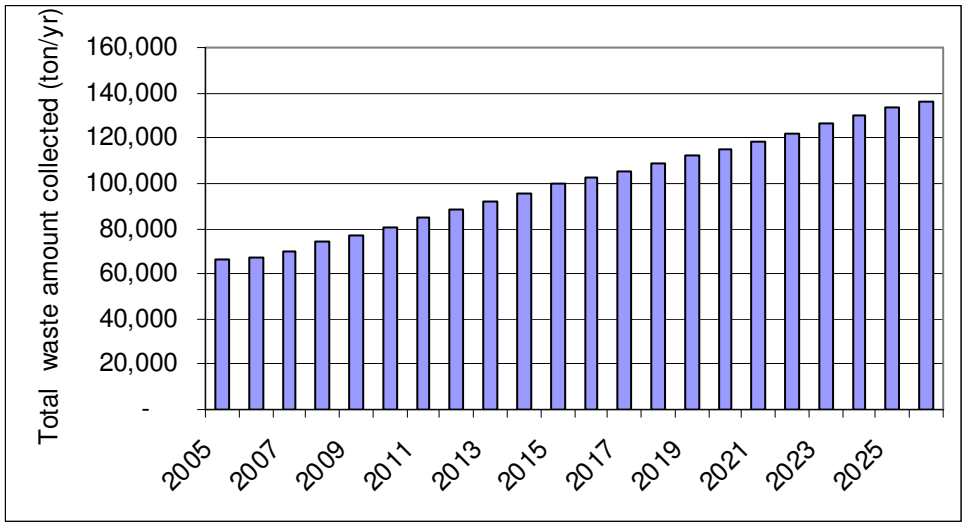
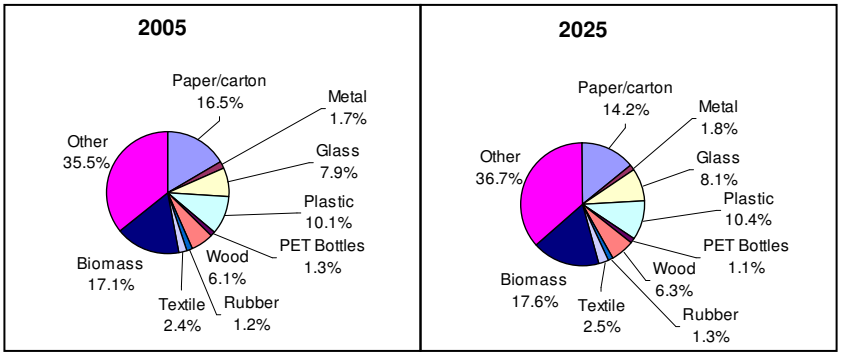


**Figure 2-2 Development of the composition of the collected waste from 2005 to 2025**




The composition will shift due to the separate collection schemes at source coming into force. However the impact is limited.

## 2.4 Recycling.

Čačak is the only municipality that has made thoughts of separate collection and recycling of certain waste streams (PET, paper/carton, ferro). Implementation (apart from pilot) still needs to be worked out. None of the other municipalities have any plans developing separate collection schemes of certain waste fractions at the source except Bajina Bašta that placed a limited number of bins/baskets for PET bottle disposal.

In Čačak recently a pilot project has started. In this project 2 x 2,000 waste bins (coloured green and blue) have been distributed for wet (mainly organic) and dry waste collection. A private firm gets the blue container and takes out PET bottles, carton and metal. The PET and carton is compacted. Revenues are not known.
The waste of the green bin (container) is dumped.

The municipality of Čačak has the intension to provide 50,000 bins (every household two bins, a green and a blue one) to the population by the end of 2011. In 2006 2,600 bins is foreseen to be provided. The investment is paid for by an extra fee of one Dinar per month on the waste collection tariff.

The objective of Čačak is to reduce the amount of waste in order to transport to landfill in Duboko as less as possible (cost reduction) and, in addition, to generate some income from the recycle activities.

## 2.5 Waste Collection and Transportation.

For the collection of waste in the municipalities open and compactor trucks are in use (Table 2-10). The open trucks were and are being replaced by compactor trucks. A/o the EAR has donated compactor trucks to some of the municipalities.

**Table 2-10 Collection vehicles (status 2005)**

| Municipality | Collection Equipment |
|---|---|
| Užice | 3 trucks with portable crane<br>7 waste-collection trucks |

| | |
|---|---|
| Arilje | ? |
| Lučani | 2 collection trucks |
| Kosjerić | 2 trucks (one new) |
| Požega | 4 collection trucks |
| Bajina Bašta | 1 FAP 131<br>1 FAP 1620<br>1 SCANIA ATRIK |
| Čajetina | 1 FAP 16-20, 15 m3 (1988)<br>1 FAP 14-14, 8m3 (1990)<br>1 FAP 14-14, 8m3 (1992)<br>1 FAP 13-14, 8m3 (1983) |
| Ivanjica | 1 Zastava 8 m3<br>1 FAP 15 m3,<br>1 buldozer for container of 5 m3<br>1 tractor |
| Čačak | 6 waste-collection trucks<br>4 trucks with portable crane<br>5 autohaleti<br>1 tractor type 549 |

The collected waste is transported to the local dumpsite were it is dumped. No weighing and/or any registration happen.

## 2.6 Paying for and Financing of Waste Management.

### 2.6.1 Introduction – data collected and used in the Report

In this paragraph the financing of the current waste management system is described and assessed in terms of, inter alia:

- Direct payments (budgeted and actual) made from the Cities, regional entities or national budget (from where to where);
- Payments (billed and actual) made by households;
- Payments (billed and actual) made by industry;
- Others.

This report is based on information that has been collected through:

1. questionnaire designed by MIASP and filled by nine municipal PUCs;
2. on PUC's external documentation (prepared for example for Central Bank and alike);
3. internal management documentation;
4. interviews with PUCs representatives.

All PUCs are performing a number of other activities, next to solid waste management, through which they are providing different communal services. Their revenues and costs are actually a composition of inflows from different sources. None of the PUCs are tracking revenues/costs for each of the separate activities. Because of this, data related to the cost and revenues solely to SWM were based on estimates by the management of the PUC.

This is the reason for some minor inconsistencies that might be observed in some of the related data (for example, data on invoiced revenues from accounting book vs. same data based on internal reports made for managerial purpose).

### 2.6.2 Scope of work of the municipal PUCs

The 9 municipalities are provided with communal solid waste related services by 9 municipal public utility companies (PUCs). The largest municipalities that are leading in the solid waste landfill investment project (Užice and Čačak) have established PUCs in which solid waste activities have a considerable share, while the other 7 municipal PUCs are performing these services together with all other communal services like water supply and sewage, street cleaning and maintaining of open green surfaces (parks), maintaining open-markets and graveyards. The reason for this is that the PUCs from smaller municipalities cannot achieve economies of scale with their number of clients they are serving at the moment, by performing one or just a few types of communal services.

The number of inhabitants per municipality is given in the table below (Municipal statistical yearbook 2005, dated March 2006).

**Table 2-11 Census data**

| Municipality | Population Census data | | | % of total population 2002 |
|---|---|---|---|---|
| | 1991 | 2002 | annual % | |
| Užice | 82.303 | 83.022 | 0,08% | 22,38% |
| Arilje | 20.107 | 19.784 | -0,15% | 5,33% |
| Lučani | 26.946 | 24.614 | -0,82% | 6,63% |
| Kosjerić | 15.236 | 14.001 | -0,77% | 3,77% |
| Požega | 33.289 | 32.293 | -0,28% | 8,70% |
| Bajina Bašta | 29.225 | 29.151 | -0,02% | 7,86% |
| Čajetina | 15.914 | 15.628 | -0,16% | 4,21% |
| Ivanjica | 36.378 | 35.445 | -0,24% | 9,55% |
| Čačak | 115.401 | 117.072 | 0,13% | 31,55% |
| **Total** | **374.799** | **371.010** | **-0,09%** | **100%** |

The revenues obtained through services related to solid waste as well as the financial flows and the share of solid waste related activities in the nine PUCs are presented in the table below.

**Table 2-12 Total PUC revenues and solid waste related revenues in respective PUCs (2005)**

| Municipal PUCs | A: Total revenues, in million CSD | B: SW related revenues* in million CSD | A/B: Share of SW in total revenues |
|---|---|---|---|
| JKP „Bioktos“, Užice | 158.8 | 53.4 | 33.6% |
| JKP „Komunalac“, Čačak | 149.0 | 86.2 | 57.9% |
| JKP „Nas dom“, Požega | 76.0 | 22.8 | 30.0% |
| JKP "12 septembar", Bajina Basta | 55.5 | 11.1 | 20.0% |
| JKP Zelen, "Arilje" | 40.0 | 10.3 | 25.8% |
| JKP "Zlatibor",Čajetina | 91.0 | 15.0 | 16.5% |

| | | | |
|---|---|---|---|
| JKP "Komunalno", Ivanjica | 59.3 | 7.5 | 12.6% |
| JKP „Elan“, Kosijeric | 28.0 | 4.8 | 17.1% |
| JKP „Komunalac“, Lučani | 42.2 | 8.4 | 19.9% |
| **TOTAL** | **699.8** | **219.5** | **31.4%** |
| TOTAL in million euros (1 euro=85 CSD) | 8.2 | 2.6 | 31.4% |

* Invoiced revenues; source: accounting book.

The analysis shows that SW related activities/services of the majority of PUCs are not the most important one within the total “package” of communal services that they are providing to their clients. This should be taken into consideration in the analysis referring to tariffs, collection rates, and PUCs policy related to these issues.

### 2.6.3 Financing of SW activities

The financing of solid waste related activities (collecting and land filling of solid waste) is directly influenced by two general expectations of the PUC’s founders, the local governments:

1. PUCs are expected to provide certain communal services (in this case services related to solid waste), by following basic market principles. The first among these would be to cover all of its costs by charging their consumers for services provided;
2. PUCs are generally expected to provide ALL members of the community (citizens) with those services, regardless of their ability and willingness to pay for it. It could be said that communal services in Serbia are traditionally considered to be public goods.

This ***dualism*** of commercial and public principles in the activities of the PUCs is reflected in their financial position. Generally, the financing of PUCs is arranged in the following way:

1. The operational (including depreciation) costs are covered by charging the customers for services provided;
2. The investments (capital costs) are financed by local budgets.

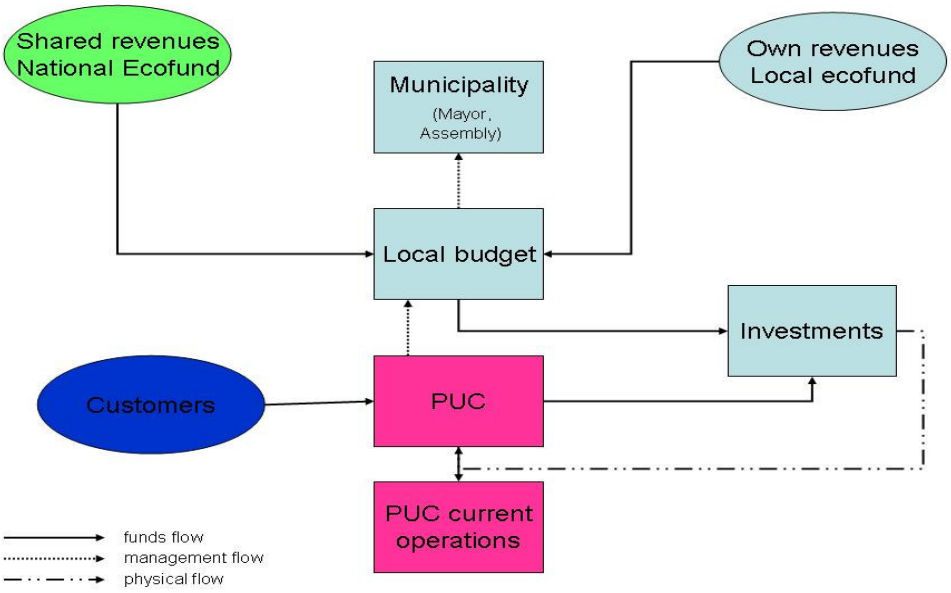
This division is not made explicitly, but it is a result of spontaneous development inherited from the socialism period, and also from the last period (nineties) when due to devastating macro-economic trends (hyper-inflation, dramatic decrease of GDP, bankruptcy of big industries, and alike) the standard of living of citizens dramatically dropped. One of the ways to mitigate this was to provide citizens with basic goods and services; and the communal services were considered as one of them.

It is important to notice that the “commercial” part of the activities, related to performing operational tasks, are not arranged in a manner of real market economy, but in a semi-market, or a controlled-market manner. PUCs are operating as monopolies that are setting the prices of their services at the level of the real costs (i.e. operation & maintenance and capital cost, ***but exclusive the investment costs***). The practice is that at the end of the budget year, PUCs prepare a plan of their activities with all operational costs included. The important fact is that these costs are not tested on real market conditions since there is no other company competing with them, nor by standardized costs elements and indicators (for example, number of employees per service unit, per customer; fuel consumption per unit of distance, etc.).

The prices do not include profit, since the PUCs are not expected to make profit. Consequently, profit & loss statements of all PUCs are usually close to zero.

In the figure below, financial and management flows are presented, which are typical for Serbian PUCs at this moment:

**Figure 2-3 Financial and management flow**




In case planned and actual financial indicators considerably diverge, the management of the PUCs is usually reacting to remedy the situation as follows:

1. If a PUC makes losses the management reacts usually by increasing the prices of its services; currently this option is constrained by the limit imposed by Central Government (currently the limit is set at 9,3%, which was the consumer price inflation projected by the Ministry of Finance for 2006). Increasing of the price within this limit is usually enough to resolve loss-situation; if not, there is an option to increase the prices of the service-like activities that PUC are performing directly for the municipality (like cleaning of the street, maintaining of the green areas, etc.). The final option is to provide operational subsidies to PUCs from the municipal budget. This is generally a very rare situation and municipalities are reluctant to do this;

2. In case the PUC makes a profit, the management reacts by slowing down the increase of the tariffs. Since the Serbian economy is operating during the last several years with a two-digit inflation rate, raising of the communal services prices is usually in accordance with the inflation rate. If avoided or at less than the inflation rate, tariffs actually are decreasing in real terms. Profits are usually directed to investments, such as small replacement of different pieces of equipment or providing PUC contribution in financing of some larger investments.

All investments in communal infrastructure, as well as in PUC assets (equipment, etc.) are normally financed by municipal budget. Regularly, the actual procurement of the investment is done by a specialised municipal department ("Direkcija"), which after procurement hands over the investment to the PUC

It should be stressed that the Duboko landfill investment has a status of top priority within the capital investment programs in the leading municipalities (Čačak and Užice), and are ranked very high in the other seven municipalities. Most of them are facing pressure to close their current municipal landfills due to not meeting the Central Government inspection criteria.

There are separate funds established specifically related to environmental protection, both at central and at local level. At the central level this fund is called "Fund for Environmental Protection", also known as the ''Ecofund". This Fund is established by Law on Environmental Protection from 2005 in which the specific sources of its revenues are defined. These are: the fee that is established for this specific purpose by the same Law; share of the revenues from privatization, other sources like donations. The municipalities have the right to establish the same kind of fund at the local level. Among nine municipalities involved in Duboko project, Čačak and Užice have established this type of fund. The local Ecofunds have two main sources of revenues:

1. Additional local fee introduced on top of the registration fee for motor vehicles; and
2. Specific fee that is included on top of invoices for solid waste services.

### 2.6.4 Tariffs for the solid waste related services

The system of setting the tariffs for providing services related to solid waste is based on the same principle in all PUCs. The tariffs are based on the total surface area (m2) of the premises of the clients to which services are delivered (houses, business premises and institutions). The only exception is the municipality of Bajina Bašta where at the moment tariffs for these services are set as a flat fee for different type of clients[1].

The differences in tariffs for solid waste services between municipalities are considerable: for households they range from 1,5 CSD/m$^2$ to 3,0 CSD/m$^2$; for business premises from 5,88 to 11,0 CSD/m$^2$; and for public sector institutions from 1,96 to 8,5 CSD/m$^2$.

**Table 2-13 Current tariffs for SW Services (september 2006)**

| Municipal PUCs | Prices CSD/m$^2$/month excluding VAT | | |
|---|---|---|---|
| | Households | Businesses | Other (public sector) |
| JKP „Bioktos", Užice | 1,96 | 7,72 | 1,96 |
| JKP „Komunalac", Čačak | 1,96 | 5,88 | 2,35 |
| JKP „Nas dom", Požega | 2,02 | 6,07 | 3,06 |
| JKP Zelen, "Arilje" | 3,00 | 6,50 | 3,00 |
| JKP "Zlatibor",Čajetina | 1,86 | 7,20 | - |
| JKP "Komunalno", Ivanjica | 1,50 | 6,00 | 3,00 |

[1] Bajina Bašta has switched from surface to flat rate in 2002 and the intention of the current Local Government in Bajina Bašta is to return in surface based tariffs in 2007.

| | | | |
|---|---|---|---|
| JKP „Elan“, Kosijeric | 2,28 | 9,00 | 3,36 |
| JKP „Komunalac“, Lučani | 2,87 | 11,00 | 8,05 |
| JKP "12 septembar", B. Bašta* | 190 | 360 | - |
| MAX | 3,00 | 11,00 | 8,05 |
| MIN | 1,50 | 5,88 | 1,96 |

* Flat rate: CSD/per client/per month

An interesting case of charging customers for solid waste related services is the fee introduced by the PUC in Lučani. In addition to standard tariffs related to the client's total dwelling surface, Lučani PUC has introduced an additional flat-fee per containers used. This fee is considerable in relative terms: it represents from 20% to 25% of the total invoiced amount for solid waste services. It is important that through this the PUC is providing additional revenues which is not under communal services price limitations imposed by the Central Government and that in a way has characteristics of fiscal revenues.

### 2.6.5 Revenues invoiced and collected per clients

In the following tables the invoiced revenues from solid waste related activities of the PUCs are presented.

**Table 2-14 Total revenues (invoiced and collected) in 2005 (in CSD)**

| Municipal PUCs | Revenues invoiced* | Collection rate % | Revenues collected |
|---|---|---|---|
| JKP „Bioktos“, Užice | 52,048,000 | 67.9% | 35,328,700 |
| JKP „Komunalac“, Čačak | 85,490,304 | 76.6% | 65,504,768 |
| JKP „Nas dom“, Požega | 22,800,000 | 75.2% | 17,138,050 |
| JKP Zelen, "Arilje" | 10,982,688 | 78.8% | 8,657,622 |
| JKP "Zlatibor",Čajetina | 15,600,775 | 64.4% | 10,049,117 |
| JKP "Komunalno", Ivanjica | 7,528,334 | 64.9% | 4,884,239 |
| JKP „Elan“, Kosijeric | 4,769,044 | 55.7% | 2,655,236 |
| JKP „Komunalac“, Lučani | 8,360,194 | 80.0% | 6,688,155 |
| JKP "12 septembar", B. Basta | 11,022,396 | 64.0% | 7,054,333 |
| **TOTAL** | **218,601,734** | **72.3%** | **157,960,218** |

* Invoiced revenues; source: internal documentations.

**Table 2-15 Revenues from households (invoiced and collected) in 2005 (in CSD)**

| Municipal PUCs | Revenues invoiced | Collection rate % | Revenues collected |
|---|---|---|---|
| JKP „Bioktos“, Užice | 23.277.000 | 60.0% | 13.966.200 |
| JKP „Komunalac“, Čačak | 37.087.000 | 73.0% | 27.073.510 |
| JKP „Nas dom“, Požega | 7.109.000 | 65.0% | 4.620.850 |
| JKP Zelen, "Arilje" | 6.064.992 | 82.0% | 4.973.293 |
| JKP "Zlatibor",Čajetina | 5.441.000 | 57.0% | 3.101.370 |
| JKP "Komunalno", Ivanjica | 4.387.000 | 70.0% | 3.070.900 |
| JKP „Elan“, Kosijeric | 1.805.000 | 50.0% | 902.500 |
| JKP „Komunalac“, Lučani | 5.660.763 | 80.0% | 4.528.610 |

| | | | |
|---|---|---|---|
| JKP "12 septembar", B. Basta | 3.797.795 | 64.0% | 2.430.589 |
| **TOTAL** | **94.629.550** | **68.4%** | **64.667.823** |

**Table 2-16 Revenues from Businesses (invoiced and collected) in 2005 (in CSD)**

| Municipal PUCs | Revenues invoiced | Collection rate % | Revenues collected |
|---|---|---|---|
| JKP „Bioktos“, Užice | 22,657,000 | 70.0% | 15,859,900 |
| JKP „Komunalac“, Čačak | 37,493,091 | 75.0% | 28,119,818 |
| JKP „Nas dom“, Požega | 15,335,000 | 70.0% | 12,268,000 |
| JKP Zelen, "Arilje" | 5,803,044 | 76.0% | 4,410,313 |
| JKP "Zlatibor",Čajetina | 9,638,957 | 69.0% | 6,650,880 |
| JKP "Komunalno", Ivanjica | 3,449,474 | 58.4% | 2,016,137 |
| JKP „Elan“, Kosijeric | 2,725,920 | 56.0% | 1,526,515 |
| JKP „Komunalac“, Lučani | 2,530,161 | 80.0% | 2,024,128 |
| JKP "12 septembar", B. Basta | 6,615,996 | 64.0% | 4,234,237 |
| **TOTAL** | **99,632,646** | **73.1%** | **72,875,692** |

The highest collection rate is achieved within public sector (institutions): 94.4%.

**Table 2-17 Other revenues (institutions) (invoiced and collected) in 2005 (in CSD)**

| Municipal PUCs | Revenues invoiced | Collection rate % | Revenues collected |
|---|---|---|---|
| JKP „Bioktos“, Užice | 6,114,000 | 90.0% | 5,502,600 |
| JKP „Komunalac“, Čačak | 9,234,112 | 98.4% | 9,087,886 |
| JKP „Nas dom“, Požega | 356,000 | 70.0% | 249,200 |
| JKP Zelen, "Arilje" | - | - | - |
| JKP "Zlatibor",Čajetina | - | - | - |
| JKP "Komunalno", Ivanjica | 43,000 | 100.0% | 43,000 |
| JKP „Elan“, Kosijeric | 238,130 | 95.0% | 226,223 |
| JKP „Komunalac“, Lučani | 169,270 | 80.0% | 135,416 |
| JKP "12 septembar", B. Basta | - | - | - |
| **TOTAL** | **16,154,513** | **94.4%** | **15,244,325** |

Except the institutions (the public sector itself) the collection rate for solid waste related services are ***low***, which is common for most of the PUCs in Serbia. There are several reasons for this:

1. *Social issues*: the communal services are traditionally in Serbia considered as a part of the minimum of the citizen living standard, and thus to considered a “public good”. The fact that PUCs are owned by Local Government and majority of their managing boards consists of LG officials, explains a lack of willingness to impose more rigorous measures against citizen who are not paying their invoices for communal services.

2. *Political issues*: increasing the prices for communal services and imposing strict measures to collect them is generally not a popular measure. Since these decisions are within the competency of the Local Government, they might impact their popularity.

3. *Lack of efficient instruments* for imposing *enforcement* in collecting the debts: Serbian law-courts are generally very slow in their work. On the other hand, the debts for unpaid communal services (especially for solid waste) are very small, and very often the taxes for pressing the charges are equal to the whole debts.

4. *Low priority*; solid waste related services are generally a smaller part of the total "package" of communal services that PUCs are providing to the citizens, so usually they do not get a high priority when it comes to collecting the debts. On the other hand, possible losses related to this activity, represent a relatively small fraction of the total revenues and could be relatively easily covered by revenues from other sources.

#### 2.6.6 Organization of the solid waste related services price collection

Most of the PUCs are issuing their invoices for solid waste services through combined invoices for all services they deliver to customers. Separate invoices for the solid waste services are distributed by Užice and Čačak. Užice PUC Bioktos is planning to start combining the invoices for communal services from beginning of 2007.

The invoices are distributed by post or directly by employees of the PUCs (full time or ad hoc engaged by PUC). The citizens are having the option to pay their bills at the PUC premises, or by post and banks.

Generally, PUCs are using similar measures regarding late payments of invoices for communal services, but with different intensity:

1. Most of the PUCs are issuing the invoices monthly and the term for paying them is usually from 10-14 days; the PUC from Čačak has a practice to send quarterly consolidated overview of outstanding debts to their customers. The customers are receiving receipts in advance for all twelve months in the year and they are expected to pay their own invoices in accordance with their debts and their convenience.

2. The practice of sending notice/reminders for the delay in paying the debts is different: most of the PUCs are doing this after one to three months. Čačak is doing this twice a year. All of the PUCs are pressing the charges for overdue debts before passing the year of their issuance. The main reason for this is the provision from the law on obligations that charges need to be pressed within one year of their issuance, otherwise the outstanding amount can not be legally claimed anymore.

3. Because of the high court fees, PUCs are usually pressing charges only for the debts beyond certain thresholds.

Because of the above mentioned reasons, most PUCs do not pursue a proactive policy regarding collection of the unpaid debts for solid waste services. Užice PUC is trying with a more proactive policy (see text box).

Užice PUC (Bioktos) has a practice which is unique among all PUCs. Bioktos is time to time hiring part time collectors of the debts who are visiting customers at their premises. Before that, PUC increases the original debts with an additional 15%. This increase is than granted to the collectors as success fee for collecting the debts. This appears to be

a very effective way: the management of Bioktos is claiming that they are getting one of the highest rates of collecting debts for overdue invoices for their services: This is however not the case yet in 2005, as set out in the table above "Total revenues (invoiced and collected) in 2005".

Since the tariffs are based on the number of square meters of premises used by the clients, accuracy of this data base is crucial for correct invoicing, and at the some time for achieving high collection rates. Some of the PUCs (like Bajina Bašta and Užice) introduced the practice of regular re-measuring the square meters used by customers; they are claiming that they were successful in increase the total revenues with 15-20% based just on this factor.

**Table 2-18 Surfaces used by PUC's clients used for setting the solid waste related tariffs (2005)**

| Municipal PUCs | Households | Businesses | Institutions |
|---|---|---|---|
| | $m^2$ | | |
| JKP „Bioktos", Užice | 1.127.761 | 269.725 | - |
| JKP „Komunalac", Čačak | 1.794.588 | 580.748 | 56.677 |
| JKP „Nas dom", Požega | 293.276 | 99.314 | 9.695 |
| JKP Zelen, "Arilje" | 168.472 | 48.392 | 13.368 |
| JKP "Zlatibor", Čajetina | 290.246 | 121.704 | - |
| JKP "Komunalno", Ivanjica | 224.214 | 27.673 | 1.200 |
| JKP „Elan", Kosijeric | 65.972 | 25.240 | 5.906 |
| JKP „Komunalac", Lučani | 176.678 | 20.651 | 1.888 |
| JKP "12 septembar", B. Basta | - | - | - |
| **TOTAL** | 4.141.207 | 1.193.448 | 88.734 |

Several (2 out of 9) municipalities do not differentiate businesses and institutions (budget beneficiaries) as separate customers.

### 2.6.7 Cost of solid waste and staffing levels

The tables below provide a break down of the 2005 cost of the current solid waste operations and staffing levels of the nine public utility companies in the project area. It should be emphasized that the expenditure data are estimates only, since the companies do not have a cost management system in place, which can track actual expenditure by service.

**Table 2-19 Cost structure solid waste operations 9 PUCs (2005)**

| Cost category | TOTAL | | |
|---|---|---|---|
| | CSD m | € th | % |
| Direct labor | 93,443 | 1,099 | 46% |
| Material cost | 13,173 | 155 | 7% |
| Maintenance | 21,452 | 252 | 11% |
| Depreciation | 12,051 | 142 | 6% |
| Financial costs | 5,714 | 67 | 3% |
| Overhead | 28,399 | 334 | 14% |
| Other | 27,663 | 325 | 14% |
| **Total** | **201,895** | **2,375** | **100%** |

Employee costs make up almost 50% of total costs, while depreciation only accounts for 6% of total cost. This confirms that the collection of solid waste is labour intensive. The low depreciation charge suggests that a large part of the collection fleet is outdated.

A further breakdown of the staff employed is set out in the table below:

**Table 2-20 Staffing levels (2005)**

| Type | TOTAL | |
|---|---|---|
| | Total | SW |
| ***By function:*** | | |
| Management | 73 | 16 |
| Non management | 967 | 270 |
| **total** | **1,040** | **286** |
| | | |
| ***By qualification:*** | | |
| Bachelor's degree | 51 | 7 |
| Associate degree | 43 | 6 |
| High school diploma | 197 | 32 |
| Highly qualified | 28 | 5 |
| Qualified | 259 | 32 |
| Semi qualified | 94 | 36 |
| Non-qualified | 368 | 168 |
| **total** | **1,040** | **286** |

Together, the nine public utility companies employ 1,040 people, out of which 286 (28%) directly related to solid waste collection. There is one management position for 17 employees in solid waste operations, which can be considered a normal ratio.

Table 2-21 provides an analysis of the efficiency of current solid waste operations. Conclusion is that the larger PUCs of Čačak and Užice collect more tons of waste/year per employee than the smaller ones by a wide margin. This is caused by economies of scale.

The average waste collected in the project area per employee is 163/ton/year. This can be considered low. Internationally, a collection efficiency of up to 600/ton/year for each employee is not uncommon. This can however only be achieved by rationalizing the utility and/or scaling up the size of the utilities.

**Table 2-21 Efficiency indicators solid waste operations (2005)**

| Municipality | Number of employees | employees per 1000 people served | m3 waste collected per employee | ton waste collected per employee |
|---|---|---|---|---|
| Uzice | 63 | 0.90 | 905 | 204 |
| Arilje | 23 | 2.59 | 626 | 141 |
| Lučani | 16 | 2.15 | 270 | 61 |
| Kosjerić | 6 | 1.05 | 333 | 75 |
| Požega | 33 | 2.25 | 800 | 180 |
| Bajina Bašta | 12 | 1.18 | 656 | 148 |
| Čajetina | 33 | 4.13 | 303 | 68 |
| Ivanjica | 24 | 1.20 | 607 | 137 |
| Čačak | 76 | 0.89 | 921 | 207 |
| **Total** | **286** | **1.24** | **722** | **163** |

The average 2005 cost of the current solid waste collection system amounts to CSD 3,054/ton, equivalent to € 36/ton. Differences are large between PUCs and vary between € 14/ton to € 97/ton, possibly due to underreporting of overhead costs. However, and not surprisingly, PUCs with the highest number of employees per ton of waste collected also have the highest unit cost.

**Table 2-22 Cost per ton waste collected by PUC (2005, CSD)**

| Municipality | cost of SW collection ('000) | cost per person served | cost per per m3 waste collected | cost per ton waste collected |
|---|---|---|---|---|
| Uzice | 58,911 | 842 | 1,033 | 3,228 |
| Arilje | 5,316 | 598 | 369 | 1,153 |
| Lučani | 11,336 | 1,526 | 2,624 | 8,200 |
| Kosjerić | 5,137 | 901 | 2,569 | 8,027 |
| Požega | 15,541 | 1,059 | 589 | 1,840 |
| Bajina Bašta | 7,192 | 708 | 914 | 2,856 |
| Čajetina | 21,956 | 2,745 | 2,196 | 6,861 |
| Ivanjica | 7,174 | 359 | 493 | 1,540 |
| Čačak | 69,332 | 814 | 990 | 3,095 |
| **Total** | **201,895** | **877** | **977** | **3,054** |

**Table 2-23 Cost per ton waste collected by PUC (2005, € )**

| Municipality | cost of SW collection ('000) | cost per person served | cost per per m3 waste collected | cost per ton waste collected |
|---|---|---|---|---|
| Uzice | 693 | 9.9 | 12.2 | 38.0 |
| Arilje | 63 | 7.0 | 4.3 | 13.6 |
| Lučani | 133 | 17.9 | 30.9 | 96.5 |
| Kosjerić | 60 | 10.6 | 30.2 | 94.4 |
| Požega | 183 | 12.5 | 6.9 | 21.6 |
| Bajina Bašta | 85 | 8.3 | 10.8 | 33.6 |
| Čajetina | 258 | 32.3 | 25.8 | 80.7 |
| Ivanjica | 84 | 4.2 | 5.8 | 18.1 |
| Čačak | 816 | 9.6 | 11.7 | 36.4 |
| **Total** | **2,375** | **10.3** | **11.5** | **35.9** |

## 2.7 Socio-economic considerations

### 2.7.1 Socio-economic structure

**Table 2-24 Geography**

| Indicator | Serbia | Central Serbia | Project area | Uzice | Arilje | Lučani | Kosjerić | Požega | Bajina Bašta | Čajetina | Ivanjica | Čačak |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total area in km2 | 88.361 | 55.968 | 5.300 | 667 | 349 | 454 | 358 | 426 | 673 | 647 | 1.090 | 636 |
| Do, as % of total | 100,0% | 63,3% | 6,0% | 0,8% | 0,4% | 0,5% | 0,4% | 0,5% | 0,8% | 0,7% | 1,2% | 0,7% |
| Agricultural area as % of total | 66% | 59% | 55% | 54% | 58% | 63% | 53% | 61% | 45% | 58% | 47% | 69% |

Source: Municipalities of Serbia 2005, Statistical Office of Republic of Serbia March 2006

Table 2-24 sets out the main indicators of the geography of the project area. The project area is comprised of the municipalities of Užice, Arilje, Lučani, Kosjerić, Požega, Bajina Bašta, Čajetina, Ivanjica and Čačak, bordering Bosnia-Hercegovina in the western part of Serbia. The project area occupies 6% of the total area of Serbia. Agricultural land is with 55% of the total area slightly less than Serbian and Central Serbian share, which is attributable to the mountainous area.

The total population of the project area according to official 2004 estimates is 367,688, almost 5% of Serbia's total population. The project area's annual population growth trend between the census years 2002 and 1991 is slightly negative at -0.09%, in line with the national average for that period (see Table 2-25). However, this trend is negatively accelerating over the period 2004 – 1999. During this period, annual growth of -0.37% is realized, well below the national average of -0.21%. All municipalities in the project area show negative growth during this period. Especially Lučani and Kosjerić municipalities show relatively large decreases of population of over 1% per annum, while Čačak municipality remains more or less the same.

As elsewhere in Serbia but more pronounced, a clear urbanization trend can be noted for the project area. On average, urban settlements grew with an average annual 0.55% during the 1991-2002 period, at the expense of rural area's with -0.71% annual growth.

Čačak municipality is the most densely populated district with 184 persons per km$^2$ and Čajetina the least with 24 persons per km2, as compared to the national average of 84 persons per km$^2$.

**Table 2-25 Demography**

| Indicator | Serbia | Central Serbia | Project area | Uzice | Arilje | Lučani | Kosjerić | Požega | Bajina Bašta | Čajetina | Ivanjica | Čačak |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Population 1991 census | 7.576.837 | 5.606.642 | 374.799 | 82.303 | 20.107 | 26.946 | 15.236 | 33.289 | 29.225 | 15.914 | 36.378 | 115.401 |
| Urban | 4.126.728 | 3.025.802 | 178.946 | 59.795 | 6.025 | 6.126 | 3.754 | 12.423 | 8.436 | 1.668 | 11.012 | 69.707 |
| Other | 3.450.109 | 2.580.840 | 195.853 | 22.508 | 14.082 | 20.820 | 11.482 | 20.866 | 20.789 | 14.246 | 25.366 | 45.694 |
| Population 2002 census | 7.498.001 | 5.466.009 | 371.010 | 83.022 | 19.784 | 24.614 | 14.001 | 32.293 | 29.151 | 15.628 | 35.445 | 117.072 |
| Urban | 4.225.896 | 3.073.601 | 190.001 | 62.162 | 6.744 | 6.319 | 4.116 | 13.206 | 9.543 | 2.344 | 12.350 | 73.217 |
| Other | 3.272.105 | 2.392.408 | 181.009 | 20.860 | 13.040 | 18.295 | 9.885 | 19.087 | 19.608 | 13.284 | 23.095 | 43.855 |
| Annual growth 1991-2002 | -0,10% | -0,23% | -0,09% | 0,08% | -0,15% | -0,82% | -0,77% | -0,28% | -0,02% | -0,16% | -0,24% | 0,13% |
| Urban | 0,22% | 0,14% | 0,55% | 0,35% | 1,03% | 0,28% | 0,84% | 0,56% | 1,13% | 3,14% | 1,05% | 0,45% |
| Other | -0,48% | -0,69% | -0,71% | -0,69% | -0,70% | -1,17% | -1,35% | -0,81% | -0,53% | -0,63% | -0,85% | -0,37% |
| | | | | | | | | | | | | |
| Population estimate 30-6-1999 | 7.540.401 | 5.506.936 | 374.621 | 83.735 | 19.936 | 25.336 | 14.450 | 32.816 | 29.587 | 15.696 | 35.769 | 117.296 |
| Population estimate 30-6-2004 | 7.463.157 | 5.440.900 | 367.688 | 82.417 | 19.690 | 23.937 | 13.584 | 31.716 | 28.776 | 15.577 | 34.876 | 117.115 |
| Annual growth 1999-2004 | -0,21% | -0,24% | -0,37% | -0,32% | -0,25% | -1,13% | -1,23% | -0,68% | -0,55% | -0,15% | -0,50% | -0,03% |
| | | | | | | | | | | | | |
| Population density (2004, in persons/km2) | 84 | 97 | 69 | 124 | 56 | 53 | 38 | 74 | 43 | 24 | 32 | 184 |

Source: Municipalities of Serbia 2005, Population Census 2002, Statistical Office of Republic of Serbia

2004 data show that the number of employed people per 1,000 inhabitants for the project area is 261, slightly below the national average of 275 (see Table 2-26). There are, however, large differences between the various municipalities: Užice, Čačak, Ivanjica and Arilje are at or above national average, while the other municipalities only have 180-220 per 1,000 inhabitants employed. It could thus be expected that the latter municipalities also have higher unemployment rates. However, this is not the case. The highest number of unemployed people per 1,000 inhabitants can be found in Čačak (151), followed by Ivanjica (137) and Užice (123) against a national average of 130; exactly those municipalities which also have the higher share of employed persons. In other words, the total share of employed plus unemployed people active on the labour market is for these municipalities higher. The most likely explanation is that the municipalities with a low share of active people are predominantly agricultural in nature, which is not recorded in the employment statistics. A better proxy to assess the socio-economic situation would then be to look at the number of people officially receiving social benefits. Here we can see marked differences as well: especially in Čačak both the absolute and relative numbers are high (5.773 people receiving social benefits; 49 for each 1,000 inhabitants). Also Kosjerić and Požega have a relatively high share of social benefit receivers (respectively 49 and 40 per 1.000 inhabitants). All other municipalities are below the national average of 29.

**Table 2-26 Employment and unemployment (2004)**

| Indicator | Serbia | Central Serbia | Project area | Uzice | Arilje | Lučani | Kosjerić | Požega | Bajina Bašta | Čajetina | Ivanjica | Čačak |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total employed persons (2004 average) | 2.050.854 | 1.513.708 | 95.872 | 25.511 | 5.150 | 4.529 | 2.495 | 7.028 | 5.177 | 3.559 | 10.683 | 31.740 |
| Do, as % of total population | 27,5% | 27,8% | 26,1% | 31,0% | 26,2% | 18,9% | 18,4% | 22,2% | 18,0% | 22,8% | 30,6% | 27,1% |
| Do, as % of labour force | 67,9% | 69,1% | 67,3% | 71,5% | 70,4% | 65,5% | 65,1% | 66,0% | 62,3% | 73,4% | 69,1% | 64,2% |
| | | | | | | | | | | | | |
| Total unemployed persons (2004 average) | 969.888 | 675.817 | 46.547 | 10.153 | 2.165 | 2.386 | 1.336 | 3.614 | 3.134 | 1.290 | 4.772 | 17.697 |
| Do, as % of total population | 13,0% | 12,4% | 12,7% | 12,3% | 11,0% | 10,0% | 9,8% | 11,4% | 10,9% | 8,3% | 13,7% | 15,1% |
| Do, as % of labour force | 32,1% | 30,9% | 32,7% | 28,5% | 29,6% | 34,5% | 34,9% | 34,0% | 37,7% | 26,6% | 30,9% | 35,8% |
| | | | | | | | | | | | | |
| # of adult persons receiving social welfare | 214.294 | 150.277 | 10.845 | 640 | 348 | 602 | 670 | 1.276 | 366 | 396 | 774 | 5.773 |
| Do, as % of total population | 2,9% | 2,8% | 2,9% | 0,8% | 1,8% | 2,5% | 4,9% | 4,0% | 1,3% | 2,5% | 2,2% | 4,9% |

Source: Municipalities of Serbia 2005, Statistical Office of Republic of Serbia March 2006

When analyzing the employment number by economic sector (Table 2-27), the most striking feature is the size of the manufacturing sector. Almost 35% of total employment is in this sector (national level 25%), with high shares to be found in Ivanjica (49%) and Lučani (53%). This makes the labour market rather dependent on this sector. For example, in Lučani employment is provided by one large plastics/chemical factory (Milan Blagojevic), presently employing approximately 2,000 people and in Ivanjica three large factories provide the bulk of employment (Javor and Ivanjica textile factories and a wood processing factory). Factories in Ivanjica are said to be close to bankruptcy or have recently been privatized and continue on a much lower level of activity.

**Table 2-27 Employment by sector**

| Indicator | Serbia | Central Serbia | Project area | Uzice | Arilje | Lučani | Kosjerić | Požega | Bajina Bašta | Čajetina | Ivanjica | Čačak |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Agriculture. Fisheries & forestry | 70.073 | 27.804 | 1.993 | 187 | 74 | 338 | 55 | 91 | 189 | 165 | 391 | 503 |
| Do, as % of total | 3,4% | 1,8% | 2,1% | 0,7% | 1,4% | 1,0% | 2,2% | 1,3% | 3,7% | 4,6% | 3,7% | 1,6% |
| Manufacturing/processing industry | 515.774 | 379.257 | 33.016 | 8.484 | 1.867 | 2.419 | 903 | 1.770 | 987 | 832 | 5.219 | 10.535 |
| Do, as % of total | 25,1% | 25,1% | 34,4% | 33,3% | 36,3% | 53,4% | 36,2% | 25,2% | 19,1% | 23,4% | 48,9% | 33,2% |
| Energy & other utilities | 46.470 | 37.375 | 2.379 | 541 | 162 | 102 | 90 | 173 | 476 | 127 | 140 | 568 |
| Do, as % of total | 2,3% | 2,5% | 2,5% | 2,1% | 3,1% | 2,3% | 3,6% | 2,5% | 9,2% | 3,6% | 1,3% | 1,8% |
| Construction | 88.274 | 67.896 | 5.252 | 1.990 | 189 | 44 | 129 | 442 | 441 | 46 | 625 | 1.346 |
| Do, as % of total | 4,3% | 4,5% | 5,5% | 7,8% | 3,7% | 1,0% | 5,2% | 6,3% | 8,5% | 1,3% | 5,9% | 4,2% |
| Trade | 208.279 | 161.921 | 8.365 | 2.045 | 187 | 254 | 218 | 368 | 403 | 324 | 670 | 3.896 |
| Do, as % of total | 10,2% | 10,7% | 8,7% | 8,0% | 3,6% | 5,6% | 8,7% | 5,2% | 7,8% | 9,1% | 6,3% | 12,3% |
| Tourism | 27.869 | 23.950 | 2.115 | 518 | 38 | 87 | - | 60 | 234 | 638 | 136 | 404 |
| Do, as % of total | 1,4% | 1,6% | 2,2% | 2,0% | 0,7% | 1,9% | 0,0% | 0,9% | 4,5% | 17,9% | 1,3% | 1,3% |
| Logistics | 119.028 | 91.996 | 5.540 | 2.390 | 160 | 107 | 65 | 404 | 145 | 24 | 496 | 1.749 |
| Do, as % of total | 5,8% | 6,1% | 5,8% | 9,4% | 3,1% | 2,4% | 2,6% | 5,7% | 2,8% | 0,7% | 4,6% | 5,5% |
| Commercial services | 88.276 | 69.788 | 1.889 | 674 | 54 | 47 | 10 | 61 | 57 | 23 | 65 | 898 |
| Do, as % of total | 4,3% | 4,6% | 2,0% | 2,6% | 1,0% | 1,0% | 0,4% | 0,9% | 1,1% | 0,6% | 0,6% | 2,8% |
| Public administration & social sector | 416.097 | 312.671 | 17.054 | 5.425 | 649 | 687 | 376 | 1.155 | 1.176 | 820 | 1.047 | 5.719 |
| Do, as % of total | 20,3% | 20,7% | 17,8% | 21,3% | 12,6% | 15,2% | 15,1% | 16,4% | 22,7% | 23,0% | 9,8% | 18,0% |
| Entrepreneurs & sole proprieters | 470.714 | 341.050 | 18.269 | 3.257 | 1.770 | 444 | 649 | 2.504 | 1.069 | 560 | 1.894 | 6.122 |
| Do, as % of total | 23,0% | 22,5% | 19,1% | 12,8% | 34,4% | 9,8% | 26,0% | 35,6% | 20,6% | 15,7% | 17,7% | 19,3% |
| Total | 2.050.854 | 1.513.708 | 95.872 | 25.511 | 5.150 | 4.529 | 2.495 | 7.028 | 5.177 | 3.559 | 10.683 | 31.740 |
| Do, as % of total | 100% | 100% | 100% | 100% | 100% | 94% | 100% | 100% | 100% | 100% | 100% | 100% |

Source: Municipalities of Serbia 2005, Statistical Office of Republic of Serbia March 2006

The 2004 national income in the project area is 4.0% of Serbia's total national income. Out of this, Čačak realized the biggest national income with 34.8% of the total project area and Čajetina municipality the smallest with 3.7%. On a per capita basis, national income is 82% of the Serbian average. Kosjerić municipality realized a surprisingly high national income per capita: 34% higher than national average and 63% higher than the project area average. This is the result of the large impact of a cement factory on the relatively small base of the municipal economy.

**Table 2-28 National income (2004)**

| Indicator | Serbia | Central Serbia | Project area | Uzice | Arilje | Lučani | Kosjerić | Požega | Bajina Bašta | Čajetina | Ivanjica | Čačak |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| National income (in '000 CSD, nominal) | 887.723.556 | 619.522.288 | 35.737.030 | 8.333.768 | 1.928.694 | 2.004.907 | 2.157.219 | 2.677.541 | 2.234.698 | 1.314.577 | 2.638.175 | 12.447.451 |
| Do, as % of total | 100,0% | 69,8% | 4,0% | 0,9% | 0,2% | 0,2% | 0,2% | 0,3% | 0,3% | 0,1% | 0,3% | 1,4% |
| Do, as % of total project area | | | 100,0% | 23,3% | 5,4% | 5,6% | 6,0% | 7,5% | 6,3% | 3,7% | 7,4% | 34,8% |
| National income per capita | 118.947 | 113.864 | 97.194 | 101.117 | 97.953 | 83.758 | 158.806 | 84.422 | 77.658 | 84.392 | 75.644 | 106.284 |

Source: Municipalities of Serbia 2005, Statistical Office of Republic of Serbia March 2006

The national income by sector data confirm the employment patterns: the manufacturing/processing sector contributes the largest share to the total national income of the project area with 31.2%, as compared to the national share of 25.3%. Next largest sector is agriculture with 21.6% (national share: 14.8%). It can thus be concluded that the project area's economy is dominated by the manufacturing/processing industry, but still has an important agricultural basis.

When looking at individual municipalities, it can be concluded that in terms of national income, the municipalities dominated by the manufacturing/processing sector are Užice and Kosjerić. Arilje, Lučani and Ivanjica are dominated by the agricultural sector, while Čačak has a more diversified local economy, with an important contribution by the trading sector with 27.5%. Čajetina municipality has an important contribution by the tourism sector and related construction industry, as a result of the fast development of the resort/ski area Zlatibor. Finally, Bajina Bašta's largest sector is energy/utilities, caused by the large hydropower plant "Bajina Bašta".

**Table 2-29 National income by sector (2004)**

| Indicator | Serbia | Central Serbia | Project area | Uzice | Arilje | Lučani | Kosjerić | Požega | Bajina Bašta | Čajetina | Ivanjica | Čačak |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Agriculture. Fisheries & forestry | 153.909.290 | 91.548.270 | 7.706.014 | 749.097 | 860.755 | 955.784 | 457.189 | 668.776 | 560.308 | 256.963 | 885.972 | 2.311.170 |
| Do, as % of total | 17,3% | 14,8% | 21,6% | 9,0% | 44,6% | 47,7% | 21,2% | 25,0% | 25,1% | 19,5% | 33,6% | 18,6% |
| Manufacturing/processing industry | 259.152.928 | 156.648.645 | 11.152.926 | 3.171.886 | 613.126 | 559.819 | 1.316.641 | 879.533 | 228.357 | 219.971 | 677.829 | 3.485.764 |
| Do, as % of total | 29,2% | 25,3% | 31,2% | 38,1% | 31,8% | 27,9% | 61,0% | 32,8% | 10,2% | 16,7% | 25,7% | 28,0% |
| Energy & other utilities | 43.053.993 | 33.248.105 | 2.378.786 | 467.928 | (83.372) | 43.981 | 12.252 | 317.419 | 808.271 | 14.528 | 102.312 | 695.467 |
| Do, as % of total | 4,8% | 5,4% | 6,7% | 5,6% | -4,3% | 2,2% | 0,6% | 11,9% | 36,2% | 1,1% | 3,9% | 5,6% |
| Construction | 62.426.798 | 50.433.602 | 2.242.380 | 592.071 | 106.786 | 35.829 | 73.130 | 188.841 | 205.270 | 142.027 | 247.785 | 650.641 |
| Do, as % of total | 7,0% | 8,1% | 6,3% | 7,1% | 5,5% | 1,8% | 3,4% | 7,1% | 9,2% | 10,8% | 9,4% | 5,2% |
| Trade | 219.635.212 | 168.559.427 | 6.934.161 | 1.708.568 | 187.884 | 249.884 | 175.006 | 315.012 | 242.658 | 305.650 | 320.390 | 3.429.109 |
| Do, as % of total | 24,7% | 27,2% | 19,4% | 20,5% | 9,7% | 12,5% | 8,1% | 11,8% | 10,9% | 23,3% | 12,1% | 27,5% |
| Tourism | 16.709.320 | 13.136.140 | 883.378 | 243.661 | 33.205 | 35.766 | 17.531 | 39.954 | 42.572 | 240.840 | 56.400 | 173.449 |
| Do, as % of total | 1,9% | 2,1% | 2,5% | 2,9% | 1,7% | 1,8% | 0,8% | 1,5% | 1,9% | 18,3% | 2,1% | 1,4% |
| Logistics | 91.612.237 | 73.110.860 | 3.526.739 | 1.122.289 | 98.051 | 84.312 | 87.971 | 227.210 | 123.909 | 103.720 | 321.116 | 1.358.161 |
| Do, as % of total | 10,3% | 11,8% | 9,9% | 13,5% | 5,1% | 4,2% | 4,1% | 8,5% | 5,5% | 7,9% | 12,2% | 10,9% |
| Commercial services | 38.068.609 | 30.210.576 | 832.716 | 255.620 | 111.610 | 34.008 | 12.838 | 23.843 | 18.336 | 29.452 | 17.524 | 329.485 |
| Do, as % of total | 4,3% | 4,9% | 2,3% | 3,1% | 5,8% | 1,7% | 0,6% | 0,9% | 0,8% | 2,2% | 0,7% | 2,6% |
| Public administration & social sector | 3.455.169 | 1.266.663 | 79.930 | 22.648 | 649 | 5.524 | 4.661 | 16.953 | 5.017 | 1.426 | 8.847 | 14.205 |
| Do, as % of total | 0,4% | 0,2% | 0,2% | 0,3% | 0,0% | 0,3% | 0,2% | 0,6% | 0,2% | 0,1% | 0,3% | 0,1% |
| Total | 888.023.556 | 618.162.288 | 35.737.030 | 8.333.768 | 1.928.694 | 2.004.907 | 2.157.219 | 2.677.541 | 2.234.698 | 1.314.577 | 2.638.175 | 12.447.451 |
| Do, as % of total | 100,0% | 99,8% | 100,0% | 100,0% | 100,0% | 100,0% | 100,0% | 100,0% | 100,0% | 100,0% | 100,0% | 100,0% |

Source: Municipalities of Serbia 2005, Statistical Office of Republic of Serbia March 2006

Finally, the table below sets out the gross and net salaries earned in the project area. The average nominal salaries over the period January to October 2006 grew with 28% in comparison with the period January to October 2005. This growth is slightly higher than the national average growth rate of 24%. Still, the gross and net average salaries of the project area are 82% of the national average during the period January to October 2006.

There are some marked differences between the nine municipalities. Salaries in Kosjerić are 30% higher than the national average, likely because of the impact of the cement factory. Užice is at the national average, while Čačak, Arilje, Lučani, Požega, Bajina Bašta and Čajetina have average salaries at around 80% of the national average. Salaries in Ivanjica are much lower than the other municipalities at 46% of the national average, although a strong increase of 55% was realized compared to the period January – October 2005. The low average salaries are caused by the impact of the ongoing restructuring of the industrial sector in this municipality.

**Table 2-30 Nominal salaries**

| Indicator | Serbia | Central Serbia | Project area | Uzice | Arilje | Lučani | Kosjerić | Požega | Bajina Bašta | Čajetina | Ivanjica | Čačak |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Jan - Oct 2005 | | | | | | | | | | | | |
| Gross salaries | 24.687 | 24.363 | 19.757 | 24.214 | 21.145 | 16.187 | 31.139 | 20.671 | 18.865 | 20.627 | 9.104 | 18.995 |
| Nett salaries | 16.877 | 16.650 | 13.494 | 16.570 | 14.278 | 11.096 | 21.326 | 14.149 | 12.860 | 14.067 | 6.153 | 12.988 |
| Jan - Oct 2006 | | | | | | | | | | | | |
| Gross salaries | 30.612 | 30.376 | 25.240 | 29.645 | 25.088 | 23.723 | 40.387 | 24.993 | 24.492 | 24.536 | 14.139 | 24.743 |
| Nett salaries | 20.932 | 20.786 | 17.246 | 20.306 | 16.788 | 16.207 | 27.640 | 17.344 | 16.664 | 16.726 | 9.609 | 16.893 |
| Growth rate | | | | | | | | | | | | |
| Gross salaries | 24% | 25% | 28% | 22% | 19% | 47% | 30% | 21% | 30% | 19% | 55% | 30% |
| Nett salaries | 24% | 25% | 28% | 23% | 18% | 46% | 30% | 23% | 30% | 19% | 56% | 30% |

Source: Communication no. 295, Statistical Office of Republic of Serbia, 20 November 2006

### 2.7.2 Maximum affordability waste tariffs

Surprisingly little is published about the maximum affordable level of the waste tariffs, in contrast to water & waste water tariffs. For the purposes of this report, we use a maximum affordable level of 1.5% of average household income/expenditure, a figure which is used in assessing maximum affordability of a number of EU-ISPA financed waste management projects in Romania. This maximum affordable level is low in comparison to other utility charges, like electricity, (district) heating and water and waste water. A recent study sets the maximum affordability of all utility services combined at 25% of average household income/expenditure with the following break down per service:

- Electricity: 10 percent of household expenditures;
- Heating: 10 percent of household expenditures;
- Water and waste water: 5 percent of household expenditures

Table 2-31 summarises affordability levels used by various institutes or governments. Note that waste bill are not included in the calculation.

**Table 2-31 Benchmarks maximum affordability utility services**

| Source | Electricity | Heating | Water | All utility bills |
|---|---|---|---|---|
| Wold Bank (2002) | 10-15 | | 3-5 | |
| WHO (2004) | 10 | | | |
| IPA Energy (2003) | 10 | 20 | | |
| UN/ECE | | 15 | | |
| UK government | | 10 | 3 | |
| US government | | 6 | 2.5 | |
| Asian Development Bank | | | 5 | |
| Ukraine government | | | | 20 |

Source: Can poor consumers pay for energy and water? Samuel Frankhauser, Tatjana Tepic (2005)

To assess the maximum affordable level of the waste tariff in the project area an estimate of the average household income is required. Since 2003, the Statistical office of the Republic of Serbia publishes data on household income and expenditure, based on a survey of more than 4,000 households. The latest available data refer to the second quarter of 2006. For this study however, data for the full year of 2005 will be used, instead of extrapolating 2006 data.

The household survey shows that total average monthly household income for Serbia during the year 2005 was CSD 26,952 (€ 317) with expenditure slightly higher at CSD 27,915 (€ 328). These data are further broken down in Central Serbia without Belgrade, Belgrade and Vojvodina, with the following results:

**Table 2-32 Household income and expenditure in Serbia (2005)**

| Description | Republic of Serbia | Central Serbia | | | Vojvodina |
|---|---|---|---|---|---|
| | | Total | Excluding Belgrade | Belgrade | |
| **Income** | 26,952 | 27,343 | 24,924 | 33,091 | 25,913 |
| **Expenditure** | 27,915 | 28,951 | 26,321 | 34,555 | 25,159 |

Largest component of income consists of salaries and wages (50%), followed by cash transfers from government organisations (state pensions, social welfare) with 27%. Expenditures are dominated by food & non-alcoholic beverages with 37%, with the next largest item spent on dwelling and utility services (17%). The latter can be compared with the maximum 25% affordability level for utility services, although it includes expenditure on housing like rent and interest.

Unfortunately, no further breakdown of these data is available for municipalities, nor are data available showing income distribution patterns. There is however a breakdown between urban and rural population available, which shows that rural population income

is 89% and urban 108% of average total income. This would indicate that income distribution is not very skewed, assuming that the rural population would have relatively more people with lower income than urban population.

Since the project area is situated in the Central Serbia, this study therefore adopts the data on household income for Central Serbia excluding Belgrade. Furthermore, to be on the safe side, the lower of either income or expenditure is used, although it is acknowledged that actual expenditure data will likely be the best proxy for total available income, since people in general are reluctant/underestimate their real sources of income. Therefore, average monthly household income in the project area is assumed to be CSD 24,924 (€ 293).

To arrive at 2006 figures and later years, the income data are escalated with inflation and real wage increases, following the base case macro-scenario in the financial model (see chapter 5). For 2006, the inflation is estimated to be 13% and the real wage increase 3%. Average 2006 income would then be CSD 29,009 (€ 318). The Q2 2006 household budget survey found an average monthly income for Central Serbia excluding Belgrade of CSD 30,760 during the period April to June 2006, so the estimate appears to be reasonable and even a bit on the low side. The latest salaries & wages data available for Central Serbia (with Belgrade) show a nominal increase of 25% for the period January to October 2006 compared to the period January to October 2005. When applying this increase, a 2006 monthly household of CSD 31,155 can be calculated. Again, this confirms that the methodology is reasonable and even rather conservative.

The next step is to calculate the maximum affordable tariff. Using the 1.5% threshold, the maximum solid waste tariff can be estimated at **CSD 374 for 2005** and **CSD 435 for 2006**.

2005 actual household expenditure on waste services is estimated at CSD 113 (including VAT), or 0.5% of monthly household income, as set out in Table 2-33. This would leave substantial room for tariff adjustments, although there are differences per municipality: affordability levels range between 0.3% and 0.8%. In addition, one should remember that this is an average indicator and does not necessarily reflect the affordability of waste tariffs to low income groups. On the other hand, tariffs are paid per $m^2$ floor space and not by the number of occupants or actual waste produced. Assuming that low income households would live in smaller than average dwellings, their actual solid waste bill would be lower than average and thus increasing the affordability of tariffs. Field checks indicate that non payment of solid waste bills is more related to poor enforcement than to affordability constraints. More than once it was stated that the most regular payers are pensioners, who would normally be considered to belong to the most vulnerable groups.

**Table 2-33 2005 tariffs and affordability**

| Municipality | Average tariff per m2 /1 | total invoiced per month /1 | Served households | | | avg tariff per household | Monthly HH income /4 | Tariff as % of HH income |
|---|---|---|---|---|---|---|---|---|
| | | | users | avg size HH/3 | number of HH | | | |
| Uzice | 1,86 | 2.094.930 | 70.000 | 3,05 | 22.951 | 91 | 24.924 | 0,4% |
| Arilje | 3,24 | 545.849 | 8.895 | 3,12 | 2.851 | 191 | 24.924 | 0,8% |
| Lučani | 2,88 | 509.469 | 7.430 | 2,97 | 2.502 | 204 | 24.924 | 0,8% |
| Kosjerić | 2,46 | 162.450 | 5.700 | 3,05 | 1.869 | 87 | 24.924 | 0,3% |
| Požega | 2,00 | 639.810 | 14.680 | 3,18 | 4.616 | 139 | 24.924 | 0,6% |
| Bajina Bašta /2 | 152 | 341.802 | 10.160 | 3,05 | 3.331 | 103 | 24.924 | 0,4% |
| Čajetina | 1,84 | 489.690 | 8.000 | 3,05 | 2.623 | 187 | 24.924 | 0,7% |
| Ivanjica | 1,62 | 394.830 | 20.000 | 3,24 | 6.173 | 64 | 24.924 | 0,3% |
| Čačak | 1,94 | 3.337.830 | 85.217 | 2,97 | 28.693 | 116 | 24.924 | 0,5% |
| **Total** | | **8.516.660** | **230.082** | **3,04** | **75.608** | **113** | **24.924** | **0,5%** |

/1 including 8% VAT
/2 flat tariff per month (average)
/3 population census 2002
/4 household budget survey 2005

For 2006, tariff increases were restricted by the National Authorities to maximum 9.3% of December 2005 tariffs. Almost all utilities have thus increased their tariffs with this maximum percentage, so that the average 2006 solid waste tariff is estimated at CSD 124/month. Because household income is growing much faster than 9.3%, average share of 2006 solid waste tariffs in household income drops to 0.4% in the project area.

## 2.8 Current Quality and Efficiency of Waste Management in the Cities.

Based on the questionnaires filled in by the nine public utility companies of the Duboko waste management scheme, it is estimated that currently almost 100% of the urban and about 19% of the rural population is served with solid waste collection services. The service in the urban areas appears to be of a satisfactory standard, although cost data suggest that the solid waste collection fleet is outdated. However, this situation is not stagnant, as during the last few years almost al municipalities have invested in replacement of some of their solid waste collection vehicles.

The efficiency in providing solid waste service varies widely per utility company. The larger utilities are more efficient in terms of tons of waste collected per employee with slightly more than 200 ton of waste collected per employee per year against an average of 163/ton/employee/year for the project area. The smaller utilities suffer from the small scale of their operations which immediately translates into a lower efficiency as measured above. Compared to international standards, where up to 600 tons of collected waste per employee per year is reported, the utilities in the Duboko area have quite some potential to improve.

The 2005 total cost of solid waste collection is estimated at € 36/ton. Again, there are large differences between the individual companies. In general, the smaller utilities have a higher unit cost than the larger ones. A World Bank study [2] estimates the collection cost of solid waste for middle income countries at between $ 30 to $ 70/ton, equivalent to € 25 to € 55/ton. The estimated cost of the project area falls within this range.

Environmental compliance is enforced by both the National Environmental Inspectorate (45 inspectors) and local environmental inspectors. In practice, these bodies mostly act reactively on environmental issues, acting for example upon citizen's complaints. All dumpsites in the Duboko area can be classified as K4 and need to be closed. In practice, however, this is not being done since an alternative is lacking.

[2] Tools for preparing for private sector participation, Sandra Cointreau-Levine (1999)

There is evidence of fly tipping in the Duboko area, especially in rural areas, which are not served by the solid waste utility companies. Enforcement of the environmental law is difficult in these cases, since the courts require sound proof. There are no financial incentives for consumers to dump waste in non designated areas since the solid waste collection fee is determined by the surface area of dwellings. This fee will have to be paid, whether or not solid waste is actually collected.

# 3 GUIDELINES AND CONDITIONS OF LAND FILL CLOSURE

## 3.1 Introduction

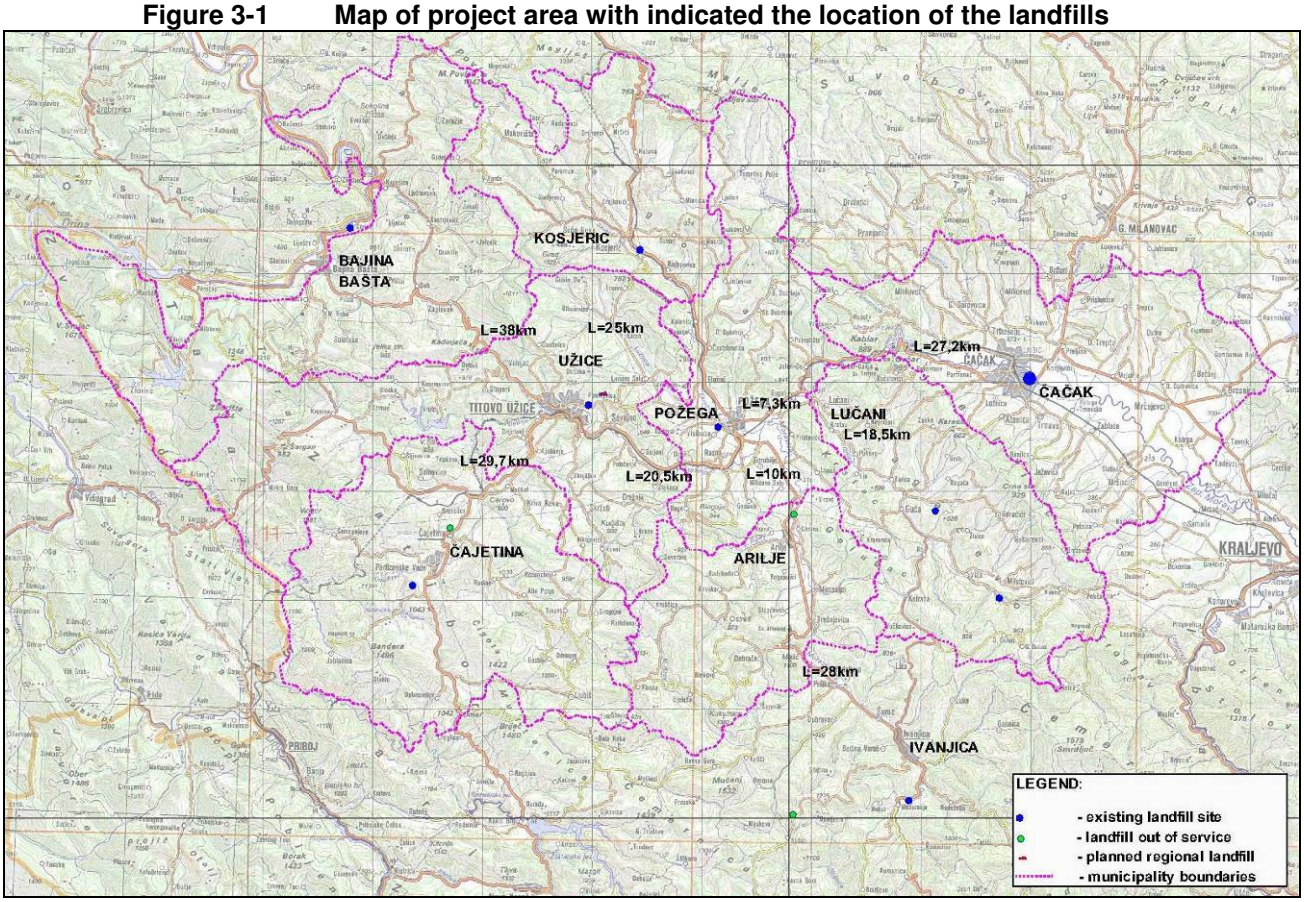
As the municipalities of Užice, Čačak, Bajina Bašta, Čajetina, Arilje, Kosjerić, Lučani, Ivanjica and Požega have agreed in erecting a regional sanitary land fill at Duboko, near the city of Užice, their present landfills (dumps) will be put out of operation. Guidelines and conditions for the environmental sound closure of these landfills have been prepared for application by the municipalities.

The guidelines and conditions underlining the steps and related costs necessary to undertake the following tasks have been prepared in order to:

1. minimize the environmental risks related to the landfills;
2. recover as much as possible the areas for alternative utilizations;
3. rehabilitate and design the lay-out of the areas in such a way to make it impossible the illegal dumping of waste.

In the project area ten (10) existing municipal landfills (see map in Figure 3-1) were found in the inventory phase. Most of the landfills are still in operation to serve part of the population for disposal of their waste. There is a possibility that a number of other (small) illegal or closed dumpsites can be found in the region.

**Figure 3-1 Map of project area with indicated the location of the landfills**




Guidelines and conditions for the environmental sound closure of these landfills have been prepared for application by the municipalities.

The inventory of the landfills (see Annex 3.1) shows that none of the sites meet the national and international standards for sanitary landfills. The existing landfills are not equipped with environmental protection measures. At none of the sites, a weighbridge is installed. Monitoring, of for instance leachate generation, groundwater and surface water quality, is not carried out. Fires occur at several sites and the smell of waste and landfill gas is spread.

The 2003 National Waste Management Strategy of Serbia, including the program of harmonization with the EU classifies four categories of deposit sites as indicated before in Table 2-1.
All dumpsites concerned fall in the category K4 *"Public deposit sites that do not fulfil any minimal protection measures"*.

The lack of financial resources is one of the problems related to the management of the existing landfills. Generally spoken at dumps there is a total absence of any kind of site management while at landfills some form of site management is practiced. Further, dumps have in most cases come to existence in a spontaneous manner while for the establishment of landfills a planning process has been followed and in several cases a landfill has been established according to some form of design. The terms dump and landfill are however not used very consistently. Therefore all ten sites are considered as landfills, not all planned but with a specific level of site management.

The existing landfills need to be closed in the period that the Duboko regional landfill will start operations. This chapter describes the measures which need to be taken. Before measures will be taken, the sites need to be investigated in order to decide on the scope of measures, and assign the budget needed for these measures.

The period for implementation of the measures is expected to be 1 to 3 years after closure, including investigations, technical design, construction permits and implementation of the civil works. The "after-care period'' starts after finalization of the civil works.

## 3.2 Existing landfills

Based on the occupied area and the volume of waste, the existing landfills can be divided in three categories:

**Table 3-1 Existing landfills**

| Category | Municipalities | Area (m2) |
|---|---|---|
| Small landfills | Arilje | 20,000 |
| | Kosjerić | 20,000 |
| | Lučani | 2,000 |
| Medium landfills | Čajetina (new site) | 22,000 |
| | Ivanjica | 20,000 |
| | Požega | 65,000 |
| Large landfills | Bajina Basta | 40,000 |
| | Čačak | 220,000 |
| | Čajetina (closed site) | 8,000 |
| | Užice | 80,000 |

The risk for the environment depends on
- waste characteristics;
- thickness of the waste layer;
- site management, and
- vulnerability of the environment.

The risks can only be estimated after an individual assessment of each site.

### 3.2.1 Small landfills

The small dumpsites have been found at smaller municipalities/suburbs. Typical small dumpsites occupy small areas (up to 2 hectares) and have an average height of approximately 5 meters. The table shows a list of the small dumpsites with an indication of possible risks to be investigated. The Arilje site has been closed and is covered with a soil layer. The Kosjerić landfill is situated adjacent to the road, and is a typical dumpsite without any operational safety measures, such as fences or daily covering. The situation is being improved as a bulldozer is used to spread the waste at the area, and concrete retaining wall elements are installed to protect the road for falling waste.

**Figure 3-2 Kosjerić landfill**

**Table 3-2 Small sized landfills**

| Municipality | Landfill area ($m^2$) | Present waste amount ($m^3$) | General site remarks | Risks |
|---|---|---|---|---|
| Arilje | 20,000 | ? | Closed<br>Soil cover<br>No drainage<br>No gas wells | Over flooding by river<br>Landfill gas emissions<br>Groundwater pollution<br>Surface water pollution |
| Kosjerić | 20,000 | ? | Illegal waste dumping<br>Weekly covering<br>No drainage<br>No gas wells<br>Adjacent to road | Landfill gas emissions<br>Groundwater pollution<br>Surface water pollution<br>Road |
| Lučani | 2,000 | 15,000 | Yearly covering<br>No drainage<br>No gas wells | Landfill gas emissions<br>Groundwater pollution<br>Surface water pollution |

### 3.2.2 Medium Landfills

A second group of sites is of an intermediate size in terms of surface area and/or waste amounts disposed of. At most landfills some form of waste management is carried out. Permanent or temporary staff is often available and equipment for waste management is present (sometimes on a temporary basis), in most cases a bulldozer to spread waste and to install the soil cover.

**Figure 3-3 Čajetina new site**

**Table 3-3 Medium sized landfills**

| Municipality | Landfill area (m2) | Present waste amount (m3) | General site remarks | Risks |
|---|---|---|---|---|
| Čajetina (new site) | 22,000 | 240,000 | Limited monthly covering<br>No drainage<br>No gas wells | Landfill gas emissions<br>Groundwater pollution<br>Surface water pollution |
| Ivanjica | 20,000 | ? | Daily covering<br>No drainage<br>No gas wells | Landfill gas emissions<br>Groundwater pollution<br>Surface water pollution? |
| Požega | 65,000 | 100,000 | Monthly covering<br>No drainage<br>No gas wells | Landfill gas emissions<br>Groundwater pollution<br>Surface water pollution |

### 3.2.2 Large landfills

The third group of sites serves the larger cities or is being used as landfill site for a long period. The landfills of Čačak and Užice are the largest sites. The small area of the closed Čajetina site is small, but the waste is being dumped with an average height of 40 meter (in a valley).

**Figure 3-4 Užice Landfill**

**Table 3-4 Large sized landfills**

| Municipality | Landfill area (m2) | Present waste amount (m3) | General site remarks | Risks |
|---|---|---|---|---|
| Bajina Bašta | 40,000 | 600,000 | Closure foreseen end 2007<br>Soil cover foreseen<br>No drainage<br>No gas wells | Over flooding by river<br>Landfill gas emissions<br>Groundwater pollution<br>Surface water pollution |
| Čačak | 220,000 | ? | 60% closed (soil cover)<br>Partly degassing<br>No drainage | Landfill gas emissions<br>Groundwater pollution<br>Surface water pollution |
| Čajetina (closed site) | 8,000 | 320,000 | Illegal waste dumping<br>Not covered (due to instability)<br>No drainage<br>No gas wells | Instability<br>Landfill gas emissions<br>Groundwater pollution<br>Surface water pollution |
| Užice | 80,000 | 875,000 | Daily covering<br>No drainage<br>No gas wells | Landfill gas emissions<br>Groundwater pollution<br>Surface water pollution |

## 3.3 Legislation

For the selection of landfill sites and the landfill operation guidelines were prepared in 1992: “Rulebook on criteria for determining location and arrangement of landfills for waste materials” (OGRS 54/92)., further called ”Rulebook”.

The existing landfills have no legal status. The landfills do not have an operation permit or a construction permit. Some of the municipalities are involved in legal disputes as the landfills are not selected or operated on a legal basis.

The Rulebook prescribes criteria for locations and protective measures for municipal solid waste landfills. Hazardous waste is excluded. Protective measures consist of technical measures against instability, bottom liner (if no barrier available at site),

fences, collection of storm water and leachate, landfill gas collection wells, daily cover, separation of solid industrial waste, groundwater monitoring wells and a final soil cover of 0.3 to 0.5 meter.

With regard to the current groundwater norms in Serbia related to remediation of the existing landfills and contamination prevention, the following can be applicable:

**The Rulebook (OGRS 54/92)**

Article 4:
A new landfill located on the terrain with greater permeability than 0.00001 cm/s will be secured in order to protect underground water with a clay layer of 0.5 m or with a plastic foil.

Furthermore Article 11 of the same Rulebook states that:

A landfill may not be located on:
- land within inner sanitary protection zone of potable water source
- land where the highest seasonal underground water table is 2 m from the bottom of a landfill and terrain with permeability higher than 0.00001 cm/s;

Based on the site reconnaissance and the existing information it appears very unlikely that the abovementioned prescribed protection measures were implemented in any of the concerned registered landfills.

Groundwater that is used for potable water supply without additional treatment, should comply with the Rulebook on potable water quality (Official Gazette of the FRY, No. 42/98), which further generally complies (except for a few water quality parameters) with the corresponding EU standards.

With regard to possible adverse effect that leachate or infiltration through the existing landfill body and dumped waste may have on underground water quality in the landfill zone, the following general procedure is recommended to be followed:

1. Check compliance of a specific landfill with the abovementioned requirements and thereafter make preliminary assessment of likelihood of groundwater contamination;
2. Check the status of the concerned aquifer, i.e. whether it is used or intended for potable water supply or as a natural mineral water source.
3. Collect, systemize and analyze all relevant existing data on recorded groundwater quality and hydro-geological features;
4. Determine the original groundwater quality status – i.e. before the existing landfill started operation by using historical data, measurements, or using appropriate hydro-geological computer simulations and modeling.
5. Establish current state of the environment – underground water quality, pollution status, by monitoring of investigation wells, pollution transport modeling and carry out analysis of possible long-term effects on underground waters of the existing landfill, as it is now, and after being closed.
6. Prescribe rehabilitation and protection measures that would help to establish and maintain in a long run the original or required (for water supply and other) underground water quality.

With regard to possible pollution of groundwater, the effects of Natural Attenuation (NA) shall be taken into consideration. The main natural processes to be considered are:

- Microbiological decay and transformation of organic pollutants;
- Chemical precipitation of heavy metals;
- Sorption to organic matter and to silt particles.

Results from investigations in The Netherlands (The influence of Natural Attenuation (NA) on the risks and aftercare of abandoned landfills W.J. van Vossen, J. van der Ben, H. Slenders, J. van der Waarde, Sardinia Congress Proceedings 2001) show that in general the concentrations of contaminants are very low, even in the landfills itself. Only anaerobically difficult degradable compounds (benzene, naphthalene) are more than incidentally found in the landfill body itself. Outside the former landfills concentrations of both contaminants and nutrients are very low, e.g. concentrations of heavy metals in leachate and leachate plumes often are lower than background concentrations.

## 3.4 Investigations of landfills

Landfills in the current technical conditions represent a potential hazard for the pollution of surface water, ground water, soil and air. The landfills create an intrusive aesthetic effect in the natural environment. The landfills shall be investigated in order to obtain data for the decision-making process.

For the municipal landfills the following tasks need to be carried out:

- evaluation of existing data;
- topographic measurements and preparation of detailed digital topographic lay-out;
- groundwater investigation;
- measurement of leachate characteristics in case of leachate flow to the surface water;
- Geotechnical investigations (where needed).

A risk analysis shall be made to define the measures to be taken during the closure and aftercare period.

Evaluation of existing data
Existing data shall be evaluated. The existing data consist of waste characteristics, site investigation reports, operational plans and reports, aerial pictures and site pictures, and available monitoring data. The existing data shall be filed per separate landfill and a summary of the results shall be reported.

Topographic measurement
The topographic measurements shall be carried out at the landfill and the surrounding area, to prepare digital map of the landfill site. The map is to be used for preparation of the technical design of the landfill closure activities, and shall include melioration ditches and surface water in the vicinity of each landfill.

Groundwater investigation
For the landfills field investigations will be necessary. According to the Rulebook at least 3 piezometric bore-holes are to be constructed during the landfill operation period, one on each side, and one down-stream from a landfill where samples should be taken 2 times a year.

None of the existing sites uses the required monitoring system. To investigate the groundwater before closure of the landfill, 1 permanent monitoring well upstream of the landfill and an average of 3 permanent monitoring wells downstream shall be installed at each site.

Each well will contain a piëzometer at least two meter below the minimum groundwater level, in which groundwater samples can be taken. Additional to the sampling of groundwater the following field measurements need to be executed: temperature, acidity (pH) and conductivity (Ec). The other analyses shall be executed in the laboratory and are focused on expected contamination: Chloride, Sulphate, Ammonium, metals, barium, volatile aromatic hydrocarbons and halogenetic organic hydrocarbons, extractable organic halogens, phenol-index, nitrate, total organic carbon, sodium and bicarbonate.

The results of the groundwater investigation shall be assessed by using the national groundwater limit values, taken into account processes such as natural attenuation. Depending on the results of the investigation, further steps shall be taken where needed.

Leachate characteristics
If site visits and existing data show that leachate can be observed at the landfill site flowing into surface water, samples shall be taken in ditches/surface water downstream from the landfill, to determine the leachate characteristics and the effects to the surface water. Samples shall be analysed on: chloride, sulphate, ammonium, COD, BOD, metals, barium, volatile aromatic hydrocarbons and halogenetic organic hydrocarbons, extractable organic halogens, nitrate, total organic carbon, sulphide, manganese, potassium, sodium and bicarbonate.

Geotechnical survey
In some cases a geotechnical survey is needed to assure that the design of the landfill will lead to a safe structure during construction and after closure. The Čajetina closed landfill is a site where a geotechnical survey and calculations shall be carried out.

**Figure 3-5 Čajetina closed landfill**

## 3.5 Measures to be taken

### 3.5.1 Introduction

Article 24 of the Rulebook prescribes the measures to be taken after operation is stopped. A landfill stops operation when it is no longer possible to deposit new waste or when it jeopardizes the environment. It is required to cover the waste with 3,000 - 5,000 m3 soil per hectare, depending on future use of the land and bearing in mind that the earth cover should be evenly distributed.

The thickness of the required soil layer will thus be approximately 0.3 to 0.5 meter. This soil layer does not prevent the infiltration of rain water into the landfill body, especially when no measures are being taken to drain rain water from the landfill top cover to the nearby surface water. If rain water is infiltrating into the landfill, leachate will produced. Therefore the European Directive 1999/31/EC on the land filling of waste prescribes the use of top covers for municipal solid waste landfills, consisting of a gas drainage layer, an impermeable mineral sealing, a drainage layer and a top cover. For hazardous waste landfills an artificial sealing liner (for example a PE liner) shall be added to the construction.

Besides the cover layer, other measures shall be considered depending on the landfill and waste characteristics, such as a leachate collection and disposal system, landfill gas extraction system, remediation of groundwater (if needed). A permanent groundwater monitoring system is needed in all cases, for which the monitoring wells of the investigation can be used.

The requirements of the Directive 1999/31/EC can be seen as best available technique. The use of best available techniques for all measures will lead to investments which are assumed not to be affordable in most cases. Therefore the need for measures shall be based on a risk analysis. The risk analysis needs to focus on the environmental and health risk, in relation to affordability of the measures to be taken.

The next table gives a summary of possible measures to be taken for each type of landfill. Measures which shall be decided on based on a risk analysis are indicated as 'optional'.

**Table 3-5 Summary of possible measures**

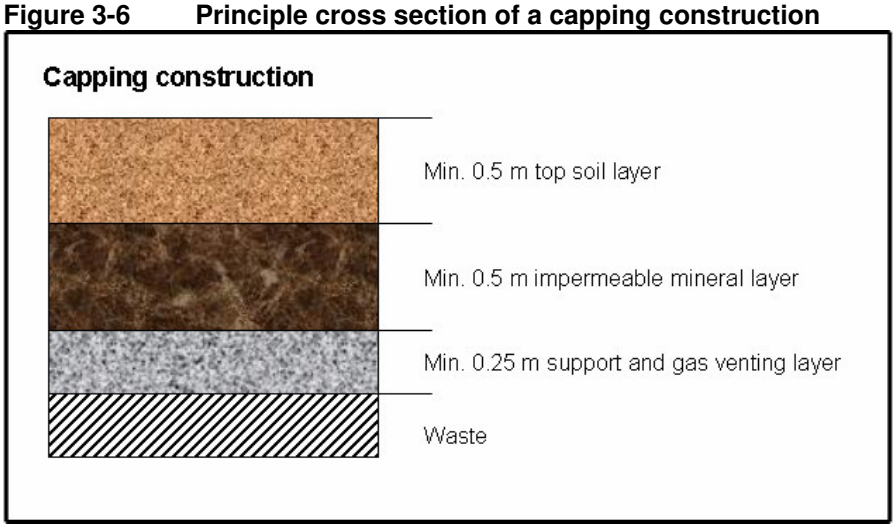
| Measure | Large landfill | Medium landfill | Small landfill |
|---|---|---|---|
| Groundwater monitoring | Yes | Yes | Yes |
| Top soil layer | Yes | Yes | Yes |
| Surface water run-off system | Yes | Yes | Yes |
| Drainage layer | Yes/Optional | Yes/Optional | Optional |
| Impermeable mineral liner | Yes/Optional | Yes/Optional | Optional |
| Gas drainage layer | Yes/Optional | Yes/Optional | Optional |
| Landfill gas extraction system | Yes | No | No |
| Passive landfill degassing | No | Yes | Optional |
| Leachate collection system | Optional | Optional | No/optional |
| Groundwater remediation | Optional | Optional | No/optional |

### 3.5.2 Top cover

It is required that during exploitation of the landfill the waste shall be covered with 0.1 to 0.3 m granular material. After reshaping of the landfill to its final shape (with stable slopes on maximum inclination of 1:3) a support layer of approximately 0.25 m shall be constructed directly on the landfill. The primary function of this layer is to give adequate support to compact the mineral barrier.

Figure 3-6 shows a principle cross-section of a capping construction that can be used for large landfills and landfills which pose a risk to the environment.

**Figure 3-6 Principle cross section of a capping construction**




In order to reduce the production of leachate, a layer of mineral material shall be installed on top of the support layer. Precautions should be taken to avoid drying out of this mineral layer and contamination by the foundation layer. The artificial geo-hydrological barrier should be a 0.5 m thick clay barrier (K≤ 1.0x10-9 m/s) or equivalent. Natural clay can be used as a geohydrological mineral barrier. An alternative for clay can be a mineral barrier of sand-bentonite or a geosynthetic liner, or Trisoplast (consisting of sand, bentonite and a polymer).

Where necessary, a sand drainage layer of 0.3 meters thickness will be installed to collect surface run-off. Drains shall be placed in this layer at the bottom of slopes. A drainage system will collect surface run-off water and discharge it. Synthetic drainage mats can be used as an alternative solution in stead of sand.

On top of the impermeable mineral barrier or drainage layer a top soil layer of at least 0.5 m thick will be constructed. This top soil layer prevents erosion of the mineral barrier and is appropriate for the growth of grass and plants. To avoid erosion of the top soil layer the whole covered surface shall be sowed with grass seed. The seed shall be any grass seed native to the area.

### 3.5.3 Other measures

Other measures consist of landfill gas extraction, leachate collection and groundwater remediation. All of these measures shall be based on the risk analysis, and are common

techniques to be used at existing landfills to prevent contamination of air, soil, groundwater and surface water.

Landfill gas extraction is an active way of degassing, using an extraction system of vertical wells and a blower to transport the landfill gas to a flare. Additionally landfill gas can be used to produce electricity (see hereafter). If the amounts of landfill gas are relatively low, degassing may take place using passive methods such as controlled venting via 'chimneys' through the top cover with a biofilter to avoid odor emissions.

Leachate collection and groundwater remediation systems shall be site specific, and depend on expected amounts which will be reduced significantly after an impermeable top cover has been installed. Collected leachate and contaminated groundwater shall be discharged in controlled way towards a sewage system or, after treatment, towards surface water.

## 3.6 Monitoring and after-care

Groundwater monitoring
Four permanent monitoring wells should be installed around the landfill body:

- 1 monitoring well stream upwards from the landfill body;
- 3 monitoring wells stream downwards from the landfill body.

The groundwater flow direction should be checked by measurement of groundwater level. The quality of the groundwater should be monitored in the following years, since the waste at the site is partly reshuffled. The frequency of sampling and chemical analyses depends on the sensitivity of the area in which the landfill is located. At least three times in a period of five years groundwater should be sampled and analyzed.

If the results of the chemical analyses show that the groundwater is contaminated above Serbian standards, measures (such as a higher frequency for monitoring, install new well stream downwards of contaminated well) should be taken in consultation with the responsible Authorities.

Continuation of groundwater monitoring after five years should be discussed with the responsible Authorities for each individual landfill site.

The groundwater samples shall be analyzed according to Serbian standards. At least the following parameters shall be included: metals (8), volatile aromatic hydrocarbons (VAH), volatile organic hydrocarbons (VOH), TPH, phenol index and EOX.

Site inspection
During the first two years the site shall be expected once a year. After 2 years every five years a visual inspection of the landfill site should take place. During the site inspection the following issues should be verified:

- Visual inspection of the cover layer and if required some control drillings to check the thickness of the cover layer;
- Visual inspection of the condition of vegetation (damage by landfill gas) on the landfill. If vegetation damage is discovered additional measures (LFG-measurements with portable equipment) should be taken;
- Visual inspection of the condition of nearby located surface water;

- Visual inspection of the use of the site (no confined spaces, no cattle, no vegetation with roots deeper than 0.3 meter, etc).

If a landfill gas extraction system is installed, or leachate collection is carried out, inspection and maintenance shall be specified during the design phase.

The findings of the site inspection should be reported to the responsible authority. The responsible authority will decide on the measures to be taken.

## 3.7 Closure costs

The costs of the activities related to the closure and after care of existing landfills depend on the measures required. Cost figures in this project stage are indicative. Cost calculations have to be prepared on a site specific approach.
Activities consist of investigations, design and tendering, construction and supervision, monitoring and aftercare.

### 3.7.1 Investigations

Data collection and evaluation, Topographic (geodetic) measurements and digital drawings, Groundwater investigations and leachate sampling and a geotechnical survey

**Table 3-6 Cost estimate investigations**

| Activity | Input | Unit price (€) | Costs (€) |
|---|---|---|---|
| Desk top study existing data and reporting | 20 days | 100 | 2,000 |
| Geodetic survey and digital drawings scale 1:1,000.<br>(may be affected by terrain characteristics) | 60 hectare | 500 | 30,000 |
| Groundwater investigations (four permanent monitoring wells, analysis, report) | 10 sites | 5,000 | 50,000 |
| Geotechnical survey, including calculations and report.<br>(may be influenced by required detail specification of investigations) | 1 site | 15,000 | 15,000 |
| **Total** | | **Approx. 100,000** | |

### 3.7.2 Design and tendering

**Table 3-7 Cost estimate design and tendering**

| Activity | Input | Unit price (€) | Costs (€) |
|---|---|---|---|
| small landfill | 3 sites | 10,000 | 30,000 |
| medium sized landfill | 3 sites | 20,000 | 60,000 |
| large landfill | 4 sites | 30,000 | 120,000 |
| **Total** | | **Approx. 210,000** | |

### 3.7.3 Construction

The construction costs of a top cover are mainly depending on the availability of required minerals in the vicinity of a landfill. If these minerals are not available nearby,

transport costs will affect the cost estimates. The following assumptions have been made to indicate the costs of top covers at landfills:

- Clay (K≤ 1.0x10-9 m/s) € 10 per m3 (but may very a lot depending on a borrow-pit distance, required compaction, etc.);
- Drainage sand (permeable sand) € 20 per m3;
- Soil (local available soil for cover) € 5 per m3.

The following tables give a breakdown for a top cover on small landfills and on medium and large landfills.

**Table 3-8 Cost breakdown covering small dumpsites**

| Description | Quantity per $m^2$ | Indicative costs per $m^2$ |
|---|---|---|
| Site clearance, waste reshaping and compaction | | € 1.50 |
| Support layer | 0.25 $m^3$ | € 1.50 |
| Clay layer | 0.50 $m^3$ | € 5.00 |
| Soil layer | 0.50 $m^3$ | € 2.50 |
| Vegetation, drainage channels, etc. | | € 2.00 |
| **Sub total** | | **€ 12.50** |
| Supervision, overhead and contingencies (approx. 20%) | | € 2.50 |
| **Unit price per $m^2$** | | **€ 15.00** |

**Table 3-9 Cost breakdown covering medium & large dumpsites**

| Description | Quantity per $m^2$ | Indicative costs per $m^2$ |
|---|---|---|
| Site clearance, waste reshaping and compaction | | € 1.50 |
| Support layer | 0.25 $m^3$ | € 1.50 |
| Clay layer | 0.50 $m^3$ | € 5.00 |
| Drainage layer | 0.30 $m^3$ | € 6.00 |
| Soil layer | 0.80 $m^3$ | € 4.00 |
| Vegetation, drainage channels, etc. | | € 2.00 |
| **Sub total** | | **€ 20.00** |
| Supervision, overhead and contingencies (approx. 20%) * | | € 4.00 |
| **Unit price per $m^2$** | | **€ 24.00** |

* For very large surface area's this can be lower

Based on above mentioned assumptions, the costs for closure of the landfills based on a top cover lining are:

**Table 3-10 Cost breakdown covering small, medium & large dumpsites (excl. investigation, design & tendering)**

| Category | Landfill | Area ($m^2$) | Unit price per $m^2$ | Total € |
|---|---|---|---|---|
| Small landfills | Arilje | 20,000 | 15 | 300,000 |
| | Kosjerić | 20,000 | 15 | 300,000 |
| | Lučani | 2,000 | 15 | 30,000 |

| | | | | |
|---|---|---|---|---|
| Medium landfills | Čajetina (new site) | 22,000 | 24 | 528,000 |
| | Ivanjica | 20,000 | 24 | 480,000 |
| | Požega | 65,000 | 23 | 1,495,000 |
| Large landfills | Bajina Bašta | 40,000 | 24 | 960,000 |
| | Čačak | 220,000 | 22 * | 4,840,000 |
| | Čajetina (closed site) | 8,000 | 24 | 192,000 |
| | Užice | 80,000 | 23 * | 1,840,000 |
| Total | | | | 10,965,000 |

* Due to its large area surface some savings can be made on the supervision & overhead, etc. costs. For Čačak and Užice / Požega this can be 2 respectively 1 Euro/$m^2$

The total costs for closure amount to approximately € 11 million. These costs do not contain investments for landfill gas extraction for utilization (if feasible at all on the specific site) and leachate collection and treatment.

### 3.7.4 Monitoring and aftercare

**Table 3-11 Yearly cost estimate**

| Activity | Input | Unit price (€) | Costs (€) |
|---|---|---|---|
| Groundwater investigations (sampling, analysis, report) | 10 sites | 3,000 | 30,000 |
| Visual inspection | 10 sites | 2,000 | 20,000 |
| **Total** | | **Approx. 50,000 per year** | |

## 3.8 Landfill gas extraction & utilization

### 3.8.1 Introduction

Landfills produce landfill gas (LFG) that can be captured and used for heating and/or electricity generating purposes. In addition Carbon Credits can be generated generating extra income. For the two largest dumpsites the expected LFG productions have been calculated. The other dumpsites are far too small for LFG extraction to make it financially feasible. Therefore these sites are not further elaborated.

<u>Introduction into the Kyoto treaty</u>
Due to the anaerobic condition in the landfill, landfill gas is produced. This gas migrates upwards and is released into the atmosphere. As LFG consists for some 55% of methane (CH4) and for some 45 % of CO2 of organic origin. As methane acts as a strong greenhouse gas (GHG) (21 x stronger than CO2), thus contributing to the green house effect being the heating-up of the atmosphere.

The EU Directive Landfill on waste (1999/31/EC of 26 April 1999 + amendments) prescribes the capturing of LFG and the subsequent combustion of it. By doing so the contribution to the GHG-effect is prevented (Note: the produced CO2 is considered of non-fossil origin, thus not contributing to the GHG effect).

All dumpsites of the municipalities will produce more or less LFG depending on factors as:

- Age of the waste;

- Composition of the waste;
- Water levels in the dumpsite;
- Dumping history, physical condition of dump, etc.

In recent years LFG capturing and flaring it (or using it for electricity production) has become very attractive thanks to the Kyoto-treaty. Countries that ratified the treaty (Note: Serbia has not yet decided) and that have no reduction obligation can develop projects in which Carbon Credits are generated that can be traded on so-called Carbon markets. Buyers are mainly Western countries that have an emission reduction obligation under the Kyoto reduction[3]. Within the EU also started Distinguished are the Clean Development Mechanism (CDM), for mostly developing countries, and the Joint Implementation (JI), concerning Central & Eastern European countries (except Croatia and also Serbia: CDM). The treaty covers the period 2006 – 2012 for CDM and 2008 – 2012 for JI. JI will cease after 2012 while CDM will continue is some form (negotiation have started).

An important criterion under JI/CDM is the "Additionality criteria". A project activity shall be additional, in other words: It will not be implemented without JI/CDM income as there are barriers (technically, financially, etc.). Legislation can prescribe LFG extraction as is the case in the EU Directive. As this Directive is not binding in Serbia a LFG project can qualify for CDM[4].

The UNFCCC[5] in Bonn registers CDM (and in near future also JI) projects and provide procedural and technical guidelines for a/o the baselines, calculations, monitoring etc.

LFG calculations are made here for the dumpsites of Užice and Čačak. For the other dumpsites no calculations are made because of the limited amount of waste dumped and/or the physical conditions of the sites that lead to low LFG productions.

The UNFCCC guidelines have been applied for the LFG and emission reduction calculations.

### 3.8.2 LFG calculation model

<u>Estimated anthropogenic emissions by sources of greenhouse gases of the baseline</u>
Following the instructions outlined in the UNFCCC Baseline Methodology (ACM0001), ex ante emission reductions estimates for methane extraction/destruction are projected for reference purposes only. The project activity (being the capturing of LFG and subsequent combustion of it), once commissioned, will determine emission reductions on an ex post basis by measuring project data as stipulated in the monitoring plan. This data will be used to calculate emission reductions for the project activity.

<u>Calculation of GHG emission reduction associated with methane combustion</u>

[3] Within the EU there exists also an Emission Trade (ET) scheme between large companies. In future the ET market will merge with the market for JI carbon credits.
[4] The focal point for Carbon Credits (the Designated National Authority - DNA) in Serbia is the Ministry of Environment of Serbia dr. Ivana Ribara 91, Novi Beograd Ms. Branka Andric (brana.andric@ecoserb.sr.gov.yu ) Head of Department for International Cooperation, Phone: (381-11) 3611 6368, Fax: (381-11)158 793
[5] United Nations Focal Climate Change Committee

The landfill gas extraction and combustion is directly monitored and used to calculate the CER's. For predicting the amount of CER's the Approved Consolidated Methodology ACM0001 has been used. A description of the used model follows hereafter.

The greenhouse gas emission reduction achieved by the project activity during a given year "y" (ERy) is calculated by using the formulas as given in method ACM0001:

$$ER_y = (MD_{project,y} - MD_{reg,y})*GWP_{CH4} + EG_y*CEF_{electricity,y} + ET_y*CEF_{thermal,y}$$

Where:

| | | |
|---|---|---|
| $ER_y$ | = | emission reduction in $tCO_2e$ equivalent during year y |
| $MD_{project,y}$ | = | the methane destroyed by the project activity in $tCH_4$ in year y |
| $MD_{reg,y}$ | = | the methane that would be destroyed in the baseline in $tCH_4$ in year y; for this project = 0 (see "determination of $MD_{reg,y}$") |
| $GWP_{CH4}$ | = | the approved Global Warming Potential of methane ($21tCO_2/tCH_4$) |
| $EG_y$ | = | the net quantity of electrical energy displaced during the year |
| $CEF_{electriicty,y}$ | = | $CO_2$ emissions intensity of the electrical energy displaced in the grid |
| $ET_y$ | = | quantity of thermal energy displaced during the year, which for this project = 0 |
| $CEF_{thermal,y}$ | = | $CO_2$ emissions intensity of the thermal energy displaced, which for this project is irrelevant since $ET_y = 0$ |

<u>Determination of $MD_{reg,y}$</u>

$$MD_{reg,y} = MD_{project,y} * AF$$

Where:

| | | |
|---|---|---|
| $AF$ | = | Adjustment Factor |

In cases where regulatory or contractual requirements do not specify $MD_{reg,y}$ an Adjustment Factor (AF) shall be used and justified, taking into account the project context where "reg" stands for "regulatory and contractual requirements". Considering the actual situation on top of the regulatory and contractual requirements, one can observe the following:

1. In the existing of Užice and Čačak dumpsites situation currently no measures are in place to capture and destroy the methane produced.
2. In Serbia no policies or regulations or contractual requirements what so ever are in place that oblige landfill operators to capture or destroy methane (REF)

Hence the AF will be 0% for the first crediting period. In accordance with the Monitoring Methodology the $MD_{reg,y}$ and therefore the AF will be evaluated at the beginning of each crediting period.

<u>Determination of $MD_{project,y}$</u>

In accordance with ACM001, $MD_{project,y}$ will be determined ex post by metering the actual quantity of methane captured and destroyed once the project activity is operational.
The methane destroyed by the project activity ($MD_{project,y}$) during a year is determined by monitoring the quantity of methane actually flared and gas used to generate electricity. Within this project there are no intentions to produce thermal energy. The applicable ACM0001-formula therefore will be:

$$MD_{project,y} = MD_{flare,y} + MD_{electricity,y} + 0$$

$$MD_{flare,y} = LFG_{flare,y} * W_{CH4,y} * D_{CH4} * FE$$

Where:

| | | |
|---|---|---|
| $MD_{flare,y}$ | = | quantity of methane destroyed by flaring |
| $LFG_{flare,y}$ | = | quantity of landfill gas flared during the year measured in normal cubic meters |
| $W_{CH4,y}$ | = | average methane fraction of the landfill gas as measured during the year |
| $D_{CH4}$ | = | density of methane = $7.168*10^{-4}$ t/Nm$^3$ |
| $FE$ | = | Flare Efficiency (the fraction of methane destroyed) |

$$MD_{electricity,y} = LFG_{electricity,y} * W_{CH4,y} * D_{CH4}$$

Where:

| | | |
|---|---|---|
| $MD_{electricity,y}$ | = | quantity of methane destroyed by generation of electricity |
| $LFG_{electricity,y}$ | = | the quantity of landfill gas fed into electricity generator |
| $W_{CH4,y}$ | = | the average methane fraction of the landfill gas is measured during the year and expressed as a fraction (m$^3$/m$^3$) |

<u>Determination ex ante of emissions reductions</u>
In accordance with ACM0001, an ex ante estimate of emissions reductions, by projecting the future GHG emissions of the landfill is applied. To calculate ex ante the GHG-emissions of the landfill a model is used ($LFG_{model}$).

The methodology used for calculation of the captured and destroyed landfill gas is based on multi-phase modelling. In the multi-phase First Order Decay Model, a number of fractions are distinguished, for which landfill gas generation is described separately. There are distinguished three phases: slow, moderate and fast degradable materials, but other subdivisions are possible, including the introduction of an inert fraction. The advantage of the multi-phase model is that the typical waste composition will be taken into account, since all types of waste contain typical fractions of slow, moderate and fast degradables.
In general, landfill gas formation models are not based on microbiological or biochemical principles, but mainly on a practical description of formation, as observed in laboratory experiments or in full-scale recovery projects.

The amount of landfill gas ($LFG_{model}$) that is generated is estimated with the following LFG generation model (multi-phase model):

$$LFG_{model} = \zeta \sum_{j=1}^{3} 1.87 * A_i * DOC_i * k_{1,i} * e^{-k_{1,i}t}$$

and

$$LFG_{model} * EE_{LFG} = LFG_{flare} + LFG_{electricity}$$

Where:

| | | |
|---|---|---|
| $LFG_{mode}$ | = | Formation of landfill gas in m³/y, 8,760 hours/year |
| *1.87* | = | A maximum amount of 1.87 m³ biogas is produced out of one kilogram degraded organic carbon |

| | | |
|---|---|---|
| $\zeta$ | = | Formation factor = $MCF * DOC_f$. |
| $DOC$ | = | Amount of (dry) organic carbon for each specific waste stream (kg/t). |
| $DOC_f$ | = | Fraction of *dry organic carbon (DOC) that* dissimilates to landfill gas. |
| $MCF$ | = | Methane Correction Factor (fraction) see table E.1 from New Baseline Methodology |
| $A$ | = | Amount of waste (t/year). |
| $K$ | = | Degradation velocity of each specific waste stream. |
| $T$ | = | Time elapsed since (prevented) depositing in years. |
| $I$ | = | Category of waste |
| $EE_{LFG}$ | = | Extraction efficiency = fraction of the generated landfill gas that is extracted and thus available for combusting or electricity production |

The methane generated in the landfill, extracted and used for energy-production is calculated using the following formula:

$$ME = LFG_{model} * W_{CH4,y} * D_{CH4} * EE_{LFG}$$

Where:

| | | |
|---|---|---|
| $ME$ | = | methane ($CH_4$) extracted (t/y) and to be combusted and/or used for electricity generation |
| $LFG_{model,y}$ | = | is the amount of Landfill gas/y as calculated by the multiphase model in $Nm^3$ LFG/y (see below) |
| $W_{CH4,y}$ | = | average methane fraction of the LFG (in $m^3$ $CH_4/m^3$ LFG); |
| $D_{CH4}$ | = | density ($t/Nm^3$) of methane ($CH_4$) |
| $EE_{LFG}$ | = | extraction-efficiency = fraction of the generated amount of landfill gas that is to be extracted |

Royal Haskoning developed in the 1980's a First Order Decay multi-phase model that fulfils UNFCCC's AMC0001 and was used in numerous LFG projects world wide. It was found to predict the LFG productions very accurate. This LFG model is used here for the following LFG calculations.

### 3.8.3 Dumpsite Užice

The amounts and composition of the wastes that was and is dumped in Užice are given in Table 3-12.

Basic data:

- Start of regularly land filling: 1973;
- Total area: 80,000 m2;
- Height: approx. 25m;
- Operating time: 300 days/year;
- Waste amount: 18,250 ton (2005) (backward scenario applied);
- Waste composition: see Table 3-12;
- Expected life-time of Užice dumpsite: closing end of 2008 (opening of Duboko site)

**Table 3-12 Waste composition**

| Waste composition | | |
|---|---|---|
| | Waste composition 2005 | |
| | % weight | % weight |
| Fraction | /1 | only Uzice |
| Paper | 14.96% | 18.02% |
| Metal | 1.95% | 1.48% |
| Glass | 6.85% | 8.99% |
| Plastic | 9.75% | 10.47% |
| PET bottles | 1.28% | 1.34% |
| Wood | 6.61% | 5.66% |
| Rubber | 1.61% | 0.85% |
| Textile | 2.46% | 2.40% |
| Biomass | 15.89% | 18.35% |
| Other | 38.65% | 32.43% |
| **Total** | **100.00%** | **100.00%** |
| /1 source: Table 1.3.3, page 12 FS Ekoindustrija april 2006 | | |

The following is recommended and supposed to be implemented:

Covering of landfill
After reshaping and some compressing of the waste, the final cover construction can be constructed. In this case, when reshaping and profiling takes place directly after the construction of the new landfill at Duboko site, the final capping construction can be erected from the second half of 2009.

Installation of a leachate collection drain around the landfill body
The present landfill lacks measures to intercept the produced leachate (no bottom liner, no leachate collection system). This problem can not be solved completely, without removing all the waste and installation of measures on the bottom. This is a very expensive and inefficient way to handle this issue. Therefore, it is proposed to cap the landfill and to reduce the production of leachate considerably. Besides, the installation of a ring drain around the landfill, intercepts at least all the leachate occurring on the bottom of the slopes of the landfill.

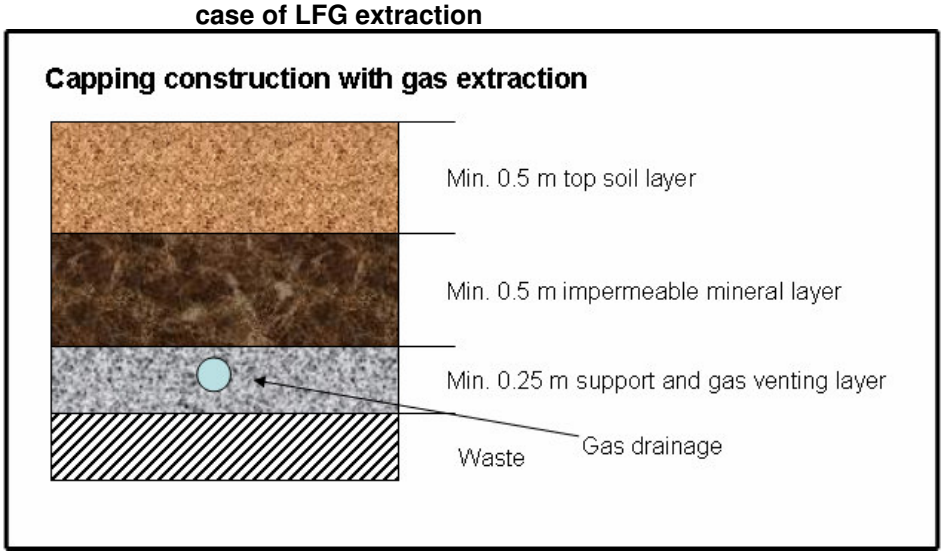
Construction of the ring drain can be done after finalizing the reshaping of the existing landfill.

Final capping of the landfill by means of an impermeable layer
Recommended without specifications in case of a final covering are:

- Artificial sealing liner;
- Impermeable mineral layer;
- Drainage layer > 0.25 m;
- Top soil cover > 0.5 m.

Figure 3-7 shows a principle cross section of the final cover construction (but without the artificial sealing layer) that is proposed to be constructed on top of the existing landfill in case a LFG extraction system for maximum utilization of the LFG is implemented (estimated timing: second half of 2009).

**Figure 3-7 Principle cross section of the proposed final cover construction in case of LFG extraction**




Top soil layer
A top soil layer for protection of the cover construction and grassing of the top surface of the closed and covered landfill is foreseen. The soil may be local available soil, but preferably a kind of soil, suitable to grow vegetation and with some resistance against erosion should be chosen. The thickness of the top soil layer shall be at least 0.5 m.

Support and gas layer
The support and gas drainage layer is made with a minimum thickness of 0.25 m (preferably 0.5m). The value of the permeability must be ≥ 1 x $10^{-3}$ m/s. The content of calcium carbonate must not exceed 10% (mass). The size of the particles must be included between 4 mm and 32 mm. The percent of superior and inferior particles can't exceed 3 % (mass). Woods, metals, plastic materials or other foreign components must not be contained in the drainage material. Drainage layer must have a tolerance in plane of maximum 2 cm/ 4.0 m.

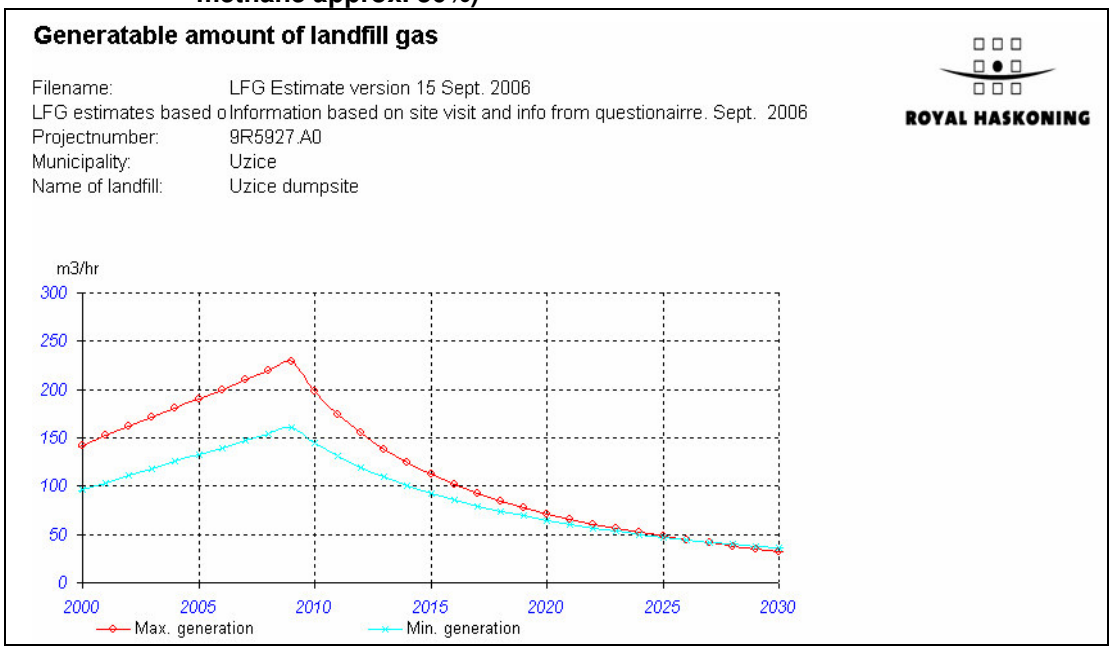
Geotextile (not included but recommended)
In order to avoid clogging of the drainage layer through soil materials penetration from the re-growing layer, a geotextile is recommended to be applied above the drainage layer. The geotextiles must be made up from long lasting term resistance materials like polypropylene (PP) or polyethylene (PE), with mass on unit surface of minimum 400 g/$m^2$.

LFG extraction
The LFG extraction system exists of vertical extraction wells that shall be drilled into the compacted land filled waste (maximum assumed depth of approximately 20 m). The wells are connected by pipes to collection headers. From the headers, main pipes lead the LFG to the extraction and utilization equipment (blower, flare and gas engines).

A total of 8 wells are foreseen.

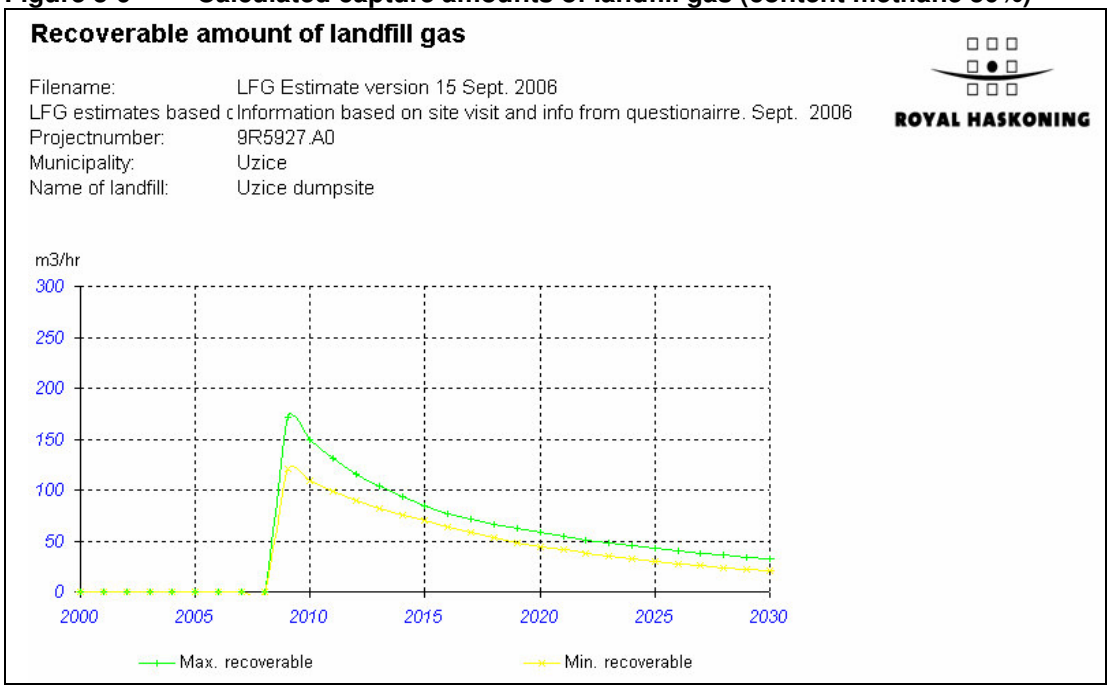
LFG generation
The generated amount of biogas (landfill gas - LFG) is given in Figure 3-8. The two lines represent the range we normally see.

**Figure 3-8 Calculated generation amount of landfill gas per hour (Content methane approx. 50%)**




Based on the covering we propose to apply we can expect that at least 75% of the generated landfill gas can be captured. Implementation can occur immediately, meaning in 2006. (75% capture rate used in model, from January 2008 onwards). The capture amounts are given in Figure 3-9.

**Figure 3-9 Calculated capture amounts of landfill gas (content methane 50%)**



Remarks:
- All calculation are based on provided information;
- Based on the standard composition of the municipal waste. The small amount of industrial waste is neglected;
- Standard design of wells and almost fully coverage (as described), resulting in a capture rate of 75% (conservative);
- Present leachate level: not known (high levels will negatively influence the LFG production);
- Land filling will continue till end of 2008;
- Extraction & utilization system in place from Jan. 2009;
- Landfill gas utilization for electricity generation is assumed.

Carbon Credits
Regarding the Carbon Credit (Emission Reduction Unit[6] (ERU) under the Joint Implementation – JI – or Certified Emission Reduction (CER) under the Clean Development Mechanism – CDM) it is calculated that some 30,000 ERU's (CER's) over the period 2008 – 2012 (Kyoto period in which the ERU's (or CER's) are tradable).

The application of the formulas described above in combination with the data given above results in emission reductions given in Table 3-13.

**Table 3-13 Emission reductions in first crediting period**

| ERU's from LFG recovery (and subsequent full combustion) from Užice dumpsite | |
|---|---|
| **Year** | **Ton (1,000 kg)** |
| 2007 | - |
| 2008 | - |
| 2009 | 10,408 |
| 2010 | 9,180 |
| 2011 | 8,171 |
| 2012 | 7,328 |
| **Total 2006 – 2012** | **30,189** |

Present long term contracted value of an ERU is around 6.5 Euro (but 10-20 Euro on the ET spot market presently). Using 6.5 Euro/ERU (conservative approach) this results in some 225,000 Euro income from ERU's over 2009-2012.

Presently "After Kyoto" negotiations are on-going that might result in continuation in some form alike the present treaty. This only counts for CDM.

Electricity
In addition by applying gas engines with generators some 6,400 MWh electricity can be generated over the period 2009-2012. The 200 kWe gas engine can operate at full capacity in 2009. However the gas production is decreasing rapidly as no fresh waste is land filled.

[6] 1 ERU = 1 tonne of $CO_2$ reduction = 1 CER (Certified Emission Reduction)

Taking net (after subtracting 0.01 Euro/kWh for maintenance) 0.05 Euro/kWh this generates 320,000 Euro over the period 2009-2012. Electricity can continued to be generated after 2012. From 2013 till 2020 some 6,000 kWh can be generated.

**Table 3-14 Investment estimation LFG extraction & utilization Užice**

| Description | Costs (€) | Comments |
|---|---|---|
| Wells + piping/collector | 70,000 | |
| Piping (main) | 20,000 | |
| Reshaping and full covering landfill site | Not included | Included in capping budget |
| Compressor | 35,000 | |
| Flare | 35,000 | |
| Gas engine/generator unit (200 kWe) | 150,000 | Rest value present, not taken into account |
| Connection to grid | 20,000 | |
| Design, engineering, project management | 25,000 | |
| Validation (JI) | 20,000 | |
| Unforeseen, risk etc. | 50,000 | Minimum estimate |
| **Total** | **Approx. 425,000** | |

Instead of new gas engine/generator unit of 200 kWe a second hand engine can be applied for approx. 75,000 Euro. This makes the total investment approx. 350,000 Euros.

Based on the provided data (landfill area, height) and the preliminary calculations the landfill is technically suitable for LFG extraction and utilization in a gas engine / generator for electricity production, provided that leachate levels are low. The preliminary financial feasibility of only electricity production is negative. With additional Carbon Credit income the LFG project can be paid back within the Kyoto period.

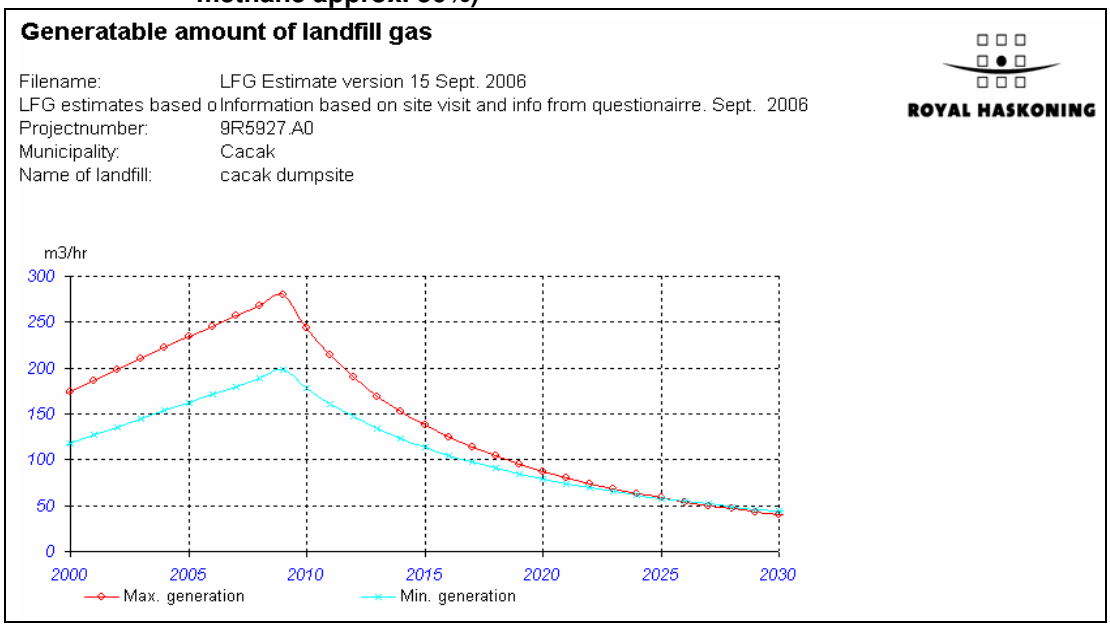
### 3.8.4 Dumpsite Čačak

Basic data:
- Start of regularly land filling: 1973;
- Total area: 30 ha (60% already closed);
- Height: approx. 15 m;
- Operating time: 300 days/year;
- Waste amounts: see table 22,400 ton (2005) (backward scenario applied). Dumping on present position of dumpsite since 2000;
- Waste composition: see Table 3-12;
- Expected life-time of Čačak dumpsite: closing end of 2008 (opening of Duboko site)

The same recommendations as mentioned under Užice are supposed to be implemented.

<u>LFG generation</u>
The generated amount of biogas (landfill gas - LFG) is given in Figure 3-10. The two lines represent the range we normally see.

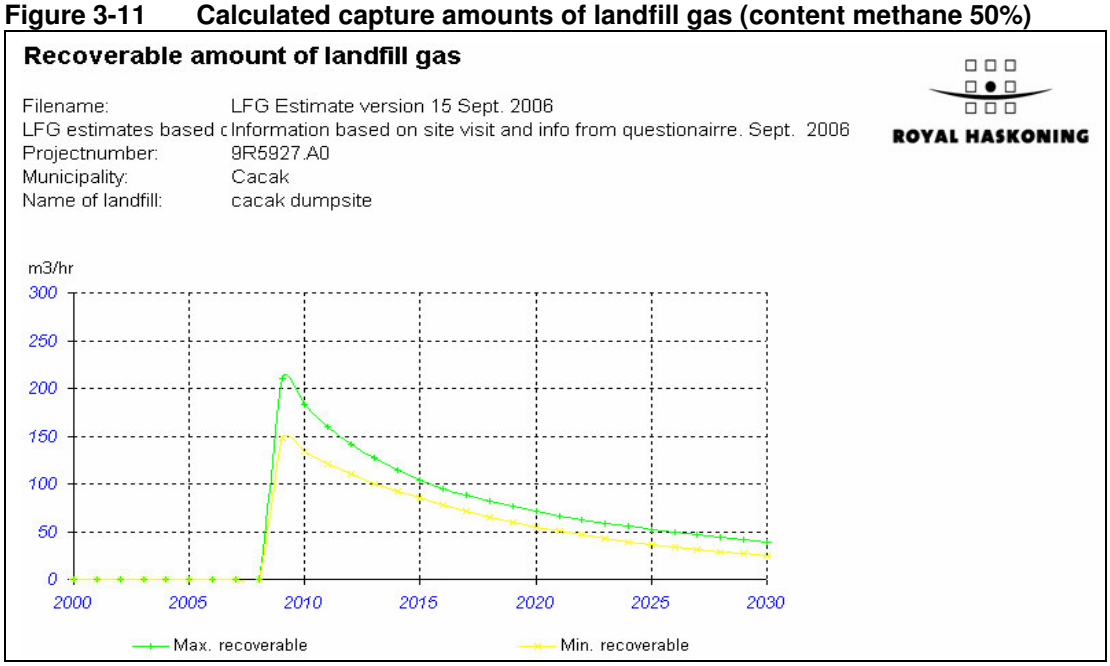
**Figure 3-10 Calculated generation amount of landfill gas per hour (Content methane approx. 50%)**




Based on the covering 40% of the area (the part presently in use) that we propose to extract LFG we can expect that at least 75% of the generated landfill gas can be captured. Implementation can occur immediately after opening of Duboko, meaning in 2009. (75% capture rate used in model, from January 2009 onwards). The already closed part will not further be covered. A 50% recovery rate by making use of the exiting de-gassing well is assumed.

The capture amounts are given in Figure 3-11.

**Figure 3-11 Calculated capture amounts of landfill gas (content methane 50%)**



Remarks:
- All calculation are based on provided information;
- Based on the standard composition of the municipal waste. The small amount of industrial waste is neglected;
- Standard design of wells and almost fully coverage (as described), resulting in a capture rate of 75%;
- Present leachate level: not known (high levels will negatively influence the LFG production);
- Land filling will continue till end of 2008;
- Extraction & utilization system in place from Jan. 2009;
- Landfill gas utilization for electricity generation is assumed.

Carbon Credits
Regarding the Carbon Credit (Emission Reduction Unit (ERU) under the Joint Implementation - JI) it is calculated that some 39,000 ERU's over the period 2008 – 2012 (Kyoto period in which the ERU's are tradable).

**Table 3-15 Emission reductions in first crediting period**

| ERU's from LFG recovery (and subsequent full combustion) from Čačak dumpsite | |
|---|---|
| **Year** | **Ton (1,000 kg)** |
| 2007 | - |
| 2008 | - |
| 2009 | 11,582 |
| 2010 | 10,174 |
| 2011 | 9,024 |
| 2012 | 8,064 |
| **Total 2006 – 2012** | **38,842** |

Present long term contracted value of an ERU is around 6.5 Euro (but 10-20 Euro on the ET spot market presently). Using 6.5 Euro/ERU (conservative approach) this results in some 250,000 Euro income from ERU's over 2009-2012.

Electricity
In addition by applying gas engines with generators some 7,100 MWh electricity can be generated over the period 2009-2012. The 250 kWe gas engine can operate at full capacity in 2009. However the gas production is decreasing rapidly as no fresh waste is land filled.

Taking net (after subtracting 0.01 Euro/kWh for maintenance) 0.05 Euro/kWh this generates 350,000 Euro over the period 2009-2012. Electricity can continued to be generated after 2012. From 2013 till 2020 some 7,500 kWh can be generated.

**Table 3-16 Investment estimation extraction & utilization Čačak**

| Description | Costs (€) | Comments |
|---|---|---|
| Wells + piping/collector | 70,000 | |
| Piping (main) | 40,000 | |
| Reshaping and full covering landfill site | Not included | Included in capping budget |
| Compressor | 45,000 | |
| Flare | 35,000 | |
| Gas engine/generator unit (250 kWe) | 200,000 | Rest value present, not taken into account |
| Connection to grid | 20,000 | |
| Design, engineering, project management | 25,000 | |
| Validation (JI | 20,000 | |
| Unforeseen, risk etc. | 50,000 | Minimum estimate |
| **Total** | **Approx. 505,000** | |

Based on the provided data (landfill area, height) and the preliminary calculations the landfill is technically suitable for LFG extraction and utilization in a gas engine / generator for electricity production, provided that leachate levels are low. The preliminary financial feasibility is negative without Carbon Credit income. With Carbon Credit income the investment can be repaid within the Kyoto-period.

### 3.8.5 Conclusion regarding LFG

Due to its small size LFG extraction & utilization for electricity production is without the income of Carbon Credits not feasible. With additional Carbon Credits income the LFG project can be made feasible provided that the project activity of LFG extraction & utilization is approved by the DNA of Serbia.

Detailed investigations are required regarding the “LFG project”.

Note that the capping costs are not included here in the “LFG project”. These costs are attributed to the “Closure project”.

## 3.9 Recommendations

1. Avoid direct access to the sites e.g. by installing a fence around each dumpsite. Sites should be consequently closed, as soon as alternate dump capacity is available at Duboko;
2. Investigate every dumpsite including a/o:
   - physical condition of the dump;
   - topographic map preparation;
   - geotechnical & hydro-geotechnical investigations;
   - leachate and groundwater analyses.
3. Identify and work-out for every dumpsite the technical solutions possible including detailed investment estimations;
4. Select the most appropriate solution for dumpsite concerned;
5. Prepare design & tender documentations for every dumpsite based on the selected solution;
6. Tender the works (for every site or clustered sites) followed by implementation of it.

The investigations can be done within three months after assignment.
Design and technical specification / tender document preparation will take some 9 months.
Depending on the settlement of the site, capping can start approximately one to two year after closure.

# 4 CONSTRUCTION OF THE DUBOKO REGIONAL SANITARY LANDFILL, RECYCLE LINE AND THE TRANSFER STATIONS

The Cities have identified the site of Duboko as the most suitable location for the regional landfill. The Consultant has reviewed all investigations available to confirm whether this location represents the best solution both economically and environmentally.

Public consultation forms an important part of the site selection process. The Consultant has reviewed the site selection process has been made in accordance with local requirements and EBRD environmental rules for category “A”-screened projects (see Chapter 7).

The Consultant has considered whether the location is acceptable from an environmental/technical point of view based on the Serbian legal requirements and EU Directives.

## 4.1 Review of the location

The site is located on a relatively steep slope that is not ideal for the purpose of a sanitary landfill. However, the surroundings of Užice are quite mountainous so it is not possible to find large relatively flat areas that are suitable as landfill sites. Two buildings are located very close to the site.

The good access road for trucks is not present. A new access road of about 1.5 km needs to be built along a very hilly profile.

## 4.2 Permitting procedures

A description is given of the permitting procedures which have been/need to be carried out. A summary of the permissions received for the proposed site (see Annex 4.1 for copies of permits) including the permissions or activities still required before the landfill can be built and start operating.

On the basis of the findings a plan has been prepared identifying remaining steps and timing for securing all legal and regulatory approvals.

## 4.3 Land acquisition for the landfill site and the access road

The total surface area of the landfill site is 15.08 ha. As stated by the Užice municipality representatives, up to January 2007 all of the land required for the landfill construction has been acquired.

The planned extension (widening) of the access road to the landfill has been geodetically marked, except for the section next to the landfill. Some land acquisition associated with extension of the access road may also be necessary.

It has been reported that a couple of former private owners are trying to acquire their rights through non adversarial court procedure, a currently ongoing process.

It is not required to await the outcome of the court cases related to the land acquisition cases before starting construction, because the public or national interest has been

declared by the national government. Determination of the financial compensation to the current land owner shall be finalized in the ongoing court procedure.

## 4.4 Overview of permits

Since the realization of the sanitary landfill project in 1993 a number of necessary administrative actions have been taken (decisions, conditions, and permits) with the relevant authorities (see Annex 4.2).

Since the ***building permit has been obtained*** it is possible to start construction of the regional landfill with appurtenant plant for selection of secondary raw materials.

**Table 4-1 Checklist of design conditions, approvals, permits and their status**

| Description | Available | Reviewed | Approved | Disclosed for MIASP* |
|---|---|---|---|---|
| **MAIN PERMITS/APPROVALS** | | | | |
| Building permit | √ | √ | √ | √ |
| EIA "2005" | √ | √ | √ | √ |
| Feasibility study 2005 | √ | √ | √ | √ |
| Final design | √ | √ | √ | √ |
| Land acquisition | √ | √ | n.a. | - |
| Study on location selection | √ | √ | √ | √ |
| Urban planning permit | √ | √ | √ | - |
| Water management design conditions/approval | √ | √ | √ | - |
| **OTHER APPROVALS** | | | | |
| Approval by the Institute for protection of monuments and cultural heritage | √ | √ | √ | - |
| Conditions for environmental protection | √ | √ | n.a. | - |
| Fire-protection study | √ | √ | √ | - |
| Geotechnical survey | √ | √ | n.a. | √ |
| Maximum rainfall analysis | √ | √ | n.a. | - |
| National defence requirements | √ | √ | √ | - |
| Opinion by the Republican Hydro-meteorological institute | √ | √ | n.a. | - |
| Power supply requirements | √ | √ | √ | - |
| Report on work safety | √ | √ | √ | - |
| Requirements for connection to the road network | √ | √ | n.a. | - |
| Sanitary approval | √ | √ | √ | - |
| Topographical survey | √ | √ | n.a. | √ |

* For documentation not made available to MIASP, the status is based on the information provided by the Directorate for planning and construction in Užice.

*Conclusions*
The consultants have concluded that all relevant permitting requirements are fulfilled, except for finalization of land acquisition to a minor extent related to widening of the access road.

## 4.5 Review of landfill at Duboko site

### 4.5.1 Design - General

A final design for the landfill has been prepared by the Duboko project team, for which several locations were evaluated. This design has been updated by the project team due to the joining of Čačak to the project. MIASP has reviewed the current final design and checked and verified the compliance with national and EU standards/regulations. MIASP has recommended on the update of the final design.

Available and relevant project documents are:

- "Sanitary landfill at the location Duboko", Part 3: "Final Project Design"
  - Technological project;
  - Release of gases;
  - Recultivation;

  By HEMCO Belgrade, November 1999;
- Adjusted technical design in line with separation line (part 3): January 2005 (revised November 2005), OSONOVA a.d. on behalf of the Consortium 'EKOINDUSTRIJA';
- Mechanical Technology, Part 2: Line for separation from communal waste at the regional landfill of Duboko", July 2005 (chapter 2.8: "leachate treatment")

<u>Approvals</u>

- Decision to approve the Environmental Impact Assessment Study is issued by the Municipal Administration Užice - Department for City Planning, Civil Engineering and Public Utility-Residential Services, No. of permit 07-502-5/05, dated on 27/09/2005.
- Decision to approve the construction of Regional Sanitary landfill is issued by the Municipal Administration Užice - Department for City Planning, Civil Engineering and Public Utility-Residential Services, No. of permit 07-351-259/05, dated on 28/09/2005.

<u>Landfill</u>

Reviewing the documents the main findings are:

- The landfill design of Nov.1999 was based on waste from Užice alone. No separation/recycling centre was foreseen;
- The adjusted technical design concerns only the addition of a recycling line at the site of Duboko.
- The landfill design has not been adjusted on developments since 1999;
- The landfill is constructed in 4 phases. In the 1999 design the first phase will last 10 years (based on old mid '90 waste data);
- A bottom liner of 2 mm PE is applied. Unit price will be in installed m2;
- A 50 cm drainage layer, consisting of gravel with perforated PVC pipes is applied;
- Land filling starts at the lowest point;
- The principle of one cell filling per day, levelling, compacting and covering with 20 or 30 cm (altering per day) soil is applied. In two days a layer of 230 cm is formed consisting of 2 x 90 waste and two layers of 20 and 30 cm;
- De-gassing pipes are collecting the formed biogas. The biogas is combusted in a flare;
- After filling phase 1 closing the phase 1 landfill consist of a soil layer with planting (a/o trees). No top liner is foreseen;

- Originally calculated total investment estimation: some 6 M€ (1999).

Comments
In principle the set-up of the Duboko landfill is according the EU/national standards:
- A drainage system is present that collects the leachate and transport it towards the leachate treatment facility;
- Modern land filling technique of filling per cell, levelling, compacting and covering is applied;
- No utilisation of the biogas is foreseen such as electricity and/or heat production. A feasibility study shall indicate if this is attractive;

The single bottom liner of 2 mm PE does not fulfil the EU Directive Land filling of waste.

### 4.5.2 Design - Bottom Construction

The EU Directive land filling of waste requires the following protective measures:

Protection of soil and water

A landfill must be situated and designed so as to meet the necessary conditions for preventing pollution of the soil, groundwater or surface water and ensuring efficient collection of leachate as and when required according to Section 2. Protection of soil, groundwater and surface water is to be achieved by the combination of a geological barrier and a bottom liner during the operational/active phase and by the combination of a geological barrier and a top liner during the passive phase/post closure.

The geological barrier is determined by geological and hydrogeological conditions below and in the vicinity of a landfill site providing sufficient attenuation capacity to prevent a potential risk to soil and groundwater. The landfill base and sides shall consist of a mineral layer which satisfies permeability and thickness requirements with a combined effect in terms of protection of soil, groundwater and surface water at least equivalent to the one resulting from the following requirements:
- landfill for hazardous waste: $k \leq 1.0 \times 10^{-9}$ m/s; thickness ≥ 5 m,
- landfill for non-hazardous waste: $k \leq 1.0 \times 10^{-9}$ m/s; thickness ≥ 1 m,
- landfill for inert waste: $k \leq 1.0 \times 10^{-7}$ m/s; thickness ≥ 1 m.

Where the geological barrier does not naturally meet the above conditions it can be completed artificially and reinforced by other means giving equivalent protection. An artificially established geological barrier should be no less than 0.5 meters thick.

In addition to the geological barrier described above a leachate collection and sealing system must be added in accordance with the following principles so as to ensure that leachate accumulation at the base of the landfill is kept to a minimum: artificial sealing liner and drainage layer ≥ 0.5 meter

In the existing reports it is written that the subsoil consists of an eluvial/diluvial cover, on top of weathered/intensively fractured sandstones and shales (Technical Report, IMS Institute, geological and geomechanical investigation).

1. Based on grain-size analysis, the values of filtration coefficient in eluvial-diluvial cover are $2.67*10^{-5}$ to $8.08*10^{-7}$ cm/sec, and in metamorphized complex of

sandstones and shales $1.42*10^{-3}$ to $9.04*10^{-6}$ cm/sec. Increased contents of clayey fraction in eluvial-diluvial cover cause decrease of filtration coefficient of this material compared to materials in substratum;

2. The results of conducted field pouring tests by “Le Franc” method are $1.29*10^{-4}$ to $5.36*10^{-7}$ cm/sec;
3. The filtration coefficient values obtained in laboratory are in eluvial-diluvial cover, the filtration coefficient values are $1.43*10^{-7}$ to $6.16*10^{-8}$ cm/sec, and in metamorphized sandstones and shales $1.39*10^{-6}$ to $3.59*10^{-6}$ cm/sec.

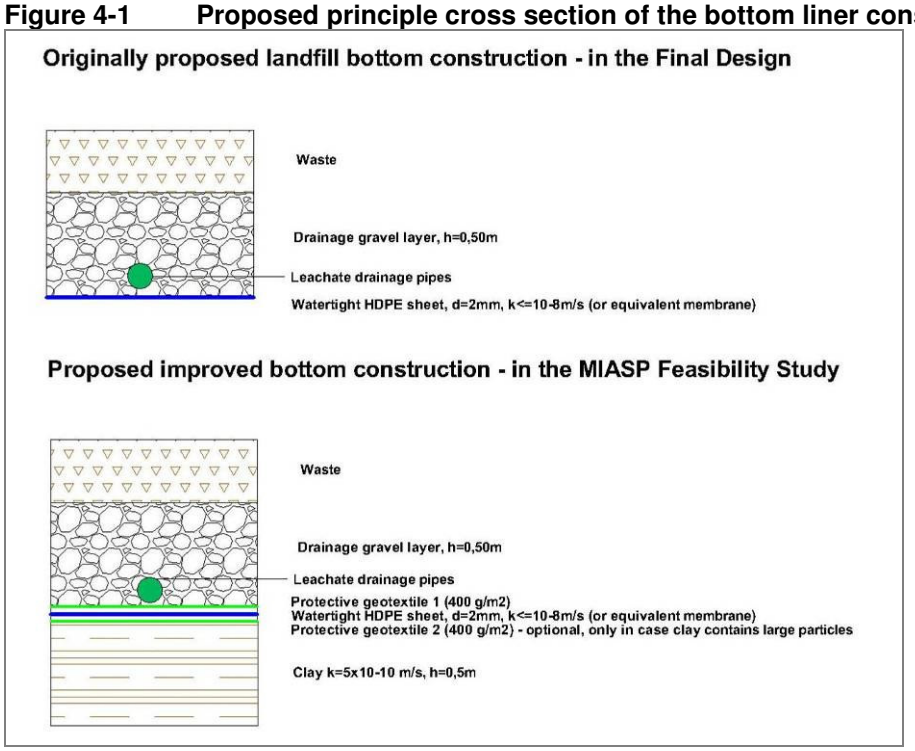
This means that the consistency of the 'natural' geological barrier is not proven. If other documents or investigations do not prove the existence of a geological barrier, an additional artificial mineral bottom liner shall be considered.

The following adaptation of the bottom line construction is proposed:

- Above the HDPE sheet a protective geotextile shall (400 gr/m2) be placed in order to prevent holes due to penetration of course materials in the drainage layer;
- A clay layer of 0.5 m layer shall be laid underneath the HDPE sheet. If the quality of the available clay is poor (or too expensive) or a sand bentonite or a trisoplast® can be applied as an alternative;
- If clay is used that might contain coarse particles that can penetrate the above placed HDPE sheet (only) than a protective geotextile shall be applied.

In Figure 4-1 the bottom liner construction is visualized.

**Figure 4-1 Proposed principle cross section of the bottom liner construction**



### 4.5.3 Design - Top Cover

No impermeable top liner (final covering) is applied. A soil layer of 50 cm is foreseen. This will not fulfil EU Directive 1999/31/EC on land filling of waste. We propose the following:

The EU Directive on land filling of waste requires the following top cover measures:

(..) If the competent authority after a consideration of the potential hazards to the environment finds that the prevention of leachate formation is necessary, a surface sealing may be prescribed. Recommendations for the surface sealing are as follows:

| Landfill category | Non hazardous | Hazardous |
|---|---|---|
| Gas drainage layer | Required | Not required |
| Artificial sealing liner | Not required | Required |
| Impermeable mineral layer | Required | Required |
| Drainage layer > 0,5 m | Required | Required |
| Top soil cover > 1 m | Required | Required |

If, on the basis of an assessment of environmental risks taking into account, in particular, Directive 80/68/EEC(1), the competent authority has decided (..) that collection and treatment of leachate is not necessary or it has been established that the landfill poses no potential hazard to soil, groundwater or surface water, the requirements in paragraphs 3.2 and 3.3 above may be reduced accordingly. (..)

It is not known if such a risk assessment has been carried out. If not, a top cover shall be installed.

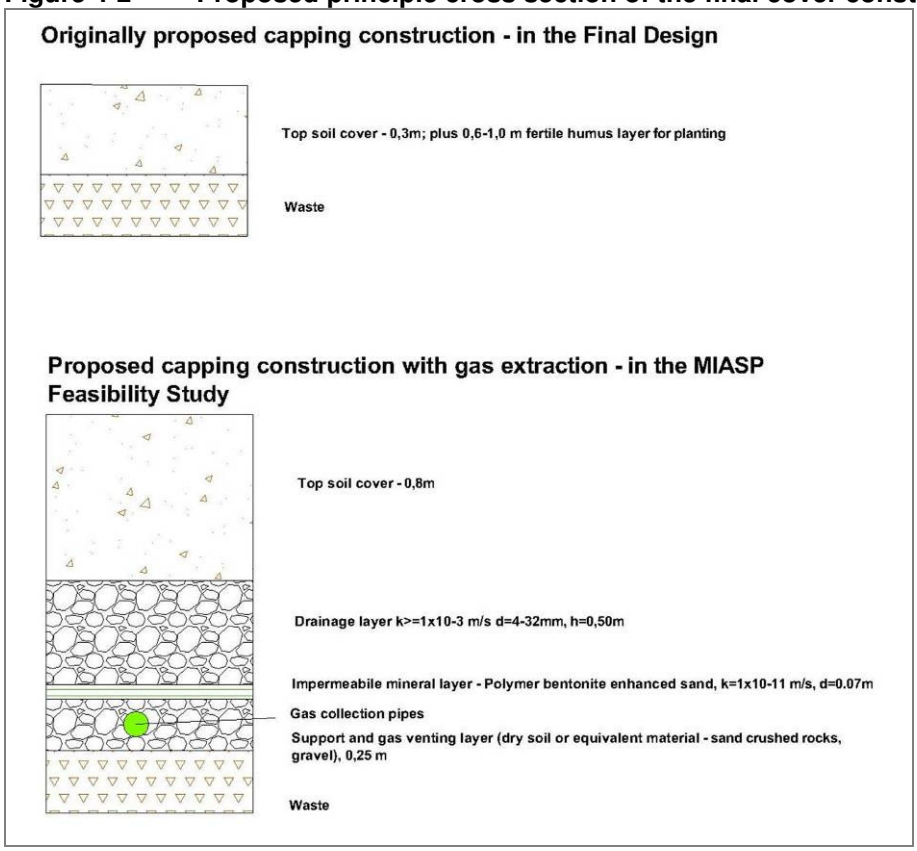
Common mineral liners, frequently used for similar purposes are:
1. Polymer bentonite enhanced sand (Trisoplast) liner (permeability of k= 5*10-12 m/s);
2. Geosynthetic Clay Liner (GCL) (permeability of k = 10-10 m/s, k=5*10-11m/s and k=3*10-11 m/s);
3. Natural clay with permeabilities possible up to k = 10-9 m/s.

The Serbian law gives in principle the following requirement: As the landfill has to settle, the final covering (capping) shall not be implemented earlier than one (preferred 2- 3) year after closure of the landfill.

As Duboko landfill shall not receive hazardous waste and artificial sealing top liner is not required. It must be clear that NO HAZARDOUS WASTE is land filled in Duboko.

The principle cross section of the final cover construction considered to be constructed on top of the landfill is given in Figure 4-2.

**Figure 4-2 Proposed principle cross section of the final cover construction**




Support layer

Any final covering requires a stable base layer. A support layer consists of approximately 0.3 dry soil or equivalent material (sand, crushed rocks, gravel, etc.). This layer shall serve as bearing layer for the construction of a mineral liner. The main part of this layer can be constructed directly after ending the landfill activities and after reshaping and profiling the landfill body.

Mineral liner

Standard mineral liners as alternatives are:

1. Trisoplast liner (Trisoplast liner of 0.07 m thickness with a k-value of $5x10^{-12}$ m/s);
2. Geosynthetic Clay Liner (GCL) of. 0.01 m thickness with a k-value of $1x10^{-11}$ (m/s).

**Table 4-2 Comparison of mineral layers**

| **Lining system**<br>0 standard properties<br>+ better then standards<br>- less then standards | **Clay 0.5 m k=$5x10^{-10}$ (m/s)**[1] | **GCL 0.01 m k=$3x10^{-12}$ (m/s)** | **Polymer bentonite enhanced sand 0.07 m k=$1x10^{-11}$ (m/s)** |
|---|---|---|---|
| Maximum leakage mm/year | 63 | 137 | 7[2] |
| Long term resistance regarding maximum leakage | 0 | -- | ++ |

| **Lining system**<br>0 standard properties<br>+ better then standards<br>- less then standards | **Clay 0.5 m k=5x10$^{-10}$ (m/s)**[1] | **GCL 0.01 m k=3x10$^{-12}$ (m/s)** | **Polymer bentonite enhanced sand 0.07 m k=1x10$^{-11}$ (m/s)** |
|---|---|---|---|
| Chemical stability | + | +/- | ++ |
| Desiccation / cracking (Drying out effect) | -- | - | ++ |
| Long term resistance regarding settlement differences | 0 | 0/- | + |
| Required thickness and stability of supporting layer | 0 | ++ | ++ |
| Construction experience | ++ | + | + |

1) This is theoretically possible. In practice a k-value of 1 x 10$^{-9}$ is achievable (see hereafter)
2) This is the most frequent used solution at the moment in Western-Europe and is according the EU-Directive.

Theoretically clay can have a k-value of 5 x 10$^{-10}$, however in general a more realistic k-value is 1 x 10$^{-9}$. Large volumes of clay are needed for the covering. Handling of clay is difficult.

Polymer bentonite enhanced sand has the best long term resistance against a decrease of the k-value and against developing of leakage caused by settlements. Polymer bentonite enhanced sand gives the lowest maximum leakage as standard layer. The chemical resistance is better than in other mineral systems. Therefore, in this specific case and regarding the long term, polymer bentonite enhanced sand is considered and proposed as the most suitable and durable system to apply in the capping construction for the landfill.

Drainage layer
The drainage layer is made with a minimum thickness of 0.50 m. The value of the permeability must be ≥ 1 x 10$^{-3}$ m/s. The content of calcium carbonate must not exceed 10% (mass). The size of the particles must be included between 4 mm and 32 mm. The percent of superior and inferior particles can't exceed 3% (mass). Woods, metals, plastic materials or other foreign components must not be contained in the drainage material. Drainage layer must have a tolerance in plane of maximum 2 cm/4.0 m.

Geotextiles (optional, not included)
To avoid clogging of the drainage layer through soil materials penetration from the cover layer, geotextiles application can be considered if the soil layer consists of small particles.

Top soil layer
A top soil layer for protection of the cover construction and grassing of the top surface of the closed and covered landfill is foreseen. The material is local available soil, but preferably a kind of soil, suitable to grow vegetation and with some resistance against erosion should be chosen. The thickness of the top soil layer shall be 0.8 m.

Other general comments:

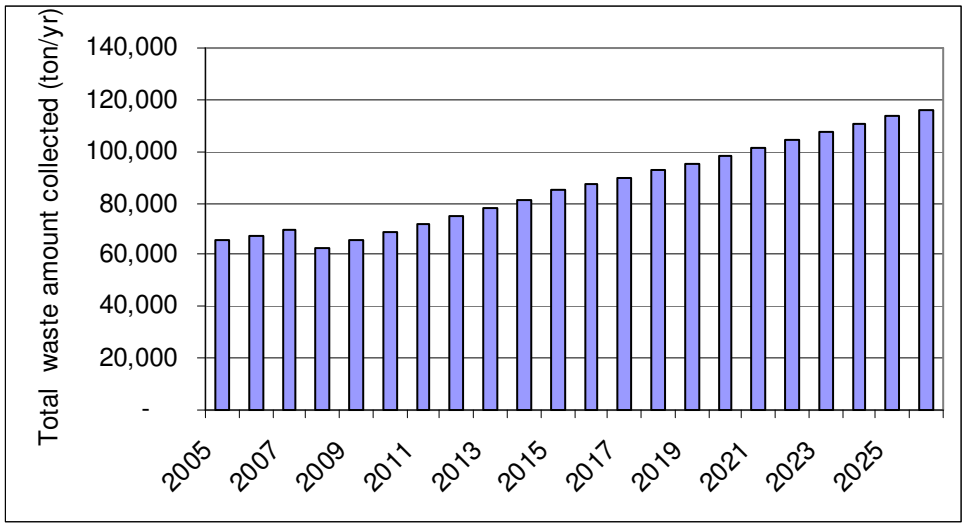
- It shall be avoided to mix municipal solid waste with other wastes. Household hazardous waste, hazardous industrial waste, slaughter waste and hospital waste should be banned from the landfill. A waste acceptation procedure must be drawn up for this purpose and shall be strictly applied.
- The advices of the (Technical Report, IMS Institute, geological and geomechanical investigation) shall be followed: this means that measures shall be considered to prevent sliding of subsoil layers (e.g. melioration ditches on the top of the slopes), and permanent expert geotechnical supervision in order to react timely to possible changes in the design, construction and operation activities.
- The slopes of the final layer (1:2) are rather steep, and might give problems due to instability of top cover layers and/or erosion of top soil.
- The slope of the embankments (3% in the direction of the slope) shall be considered to be changed into a slope (3%) in opposite direction (towards the hill side). This, including drainage measures, reduces the risk of erosion of top soil.

*Note:*
*It is strongly recommended that, during project design adjustment and tender document preparation phases, technical proposal cost optimization be carried out, taking into account availability of the abovementioned materials at the local market, market prices, etc. These adjustments are aimed at reducing overall investment costs and utilizing the materials that best suit local conditions.*

### 4.5.4 Amounts of waste to be land filled

With the scenarios applied and the removal efficiencies of the recycle line taken into account the amount of waste to be land filled has been calculated.

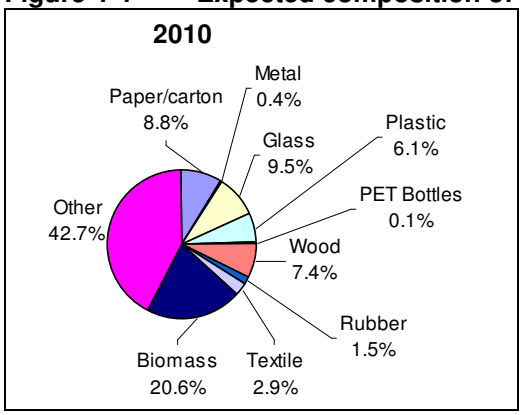
**Figure 4-3 Development of the total amount of waste to be land filled**




The reduction due to the recycling activity is some 15% (form 2009 onwards).

Figure 4-4 shows the composition of waste in 2010.

**Figure 4-4 Expected composition of the waste to be land filled in 2010**




### 4.5.5 Life-time landfill Duboko

The Duboko sanitary landfill will be developed in 5 (five) phases. The phases I & II are proposed to be constructed at the start of the project. The other phases will see construction as phase II approaches its filling-up.

The Duboko landfill staging in accordance with the existing final design is given below.

**Table 4-3 Volumes in the phases of landfilling**

| | Net-effective volume for waste disposal ($m^3$) | Volume of inert material for covering ($m^3$) | Total volume ($m^3$) | Net-effective volume for waste disposal- cumulative ($m^3$) | Volume of inert material for covering - cumulative- ($m^3$) | Total volume - cumulative ($m^3$) |
|---|---|---|---|---|---|---|
| **Phase I** | 200,400 | 17,400 | 217,800 | 200,400 | 17,400 | 217,800 |
| **Phase II** | 344,800 | 30,000 | 374,800 | 545,200 | 47,400 | 592,600 |
| **Phase III** | 47,400 | 4,100 | 51,500 | 592,600 | 51,500 | 644,100 |
| **Phase IV** | 96,000 | 8,300 | 104,300 | 688,600 | 59,800 | 748,400 |
| **Phase V** | 333,000 | 29,000 | 362,000 | 1,021,600 | 88,800 | 1,110,400 |
| | **1,021,600** | **88,800** | **1,110,400** | **1,021,600** | **88,800** | **1,110,400** |

The net cumulative effective volume for waste disposal amounts just over 1 million m3. With the waste amounts expected to be land filled this gives an expected life-time of 12 years (Table 4-4).

**Table 4-4 Life-time of Duboko landfill**

| | Total waste collected in tons | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Municipality** | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** | **2014** | **2015** | **2016** | **2017** | **2018** | **2019** | **2020** | |
| Užice | 18,278 | 18,211 | 16,265 | 17,167 | 17,947 | 18,768 | 19,625 | 20,525 | 21,346 | 22,200 | 23,088 | 23,780 | 24,494 | 25,229 | 25,986 | 26,765 | |
| Arilje | 4,609 | 4,799 | 4,200 | 4,365 | 4,585 | 4,815 | 5,056 | 5,309 | 5,521 | 5,742 | 5,972 | 6,151 | 6,335 | 6,525 | 6,721 | 6,923 | |
| Lučani | 1,382 | 1,442 | 1,262 | 1,312 | 1,378 | 1,447 | 1,520 | 1,596 | 1,659 | 1,726 | 1,795 | 1,849 | 1,904 | 1,961 | 2,020 | 2,081 | |
| Kosjerić | 640 | 666 | 583 | 606 | 636 | 668 | 701 | 737 | 766 | 797 | 829 | 853 | 879 | 905 | 932 | 960 | |
| Požega | 8,448 | 8,819 | 7,718 | 8,021 | 8,425 | 8,850 | 9,292 | 9,757 | 10,147 | 10,553 | 10,975 | 11,305 | 11,644 | 11,993 | 12,353 | 12,723 | |
| Bajina Bašta | 2,518 | 2,647 | 2,309 | 2,400 | 2,521 | 2,648 | 2,780 | 2,919 | 3,036 | 3,157 | 3,284 | 3,382 | 3,484 | 3,588 | 3,696 | 3,807 | |
| Čajetina | 3,224 | 3,355 | 2,936 | 3,053 | 3,206 | 3,366 | 3,535 | 3,711 | 3,860 | 4,015 | 4,175 | 4,300 | 4,429 | 4,562 | 4,699 | 4,840 | |
| Ivanjica | 4,576 | 4,771 | 4,176 | 4,340 | 4,558 | 4,788 | 5,027 | 5,279 | 5,490 | 5,709 | 5,938 | 6,116 | 6,299 | 6,488 | 6,683 | 6,884 | |
| Čačak | 22,400 | 22,347 | 19,959 | 21,086 | 22,060 | 23,083 | 24,082 | 25,187 | 26,195 | 27,242 | 28,332 | 29,182 | 30,058 | 30,959 | 31,888 | 32,845 | |
| | **66,076** | **67,057** | **59,408** | **62,349** | **65,316** | **68,432** | **71,619** | **75,019** | **78,020** | **81,141** | **84,387** | **86,918** | **89,526** | **92,212** | **94,978** | **97,827** | |
| Density after compacting | | | | | | | | | | | | | | | | | |
| kg/m3 | 900 | 900 | 900 | 900 | 900 | 900 | 900 | 900 | 900 | 900 | 900 | 900 | 900 | 900 | 900 | 900 | kg/m$^3$ |
| m$^3$/year | 73,418 | 74,507 | 66,009 | 69,277 | 72,573 | 76,036 | 79,576 | 83,355 | 86,689 | 90,157 | 93,763 | 96,576 | 99,473 | 102,458 | 105,531 | 108,697 | m$^3$ |
| Cummulative m$^3$ of waste | | | | 69,277 | 141,850 | 217,886 | 297,462 | 380,817 | 467,506 | 557,663 | 651,426 | 748,002 | 847,475 | 949,933 | 1,055,464 | 1,164,161 | m$^3$ |
| | | | | | | | 79,576 | 162,931 | 249,620 | 339,777 | 433,540 | | | | | | |
| | | | | | | | | | | | | 96,576 | | | | | |
| | | | | | | | | | | | | | 99,473 | 193,237 | 289,813 | | |
| **Phase I** | | | | | | | | | | | | | | | | | |
| **Phase II** | | | | | | | | | | | | | | | | | |
| **Phase III** | | | | | | | | | | | | | | | | | |
| **Phase IV** | | | | | | | | LIFE SPAN landfill Duboko | | | | | | | | | |
| **Phase V** | | | | | | | | 12 year | | | | | | | | | |

### 4.5.6 Leachate treatment

Reviewing the documents the main findings are:

- The landfill has a drainage layer of gravel with perforated PVC pipes in which the leachate is collected. At the lowest point of the landfill a lagoon is foreseen that will be forced aerated in order to achieve a biological degradation. In a subsequent second lagoon sedimentation takes place.
- Although not mentioned the sediment/sludge will be most likely deposited in the landfill. The treated water shall be dispose off to a sewage system that is connected to a waste water treatment plant or brought direct to a WTTP. It is noted that in Užice there is no WTTP meaning that the treated water will end up in the river.
- Estimated investment: 3 million Dinar (approx. 36,000 €).

*Comment*
The bottom liner of the landfill intercepts the water inside the landfill (leachate) from leaching to the sub-soil and groundwater. To drain off this leachate a drainage layer shall be installed. At the bottom of the drainage layer HDPE (preferred instead of PVC) drainage pipes shall be installed to collect the leachate. The in-between distance of two drains shall be around 15 m. Each leachate drain shall be connected to a slotted leachate collection drain downstream in the landfill cell. The collection drains shall discharge the leachate water to a collection pit. The collected leachate in this pit shall be discharged via a leachate discharge system to the aeration and subsequent sedimentation lagoon as proposed.

The leachate drains need to have an opening on each end (where possible) for inspection and maintenance. For that reason leachate drain length shall not exceed approximately 200 meter if an inspection device is available on both ends.

A protective layer shall be installed between the drainage material (gravel) and the PE liner. The protective layer shall consist of a geotextiles. The dimensions of the

geotextiles shall be designed based on the waste load and gravel specifications (coarseness, type).

Lagoons
The bottom liner of the lagoons is preferred to be constructed out of a mineral liner or a PE-liner thus preventing of the collected leachate to infiltrate into the sub soil.

Surplus leachate that temporary does not fit in the lagoons (after heavy rains) shall be stored in the landfill cell itself. The landfill design at the lowest part shall be adjusted for this purpose.

Aeration and sedimentation
Shall be recalculated taking into account the proposed recirculation of treated leachate water

Recirculation
As there is no WTTP in Užice the treated leachate water will end up in the local stream. To minimize discharge, we propose to spray the collected, aerated and sedimented leachate-water over the landfill. The main part of the water will evaporate (> 50%). The remaining water will prevent dust problems and will infiltrate in the landfill body and enhance biodegradation and LFG production.

The recirculation of leachate can be done by means of a movable irrigation pump with fire-hoses to transport water to a spraying unit. In this way, a simple and flexible leachate infiltration system is guaranteed. When needed, the system can easily be extended with more pumps/hoses in order to raise the recirculation capacity.

The recirculation will increase the leachate flow. The design capacities have to be recalculated.

### 4.5.7 Landfill gas (LFG) extraction

Reviewing the documents the main findings are:
- De-gassing piping is foreseen;
- LFG amount calculation is present, but based on 1999 situation (only Užice, no recycling);
- The LFG is collected and subsequently flared.

Comments
Land filled waste produces landfill gas (LFG). This gas has positive and negative properties. The main negative properties are the smell, the contribution to the global warming problem and the damage it causes to vegetation. Positive properties are its combustion features and energetic contents.

Extraction and utilization of the LFG combines the solving of the negative properties and taking the benefits of the positive properties. Therefore, the implementation of LFG extraction and utilization is therefore taken into account at Duboko landfill

Present LFG-extraction techniques make it possible to start LFG extraction already during the landfill activities.

Wells, headers and pipes

In the Duboko landfill case, the extraction of landfill gas is most effective by installing vertical extraction wells. It is foreseen to build up the extraction wells during the exploitation period of the new landfill cell (and future cells). This makes it possible to start landfill gas extraction from the earliest moment of production (approximately 3 years after land filling of the concerned waste).

In general, the landfill gas extraction (until the blower/flare units) system consists of:

- landfill gas extraction wells (extendable build-up wells);
- landfill gas collection headers;
- landfill gas collection and transport piping system;
- Condense water siphons.

The operator of the landfill has to install the vertical extraction wells already during the start of the exploitation of the landfill. After approximately 2 m height of waste is dumped the wells can be installed direct at the sand drainage layer. During exploitation those wells shall be pulled up until the final level.

The bottom of the extraction pipe is placed at least 1 m above the bottom lining system. The extraction pipe consists of a slotted HDPE-pipe. The slotted part of the extraction pipe must be completely covered with filter gravel. The top of the extraction well is covered by a steel protection pipe/casing.

After reaching the final level of the landfill a telescopic connection is installed to absorb the settlement of the landfill at the upper-part of the slotted pipe. A blind HDPE pipe slides into this telescopic connection. Above the slotted part and the gravel column a 60 cm thick impermeable plug of compacted clay/bentonite mineral shall be installed.

The head of the extraction well connects the extraction well to the extraction piping system. The landfill gas extracted from several extraction wells (approximately 8 wells) is collected at one central point, the landfill gas collection header. From the header, a main piping network leads the gas to the blower, flare and utilization units. The collection and transport piping system shall be covered with soil. Condense water from the pipes will be discharged to the leachate collection system.

The amounts of LFG produced and captured have been recalculated based on the expected amounts of waste to be land filled over time and its composition over time.

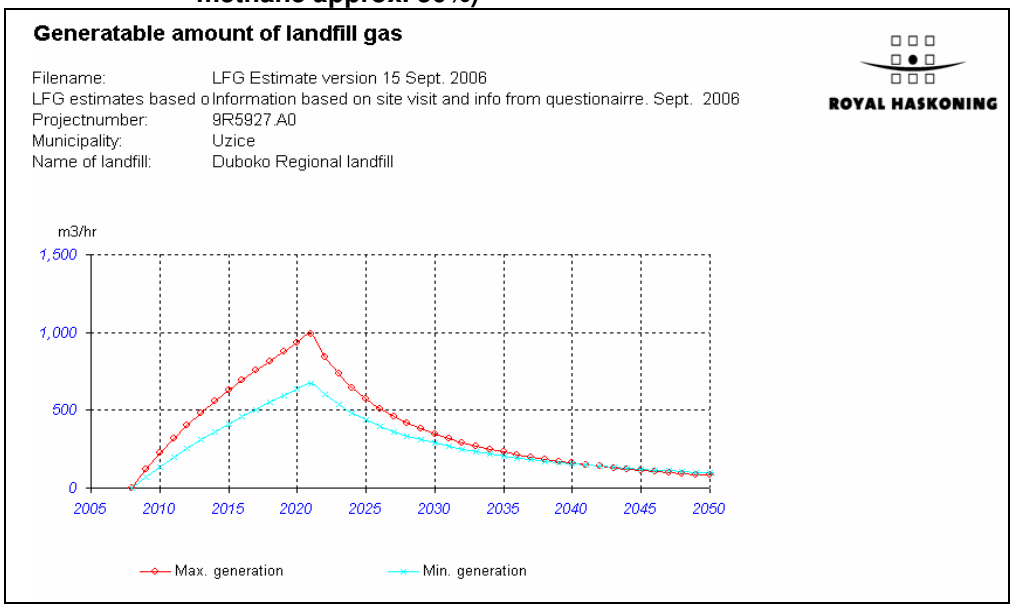
Basic data

- Design landfill, conform design with proposed adjustments
- Start of land filling: Jan, 2008;
- 5 phases;
- Waste amounts: see Figure 4-3;
- Waste composition: see Figure 4-4.

LFG generation

The generated amount of biogas (landfill gas - LFG) is given in Figure 4-5. The two lines represent the range we normally see.

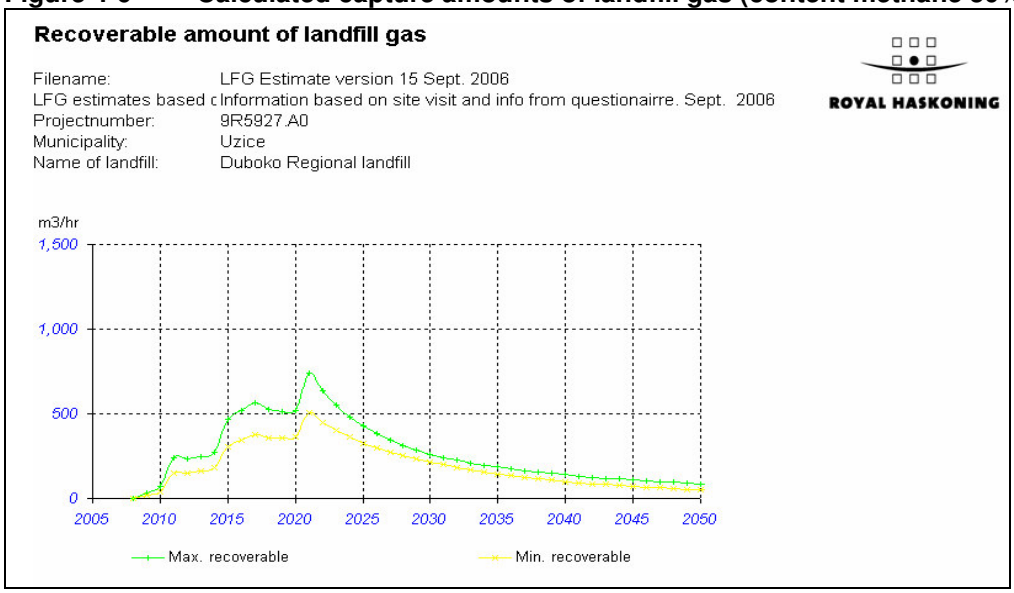
**Figure 4-5 Calculated generation amount of landfill gas per hour (content methane approx. 50%)**




From 2009 onwards the first cell of the Duboko landfill is being filled up with waste. Temporary gas extraction wells are being installed from the start of filling a new cell. The vertical extraction wells will “grow” with the height of waste in the cell. As soon as the cell in filled up the cell is closed and covered with a (temporary) sand layer after which it is expected that some 70% of the gas produced will be captured. After settling of the cell (after some 2-3 years) a final cover shall be placed, increasing the recovery rate to at least 85%. During filling-up it is possible to capture some of the gas that is produced. In practice the gas is (will be) released to the atmosphere in a controlled way (using the wells for venting / controlled release). Therefore low capturing rates (25-35%) are used in the LFG modelling during the land filling activity.

Using these recovery rates we get the following LFG capture amounts (Figure 4-6).

**Figure 4-6 Calculated capture amounts of landfill gas (content methane 50%)**




The typical shape of the amount of LFG captured is explained as follows:

After opening the first new cell the present dump location is closed and immediately covered with a soil layer of 0.5 m. The new cell will produce LFG however this can not (first year) or only partly (following years till closing) be captured as the cell is used and no covering is present (apart from a daily sand layer). As soon as the cell is filled up this cell is covered and some 70% of the produced LFG is captured. After filling up the cells in phase 1 and the settling of the cells the final cover can be put in place. This increases the recovery rate further far above 85% (for a conservative approach 75% is used in the calculation).

As soon as the cells of phase 1 are filled up no fresh waste is deposited resulting in a decrease of LFG production. As LFG capturing from the cells of phase 2 is in the beginning low, we get the typical shape of Figure 4-6

The amounts of electricity production and emission potentials up to 2018 are given in Table 4-5.

**Table 4-5 Electricity production and emission reduction potential**

| Year | Electricity production | ERU's from prevented fossil fuel in power generating facilities due to replacement[2)] | ERU's from LFG recovery (and subsequent full combustion) from Duboko sanitary landfill | Total ERU's from LFG recovery and prevented fossil fuel in power stations |
|---|---|---|---|---|
| | MWh/yr | ton (1,000kg)/yr | ton (1,000kg)/yr | ton (1,000kg)/yr |
| 2008 | - | - | - | - |
| 2009 | - 1 | - | 1,604 | 1,603 |

| | | | | |
|---|---|---|---|---|
| 2010 | - 1 | 1 | 3,618 | 3,617 |
| 2011 | - 5 | 3 | 12,855 | 12,852 |
| 2012 | 2,506 | 1,366 | 12,655 | 14,301 |
| **Total 2008–2012 First credit period under Kyoto** | **2,499** | **1,362** | **30,742** | **32,104** |
| 2013 | 2,650 | 1,444 | 13,394 | 14,838 |
| 2014 | 2,939 | 1,602 | 14,856 | 16,458 |
| 2015 | 5,077 | 2,767 | 25,661 | 28,428 |
| 2016 | 5,614[1)] | 3,060 | 28,494 | 31,554 |
| 2017 | 5,613 | 3,059 | 31,191 | 34,250 |
| 2018 | 5,614 | 3,060 | 29,164 | 32,223 |
| **Total 2008–2018** | **30,007** | **16,354** | **173,502** | **189,856** |

1) Based on a Jenbacher gas engine with maximum LFG consumption of 430 $m^3$/h (resulting in a max. electrical output of the gas engine of 642 kW)

2) Used grid emission factor: 0.545 tonCO2/MWh

The design is such that it fulfils the requirements regarding the Kyoto protocol, especially measuring monitoring, etc.

### 4.5.8 LFG utilisation

The technology proposed for the utilization of biogas can be regarded as standard technology.

<u>The blower</u>
A pressure gradient in the extraction system has to be realised to extract landfill gas. To create this pressure gradient a blower shall be installed. The capacity of the blower is based on the expected amount of biogas. According to our calculations (including the implementation of more new landfill cells) a compressor with a maximum capacity of ~1,000 $Nm^3$/hr should be installed. This capacity shall be adjusted in the future, when more detailed information on quantity and quality of the LFG is obtained.

<u>The flare</u>
A flare is needed to burn excessive landfill gas. When the landfill gas is used for utilization purposes the flare needs to secure the gas extraction while doing maintenance on the utilization plant and during calamities. The maximum capacity of the flare shall be equivalent to the maximum capacity of the blower (~1,000 $Nm^3$/hr).

The flare is foreseen to be a noiseless, closed flare. This means that the flame shall burn silently and only inside the flare (invisible).

<u>Utilization of LFG</u>
When the amounts of LFG become suitable to run gas engines, utilization of LFG can be implemented. In the case of the Duboko landfill, utilization (electricity production) of the landfill gas is foreseen to take place from the first quarter of 2010.

The electrical output of gas engines depends on the total energy content of the landfill gas and the gas engine efficiency. The main characteristics of landfill gas and electricity generation are given below.

**Table 4-6 Engine electrical efficiency**

| Variable | Unit | Expected minimum methane content | | Expected maximum methane content | |
|---|---|---|---|---|---|
| Methane content | % | 45 | | 55 | |
| Total energy (based on lower burning value of methane) | $kWh/m^3$ | 4.5 | | 5.5 | |
| Gas engine efficiency | % | 33 | 36 | 33 | 36 |
| Electrical output | $kWh/m^3$ | 1.44 | 1.61 | 1.75 | 1.97 |

The engine efficiency depends upon the quality of gas, the amount of gas (between 60% and 100% of the gas engine capacity), the burning conditions and the cooling equipment. Reciprocating gas engines for landfill gas applications range from stoichometric combustion (naturally aspirated) to leaner combustion engines (lean-burn, turbo-charged). The expected electrical output of the gas engines is within the range of 1.44 to 1.97 $kWh/m^3$. Combined with an average methane content of 50% the electrical output is expected to be not more than 1.75 $kWh/m^3$.

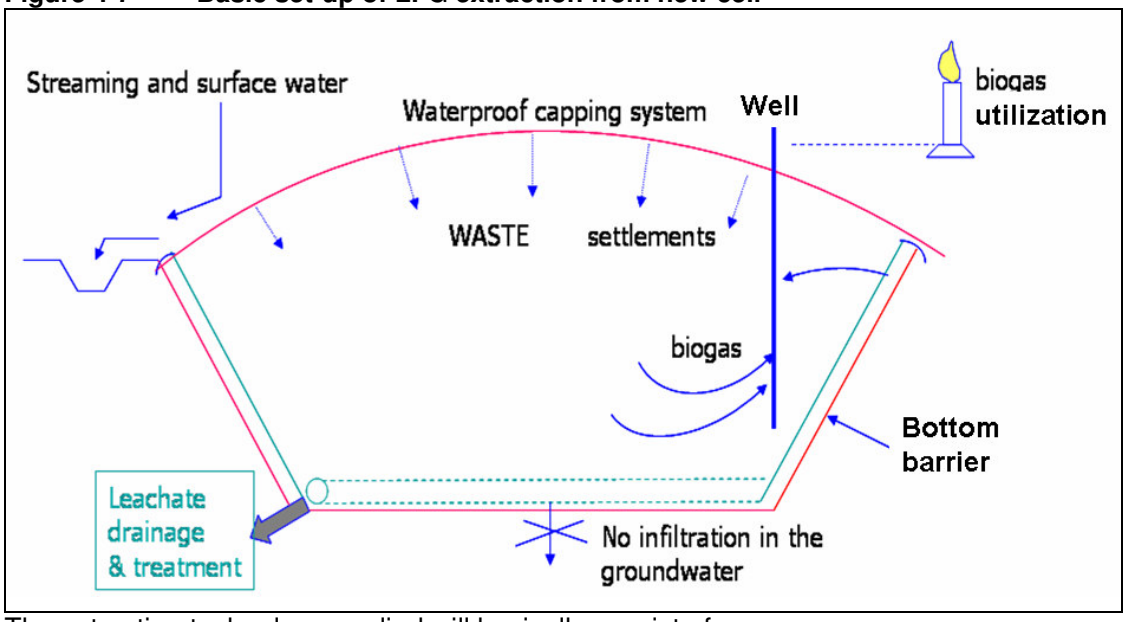
The emissions from the landfill consist mainly of $CH_4$ and $CO_2$. By utilizing landfill gas the available energy is used in a profitable way. The traces of pollutants may vary greatly in time and in place, since these levels are strongly dependent on the types of waste that have been landfilled.

**Table 4-7 Common properties of landfill gas**

| Component | Amount in landfill gas |
|---|---|
| Methane | 50-60% |
| Carbon dioxide | 35-40% |
| Nitrogen | 0-10% |
| Oxygen | 0-2% |
| Calorific value (LHV) | 18 - 21.5 MJ/Nm3 |
| Traces of pollutants<br>- Sulphur components<br>- Chlorine and fluorine | <br>0-300 ppm<br>0-40 ppm |

A basic scheme of a LFG extraction from (a) cell(s), with bottom liner, is presented in Figure 4-7 .

**Figure 4-7 Basic set-up of LFG extraction from new cell**




The extraction technology applied will basically consist of:

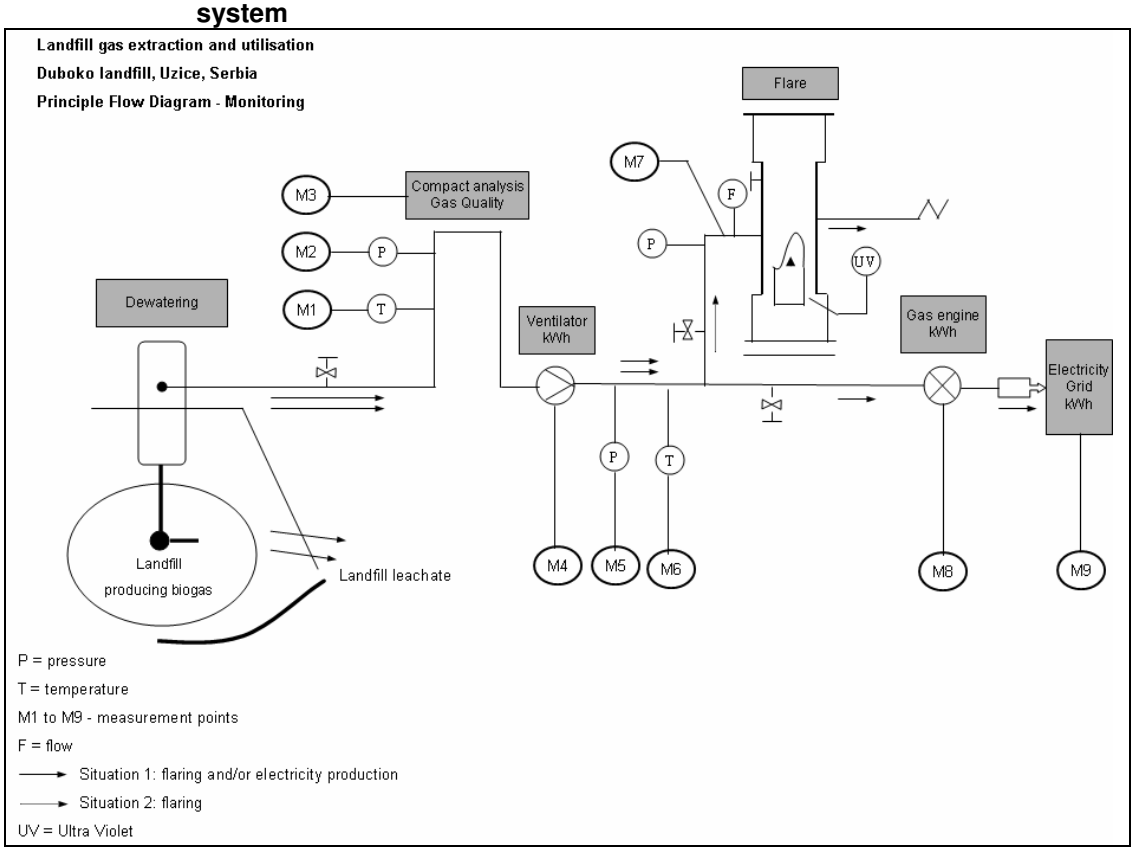
- X vertical wells (to be determined);
- connection PEHD piping (110 mm) of well to a collector header;
- collector headers (that serve 8 wells);
- a closed PEHD piping system (160 & 200 mm), connected to a compressor system;
- condensate separators;
- 1 compressor;
- simple leachate treatment installation with re-injection.

The landfill gas utilization equipment consists of:

- 1 flare (for burning any excess landfill gas that can not be utilized in the gas motors);
- 2 containerized reciprocating gas engines (landfill gas dedicated) connected to electric generators (proposed brand: Biogas dedicated engines from GE-Jenbacher or Caterpillar, rated output 2 x 500 kWe at peak LFG production);
- Hook-up to grid devices (including transformer).

The simplified P&ID of the extraction and utilization system, the electrical connection to the grid of the system is given below.

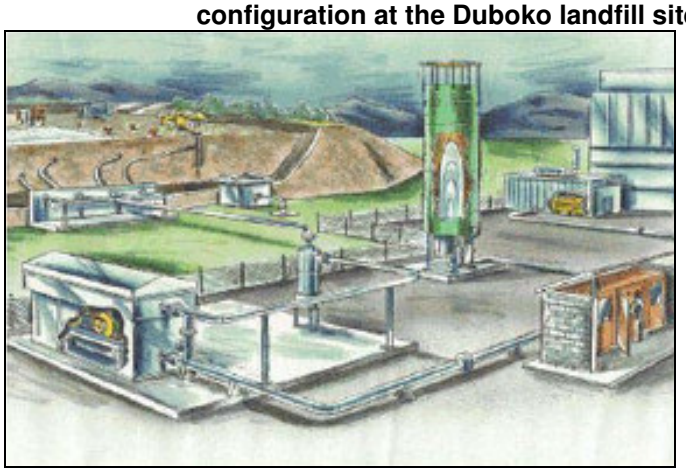
**Figure 4-8 Principle schematic set-up of a landfill gas extraction & utilization system**




The foundation has some reserve positions for 1 extra compressor, 1 gas engine with generator and transformer for future extension (when more cells produces gas).

The visual set-up could be as indicated in the picture below. The compressors and containers can be placed in containers. This makes it possible to place extra unit(s) or remove unit(s) when the LFG amount is or becomes more respectively less.

**Figure 4-9 Artist impression of possible landfill gas extraction & utilization configuration at the Duboko landfill site**



## 4.6 Waste separation line

Review

Available and relevant project documents that have been studied are:

- Design report, Part 2[7]: Mechanical and technological design of "Line for the separation of secondary materials from communal waste at the regional landfill Duboko", Consortium 'EKOINDUSTRIJA' of July 2006. Approval date: September 2005;
- EIA, Consortium 'EKOINDUSTRIJA', 2005.

At the new regional landfill site of Duboko it is proposed to erect a recycle line (the recycle centre) where valuable materials are taken out.

In principle all the waste that arrives will go through this recycle centre. Part 2 *Mechanical and technological design* of "Line for the separation of secondary materials from communal waste at the regional landfill Duboko": gives detailed information on the technical aspects of the recycle centre. It also gives investment estimation.

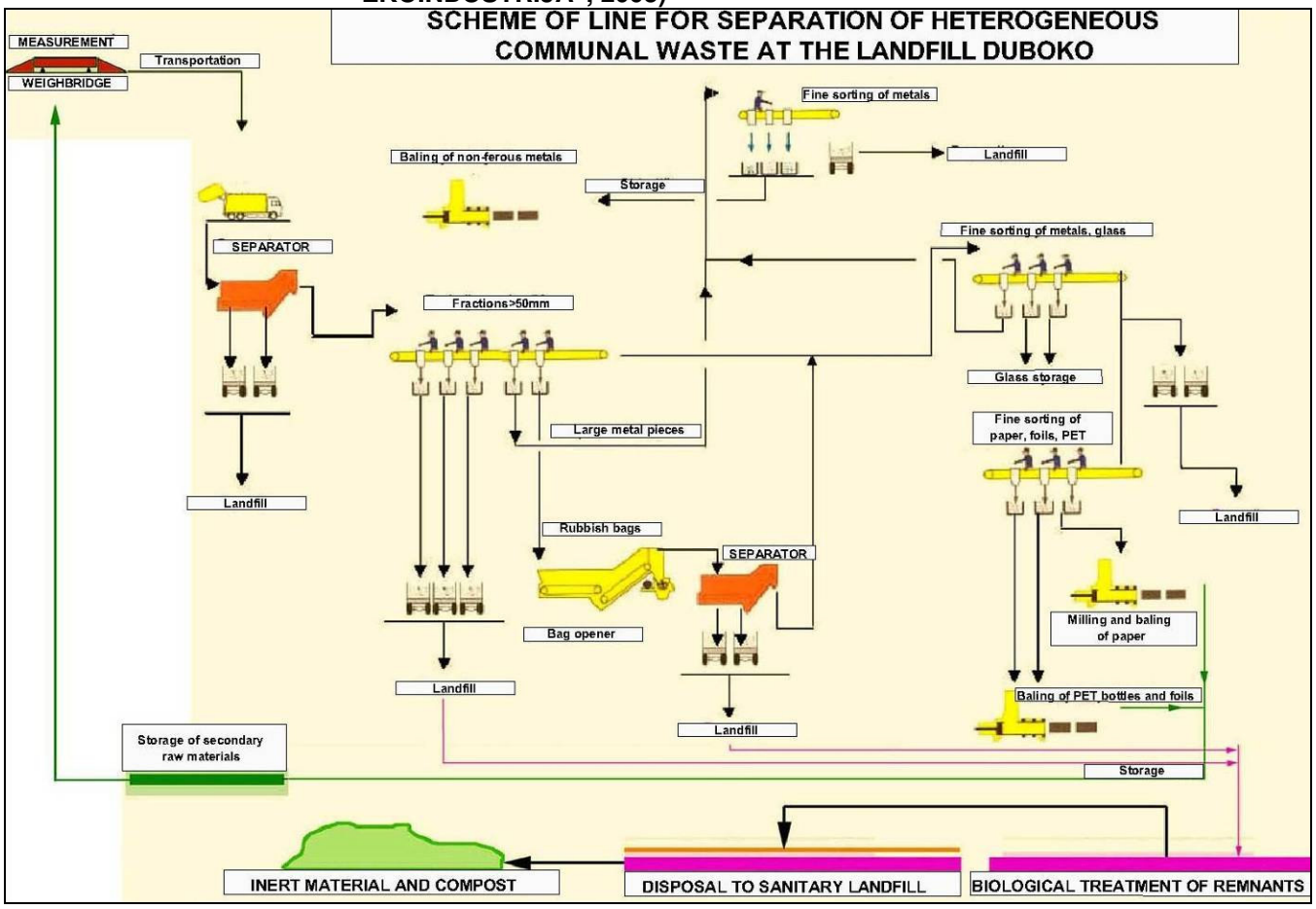
Reviewing the above mentioned document we conclude the following (main findings):

- The recycle (sorting) line basically consists of (see picture):
  - Unloading platform, feeding of first vibrating screen;
  - First vibrating screen with < 50 mm fraction going directly to landfill
  - First handpicking sorting line for > 50 mm fraction. Non-recyclables are taken out here and send to the landfill. Fine materials go to a second handpicking sorting line for a/o metal removal;
  - Rest is going to a bag opener machine that feeds the second vibrating screen;
  - Second vibrating screen with < 50 mm fraction to third handpicking sorting line;
  - Third handpicking sorting line for fine fraction that takes out PET bottles, plastics sheets, glass and paper;
  - Fourth handpicking sorting line for coarse fraction that takes out PET bottles, plastics sheets and paper;
  - Three compactors for paper, plastics and PET bottles;
  - Capacity: 68.000 ton/year or 34 ton/h based on 2000 working hour/year and 0.3 ton/m3 non-compacted waste. Not taken into account is the recycle centre in Čačak that is seriously considered by the PUC of Čačak. This will reduce the capacity requirement considerable;
- The ***designed set-up is very complex*** due to many lines and machines. High dependence on the functioning of almost all lines/machines, and therefore the reliability is questionable;
- ***Unrealistic high recovery rates*** are reported for the recyclables;
- Total investment estimated to be 125 million Dinar (1.5 M€).This ***seems to be too low*** for such a complex recycle centre.

The set-up of proposed recycle (sorting) line at Duboko landfill is given in the next figure.

[7] The other parts deal with the electrical, water supply, architecture designs and gives approval documentation that is considered here of less importance

**Figure 4-10 Set-up of proposed recycle (sorting) line at Duboko landfill (design "EKOINDUSTRIJA", 2005)**




Proposal: 2 recycling lines

The by EKOINDUSTRIJA proposed recycle centre is complex which has consequences regarding the reliability. We propose a State of the Art approach with proven technology resulting in a fit for purpose set-up and a high operational reliability.

Čačak

The municipality of Čačak has developed a plan to erect a recycle line on its territory. The PUC of Čačak bought recently a firm with a corresponding site of some 7.5 ha that has a large hall where separation of PET, metal, paper will be developed. Reported was that a (part of a) sorting machine was already present.

During the site visit on Oct. 31 it turned out that only a 30-year old baler press was present. This press needs repair for at least an estimated 40,000 Euro. It was further noticed that the hall needs rehabilitation. Further old aluminium ovens and processing machines and aluminium waste was present from the previous owner. Considerable costs must be made for repairs, removal and cleaning the site / hall.

Apart from a recycle line at the site of Duboko landfill a recycle line in Čačak can be considered. This could be justified by:

- the on-going development of a recycling line in Čačak;

- the reduced number of transports required to Duboko landfill.

***However, calculations indicated that two recycle lines are not feasible and therefore cannot be justified on financial/economical grounds. Despite the good initiative in Čačak we advice to erect only one recycle line at the Duboko landfill site.***

The municipality of Čačak still intends to invest in and operate its own separation plant. The costs involved in investing in and operating this plant will be paid for by Čačak and are not part of the Duboko scheme. A separate tipping fee will be applied for the separated waste delivered by Čačak. This fee will be determined and proposed by appropriate techno-economic analysis and approved by the municipalities at a technical meeting.

Proposed separation plant
The principle set-up of the separation plant at Duboko is presented in Figure 4-11 and Figure 4-12.

It consists in principle of:
- A Weighbridge;
- A ramp towards an unloading platform;
- A drum screen with an integrated plastic bags opener. The waste is separated in a fine and coarse fraction;
- Two sorting lines consisting of a conveyor belt with handpicking;
- A magnetic separator.

The following recycle rates are achievable:

**Table 4-8 Recycle rates**

| Recycling efficiencies | |
|---|---|
| **Fraction** | **% removal** |
| Paper | 50.00% |
| Metal | 80.00% |
| Glass | 0.00% |
| Plastic | 50.00% |
| PET bottles | 90.00% |
| Wood | 0.00% |
| Rubber | 0.00% |
| Textile | 0.00% |
| Biomass | 0.00% |
| Other | 0.00% |

The PET bottles, preferable separated on colour, the paper/carton and (when technical possible) plastic fraction shall be compacted in order to reduce the volume and to fetch a better sale price.

The recycle line requires a plot of at least 2 ha (minimum outside dimensions are about 120 x 170 m). At the entrance/exit a weighbridge is required for all incoming and outgoing waste transports and for the recyclables. Safety devices like fire fighting

equipment shall be present. The area shall be totally fenced, and a groundwater monitoring system shall be installed.

For internal transport purposes 2 shovels are required.

Total investment in the mechanical part of the recycle line is estimated to be around 2 million Euro.

**Figure 4-11 Preliminary design of the lay-out of the recycle line**

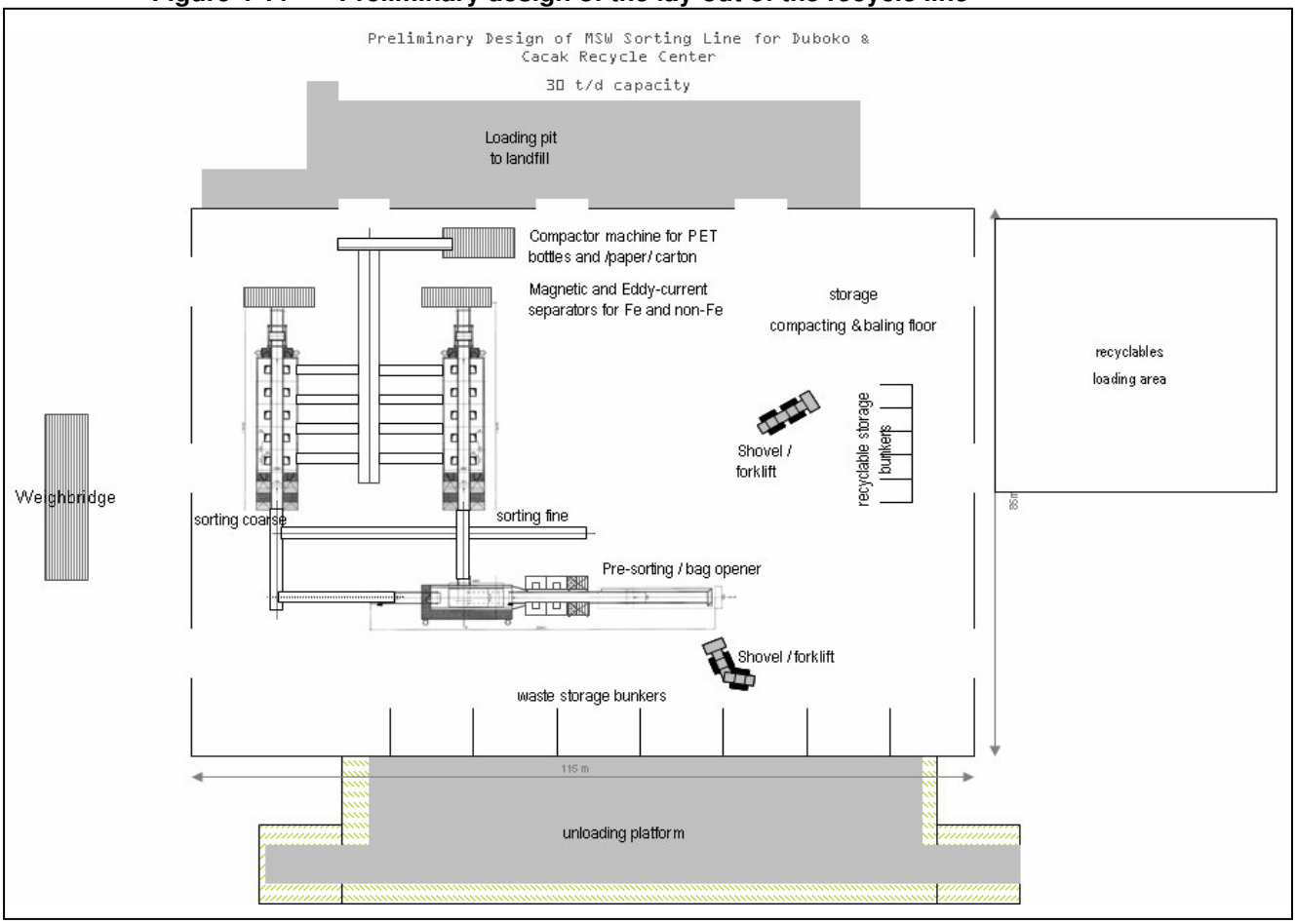
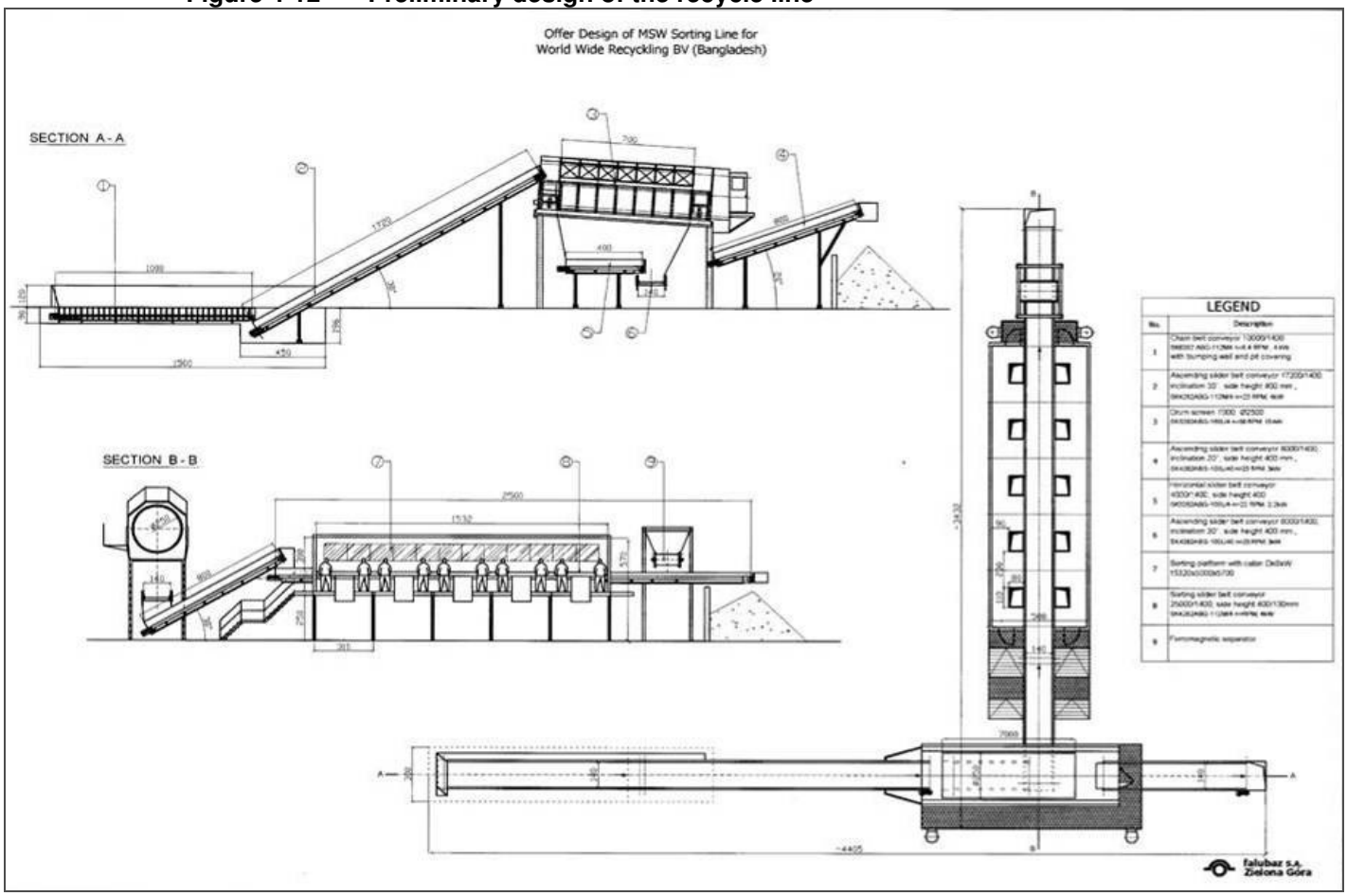


**Figure 4-12 Preliminary design of the recycle line**




## 4.7 Transport

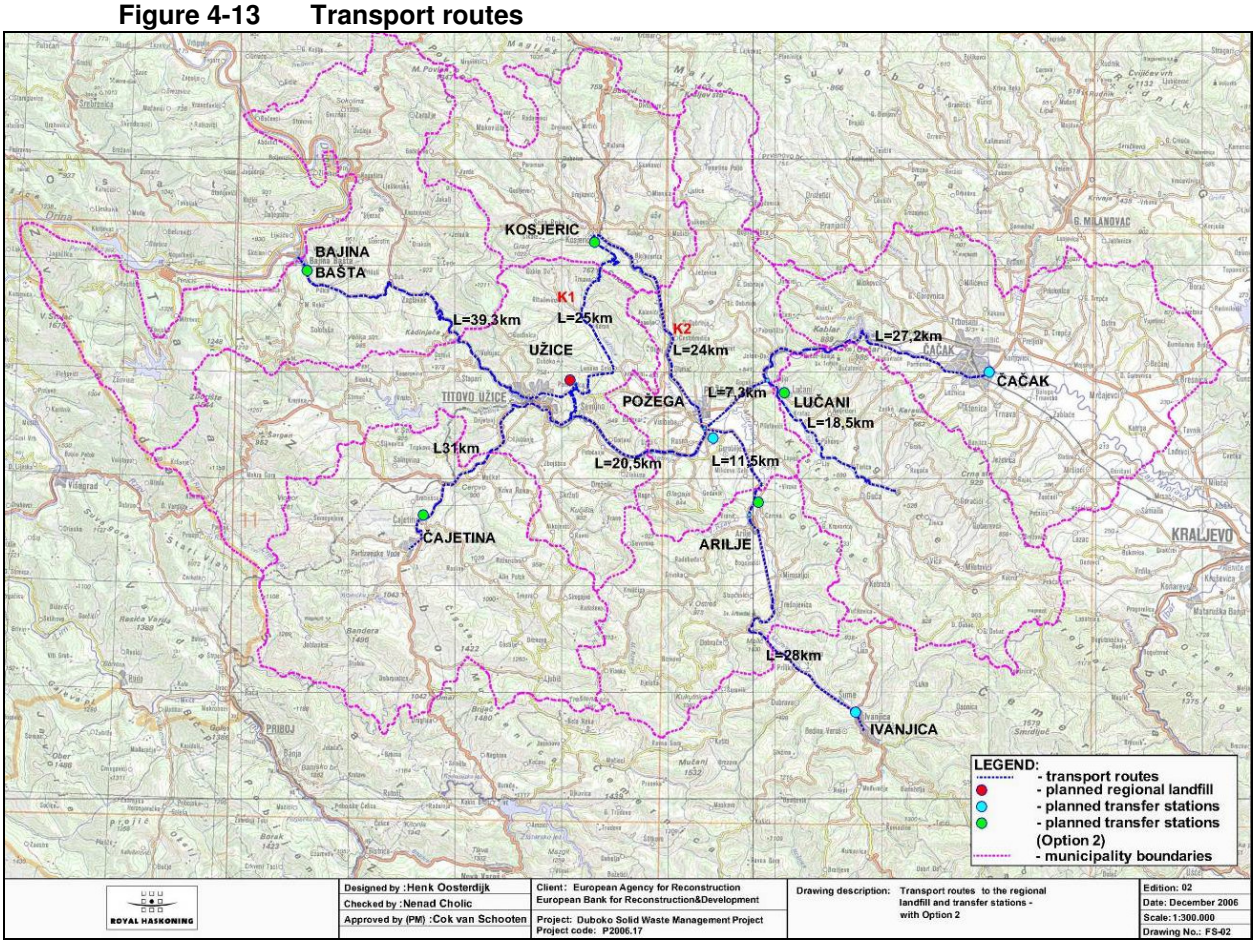
The main routes and distances from the municipalities to the new regional landfill "Duboko", taken into account the condition and capacity of the roads, are given in Table 4-9. The distances are measured from city centre to Duboko landfill site. Alternatives routes are given for the winter season situation, in case the main routes are blocked, or for unforeseen situations. The main routes are presented in Figure 4-13.

**Table 4-9 Main and alternative waste transport routes**

| Municipality | Main (proposed) route | km | Alternative route | km |
|---|---|---|---|---|
| Arilje | Arilje-Požega-Lunovo Selo-Duboko | 35 | Arilje –Požega-Užice-Duboko | 41 |
| Lučani-Guča | Guča-Lučani-Požega-Lunovo Selo-Duboko | 48 | Guča-Lučani-Požega-Užice-Duboko | 43 |
| Bajina Bašta | Bajina Bašta-Dub-Užice-Duboko | 40 | | |
| Kosjerić | Kosjerić-Karan-Lunovo Selo-Duboko | 25 | Kosjerić-Požega-Lunovo Selo-Duboko | 50 |
| Požega | Požega-Lunovo Selo-Duboko | 22 | Požega-Užice-Duboko | 25 |
| Čajetina | Zlatibor-Čajetina-Užice-Duboko | 34 | | |

| | | | | |
|---|---|---|---|---|
| Ivanjica | Ivanjca-Arilje-Požega-Lunovo Selo-Duboko | 65 | Ivanjca-Arilje-Požega-Užice-Duboko | 70 |
| Čačak | Lučani-Požega-Lunovo Selo-Duboko | 55 | | |

**Figure 4-13 Transport routes**




### 4.7.1 Review of the designed Transfer Stations (TS)

The Consultant has considered and analysed technical options for introduction of the transfer stations, including:

- Proposed, preferable number, size and locations based on technical and economic analysis;
- Indicative Layouts and technological schemes of the proposed transfer stations indicating required surface area, appurtenant structures, equipment and facilities;
- Estimates of investment and operational costs;
- Indicative Lists of the equipment necessary for operation, including special vehicles necessary for waste transportation to the regional sanitary landfill;
- Assessment of the necessity of corresponding EIA for transfer stations.

In the original plans transfer stations were not worked out. The Consortium "EKOINDUSTIJA" prepared in April 2006 a *Transfer station study* in which it is proposed to establish in *all* towns a transfer station. It is proposed to consist mainly of

- a terrain (land plot) of approx. 1 ha with gate/fence;
- a weighbridge;
- an approach ramp;
- an unloading platform;
- a steel roof construction;
- several reinforced containers suitable for compacting the waste;
- a hydraulic press and
- auxiliary equipment like fire extinguishing net, water supply, sewerage, administrative office, electric grid connection etc.

Three conceptual designs are presented in that study. The transfer stations are not worked out in detail (capacities, number of containers, trucks, set-up) for the different towns. An investment estimation of 6 million euro (average 750,000 euro each) was estimated to be required for TS's in all eight, except Užice, municipalities.

### 4.7.2 Proposed number of transfer stations

The condition and capacity of the proposed routes is such that large trucks with a > 30" container (some 50 $m^3$ net capacity) will have problems to make use of these routes. Trucks with only one large (50 $m^3$) container are the maximum sized truck-container combination possible without damaging the roads and endangering the other traffic.

According to our opinion transfer stations in all towns are not cost efficient, as most town produce only a small amount of waste and some distances are relatively small.

In order to decide on the number of TS's we have made a calculation by applying a Transfer Station model, developed by Royal Haskoning.

With the year 2010 as a reference we have:

1. Baseline scenario
   All municipalities transport their waste to Duboko with 15 $m^3$ compactor-collection trucks.
2. EKOINDUSTRIJA scenario
   The by "EKOINDUSTIJA" proposed TS's in all towns. Transport to Duboko by trucks with 50 $m^3$ container in which the waste in compacted by hydraulic press

In addition, an alternative has been investigated in which the smaller municipalities deliver their waste by means of their compactor-collection trucks of 12 or 15 $m^3$ capacity to the nearest larger city where it is transferred. Transport to Duboko by trucks with 50 $m^3$ container in which the waste in compacted.

The operational cost for the year 2010 for the two scenario's and the alternative have been calculated (see Table 4-10).

**Table 4-10 Operational cost for the year 2010 for two scenario's and alternative**

| | | | Scenario 1 | Scenario 2 | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Municipality | Waste quantity | Cost transport from virtual transfer station at border of municipality | Cost transfer station | Cost hauling | Cost transfer station + cost hauling | Hauling vehicles required | Compactor vehicles required | Qualifies? |
| | | Ton/year | CSD/year | CSD/year | CSD/year | CSD/year | pcs | pcs | |
| 1 | Arilje | 5,722 | 7,414,107 | 6,659,696 | 1,526,692 | 8,186,388 | 0.3 | 1.2 | No |
| 2 | Lučani-Guča | 1,720 | 2,897,294 | 5,779,466 | 590,982 | 6,370,448 | 0.1 | 0.4 | No |
| 3 | Bajina Bašta | 3,156 | 4,352,037 | 6,095,359 | 935,331 | 7,030,690 | 0.2 | 0.7 | No |
| 4 | Kosjerić | 794 | 738,393 | 5,575,792 | 208,199 | 5,783,990 | 0 | 0.1 | No |
| 5 | Požega | 10,517 | 9,536,560 | 8,261,587 | 1,998,108 | 10,259,695 | 0.5 | 1.8 | No |
| 6 | Čajetina | 4,000 | 5,063,366 | 6,280,986 | 1,043,640 | 7,324,625 | 0.2 | 0.8 | No |
| 7 | Ivanjica | 5,690 | 12,478,201 | 8,137,898 | 2,526,570 | 10,664,467 | 0.5 | 1.8 | **Yes** |
| 8 | Čačak | 27,018 | 51,172,648 | 15,165,772 | 10,401,495 | 25,567,267 | 2 | 7.7 | **Yes** |
| 9 | Požega (+Arilje + Lučani-Guča) | 17,958 | 16,285,000 | 12,235,258 | 3,412,046 | 15,646,304 | 0.8 | 2.7 | **Yes** |
| | | | | | | **Total** | 3.3 | 3.3 | |

Based on the calculation, only Čačak and Invanjica qualify for a transfer station (No.7 and 8 in Table 4-10).

The alternative in which smaller municipalities transport their waste by their compactor-collector trucks to a larger municipality resulted in the identification of a Transfer Station in Požega with waste supply from Arilje and Lučani. This also qualifies, however the margin is small (No.9 in Table 4-10).

Consultants propose therefore to establish Transfer Stations as follows:

- 1 large sized TS in Čačak;
- 1 medium size TS in Požega that will serve Požega, Arilje and Lučani;
- 1 small TS in Ivanjica.

Every Transfer Station will be equipped with a hydraulic press and with 4-6 reinforced containers (total 15). Four (4) long-haul trucks are required.

In spite of this, the Municipalities promoted and adopted a different approach, as described hereinafter. The Municipalities proposed and agreed to include transfer stations in all municipalities, except for Užice. The municipalities will cover the additional costs for the 5 extra transfer stations.

- The local PUC-s collect waste at the territory of their municipality, transport it to a local re-loading/transfer station that shall be constructed at a location defined by the municipality.
- The SPV Duboko accepts waste at the transfer station and is in charge of transportation between the transfer stations and the regional landfill.
- The abovementioned applies for all municipalities, except for Užice, where the local PUC shall transport collected waste directly to the landfill.

The EBRD does not have any objection to this decision, provided all municipalities reach consensus on the subject.

The investment cost of these eight transfer stations or re-loading stations is specified in Table 4-11.

**Table 4-11 CAPEX estimation for the TS including mobiles**

| Description | Budget Summary (€) |
|---|---|
| **Transfer Stations** | |
| TS Čačak | 305,000 |
| TS Požega | 275,000 |
| TS Ivanjica | 275,000 |
| TS Bajina Bašta | 275,000 |
| TS Lučani | 251,000 |
| TS Kosjerić | 251,000 |
| TS Čajetina | 259,000 |
| TS Arilje | 259,000 |
| **Total transfer stations** | **1,900,000** |
| | |
| **Intercity transport fleet** | |
| Long-haul trucks (6) | 600,000 |
| Open truck for bulky material | 90,000 |
| **Total transport** | **690,000** |
| | |
| **Gross total TS's and trucks** | **2,840,000** |

Bulk materials
For the time being, citizens or local PUC-s are collecting and delivering bulk waste originating from households (old furniture, home appliances, etc.) to their local landfill site. For instance in Užice it was estimated that they collect and dispose 200 t of bulk waste per annum.

The local landfills are going to be closed. Without a collection alternative for the bulk waste in each municipality a non-wanted environmental situation will develop. It is proposed that the bulk waste is collected by the PUC of Duboko (or the local PUC's) on a regular interval (e.g. quarterly). Bulk waste can be placed along the roads or brought at certain collection points. A truck with an open 20 – 25 $m^3$ container shall collect this waste and transports it to Duboko where it is going through the recycle line (if required after manual dismantling) or is land filled directly depending on the nature of the bulk waste. This truck shall be under control of the PUC Duboko.

### 4.7.3 Set-up of a Transfer Station (TS)

Each proposed transfer station in principle consists of:
- a weighbridge;
- an approach ramp;
- an unloading platform with roof;
- several reinforced containers suitable for compacting the waste;
- a hydraulic press and
- auxiliary equipment like fire extinguishing net, water supply, administrative office, electric grid connection etc.

The unloading platform must be large enough in order to let the truck to manoeuvre and, when required, makes it possible to let a wheel loader to operate (pre-selection, take out large pieces etc). The unloading platform shall be fully covered.

The TS area shall be spacious in order to allow trucks to manoeuvre and must be completely fenced. The TS area shall have a container storage area, a small administrative office, etc.

A conceptual lay-out is presented in the figure below.

**Figure 4-14 Conceptual lay-out of the TS area**

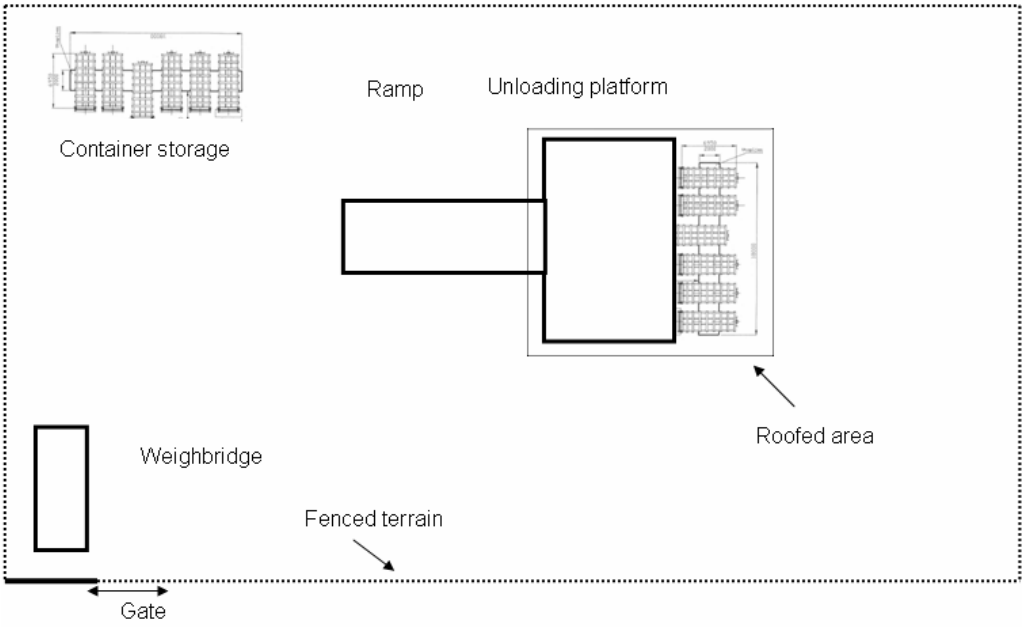



Figure 4-15 and Figure 4-16 give a possible side and top view of the unloading platform.

**Figure 4-15 Side view unloading platform TS**

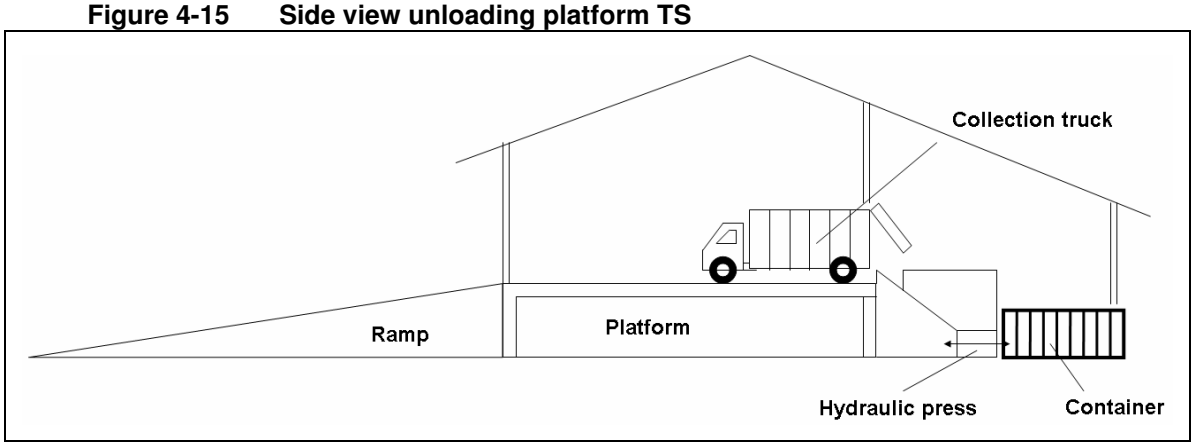
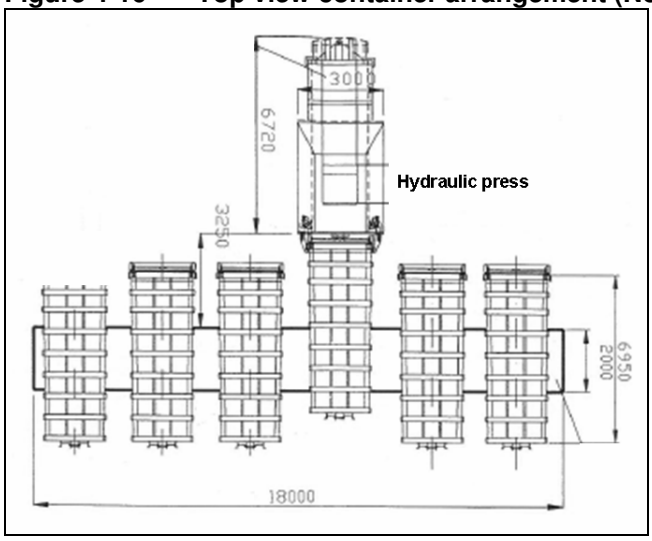


**Figure 4-16 Top view container arrangement (Note: measurements are indicative)**




The height of the roof shall be large, as dump trucks have other unloading principles too. See photo of the PCF project Liepaja (Latvia) transfer station that has been designed by Haskoning

**Figure 4-17 Truck on unloading platform**

4.7.4 Location of the Transfer Stations – Alternative Proposal by PUC Duboko

As described hereinafter erection of transfer stations in all municipalities included in the scheme can not be justified by techno-economical analysis. However, after the Preliminary Draft Report of the Feasibility Study for the Duboko Solid Waste Management Project was submitted to the representatives of the PUC Duboko, three meetings of the MIASP and the PUC Duboko technical committee were organized in November 2006, in order to present major findings of the study to the PUC Duboko and get their comments and suggestions on the Preliminary Draft report. The comments and suggestions prepared by the PUC were submitted to the MIASP as a written supplement

outlining basic elements of the proposal, which is summarized in the following text and called the Alternative 2.

Alternative 2
Basically it was insisted that the number of transfer stations should not to be based on techno-economical considerations and optimization only, but it should also reflect specifics of local communal services and current practices. Therefore the PUC Duboko suggested even-handed approach, where each municipality (apart from Užice) is allocated a single environmental yard (or simplified transfer station) in order to get all communal waste collected in a particular municipality to that location. In such a way individual PUC's collecting waste in the municipalities would generally carry out waste collection services unchanged – delivering waste to a single location in their municipality and would not incur additional transportation expenses (which are considered essential by the PUC Duboko representatives).

**As mentioned earlier, this alternative was adopted by the municipalities as the preferred option and also accepted by the EAR and EBRD.**

### 4.7.5 Location of the Transfer Stations

The municipality of Čačak has bought a terrain on an industrial area along the road from the city centre toward the present dumpsite where they intend to erect the recycle / transfer centre.

No sites have been selected yet for the other towns.

In the Transfer Stations study "General project design of the transfer stations, EKOINDUSTRIJA", 2006 criteria are given for the site selection. It is said to be based on the laws and regulations in force (in particular the Law on environmental protection, Law on waters, Law on national parks and cultural heritage, Rulebook on criteria for determining location and arrangement of landfills for waste materials, etc.).

The macro (general) location of a transfer station should fulfil the following requirements:

- More than 0.5 km away from the nearest residential houses (out of settlements);
- Landfill location should not be in a sanitary protection zone of potable water supply sources;
- Should be at a distance of more than 0.5 km from rivers, lakes and reservoirs;
- Should be more than 0.5 km away from a cultural heritage monument or protected environmental zone;
- At least 0.5 km from the closest railway or bus station, storage of flammable materials or military structures;
- At least 2.0 km from a medical institution with stationary patients, spas or food processing industries;
- At least 0.1 km from gas, oil and power supply lines;
- Must not be above installations for irrigation, underground structures such as tunnels and shelters;
- Elevation of terrain at the transfer station should be above the flood with 100-year re-occurrence interval

Although the proposed Čačak site is situated in an industrial area it fulfils the requirements.

Conclusion
It is concluded that the locations of existing dumps are in principle suitable as micro-locations. We do however not recommend establishing constructions on closed dumpsites as dumpsites are in general not stable. Furthermore settlements will occur for many years after closure. Instead a site next to the landfills might be preferred.

## 4.8 Priority Investment Plan (PIP)

Based on the findings above, the SPV's borrowing capacity, and consultations with the financing institutions, the Consultant prepare the Priority Investment Plan (PIP), screened different design options and proposed the one to be implemented.

While doing so, the Consultant compared different EU and Serbian standards applicable to the construction of the landfill, and specifically for the geo-technique and for the use of geomembranes and geosynthetics.

The PIP includes an estimation of costs for the construction of the landfill and for the appurtenant equipment. As mentioned earlier, the Priority Investment Plan has been prepared by the Consultant in close cooperation with the PUC Duboko and agreed on with the representatives of the EBRD and EAR.

The Priority Investment Plan is presented in the following table:

**Table 4-12 Duboko Solid Waste Mangement Scheme – Priority Investment Plan**

| | Phase I | Phase II |
|---|---|---|
| **Item/works description** | **Year 2007 Investment (€)** | **Year 2007 Investment (€)** |
| Access road | 379.335 | |
| **Access road - subtotal** | **379.335** | **-** |
| Transformer station 10/0,4 kV with all necessary equipment and appurtenant structure | 37.180 | |
| Power supply line | 26.167 | |
| Administration building | 92.400 | |
| Facility for washing and disinfection | 79.750 | |
| Water supply line with appurtenant equipment and water tank, sewerage | 71.500 | |
| Regulation of area for disposal (Phases I-V) | 1.130.202 | 894.786 |
| Service road at the landfill (preliminary works, earthworks, sub-base, asphalting, drainage, fence and gate) | 298.229 | |
| Technological part (geo-membrane + 50 cm clay, gas-release equipment) | 794.376 | 546.211 |
| Compactor | 225.345 | |
| Tractor TG-140B with ripper | 160.225 | |
| Wastewater (leachate) treatment plant - construction, technological equipment, electrical equipment) | 165.000 | |
| Landfill area recultivation | 95.225 | 65.477 |
| **Landfill - subtotal** | **3.175.599** | **1.506.474** |

| | Phase I | Phase II |
|---|---|---|
| **Item/works description** | **Year 2007 Investment (€)** | **Year 2007 Investment (€)** |
| Preparation of area for separation plant (earthworks, concrete works, asphalting, etc.) | 385.000 | |
| Structures of the plant for separation (earthworks, concrete, steel structures, sheet metal works, carpentry works, etc.) - complete hall | 275.000 | |
| Mechanical equipment for the separation plant | 1.964.347 | |
| Delivery & installation | 275.000 | |
| Mobiles (2 forklift) | 88.000 | |
| Hydrant network | 11.000 | |
| Electrical installation | - | |
| Electronic weighbridge | 50.171 | |
| **Separation line at Duboko landfill- sub total** | **3.048.518** | **-** |
| Transfer stations including all construction works and appurtenant equipment (8 stations-Čačak, Požega, Ivanjica, Bajina Bašta, Kosjerić, Lučani, Arilje, Čajetina) | 2.150.000 | |
| Long-haul trucks | 690.000 | |
| **Transfer stations - subtotal** | **2.840.000** | **-** |
| **Subtotal investment costs** | **9.443.452** | **1.506.474** |
| Engineering, supervision, commissioning - 4% | 377.738 | 60.259 |
| Contingencies - 7.5% | 708.259 | 112.986 |
| **TOTAL INVESTMENT COSTS excluding VAT** | **10.529.449** | **1.679.719** |
| VAT 0% * | - | - |
| **TOTAL INVESTMENT COSTS including VAT** | **10.529.449** | **1.679.719** |
| **TOTAL INVESTMENT COSTS phase I + II including VAT** | **12.209.167** | |

*) assuming paid VAT is reimbursed by tax authorities

**Table 4-13 SWMP Duboko – Total Investments Summary**

| Description | Amount (€) |
|---|---|
| Phase I + II | 12.209.167 |
| Phase III + IV +V | 2.414.785 |
| **Total** | **14.623.953** |

It should be noted that the abovementioned investments also included contractor's implementation costs of 3% and general costs, profit and risks of 7%.

The abovementioned PIP shown in the Table 4-12 includes works and equipment that are to be executed/installed in the first – priority phase of project implementation. The priority works include what was earlier defined as the first and the second stage of landfill construction, erection of the plant for waste separation, construction of transfer stations in all municipalities except for Užice and purchase of the inter-city fleet for waste transportation.

The second stage of implementation of this project includes works previously listed as the third, fourth and fifth phase of the landfill construction.

This re-arranging of the project phasing was necessary in order to allow normal operation of the facilities for a number of years before construction of the next stage is required.

## 4.9 Project Implementation and Procurement Plan

The Consultant detailed the tasks and timetable required for implementation of the Project and procurement plan as it is shown in the section 9.2.

## 4.10 Proposed Financing of Identified Lots

Based on the current information available by the consultants, below mentioned financing of identified lots is proposed.

**Table 4-14 Proposed financing of identified lots***

| Lot Nr | Lot | Cost estimate (K€) | Financed by |
|---|---|---|---|
| 1 | 8 Transfer stations and containers | 2,311 | EBRD/Municipalities |
| 2 | Trucks | 742 | EBRD/Municipalities |
| 3 | Selection line Duboko | 3,277 | EAR (major equipment)<br>Municipalities (works and infrastructure) |
| 4 | Landfill Duboko and access road | 5,441 | EBRD/Fund for environmental protection |
| 5 | TA tendering and supervision | 437 | EAR |
| **Subtotal** | | **12,209** | |
| | Working capital | 350 | Municipalities |
| **Total investment** | | **12,559** | |
| 6 | Master Plan landfills closure | 200 | - |
| 7 | Regional Waste Management Strategy | 200 | - |
| 8 | FOPEP | 300 | EBRD |
| 9 | Public consultation process (if needed): | 100 | Municipalities |
| **Total additional TA** | | **800** | |

* figures in this table are including contingencies (7,5%)

# 5 THE SPV COMPANY PUC DUBOKO ORGANISATION AND BUSINESS PLAN

## 5.1 Scope

The scope of operations of the Special Purpose Vehicle (SPV) is envisaged by the municipalities to be:
Operation of the transfer stations;
Transport from the transfer stations to the regional landfill;
Operation of the regional landfill;
Operation of the waste separation line.

An assessment has been made of the feasibility of (1) operation of transfer station, transport from transfer station to regional landfill and operation of regional landfill and (2) operation of potential additional revenue generators such as waste separation, gas/electricity production and carbon credit sale. The base line financial model will be built upon option (1), with the various potential additional revenue generators mentioned under (2) modelled in such a way to enable comparison with the baseline financial model.

## 5.2 Corporate structure

The 9 municipalities have set up a public utility company to manage and operate the SWM system; the consultants have build on this set up.

Communal services in Serbia are managed by Public Utility Companies (PUC) in accordance with the Law on Communal Services (Official Gazette 16/97 and 42/98) and the Law on Public Utilities (Official Gazette RS 107/05). There is no specific legal framework for the formation of an intermunicipal PUC and related agreements. A PUC to manage the Duboko Waste Management Scheme has been subsequently established on 13 October 2005 by the 8 Municipalities of Užice, Bajina Bašta, Požega, Arilje, Čajetina, Kosjerić, Lučani, and Ivanjica. Čačak later joined the founding partners on 26 October 2005. The Founding Act has been duly ratified by the Assemblies of the 9 Municipalities and the PUC Duboko was duly registered by the Serbian Business Registers Agency on 5 December 2005. The Founding Act of the PUC and its Annex I in which Čačak is joining the founding partners, are enclosed as Annex 5.1.

At this moment two documents are available that define the proposed operation and the relations between the different partners, i.e. the Founding Act and the Statutes, adopted by the Management Board on 7 December 2005 (Annex 5.2).

The **Founding Act** is the agreement between the 9 partners to establish and operate the Duboko WMS and their mutual rights and obligations. It defines (i) the purpose of the Company, (ii) the resources (capital) put at the disposal of the Company, (iii) the obligations of the partners, (iv) decision making, and (v) eventual profit sharing.

The **Statutes** are more detailed and follow closely the stipulations as set out in the Law on Public Companies (Official; Gazette of the RS, no. 25/2000, 25/2002 and 105/1005).

***Still lacking are the procedures for the Management and Supervisory Board, a manual on the internal organisation with job descriptions and the accounting manual (requirement under the Statutes, art. 44).***

**Governing organs** in the new Company will comprise a Supervisory Board, a Management Board, and a General Manager. The management of the Company will be ensured by the General Manager and the Management Board (the Administration). The Statutes clearly define the mandates of both the General Manager and the Management Board. Day-to-day management, including personnel management is handled by the General Manager. The General Manager has the right to hire and fire personnel. The Management Board decides a.o. on general policies, approves financial reports, budgets, investments, and tariffs, decides on the allocation of profits c.q. coverage of losses (considering the advice of Supervisory Board), and strategic planning (term as well as middle term). The Management Board comprises 9 members nominated by the Municipalities. The Statutes allow for the nomination of a representative of the Employees.

The Supervisory Board monitors on behalf of the Owners the general functioning of the Company and ensures that the Company operates within the Law. The Board advises on the allocation of profits. The Board is composed of 9 members nominated by the Municipalities. The members have a qualified vote based on the shares of each Municipality. The Founding Act specifies that Užice and Čačak each take a share of 25,39% and exercise jointly a controlling vote. This is a deliberate choice as Čačak has in fact more inhabitants than Užice.

**Capital** of the Company has been set at € 5,975,788. This amount is based on the original cost estimates of the landfill and preparatory costs. Shares are calculated on basis of the population of each Municipality. There is no obligation to place capital by the share holders as this is a Public Company. The Founding Act contains an obligation to reimburse Užice for the preparation costs (€ 362,102). So far, four Municipalities have paid up. The Municipalities engage themselves to cover losses incurred pro rata.

The **Scope** of the Duboko WMS has been clearly defined and deals with acceptance of collected waste, separation, and disposal. The PUC Duboko has a priority right to the secondary raw material in the territory of the 9 Municipalities which are obliged to cover for the loss of the PUC in event of lower quantities delivered.

The principles laid down in these 2 documents are clear and conductive to good business. The representation of the 9 Municipalities in the both Boards will provide a forum for objective decision-making. It is not clear, however, how the shareholders will exercise their rights in this set-up. Usually this is done in a General Assembly of Shareholders but the PUC has replaced this by the Municipal Council advised by the Supervisory Board. This works well for one Municipality but is not evident for 9 Municipalities (and Councils) at the time. The Management Board does not have a system of qualified votes (as the Supervisory Board). This should be clarified in the decision-making procedures of both Boards. Decision making will be facilitated by the majority of Čačak and Užice.

Major decisions, i.e. annual report, budgets, and tariff revisions have to be ratified by the Assemblies of all Municipalities. The decision of the Management Board, however, is binding. This is a potential source of conflicts. Experience, however, in the Rzav Water Supply Scheme (see text box) show that Municipalities are able to reach a “modus vivendi” to address these complications but are weak in providing for future investments.

The **Regional Water Supply Utility Rzav** (http://www.rzav.co.yu) sells drinking water in bulk to the PUCs of the surrounding municipalities of Arilje, Požega, Lučani, Čačak and Gornji Milanovac. It was founded in 1990 as a separate PUC by the Municipalities for the sole purpose of producing drinking water and is operational since 1999. It is one of the few regional PUCs active in Serbia and more interesting and 4 of its Founders will also participate in Duboko.

The management structure is identical to the PUC Duboko with the exception of the Coordination Body.

1. **Management Board**: 11 members, 1 from each of the municipalities-founders while five are appointed form the municipality of Čačak; one representative of the employees and one representative of the Ministry of agriculture, forestry and water management.
2. **Supervisory Board**: five members, each one representing a municipalities-founders
3. **General Manager**: selected by agreement of all municipal parliaments
4. **Coordination Body**: consisting of the representatives of the Founders and established to assure unity in further construction and use of the Rzav system.

Decision making in the Management Board is made by simple majority (51%) where the representative of the employees also has a vote. All decisions must be ratified by each Municipality (read Council). The Statutes specify that decisions must be made within 3 months. This system appears to be working within the context of the 5 Municipalities concerned.

A quick review of the financial performance reveals that the PUC operates at cash break-even point and is subsequently unable to provide for reservations for replacements. This is a deliberate policy, compounded by a weak payment discipline of the PUCs: collection rates ranged in the order of 50% to 91%. A way-out of this undesirable situation has been the condition to submit blank drafts (bills) as a guarantee for regular payments. Two blank drafts (bills) have already been activated. Rzav also decreased the volume of water delivered to one of the PUCs until the blank bill was submitted.

We conclude that the system works well to ensure coverage of O&M costs but is flawed for future expansion or replacement investments.

## 5.3 Service Level Agreements

Both the Founding Act and the Statutes are of a very general nature and are not specific to the desired levels of operation of the PUC in financial, operational, as well as managerial terms. It is good practice to define these requirements in a contract. This is usually done through a management contract or a Service Level Agreement (SLA). Experience with a SLA has been gained in Serbia with the PUC of Subotica for drinking water and wastewater.

Basically, a SLA is an agreement between the Municipalities and the PUC on the sustainable exploitation of the Duboko system. It defines the roles and responsibilities of the Municipalities and the PUC vis-à-vis the Users and the General Public. The SLA breaks down the business processes of the PUC and identifies the acceptable practices

to be applied, the service levels and the performance indicators which should be met (benchmarking).

### 5.3.1 Accepted Practices

Accepted Practices in general contain a brief description of a critical process, identify the required methodologies, and indicate the minimum acceptable standards. The SLA should comprise at least accepted practices for the following key processes:

- Acceptance of waste, i.e. the acceptance or rejection of waste offered to the PUC Duboko (either at a transfer station, or the landfill);
- Separation of valuable components
- Processing of valuable components
- Compacting of waste
- Transportation of waste
- Deposit at sanitary landfill
- Operating of the sanitary landfill
- Waste registration and reporting, also anticipating on future legal requirements
- Maintenance of the assets of the PUC
- Billing and collection
- Complaints
- HSE (Health, Safety, and Environment)
- HRM (Human Resources Management)

### 5.3.2 Service levels

Service levels define the minimum service level provided by the Utility to its clients, i.e. the 9 PUCs. This in fact only relates to acceptance and billing.

- Acceptance
  - operating hours
  - queuing time,
  - hygienic conditions
- Billing and collection
  - Invoicing
  - Debt management

### 5.3.3 Performance indicators

The 9 Owners are entitled to expect that the management of Duboko is efficient and state-of-the-art. This is usually measured through performance indicators (benchmarks). The final choice of the performance indicators depends on the level of detail and the meaning the management wishes to assign to this tool.

- Effectiveness
  - Transfer Station: Average queuing time
  - Transportation: Transported tons/km
  - Separation: % of materials separated, per category
  - Maintenance: downtime/category of equipment
- Efficiency
  - Transfer Station: Costs/ton collected waste
  - Transportation: Costs/ton transported waste
  - Separation: Cost/ton separated waste
  - Sanitary landfill: Costs/deposited waste

- Financial
  - Cost recovery
  - Collection Efficiency
  - Balance ratio's
- Management
  - Staff/ton collected waste
  - Compliance with the law (including all necessary permits).
  - HSES

A vital component of the SLA is also the list of the obligations of the Municipalities to ensure the sustainability of the operation. For Duboko these should as a minimum comprise:

- Policy:
  - The establishment of a Regional Waste Management Plan endorsed by all Municipalities
- Financial:
  - The engagement of the Municipalities to maintain the adequate balance ratio's
  - The engagement of the Municipality to cover defaulting local PUCs

The SLA finally should deal with the case of non-respect of the agreement and deal with sanctions, arbitration and resiliation.

#### 5.3.4 Recommendation

We recommend that the SLA will be developed during the project implementation phase and agreed upon by all major players before the system start to operate. It will be necessary to update the SLA regularly and it is advised to let the update coincide with the nomination of a new management.

## 5.4 Organisation and operational arrangements

#### 5.4.1 Business Model

Before dealing with the organisation and the operational arrangement, it will be useful to highlight the business model behind the operations of the Duboko WMS.

The object of the operation is to

- accept waste collected by the Municipalities at a Transfer Station, or at the Duboko Sanitary Landfill;
- separate and process the valuable components;
- compact and transport the waste to Duboko, in case the waste is offered to a Transfer Station ;
- sanitary disposal of the waste;
- sell the valuable components.

The revenues of the operations are generated by the waste charges to the 9 Municipal PUC responsible for the collection of waste in the respective Municipalities and by the sales of the valuable components (secondary raw materials). Duboko should conclude contracts with each of the 9 PUCs for its services. The Municipalities should recover their costs by raising their fees for the various waste categories.

The economic rationale behind operating a landfill is that the economic lifetime should be extended as much as possible by waste minimisation. The volume of waste is minimised by separating those components which can be processed in different ways, i.e. reuse, recycling, composting, and incineration. The last option is always disposal. Waste is preferably separated at the source. It is the task of the Municipality to promote this among the population, as is happening in a number of cases. The second best solution is sorting at the Transfer Station or Landfill. The residual waste is subsequently compacted and transported in containers to the Landfill. In this way transportation costs are minimised. The separated waste materials are depending on the material cleaned, processed and sold to the recycling industries. Operating a landfill is financially always a losing operation but proper management could lead to significant cost reductions. This requires attention for the following three aspects, viz. extension of the economic life of the Landfill by minimising waste, cost control, and offsetting some of these costs by selling the valuable components. We have developed elsewhere the possibilities of Carbon Credit Schemes. An appropriate tariff strategy should stimulate waste minimisation.

### 5.4.2 Issues which may prevent PUC Duboko from being operated on a self-sustainable basis

The PUC has a number of important factors working for it such as a clear need for a sanitary landfill in the region, a clear commitment of the 9 founding municipalities, a legal set-up which could work if strictly applied, a logic Business Model, and compliance with national policies. However, a number of issues appeared which need to be addressed. These issues concern:

<u>Decision making processes</u>
All major decisions of the Management Board need to be ratified by the Municipal Councils. This is time consuming while it is also not clear what will happen if no consensus has been reached among the Councils. It will be necessary to come to a working arrangement to address this possibility. The obvious controversial items will be like the case with tariff increases and investment decisions. An agreement on a tariff formula with allowances for inflation that is updated annually will be highly useful. Decision procedures need to be standardised for all Councils with fixed time limits.

Proposed solutions
1. Tariffs should be based on an agreed formula based on full costs, including depreciation and debt service, and the approved budget for the coming year. Tariff levels shall be evaluated annually by the Supervisory Board based on audited accounts, who will advise the Municipalities/Councils accordingly
2. Standardise decision processes and fix the time limits
3. Reach consensus how to deal with diverging minority votes and adapt, either through the manual of procedures of the Management Board or through the Intermunicipal Agreement.

<u>Cost recovery</u>
A modern Sanitary Landfill will require on average that a new cell will be constructed every 5 years. This will require a strict adherence to the full cost recovery principle in order to reserve sufficient funds for future investments. The principle of full cost recovery has been recognised in the NWMS and confirmed in the draft Waste Law. Issues to address in this respects are tariff setting and approval, collection of outstanding

invoices, and safeguards that sufficient reserves can be built up for debt service and future investments. The experiences in the RZAV Water Supply Scheme are illustrative.

Proposed solutions:
4. Municipalities will guarantee the payment in due time of their own PUCs.
5. A special bank account shall be created for a dedicated reserve earmarked for debt service and investments

Management
Duboko will constitute the first sanitary landfill in Serbia and it will be nearly impossible to identify an experienced manager in the Public Sector with a track record in this particular field. The demands on the managerial skills of the management are high, not only in the field of operating a sanitary landfill in compliance with the requirements of the new Waste Law but dealing with Investment Planning and Commercial Management, i.e. sales of the valuable components. There is always the danger of interference of the owners in the day-to-day management, in particular hiring and firing of personnel.

Managerial experience is available on the market by contracting qualified Operators or Technical Assistance. There seems, however, a majority view that Private Sector Participation (PSP) is less desirable during the first years of this scheme. Remain the option of outsourcing some activities or management contracts. Technical Assistance could cover a wide range of activities such as providing the specific technical skills, advising the Management, and train staff. This could be either realised by attracting a retired manager or through a Financial and Operational Performance Improvement Programme. The latest has the advantages that a number of preparatory measures before starting up the landfill could be realised.

Proposed solutions:
6. Implement a Financial and Operational Performance Improvement Programme designed to prepare the PUC Duboko for the exploitation of the scheme and to create the proper conditions. The measures shall include as a minimum:
   a. **Policy framework**: assist the 9 municipalities to prepare a Regional Waste Management Plan which will ensure a comprehensive approach of waste management and address the issues not covered by the Duboko scheme, such as collection upstream, recycling, industrial and hazardous waste, etc.
   b. **SLA**: assist the 9 Municipalities and the PUC to develop a Service Level Agreement with realistic targets;
   c. **Decision making**: assist the 9 Municipalities and the PUC to come up with pragmatic procedures for decision-making on strategic issues. Reach consensus on a tariff structure and its approval.
   d. **Information Systems**: develop and implement the required information systems with at least an accounting system, a waste registration system and a Management Information System (MIS).
   e. **Outsourcing**: identify tasks which are economically attractive and feasible to outsource and conclude the necessary arrangements. These tasks could include transportation, maintenance, and accounting/system administration.
   f. **Organising**: design of the organisation structure and staffing requirements, recruitment, and training. Develop and implement the necessary manuals of procedures. Issues to address are a.o. how to deal with waste which is not accepted at the landfill, how to deal with large waste producers, etc.

g. **Business Plan**: develop with the new Management of Duboko a business plan with a time horizon of 5 years with clear targets. Investigate the possibility of a performance-based incentive scheme.

7. Attract a retired manager as Advisor to the management of the PUC Duboko

### 5.4.3 The concept of regionalisation

Regionalisation is a basic principle of the NWMS (e.g. regional landfills, transfer stations, recycling centre, etc) but seems an institutional void when analysing the practicalities of setting up a legal institution to manage regional entities. We have highlighted the problem of effective control and decision making of the Utility. Duboko is only a pilot in this respect which could come up with workable solutions but it would be worthwhile to investigate a legally responsive structure which addresses issues as borrowing, ownership, and corporate decision-making.

Proposed solutions:

8. Identify the most appropriate legal set-up of an regional PUC considering issues as borrowing, ownership, and corporate decision-making

## 5.5 Organisational and management structure

### 5.5.1 Basic considerations

A skeleton organisation has been approved by the Board of Management and provides for a Director, a Secretary, a Chief Engineer and a Technician. This is clearly a project organisation conceived to facilitate the realisation of Duboko but could be an asset for its future evolution into a full-fledge organisation to manage the entire system. Basically, the organisation shall need to be able to cope with the following functions:

- Managerial: general management, external relations
- Technical: 4 sections dealing with the transfer stations, separation, transportation, and the sanitary landfill
- Administrative: sections dealing with accounting and customer relation (billing and collection), personnel management, commercial (sales of secondary raw materials) and housekeeping (security, general maintenance).
- Staff and support: financial analysis, planning, budgeting, and monitoring

The Feasibility Study (EKOINDUSTRIJA considering a separation line at Duboko and 8 transfer stations arrived at a total of 117 employees. This has been revised to a set-up with one sanitary landfill, 1 recycling line (at Duboko/Užice), 8 transfer stations and a transport division comprising 7 trucks. We note further that management and administration have been underestimated. We have noted the wish to outsource accounting but will maintain one accountant/cashier.

The following assumptions have been used in the review of the proposed organisation

- A separate Head Office shall be established in Užice;
- Working hours of the system shall be limited to 8 hours per weekday (40 hours in total)
- Accounting and major vehicle maintenance will be outsourced

### 5.5.2 Management

The proposed management structure comprises a manager, an administrative assistant and a dispatcher. We feel that this understates the importance of effective management. The Management should be able to (i) deal with new technologies, (ii) operate in a complex political environment, (iii) manage an operation at a number of different locations, (iv) market the valuable waste components, and (v) realise this all in a cost effective manner. We propose that the Management structure consist of the following three management positions:

- **General Manager**: general management, sales (of secondary raw materials), external relations;
- **Chief Technical Services**: responsible for all technical operations i.e. transfer stations, transportation, separation lines, and the landfill;
- **Chief Administrative Services**: responsible for all administrative operations, i.e. accounting and administration, customer relations (billing and collection), personnel management and house keeping.

The management shall be supported by the following staff positions:

- **Planner** (staff): financial planning, tariff setting, waste flow monitoring, analysis, and reporting (in compliance with current environmental requirements);
- **Business Secretary**;
- **System Administrator** (part-time or outsourced).

### 5.5.3 Technical Services

The technical operations shall be directed by the Chief Technical Services and comprise the following operation

- Sanitary Landfill
  Operations comprise acceptance of waste, sanitary disposal, waste, monitoring of the landfill, and general hygiene. Staff includes a supervisor, shovel driver and sweepers.
- Transfer Stations
  Operations comprise acceptance of offered waste, registration (weighing depending on the availability of a weigh bridge), disposal in containers and shunting (replace full containers by empty ones), release containers for transport (weighing), and maintenance of general hygiene. Staff comprises a supervisor charged with acceptance, operating the weighbridge, and waste administration, a driver/operator, and sweeper.
- Recycling Centre
  Operations comprise separation of secondary raw materials from waste and subsequent cleaning and storage of retained waste, registration (weighing), operation and maintenance of associated equipment, arranging of containers, and general hygiene. Staff comprises a supervisor, 15-20 (fifteen, increasing to twenty) sorters, a maintenance engineer, a driver/operator, and a sweeper.
- Transportation
  This operation concerns the transportation of containers from a transfer station to the Duboko landfill. Operations include operating a fleet of five trucks, small maintenance and urgent repairs. Staff will include, one mechanic and five drivers.

### 5.5.4 Administrative Services

The administrative operations shall be directed by the Chief Administrative Services and comprise the following operations

- Accounting: accounting will be outsourced and the activities here will only consist of collecting information, preparation of the necessary input files, verification of the contractor and consultation/reporting for the MIS. Staff will only consist of one accountant cum cashier and a clerk dealing with personnel records
- Customer relations: one accountant, one clerk billing and collection for offered waste and sales, and a data entry typist
- Housekeeping: this operation includes security and general maintenance. Three guards will be planned for each object. These positions could be eliminated if the transfer stations are already located in a secure site, e.g. that of the local PUC. A coffee lady/cleaner has been planned for the largest object in Užice.

**Table 5-1 Staffing schedules**

| Position | Education | Tasks | Loca-tion | No | Total |
|---|---|---|---|---|---|
| **Management** | | | *1* | | |
| General Manager | Academic | General management, sales. external relations | | 1 | 1 |
| Chief Technical Services | Academic | Technical management, responsible for the landfill, separation, transportation, and the transfer station | | 1 | 1 |
| Chief Administrative Services | Academic | Accounting and administration, customer relations and sales, commercial, personnel and house keeping | | 1 | 1 |
| Planner | Academic | Analysis of technical and financial data, tracks waste flows, environmental monitoring and reporting, planning, budgeting, and tariff studies | | 1 | 1 |
| **Technical** | | | | | |
| *Landfill* | | | *1* | | |
| Supervisor/ Receptionist | Technician | Accepts waste, weighbridge, registration, issues statements | | 1 | 1 |
| Driver/ operator | Technician | Operates shovels and other heavy equipment | | 1 | 1 |
| Sweeper | Unschooled | Cleaning | | 2 | 2 |
| *Recycling centre* | | | *1* | | |
| Supervisor | Technician | Management of the recycling centre | | 1 | 1 |
| Sorter | Unschooled | Handpicking of valuable components[8] | | 15-20 | 15-20 |

[8] Will increase from 15 pickers (year 1) to 20 pickers (final year)

| Position | Education | Tasks | Loca-tion | No | Total |
|---|---|---|---|---|---|
| Driver/ operator | Technician | Operates shovels and other heavy equipment, shunts containers[9] | | 1 | 1 |
| Maintenance engineer | Technician | Maintenance | | 1 | 1 |
| Sweeper | Unschooled | Cleaning | | 1 | 1 |
| Security | | General security | | 3 | 3 |
| *Transfer stations* | | | *8* | | |
| Supervisor/ Receptionist | Technician | Accepts waste, weighbridge, registration, issues statements | | 1 | 8 |
| Driver/ operator | Technician | Operates shovels and other heavy equipment, shunts containers | | 1 | 1 |
| Sweeper | Unschooled | Cleaning | | 1 | 8 |
| Security | | General security[10] | | 3 | 0-24 |
| *Transportation* | | | *1* | | |
| Driver | Technician | Transportation of compacted waste containers and offloading | | 7 | 7 |
| Mechanic | Technician | Minor maintenance and urgency repairs | | 1 | 1 |
| **Administrative** | | | | | |
| *Accounting* | | | *1* | | |
| Accountant/ cashier | Technician | Collection of information, preparation of the necessary input files, verification of the contractor and consultation/reporting for the MIS | | 1 | 1 |
| Clerk | Schooled | Maintenance of personnel records; input files for accounting | | 1 | 1 |
| *Customer relations* | | | | | |
| Clerk | Technician | Billing and collection - disposal as well as sales of secondary raw materials | | 1 | 1 |
| House keeping and support staff | | | | | |
| Secretary | Technician | General secretarial work, correspondence, archiving | | 1 | 1 |

[9] Only for Cacak; this task will be carried by the Supervisor/Receptionist in the other Transfer Stations

[10] These positions could be eliminated if the transfer station are already located in a guarded site

| Position | Education | Tasks | Loca-tion | No | Total |
|---|---|---|---|---|---|
| Junior Secretary | Technician | General secretarial work, correspondence, archiving | | 1 | 1 |
| Store keeper | Schooled | Store keeping | | 1 | 1 |
| Coffee lady/ cleaning | Unschooled | | | 1 | 1 |
| **Total Staff** | | | | | **62-91** |

### 5.5.5 Management Information Systems

Modern IT applications will be required to ensure that Duboko will be managed adequately as a system in its various aspects, also noting the demonstration effects of this Project. The following systems shall be needed:

Accounting system
The system needs to support International Accounting Standards (IAS) and International Financial Reporting Standards (IFRS). The system shall recognize cost centres and contain a budgeting module. The system shall be linked to a Management Information System to allow monitoring of previous defined benchmarks.

Waste flow administration
This system shall record the waste flows from their first entry into the system, the various transformations and its ultimate destination. It shall deal with acceptance, recycling, transportation, disposal and billing. Automated data acquisition from the weighbridges should be considered. Data transfer should be effected through dial-up links on a daily routine. Automated billing (for both disposed waste and sold secondary raw materials) may be considered but obviously depend on the volume. The systems should be able to produce a number of standard reports aimed at different audiences. It shall contain all information which will enable it to generate the required reports to the competent Ministries in line with the legal requirements.

Planning Systems
Considering the relative short life cycle of the investments, it will be necessary that Duboko shall maintain adequate models for financial planning which will be able to cope with capital planning as well as revenue planning.

Management Information System
The Management Information System should combine financial, technical, and commercial information, both short-term and long-term. It should be structured as a Business Plan with clearly defined operational targets and monitored regularly (monthly) for its realisation. The system should allow benchmarking and will facilitate the application of performance-based incentive schedules for core staff members.

## 5.6 Financial analysis of SPV and affordability analysis

### 5.6.1 Introduction

Based on several assumptions as outlined below, this chapter analyses the financial feasibility of the SPV company Duboko. The analysis and projections for the profit & loss account, balance sheet and cash flow statement of the company will be carried out in

both CSD and EURO for the duration of the loan + 1 year (eleven years), i.e. for the period 2007 up to and including 2017. The financial cost-benefit analysis, however, will be carried out for the period 2007 up to and 2019, or 13 years (1 year construction and 12 years operation), which coincides with the estimated usable lifetime of the landfill.

The model uses as an input the waste production, source selection and recycling data as elaborated upon in chapter 2. Furthermore, it builds upon the estimated staffing numbers required to operate the scheme as set out in paragraph 5.5 and the priority investment plan detailed in paragraph 4.8.

All revenues and expenditures are presented in nominal values.

No further specific analysis is made of the two main solid waste utilities in Užice and Čačak, since the loan and all incremental operational costs of the project are to be borne by the new regional PUC. Of course, in the end tipping fees will have to be paid by the municipal solid waste utilities. However, the affordability analysis in this chapter shows that this can be financed, within affordability constraints, by an increase in solid waste tariffs.

The appendices contain the detailed outputs of the financial model.

### 5.6.2 Assumptions

Macroeconomic scenarios

Underlying macro-economic assumptions of the model build upon data provided by the EBRD. A base case scenario, with a probability of 50% will be used throughout this chapter. Pessimistic and optimistic scenarios are used to assess the sensitivity of the financial model to changes in these assumptions.

The table below summarizes the three scenarios:

**Table 5-2 Base case scenario**

| | Units | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Macroeconomics** | | | | | | | | | | | | | | |
| CSD Inflation | % | 16,0% | 13,0% | 9,0% | 5,0% | 5,0% | 5,0% | 5,0% | 5,0% | 5,0% | 5,0% | 5,0% | 5,0% | 5,0% |
| EUR Inflation | % | 2,0% | 2,0% | 2,0% | 2,0% | 2,0% | 2,0% | 2,0% | 2,0% | 2,0% | 2,0% | 2,0% | 2,0% | 2,0% |
| CSD/EUR Nominal Exchange Rate | CSD | 85,00 | 91,30 | 107,60 | 109,70 | 111,90 | 114,00 | 115,60 | 117,20 | 118,90 | 120,60 | 122,30 | 124,08 | 125,88 |
| Real Appreciation CSD vs EUR | % | -2,6% | 3,1% | -9,3% | 0,9% | 1,0% | 1,0% | 1,5% | 1,5% | 1,5% | 1,5% | 1,5% | 1,5% | 1,5% |
| Real GDP Growth | % | 6,0% | 4,0% | 4,0% | 4,0% | 5,0% | 5,0% | 5,0% | 5,0% | 4,0% | 4,0% | 4,0% | 3,0% | 3,0% |
| Real labour wage increase | % | 8,0% | 3,0% | 3,0% | 3,0% | 3,0% | 4,0% | 4,0% | 5,0% | 5,0% | 5,0% | 5,0% | 3,0% | 3,0% |
| EURIBOR | % | | 3,1% | 4,0% | 4,0% | 4,0% | 4,0% | 4,0% | 4,0% | 4,0% | 4,0% | 4,0% | 4,0% | 4,0% |

**Table 5-3 Pessimistic scenario**

| | Units | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Macroeconomics** | | | | | | | | | | | | | | |
| CSD Inflation | % | 16,0% | 30,0% | 25,0% | 20,0% | 10,0% | 8,0% | 7,0% | 6,0% | 5,0% | 5,0% | 5,0% | 5,0% | 5,0% |
| EUR Inflation | % | 2,0% | 2,0% | 2,0% | 2,0% | 2,0% | 2,0% | 2,0% | 2,0% | 2,0% | 2,0% | 2,0% | 2,0% | 2,0% |
| CSD/EUR Nominal Exchange Rate | CSD | 85,00 | 117,70 | 144,20 | 169,60 | 182,90 | 193,60 | 203,00 | 208,90 | 212,90 | 214,80 | 216,70 | 222,98 | 225,08 |
| Real Appreciation CSD vs EUR | % | -2,6% | -8,0% | 0,0% | 0,0% | 0,0% | 0,0% | 0,0% | 1,0% | 1,0% | 2,0% | 2,0% | 2,0% | 2,0% |
| Real GDP Growth | % | 6,0% | -2,0% | 0,0% | 0,0% | 1,0% | 2,0% | 2,0% | 2,0% | 2,0% | 3,0% | 3,0% | 3,0% | 3,0% |
| Real labour wage increase | % | 8,0% | 0,0% | 0,0% | 0,0% | 1,0% | 1,0% | 1,0% | 1,0% | 1,0% | 2,0% | 2,0% | 2,0% | 2,0% |
| EURIBOR | % | | 3,1% | 4,0% | 4,0% | 4,0% | 4,0% | 4,0% | 4,0% | 4,0% | 4,0% | 4,0% | 4,0% | 4,0% |

**Table 5-4 Optimistic scenario**

| | Units | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Macroeconomics** | | | | | | | | | | | | | | |
| CSD Inflation | % | 16,0% | 11,0% | 5,0% | 4,0% | 4,0% | 4,0% | 4,0% | 4,0% | 4,0% | 4,0% | 4,0% | 4,0% | 4,0% |
| EUR Inflation | % | 2,0% | 2,0% | 2,0% | 2,0% | 2,0% | 2,0% | 2,0% | 2,0% | 2,0% | 2,0% | 2,0% | 2,0% | 2,0% |
| CSD/EUR Nominal Exchange Rate | CSD | 85,00 | 90,70 | 91,50 | 91,40 | 91,30 | 91,30 | 91,20 | 91,60 | 92,00 | 92,40 | 92,80 | 95,06 | 97,38 |
| Real Appreciation CSD vs EUR | % | -2,6% | 2,0% | 2,0% | 2,0% | 2,0% | 2,0% | 2,0% | 1,5% | 1,5% | 1,5% | 1,5% | 1,5% | 1,5% |
| Real GDP Growth | % | 6,0% | 6,0% | 7,0% | 7,0% | 6,0% | 6,0% | 6,0% | 6,0% | 6,0% | 6,0% | 6,0% | 6,0% | 6,0% |
| Real labour wage increase | % | 8,0% | 0,0% | 0,0% | 0,0% | 1,0% | 1,0% | 1,0% | 1,0% | 1,0% | 2,0% | 2,0% | 2,0% | 2,0% |
| EURIBOR | % | | 3,1% | 4,0% | 4,0% | 4,0% | 4,0% | 4,0% | 4,0% | 4,0% | 4,0% | 4,0% | 4,0% | 4,0% |

Investments

In paragraph 4.8, a priority investment plan is elaborated upon. The financial model assumes that the priority investment plan can be completed during the year 2007. Furthermore and based upon the predicted waste streams to be land filled (base case scenario), it is estimated that a further investment in land filling capacity will be required in 2013. Finally, replacement investments of all mobile equipment (long haul trucks, shovels, tractors etc) will be required after seven years of operations, which is the estimated economical life time.

The estimated investment amounts are summarized in the table below. Individual items include provisions for contractors mark-up and contingencies.

**Table 5-5 Investments**

| | Units | Total | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Investment by phase and component** | | | | | | | | | | |
| **Priority investment plan** | | | | | | | | | | |
| Access road to Landfill | € m | 0.41 | 0.41 | | | | | | | |
| Landfill phase 1-2 | € m | 5.03 | 5.03 | | | | | | | |
| Engineering & supervision | € m | 0.44 | 0.44 | | | | | | | |
| Transfer stations | € m | 2.05 | 2.05 | | | | | | | |
| Transportation TS to LF | € m | 1.00 | 1.00 | | | | | | | |
| Waste separation line Duboko landfill | € m | 3.28 | 3.28 | | | | | | | |
| **Subtotal PIP** | **€ m** | **12.21** | **12.21** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |
| Extension landfill (original phase 3-5) | € m | 2.41 | | | | | | | 2.41 | |
| Re-investment mobiles | € m | 1.51 | | | | | | | | 1.51 |
| **Subtotal** | **€ m** | **3.92** | **-** | **-** | **-** | **-** | **-** | **-** | **2.41** | **1.51** |
| LFG - infrastructure (pipes, civil works) | € m | - | | | | | | - | | |
| LFG - compressor & gas engines | € m | - | | | | | | - | | |
| **Subtotal** | **€ m** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |
| **Total** | **€ m** | **16.13** | **12.21** | **-** | **-** | **-** | **-** | **-** | **2.41** | **1.51** |

The above estimate does not include amounts already paid by Uzice municipality for preparation and land acquisition, nor does it include a provision for any final settlement of the remaining land to be purchased for the Duboko regional landfill site. It does, however, include an amount for land to be purchased for the eight transfer stations or reloading stations.

No provisions have been made in the model for other discretionary investments, since the investment program above is assessed to capture all required investments for support of the operations of this new company. In addition, sizable allocations are made in the projections for maintenance and repair, which should be sufficient to keep the investments in a proper condition.

In addition to the above investment estimate, start up costs of the newly formed company, interest during construction as well as costs to ensure a minimum debt service coverage ratio of 1.3 will need to be financed. This will be required for the year 2007. Start-up costs are estimated to amount to € 0.35M.

Financing

The priority investment plan is assumed to be financed by the nine participating municipalities themselves, contribution from the National Eco fund (CSD 30M, equivalent to € 0.35M already disbursed to Užice municipality and a further CSD 96M committed; total commitment equivalent to € 1.5M), an EBRD loan and a grant from the EAR.

**Table 5-6 Source of financing with start-up costs**

| | Unit | Total | 2007 |
|---|---|---|---|
| **Financing plan** | | | |
| Municipal contribution | € m | 3.06 | 3.06 |
| investment phase I/PIP | € m | 2.71 | 2.71 |
| start-up & interest during constructio | € m | 0.35 | 0.35 |
| State budget (ecofund) | € m | 1.50 | 1.50 |
| EBRD loan | € m | 5.00 | 5.00 |
| EAR | € m | 3.00 | 3.00 |
| **Total** | **€ m** | **12.56** | **12.56** |

Without the start-up costs and interest during constructing, financing would be required as follows:

**Table 5-7 Source of financing without start-up costs**

| | Units | Total | 2007 |
|---|---|---|---|
| **Financing plan short term investments** | | | |
| Municipal contribution | € m | 2.71 | 2.71 |
| State budget (ecofund) | € m | 1.50 | 1.50 |
| EBRD loan | € m | 5.00 | 5.00 |
| EAR | € m | 3.00 | 3.00 |
| Internally generated funds | € m | - | |
| **Total** | **€ m** | **12.21** | **12.21** |

The above municipal contribution assumes that no further state grants will be made available. If any further state grants will be secured, the required municipal financing can be lowered.

In inter municipal agreement dated 13 october 2005, with amendments dated 26 october 2005, the nine participating municipalities agreed on a certain percentage sharing of investments to finance the Duboko landfill & separation line, amounting to € 5.976.057. Using this agreed percentage sharing, the following would need to be financed by the municipalities during the year 2007, based on the above estimates including start-up costs:

**Table 5-8 Breakdown financing per municipality**

| | Unit | Rate | Total | 2007 |
|---|---|---|---|---|
| **Detailed financing plan municipal contribution** | | | | |
| Uzice | € m | 23.91% | 0.73 | 0.73 |
| Arilje | € m | 5.70% | 0.17 | 0.17 |
| Lučani | € m | 7.09% | 0.22 | 0.22 |
| Kosjerić | € m | 4.03% | 0.12 | 0.12 |
| Požega | € m | 9.30% | 0.28 | 0.28 |
| Bajina Bašta | € m | 8.39% | 0.26 | 0.26 |
| Čajetina | € m | 4.50% | 0.14 | 0.14 |
| Ivanjica | € m | 10.20% | 0.31 | 0.31 |
| Čačak | € m | 26.88% | 0.82 | 0.82 |
| **Total** | | **100.00%** | **3.06** | **3.06** |

The ERBD loan agreement is assumed to be made directly with the SPV without sovereign guarantee. The financial conditions of the loan are assumed to be:

Loan duration: 10 years, starting 2007
Grace period: 3 years
Interest: EURLIBOR + 3%
Front-end fee: 1.0%
Commitment fee: 0.5%

This would result in the following loan drawdown and repayment schedule:

**Table 5-9 EBRD loan drawdown and repayment schedule in Euro**

| | Unit | Total | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **EBRD Loan** | | | | | | | | | | | | |
| Tenor | years | 10 | | | | | | | | | | |
| Grace Period | years | 3 | | | | | | | | | | |
| Interest rate margin | % | 3.00% | | | | | | | | | | |
| Interest rate | | | 7.0% | 7.0% | 7.0% | 7.0% | 7.0% | 7.0% | 7.0% | 7.0% | 7.0% | 7.0% |
| Front-end fee | | 1.00% | | | | | | | | | | |
| Commitment Fee | | 0.50% | | | | | | | | | | |
| EBRD loan | € m | 5.0 | | | | | | | | | | |
| Opening balance | € m | | - | 5.00 | 5.00 | 5.00 | 4.29 | 3.57 | 2.86 | 2.14 | 1.43 | 0.71 |
| Drawdown | € m | 5.00 | 5.00 | - | - | - | - | - | - | - | - | - |
| Average undisbursed amount | € m | | 2.50 | - | - | - | - | - | - | - | - | - |
| Front-end fee | € m | 0.05 | 0.05 | - | - | - | - | - | - | - | - | - |
| Commitment fee | € m | 0.01 | 0.01 | - | - | - | - | - | - | - | - | - |
| Interest | € m | 2.28 | 0.18 | 0.35 | 0.35 | 0.35 | 0.30 | 0.25 | 0.20 | 0.15 | 0.10 | 0.05 |
| Capital repayment | € m | 5.00 | - | - | - | 0.71 | 0.71 | 0.71 | 0.71 | 0.71 | 0.71 | 0.71 |
| Interest payment | € m | 2.34 | 0.24 | 0.35 | 0.35 | 0.35 | 0.30 | 0.25 | 0.20 | 0.15 | 0.10 | 0.05 |
| Closing balance | € m | | 5.00 | 5.00 | 5.00 | 4.29 | 3.57 | 2.86 | 2.14 | 1.43 | 0.71 | - |

The same schedule as above, but presented in CSD using the base case scenario is set out in the table below. Note that the loan is repayable in Euro, so CSD equivalent is recalculated using the applicable exchange rate at the time of payment.

**Table 5-10 EBRD loan drawdown and repayment schedule in CSD**

| | Unit | Total | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **EBRD Loan** | | | | | | | | | | | | |
| Tenor | years | 10 | | | | | | | | | | |
| Grace Period | years | 3 | | | | | | | | | | |
| Interest rate margin | % | 3,00% | | | | | | | | | | |
| Interest rate | | | 7,0% | 7,0% | 7,0% | 7,0% | 7,0% | 7,0% | 7,0% | 7,0% | 7,0% | 7,0% |
| Front-end fee | | 1,00% | | | | | | | | | | |
| Commitment Fee | | 0,50% | | | | | | | | | | |
| EBRD loan | CSD m | 538,0 | | | | | | | | | | |
| Opening balance | CSD m | | - | 538,0 | 548,5 | 559,5 | 488,6 | 412,9 | 334,9 | 254,8 | 172,3 | 87,4 |
| Exchange rate loss/gain | CSD m | 56,8 | - | 10,5 | 11,0 | 10,5 | 6,9 | 5,7 | 4,9 | 3,6 | 2,4 | 1,3 |
| Drawdown | CSD m | 538,0 | 538,0 | - | - | - | - | - | - | - | - | - |
| Average undisbursed amount | CSD m | 269,0 | 269,0 | - | - | - | - | - | - | - | - | - |
| Front-end fee | CSD m | 5,4 | 5,4 | - | - | - | - | - | - | - | - | - |
| Commitment fee | CSD m | 1,3 | 1,3 | - | - | - | - | - | - | - | - | - |
| Interest | CSD m | 260,6 | 18,8 | 38,4 | 39,2 | 39,9 | 34,7 | 29,3 | 23,8 | 18,1 | 12,2 | 6,2 |
| Capital repayment | CSD m | 594,8 | - | - | - | 81,4 | 82,6 | 83,7 | 84,9 | 86,1 | 87,4 | 88,6 |
| Interest payment | CSD m | 267,3 | 25,6 | 38,4 | 39,2 | 39,9 | 34,7 | 29,3 | 23,8 | 18,1 | 12,2 | 6,2 |
| Closing balance | CSD m | | 538,0 | 548,5 | 559,5 | 488,6 | 412,9 | 334,9 | 254,8 | 172,3 | 87,4 | - |

Revenues

In the base case scenario, two main revenue streams for the SPV can be distinguished:

- Proceeds from tipping fees payable by the waste collection companies of the nine municipalities. Tipping fee will be charged against actual delivered quantities of waste as measured either at the Landfill/waste separation line at Duboko or at one of the transfer stations;
- Proceeds from the sale of secondary materials. This revenue is either the result of the operations of the waste separation line at Duboko Landfill or waste collected at source by Užice municipality. Because Čačak municipality will manage it's own separation line and source selection activities, it is assumed that revenues generated from this will not accrue to the SPV.

The setting of the tipping fee will be elaborated upon in paragraph 5.6.4.

For the proceeds of the secondary materials the following 2006 prices are assumed. It is assumed that these prices will increase with the Euro inflation rate.

**Table 5-11 Ex-factory prices secondary materials (2006 price level)**

| | | |
|---|---|---|
| Paper | €/ton | 55 |
| Metal (ferrous + non ferrous) | €/ton | 250 |
| Glass | €/ton | 12 |
| Plastic | €/ton | 50 |
| PET bottles (compressed) | €/ton | 200 |

To be on the safe side, prices have been estimated at the lower end of the prices as elaborated upon in the feasibility study of "Ekoindustrija" (2006). Prices have been cross checked with local wholesale traders and are assessed to be reasonable. Prices are inflated each year with the Euro inflation rate.

For the Landfill Gas project, projections are based on the following assumed prices:

**Table 5-12 Market prices LFG**

| | | |
|---|---|---|
| Carbon credit | €/ton CO2 | 6.50 |
| Electricity sale to grid from LFG | CSD/kwh | 3.60 |

The carbon credit market price is the current price for long term contracts. In contrast, spot market prices are considerably higher. The assumed market price for carbon credits is therefore rather conservative. Market prices for electricity produced by landfill gas are assumed to be 80% of the consumer price of electricity.

Expenditures

Expenditures are distinguished in two categories:

- Variable costs (electricity, fuel, water, chemicals). These costs directly fluctuate with the amount of waste processed or landfilled;
- Fixed costs (wages, maintenance, insurance, depreciation). These costs do not directly fluctuate with the amount of waste processed or landfilled.

The following 2006 base prices are assumed for the various expenditure categories:

**Table 5-13 Variable operation and maintenance assumptions (2006 prices)**

| | | |
|---|---|---|
| **Variable costs** | | |
| Electricity | CSD/kwh | 4.50 |
| Electricity use separation line | Kwh/ton | 10 |
| Diesel | CSD/liter | 75 |
| Chemicals | CSD/liter | 44 |
| Water | CSD/m3 | 25 |

**Table 5-14 Fixed operation and maintenance assumptions (2006 prices)**

| | | |
|---|---|---|
| **Fixed costs** | | |
| **Employee costs (gross salaries)** | | |
| Unskilled Labour | CSD/year | 300,000 |
| Skilled Labour | CSD/year | 420,000 |
| Lower/ Mid level management | CSD/year | 600,000 |
| Higher Management | CSD/year | 840,000 |
| **Employee benefits** | % | 25.0% |
| **Maintenance rates % of investment** | | |
| Civil works | % | 0.5% |
| Plant equipment | % | 5.0% |
| Mobile equipment | % | 7.5% |
| Compressors & gas engines LFG | €/hour | 10.0 |
| Compressors & gas engines LFG - operati | hrs/year | 8,000 |
| Infra/distribution pipes LFG | % | 3.0% |
| **Insurance costs % of investment** | | |
| Civil works | % | 0.5% |
| Plant equipment | % | 0.75% |
| Mobile equipment (incl. vehicle/road tax) | % | 4.0% |
| **Depreciation** | | |
| Landfill | years | 6 |
| Civil works | years | 25 |
| Installations/equipment | years | 15 |
| Mobile equipment | years | 7 |
| LFG equipment + infrastructure | years | 25 |

Although civil works in nature, the depreciation for the landfill works itself is set at its useful technical life (6 years for phase I/PIP investment and 6 years for the second phase investment).

Starting from the first year of operations, input prices are adjusted for real and nominal price increases, using the following assumptions:

| | |
|---|---|
| Wages and salaries: | inflation + real wage increase |
| Employee benefits: | inflation + real wage increase |
| Electricity: | inflation + real GDP growth |
| Fuel: | inflation + real GDP growth |
| Maintenance: | inflation + 50% real wage increase |
| Other costs: | inflation only |

This results in the following nominal increases

**Table 5-15 Price escalation O&M costs**

| | Unit | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Nominal increase opex** | | | | | | | | | | | | |
| ***annual increase*** | | | | | | | | | | | | |
| Wages and Salaries | % | 12.3% | 8.2% | 8.2% | 9.2% | 9.2% | 10.3% | 10.3% | 10.3% | 10.3% | 8.2% | 8.2% |
| Employee benefits | % | 12.3% | 8.2% | 8.2% | 9.2% | 9.2% | 10.3% | 10.3% | 10.3% | 10.3% | 8.2% | 8.2% |
| Electricity | % | 13.4% | 9.2% | 9.2% | 10.3% | 10.3% | 10.3% | 10.3% | 9.2% | 9.2% | 9.2% | 8.2% |
| Fuel | % | 13.4% | 9.2% | 9.2% | 10.3% | 10.3% | 10.3% | 10.3% | 9.2% | 9.2% | 9.2% | 8.2% |
| Maintenance | % | 10.6% | 6.6% | 6.6% | 7.1% | 7.1% | 7.6% | 7.6% | 7.6% | 7.6% | 6.6% | 6.6% |
| Other costs | % | 9.0% | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% | 5.0% |

Apart from unit prices and unit price increases, expenditure patterns are estimated based on the following assessment (major items only):

- Staffing follows the schedules as elaborated upon in chapter 5.5, whereby the maximum required staff numbers have been used;
- Landfill
  - Electricity 100,000 Kwh/year;
  - Diesel 15,000 liter/year/equipment;
  - Water 35,000 $m^3$/year;
- Transfer stations
  - Electricity 50,000 Kwh/year/transfer station;
- Transportation transfer stations to landfill
  - Solid waste transported 25 ton pay load/trip
  - Diesel consumption 40 liter/100km;
- Waste separation line
  - Electricity 10 Kwh/ton waste processed;
  - Diesel 5,000 liter/year/equipment.

Waste quantities and secondary material analysis

Waste quantity computation has been elaborated upon in the baseline survey. This is used as an input in the financial model. The amount of waste to be presented at either transfer station or landfill for which tipping fees will have to be paid is set out below.

**Table 5-16 Waste amounts for tipping fee calculation**

| | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Uzice | 18,932 | 20,257 | 21,116 | 22,019 | 22,947 | 23,922 | 24,879 | 25,874 | 26,909 | 27,716 | 28,548 |
| Arilje | 5,003 | 5,210 | 5,477 | 5,758 | 6,053 | 6,363 | 6,626 | 6,891 | 7,166 | 7,381 | 7,603 |
| Lučani | 1,504 | 1,566 | 1,647 | 1,731 | 1,820 | 1,914 | 1,993 | 2,076 | 2,159 | 2,224 | 2,290 |
| Kosjerić | 693 | 721 | 757 | 795 | 835 | 877 | 912 | 948 | 986 | 1,016 | 1,046 |
| Požega | 9,176 | 9,554 | 10,042 | 10,556 | 11,095 | 11,663 | 12,142 | 12,642 | 13,147 | 13,542 | 13,948 |
| Bajina Bašta | 2,736 | 2,849 | 2,995 | 3,149 | 3,310 | 3,480 | 3,624 | 3,768 | 3,919 | 4,037 | 4,158 |
| Čajetina | 3,496 | 3,639 | 3,825 | 4,017 | 4,217 | 4,428 | 4,605 | 4,790 | 4,981 | 5,131 | 5,284 |
| Ivanjica | 4,967 | 5,170 | 5,434 | 5,711 | 6,003 | 6,309 | 6,561 | 6,824 | 7,097 | 7,309 | 7,529 |
| Čačak | 23,237 | 24,874 | 25,941 | 27,063 | 28,242 | 29,443 | 30,620 | 31,845 | 33,119 | 34,112 | 35,136 |
| **Total** | **69,744** | **73,840** | **77,234** | **80,797** | **84,523** | **88,398** | **91,962** | **95,657** | **99,483** | **102,468** | **105,542** |

The abovementioned amounts are exclusive of waste collected separately at source. It is assumed that only paper and PET bottles will be separately collected at source, following the scenario described in the baseline survey. Based on assumptions of source selection, the relevant amounts of this waste stream are:

**Table 5-17 Separate collection paper**

| | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Uzice | - | 167 | 357 | 578 | 832 | 1,130 | 1,175 | 1,222 | 1,271 | 1,309 | 1,349 |
| Arilje | - | - | - | - | - | - | - | - | - | - | - |
| Lučani | - | - | - | - | - | - | - | - | - | - | - |
| Kosjerić | - | - | - | - | - | - | - | - | - | - | - |
| Požega | - | - | - | - | - | - | - | - | - | - | - |
| Bajina Bašta | - | - | - | - | - | - | - | - | - | - | - |
| Čajetina | - | - | - | - | - | - | - | - | - | - | - |
| Ivanjica | - | - | - | - | - | - | - | - | - | - | - |
| Čačak | - | 204 | 439 | 710 | 1,024 | 1,391 | 1,446 | 1,504 | 1,565 | 1,611 | 1,660 |
| **Total** | **-** | **371** | **796** | **1,287** | **1,857** | **2,521** | **2,622** | **2,727** | **2,836** | **2,921** | **3,008** |

**Table 5-18 Separate collection PET bottles**

| | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Uzice | - | 12 | 23 | 34 | 44 | 54 | 56 | 58 | 60 | 62 | 64 |
| Arilje | - | - | - | - | - | - | - | - | - | - | - |
| Lučani | - | - | - | - | - | - | - | - | - | - | - |
| Kosjerić | - | - | - | - | - | - | - | - | - | - | - |
| Požega | - | - | - | - | - | - | - | - | - | - | - |
| Bajina Bašta | - | - | - | - | - | - | - | - | - | - | - |
| Čajetina | - | - | - | - | - | - | - | - | - | - | - |
| Ivanjica | - | - | - | - | - | - | - | - | - | - | - |
| Čačak | - | 15 | 28 | 42 | 54 | 66 | 69 | 72 | 74 | 77 | 79 |
| **Total** | **-** | **27** | **52** | **75** | **98** | **120** | **125** | **130** | **135** | **139** | **143** |

Since Čačak municipality is developing its own separation line and source selection, the above mentioned quantities are assumed not to be delivered to the SPV and the revenues of this activity will be for the benefit of Čačak municipality. This is in contrast to the forecasted separate source selection of Užice municipality. Here it is assumed that Užice municipality will deliver separate collected recyclable materials to the SPV, for which the municipality would not have to pay a tipping fee. The proceeds of the sale of these recyclable materials are assumed to accrue to the SPV.

Based on the recycle efficiencies elaborated upon in chapter 2 and the composition of the collected waste, the proposed separation line in Duboko is forecasted to produce the following quantities of recycled material:

**Table 5-19 Secondary material quantities**

| | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Paper/carton | - | 5,766 | 5,883 | 6,005 | 6,132 | 6,263 | 6,516 | 6,778 | 7,049 | 7,261 | 7,479 |
| Metal | - | 1,022 | 1,075 | 1,130 | 1,187 | 1,247 | 1,297 | 1,349 | 1,403 | 1,445 | 1,489 |
| Glass | - | - | - | - | - | - | - | - | - | - | - |
| Plastic | - | 3,767 | 3,960 | 4,163 | 4,374 | 4,595 | 4,780 | 4,972 | 5,171 | 5,326 | 5,486 |
| PET Bottles | - | 823 | 839 | 857 | 875 | 894 | 930 | 967 | 1,006 | 1,036 | 1,067 |
| Wood | - | - | - | - | - | - | - | - | - | - | - |
| Rubber | - | - | - | - | - | - | - | - | - | - | - |
| Textile | - | - | - | - | - | - | - | - | - | - | - |
| Biomass | - | - | - | - | - | - | - | - | - | - | - |
| Other | - | - | - | - | - | - | - | - | - | - | - |
| | **-** | **11,379** | **11,757** | **12,154** | **12,568** | **12,999** | **13,523** | **14,067** | **14,629** | **15,068** | **15,520** |

This leads to a reduction of waste to be land filled of approximately 15%.

### 5.6.3 Expenditure forecast

The operational and maintenance cost of the Duboko regional waste management system is summarized in the table below. More detailed information per component is included in the annexes.

**Table 5-20 Operational costs by cost category**

| | Unit | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Total variable + fixed costs** | | **4,874** | **246,995** | **256,482** | **267,768** | **280,777** | **295,345** | **311,966** | **309,102** | **331,793** | **349,878** | **370,039** |
| **Variable costs** | **CSD '000** | **-** | **19,188** | **21,829** | **25,064** | **28,787** | **33,055** | **37,743** | **42,710** | **48,329** | **54,187** | **60,207** |
| Electricty | CSD '000 | - | 6,899 | 7,884 | 9,098 | 10,500 | 12,114 | 13,894 | 15,782 | 17,924 | 20,160 | 22,457 |
| Diesel | CSD '000 | - | 10,926 | 12,444 | 14,313 | 16,468 | 18,940 | 21,663 | 24,540 | 27,798 | 31,208 | 34,700 |
| Other | CSD '000 | - | 1,364 | 1,501 | 1,653 | 1,819 | 2,001 | 2,186 | 2,388 | 2,607 | 2,820 | 3,050 |
| **Fixed costs** | **CSD '000** | **4,874** | **227,806** | **234,653** | **242,704** | **251,991** | **262,290** | **274,223** | **266,392** | **283,463** | **295,690** | **309,831** |
| Wages & salaries | CSD '000 | 2,560 | 36,717 | 39,710 | 43,363 | 47,822 | 52,724 | 58,699 | 64,716 | 72,044 | 77,915 | 85,077 |
| Employee benefits | CSD '000 | 640 | 9,179 | 9,927 | 10,841 | 11,956 | 13,181 | 14,675 | 16,179 | 18,011 | 19,479 | 21,269 |
| Maintenance | CSD '000 | - | 33,762 | 35,982 | 38,537 | 41,273 | 44,420 | 47,807 | 51,453 | 55,376 | 59,017 | 62,897 |
| Insurance | CSD '000 | - | 12,908 | 13,553 | 14,231 | 14,942 | 15,689 | 16,474 | 17,298 | 18,162 | 19,071 | 20,024 |
| Depreciation | CSD '000 | - | 130,433 | 130,433 | 130,433 | 130,433 | 130,433 | 130,433 | 110,305 | 113,107 | 113,107 | 113,107 |
| Other costs | CSD '000 | 1,674 | 4,807 | 5,047 | 5,300 | 5,565 | 5,843 | 6,135 | 6,442 | 6,764 | 7,102 | 7,457 |

To analyze the operational and maintenance cost, a percentage table is useful:

**Table 5-21 Percentage distribution operational costs by cost category**

| | Unit | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Variable costs** | **%** | **0%** | **8%** | **9%** | **9%** | **10%** | **11%** | **12%** | **14%** | **15%** | **15%** | **16%** |
| Electricty | % | 0% | 3% | 3% | 3% | 4% | 4% | 4% | 5% | 5% | 6% | 6% |
| Diesel | % | 0% | 4% | 5% | 5% | 6% | 6% | 7% | 8% | 8% | 9% | 9% |
| Other | % | 0% | 1% | 1% | 1% | 1% | 1% | 1% | 1% | 1% | 1% | 1% |
| **Fixed costs** | **%** | **100%** | **92%** | **91%** | **91%** | **90%** | **89%** | **88%** | **86%** | **85%** | **85%** | **84%** |
| Wages & salaries | % | 53% | 15% | 15% | 16% | 17% | 18% | 19% | 21% | 22% | 22% | 23% |
| Employee benefits | % | 13% | 4% | 4% | 4% | 4% | 4% | 5% | 5% | 5% | 6% | 6% |
| Maintenance | % | 0% | 14% | 14% | 14% | 15% | 15% | 15% | 17% | 17% | 17% | 17% |
| Insurance | % | 0% | 5% | 5% | 5% | 5% | 5% | 5% | 6% | 5% | 5% | 5% |
| Depreciation | % | 0% | 53% | 51% | 49% | 46% | 44% | 42% | 36% | 34% | 32% | 31% |
| Other costs | % | 34% | 2% | 2% | 2% | 2% | 2% | 2% | 2% | 2% | 2% | 2% |
| **Total** | | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |

As can be concluded from the table, depreciation is by far the largest cost category of the system with 48% in 2007, declining to 34% in 2017. The relative decline is a result of historical cost depreciation. Next largest item is personnel costs (wages/salaries and employee benefits) with a share of 19% in 2008, increasing to 29% in 2017. Variable costs are relatively minor, ranging from 8% to 16%.

The cost by component, as well as a percentage breakdown by component is presented below.

**Table 5-22 Operational costs by component**

| | Unit | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Total costs by compone** | **CSD '000** | **-** | **246,995** | **256,482** | **267,768** | **280,777** | **295,345** | **311,966** | **309,102** | **331,793** | **349,878** | **370,039** |
| Landfill | CSD '000 | | 105,493 | 107,236 | 109,257 | 111,458 | 113,979 | 116,674 | 98,775 | 102,661 | 105,708 | 108,900 |
| Transfer stations | CSD '000 | | 43,299 | 45,984 | 49,229 | 52,785 | 57,047 | 61,725 | 67,066 | 72,693 | 77,827 | 83,320 |
| Transportation | CSD '000 | | 40,480 | 42,709 | 45,363 | 48,318 | 51,728 | 55,453 | 59,639 | 65,998 | 70,389 | 74,972 |
| Waste separation line | CSD '000 | | 57,723 | 60,554 | 63,919 | 68,216 | 72,591 | 78,114 | 83,622 | 90,441 | 95,954 | 102,848 |
| LFG | CSD '000 | | - | - | - | - | - | - | - | - | - | - |

**Table 5-23 Percentage distribution operational costs by component**

| | Unit | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Landfill | % | | 43% | 42% | 41% | 40% | 39% | 37% | 32% | 31% | 30% | 29% |
| Transfer stations | % | | 18% | 18% | 18% | 19% | 19% | 20% | 22% | 22% | 22% | 23% |
| Transportation | % | | 16% | 17% | 17% | 17% | 18% | 18% | 19% | 20% | 20% | 20% |
| Waste separation line | % | | 23% | 24% | 24% | 24% | 25% | 25% | 27% | 27% | 27% | 28% |
| LFG | % | | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |
| **Total** | **%** | | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** | **100%** |

The landfill operations are the most costly component of the solid waste management systems, although the share is declining over time from 43% during 2008 to 29% in 2017. This is mainly because of a relatively fast decline of depreciation costs. Next largest item is the operation of the waste separation line with a slightly increasing share in the total cost structure.

### 5.6.4 Setting the tipping fee

The unit cost price per ton of collected solid waste is calculated in such a way to cover at least the below mentioned costs. Full cost coverage is achieved if the tipping fee is set equal or more to the cost price as calculated below.

- Operation & maintenance costs;
- Depreciation;
- Re-payment of principal installments above the depreciation charge, in such a way that in any one year a minimum total debt service factor of 1.3 is maintained. In other words, the debt service coverage ratio should be maintained at a minimum of 1.3;
- Interest payment;
- Working capital;
- Profit margin is set at 0%;
- Collection rate is assumed to be 100%: it is assumed that the 9 participating municipalities will ensure that their waste collection PUC's will pay the tipping fee charges as agreed upon. To ensure this, it is recommended to include a requirement to this effect in the inter-municipal agreement as well as in the EBRD loan agreement. It is advised to have, as a specific loan covenant, the issuance of irrevocable payment guarantees, issued by the PUC's and backed by the respective municipalities before the systems starts to operate;
- Costs to cover is decreased with proceeds of the sale of secondary materials.

This results in an average cost price per ton of collected solid waste of € 25/ton in 2008, decreasing to € 12/ton in 2017, as elaborated upon in the table below.

**Table 5-24 Cost price collected waste**

| | Units | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Operating costs & depreciation | CSD m | 5 | 247 | 256 | 268 | 281 | 295 | 312 | 309 | 332 | 350 | 370 |
| Increase in working capital | CSD m | (1) | 22 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 |
| Bad debt | CSD m | | | | | | | | | | | |
| Interest and fee payment | CSD m | 26 | 38 | 39 | 40 | 35 | 29 | 24 | 18 | 12 | 6 | - |
| Profit | CSD m | - | - | - | - | - | - | - | - | - | - | - |
| DSCR over depreciation | CSD m | 8 | - | - | - | - | - | - | 7 | 4 | 4 | - |
| **Total** | **CSD m** | **37** | **308** | **298** | **310** | **318** | **327** | **338** | **337** | **351** | **363** | **373** |
| Less revenues secondary materials | CSD m | - | 107 | 117 | 127 | 138 | 150 | 162 | 174 | 187 | 199 | 213 |
| **Total costs to cover** | **CSD m** | **37** | **201** | **181** | **183** | **180** | **177** | **176** | **163** | **164** | **163** | **160** |
| | | | | | | | | | | | | |
| Tons of waste collected | tons | - | 73,840 | 77,234 | 80,797 | 84,523 | 88,398 | 91,962 | 95,657 | 99,483 | 102,468 | 105,542 |
| Unit cost of waste (full cost coverage) | CSD/ton | | 2,717 | 2,346 | 2,263 | 2,126 | 2,003 | 1,919 | 1,704 | 1,646 | 1,594 | 1,519 |
| | €/ton | | 25 | 21 | 20 | 18 | 17 | 16 | 14 | 13 | 13 | 12 |

The trend of operating costs to cover in CSD is a slight nominal increase. After deducting proceeds of the sale of secondary material, net costs to cover decrease in nominal terms.

When calculating costs per ton of waste delivered at the gate, costs decrease even more. This is because the waste stream increases, but the main cost category, depreciation, remains the same over time as a result of historical cost valuation and straight line depreciation.

Costs differ per municipality because of differences in distance to the Duboko landfill site, which drives transportation costs. Another reason is different quantities of waste processed at the transfer station, which lowers per unit costs, because of economies of scale. The table below sets out the total net costs (after deducting proceeds of the sale of secondary materials) by municipality which would need to be covered to achieve full cost coverage. Costs have been allocated to each municipality as follows:

- Landfill, waste separation costs and revenues and landfill gas costs and revenues are allocated pro-rata the quantity of waste delivered to the transfer station or Duboko landfill;
- Transfer station operational and depreciation costs are calculated separately per municipality, taking into account the quantity of waste processed at that station. For Užice municipality no costs are involved, since no transfer station is proposed in this municipality;
- Transportation costs are calculated pro-rata the amount of ton-kilometres of waste transported from the transfer station to the Duboko landfill;
- Working capital, interest and DSCR over depreciation are allocated pro-rata the total operational costs incurred.

**Table 5-25 Net costs to cover by municipality**

| | Units | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Uzice | CSD m | 26 | 21 | 20 | 18 | 15 | 13 | 7 | 5 | 3 | 0 |
| Arilje | CSD m | 17 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 |
| Lučani | CSD m | 10 | 10 | 10 | 10 | 10 | 11 | 11 | 11 | 12 | 12 |
| Kosjerić | CSD m | 8 | 7 | 8 | 8 | 8 | 9 | 9 | 9 | 10 | 10 |
| Požega | CSD m | 24 | 21 | 21 | 21 | 21 | 20 | 18 | 18 | 18 | 18 |
| Bajina Bašta | CSD m | 13 | 12 | 12 | 12 | 12 | 13 | 13 | 13 | 13 | 13 |
| Čajetina | CSD m | 14 | 13 | 13 | 13 | 13 | 14 | 13 | 14 | 14 | 14 |
| Ivanjica | CSD m | 20 | 19 | 19 | 20 | 20 | 20 | 20 | 20 | 21 | 21 |
| Čačak | CSD m | 69 | 62 | 63 | 62 | 61 | 61 | 56 | 57 | 57 | 56 |
| **Total** | **CSD m** | **201** | **181** | **183** | **180** | **177** | **177** | **163** | **164** | **164** | **161** |

The resulting full unit cost price per ton of waste collected by municipality is set out in the tables below.

**Table 5-26 Full unit cost price by municipality (CSD)**

| | Units | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Uzice | CSD/ton | 1,304 | 1,013 | 907 | 772 | 640 | 538 | 260 | 172 | 94 | 8 |
| Arilje | CSD/ton | 3,290 | 2,883 | 2,802 | 2,659 | 2,535 | 2,457 | 2,268 | 2,216 | 2,173 | 2,103 |
| Lučani | CSD/ton | 6,364 | 5,770 | 5,718 | 5,552 | 5,430 | 5,384 | 5,323 | 5,298 | 5,299 | 5,247 |
| Kosjerić | CSD/ton | 10,589 | 9,747 | 9,743 | 9,552 | 9,444 | 9,456 | 9,592 | 9,583 | 9,645 | 9,619 |
| Požega | CSD/ton | 2,472 | 2,114 | 2,026 | 1,889 | 1,763 | 1,677 | 1,453 | 1,389 | 1,334 | 1,259 |
| Bajina Bašta | CSD/ton | 4,392 | 3,918 | 3,848 | 3,697 | 3,574 | 3,508 | 3,367 | 3,324 | 3,298 | 3,234 |
| Čajetina | CSD/ton | 3,812 | 3,375 | 3,304 | 3,161 | 3,041 | 2,973 | 2,810 | 2,763 | 2,730 | 2,665 |
| Ivanjica | CSD/ton | 3,922 | 3,478 | 3,404 | 3,259 | 3,135 | 3,064 | 2,899 | 2,867 | 2,834 | 2,767 |
| Čačak | CSD/ton | 2,785 | 2,408 | 2,326 | 2,190 | 2,068 | 1,984 | 1,771 | 1,727 | 1,678 | 1,604 |
| **Total** | **CSD/ton** | **2,718** | **2,347** | **2,264** | **2,128** | **2,005** | **1,921** | **1,706** | **1,648** | **1,596** | **1,521** |

**Table 5-27 Full unit cost price by municipality (€)**

| | Units | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Uzice | €/ton | 12 | 9 | 8 | 7 | 5 | 5 | 2 | 1 | 1 | 0 |
| Arilje | €/ton | 30 | 26 | 25 | 23 | 22 | 21 | 19 | 18 | 18 | 17 |
| Lučani | €/ton | 58 | 52 | 50 | 48 | 46 | 45 | 44 | 43 | 43 | 42 |
| Kosjerić | €/ton | 97 | 87 | 85 | 83 | 81 | 80 | 80 | 78 | 78 | 76 |
| Požega | €/ton | 23 | 19 | 18 | 16 | 15 | 14 | 12 | 11 | 11 | 10 |
| Bajina Bašta | €/ton | 40 | 35 | 34 | 32 | 30 | 30 | 28 | 27 | 27 | 26 |
| Čajetina | €/ton | 35 | 30 | 29 | 27 | 26 | 25 | 23 | 23 | 22 | 21 |
| Ivanjica | €/ton | 36 | 31 | 30 | 28 | 27 | 26 | 24 | 23 | 23 | 22 |
| Čačak | €/ton | 25 | 22 | 20 | 19 | 18 | 17 | 15 | 14 | 14 | 13 |
| **Total** | **€/ton** | **25** | **21** | **20** | **18** | **17** | **16** | **14** | **13** | **13** | **12** |

Unit costs for the smaller municipalities are much higher than average, as a result of low quantities of waste collected in combination with almost equal costs for transfer stations. The full cost price of Uzice municipality is much lower than average, because this municipality does not incur any costs for transfers stations or transportation between transfer station and the Duboko landfill. Transport of solid waste is done straight by the waste collection fleet of the PUC of Uzice itself, which will bear the related costs directly.

The table below provides a further breakdown of the unit cost by municipality and component for the year 2008. This table clearly shows the main cost drivers per municipality. The percentage deviation column (final column) can be used to arrive at differentiated tipping fees for the year 2008.

**Table 5-28 Full 2008 unit cost price by municipality and component**

| | Units | Landfill | Waste separation line | LFG | Transfer station | Transportation | Proceeds waste separation line | Total | deviation from avg % |
|---|---|---|---|---|---|---|---|---|---|
| Uzice | CSD/ton | 1,779 | 974 | - | - | - | (1,449) | 1,304 | -52% |
| Arilje | CSD/ton | 1,779 | 974 | - | 1,259 | 727 | (1,449) | 3,290 | 21% |
| Lučani | CSD/ton | 1,779 | 974 | - | 4,063 | 997 | (1,449) | 6,364 | 134% |
| Kosjerić | CSD/ton | 1,779 | 974 | - | 8,766 | 519 | (1,449) | 10,589 | 290% |
| Požega | CSD/ton | 1,779 | 974 | - | 711 | 457 | (1,449) | 2,472 | -9% |
| Bajina Bašta | CSD/ton | 1,779 | 974 | - | 2,257 | 831 | (1,449) | 4,392 | 62% |
| Čajetina | CSD/ton | 1,779 | 974 | - | 1,779 | 706 | (1,449) | 3,789 | 39% |
| Ivanjica | CSD/ton | 1,779 | 974 | - | 1,268 | 1,350 | (1,449) | 3,922 | 44% |
| Čačak | CSD/ton | 1,779 | 974 | - | 339 | 1,142 | (1,449) | 2,785 | 3% |
| **Total** | **CSD/ton** | **1,779** | **974** | **-** | **730** | **683** | **(1,449)** | **2,717** | |

Because costs per component increase at different rates over time, deviation from the total cost price by municipality also will differ over time. The table below sets out the deviation from the average total cost price by municipality over time.

**Table 5-29 Deviation from average unit price by municipality**

| | Units | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Uzice | % | -52% | -57% | -60% | -64% | -68% | -72% | -85% | -90% | -94% | -100% |
| Arilje | % | 21% | 23% | 24% | 25% | 26% | 28% | 33% | 34% | 36% | 38% |
| Lučani | % | 134% | 146% | 153% | 161% | 171% | 180% | 212% | 221% | 232% | 245% |
| Kosjerić | % | 290% | 315% | 330% | 349% | 371% | 392% | 462% | 481% | 504% | 532% |
| Požega | % | -9% | -10% | -11% | -11% | -12% | -13% | -15% | -16% | -16% | -17% |
| Bajina Bašta | % | 62% | 67% | 70% | 74% | 78% | 83% | 97% | 102% | 107% | 113% |
| Čajetina | % | 40% | 44% | 46% | 49% | 52% | 55% | 65% | 68% | 71% | 75% |
| Ivanjica | % | 44% | 48% | 50% | 53% | 56% | 59% | 70% | 74% | 78% | 82% |
| Čačak | % | 2% | 3% | 3% | 3% | 3% | 3% | 4% | 5% | 5% | 5% |
| **Total** | % | **0%** | **0%** | **0%** | **0%** | **0%** | **0%** | **0%** | **0%** | **0%** | **0%** |

The average tipping fee is proposed to be fixed at CSD 2.350/ton (€ 21)during the first year of operations (2008) and is adjusted thereafter with inflation only. Initially, this will be slightly below full cost recovery. However, during the second operational year, full cost recovery is achieved and the company will break even. By escalating the tipping fee with inflation only, sufficient funds will be built up to fund, from internal cash generation, the extension of the landfill in the year 2013 and the re-investment in mobile equipment in the year 2014. The table below summarizes the development of the tipping fee as compared to the full unit cost price. Note that the full unit cost price is actually decreasing over time, mainly as a result of increasing waste quantities and declining total net costs to cover.

**Table 5-30 Tipping fee**

| | Units | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Unit cost of waste | CSD/ton | 2,717 | 2,346 | 2,263 | 2,126 | 2,003 | 1,919 | 1,704 | 1,646 | 1,594 | 1,519 |
| | €/ton | 25 | 21 | 20 | 18 | 17 | 16 | 14 | 13 | 13 | 12 |
| Proposed tipping fee | CSD/ton | 2,350 | 2,468 | 2,591 | 2,720 | 2,856 | 2,999 | 3,149 | 3,307 | 3,472 | 3,646 |
| | €/ton | 21 | 22 | 23 | 24 | 24 | 25 | 26 | 27 | 28 | 29 |

When applying the average tipping fee to the amounts of waste collected per municipality, the following amounts would be payable by municipality:

**Table 5-31 Total tipping fee due by municipality**

| | Units | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Uzice | CSD m | 48 | 52 | 57 | 62 | 68 | 75 | 81 | 89 | 96 | 104 |
| Arilje | CSD m | 12 | 14 | 15 | 16 | 18 | 20 | 22 | 24 | 26 | 28 |
| Lučani | CSD m | 4 | 4 | 4 | 5 | 5 | 6 | 7 | 7 | 8 | 8 |
| Kosjerić | CSD m | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 4 | 4 |
| Požega | CSD m | 22 | 25 | 27 | 30 | 33 | 36 | 40 | 43 | 47 | 51 |
| Bajina Bašta | CSD m | 7 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| Čajetina | CSD m | 9 | 9 | 10 | 11 | 13 | 14 | 15 | 16 | 18 | 19 |
| Ivanjica | CSD m | 12 | 13 | 15 | 16 | 18 | 20 | 21 | 23 | 25 | 27 |
| Čačak | CSD m | 58 | 64 | 70 | 77 | 84 | 92 | 100 | 110 | 118 | 128 |
| **Total** | **CSD m** | **174** | **191** | **209** | **230** | **253** | **276** | **301** | **329** | **356** | **385** |

As discussed and elaborated upon above, unit costs differ considerably per municipality. We propose only to give the Municipality of Užice a discount on the average tipping fee, because this municipality does not have a transfer station and transports its own waste straight to the Duboko landfill site. Based on the solidarity principle, an average tipping fee could then be calculated for the other municipalities. This would mean that for the year 2008, Užice municipality could be granted a tipping fee discount of up to 52% of the average tipping fee. This would have as an effect that in the year 2008 the other municipalities will have to pay 20% more than the average tipping fee.

Based on the percentage deviation table above and the proposed tipping fee, the following amounts and tipping fees would be payable by municipality:

**Table 5-32 Differentiated tipping fee (CSD)**

| | Units | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Uzice | CSD/ton | 1,127 | 1,064 | 1,038 | 987 | 912 | 840 | 480 | 345 | 205 | 18 |
| Arilje | CSD/ton | 2,812 | 2,995 | 3,172 | 3,366 | 3,578 | 3,800 | 4,139 | 4,405 | 4,683 | 4,991 |
| Lučani | CSD/ton | 2,812 | 2,995 | 3,172 | 3,366 | 3,578 | 3,800 | 4,139 | 4,405 | 4,683 | 4,991 |
| Kosjerić | CSD/ton | 2,812 | 2,995 | 3,172 | 3,366 | 3,578 | 3,800 | 4,139 | 4,405 | 4,683 | 4,991 |
| Požega | CSD/ton | 2,812 | 2,995 | 3,172 | 3,366 | 3,578 | 3,800 | 4,139 | 4,405 | 4,683 | 4,991 |
| Bajina Bašta | CSD/ton | 2,812 | 2,995 | 3,172 | 3,366 | 3,578 | 3,800 | 4,139 | 4,405 | 4,683 | 4,991 |
| Čajetina | CSD/ton | 2,812 | 2,995 | 3,172 | 3,366 | 3,578 | 3,800 | 4,139 | 4,405 | 4,683 | 4,991 |
| Ivanjica | CSD/ton | 2,812 | 2,995 | 3,172 | 3,366 | 3,578 | 3,800 | 4,139 | 4,405 | 4,683 | 4,991 |
| Čačak | CSD/ton | 2,812 | 2,995 | 3,172 | 3,366 | 3,578 | 3,800 | 4,139 | 4,405 | 4,683 | 4,991 |
| **Total** | **CSD/ton** | **2,350** | **2,468** | **2,591** | **2,720** | **2,856** | **2,999** | **3,149** | **3,307** | **3,472** | **3,646** |

**Table 5-33 Differentiated tipping fee (€)**

| | Units | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Uzice | €/ton | 10 | 10 | 9 | 9 | 8 | 7 | 4 | 3 | 2 | 0 |
| Arilje | €/ton | 26 | 27 | 28 | 29 | 31 | 32 | 34 | 36 | 38 | 40 |
| Lučani | €/ton | 26 | 27 | 28 | 29 | 31 | 32 | 34 | 36 | 38 | 40 |
| Kosjerić | €/ton | 26 | 27 | 28 | 29 | 31 | 32 | 34 | 36 | 38 | 40 |
| Požega | €/ton | 26 | 27 | 28 | 29 | 31 | 32 | 34 | 36 | 38 | 40 |
| Bajina Bašta | €/ton | 26 | 27 | 28 | 29 | 31 | 32 | 34 | 36 | 38 | 40 |
| Čajetina | €/ton | 26 | 27 | 28 | 29 | 31 | 32 | 34 | 36 | 38 | 40 |
| Ivanjica | €/ton | 26 | 27 | 28 | 29 | 31 | 32 | 34 | 36 | 38 | 40 |
| Čačak | €/ton | 26 | 27 | 28 | 29 | 31 | 32 | 34 | 36 | 38 | 40 |
| **Total** | **€/ton** | **21** | **22** | **23** | **24** | **24** | **25** | **26** | **27** | **28** | **29** |

**Table 5-34 Differentiated total amount payable (CSD)**

| | Units | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Uzice | CSD m | 23 | 22 | 23 | 23 | 22 | 21 | 12 | 9 | 6 | 1 |
| Arilje | CSD m | 15 | 16 | 18 | 20 | 23 | 25 | 29 | 32 | 35 | 38 |
| Lučani | CSD m | 4 | 5 | 5 | 6 | 7 | 8 | 9 | 10 | 10 | 11 |
| Kosjerić | CSD m | 2 | 2 | 3 | 3 | 3 | 3 | 4 | 4 | 5 | 5 |
| Požega | CSD m | 27 | 30 | 33 | 37 | 42 | 46 | 52 | 58 | 63 | 70 |
| Bajina Bašta | CSD m | 8 | 9 | 10 | 11 | 12 | 14 | 16 | 17 | 19 | 21 |
| Čajetina | CSD m | 10 | 11 | 13 | 14 | 16 | 18 | 20 | 22 | 24 | 26 |
| Ivanjica | CSD m | 15 | 16 | 18 | 20 | 23 | 25 | 28 | 31 | 34 | 38 |
| Čačak | CSD m | 70 | 78 | 86 | 95 | 105 | 116 | 132 | 146 | 160 | 175 |
| **Total** | **CSD m** | **174** | **191** | **209** | **230** | **253** | **276** | **301** | **329** | **356** | **385** |

### 5.6.5 Final consumer tariff and affordability

From the questionnaire sent to the nine waste collection PUC's, the following share in waste quantities per customer group can be calculated:

**Table 5-35 Waste quantities per customer group (in $m^3$, 2005)***

| | Domestic | Industry | Public | Total |
|---|---|---|---|---|
| Uzice | 49,000 | 8,000 | | 57,000 |
| Arilje | 11,523 | 2,449 | 432 | 14,404 |
| Lučani | not specified | | | - |
| Kosjerić | 1,700 | 200 | 100 | 2,000 |
| Požega | 18,480 | 5,280 | 2,640 | 26,400 |
| Bajina Bašta | 4,500 | 3,000 | 370 | 7,870 |
| Čajetina | not specified | | | - |
| Ivanjica | 10,400 | 3,650 | 250 | 14,300 |
| Čačak | 42,000 | 28,000 | | 70,000 |
| **Total** | **137,603** | **50,579** | **3,792** | **191,974** |
| **% of total waste** | **72%** | **26%** | **2%** | **100%** |

*) Some municipalities have categorized public institutes together with industry

Using these percentage figures, waste quantities per customer group can be computed as follows:

**Table 5-36 Waste quantities by customer group (in tons)**

| | | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Domestic | 72% | 47,575 | 48,143 | 50,216 | 53,165 | 55,608 | 58,174 | 60,856 | 63,646 | 66,213 | 68,873 | 71,628 | 73,777 | 75,990 |
| Industry | 26% | 17,180 | 17,385 | 18,133 | 19,199 | 20,081 | 21,007 | 21,976 | 22,983 | 23,910 | 24,871 | 25,866 | 26,642 | 27,441 |
| Public | 2% | 1,322 | 1,337 | 1,395 | 1,477 | 1,545 | 1,616 | 1,690 | 1,768 | 1,839 | 1,913 | 1,990 | 2,049 | 2,111 |
| **Total** | **100%** | **66,076** | **66,865** | **69,744** | **73,840** | **77,234** | **80,797** | **84,523** | **88,398** | **91,962** | **95,657** | **99,483** | **102,468** | **105,542** |

From the baseline study, actual invoiced amounts per customer group are known. From this, an average charge per ton of waste is calculated:

**Table 5-37 Solid Waste Tariff by customer group (2005)**

| Customer group | Invoiced CSD | Waste (tons) | Charge/ton | |
|---|---|---|---|---|
| | | | CSD | € |
| Domestic | 91,792,180 | 47,575 | 1,929 | 23 |
| Industry/Public | 115,787,159 | 18,501 | 6,258 | 74 |
| **Total** | **207,579,339** | **66,076** | **3,142** | **37** |

Conclusion therefore is that current solid waste tariffs are cross subsidized. However, domestic solid waste tariffs are charged per m2 of build property, which has no direct relation with the quantity of waste produced. Economic prizing of solid waste services would therefore not provide incentives to minimize waste. The solid waste fee has to be paid regardless of how much waste is actually produced.

In calculating the impact of the regional system on the domestic client group, we have used as a principle that the additional charge will be paid pro-rata the waste produced. Thus, the additional charge is not cross subsidized. Furthermore, we have assumed that the current tariff is only adjusted with inflation over time. Next, it is assumed that the average household income will grow with inflation and real wage increase and that household size will decrease from 3.04 to 2.90 in 2012 in line with the trend over the period 1991 – 2002. Additional people served from rural areas, in accordance with the waste quantity forecast, is included as well. Finally, the base case assumes that the collection rate for domestic clients increases from 68% in 2005 to 95% in 2010. A low case scenario, assuming no change in collection rates, is presented as well.

The tables below summarize the impact of the introduction of the tipping fee on the average monthly household solid waste charge:

**Table 5-38 Household tariff and affordability, base case**

| | Units | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average collection rate households | | 68% | 68% | 70% | 80% | 90% | 95% | 95% | 95% | 95% | 95% | 95% | 95% | 95% |
| Average household size | | 3.04 | 3.02 | 3.00 | 2.98 | 2.96 | 2.94 | 2.92 | 2.90 | 2.90 | 2.90 | 2.90 | 2.90 | 2.90 |
| Number of HH served - current | | 75,608 | 76,109 | 78,210 | 82,837 | 87,574 | 92,041 | 96,432 | 100,177 | 101,713 | 102,922 | 103,566 | 103,566 | 103,566 |
| Additional people served | | | 4,781 | 12,225 | 12,364 | 11,382 | 10,982 | 8,932 | 4,454 | 3,504 | 1,868 | | | |
| Additional HH served | | | 1,583 | 4,075 | 4,149 | 3,845 | 3,735 | 3,059 | 1,536 | 1,208 | 644 | - | - | - |
| Total HH served | | 75,608 | 77,692 | 82,285 | 86,986 | 91,419 | 95,776 | 99,491 | 101,713 | 102,922 | 103,566 | 103,566 | 103,566 | 103,566 |
| No. of paying HH | | 51,413 | 52,831 | 57,599 | 69,589 | 82,277 | 90,987 | 94,516 | 96,627 | 97,775 | 98,388 | 98,388 | 98,388 | 98,388 |
| Current average SW tariff (incl. 8% VAT | CSD/mnth | 113 | 124 | 135 | 141 | 148 | 156 | 164 | 172 | 180 | 189 | 199 | 209 | 219 |
| Additional SW tariff per HH (incl 8% VAT | CSD/mnth | | | | 162 | 150 | 149 | 158 | 169 | 183 | 198 | 217 | 234 | 253 |
| **Total SW tariff per HH** | **CSD/mnth** | **113** | **124** | **135** | **303** | **299** | **305** | **321** | **341** | **363** | **388** | **416** | **443** | **473** |
| Nominal increase | % | | 9.3% | 9.0% | 125.0% | -1.5% | 2.1% | 5.4% | 6.2% | 6.5% | 6.8% | 7.1% | 6.6% | 6.7% |
| Real increase | % | | -3.3% | 0.0% | 114.3% | -6.2% | -2.7% | 0.3% | 1.1% | 1.4% | 1.7% | 2.0% | 1.6% | 1.6% |
| Cumulative real increase | % | | -3.3% | -3.3% | 107.3% | 94.5% | 89.3% | 89.9% | 92.1% | 94.7% | 98.0% | 102.1% | 105.2% | 108.5% |
| Nominal average household income | CSD/mnth | 24,924 | 29,009 | 32,568 | 35,223 | 38,093 | 41,598 | 45,425 | 50,081 | 55,214 | 60,874 | 67,113 | 72,583 | 78,499 |
| **Affordability ratio** | | **0.5%** | **0.4%** | **0.4%** | **0.9%** | **0.8%** | **0.7%** | **0.7%** | **0.7%** | **0.7%** | **0.6%** | **0.6%** | **0.6%** | **0.6%** |

The proposed tipping fee would lead to an increase of the average household charge with cumulative 108% in real terms to 2017. This is, however, well within the affordability limit of 1.5% of disposable income. Maximum affordability ratio is reached in the year 2008 with 0.9%.

The graphs below set out both nominal and real tariffs and its development over time:

**Figure 5-1 Monthly Tariff per Household (nominal in CSD/month)**

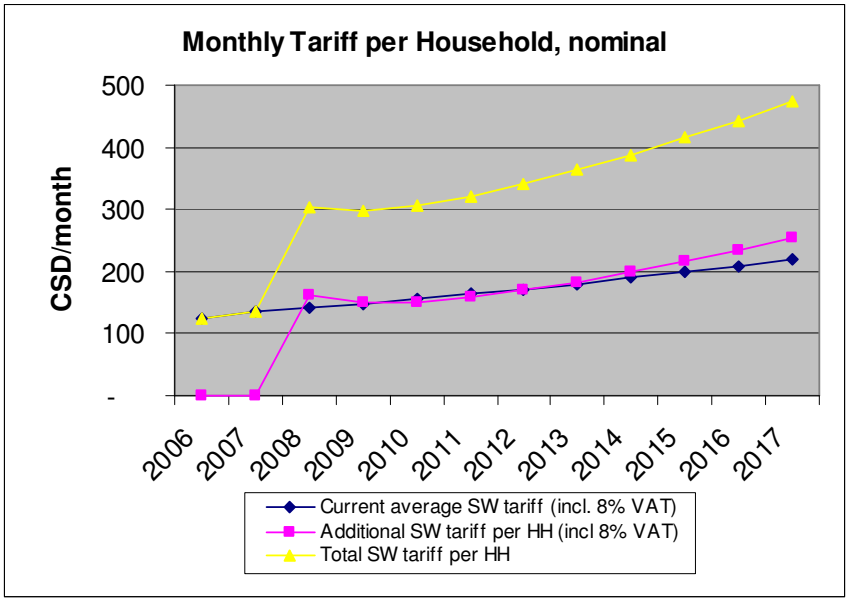
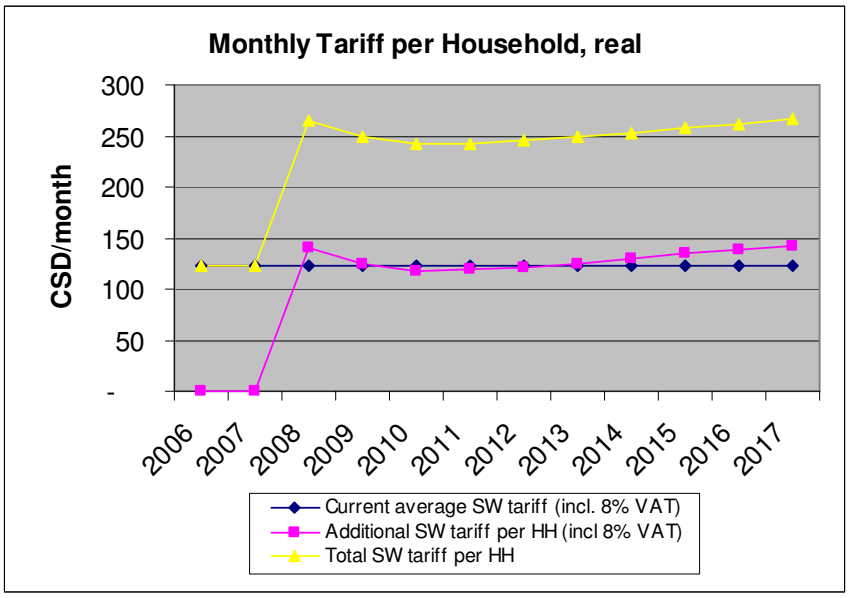


**Figure 5-2 Monthly Tariff per Household (real in CSD/month)**



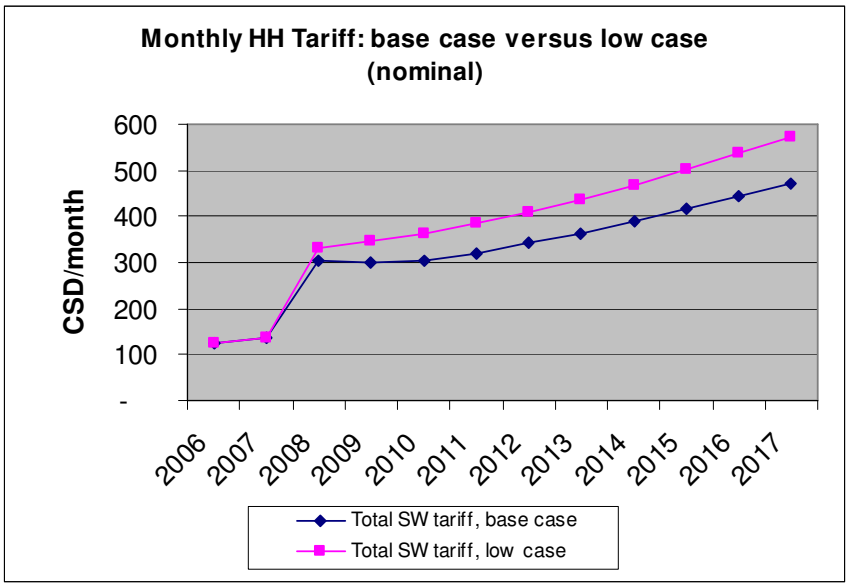

Assuming a low case collection rate scenario with the same starting tipping fee of CSD 2,350/ton, a real tariff increase of 153% cumulative would be required. This tariff is within affordability constraints: maximum of 0.9% is achieved during the years 2008, 2009 and 2010.

**Table 5-39 Household tariff and affordability, low case**

| | Units | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average collection rate households | | 68% | 68% | 68% | 68% | 68% | 68% | 68% | 68% | 68% | 68% | 68% | 68% | 68% |
| Average household size | | 3.04 | 3.02 | 3.00 | 2.98 | 2.96 | 2.94 | 2.92 | 2.90 | 2.90 | 2.90 | 2.90 | 2.90 | 2.90 |
| Number of HH served - current | | 75,608 | 76,109 | 78,210 | 82,837 | 87,574 | 92,041 | 96,432 | 100,177 | 101,713 | 102,922 | 103,566 | 103,566 | 103,566 |
| Additional people served | | | 4,781 | 12,225 | 12,364 | 11,382 | 10,982 | 8,932 | 4,454 | 3,504 | 1,868 | | | |
| Additional HH served | | | 1,583 | 4,075 | 4,149 | 3,845 | 3,735 | 3,059 | 1,536 | 1,208 | 644 | - | - | - |
| Total HH served | | 75,608 | 77,692 | 82,285 | 86,986 | 91,419 | 95,776 | 99,491 | 101,713 | 102,922 | 103,566 | 103,566 | 103,566 | 103,566 |
| No. of paying HH | | 51,413 | 52,831 | 55,954 | 59,151 | 62,165 | 65,128 | 67,654 | 69,165 | 69,987 | 70,425 | 70,425 | 70,425 | 70,425 |
| Current average SW tariff (incl. 8% VAT | CSD/mnth | 113 | 124 | 135 | 141 | 148 | 156 | 164 | 172 | 180 | 189 | 199 | 209 | 219 |
| Additional SW tariff per HH (incl 8% VAT | CSD/mnth | | | | 190 | 199 | 208 | 220 | 237 | 255 | 277 | 303 | 327 | 354 |
| **Total SW tariff per HH** | **CSD/mnth** | **113** | **124** | **135** | **331** | **347** | **364** | **384** | **408** | **436** | **467** | **502** | **536** | **573** |
| Nominal increase | % | | 9.3% | 9.0% | 146.2% | 4.7% | 4.9% | 5.4% | 6.4% | 6.7% | 7.1% | 7.5% | 6.9% | 6.9% |
| Real increase | % | | -3.3% | 0.0% | 134.5% | -0.3% | -0.1% | 0.4% | 1.3% | 1.6% | 2.0% | 2.4% | 1.8% | 1.8% |
| Cumulative real increase | % | | -3.3% | -3.3% | 126.8% | 126.2% | 126.0% | 126.9% | 129.9% | 133.6% | 138.3% | 143.9% | 148.3% | 152.9% |
| Nominal average household income | CSD/mnth | 24,924 | 29,009 | 32,568 | 35,223 | 38,093 | 41,598 | 45,425 | 50,081 | 55,214 | 60,874 | 67,113 | 72,583 | 78,499 |
| **Affordability ratio** | | **0.5%** | **0.4%** | **0.4%** | **0.9%** | **0.9%** | **0.9%** | **0.8%** | **0.8%** | **0.8%** | **0.8%** | **0.7%** | **0.7%** | **0.7%** |

The effect on domestic consumer tariffs of the low collection rate versus increased collection rate can be seen from the graph below:

**Figure 5-3 Monthly Tariff per Household: base case versus low case**




### 5.6.6 Revenues

Revenues consist of:

- Tipping fees payable by solid waste collection PUC's. Initial average tipping fee is CSD 2,350/ton in 2008 and adjusted for inflation thereafter. Total proceeds of this revenue will be equal, regardless of differentiated tipping fees or not;
- Proceeds of separately collected materials: proceeds of separately collected materials accrue to the SPV company. Incentive for solid waste collection by the PUC would be that no tipping fee would have to be paid for paper or PET bottles which are separately delivered at the gate of the waste separation line. Since Cacak municipality invests in its own separation line, proceeds of the separate collection do not accrue to the SPV company;
- Proceeds of recycled material after processing by the separation line.

Revenues are estimated based on proposed tipping fee, forecasted waste quantities and prices of secondary materials.

**Table 5-40 Revenues**

| | Units | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Tipping fee | CSD m | 174 | 191 | 209 | 230 | 253 | 276 | 301 | 329 | 356 | 385 |
| *Separate collection* | | | | | | | | | | | |
| Paper/carton | CSD m | 1 | 2 | 4 | 6 | 8 | 9 | 9 | 10 | 11 | 12 |
| PET Bottles | CSD m | 0 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 |
| *Recycling* | | | | | | | | | | | |
| Paper/carton | CSD m | 36 | 38 | 41 | 43 | 45 | 49 | 53 | 57 | 60 | 64 |
| Metal | CSD m | 29 | 32 | 35 | 38 | 41 | 44 | 48 | 51 | 55 | 58 |
| Glass | CSD m | - | - | - | - | - | - | - | - | - | - |
| Plastic | CSD m | 21 | 24 | 26 | 28 | 30 | 33 | 35 | 38 | 40 | 43 |
| PET Bottles | CSD m | 19 | 20 | 21 | 22 | 24 | 25 | 27 | 29 | 31 | 33 |
| Wood | CSD m | | | | | | | | | | |
| Rubber | CSD m | | | | | | | | | | |
| Textile | CSD m | | | | | | | | | | |
| Biomass | CSD m | | | | | | | | | | |
| Other | CSD m | | | | | | | | | | |
| *LFG option* | | | | | | | | | | | |
| LFG - carbon credit | CSD m | - | - | - | - | - | - | - | - | - | - |
| LFG - avoided electricity | CSD m | - | - | - | - | - | - | - | - | - | - |
| LFG - electricity to grid | CSD m | - | - | - | - | - | - | - | - | - | - |
| **Total revenues** | **CSD m** | **280** | **307** | **337** | **368** | **403** | **437** | **475** | **516** | **555** | **597** |

### 5.6.7 Profit & loss, balance sheet and cash flow statement

This paragraph presents the final outcome of the financial model. Full printouts of the model, both in CSD as well as Euro, are included in the annexes.

**Table 5-41 Profit and Loss statement (CSD million)**

| | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Revenue** | | | | | | | | | | | |
| Tipping fee | 0 | 174 | 191 | 209 | 230 | 253 | 276 | 301 | 329 | 356 | 385 |
| Proceeds secondary ma | 0 | 107 | 117 | 127 | 138 | 150 | 162 | 174 | 187 | 199 | 213 |
| Land fill gas | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Other | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Subsidies | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Revenue** | **0** | **280** | **307** | **337** | **368** | **403** | **437** | **475** | **516** | **555** | **597** |
| **Expenditure** | | | | | | | | | | | |
| **Variable costs** | 0 | 19 | 22 | 25 | 29 | 33 | 38 | 43 | 48 | 54 | 60 |
| Electricity | 0 | 7 | 8 | 9 | 11 | 12 | 14 | 16 | 18 | 20 | 22 |
| Diesel | 0 | 11 | 12 | 14 | 16 | 19 | 22 | 25 | 28 | 31 | 35 |
| Other | 0 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 |
| **Fixed costs** | 5 | 97 | 104 | 112 | 122 | 132 | 144 | 156 | 170 | 183 | 197 |
| Wages & salaries | 3 | 37 | 40 | 43 | 48 | 53 | 59 | 65 | 72 | 78 | 85 |
| Employee benefits | 1 | 9 | 10 | 11 | 12 | 13 | 15 | 16 | 18 | 19 | 21 |
| Maintenance | 0 | 34 | 36 | 39 | 41 | 44 | 48 | 51 | 55 | 59 | 63 |
| Insurance | 0 | 13 | 14 | 14 | 15 | 16 | 16 | 17 | 18 | 19 | 20 |
| Other costs | 2 | 5 | 5 | 5 | 6 | 6 | 6 | 6 | 7 | 7 | 7 |
| **Operating costs** | **5** | **117** | **126** | **137** | **150** | **165** | **182** | **199** | **219** | **237** | **257** |
| **EBITDA** | **-5** | **164** | **181** | **199** | **218** | **238** | **256** | **276** | **297** | **318** | **340** |
| Depreciation | 0 | 130 | 130 | 130 | 130 | 130 | 130 | 110 | 113 | 113 | 113 |
| Bad debt | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total costs** | **5** | **247** | **256** | **268** | **281** | **295** | **312** | **309** | **332** | **350** | **370** |
| **Net Operating Income** | **-5** | **33** | **51** | **69** | **87** | **107** | **125** | **166** | **184** | **205** | **227** |
| Interest charges | 26 | 38 | 39 | 40 | 35 | 29 | 24 | 18 | 12 | 6 | 0 |
| FX loss (gain) | 0 | 11 | 11 | 11 | 7 | 6 | 5 | 4 | 2 | 1 | 0 |
| **Net Income before Ta** | **-30** | **-15** | **1** | **18** | **46** | **72** | **97** | **144** | **170** | **198** | **227** |
| Income tax | 0 | 0 | 0 | 0 | 2 | 7 | 10 | 14 | 17 | 20 | 23 |
| **Net Income after Tax** | **-30** | **-15** | **1** | **18** | **44** | **65** | **87** | **130** | **153** | **178** | **205** |
| EBITDA % | | 58% | 59% | 59% | 59% | 59% | 59% | 58% | 58% | 57% | 57% |
| Net operating income % | | 12% | 17% | 20% | 24% | 27% | 29% | 35% | 36% | 37% | 38% |

With an initial tipping fee of CSD 2,350/ton, the SPV operates at a net loss during the first operational year, but breaks even during its second year of operations. An average

tipping fee of CSD 2,560/ton would be required to break even during the first operational year.

As can be concluded from the table, profit margins increase rapidly. This is a result of on the hand low increase of costs with less than inflation and increasing revenues from tipping fees as a result of growth in waste quantities.

**Table 5-42 Balance sheet (in CSD million)**

| | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Fixed assets** | 1,314 | 1,183 | 1,053 | 922 | 792 | 662 | 818 | 890 | 777 | 664 | 551 |
| **Current assets** | | | | | | | | | | | |
| Inventories | 0 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 |
| Receivables | 0 | 35 | 38 | 41 | 45 | 50 | 54 | 59 | 64 | 68 | 74 |
| Cash | 8 | 111 | 251 | 326 | 424 | 547 | 404 | 392 | 587 | 808 | 1,145 |
| **Total** | **8** | **147** | **290** | **369** | **471** | **598** | **460** | **452** | **653** | **879** | **1,222** |
| Non-operating | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total assets** | **1,321** | **1,330** | **1,343** | **1,292** | **1,263** | **1,260** | **1,278** | **1,342** | **1,430** | **1,542** | **1,772** |
| *Equity bf* | *0* | *783* | *767* | *768* | *786* | *832* | *904* | *1,001* | *1,146* | *1,315* | *1,513* |
| *Retained earnings* | *-30* | *-15* | *1* | *18* | *46* | *72* | *97* | *144* | *170* | *198* | *227* |
| *Grants* | *813* | *0* | *0* | *0* | *0* | *0* | *0* | *0* | *0* | *0* | *0* |
| ***Equity cf*** | ***783*** | ***767*** | ***768*** | ***786*** | ***832*** | ***904*** | ***1,001*** | ***1,146*** | ***1,315*** | ***1,513*** | ***1,740*** |
| **Long term liabilities** | | | | | | | | | | | |
| Equity | 783 | 767 | 768 | 786 | 832 | 904 | 1,001 | 1,146 | 1,315 | 1,513 | 1,740 |
| Long-term liabilities | 538 | 549 | 560 | 489 | 413 | 335 | 255 | 172 | 87 | 0 | 0 |
| **Total** | **1,321** | **1,316** | **1,327** | **1,275** | **1,245** | **1,239** | **1,256** | **1,318** | **1,403** | **1,513** | **1,740** |
| **Current liabilities** | | | | | | | | | | | |
| Payables | 1 | 14 | 16 | 17 | 19 | 20 | 22 | 25 | 27 | 29 | 32 |
| Overdraft | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Other | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total** | **1** | **14** | **16** | **17** | **19** | **20** | **22** | **25** | **27** | **29** | **32** |
| Non-operating | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Total liabilities** | **1,321** | **1,330** | **1,343** | **1,292** | **1,263** | **1,260** | **1,278** | **1,342** | **1,430** | **1,542** | **1,772** |
| **Key ratios** | | | | | | | | | | | |
| **Current ratio** | **12.8** | **10.2** | **18.7** | **21.8** | **25.4** | **29.4** | **20.6** | **18.5** | **24.2** | **30.1** | **38.6** |
| **Leverage** | **41%** | **42%** | **42%** | **38%** | **33%** | **27%** | **20%** | **13%** | **6%** | **0%** | **0%** |

Usually, the first year following the end of the grace period is critical in maintaining a debt service coverage ratio (DSCR) of 1.3. With the proposed tipping fee, this can be achieved. However, as a result of extension of the landfill in the year 2013 and substantial re-investments in mobile equipment in 2014, the DSCR drops below 1.3, whereas the cash flow is negative during these years as well. On the other hand, there is sufficient cash available, accumulated during the preceding years, to finance these investments from internally generated funds and maintain a positive cash balance. If the available cash is added to the year's cash flow, a minimum DSCR of 1.3 for any one year can be maintained.

Several measures could be taken to increase the DSCR for these years:

- Spreading the investment over more years;
- Financing these investments with another loan, or by attracting grant funding:
  - To ensure a DSCR of 1.3 during 2013, approximately € 1.5M would need to be financed by means of a loan, grant or municipal contribution;

- To ensure a DSCR of 1.3 during 2014, approximately € 0.4M would need to be financed by means of a loan, grant or municipal contribution;

- Raising the tipping fees;
- Or a combination of the above.

**Table 5-43 Cash flow statement (in CSD million)**

| | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cash bf | - | 8 | 111 | 251 | 326 | 424 | 547 | 404 | 392 | 587 | 808 |
| Overdraft bf | - | - | - | - | - | - | - | - | - | - | - |
| **Net cash bf** | **-** | **8** | **111** | **251** | **326** | **424** | **547** | **404** | **392** | **587** | **808** |
| **Revenue** | | | | | | | | | | | |
| Tipping fee | - | 174 | 191 | 209 | 230 | 253 | 276 | 301 | 329 | 356 | 385 |
| Proceeds secondary materials | - | 107 | 117 | 127 | 138 | 150 | 162 | 174 | 187 | 199 | 213 |
| Land fill gas | - | - | - | - | - | - | - | - | - | - | - |
| Less bad debt | - | - | - | - | - | - | - | - | - | - | - |
| **Total** | **-** | **280** | **307** | **337** | **368** | **403** | **437** | **475** | **516** | **555** | **597** |
| **Costs** | | | | | | | | | | | |
| **Variable costs** | - | 19 | 22 | 25 | 29 | 33 | 38 | 43 | 48 | 54 | 60 |
| Electricity | - | 7 | 8 | 9 | 11 | 12 | 14 | 16 | 18 | 20 | 22 |
| Diesel | - | 11 | 12 | 14 | 16 | 19 | 22 | 25 | 28 | 31 | 35 |
| Other | - | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 |
| **Fixed costs** | 5 | 97 | 104 | 112 | 122 | 132 | 144 | 156 | 170 | 183 | 197 |
| Wages & salaries | 3 | 37 | 40 | 43 | 48 | 53 | 59 | 65 | 72 | 78 | 85 |
| Employee benefits | 1 | 9 | 10 | 11 | 12 | 13 | 15 | 16 | 18 | 19 | 21 |
| Maintenance | - | 34 | 36 | 39 | 41 | 44 | 48 | 51 | 55 | 59 | 63 |
| Insurance | - | 13 | 14 | 14 | 15 | 16 | 16 | 17 | 18 | 19 | 20 |
| Other costs | 2 | 5 | 5 | 5 | 6 | 6 | 6 | 6 | 7 | 7 | 7 |
| **Total** | **5** | **117** | **126** | **137** | **150** | **165** | **182** | **199** | **219** | **237** | **257** |
| **Working capital required** | (1) | 22 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | 3 | 3 |
| **Operating cash flow** | **(4)** | **142** | **179** | **197** | **215** | **235** | **254** | **274** | **295** | **316** | **338** |
| Capex & start-up subsidy | 490 | - | - | - | - | - | - | - | - | - | - |
| Capex | 1,314 | - | - | - | - | - | 287 | 182 | - | - | - |
| Discretionary capex | - | - | - | - | - | - | - | - | - | - | - |
| **Investment cash flow** | **823** | **-** | **-** | **-** | **-** | **-** | **287** | **182** | **-** | **-** | **-** |
| Credit / overdraft interest | - | - | - | - | - | - | - | - | - | - | - |
| Debt drawdown | 538 | - | - | - | - | - | - | - | - | - | - |
| Grants | 323 | - | - | - | - | - | - | - | - | - | - |
| **Financing cash flow** | **861** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |
| **Cash for debt service** | **33** | **142** | **179** | **197** | **215** | **235** | **(34)** | **92** | **295** | **316** | **338** |
| Capital repayment | - | - | - | 81 | 83 | 84 | 85 | 86 | 87 | 89 | - |
| Interest and fee payment | 26 | 38 | 39 | 40 | 35 | 29 | 24 | 18 | 12 | 6 | - |
| **Total debt service** | **26** | **38** | **39** | **121** | **117** | **113** | **109** | **104** | **100** | **95** | **-** |
| **Net change in cash** | **8** | **103** | **140** | **76** | **98** | **122** | **(142)** | **(12)** | **195** | **221** | **338** |
| Cash cf | 8 | 111 | 251 | 326 | 424 | 547 | 404 | 392 | 587 | 808 | 1,145 |
| Overdraft cf | - | - | - | - | - | - | - | - | - | - | - |
| **Net cash cf** | **8** | **111** | **251** | **326** | **424** | **547** | **404** | **392** | **587** | **808** | **1,145** |
| **DSCR** | **1.30** | **3.69** | **4.57** | **1.62** | **1.84** | **2.08** | **-0.31** | **0.88** | **2.96** | **3.33** | |
| **DSCR including cash C/F** | **1.30** | **3.89** | **7.40** | **3.69** | **4.62** | **5.84** | **4.72** | **4.76** | **6.89** | **9.52** | |

### 5.6.8 Financial cost benefit analysis

A financial cost-benefit analysis has been carried out based on the assumptions set out in previous paragraphs. A nominal discount rate of 8% is used, consisting of 6% real discount rate (commonly used for EU financed infrastructural projects and used in other EBRD financed projects in Serbia) and 2% inflation.

When analyzing the “with” and “without” project situation, one could argue about whether or not to include tipping fees as a result of the project intervention. We have chosen to include tipping fees, on the grounds that the project adds (environmental)

value to the overall solid waste management system; additional tipping fees would not be levied in the “without project” situation.

Furthermore, the analysis only takes 13 years into account (2007 – 2019), in line with the estimated life time of the landfill of 12 years. The first year of the project is devoted to realize the investment. The next 12 years the landfill is operated.

Some assets have a longer lifetime than 13 years, such as civil works for the transfer stations and plant equipment of the separation line. In spite of this, no residual values of assets are taken into account in year 13 of the analysis, to have a conservative estimate. Obviously, results of the analysis would improve if these were taken into consideration.

Full printouts of the financial cost-benefit analyses are included in the annexes.

The results of the analysis are:
- During the 13 year analysis period, the nominal internal rate of return is 9.6%;
- Net present value at 8% discount rate is € 1,094K;
- With the proposed tipping fee, subsequent increases and additional investments in respectively 2013 and 2014, the project is financially feasible, however with a rather minimal margin.

To assess the feasibility of the waste separation line in Duboko, a separate cost benefit analysis has been conducted. This would help to decide whether it is financially feasible to invest in such a business activity. The analysis takes into consideration direct costs, investments and revenues of proceeds of secondary material. It does not take into account avoided costs of land filling non separated material. Since the expected technical lifetime of the equipment of the waste separation line is 15 years, both a 13 year and a 16 year period will be included and compared in the analysis.

The results of this analysis are:
- During the 13 year analysis period, the nominal internal return is 20.4%. If the analysis is conducted over 16 years, an IRR of 22.0% would be achieved;
- Net present value at 8% discount rate is respectively € 2,454K for 13 years and € 3,483K for 16 years;
- Based on this analysis and the assumptions outlined above, an investment in the waste separation line is financially feasible.

### 5.6.9 Sensitivity analysis

A sensitivity analysis is conducted to analyze the impact of:
- Variations in the macro-economic environment;
- Identify the sensitivity of the model to changes in some key input factors.

The table below summarizes the results of the sensitivity analysis for changes in the macro-economic environment:

**Table 5-44 Sensitivity analysis macro-economic assumptions**

| | Min. DSCR | Occurs in | Min. DSCR cumulative | Occurs in | IRR 13 yrs | NPV € '000 | Remarks |
|---|---|---|---|---|---|---|---|
| ***Macro-economic scenario*** | | | | | | | |
| Base case | -0.31 | 2013 | 3.69 | 2010 | 9.6% | 1,094 | Cash flow negative in 2013 and 2014, cumulative cash positive |
| Optimistic | 0.61 | 2013 | 4.95 | 2008 | 17.3% | 7,440 | Cash flow negative in 2013, cumulative cash positive |
| Pessimistic case | -1.47 | 2013 | -2.20 | 2014 | -3.0% | -6,022 | Cash flow negative in 2010, 2013 and 2014 cumulative cash negative 2013-2017 |

An optimistic macro-economic scenario development would clearly benefit the main indicators of the financial model. To the contrary, a pessimistic macro-economic development would cause the project to return a negative internal rate of return and have a negative cumulative cash balance during the final years of the analysis period. The main driver of this impact is related to lower GDP growth than the base case, which causes the growth of solid waste collected to stagnate.

**Table 5-45 Sensitivity analysis key input variables**

| | Min. DSCR | Occurs in | Min. DSCR cumulative | Occurs in | IRR 13 yrs | NPV € '000 | Remarks |
|---|---|---|---|---|---|---|---|
| ***Key input variables*** | | | | | | | |
| Waste quantities -10% | -0.69 | 2013 | 2.43 | 2014 | 6.0% | -1,305 | Cash flow negative in 2013 and 2014, cumulative cash positive |
| Waste quantities -20% | -1.06 | 2013 | 0.10 | 2014 | 1.9% | -3,704 | Cash flow negative in 2013 and 2014, cumulative cash positive |
| Market prices secondary materials -10% | -0.46 | 2013 | 3.41 | 2010 | 8.2% | 164 | Cash flow negative in 2013 and 2014, cumulative cash positive |
| Market prices secondary materials -20% | -0.60 | 2013 | 2.93 | 2014 | 6.8% | -766 | Cash flow negative in 2013 and 2014, cumulative cash positive |
| Investment cost +10% | -0.63 | 2013 | 3.57 | 2010 | 7.1% | -635 | Cash flow negative in 2013 and 2014, cumulative cash positive |
| Investment cost +20% | -0.95 | 2013 | 3.11 | 2014 | 4.9% | -2,363 | Cash flow negative in 2013 and 2014, cumulative cash positive |

The largest impact on the feasibility of the project is clearly variations in solid waste quantities collected. The analysis shows that a variation of -20% in quantities collected would cause the internal rate of return to drop to 1.9%, although cumulative net cash would still be positive throughout the analysis period. Since the forecast of the solid waste quantities is not based on actually measured quantities (or samples), but based on estimates of the local public utilities themselves by means of a questionnaire, there is uncertainty in this number. On the other hand, a rule of thumb is that an average person in Serbia produces about 0.75 kg waste per day. Based on a served population of approximately 230,000 people in the year 2005, a total amount of 63,000 ton of domestic solid waste could be expected, excluding industrial waste. This study estimates the quantity of waste collected during 2005 at some 66,000 ton, including waste collected from industries. Taking into account that the public utility companies have reported that, out of the total waste collected, 72% originates from residents, 26% from businesses & industries and the remainder from the public sector, there might also be some upward potential in the waste quantity estimate.

Since the financial feasibility is very sensitive to the actual quantities of waste collected, consultants recommend reviewing the tipping fee after some 6 months of operations, to assess whether solid waste quantities collected are in line with the estimates and to see whether tipping fees would need to be adjusted to ensure financial sustainability of the project.

## 5.7 Potential for additional revenues

The following additional revenue generation possibilities have been analyzed:

- Landfill gas to electricity **excluding** carbon credit sale
- Landfill gas to electricity **including** carbon credit sale

The reason for the distinction is that Serbia presently cannot make use of a carbon credit scheme, because the relevant treaty has not been ratified yet.

Assumptions of the landfill gas to electricity project are elaborated upon in paragraph 5.6.2. In addition, the calculations assume that carbon credit sale will be possible after 2012, when the current regulation ends. Since the project can technically continue to run after closure of the regional landfill, both impact on the main project's 13 year period will be presented, as well as an analysis of 30 years, covering the landfill gas projects' technical life time. Only the impact on the macro-economic base case scenario will be analyzed.

The associated investments for both options are the same and presented in the table below:

**Table 5-46 Landfill gas to electricity investment schedule**

| | Units | Total | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|---|---|---|
| LFG - infrastructure (pipes, civil works) | € m | 0.88 | 0.20 | | | 0.22 | 0.12 | 0.13 | 0.21 |
| LFG - compressor & gas engines | € m | 0.53 | 0.33 | | | 0.19 | | | |
| **Subtotal** | **€ m** | **1.40** | **0.53** | **-** | **-** | **0.41** | **0.12** | **0.13** | **0.21** |

The analysis assumes that the investments will be financed from internally generated funds.

Revenues from electricity sales to the national grid start from the year 2013. Carbon credit sales start slightly earlier, during the year 2010. Part of the generated electricity will be used by the waste separation line and landfill operations This will fetch higher revenues than sale to the national grid, because these avoided costs are valued at 100% of consumer prices, whereas electricity sale to the national grid is estimated to be 80% of consumer prices.

The landfill gas to electricity project **excluding** carbon credit sale show the following result:

- During the 13 year period 2007 to 2019, the internal rate of return is -1.1% and net present value € -127K at 8% nominal discount rate;
- During the 30 year period 2007 to 2036, the internal rate of return is 22.7% and net present value € 1.097K at 8% nominal discount rate;
- The overall project internal rate of return will be slightly lower at 9.5%. Without project, the internal rate of return is 9.6%;
- The investment in the land fill gas project can be financed from internal sources without causing the DSCR to drop below 1.3, apart from the years 2013 and 2014;
- The DSCR ratio actually improves in 2013 from respectively -0.31 to -0.21 in 2013 and from 0.88 to 1.02 in 2014 as electricity sales to the national grid commence during these years.

The landfill gas to electricity project **including** carbon credit sale show the following result:

- During the 13 year period 2007 to 2019, the internal rate of return is 40.7% and net present value € 442K at 8% nominal discount rate;
- During the 30 year period 2007 to 2036, the internal rate of return is 49.3% and net present value € 2.234K at 8% nominal discount rate;
- The overall project internal rate of return will be higher at 10.2%. Without project, the internal rate of return is 9.6%;
- The investment in the land fill gas project can be financed from internal sources without causing the DSCR to drop below 1.3, apart from the years 2013 and 2014;
- The DSCR ratio actually improves in 2013 from respectively -0.31 to -0.12 in 2013 and from 0.88 to 1.13 in 2014 as electricity sales to the national grid commence during these years.

Based on this analysis, it is recommended to start with a landfill gas to electricity project, since both options generate sufficiently high returns in the long run.

Full output reports of both options are included in the appendices.

# 6 CREDITWORTHINESS ASSESSMENT OF THE CITIES OF ČAČAK AND UŽICE

## 6.1 Analysis of the national and local context

The current legal basis for local budget revenues is governed by the Law on Local Self-Government from 2002. Financing of local governments, went through some changes:

- In 2004, local governments' share of revenues based on salary fund tax was discontinued. In order to compensate this decrease in revenues to local budgets, the share of local government in income taxes was increased from 5% to 30%, In addition, the share of sales tax was increased in favor of selected poorer municipalities;
- From January 2005 onwards, sales tax has been replaced with value added tax (VAT). This change affects the way of providing local government budgets with revenues. Instead of sharing the sales tax with central government, the VAT is now going directly to the central funds, from which local governments are getting current transfers.
- In 2006, a new law on local government finance has been adopted. The law itself will become effective from January 1st, 2007. The main novelty is the decentralization of property tax. Property tax used to be collected by local offices of the National Government and than distributed to local government. As from 2007, this tax will be directly collected by local government itself and thus will broaden the own tax base/original revenues. Consequently, a unit for collecting property tax will be established at the local level and related expenditure is to be borne by local government.

According to the new law, the local government budgets obtain revenues from three main sources:

- Through local level, where local government can set taxes and collect it's own revenues. These are called original revenues, according to the law terminology;
- Through central level, by allocating or sharing the revenues with the central government. These are called shared revenues; and
- Through transfers from central government. This source is defined separately, but since it is coming from central funds it might be considered as a specific type of shared revenue.

<u>Original (own) revenues.</u> The original revenues of local government budgets comprise:

- **Local fees** - administrative, communal and tourist fees;
- **Charges on construction land** - charges for utilization and for development of the city construction land;
- **Other revenues** - include a dozen different revenues (charges for natural resources, charges on sales of assets, interest on deposited budget funds, etc). Generally, revenues generated from this group is small compared to the above two sources. In particular cases these can however provide substantial revenues
- **Self-contribution** – this revenue can be introduced by the decision of citizens made through local referendum. By definition, it is used for development of local capital infrastructure;
- **Donations** – donations could come from different sources such as central level, international organization and other. In this case, they are going directly to the local government;
- **Property taxes** - according to the new law on local government financing, taxes on property of the private and legal entities are becoming original revenues. This

change is important as such, but equally important is the changes related to the way how it is collected. From January 1st 2007, local governments will take over part of the central tax administration in order to fully control collection of this revenue.

Shared (allocated) revenues. The second large group of local budget revenues consists of revenues that are allocated by national level to the local level. According to the legal terminology, these are called shared revenues. These revenues consist of:

- **Income taxes** – includes a number of taxes on different personal incomes generated from different sources: agriculture and forestry, private business activities, immovable property, leased movable property; prizes in games of chance, personal insurance, part of the salary tax and others;
- **Property related taxes** – includes taxes on inheritance and gift tax, on transfer of absolute rights and on goods and services;
- **Different charges on assets of public interest** – includes charges for the utilization of different assets of public interest like mineral raw materials; river material; forest land; agricultural land, public roads, environmental protection and environment; investments;
- **Privatization revenues** – includes part of the funds (5%) collected through the sale of capital in the privatization process that is taking place within the municipal territory;
- **Transfers** – includes transfers from central government. Transfers as a specific type of local budget revenues was introduced in 2005 when the sales tax was replaced by VAT. The new law on local government finance introduces a wide array of transfers: categorical and non-categorical transfers (which include equalization transfers), compensation, transitional, general and block transfers.

The investment capacity and creditworthiness of local budgets depends on the efficiency of the overall local financial management, which includes the capacity for generating revenues as well as the way in which these revenues are spent. Certain revenues are especially important for funding capital expenditure. These are:

- **Land use development charge**. This revenue is directly related to local investments. It is paid by investors who are planning to invest in construction on land within municipal boundaries. The investor is obliged to pay this charge in cases when he is the owner of the specific construction site, but also when he has the right for using it or the right to erect objects on it. The charge is set in accordance with the costs of developing the site, the purpose of the object and the city zone. Setting the base and rate of this charge is under the jurisdiction of local government.
- **Land use charge**. This charge is used to cover the costs of maintenance of local infrastructure and it is set in accordance with the costs of maintenance. This charge is also under the jurisdiction of local government.
- **Revenue from renting the City assets**. Revenues from renting immobile and mobile assets of the local governments are original revenues. They are supposed to be used exclusively for capital investments. But, since this is not strictly prescribed by law, in certain cases they are used for covering costs of current operations.
- **Self-contribution**. Self-contribution is a traditional revenue source of local government that is to be used for capital investment of special local communities needs such as water supply, roads etc. The contribution is raised and set by local referendum.

- **Privatization revenues**. According to the Law on Privatization, 5% of the proceeds received from selling state or socially owned companies on the territory of the municipality is going to the local government budget.
- **Donations**. From the year 2000 donations, especially from international funds, became an important source of funding capital investments at local government level. In the near future, local government is still planning certain financial inflow from this source, but in mid, and especially in longer period, it is expected that this will decrease.
- **Transfers**. Transfers are a relatively new type of revenues for Serbian local government. Although currently relatively small, it is expected that this source will become very important for local government, after its introduction in the new law on local government finance.
- **Property tax**. From January 1st 2007, local governments will set the rate, within the framework defined by central government, collect and control property tax. It is expected that this revenue will grow in the near future, due to the higher motivation at the local level to collect it. Establishment of the local tax administration is considered to be a big change as such and it is expected that this might generally increase fiscal capacity of local government in Serbia.

## 6.2 Analysis of Čačak and Užice financial operations

### 6.2.1 Budget revenues

The total realized 2005 revenues of the two leading municipalities in the Duboko solid waste management scheme, the municipalities of Čačak and Užice, amounted to CSD 2.3 billion, equivalent to € 27.6 million. Out of this, CSD 1.36 billion was realized by Čačak municipality (€ 16.0 million) and CSD 0.98 billion (€ 11.6 million) by Užice municipality.

Generally, the revenues of the Serbian municipalities consist of two main groups of revenues: own or original revenues and allocated or shared revenues. Own or original revenues are revenues that local governments control, both in defining its level as well as in collecting it. Allocated or shared revenues are collected by the central government and then distributed to the local level. One of the major officially proclaimed goals of local government reform in Serbia is the increase of the autonomy of local government. One of the main instruments, and at the same time an indicator of progress towards this goal, is the increase of local government revenue, and within this, especially the increase of the original revenues.

The data in the tables below show that, during the last few years, the local budgets of Čačak and Užice have been growing nominally as well as in real terms. Against an inflation of approximately 52% during the period 2003 to 2006, budgets have been growing at respectively 129% and 124%.

At the same time however, the share of original revenues was stagnating. A considerable change is expected to happen from January 1, 2007, when tax on property will change its status from shared to original local government revenues. So, during the 2007 budget year and provided the trend from the last few years continues, it could be expected that the share of original revenues in both municipalities will be around 1/3 of total budget revenues.

**Table 6-1 Budget revenues Čačak**

| No | Type of revenues | 2003 | | 2004 | | 2005 | | 2006 plan | |
|---|---|---|---|---|---|---|---|---|---|
| | | CSDm | % | CSDm | % | CSDm | % | CSDm | % |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **I** | **Original revenues** | **370** | **47%** | **395** | **36%** | **437** | **32%** | **386** | **21%** |
| 1.1. | Fees (administrative, communal, tourist) | 52 | 7% | 62 | 6% | 65 | 5% | 75 | 4% |
| 1.2. | Land development charge | 104 | 13% | 172 | 16% | 163 | 12% | 203 | 11% |
| 1.3. | Other | 214 | 27% | 162 | 15% | 209 | 15% | 108 | 6% |
| **II** | **Allocated revenues** | **422** | **53%** | **697** | **64%** | **914** | **67%** | **1,271** | **70%** |
| 2.1. | Sales tax | 194 | 24% | 271 | 25% | - | 0% | - | 0% |
| 2.2. | Income tax | 36 | 5% | 154 | 14% | 413 | 30% | 470 | 26% |
| 2.3. | Property tax | 49 | 6% | 62 | 6% | 73 | 5% | 81 | 4% |
| 2.4. | Property tax and tax on passing the absolute rights | 67 | 8% | 128 | 12% | 131 | 10% | 183 | 10% |
| 2.5. | Transfers | 7 | 1% | 0 | 0% | 184 | 14% | 379 | 21% |
| 2.6. | Other | 68 | 9% | 82 | 7% | 112 | 8% | 158 | 9% |
| **III** | **Privatization revenues** | **-** | **0%** | **1** | **0%** | **10** | **1%** | **23** | **1%** |
| **IV** | **Credits** | **-** | **0%** | **-** | **0%** | **-** | **0%** | **130** | **7%** |
| | **TOTAL REVENUES** | **792** | **100%** | **1,094** | **100%** | **1,361** | **100%** | **1,810** | **100%** |

At the moment, the most important source of original revenues are charges for construction land development and land use and different local fees. The local governments are fully entitled to introduce and collect fees (communal, administrative and tourist). The charge for land development is a specific revenue which is especially important because it is one of the revenues that is supposed to be used exclusively for capital expenditures. From January 2007, the tax on properties is changing its status, and it is expected that it will become one of the most important sources of original revenues.

**Table 6-2 Budget revenues Užice**

| No | Type of revenues | 2003 | | 2004 | | 2005 | | 2006 plan | |
|---|---|---|---|---|---|---|---|---|---|
| | | CSDm | % | CSDm | % | CSDm | % | CSDm | % |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **I** | **Original revenues** | **161** | **25%** | **105** | **12%** | **183** | **19%** | **282** | **19%** |
| 1.1. | Fees (administrative, communal, tourist) | 18 | 3% | 13 | 1% | 87 | 9% | 37 | 3% |
| 1.2. | Land development charge | 68 | 10% | 28 | 3% | 41 | 4% | 67 | 5% |
| 1.3. | Other | 76 | 12% | 64 | 7% | 56 | 6% | 178 | 12% |
| **II** | **Allocated revenues** | **485** | **74%** | **637** | **71%** | **762** | **78%** | **993** | **68%** |
| 2.1. | Sales tax | 134 | 20% | 186 | 21% | - | 0% | - | 0% |
| 2.2. | Income tax | 205 | 31% | 241 | 27% | 429 | 44% | 492 | 34% |
| 2.3. | Property tax and tax on passing the absolute rights | 59 | 9% | 110 | 12% | 115 | 12% | 141 | 10% |
| 2.4. | Transfers | 28 | 4% | 15 | 2% | 143 | 15% | 254 | 17% |
| 2.5. | Other | 59 | 9% | 84 | 9% | 75 | 8% | 106 | 7% |
| **III** | **Privatization revenues** | **7** | **1%** | **4** | **0%** | **6** | **1%** | **1** | **0%** |
| **IV** | **Surplus** | | **0%** | **32** | **4%** | **32** | **3%** | **-** | **0%** |
| **V** | **Credits** | **-** | **0%** | **120** | **13%** | **-** | **0%** | **187** | **13%** |
| | **TOTAL REVENUES** | **654** | **100%** | **898** | **100%** | **983** | **100%** | **1,463** | **100%** |

The most important allocated (shared) revenues until 2005 were income taxes, which are making up around 1/3 of total revenues. In Čačak it has reached a share of 30%, whilst the plan for 2006 is 26% of total revenues. In Užice, its share was 45% and the plan for 2006 is 34%.

The second most important allocated (shared) revenue until 2004 was revenue from sales tax. In 2005, it was replaced with tax on value added (VAT). Introduction of VAT affects the mechanism of transferring revenues from central to local level. The funds created by collection of VAT are allocated to the local budgets through a new mechanism: transfers from central to local level budgets. The share of these transfers in the total 2005 budget was around 14% in Čačak and 15% in Užice. Thus, this tax has become one of the most important sources of local budget revenue.

Together, these two sources of revenue (income taxes and transfers) represent around 50% of total local budget revenues.

### 6.2.2 Budget expenditures

All Serbian municipalities are spending their budget predominantly within the following three areas or purposes:

- Financing the costs of local government administration and governmental bodies (municipal council, Mayor office, etc.). This is performed directly through local budgets;
- Financing the costs of performing social functions that are under local governments competency like education, sport, culture, etc. This is performed through transferring funds to the local budget beneficiaries; and
- Financing investments, mostly in local infrastructure. The mechanism of financing this function is described in more detail in the following section.

The tables below detail this structure of the budget expenditures in the two municipalities. The first two items I and II relate to the expenditures incurred for respectively governmental and social functions. Investments are mainly categorized under V and VI, but these also include some additional spending.

**Table 6-3 Budget expenditure by users – Čačak**

| No | Type of expenditure | 2003 | | 2004 | | 2005 | | 2006 plan | |
|---|---|---|---|---|---|---|---|---|---|
| | | CSDm | % | CSDm | % | CSDm | % | CSDm | % |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **I** | **Municipal bodies and administration** | **169** | **22%** | **176** | **18%** | **225** | **17%** | **323** | **18%** |
| **II** | **Social functions (education, sport, culture, welfare)** | **226** | **30%** | **364** | **37%** | **597** | **45%** | **609** | **34%** |
| **III** | **Reserves** | **-** | **0%** | **-** | **0%** | | **0%** | **31** | **2%** |
| **IV** | **Funds-residential & others** | **130** | **17%** | **124** | **13%** | | **0%** | **167** | **9%** |
| **V** | **Agency for urbanism and development** | **-** | **0%** | **-** | **0%** | **305** | **23%** | **373** | **21%** |
| **VI** | **Subsidies** | **226** | **30%** | **279** | **28%** | **128** | **10%** | **234** | **13%** |
| 1 | Current subsidies | 195 | 26% | 6 | 1% | 12 | 1% | 9 | 0% |
| 2 | Capital subsidies | 31 | 4% | 272 | 28% | 116 | 9% | 225 | 12% |
| **VII** | **Self-contribution** | **-** | **0%** | **-** | **0%** | **11** | **1%** | | **0%** |
| **VIII** | **Other budget expenditure** | **-** | **0%** | **38** | **4%** | **66** | **5%** | **74** | **4%** |
| | **TOTAL EXPENDITURE** | **752** | **100%** | **980** | **100%** | **1,331** | **100%** | **1,810** | **100%** |

It should be noted that this categorization of budget expenditures is relatively rough, especially for the third group of expenditures: investments. Besides investments, this item also includes expenditures that do not belong to the investments in a narrow sense. But these costs are related to local development in a wider sense, which bring them into the same family of costs. For example, spending of the local Agency for Urbanism and

Construction partly refers to direct investments into local infrastructure, and partly to the work of the Agency which is dealing with the spatial and local development planning.

A rough rule of thumb for the approximate spend on any of these three broad areas in Serbian municipalities is that approximately 1/3 of total budget is going to each of them.

**Table 6-4 Budget expenditure by users – Užice**

| No | Type of expenditure | 2003 | | 2004 | | 2005 | | 2006 plan | |
|---|---|---|---|---|---|---|---|---|---|
| | | CSDm | % | CSDm | % | CSDm | % | CSDm | % |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **I** | **Municipal bodies and administration** | **86** | **14%** | **200** | **23%** | **251** | **28%** | **489** | **33%** |
| **II** | **Social functions (education, sport, culture, welfare)** | **205** | **35%** | **232** | **27%** | **301** | **34%** | **416** | **28%** |
| **III** | **Reserves** | **15** | **3%** | **-** | **0%** | **-** | **0%** | **11** | **1%** |
| **IV** | **Funds-residential & others** | **35** | **6%** | **34** | **4%** | **21** | **2%** | **24** | **2%** |
| **V** | **Agency for urbanism and development** | **254** | **43%** | **400** | **46%** | **317** | **36%** | **516** | **35%** |
| **VI** | **Subsidies** | **-** | **0%** | **-** | **0%** | **-** | **0%** | **-** | **0%** |
| 1 | Current subsidies | - | 0% | - | 0% | - | 0% | - | 0% |
| 2 | Capital subsidies | - | 0% | - | 0% | - | 0% | - | 0% |
| **VII** | **Self-contribution** | **-** | **0%** | **-** | **0%** | **-** | **0%** | **-** | **0%** |
| **VIII** | **Other budget expenditure** | **-** | **0%** | **-** | **0%** | **-** | **0%** | **8** | **1%** |
| | **TOTAL EXPENDITURE** | **595** | **100%** | **866** | **100%** | **890** | **100%** | **1,463** | **100%** |

Data from the Užice local budget confirm this rule of thumb: approximately 1/3 of the total budget is going to each of the three main areas. For Cacak, this is only valid for the second area, the social functions. Tendency of the Cacak budget is to decrease the share of spending for municipal and administration, while the share of investments in total spending is growing. According to the 2006 planned budget, investments will reach over 34% of the total budget.

### 6.2.3 Investment expenditure

The tables presented above describe in rather general terms budget spending related to the different budget beneficiaries. In this section, capital investment spending is elaborated upon in more detail. The table below includes data on spending related to investments in a more narrow sense: it includes investments in different local infrastructural projects as well as investments in assets of the local budget institutions or beneficiaries.

In 2005, the municipalities of Čačak and Užice combined invested CSD 471 million (€ 5.6 million), out of which CSD 320 million (€ 3.8 million) refers to Cacak and CSD 151 million (€ 1.8 million) to Užice.

The structure of the investments can be seen in the tables below. The municipality of Cacak has had a relatively intensive and diversified investment portfolio during the last three years (almost 40 line items), while municipality of Užice has had less intensive investment activities which also were concentrated on a limited number of institutions.

One of the obvious reasons for this situation is the different position of the local budgets, i.e. the bigger budget funds available in Cacak, compared to Užice. The other is the difference in finance mechanism used in these municipalities.

In Serbian municipalities, four main mechanisms of financing investments can be distinguished. These are:

- Capital subventions to public companies (PC's) specifically established to deal with municipal investments and development; most of the Serbian municipalities have established an entity, commonly named as Agency for Construction and/or Development, which scope of work usually includes spatial planning and development of urban plans, designing and implementation or monitoring of different municipal investment/infrastructural projects;
- Capital transfers to budget beneficiaries/institutions; in accordance with the Law on Local Self Government, local governments are legally obliged to provide their citizens with certain services such as children welfare, culture, sport and covering the material costs of primary and secondary education institutions. Local budgets are financing the entities that are providing these services. This financing includes the costs of current operations as well as capital expenditures.
- Capital subventions to public companies (PCs); this includes transferring of investment funds to public companies (communal and other);
- Direct investments; in this case municipalities are investing directly into certain projects, so that officially the investor is the municipal administration as a whole. De facto, the investor is usually some of the municipal administration departments. This method is rarely used.

The first two mechanisms are strictly speaking the same: the transfers are made to entities or institutions founded by local government and they have the status of budget beneficiaries, since their legal framework is defined by the Law of Budget System. The practical consequence of this is that all of these institutions are from the financial point of view part of the local public finance system, meaning that all of them financially are operating within the local treasury system. The only difference is that in the first case municipalities are transferring capital funds to one specialized entity which is then dealing with different investments, while in the second case, each of the entities is supposed to carry out its own investments.

On the other hand, the third mechanism, subventions to public utility companies, is basically different because the transfers are made to the public companies that do not have a status of budget beneficiaries, although they are users of budget funds. Their legal framework is defined by the Law on Companies/Enterprises, which means that they are not operating within the system of public finance. After the transfer of subventions, the further financial flow to and from the public utility companies is out of the local treasury. In other words, their actual expenditure is not reflected in the local government accounts.

**Table 6-5 Capital investment from municipal budget – Čačak**

| No | Type of revenues | 2003 | | 2004 | | 2005 | | 2006 plan | |
|---|---|---|---|---|---|---|---|---|---|
| | | CSDm | % | CSDm | % | CSDm | % | CSDm | % |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **I** | **Capital subventions** | **31.3** | **15%** | **272.2** | **54%** | **115.6** | **36%** | **225.2** | **36%** |
| 1 | PC "Gradac" Cacak | 19.2 | 9% | 267.1 | 53% | - | 0% | - | 0% |
| 2 | Landfill and center for recycling | - | 0% | 1.0 | 0% | 5.6 | 2% | 13.4 | 2% |
| 3 | Gasification | - | 0% | 4.0 | 1% | 8.5 | 3% | 20.0 | 3% |
| 4 | Water supply | - | 0% | - | 0% | 36.4 | 11% | 50.0 | 8% |
| 5 | PUC "Cacak" Cacak | - | 0% | - | 0% | 10.0 | 3% | 30.0 | 5% |
| 6 | Low-voltage network | - | 0% | - | 0% | 9.2 | 3% | 10.0 | 2% |
| 7 | Sewage | - | 0% | - | 0% | 29.9 | 9% | 60.0 | 10% |
| 8 | Public objects | - | 0% | - | 0% | 16.1 | 5% | 12.0 | 2% |
| 9 | Subvention from city administration | 2.2 | 1% | - | 0% | - | 0% | 17.5 | 3% |
| 10 | Intervention in public infrastructure | 9.9 | 5% | - | 0% | - | 0% | - | 0% |
| 11 | Water-supply System Rzav | - | 0% | - | 0% | - | 0% | 12.3 | 2% |
| **II** | **Capital expenditures of budget beneficiaries** | **180.3** | **85%** | **230.2** | **46%** | **204.2** | **64%** | **398.6** | **64%** |
| 1 | Municipal administration | 18.5 | 9% | 18.1 | 4% | 17.3 | 5% | 35.3 | 6% |
| 2 | Culture | 1.2 | 1% | 19.2 | 4% | 9.2 | 3% | 16.3 | 3% |
| 3 | Children care | - | 0% | 28.9 | 6% | 42.0 | 13% | 4.3 | 1% |
| 4 | Sport | 3.7 | 2% | 13.2 | 3% | 13.1 | 4% | 24.4 | 4% |
| 5 | Primary education | 4.5 | 2% | 13.7 | 3% | 35.7 | 11% | 42.7 | 7% |
| 6 | Secondary education | 2.2 | 1% | 5.1 | 1% | 0.1 | 0% | 60.8 | 10% |
| 7 | Social welfare | - | 0% | 1.6 | 0% | 4.9 | 2% | 2.0 | 0% |
| 8 | Tourism | 0.1 | 0% | - | 0% | 0.4 | 0% | 1.2 | 0% |
| 9 | Public information | - | 0% | 1.1 | 0% | 0.5 | 0% | 0.2 | 0% |
| 10 | Environment | - | 0% | 0.7 | 0% | - | 0% | - | 0% |
| 11 | System Rzav | 4.0 | 2% | 0.2 | 0% | 4.7 | 1% | - | 0% |
| 12 | Water-supply | 7.0 | 3% | 8.6 | 2% | - | 0% | - | 0% |
| 13 | Central heating | 10.8 | 5% | 7.5 | 1% | - | 0% | - | 0% |
| 14 | Landfill and center recycle | - | 0% | 1.8 | 0% | 10.5 | 3% | 145.4 | 23% |
| 15 | Fire brigade | 2.9 | 1% | 3.7 | 1% | - | 0% | 0.2 | 0% |
| 16 | Solidarity apartments | 18.5 | 9% | 8.2 | 2% | - | 0% | - | 0% |
| 17 | Gasification | 19.6 | 9% | 0.4 | 0% | - | 0% | - | 0% |
| 18 | Low-voltage network | 8.0 | 4% | 7.4 | 1% | - | 0% | - | 0% |
| 19 | Sewage | 7.2 | 3% | 20.1 | 4% | - | 0% | - | 0% |
| 20 | Graveyard | 20.5 | 10% | 12.7 | 3% | 0.7 | 0% | 2.0 | 0% |
| 21 | Public objects | 17.6 | 8% | 0.3 | 0% | - | 0% | 19.5 | 3% |
| 22 | Sport objects | 16.9 | 8% | 27.4 | 5% | 20.2 | 6% | - | 0% |
| 23 | School and pre-school objects | 17.1 | 8% | 28.4 | 6% | - | 0% | - | 0% |
| 24 | Other capital expenditures | - | 0% | 1.7 | 0% | 0.5 | 0% | 5.0 | 1% |
| 25 | PC "Gradac" Cacak | - | 0% | - | 0% | 44.3 | 14% | 38.3 | 6% |
| 26 | Municipal housing agency | - | 0% | - | 0% | - | 0% | 0.3 | 0% |
| 27 | Transfer policy | - | 0% | - | 0% | - | 0% | 0.7 | 0% |
| | **Total I+II** | **211.6** | **100%** | **502.4** | **100%** | **319.8** | **100%** | **623.7** | **100%** |

It can be concluded from the above table that Cacak is using three types of mechanism for financing its capital investment program:

- Most of the local investments were financed through local budget beneficiaries which are financed through standard budget appropriations consisting of two parts: one for operational expenditures and the other for capital expenditures;
- Transfers to the public company in charge of investments and/or development. In the case of Cacak this is PC Gradac. This company has received considerable subventions (CSD 267 million) in 2004;
- At the same time Cacak has released subventions to other public companies for different type of local communal infrastructure such as water supply, sewage, electricity, gasification, etc.

**Table 6-6 Capital investment from municipal budget – Užice**

| No | Type of revenues | 2003 | | 2004 | | 2005 | | 2006 plan | |
|---|---|---|---|---|---|---|---|---|---|
| | | CSDm | % | CSDm | % | CSDm | % | CSDm | % |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **I** | **Capital subventions** | **-** | **0%** | **-** | **0%** | **-** | **0%** | **-** | **0%** |
| **II** | **Capital expenditures of budget beneficiaries** | **21.5** | **100%** | **188.3** | **100%** | **151.1** | **100%** | **324.4** | **100%** |
| 1 | Municipal administration | 2.0 | 9% | 6.1 | 3% | 5.4 | 4% | 273.0 | 84% |
| 2 | Culture | 4.6 | 21% | - | 0% | - | 0% | 22.6 | 7% |
| 3 | Social care of children | 5.0 | 23% | 6.7 | 4% | 1.9 | 1% | 27.4 | 8% |
| 4 | Sport | 1.6 | 7% | - | 0% | - | 0% | - | 0% |
| 5 | Elementary education | - | 0% | 8.2 | 4% | - | 0% | - | 0% |
| 6 | Secondary education | - | 0% | 8.4 | 4% | - | 0% | - | 0% |
| 7 | Social welfare | 0.1 | 0% | - | 0% | - | 0% | - | 0% |
| 8 | OJP | - | 0% | - | 0% | - | 0% | - | 0% |
| 9 | Agency for development and construction | 8.2 | 38% | 158.9 | 84% | 143.8 | 95% | 1.3 | 0% |
| | **TOTAL (I+II)** | **21.5** | **100%** | **188.3** | **100%** | **151.1** | **100%** | **324.4** | **100%** |

The municipality of Užice, on the other hand, is almost exclusively using the first mechanism. Almost all local investments from the local budget are financed through the Agency for Development and Construction: in 2004 the Agency has implemented 84,4% of all investments financed by the local budgets and in 2005 this number was 95%.

In 2006 however, 84 % of investments were planned to go through the municipal administration, while the Agency would just receive 0,4%. This big change is the result of a large gasification project in Užice. This specific investment project is managed directly by the municipal administration and has absorbed almost all available investment funds. Hence, the Agency was not able to finance its projects in 2006.

### 6.2.4 Analysis of local budget balance sheets

The balance sheets of the Serbian municipalities are burdened with one big deficiency. Formally, it lacks fixed assets, because during the 1990-ties, the Republican government took ownership of all local government property. However, most of the municipalities just continued to keep these assets in their balance sheets. Čačak and Užice municipality continued to do this as well.

The major findings regarding the Cacak balance sheet are the following:

- The fixed assets appear in the budget accounts as from 2005. During the previous years, the assets were recorded in the books of the municipal administration. In 2004, the accounts of the administration were cancelled and absorbed in the municipal budget accounts;
- Current assets dominantly consist of cash. During the last three years its share in total current assets ranged between 90% and 99%. These were offset by budget surpluses which were dominant on the side of capital;
- The 2005 budget had a deficit of CSD 85 million.

**Table 6-7 Balance sheet of Čačak municipality budget (CSD million)**

| | 2003 | 2004 | 2005 |
|---|---|---|---|
| **ASSETS** | | | |
| **Fixed assets** | **-** | **-** | **140** |
| Buildings | - | - | 104 |
| Equipment | - | - | 28 |
| Other assets | - | - | 4 |
| Land | - | - | 4 |
| Non-financial assets in preparation | - | - | - |
| **Current assets** | **30** | **115** | **33** |
| Cash | 29 | 115 | 29 |
| Reserves | - | - | - |
| Receivables (funds) | 1 | 0 | 3 |
| **TOTAL** | **30** | **115** | **172** |
| **CAPITAL AND LIABILITIES** | | | |
| **Capital** | **30** | **115** | **256** |
| Buildings | - | - | - |
| Equipment | - | - | - |
| Non-financial assets in preparation | - | - | 140 |
| Received deposits | 0 | 0 | 0 |
| Transfers | 1 | 1 | 1 |
| Payable | - | - | 1 |
| Revenues brought from previous years | - | - | 114 |
| Surplus of revenues | 29 | 114 | - |
| **Liabilities** | **-** | **-** | **(84)** |
| Credits | - | - | - |
| Privatization fund | - | - | - |
| Refunds | - | - | - |
| Deficit | - | - | (84) |
| **TOTAL** | **30** | **115** | **172** |

The major findings regarding Užice budget balance sheet are the following:

- The biggest part of assets in last two years refers to the investments made in the in city gasification. The municipality is investor, but after its implementation it is expected that the total value of the assets will be transferred to the public company that will continue with operational activities;
- The biggest part of liabilities (89%) refers to credit, and almost all current assets refer to cash (99%).

**Table 6-8 Balance sheet of Užice municipality budget (CSD million)**

| | 2003 | 2004 | 2005 |
|---|---|---|---|
| **ASSETS** | | | |
| **Fixed assets** | **-** | **169** | **271** |
| Buildings | - | 16 | 16 |
| Equipment | - | 29 | 26 |
| Other assets | - | 0 | 0 |
| Non-financial assets in preparation | - | 123 | 229 |
| **Current assets** | **-** | **44** | **95** |
| Cash | - | 33 | 94 |
| Reserves | - | 10 | - |
| Receivables (funds) | - | 0 | 0 |
| **TOTAL** | **67** | **212** | **366** |
| **CAPITAL AND LIABILITIES** | | | |
| **Capital** | **-** | **173** | **365** |
| Buildings | - | 18 | 16 |
| Equipment | - | 29 | 26 |
| Non-financial assets in preparation | - | 87 | 229 |
| Revenues brought from previous years | - | 10 | - |
| Surplus of revenues | - | 30 | 94 |
| **Liabilities** | **-** | **39** | **0** |
| Credits | - | 35 | - |
| Privatization fund | - | 4 | - |
| Refunds | - | 0 | 0 |
| **TOTAL** | **67** | **212** | **366** |

### 6.2.5 Credit history and financial management capacity of the municipalities

In general, Serbian municipalities do not have a long credit history since the legal framework enabling municipalities to borrow was very limited in the past. Major changes were initiated starting from 2002 with the new Budget System Law which introduced the possibility for Serbian municipalities to make use of capital markets, draw loans and issue municipal bonds. However, the practice of taking long term credits to finance large investment projects did not become significant until very recently and in very few municipalities.

As an illustration to this, it can be mentioned that the municipality of Čačak has taken a multiyear loan in 2005, but the loan was repaid during the very same year as a result of a management decision.

The same applies for Užice municipality until recently. However, in 2006 Užice arranged for its first bigger loan to finance investments in local infrastructure. A credit to finance the gasification of the city was taken, amounting to CSD 174 million with a 10 year repayment period.

So at this moment, both municipalities do not have a track record in credit repayments and consequently there has not been any technical default or rescheduling. On the contrary, it could be said that the municipalities are applying quite conservative financial policies of avoiding loans and keeping a relatively high surplus of cash in order to avoid any liquidity problems.

The municipalities of Čačak and Užice are front runners amongst local governments in the region in many ways, including their municipal management functioning and especially the financial management capacities. Both municipalities have introduced relatively efficiently all of the reforms introduced in Serbian public finance at local level: new accounting system in accordance with international standards, public procurement law, local treasury system, new budget procedures, etc. In addition to this, the financial management of these municipalities took a very active part in initiating and now implementing the new law on local government financing.

## 6.3 Creditworthiness assessment and financial projections

### 6.3.1 Creditworthiness during the period 2003-2006

The table below is summarizing the trends regarding the financial position of the Čačak municipality local budget:

- Total revenues have been growing during the period 2003 to 2005, both in nominal and real terms;
- Total expenditures, however, grew faster than total revenues at respectively 77% versus 60%;
- Positive trend is that capital revenues grew much faster than current revenues;
- Negative trend is that the current expenditures grew much faster than capital expenditures at respectively 87% and 51%.

**Table 6-9 Čačak municipality actuals 2003-2005 and plan 2006 (CSD million)**

| No | Item | 2003 | 2004 | 2005 | 2006 plan |
|---|---|---|---|---|---|
| **I** | **Current Revenues (1+2+3+4)** | **733** | **964** | **1,098** | **1,480** |
| 1 | Own Current Revenues | 120 | 160 | 194 | 228 |
| 2 | Share of State Taxes | 602 | 801 | 739 | 896 |
| 3 | Other State Transfers | 11 | 3 | 162 | 328 |
| 4 | Donations | - | 0 | 3 | 29 |
| **II** | **Current Expenditures** | **540** | **477** | **1,011** | **1,163** |
| **A** | **Current Surplus/Deficit (I-II)** | **193** | **487** | **87** | **317** |
| 5 | Capital Revenues | 47 | 101 | 150 | 170 |
| 6 | Capital Expenditures | 212 | 502 | 320 | 624 |
| **B** | **Capital Surplus/Deficit (5-6)** | **(164)** | **(401)** | **(170)** | **(454)** |
| **C** | **Net Surplus/Deficit Before Financing (A+B)** | **29** | **85** | **(83)** | **(137)** |
| 7 | Borrowing | - | - | - | 130 |
| 8 | Cash brought from previous year | - | 29 | 114 | 30 |
| 9 | Debt Service | - | 0 | 0 | 23 |
| 10 | Reserves | - | - | - | - |
| **D** | **Net Debt Increase/Decrease (7+8-9-10)** | **-** | **29** | **114** | **137** |
| **E** | **Net Surplus/Deficit (C+D)** | **29** | **114** | **30** | **-** |

These trends effect the municipal current surplus: the current surplus of CSD 193 million in 2003 has decreased to CSD 87 million in 2005. It is planned in 2006 that the operating result will again grow and reach CSD 317 million.

The capital cash flow is consistently negative, because of relatively large investments. A positive operating result has covered this deficit until the year 2004, but in 2005 the net balance turned into a deficit as well of CSD -83 million. It is planned for 2006 that this deficit will grow even more to CSD -137 million.

The 2005 net deficit was covered by cash brought forward from previous years, so that there still was a net surplus after financing. For 2006 it is expected for the first time that the negative net result will be partly financed by borrowed funds.

The table below presents a few selected indicators regarding Čačak municipalities' financial position. The indicators are confirming the above mentioned findings:

- The share of current in total revenues is slightly decreasing as a result of an increase in capital revenues and transfers;
- The share of shared or allocated revenues in the total decreased considerably from 77% to 54%. This was caused by an increase in transfers, while the local/original revenues remained stable at around 15%;
- The ratio between operating result and current revenues varied considerably, but generally is at a relatively high level of over 20%;
- Čačak did not have any debt or debt service obligations at year end during the period 2003 to 2005. The planned debt for 2006 is 10% and debt service 2% of realized total 2005 revenues.

**Table 6-10 Municipal financial indicators – Čačak**

| | Benchmark | 2003 | 2004 | 2005 | 2006 plan |
|---|---|---|---|---|---|
| **Indicators of revenues** | | | | | |
| Current revenues / Total revenues | | 94% | 91% | 88% | 90% |
| Shared revenues / Total revenues | | 77% | 75% | 59% | 54% |
| Original (local) revenues / Total revenues | | 15% | 15% | 16% | 14% |
| Revenues from sale of property / Total revenues | 2 - 5% | 0% | 0% | 0% | 0% |
| Capital revenues / Total revenues | | 6% | 9% | 12% | 10% |
| Operating result / Current revenues | | 26% | 50% | 8% | 21% |
| | | | | | |
| **Indicators of expenditures** | | | | | |
| Current expenditures / Total expenditures | | 72% | 49% | 76% | 65% |
| Operating result / Current expenditures | | 36% | 102% | 9% | 27% |
| Capital revenues / Capital expenditures | | 22% | 20% | 47% | 27% |
| Capital investments / Total expenditures | | 28% | 51% | 24% | 35% |
| | | | | | |
| **Indicators of financial state** | | | | | |
| Total expenditures / Total revenues | 95% - 100% | 96% | 92% | 107% | 108% |
| Total expenditures / Current revenues | | 103% | 102% | 121% | 121% |
| | | | | | |
| **Indicators of indebtedness** | | | | | |
| Debt / Total revenues from previous year | | | 0% | 0% | 10% |
| Debt service / Total revenues from previous year | | | 0% | 0% | 2% |

The indicators of the financial position of the municipality of Užice show the following trends:

- During the period 2003 to 2005, total actual revenues grew by 51%, which is an increase in both nominal and real terms;
- Within the same period of time, total expenditure increased, albeit at the slightly lower rate of 42%;
- Growth in current expenditure was even lower at 27%; actual capital expenditure grew by 184%.

**Table 6-11 Užice municipality actuals 2003-2005 and plan 2006 (CSD million)**

| No | Item | 2003 | 2004 | 2005 | 2006 plan |
|---|---|---|---|---|---|
| **I** | **Current Revenues (1+2+3+4)** | **548** | **684** | **844** | **966** |
| 1 | Own Current Revenues | 62 | 84 | 128 | 133 |
| 2 | Share of State Taxes | 457 | 594 | 618 | 741 |
| 3 | Other State Transfers | 29 | 6 | 97 | 91 |
| 4 | Donations | - | - | - | |
| **II** | **Current Expenditures** | **538** | **565** | **683** | **1,019** |
| **A** | **Current Surplus/Deficit (I-II)** | **10** | **119** | **162** | **(54)** |
| 5 | Capital Revenues | 75 | 41 | 97 | 217 |
| 6 | Capital Expenditures | 57 | 212 | 162 | 415 |
| **B** | **Capital Surplus/Deficit (5-6)** | **18** | **(171)** | **(66)** | **(199)** |
| **C** | **Net Surplus/Deficit Before Financing (A+B)** | **28** | **(53)** | **96** | **(252)** |
| 7 | Borrowing | - | 120 | - | 187 |
| 8 | Cash brought from previous year | 23 | 51 | 34 | 94 |
| 9 | Debt Service | - | 85 | 35 | 18 |
| 10 | Reserves | - | - | - | 11 |
| **D** | **Net Debt Increase/Decrease (7+8-9-10)** | **23** | **86** | **(1)** | **253** |
| **E** | **Net Surplus/Deficit (C+D)** | **51** | **34** | **94** | **0** |

As a result of these trends, the operating result of Užice municipality was positive until the year 2005. In 2006 the municipality has planned a negative operating result of CSD -54 million.

Capital expenditure has increased strongly over the years, with a large planned expenditure during the year 2006. In order to finance the capital budget, the municipality has drawn considerable credits during recent years: CSD 120 million in 2004 and CSD 187 million in 2006. Part of the capital budget is also financed by cash brought forward from previous years.

The indicators of the financial situation of Užice municipality show the following results:

- The share of current revenues in total revenues is expected to decrease as a result of increase of capital revenues and central level budget transfers;
- The share of shared or allocated revenues also decreased from 73% to 63%. This happened because of an increase in transfers, while local/original revenues remained relatively stable with a share between 10 and 14%.
- The Ratio between operating result and total revenues has been relatively favorable with 2% in 2003, 17% in 2004 and 19% in 2005. It is expected however that this ratio will become negative during the year 2006.
- Debt was assumed as early as 2004, amounting to 19% of total revenues from the previous year. In 2005, no new debt was assumed, but during 2006 the municipality planned to draw a new credit line amounting to 20% of the previous' year realized total revenues. At the same time, the debt service obligation decreased from 14% in 2004 to an expected 2% in 2006 of the previous' year total revenues.

**Table 6-12 Municipal financial indicators – Užice**

| | Benchmark | 2003 | 2004 | 2005 | 2006 plan |
|---|---|---|---|---|---|
| **Indicators of revenues** | | | | | |
| Current revenues / Total revenues | | 88% | 94% | 90% | 82% |
| Shared revenues / Total revenues | | 73% | 82% | 66% | 63% |
| Original (local) revenues / Total revenues | | 10% | 12% | 14% | 11% |
| Revenues from sale of property / Total revenues | 2 - 5% | 0% | 0% | 0% | 0% |
| Capital revenues / Total revenues | | 12% | 6% | 10% | 18% |
| Operating result / Current revenues | | 2% | 17% | 19% | -6% |
| | | | | | |
| **Indicators of expenditures** | | | | | |
| Current expenditures / Total expenditures | | 90% | 73% | 81% | 71% |
| Operating result / Current expenditures | | 2% | 21% | 24% | -5% |
| Capital revenues / Capital expenditures | | 132% | 19% | 60% | 52% |
| Capital investments / Total expenditures | | 10% | 27% | 19% | 29% |
| | | | | | |
| **Indicators of financial state** | | | | | |
| Total expenditures / Total revenues | 95% - 100% | 95% | 107% | 90% | 121% |
| Total expenditures / Current revenues | | 109% | 114% | 100% | 149% |
| | | | | | |
| **Indicators of indebtedness** | | | | | |
| Debt / Total revenues from previous year | | | 19% | 0% | 20% |
| Debt service / Total revenues from previous year | | | 14% | 5% | 2% |

### 6.3.2 Creditworthiness and financial projections during the period of 2007-2017

The projection of the municipal budgets creditworthiness is performed based on data supplied by the budget departments of both municipalities and consultants' estimate of the impact of the introduction of the new law on local government finance. Furthermore, the analysis is carried out under three macro-economic scenarios as elaborated upon in paragraph 5.6.2. The forecast horizon is set at 11 years, i.e. the period 2007 to 2017, equivalent to the assumed EBRD loan principal repayment schedule, plus one year.

Both current and capital revenues, as well as current expenditures are projected for the 11 year period using the following assumptions:

- Division of the local budget revenues in accordance with the new law on local government finance. The projection assumes that local government revenues consist of original/own and shared/allocated revenues;
- According to the same law, from January 1, 2007, the tax on property is going to change its status from allocated to own revenues. For this purpose, the tax administration will be decentralized and the local government will be in charge of collection of this specific tax. This fact is taken into consideration as a reason of increase of this revenue in the future;
- The specific assumptions that have been used for projections are presented in the following table:

**Table 6-13 Assumptions revenues forecast**

| I | Own revenues | Will grow with: |
|---|---|---|
| I.1 | Fees (administrative, communal, tourist) | - CSD Inflation<br>- Real GDP growth |

| | | |
|---|---|---|
| I.2 | Charge for land use and development | - CSD Inflation<br>- Real GDP growth<br>- Autonomous growth of this revenue is 1,5% (base case), 3% (optimistic case), 0% (pessimistic case) |
| I.3 | Property tax | - CSD Inflation<br>- Real GDP growth<br>- Autonomous growth of this revenues from 0% (1-5 year) in all scenario's; 3%/5%/0% (5-10 year) and 6%/10%/0% (11-15 year) for respectively base, optimistic and pessimistic scenario |
| I.4 | Other | - CSD Inflation |
| **II** | **Allocated revenues** | |
| II.1 | Income tax | - CSD Inflation<br>- Real Wage Increase |
| II.2 | Heredity tax and tax on passing the absolute rights | - CSD Inflation<br>- Real GDP growth |
| II.3 | Property tax | - CSD Inflation<br>- Real GDP growth |
| II.4 | Transfers | - CSD Inflation<br>- Real GDP growth |
| II.5 | Other | - CSD Inflation |

The projections of the budget expenditures are based on expenditures differentiated into three main groups:

- Expenditure related to the administration and governmental bodies;
- Expenditures related to social functions;
- Current subsidies; and
- Other expenditure.

Projections of budget expenditures are made using the following assumptions:

**Table 6-14 Assumptions expenditure forecast**

| | **Current expenditure** | **Will grow with:** |
|---|---|---|
| 1. | Administration and municipal bodies | - CSD Inflation |
| 2. | Social functions | - CSD Inflation<br>- Real GDP growth |
| 3. | Current subsidies | - CSD Inflation<br>- Real GDP growth |
| 4. | Other current expenses | - CSD Inflation |

After projecting revenues and expenditures, the net surplus before financing and before capital expenditure is estimated under the three macro economic scenarios.

Next, existing debt service obligations are calculated and deducted from the net surplus before financing and investment. This is only done for the long term loan Užice took in 2006. Čačak municipality budgeted for and received a loan during 2006, but this debt is likely to be paid back in full during 2006.

The final step is to include the debt service obligation arising form the proposed € 5 million EBRD loan, as well as the proposed municipal budget financing of the Duboko solid waste management project. Details of debt service and the principal repayment schedule are elaborated in chapter 5.

The net balance after debt service and committed capital expenditure is available to fund other capital programs of the municipalities.

The final results of the projections under the macro economic base case scenario are presented in the tables below. The results are given in CSD and Euro. In addition, an indicator table is provided as well.

**Table 6-15 Projection municipal budget Čačak – base case**

| | Unit | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total budget revenues | CSD m | 1,832 | 1,988 | 2,170 | 2,376 | 2,603 | 2,863 | 3,133 | 3,429 | 3,754 | 4,065 | 4,409 |
| Total current expenditures | CSD m | 1,296 | 1,393 | 1,505 | 1,627 | 1,759 | 1,903 | 2,048 | 2,205 | 2,374 | 2,541 | 2,721 |
| **Operating result** | **CSD m** | **536** | **595** | **665** | **749** | **843** | **960** | **1,085** | **1,225** | **1,380** | **1,523** | **1,688** |
| Capital contribution to Duboko proj | CSD m | 88 | - | - | - | - | - | - | - | - | - | - |
| EBRD debt service | CSD m | 26 | 38 | 39 | 121 | 117 | 113 | 109 | 104 | 100 | 95 | - |
| Other debt service | CSD m | - | - | - | - | - | - | - | - | - | - | - |
| **Available for capital spending** | **CSD m** | **422** | **557** | **626** | **628** | **726** | **847** | **976** | **1,120** | **1,281** | **1,428** | **1,688** |
| | | | | | | | | | | | | |
| Total budget revenues | € th | 17,030 | 18,126 | 19,396 | 20,845 | 22,513 | 24,431 | 26,351 | 28,435 | 30,699 | 32,757 | 35,023 |
| Total current expenditures | € th | 12,048 | 12,699 | 13,450 | 14,270 | 15,218 | 16,240 | 17,225 | 18,281 | 19,412 | 20,482 | 21,616 |
| **Operating result** | **€ th** | **4,982** | **5,427** | **5,946** | **6,575** | **7,295** | **8,191** | **9,126** | **10,155** | **11,287** | **12,275** | **13,407** |
| Capital contribution to Duboko proj | € th | 822 | | | | | | | | | | |
| EBRD debt service | € th | 238 | 350 | 350 | 1,064 | 1,014 | 964 | 914 | 864 | 814 | 764 | - |
| Other debt service | € th | - | - | - | - | - | - | - | - | - | - | - |
| **Available for capital spending** | **€ th** | **3,923** | **5,077** | **5,596** | **5,510** | **6,280** | **7,226** | **8,212** | **9,291** | **10,473** | **11,511** | **13,407** |

**Table 6-16 Projection municipal budget Užice – base case**

| | Unit | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total budget revenues | CSD m | 1,329 | 1,441 | 1,571 | 1,719 | 1,882 | 2,072 | 2,272 | 2,492 | 2,733 | 2,960 | 3,213 |
| Total current expenditures | CSD m | 1,129 | 1,210 | 1,305 | 1,408 | 1,520 | 1,641 | 1,764 | 1,896 | 2,039 | 2,180 | 2,332 |
| **Operating result** | **CSD m** | **200** | **231** | **266** | **311** | **362** | **431** | **508** | **596** | **694** | **780** | **881** |
| Capital contribution to Duboko proj | CSD m | 79 | - | - | - | - | - | - | - | - | - | - |
| EBRD debt service | CSD m | 26 | 38 | 39 | 121 | 117 | 113 | 109 | 104 | 100 | 95 | - |
| Other debt service | CSD m | 32 | 32 | 32 | 31 | 30 | 28 | 28 | 28 | 27 | 5 | - |
| **Available for capital spending** | **CSD m** | **64** | **160** | **195** | **159** | **215** | **290** | **372** | **464** | **567** | **680** | **881** |
| | | | | | | | | | | | | |
| Total budget revenues | € th | 12,352 | 13,140 | 14,037 | 15,080 | 16,279 | 17,683 | 19,110 | 20,660 | 22,347 | 23,856 | 25,525 |
| Total current expenditures | € th | 10,491 | 11,033 | 11,662 | 12,349 | 13,146 | 14,005 | 14,835 | 15,722 | 16,672 | 17,573 | 18,525 |
| **Operating result** | **€ th** | **1,861** | **2,107** | **2,376** | **2,730** | **3,133** | **3,677** | **4,275** | **4,938** | **5,674** | **6,283** | **6,999** |
| Capital contribution to Duboko proj | € th | 731 | | | | | | | | | | |
| EBRD debt service | € th | 238 | 350 | 350 | 1,064 | 1,014 | 964 | 914 | 864 | 814 | 764 | - |
| Other debt service | € th | 299 | 295 | 283 | 271 | 259 | 241 | 235 | 229 | 223 | 38 | - |
| **Available for capital spending** | **€ th** | **593** | **1,462** | **1,743** | **1,395** | **1,859** | **2,473** | **3,126** | **3,845** | **4,637** | **5,481** | **6,999** |

**Table 6-17 Projection municipal budget indicators – base case**

| | Unit | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cacak** | | | | | | | | | | | | |
| Operating result / total revenues | % | 29% | 30% | 31% | 32% | 32% | 34% | 35% | 36% | 37% | 37% | 38% |
| Operating result / Total debt service | multiple | 21.0 | 15.5 | 17.0 | 6.2 | 7.2 | 8.5 | 10.0 | 11.7 | 13.9 | 16.1 | - |
| Outstanding Debt / operating result | multiple | 1.3 | 1.0 | 0.9 | 0.8 | 0.6 | 0.4 | 0.3 | 0.2 | 0.1 | - | - |
| Outstanding Debt / revenues previous yı | % | 28% | 29% | 28% | 22% | 17% | 13% | 9% | 5% | 3% | 0% | 0% |
| Debt service / revenues previous yr | % | 1% | 2% | 2% | 5% | 5% | 4% | 4% | 3% | 3% | 2% | 0% |
| | | | | | | | | | | | | |
| **Uzice** | | | | | | | | | | | | |
| Operating result / total revenues | % | 15% | 16% | 17% | 18% | 19% | 21% | 22% | 24% | 25% | 26% | 27% |
| Operating result / Total debt service | multiple | 3.5 | 3.3 | 3.8 | 2.0 | 2.5 | 3.1 | 3.7 | 4.5 | 5.5 | 7.8 | - |
| Outstanding Debt / operating result | multiple | 3.6 | 3.1 | 2.6 | 2.0 | 1.4 | 1.0 | 0.6 | 0.3 | 0.1 | 0.0 | - |
| Outstanding Debt / revenues previous yı | % | 52% | 52% | 48% | 38% | 29% | 22% | 15% | 9% | 4% | 0% | 0% |
| Debt service / revenues previous year | % | 4% | 5% | 5% | 10% | 8% | 7% | 6% | 6% | 5% | 4% | 0% |

Conclusions of the projection under the base case macro economic scenario are:

- Čačak municipality is projected to have a relatively and absolutely much larger operating result than Užice municipality and therefore can more easily fund capital projects;
- Based on the projection, Čačak municipality can comfortably fund the full EBRD loan and debt service obligations and still have sufficient room to finance other capital expenditure projects;
- If Užice municipality were to assume the full EBRD loan, a legally imposed limit to borrowing would be surpassed, although with a small margin. Current law stipulates that total debt cannot be more than 50% of realized revenues of the preceding year. During the years 2007 and 2008, this ratio is forecasted to be 52%.
- With the current debt and future EBRD debt service obligation, Užice municipality would commit 30% to 50% of its operating result during the years 2007 to 2013.

The tables below provide an analysis of the sensitivity of the forecast to changes in the macro economic assumptions.

**Table 6-18 Projection municipal budget Čačak – optimistic case**

| | Unit | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total budget revenues | CSD m | 1,798 | 1,969 | 2,147 | 2,348 | 2,569 | 2,827 | 3,114 | 3,432 | 3,784 | 4,155 | 4,582 |
| Total current expenditures | CSD m | 1,269 | 1,373 | 1,478 | 1,593 | 1,719 | 1,855 | 2,004 | 2,166 | 2,344 | 2,538 | 2,749 |
| **Operating result** | **CSD m** | **528** | **596** | **668** | **754** | **851** | **972** | **1,110** | **1,265** | **1,440** | **1,618** | **1,833** |
| Capital contribution to Duboko project | CSD m | 75 | - | - | - | - | - | - | - | - | - | - |
| EBRD debt service | CSD m | 22 | 32 | 32 | 97 | 93 | 88 | 84 | 80 | 76 | 73 | - |
| Other debt service | CSD m | - | - | - | - | - | - | - | - | - | - | - |
| **Available for capital spending** | **CSD m** | **432** | **564** | **636** | **657** | **758** | **884** | **1,026** | **1,185** | **1,365** | **1,545** | **1,833** |
| | | | | | | | | | | | | |
| Total budget revenues | € th | 19,647 | 21,544 | 23,512 | 25,714 | 28,169 | 30,867 | 33,847 | 37,139 | 40,777 | 43,711 | 47,053 |
| Total current expenditures | € th | 13,871 | 15,022 | 16,193 | 17,452 | 18,843 | 20,251 | 21,781 | 23,445 | 25,256 | 26,693 | 28,232 |
| **Operating result** | **€ th** | **5,776** | **6,523** | **7,318** | **8,262** | **9,326** | **10,616** | **12,066** | **13,693** | **15,521** | **17,018** | **18,821** |
| Capital contribution to Duboko project | € th | 822 | | | | | | | | | | |
| EBRD debt service | € th | 238 | 350 | 350 | 1,064 | 1,014 | 964 | 914 | 864 | 814 | 764 | - |
| Other debt service | € th | - | - | - | - | - | - | - | - | - | - | - |
| **Available for capital spending** | **€ th** | **4,717** | **6,173** | **6,968** | **7,198** | **8,312** | **9,652** | **11,151** | **12,829** | **14,707** | **16,253** | **18,821** |

**Table 6-19 Projection municipal budget Užice – optimistic case**

| | Unit | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total budget revenues | CSD m | 1,300 | 1,418 | 1,541 | 1,682 | 1,837 | 2,022 | 2,225 | 2,451 | 2,702 | 2,959 | 3,256 |
| Total current expenditures | CSD m | 1,101 | 1,180 | 1,260 | 1,347 | 1,442 | 1,544 | 1,655 | 1,775 | 1,906 | 2,048 | 2,202 |
| **Operating result** | **CSD m** | **199** | **238** | **281** | **335** | **396** | **478** | **571** | **676** | **796** | **911** | **1,054** |
| Capital contribution to Duboko project | CSD m | 67 | - | - | - | - | - | - | - | - | - | - |
| EBRD debt service | CSD m | 22 | 32 | 32 | 97 | 93 | 88 | 84 | 80 | 76 | 73 | - |
| Other debt service | CSD m | 27 | 27 | 26 | 25 | 24 | 22 | 22 | 21 | 21 | 4 | - |
| **Available for capital spending** | **CSD m** | **83** | **179** | **223** | **213** | **280** | **367** | **465** | **575** | **700** | **835** | **1,054** |
| | | | | | | | | | | | | |
| Total budget revenues | € th | 14,204 | 15,515 | 16,881 | 18,427 | 20,147 | 22,069 | 24,190 | 26,530 | 29,115 | 31,122 | 33,432 |
| Total current expenditures | € th | 12,031 | 12,907 | 13,803 | 14,756 | 15,806 | 16,853 | 17,985 | 19,209 | 20,535 | 21,540 | 22,613 |
| **Operating result** | **€ th** | **2,173** | **2,608** | **3,079** | **3,671** | **4,341** | **5,216** | **6,205** | **7,321** | **8,580** | **9,582** | **10,820** |
| Capital contribution to Duboko project | € th | 731 | | | | | | | | | | |
| EBRD debt service | € th | 238 | 350 | 350 | 1,064 | 1,014 | 964 | 914 | 864 | 814 | 764 | - |
| Other debt service | € th | 299 | 295 | 283 | 271 | 259 | 241 | 235 | 229 | 223 | 38 | - |
| **Available for capital spending** | **€ th** | **905** | **1,963** | **2,446** | **2,336** | **3,067** | **4,011** | **5,056** | **6,228** | **7,543** | **8,780** | **10,820** |

## Table 6-20 Projection municipal budget indicators – optimistic case

| | Unit | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cacak** | | | | | | | | | | | | |
| Operating result / total revenues | % | 29% | 30% | 31% | 32% | 33% | 34% | 36% | 37% | 38% | 39% | 40% |
| Operating result / Total debt service | multiple | 24.3 | 18.6 | 20.9 | 7.8 | 9.2 | 11.0 | 13.2 | 15.8 | 19.1 | 22.3 | - |
| Outstanding Debt / operating result | multiple | 1.1 | 0.8 | 0.7 | 0.6 | 0.4 | 0.3 | 0.2 | 0.1 | 0.0 | - | - |
| Outstanding Debt / revenues previous yı | % | 27% | 25% | 23% | 18% | 14% | 10% | 7% | 4% | 2% | 0% | 0% |
| Debt service / revenues previous yr | % | 1% | 2% | 2% | 5% | 4% | 3% | 3% | 3% | 2% | 2% | 0% |
| | | | | | | | | | | | | |
| **Uzice** | | | | | | | | | | | | |
| Operating result / total revenues | % | 15% | 17% | 18% | 20% | 22% | 24% | 26% | 28% | 29% | 31% | 32% |
| Operating result / Total debt service | multiple | 4.0 | 4.0 | 4.9 | 2.7 | 3.4 | 4.3 | 5.4 | 6.7 | 8.3 | 11.9 | - |
| Outstanding Debt / operating result | multiple | 3.1 | 2.5 | 2.0 | 1.5 | 1.0 | 0.7 | 0.4 | 0.2 | 0.1 | 0.0 | - |
| Outstanding Debt / revenues previous yı | % | 51% | 46% | 40% | 32% | 24% | 17% | 12% | 7% | 3% | 0% | 0% |
| Debt service / revenues previous year | % | 4% | 5% | 4% | 8% | 7% | 6% | 5% | 5% | 4% | 3% | 0% |

## Table 6-21 Projection municipal budget Cacak – pessimistic case

| | Unit | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total budget revenues | CSD m | 2,034 | 2,440 | 2,708 | 2,966 | 3,219 | 3,461 | 3,686 | 3,960 | 4,254 | 4,571 | 4,911 |
| Total current expenditures | CSD m | 1,454 | 1,745 | 1,930 | 2,108 | 2,281 | 2,445 | 2,597 | 2,774 | 2,964 | 3,168 | 3,386 |
| **Operating result** | **CSD m** | **580** | **695** | **777** | **858** | **938** | **1,015** | **1,089** | **1,185** | **1,290** | **1,403** | **1,525** |
| Capital contribution to Duboko project | CSD m | 119 | - | - | - | - | - | - | - | - | - | - |
| EBRD debt service | CSD m | 34 | 59 | 64 | 206 | 206 | 201 | 195 | 186 | 176 | 170 | - |
| Other debt service | CSD m | - | - | - | - | - | - | - | - | - | - | - |
| **Available for capital spending** | **CSD m** | **427** | **636** | **713** | **652** | **732** | **814** | **894** | **1,000** | **1,113** | **1,232** | **1,525** |
| | | | | | | | | | | | | |
| Total budget revenues | € th | 14,104 | 14,390 | 14,803 | 15,319 | 15,855 | 16,566 | 17,313 | 18,434 | 19,631 | 20,498 | 21,820 |
| Total current expenditures | € th | 10,085 | 10,289 | 10,554 | 10,889 | 11,237 | 11,706 | 12,199 | 12,916 | 13,680 | 14,207 | 15,045 |
| **Operating result** | **€ th** | **4,019** | **4,100** | **4,249** | **4,430** | **4,619** | **4,860** | **5,114** | **5,518** | **5,951** | **6,290** | **6,775** |
| Capital contribution to Duboko project | € th | 822 | | | | | | | | | | |
| EBRD debt service | € th | 238 | 350 | 350 | 1,064 | 1,014 | 964 | 914 | 864 | 814 | 764 | - |
| Other debt service | € th | - | - | - | - | - | - | - | - | - | - | - |
| **Available for capital spending** | **€ th** | **2,959** | **3,750** | **3,899** | **3,366** | **3,604** | **3,896** | **4,200** | **4,653** | **5,137** | **5,526** | **6,775** |

## Table 6-22 Projection municipal budget Užice – pessimistic case

| | Unit | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total budget revenues | CSD m | 1,476 | 1,771 | 1,965 | 2,151 | 2,333 | 2,507 | 2,668 | 2,865 | 3,076 | 3,303 | 3,548 |
| Total current expenditures | CSD m | 1,273 | 1,528 | 1,688 | 1,838 | 1,983 | 2,121 | 2,246 | 2,389 | 2,543 | 2,706 | 2,881 |
| **Operating result** | **CSD m** | **203** | **243** | **278** | **313** | **350** | **386** | **422** | **475** | **533** | **597** | **667** |
| Capital contribution to Duboko project | CSD m | 105 | - | - | - | - | - | - | - | - | - | - |
| EBRD debt service | CSD m | 34 | 59 | 64 | 206 | 206 | 201 | 195 | 186 | 176 | 170 | - |
| Other debt service | CSD m | 43 | 50 | 52 | 53 | 53 | 50 | 50 | 49 | 48 | 8 | - |
| **Available for capital spending** | **CSD m** | **20** | **134** | **162** | **55** | **91** | **134** | **177** | **240** | **309** | **418** | **667** |
| | | | | | | | | | | | | |
| Total budget revenues | € th | 10,235 | 10,442 | 10,745 | 11,112 | 11,493 | 11,999 | 12,531 | 13,336 | 14,195 | 14,815 | 15,762 |
| Total current expenditures | € th | 8,829 | 9,009 | 9,227 | 9,494 | 9,771 | 10,151 | 10,549 | 11,124 | 11,733 | 12,136 | 12,799 |
| **Operating result** | **€ th** | **1,405** | **1,434** | **1,518** | **1,618** | **1,722** | **1,848** | **1,982** | **2,212** | **2,462** | **2,678** | **2,963** |
| Capital contribution to Duboko project | € th | 731 | | | | | | | | | | |
| EBRD debt service | € th | 238 | 350 | 350 | 1,064 | 1,014 | 964 | 914 | 864 | 814 | 764 | - |
| Other debt service | € th | 299 | 295 | 283 | 271 | 259 | 241 | 235 | 229 | 223 | 38 | - |
| **Available for capital spending** | **€ th** | **137** | **789** | **885** | **282** | **448** | **643** | **833** | **1,119** | **1,425** | **1,876** | **2,963** |

## Table 6-23 Projection municipal budget indicators – pessimistic case

| | Unit | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cacak** | | | | | | | | | | | | |
| Operating result / total revenues | % | 28% | 28% | 29% | 29% | 29% | 29% | 30% | 30% | 30% | 31% | 31% |
| Operating result / Total debt service | multiple | 16.9 | 11.7 | 12.1 | 4.2 | 4.6 | 5.0 | 5.6 | 6.4 | 7.3 | 8.2 | - |
| Outstanding Debt / operating result | multiple | 1.7 | 1.3 | 1.3 | 1.3 | 1.0 | 0.7 | 0.5 | 0.3 | 0.1 | - | - |
| Outstanding Debt / revenues previous yı | % | 36% | 35% | 35% | 29% | 23% | 18% | 13% | 8% | 4% | 0% | 0% |
| Debt service / revenues previous yr | % | 2% | 2% | 2% | 7% | 7% | 6% | 6% | 5% | 4% | 4% | 0% |
| | | | | | | | | | | | | |
| **Uzice** | | | | | | | | | | | | |
| Operating result / total revenues | % | 14% | 14% | 14% | 15% | 15% | 15% | 16% | 17% | 17% | 18% | 19% |
| Operating result / Total debt service | multiple | 2.6 | 2.2 | 2.4 | 1.2 | 1.4 | 1.5 | 1.7 | 2.0 | 2.4 | 3.3 | - |
| Outstanding Debt / operating result | multiple | 4.8 | 4.5 | 4.1 | 3.3 | 2.6 | 1.9 | 1.3 | 0.8 | 0.3 | 0.0 | - |
| Outstanding Debt / revenues previous yı | % | 66% | 63% | 60% | 50% | 40% | 31% | 22% | 13% | 6% | 0% | 0% |
| Debt service / revenues previous year | % | 5% | 6% | 6% | 12% | 11% | 10% | 10% | 9% | 8% | 6% | 0% |

Main conclusions of the analysis of the impact of optimistic and pessimistic macro economic scenarios are:

- Čačak budget forecast remains robust, even under pessimistic macro-economic circumstances. In any one year of the analysis, not more than 25% of the operating result is devoted to debt service obligations;
- Užice municipality would, under pessimistic macro-economic circumstances, be able to fund debt service obligations throughout the analyzed period, but with a narrow margin in the year 2010: the operating result over debt service reaches a multiple of 1.2 during this year;
- In addition, the legal 50% limit of outstanding debt over the prior year's realized revenue would not be met during the years 2007 to 2009;
- Under the pessimistic scenario, existing debt service and EBRD debt service would absorb between 40 to 80% of Užice's operational surplus during the period 2007 to 2015. It would therefore limit funding possibilities of other investment projects.

The above analysis assumes that both cities would have to take on liability for the full EBRD loan. In the current situation, this is not likely to happen. The EBRD loan is intended to be made available directly to the regional PUC, rather than via a municipality or combination of municipalities. Instead, it is envisaged that all nine municipalities guarantee, via a pay-or-deliver contract, certain minimum quantities of waste multiplied by an agreed tipping fee. In principle, the tipping fees are to be covered for the full 100% by an increase in the solid waste collection tariffs, levied by the public utility companies. In case a municipal public utility company is not paying the agreed tipping fees, or does not deliver the agreed minimum quantity of waste, the relevant municipality is obliged to settle the difference. In extreme cases, this would amount to 100% of the agreed minimum waste quantity, multiplied by the tipping fee.

In chapter 5, an average and a differentiated tipping fee were proposed. If we assume that the forecasted quantities of waste to be delivered by the public utility companies are also the minimum quantities, the **maximum** liability in both cases would be:

**Table 6-24 Municipal pay-or-deliver liability compared to EBRD debt service – base case**

| | Unit | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|---|---|---|---|
| Čačak average tipping fee | CSD m | 58 | 64 | 70 | 77 | 84 | 92 | 100 | 110 | 118 |
| Čačak differentiated tipping fee | CSD m | 70 | 78 | 86 | 95 | 105 | 116 | 132 | 146 | 160 |
| Uzice average tipping fee | CSD m | 48 | 52 | 57 | 62 | 68 | 75 | 81 | 89 | 96 |
| Uzice differentiated tipping fee | CSD m | 23 | 22 | 23 | 23 | 22 | 21 | 12 | 9 | 6 |
| EBRD Debt service (base case) | CSD m | 38 | 39 | 121 | 117 | 113 | 109 | 104 | 100 | 95 |

From the above table it can be concluded that:

- For both Čačak and Užice, average tipping fees would be lower than EBRD debt service as from 2010. Both cities can thus accommodate this liability within their forecasted operating revenues. For the years 2008 and 2009, tipping fees are higher EBRD debt service. Still, this can be accommodated by the projected operating results of both cities, although by a small margin in Užice;
- If differentiated tipping fees are applied, the maximum liability of Čačak municipality would be higher than the EBRD debt service in certain years. However, given the large operating surplus, this liability could be easily accommodated;
- Differentiated tipping fees substantially lower the potential liability of Užice municipality, making it easier to cover this from operating surpluses.

### 6.3.3 Risks and weaknesses and creditworthiness enhancement program

The risk of default on credits and other financial obligations of municipalities in Serbia is generally not very high, because of the strict application of the law on public finance by the Central Government/Ministry of Finance. This law regulates the municipal debt market by setting the limit to accumulated municipal debt to maximum 50% of the previous' year realized budget revenues. In addition, debt service is not to exceed 15% of the previous' year realized budget revenues. Municipalities have to apply for a permit to the Ministry of Finance for any debt they wish to take. The Ministry of Finance controls whether the municipalities adhere to the stipulations of the law on public finance and especially these debt limits, before issuing the permit.

The other factor that is decreasing risk in servicing debts of local governments is the still relatively slow procedure in creating debts. According to the new law on public procurement and new treasury procedures, the process of initiating project implementation is very slow. It could be said that Serbian municipalities still did not develop management capacity to spend efficiently funds available on viable projects. This is one of the reasons for not having spent funds as planned during the budget year.

The financial position of Čačak and Užice municipalities can not be seen as very risky, since the debt ratio is low, and, in general, the municipalities are applying a conservative financial policy.

Certain risks could be related to the coming reform of the local governmental system which includes considerable changes in the financial operational system:

- The new law on local governments financing envisages the establishment of a tax administration at the local level and take over much bigger responsibility for collecting larger original (own) revenues;
- Introduction of the new elaborated treasury system that will integrate the system of public finance in Serbia;
- Introduction of public procurement law;
- Starting with the accounts of the 2006 financial year, municipalities and public companies are obliged to have their accounts audited and certified by an external auditor.

The risk is related to the reforms not being implemented successfully or creating excessive bureaucracy. On the other hand, a successful implementation will enhance the local government financial management system and increase the creditworthiness of the municipalities.

There is a political risk. Change of either the mayor or the constitution of the assembly can change political priorities. Frequently, (senior) managers in both the city administration as well as related public companies are changed as a result of a newly elected mayor from a different political party or a change of the assembly.

The current system of planning capital investment projects is rather weak. Usually, investments are planned with a one year horizon, i.e. the next years' budget, without assessing the multi year consequences of initiated investments. Longer term operation & maintenance impact of investment projects is not taken into consideration. There is no systematic effort to make an integrated long term capital investment plan, with a

supporting financing plan. Long term investment needs of public utility companies are not known, let alone integrated in the overall municipal capital investment plan, assuming that part of these investments are to be financed from the municipal budget. In addition, although municipal accounts do separate between capital and current accounts, little attention is paid to a strict separation of the two types of expenditure. Frequently, current and investment expenditures are mixed up. Actual expenditures of subventions given to public utility companies are not reflected in the municipal accounts. This all makes it difficult to track planned investment versus actual expenditure.

Conclusion is that many local government reforms are recently introduced which, if implemented successfully, will contribute to enhance the creditworthiness of municipalities. A potential item for a creditworthiness enhancement program could be strengthening the municipalities' capacity to plan and track long term capital investment.

# 7 ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

## 7.1 Introduction

The EAR and the EBRD require the preparation of an Environmental Impact Assessment (EIA) prior to the construction of the regional sanitary landfill. The ToR for the EIA was provided by the EBRD. An EIA was concluded by the Duboko Project Team in September 2005 (referred to as 'EIA 2005'). This ''EIA 2005" followed the EU directions and was approved on 27 September 2005 by the Department for Urban Development, Construction and Communal Services of Užice, in accordance with the Serbian Law on EIA (see annex 4.1)

In this Feasibility Study 'EIA 2005' has been reviewed, it reports on non-compliance with the requirements set by the EAR and EBRD and recommends how these requirements can be met in the shortest possible time frame.

## 7.2 EIA procedure

### 7.2.1 Serbian requirements

According to Serbian legislation, an Environmental Impact Assessment has to be conducted and approved in order to obtain a construction permit. The Law on Environmental Impact Assessment (Official Gazette of the Republic of Serbia 135/2004) gives the requirements for such an EIA. This Law on EIA has been developed to be compatible with EU directives.

<u>EIA scope and contents</u>
According to article 12 - 15 of the Serbian Law on EIA, the Competent Authority decides on the required scope and contents of an EIA study. Article 17 of the Law lists the following data, information and documents that the EIA shall contain:

1. The data on project developer;
2. The description of the planned project site;
3. The description of the project;
4. The outline of the main alternatives studied by the project developer;
5. The outline of the environmental status at the site and its close vicinity (micro location and macro-location);
6. The description of likely significant effects of the project on the environment;
7. The environmental impact assessment in cases of accidents;
8. The description of measures envisaged to prevent, reduce and, if possible, eliminate any significant adverse effects on the environment;
9. The programme of monitoring of impact on the environment;
10. The short non-technical summary of data listed in points 2) to 9);
11. The data on technical shortcomings, absence of the appropriate expertise and skills or, impossibility of obtaining the appropriate data

<u>Public consultation</u>

Article 14 of the Law on EIA requires public announcement of the decision by the Competent Authority on the scope.
Article 20 and 21 describe the public consultation procedures to be followed on the results of the EIA.

### 7.2.2 Requirements set by EAR and EBRD

EIA scope and contents
The EAR and EBRD require an EIA according to the terms of reference as given in Annex 1 to the Work Plan for the Feasibility Study by MIASP (4 August 2006). These requirements are more elaborate than the Serbian law. Additional requirements are:

- Discussion of public acceptability of the proposed facilities and haulage routes;
- Discussion of land acquisition and displacement of people;
- Discussion of socio-economic impacts;
- Evaluation of project alternatives (at least the no-action alternative);
- Site selection.

Public consultation Process (PCP)
Subsequently the EAR and EBRD require a public consultation process to be executed in compliance with the EBRD Public Information Policy.

A credible Public Consultation Process (PCP) is crucial to the successful completion of the assignment and to the preparation of an acceptable Environmental Management Plan (EMP) and Resettlement Action Plan if required. The PCP needs to comply with EBRD Environmental and Public Information Policies and should continue through project implementation and facility operation. The Cities should at least:

a. identify and convene the key stakeholders;
b. prepare and disseminate information in relation to the project;
c. establish mechanisms and conduits for consulting communities and representative groups;
d. keep records of information and consultation; and
e. propose a strategy for continuing community and NGO monitoring during facility construction and operation.

### 7.2.3 Followed Procedure for the 'EIA 2005'

EIA
In line with requirements by Serbian law, Dragoprojekt, contracted by the municipality of Užice, carried out an Environmental Impact Assessment procedure in 2005. This EIA was approved by the Serbian competent authority, the Department for Urban Development, Construction and Communal Services of Užice, on 27 September 2005. This approval can be found in Annex 4.1

Public consultation
The municipality of Užice informed MIASP that the following public consultation activities were executed:

- The zone of Duboko was defined as a potential landfill location in the General Urban Master Plan of the city of Užice in 1991. This plan is subject to public consultations.
- The report by the expert team on site selection in 1994 was presented in the local media, in particular in the local newspaper 'Vesti' and in 'Uzicki ekolog', a publication of the Užice Ecological Fund.
- The concept of the sanitary landfill in Užice at the Duboko site was presented at the local TV station TV-5 in 1994, and on environmental fairs in Niš and Novi Sad.

- A regulatory plan for the location of Duboko was completed in 1996, and was subject to public consultation and information over a period of 15 days. The plan was distributed in the local district offices. The public, especially citizens living in the vicinity of Duboko, or affected by land acquisition, enquired mainly about **property issues, environmental effects** and **environmental improvements**.
- The Ecological Fund of Užice coordinated the technical documentation preparation procedure. Major decisions and activities in this procedure were announced, published and promoted through local newspapers and electronic media between 1995 and 2006. Live broadcasted public debates were held on TV, with solid waste experts, mayors and republican ministers, promoting the landfill project.
- Professional and general public in Užice were informed on the concept of the regional sanitary landfill Duboko through specialized TV shows and short movies.
- In 2005, in the course of preparation of a project design and corresponding EIA, the procedure of public consultation and public information was conducted in compliance with the requirements set in the relevant Serbian regulations.

Documentation used in the aforementioned public information procedures is attached in Annex 7.1

**Figure 7-1 Images from TV shows on the landfill project**

No details are known to the consultants on the results of the public consultation and on the way these results were processed in the project. The new 'Rulebook on the procedure of public consultation, presentation and public debate for EIA' (OGRS 69/2005) was not used, since this was first published on 9 August 2005.

In the processes described above, only the new landfill in Duboko was discussed. No consultation procedures were held on other components of the project. For municipalities other than Užice, no information is available on public consultation procedures.

## 7.3 Gap Analysis

Between the 'EIA 2005' and the EIA as required for this feasibility study, gaps exist in both the scope of the project and in the requirements of contents. In the following paragraphs these gaps are specified.

### 7.3.1 Scope

The 'EIA 2005' covers the impacts of only the landfill itself, counting for participation of eight municipalities (Užice, Čajetina, Bajina Bašta, Kosjerić, Požega, Arilje, Lučani and Ivanjica). This scope of this feasibility study encompasses the whole landfill scheme, including transfer stations, transport routes and the closure of old landfills. These topics have to be covered in a revised EIA.

Besides that, the scope of the project has changed, since the municipality of Čačak now as well participates in the regional landfill. Čačak is – with Užice – a large municipality in the region. Including Čačak in the regional landfill scheme implies changes in the amounts of waste to be landfilled and in transport movements. These have to be included in the revised EIA.

### 7.3.2 Requirements for EIA as set by EAR and EBRD

For this feasibility study, the EAR and EBRD require several topics to be assessed in an EIA which are not included in the 'EIA 2005'. The table below gives an overview of the requirements that should be covered according Serbian, EAR and EBRD requirements.

**Table 7-1 Overview of EIA requirements**

| Requirement | 'EIA 2005' |
|---|---|
| The data on project developer | ✓ |
| The description of the planned project site | ✓ |
| The description of the project | ✓ |
| The outline of the main alternatives studied by the project developer | not covered |
| The outline of the environmental status at the site and its close vicinity (micro location and macro-location) | ✓ |
| The description of likely significant effects of the project on the environment | ✓ |
| The environmental impact assessment in cases of accidents | ✓ |
| The description of measures envisaged to prevent, reduce and, if possible, eliminate any significant adverse effects on the environment | ✓ |
| The programme of monitoring of impact on the environment | ✓ |
| The short non-technical summary | not covered |
| The data on technical shortcomings, absence of the appropriate expertise and skills or, impossibility of obtaining the appropriate data | not covered |
| Discussion of public acceptability of the proposed facilities and haulage routes | not covered |
| Discussion of land acquisition and displacement of people | not covered |
| Discussion of socio-economic impacts | not covered |
| Evaluation of project alternatives (at least the no-action alternative). | not covered |
| Site selection | not covered |

### 7.3.3 Overview of gaps

Figure 7-2 visualises the gaps that exist between the 'EIA 2005' and the requirements of EAR and EBRD.

**Figure 7-2 Gaps in the 'EIA 2005'**

| | | Scope | | | | |
|---|---|---|---|---|---|---|
| | | Landfill Duboko, 8 Municipalities | Čačak | Transfer Stations | Transport Routes | Closure of Old Landfills |
| Requirements | Serbian | | | | | |
| | EAR and EBRD | | | | | |

| | |
|---|---|
| | Contents covered by existing EIA |
| | Gap area |

## 7.4 Proposed changes and Additions to the Existing 'EIA 2005'

### 7.4.1 Waste and collection data

The expansion of the scope with the municipality of Čačak implies a larger volume of waste to be transported to and put on the Duboko landfill. The updated information on waste amounts etc. is found in chapter 2 of this feasibility study.

### 7.4.2 Transfer stations, haulage routes and closure of old landfills

Chapter 3 of the feasibility study gives recommendations and guidelines for the closure of the existing landfills. The design and location of transfer stations and the proposed haulage routes are described in chapter 4.

### 7.4.3 Environmental impacts

The project proposes a regional plan for transport and disposal of waste and includes transfer stations, recycling centres, a landfill and the closure of existing landfills. Each of these infrastructural works has a potential influence on the environment. The following paragraphs identify the main impacts on the natural environment of each component of the Duboko regional landfill project.

<u>Transfer stations</u>
Transfer stations are facilities where municipal solid waste materials, including yard waste, demolition materials, and household refuse, are transferred from small vehicles to large trucks for efficient transport to the Duboko landfill. Waste can be transferred directly from vehicle into vehicle or through a buffer where waste is temporary stored on site.

Environmental impacts at the site of the transfer stations are the following:

| | |
|---|---|
| Soil, groundwater, surface water: | The quality of the soil, ground and surface water can be adversely affected by discharge, leachate and precipitation run-off. |
| Air: | The quality of the air can be adversely affected by dust and gaseous emissions (e.g. odour). |
| Traffic and noise: | Traffic movement around the site will increase because small volume vehicles will bring the waste to the transfer station and large volume trucks will leave from the transfer station. This will increase the dust, exhaust gas and noise level at the site and the surrounding of the site. |

Depending on the local situation, items as land use, flora, fauna, ecosystems and landscape could be influenced. Based on size and potential locations this however is more than likely of no concern.

Waste separation line

The main activity at the waste separation line in Užice at the Duboko Landfill site is to sort waste and recover paper, glass, metal, PET bottles and plastic foil from the waste stream. On a microscopic level (at the site of the waste separation line), the waste separation line could have similar environmental impacts as transfer stations. The major environmental benefit of a waste separation line is the volume reduction of the waste stream.

Duboko regional landfill

At the Duboko landfill, waste will be stored permanently. With the introduction of the landfill a number of environmental effects can potentially be experienced:

| | |
|---|---|
| Soil, groundwater, surface water: | The quality of the soil, ground and surface water could be adversely affected by discharge, leachate and precipitation run-off. |
| Air: | The quality of the air can be adversely affected by dust and gas emission. The landfill gas however can now be extracted in a controlled manner and used for energy purposes. |
| Traffic and noise: | Arriving vehicles and landfill equipment produce noise, dust and exhaust gases. |
| Land use: | The landfill will change not only the land use of the landfill site but potentially also of the areas surrounding Duboko. |
| Flora/ fauna/ ecosystems: | The existing ecosystem could be altered. |
| Landscape: | Creation of the landfill will change the landscape. |

These environmental effects occur during construction, operation, closure and aftercare. The construction activities however have little effect on quality of soil, groundwater and surface water, especially since these activities take place in a very short time.

Quantification:

Based on data in preliminary design an estimate should be made on the total air emissions.

Transport
Transport will increase by the Duboko regional landfill scheme. The waste from all municipalities, except Užice, now has to be transported over a longer distance. This increase in transport will cause the following effects on the environment.

| | |
|---|---|
| Air, traffic and noise: | There will be an increase in noise, dust and exhaust gases. These effects will be the strongest experienced by people living next to major transport routes, especially the access road to the Duboko Landfill. |

Influence of the transport on soil, groundwater, surface water, land use, flora, fauna, ecosystems and landscape will be of little to no concern.

Closure of existing landfills
Existing landfills in the participating municipalities will be closed. Recommendations for the closure of these landfills are given in chapter 3. Environmental impacts to be expected in the immediate vicinity of these landfills are:

| | |
|---|---|
| Soil, groundwater, surface water: | The amount of leachate will decrease, so in time the quality of soil and water will improve. |
| Air: | The quality of the air will improve as there will be less dust and odour. The escape of methane will however not immediately stop. |
| Traffic and noise: | No more vehicles will attend the sites and landfill equipment will not operate any longer, so the noise, dust and exhaust gases will disappear. |
| Landscape: | The landscape will improve after the landfills are covered with soil and grass. |
| Land use: | The possibilities for land use will certainly improve, but will remain limited. |
| Flora/ fauna/ ecosystems: | There will be no more traffic which is positive for flora, fauna and ecosystems. |

### 7.4.4 Social impacts

Public acceptability
The municipality carried out a number of activities to inform the public on the regional landfill scheme. It was reported that the general attitude of the public towards the project is positive and that the regional landfill scheme has never been seriously criticized by any of the elected municipal assemblies.

In order to enhance public acceptability of the Duboko Landfill site, a form of ecological tax could be introduced in all municipalities participating in the Regional Solid Waste Management Scheme. The proceeds collected could be specifically used towards the zone, i.e. the settlements in the vicinity of the planned regional landfill in Užice municipality, in order to improve infrastructural and environmental projects in the settlements mostly affected by the new landfill. This approach would result in a number

of environmental, social and health benefits for the population affected, and would in a long run ensure sustainable and stable public acceptance of the project in Užice municipality.

Land acquisition and displacement of people
For the Duboko site, the access road to the landfill and for the sites of the transfer stations land has to be acquired.
The cadastral information available to MIASP (plots which are included in the urban planning permission, those on the list for acquisition and on the topographic overview) is inconsistent. It is essential that this information is updated.
It is reported that for the landfill the acquisition of nine of the total of fifteen hectares is completed; for the remaining area, court cases are ongoing.
The required area for the access road is determined, but acquisition procedures have not yet started.

The locations of the transfer stations are not yet determined, so plans for land acquisition do not exist.

Socio-economic development
The construction and operation of the Duboko landfill will create approximately 80 jobs (see chapter 5). During operation, personnel will be needed for transport of the waste from the municipalities to the landfill, for the separation lines (both in Užice and in Čačak), for placing the waste on the landfill, for maintenance of equipment and installations and for security.

At existing landfills some people might lose their job, but possibly these people can be relocated to the transfer stations, the separation line in Čačak or to the Duboko landfill. People that are scavenging the landfills for recyclable items will lose their source of income.

The tariffs for waste collection services will significantly increase, since the operation costs of the landfill will be much higher than they are now. This is however not expected to be problematic for most people. More information on this can be found in chapter 5 of the feasibility study.

Public health
Waste that is not properly managed, especially sanitary waste, is a serious health hazard and may lead to the spread of infectious diseases. People involved in scavenging in the waste dumps for items that can be recycled, may sustain injuries and come into direct contact with these infectious items. The existing waste dumps are in some cases situated close to houses and are often not well fenced and not frequently covered with soil.
The project will lead to an important improvement of the situation. The number of locations where waste is landfilled is reduced from nine to one. The Duboko landfill will be daily covered with soil, scavenging at the landfill will be prohibited and the site will be fenced off, thus preventing animals to feed.

Occupational health
Workers involved in the, sorting, recycling and disposal of wastes are exposed to health risks as skin and blood infections resulting from direct contact with waste, eye and respiratory infections resulting from exposure to infected dust and intestinal infections transmitted by flies and other insects feeding on the waste.

At the Duboko landfill, protection measures will be introduced, including the use of protective clothing, and basic sanitary facilities (a/o workers shed with water) are foreseen. In terms of occupational health therefore, the project is anticipated to lead to an improvement of the situation.
The introduction of better landfill management practices (e.g. daily covering of the waste) will further reduce health risks. The same counts for waste separation at the source which should therefore be stimulated.

Occupational safety
The main safety risks to workers at the existing landfills are: infecting wounds resulting from contact with sharp objects, infections caused by contact with medical waste, poisoning and chemical burns resulting from contact with small amounts of hazardous chemical waste mixed with general waste.
Safety practices (e.g. the use of protective clothing and better landfill management), will eliminate the risk of burning and methane explosions and reduces the risks related to hazardous wastes. On the other hand, however, the introduction of new machinery might introduce new risks of accidents. Training will minimize this risk.

Contingencies
Possible accidents and incidents include:
- Fire, caused by spontaneous combustion, careless operation or by intentional setting
- Explosions of a landfill gas – air mixture
- Damage to the impermeable liner or its protection
- Instability of the landfill structure
- Instability of waste in the landfill
- Accident to equipment on the landfill
- Accident to equipment/vehicle in the operations area
- Accident with vehicle during waste transport
- Spillage of leachate or wastewater from the treatment plant
- Blockage of leachate pipework
- Introduction of hazardous waste
- Blockage of gas system
- Fire in operations area

### 7.4.5 Mitigation plan

The regional landfill Duboko is designed as a sanitary landfill, including protection measures such as a bottom liner, a leachate collection system and operational procedures to avoid hindrance. The envisaged measures for prevention, mitigation and elimination of considerable hazardous environmental impacts at the landfill are described in chapter 8 of the 'EIA 2005'.

For the transfer stations and waste separation line, the following should be taken into consideration:
- watertight floor,
- sound barrier,
- waste acceptance procedures and
- operational manual with cleaning instructions.

The waste acceptance procedures and operational manual will be part of a management plan for the transfer stations and recycling centres.

### 7.4.6 Management plan

Duboko regional landfill

The 'EIA 2005', the current "EAR/EBRD Feasibility study 2006' and the project design documents all contain elements of a management plan for the landfill. A complete and coherent management plan however, is not yet available. Such a document should at least contain the following elements:

1. An introduction (with information on the site, waste inputs, plant and staff)
2. A site assessment (information on geology, hydrogeology and hydrology)
3. A description of all infrastructure
4. A site development plan including waste placement, traffic flow, landfill closure and aftercare.
5. An operational plan with detailed method statements for all operations, including at least:
   - waste reception: recording and inspection,
   - measures and criteria to assess the acceptability of waste on reception,
   - dealing with, and disposing of unsuitable wastes,
   - handling, placement, compacting and covering of wastes,
   - movements of waste trucks over site,
   - adverse weather operation;
6. A site management plan, including at least:
   - organization chart,
   - personnel,
   - job descriptions,
   - health and safety,
   - record keeping,
   - traffic,
   - staff recruitment and training,
   - communications;
7. An environmental management plan
   - *Environmental management and control* (concerning leachate, landfill gas, surface water and protection local amenities). especially all details about leachate handling and treatment and landfill gas extraction: flow diagram, description of operations, principles, operational parameters, required conditions for process and discharge;
   - *Environmental monitoring*:
     - method statement (sampling, preservation and handling, labels, analytical procedures, quality assurance and control, monitoring frequency),
     - documentation,
     - trigger levels,
     - action plan for control of leachate, gas and groundwater levels and quality, and surface water quality,
     - required contacts,
     - meteorological parameters;
8. Maintenance and repair schedules and procedures of all equipment and site infrastructure at the site and the access road. List of machines and equipment, overview technical documentation of machines
9. As-built records and drawings.

*Leachate on Duboko site*
As there is no waste water treatment plant in Užice, the leachate water, treated in the aeration and sedimentation lagoons, will eventually end up in surface water. To minimize discharge, it is proposed to spray the collected and treated leachate-water over the landfill. The mayor part of the water will evaporate (> 50%). The remaining water will prevent dust problems and will infiltrate in the landfill body and enhance biodegradation and LFG production.

The recirculation of leachate can be done by means of a movable irrigation pump with fire-hoses to transport water to a spraying unit. In this way, a simple and flexible leachate infiltration system is guaranteed. When needed, the system can easily be extended with more pumps/hoses in order to raise the recirculation capacity. The recirculation will increase the leachate flow, so design capacities have to be recalculated.

Transfer stations
A basic management plan should also be composed for the transfer stations. These plans should at least contain the items 1, 5, 6 and 8 of the listing given above.

### 7.4.7 Monitoring plan

Chapter 9 of the 'EIA 2005' describes the environmental monitoring program. It covers, in general terms, a monitoring program for waste acceptance, land filling process, maintenance of infrastructure, health and safety regulations, volume and composition of leachate (before and after treatment), wastewater after treatment at the sediment tank, groundwater quality, and volume and composition of landfill gas.

The European Directive 1999/31/EC on the land filling of waste prescribes the following regarding control and monitoring in the operational phase:

1. The operator of a landfill shall carry out during the operational phase a control and monitoring programme in which the minimum procedures to be carried out are to check:
   - that waste has been accepted to disposal in accordance with the criteria set for the category of landfill in question,
   - that the processes within the landfill proceed as desired,
   - that the environmental protection systems are functioning fully as intended,
   - that the permit conditions for the landfill are fulfilled.

     In addition meteorological data, emission data (leachate and surface waters, gas as well volume as composition), groundwater (sampling, monitoring, trigger levels) should be measured and the topography of the site should be determined.
2. The operator shall notify the competent authority of any significant adverse environmental effects revealed by the control and monitoring procedures and follow the decision of the competent authority on the nature and timing of the corrective measures to be taken. These measures shall be undertaken at the expense of the operator.

   At a frequency to be determined by the competent authority, and in any event at least once a year, the operator shall report, on the basis of aggregated data, all monitoring results to the competent authorities for the purpose of demonstrating compliance with permit conditions and increasing the knowledge on waste behaviour in the landfills;

3. The quality control of the analytical operations of the control and monitoring procedures and/or of the analyses is carried out by competent laboratories.

For Duboko, in addition to the abovementioned requirements, the following should be included in a monitoring plan:

- Geotechnical monitoring of each design and construction stage.
  The landfill will be situated at a slope, and geotechnical investigations have shown potential instability of a clayey subsoil layer, in case this layer becomes saturated. Drainage measures shall increase the protection against instability. During design, changes in design and construction measures, supervision by a geotechnical engineer is necessary.
- Geotechnical monitoring of landfill operations, closure and aftercare.
  Measures shall be taken to protect the landfill body and slopes against erosion and instability of top cover layers.

## 7.5 Alternatives

### 7.5.1 Alternative sites

In both Užice and Čačak, different options for landfill locations were investigated. The findings of the selection procedures are described in the paragraphs below.

<u>Užice</u>
The municipality of Užice started in 1994 with the first plans for a new landfill. In that year studies on a suitable location for the landfill were carried out.

*Macro location*
An expert group was established by the Executive Council of the Užice municipality in order to investigate and evaluate potential macro locations for construction of a sanitary landfill in Užice. The results of this research were presented in the 'Report on evaluation of potential locations for Užice sanitary landfill' (1994)

The objective of the research was to identify a location for a landfill that has sufficient capacity to ensure at least 20 years of operation (1.140.000 $m^3$).
An overview of the potential locations was prepared taking into account the existing urban master and spatial plans and the administrative boundaries of the municipality.
The following locations were taken into consideration:

1. Todorovića Potok
2. Turski Potok – Duboko
3. Garevine – Uzunovića brdo
4. Kujundžići
5. Gostinica – Osoja brdo
6. Jelova Gora
7. Osoje – Jasikovac

The 1994-report gives a detailed description and summarises geological and hydro-geological features of all sites. The criteria that were used in the evaluation process complied with the main criteria incorporated in the "Rulebook on criteria for determining location and arrangement of landfills for waste materials" (OGRS 54/92).
Major findings of the 1994-report were:

- With regard to geological and hydro-geological conditions, no location was found to be unacceptable.

- Location Osoje – Jasikovac, was eliminated because of its vicinity to an environmentally sensitive zone.
- The location Turski Potok – Duboko was identified as the most favourable in terms of potential capacity and as the most favourable location in terms of overall visual effects, because it is well hidden by the surrounding woods.

The expert group recommended selecting the location in Duboko for planning, design, construction and operation of a sanitary landfill. Their report does not contain clear information on how the location in Duboko scored in relation to the other alternatives.

*Micro location*
Once the macro location of Duboko was selected, a second study, now on micro location was done by Mark-Impex, Belgrade in 1994.

The study evaluated three potential locations for micro-location of a future Užice landfill, all situated in the previously proposed macro-location.
The study was conducted according the "Rulebook on criteria for determining location and arrangement of landfills for waste materials" (OGRS 54/92) and the "Model for valuation of landfill locations" (YU.88.L2) which follows the recommendations from the Rulebook.

The set of the criteria against which the micro-locations were tested is summarized as follows:
1. Road network – distances and quality;
2. Infrastructural connections - power supply, public telephone network, potable water supply, sewerage;
3. Covering material – availability, distance to the borrow pit;
4. Terrain characteristics - flooding probability, topography, slopes, stability;
5. Seismic characteristics;
6. Landfill technical compatibility – capacity, suitability in surrounding areas, compliance with urban master plan, land ownership
7. Position in relation to functions and settlements that could be affected;
8. Affectability of ground water and surface water;
9. Climate;
10. Geological features – depth of bedrock, mineral raw materials
11. Natural potential – presence of agricultural land, forests

The location Duboko was evaluated as the most favourable location for construction of a future sanitary landfill with the highest overall score and the highest scores for environmental protection.

<u>Čačak</u>
The municipality of Čačak reported to have investigated three different locations for a new landfill. For all three locations a design was completed, but none of these designs were realised because of very strong resistance of the public.

No documentation of these researches was presented to MIASP.

<u>Locations outside Čačak and Užice</u>
There have not been reports submitted to the MIASP Team describing that outside Užice and Čačak research was performed to select a location for a landfill.

### 7.5.2 No-action alternative

Multi-criteria Analysis

Table 7-2 compares the execution of the Duboko regional landfill plans and taking no action at all, thus leaving and using the nine landfills as they are now. These two alternatives are compared on environmental and socio-economic issues.

**Table 7-2 No-action alternative vs. Duboko regional landfill**

| | No-action | Duboko regional landfill |
|---|---|---|
| **Environmental impacts** | | |
| Soil, ground water, surface water | Soil, groundwater and surface water are affected in nine locations. This will worsen. | At Duboko contamination will be prevented. At existing landfills, situation will stabilise. |
| *Score* | - | ++ |
| Air | Smell at existing landfills will not improve; there is no covering with soil. Uncontrolled emission of methane. | Elimination of smell at old landfills, daily covering at new landfill. Controlled extraction and utilisation of landfill gas. |
| *Score* | - | ++ |
| Traffic and noise | Only local transport of waste. | Regional transport of waste will cause more traffic movements. |
| *Score* | 0 | - |
| Land use | On and around existing landfills no improvement is expected. | Improvement expected on and around old landfills, Duboko area will be negatively affected. |
| *Score* | 0 | 0 |
| Flora, fauna, ecosystems | Flora, fauna and ecosystems remain affected at existing locations | The flora, fauna and ecosystems at Duboko area will alter. Improvement expected at old landfills. |
| *Score* | - | 0 |
| Landscape | The landscape will remain affected at nine locations. | The landscape at existing locations will improve, but it will be impacted at Duboko. |
| *Score* | - | + |
| Recycling | Hardly any infrastructure for separation and recycling is present, only little improvement is to be expected. | Waste separation line will limit the amount of waste to be landfilled. |
| *Score* | - | ++ |
| **Socio-economic impacts** | | |
| Socio-economic development | No changes expected. | Jobs will be created. Tariffs increase. Recycling will generate some extra revenues. |
| *Score* | 0 | + |
| Public health | Not all dumps are fenced or frequently covered with soil. Also hazardous waste is dumped. People | Only one landfill, daily covering with soil, no more scavenging, control of |

| | | |
|---|---|---|
| | are scavenging on dumps. | delivered waste. |
| *Score* | -- | + |
| Occupational health | Protective clothing and sanitary facilities are mostly not available | Protective clothing is available. Sanitary facilities will be built. |
| *Score* | -- | + |
| Occupational safety | Risk of infection and injury due to hazardous waste and fires. | Safety procedure should reduce risks. Untrained use of new equipment could cause accidents. |
| *Score* | -- | + |

Conclusion
The comparison between the no-action alternative and the Duboko regional landfill shows that regarding most environmental and all socio-economic criteria, Duboko is preferred over the no action alternative. Overall, Duboko is an improvement for both the environmental and the socio-economic situation.

## 7.6 Recommendations

### 7.6.1 Research and additional information

Environmental impacts
The environmental impacts of all components of the regional landfill scheme are described in paragraph 7.4.3.

It is recommended to quantify expectations on emission, for both the existing situation and the planned scheme. For this quantification, the total transport (see chapter 4) and landfill gas emissions (chapter 4) should be taken into account.

Risk Assessment
To obtain a full overview of possible accidents, a full risk assessment, as part of the contingency planning and emergency response, should be done.

Mitigation plan
The current mitigation plan as described in chapter 8 of the 'EIA 2005' is considered sufficient for the Duboko landfill. For the transfer stations and recycling centres the measures described in paragraph 7.4.5 should be taken into account.

Management plan
It is recommended to compose a complete and coherent plan for the management of the Duboko landfill (using the existing management plans from the 'EIA 2005', the 'Feasibility Study 2005' and the project design documents), according the requirements listed in paragraph 7.4.6.

Monitoring plan
It is recommended to expand and adapt the proposed monitoring plan from the 'EIA 2005'. Such a document should take into account the requirements for monitoring and control as mentioned in paragraph 7.4.7, and should have the following contents:
1. Introduction (environmental effects, monitoring philosophy)
2. Design issues and monitoring objectives (including responsibilities)
3. Monitoring locations and schedules
4. Assessment criteria and contingency actions
5. Design of monitoring points

6. Monitoring methodology
7. Data management and reporting
8. Cost estimates

Land acquisition and displacement of people
The overview of cadastral numbers, those necessary for the landfill, in the urban planning permission and of plots acquired and to be acquired, should be updated.

For the completed land acquisition procedures, no further action is required.

Where the procedure has not yet started or is still ongoing, it should be taken into account that people affected are:

- consulted regarding resettlement activities;
- provided with timely compensation for lost assets at full replacement cost;
- provided with alternative sites for relocation;
- provided with resettlement assistance, if required; and
- restored to livelihoods whose standards compare with, and preferably exceed, those that prevailed before resettlement.

Alternatives
In Užice the study resulted in the selection of the location 'Duboko', for which a design has now been prepared and approved. In Čačak the municipality evaluated three locations, which all three were not acceptable.

Potential sites in other municipalities were not evaluated.

### 7.6.2 Public consultation process

During revision of the EIA, a public consultation process should be prepared and executed according the EAR/EBRD guidelines. The public consultation should cover all components of the project and should be set up within all nine municipalities.

# 8 RISK ANALYSIS

Table 8-1 summarizes the most important financial, environmental, operational, institutional and socio-economic risks associated with the project and the project implementation. The probability that these risks will occur has been assessed, the severity of the effects has been indicated and mitigation measures have been proposed.

**Table 8-1 Risk matrix**

| **Risk** | **Category**<br>Financial,<br>Environmental,<br>Operational,<br>Institutional<br>Socio-economic | **Probability**<br>H: High<br>M: Moderate<br>L: Low | **Adverse effect**<br>From:<br>1 (Severe)<br>To: 5 (None) | **Mitigation measures**<br>(for effects 1, 2 and 3 only) |
|---|---|---|---|---|
| **PROJECT PREPARATION** | | | | |
| *Acquisition of the remaining land for the landfill unsuccessful* | Institutional/ Socio-economic | Moderate | 2 | Follow closely the pending court case and adopt approach when required. |
| *Acquisition of the remaining land for the access road unsuccessful* | Institutional/ Socio-economic | Moderate | 2 | Follow closely the pending court case and adopt approach when required. |
| *Loan can not be guaranteed.* | Financial | High | 1 | Pay or deliver contract → alternative financing |
| *Complex decision making processes within municipalities* | Institutional | Moderate | 3 | Support as much as possible a transparent and swift decision making process. |
| *Public acceptance of regional scheme low* | Socio-economic | Low | 3 | Initiate, stimulate and enhance pro-actively the public consultation process. |
| *Limited management capacity available* | Operational/ Institutional | High | 1 | Capacity enhancement programs |
| **PROJECT IMPLEMENTATION** | | | | |
| *Construction delays may occur due to longer than expected unworkable winter periods* | Operational | Moderate | 4 | - |

| **OPERATION** | | | | |
|---|---|---|---|---|
| *Uncontrolled streams of not accepted waste (industrial, mining, agricultural, construction, hazardous, medical, slaughter, bulky, cars, etc).* | Operational | High | 1 | Formulate regional waste management strategy.<br>Assure alternate destinations for not accepted waste. |
| *Enforcement of illegal dumping fails* | Institutional | Moderate | 3 | |
| *Inadequate tariff policies* | Institutional | Moderate | 2 | Strengthen the institutions.<br>Formulate regional waste management strategy. |
| *Limited waste/land fill management experience* | Institutional | High | 1 | Strengthen the institutions. |
| *The capacity of the landfill is insufficient to ensure financial feasibility.* | Financial/operational | High | 1 | Foresee enlargement of the landfill;<br>Assure additional and timely funding. |

# 9 IMPLEMENTATION SCHEDULE

## 9.1 Introduction

We distinguish the following sub-projects:
1. The closure of the existing landfills;
2. The Transfer Stations;
3. The mobile transport equipments;
4. The waste separation line at Duboko site;
5. And the sanitary landfill at Duboko.

### 9.1.1 Closure of the existing landfills

The following activities shall be started as soon as possible (with time requirement)
1. Investigate every dumpsite including a/o (three months):
   - physical condition of the dump;
   - topographic map preparation;
   - geotechnical & hydro-geotechnical investigations;
   - leachate and groundwater analyses,
2. Identify and work-out for every dumpsite the technical solutions possible including detailed investment estimations (2 months);
3. Select the most appropriate solution for dumpsite concerned (1 month);
4. Prepare detail design & tender documentations (category: Works) for every dumpsite based on the selected solution (9 months);
5. Tender the works (for every site or clustered sites).

As soon as Duboko landfill comes into operation the works can start by taking basic environmental measures a/o:
- Avoid direct access to the sites e.g. by installing a fence around each dumpsite;
- Sites should be consequently closed by covering. Only after 1-3 years, depending on the settlement of the site, final closure can take place as proposed in chapter 3.

It is proposed to assign a consultant experienced with the EU legislation for the tasks 1 to 5.

### 9.1.2 Transfer Stations

The site selection shall start as soon as possible. Only after the site selection the conceptual design can be worked out and tender documents can be drawn up. This can be done for each TS-site or for the total cluster.
Tender can start hereafter. There is no strict time requirement, only ready by the opening of Duboko.

### 9.1.3 Mobile transport equipments

Some detailing research still has to be done after which a tender document can be drawn up. The tender document (Category: Delivery of goods) can contain requirements concerning maintenance (after-sale service) etc.
Alternatively the waste transport can be outsourced. In this case a tender document for a service contract shall be drawn up.

### 9.1.4 Waste separation line at Duboko

It is proposed to draft a Programme of Requirements for the recycle line. The requirements include the design, engineering, delivery on site, installation, commissioning and guaranteeing the installations for at least one year.
Tendering (category: Works) to be done on the EU-market plus Serbia.

### 9.1.5 Sanitary landfill at Duboko.

The detailed designs from 1999 shall be adjusted in accordance with the EU Directive as described in chapter 4. Also, aspects related to the changed situation a/o the participation of 8 more municipalities and a recycle line must be taken into account.
It is proposed that a Serbian design bureau (can be the original design bureau) adjust the design with extensive help from an experienced EU-consultant.
As this process will take some time it is advised to start with these design works as soon as possible.
The design works will be part of the tender document (category: Works).

### 9.1.6 Technical assistance elements

The Feasibility Study has identified the following Technical Assistance (TA) elements:

**Table 9-1 TA elements identified in MIASP Feasibility Studies**

| Project | Time frame | Assessed costs (€x1000) |
|---|---|---|
| **Duboko SWM**<br>Regional Solid waste management strategy.<br>EAR | Mar-Dec 07 | 200 |
| **Duboko SWM**<br>Master Plan for the closure of 9 abandoned landfills.<br>Site investigations and closure plans of 9 abandoned landfills.<br>EAR | Mar-Dec 07 | 200 |
| **Duboko SWM**<br>Tendering and Supervision of the scheme.<br>EAR | Mar 07-Jun 08 | 437 |
| **Duboko SWM**<br>Public Consultation Process.<br>(might be considered as done) | Mar-Jun 07 | 100 |
| **Duboko SWM**<br>Financial Operation and Performance Enhancement Program (FOPEP)<br>EBRD (PUM) | Mar 07-Mar 08 | 300 |

## 9.2 Time schedule

A preliminary time schedule (planning) of the above sub-projects is given in Annex 9.1.

As shown in the attached Project Implementation Schedule the works are grouped in the following major lots:

1. Closure of the existing landfills (not in the scope for financing in this project)
2. Transfer Stations
3. Mobile Transport Equipment
4. Waste separation line at Duboko Site
5. Sanitary Landfill at Duboko

This schedule is to be considered as preliminary, based on the information available in January 2007, and should be regularly updated as tendering, contracting and works progress.