



Preparation of project studies (FSs, EIAs, CBAs), design and tender documentation for establishing an integrated and financially self-sustainable waste management system in the east and northeast regions

*EuropeAid/136070/IH/SER/MK*

**Contract number 12-9539/1**



**Ad Hoc Report:**

**“SITE SELECTION FOR CENTRAL WASTE MANAGEMENT FACILITY”**

**1<sup>st</sup> AUGUST 2016**



This project is funded by  
the European Union

A project implemented by

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in consortium with EPEM SA



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## 1 Introduction

The selection of the appropriate location of waste management infrastructure and especially for waste landfills has always been an issue of great concern in every waste management system. The inappropriate selection of a site can contribute to the bad image and reputation affecting landfill operations. The direct public involvement, the economic impact in the surroundings of a waste management facility and particularly a landfill and the need for combination of technical, social and legislative issues are some typical factors that increase the difficulties for a successful site selection.

In this respect, the Not In My Back Yard (NIMBY) and even worse the Built Absolutely Nothing Anywhere Near Anyone (BANANA) Syndromes may generate significant problems in finding a suitable location for the development of the waste management infrastructure.

In this framework, landfill site selection is a step-by-step process, it is necessary for the selection of the location of the waste management facilities to be transparent based on solid technical, environmental and financial criteria. Moreover the development of the infrastructure should be such in order to ensure the absolute protection of the environment and public health. In this way the selection may be accepted by the public and future delays in the actual development of the disposal and treatment facilities will be avoided.

As an ideal selection depends on considering several independent factors concerning land use, socio economy, geology and, hydrogeology, the use of a multi criteria evaluation method seems inevitable.

The selection of the locations of the main waste management infrastructure will consist of the following steps:

- Preliminary identification of potential sites;
- Site visits;
- Development of exclusion and selection criteria;
- Application of exclusion and selection criteria for the site under investigations;
- Recommendations and Consultation.



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## 2 Preliminary identification of potential sites

Since the beginning and particularly in the period following the submission of the inception report, the Consultant has initiated the activities to identify potential sites for the development of waste management infrastructure. These activities included:

- Review of existing studies (e.g. spatial plans, national and regional waste management plans, other technical studies, etc);
- Proposals from stakeholders (MoEPP, and Inter-municipal Waste Management Boards from East and Northeast regions, actors active in the region in relation to waste management and dumpsite rehabilitation).

Following these activities **several sites (16 in total)** have been identified as follows:

- Sites in existing dumpsites:
  - Stip – East Region;
  - Kumanovo – Northeast Region;
  - Kočani– East Region;
  - Kriva Palanka – Northeast Region.
- Other sites:
  - Sveti Nicole – East Region;
  - Karbinci – East Region;
  - Staro Nagorichane (old quarry) – Northeast Region;
  - Rankovtse (old quarry) – Northeast Region;
  - K’shanje (2 sites) – Northeast Region;
  - Stip (quarry) – East Region;
  - Cesinovo (quarry) – East Region;
  - Crn Vrv – East Region;
  - Sveti Nikole, Meckuevci – Arbasanci – East Region;
  - Kocani, Istibanja, Prevalec – East Region;
  - Krupiste – East Region.

The location of the alternative sites is presented in the following figure.



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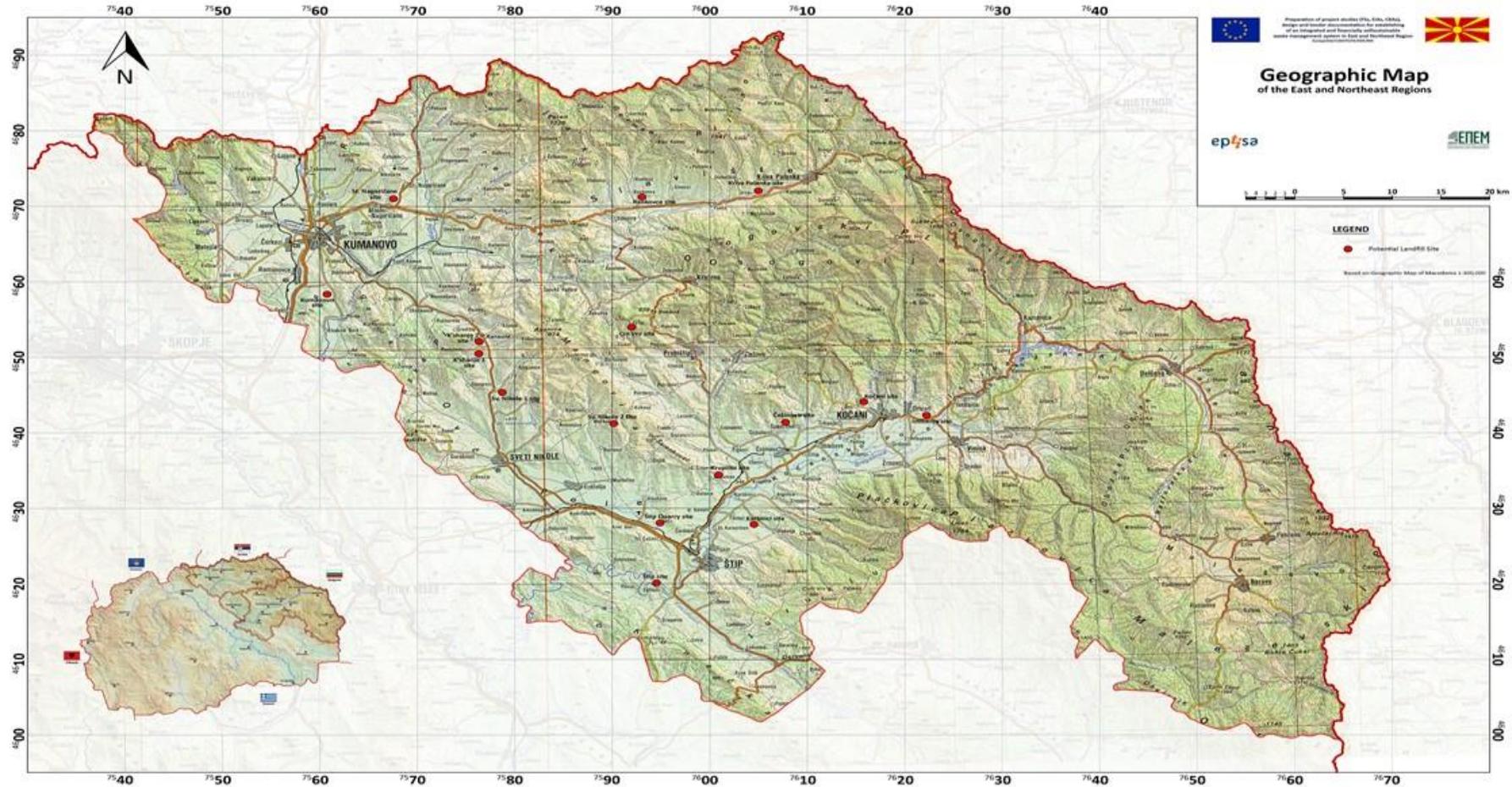


Figure 1: The proposed alternative locations for the waste management facilities in east and northeast region

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### 3 Site visits

Following the site identification, the Consultant team carried out site visits to all the sites under investigation. The site visits were carried out in the period 11-14 April, 9 - 13 May, 11 – 15 July 2016 and 16<sup>th</sup> September 2016.

In order to maximize the efficiency of the site visit and ensure the feasibility of assessing the appropriateness of the sites the Consultant prepared, prior to the visit, a Site Visit Checklist, which was used for the registration of the main characteristics of each site.

Following short descriptions of the sites that have been visited are presented.

#### 3.1 East Region

##### Sites in Existing Dumpsites

- **Stip:** The assessed site is the currently active landfill of Stip, serving approx. 35,000 people. The site operates since 2004 and covers an area of ~40,000 m<sup>2</sup>. The site is located on the West side of the city, on the place called Trestena Skala, nearby the regional road Stip - Radovis, around 8 km from the city centre. The landfill is located at the edge of a plateau (upstream at about 320 m.a.s.l.), on flat surface surrounded with hills gorge with slope and has orientation East – West, above the Bregalnica River narrow valley (meander). The landfill has a garage and a fence with several holes, which is used mostly as a means to catch air blown litter. No equipment was present during the site visit, but there is evidence that waste is occasionally covered and spread. In addition, there were several scavengers on site who had set fires to recover recyclables. No environmental monitoring systems have been installed on site. The slopes of the site formed at the edge of the hill are very steep. The access road to the site is very good and only a couple of holes are observed at its beginning, close to the connection with the central road. No agricultural activities take place in the surroundings. There is nothing but grassland for more than a km. Several pigs were observed at the entrance of the landfill as well as a pastor with his goats. There is no surface water in the site vicinity. However, several minor intermittent streams run from the area towards the Bregalnica River which cuts the hills (meandering at about 1 km east of the site, at elevation about 100 m lower than the site). Last, no network is available on site. It needs to be mentioned that the regional gas pipe has been installed and is located approx. 1 km away from the entrance of the site. The site has been categorized by MOEPP as a low risk landfill and it was indicated by the municipality of Stip as a potential site to construct the landfill of the region.
- **Kočani:** This proposed site refers to the currently active dumpsite of Kocani located approx. 1.2 km northeast (road distance) of village Beli, located at about 550 m.a.s.l. The dumpsite has been active for the last 40 years, covering an area of approx. 40,000 m<sup>2</sup>. Ownership of the dumpsite is public but currently it is operated by a private company under the agreement that operator will excavate waste mass and will retrieve recyclable materials. Actually the operator



is a person that handles a small bulldozer and there is a team of scavengers that put fires and collect recyclable materials. The site is not guarded and not equipped with a weighbridge. No environmental protection system has been installed. Basic operations take place daily (probably). There is a water tank (with no evidence of water) and a garage. Leachate is collected into a pit. A fire protection zone has been excavated in the perimeter of the site. The landfill is not connected to the electricity grid. Material for landfill covering is excavated just outside the site according to the needs. The wider area is hilly, at the foothill of the Osogovo mountain, with limited cultivation activities – mostly vineyards – and woodlands adjacent to the site. Formally, the site is located within the protected landscape of the Osogovo Mountain, at its very southern boundary. No surface water flows were observed in the vicinity at the time of the site visit (April 2016). The Kocanska River is the main water flow in the area, running from the Osogovo Mountain, located about 1.2 km east of the site. The access road is narrow, especially for big trucks. To access the site one needs to cross the town of Kocani, including a hospital.

#### Other Sites

- **Sveti Nicole:** The visited location of Sveti Nikole was assessed as an alternative to serve both regions of Stip and Kumanovo, since it lays approx 40km away from Kumanovo and less than 30 km from Stip. The site is located within the wide Ovce Polje Basin (at about 380-400 m.a.s.l.), 1.9 km southwest from the village of Dolno Gjugjanci and covers more than 100,000 m<sup>2</sup>. The terrain is undulated and mildly sloped. The site is a valley surrounded by several small hills, which is characterized as grassland area with numerous cultivated plots. The site is accessible from two directions: (1) from the main regional road P-201 and (2) from the local asphalt road connecting the main road with the nearby village of Dolno Gjugjanci. A part of the site is visible from the regional road and a berm will be needed to make the site visually isolated. No settlements are present in the radius of almost 1 km. There is no surface water in the site vicinity. There are two small rivers running west and east of the site at a distance of about 700 m, each.
- **Karbinci:** The proposed site is located 3.4 km southeast of Karbinci in the Kozjacka River valley at the foothill of the Plackovica Mountain. Terrain is undulated and mildly sloped. The site is located between two small hills (425 and 403 m.a.s.l respectively). The potential site area is at about 360 m.a.s.l. In terms of geomorphology, the area is quite flat and when the landfill will be formed it will be easily visible from the surrounding area. What is more, only if the surrounding hills would be used to lay a slope of waste would make the use of this area appropriate for landfill construction. However, there is plenty of area available, of which, unfortunately, the ownership is unknown. The surrounding area is covered mostly with cultivations of wheat and grassland. No surface water flows exist in the site vicinity. The closest surface waters are the Kozjacka River (running at about 1 km north of the site) and the Radanjska River (1.5 km south) of the site. There is no road to the proposed area, which lays approx. 1.5 km far from the regional road.
- **Stip quarry:** The assessed area is a Basalt open pit mine called “Eževo Brdo” located in the municipality of Štip. The quarry is located 6.5 km northwest of the town of Stip and it has been



active for the last 74 years. The quarry is approx. 250,000 m<sup>2</sup>, but the active areas are approx. 70,000 m<sup>2</sup>. Ownership of the area is private and “Geotehnika Skopje” (private company) has the concession rights. The mining site is located on the Ezevo hill (isolated volcanic hill) which divides two large flat valleys (fields). The mining site is located at the altitude of 490 m.a.s.l. while the surrounding fields are at about 350 m.a.s.l. and lower. Therefore, the site is visible from the surrounding areas. The surrounding area is cultivated land and pastures with grassland, whereas no settlements are met for at least 1.8 km (Sarcievo to the west). The closest industry from the site is about 3.5 km to the south-east.

Minor intermittent streams are formed at the hill flowing towards the surrounding fields and no major surface water bodies are met. A thing that must not be ignored is that the quarry will be active for the next 35 years!

- **Cesinovo:** The visited site is located in the hilly area at the foothill of the large Osogovo mountain at the altitude of 480 m.a.s.l., about 700-1000 m northwest of the village of Spančevo. The site is a partially active quarry in which excavations of opallite and tuff (both used in cement industry) take place only during summer. The mining company has the concession right, therefore the ownership of the site is considered private. The site is visible from the road. The area that excavations take place is approx. 100,000 m<sup>2</sup>, but the whole quarry is much bigger. Intensive sheep and cow grazing take place at very close proximity to the site, whereas large rice fields exists at about 1 km south from the site. Water is abundant in the area with several intermittent flows coming from the hills towards the Bregalnica valley. Small springs (captures) in the hills are used for local supply. The access road is in a mediocre condition, but very narrow and passes through several villages. With regard to the surrounding area, there are no natural conservation areas but white stork (*Ciconia ciconia*) has numerous nests in the area (about 70) with about 180 pairs of storks. The municipality of Češinovo - Obleševo is one of the European Stork Villages proclaimed by the conservation non-profit foundation EURONATUR.
- **Crn Vrv:** The assessed site is a formally active pit quartzite mine located on the top of a mountain, approx. 7.5 km southwest of Kratovo. The area is owned by the private company RIK Silex from Kratovo. The area of the mine is rather large (more than 20 ha) and the exploitation fields are spread over the area following the site topography. The site is visible only from very far from the local road. There surrounding area is uninhabited and vacant with shrubs and woodland. With regard to surface water, there are only intermittent flows originating on the hills. The main road along the mountain is in good condition, but with high inclinations. Apart from the main road, the access road includes a long way on the mountain road constructed for the quarry purposes. Given the road conditions and the high altitude of the site, it is believed that the access road will be difficult to use during winter, and especially the last part of it which climbs the mountain.
- **Sveti Nikole, Meckuevci – Arbasanci:** This site was proposed by the municipality of Sveti Nikole. It is a Greenfield location which lies between Meckuevci, which is considered the main location, and Arbasanci, which is considered as potential area for expansion. The area of Meckuevci is 7,800 m<sup>2</sup> whereas the available area of Arbasanci is 375,000m<sup>2</sup>. The wider area is hilly, with average altitude of 550-600 m.a.s.l. The ownership of the proposed site is public.



The site is visible from the road and it can be approached by the local asphalt road S. Nikole – Probistip. The site lies 15 km away from Sveti Nikole. The asphalt road is in poor condition with high inclinations. The road is narrow, especially for big trucks. No settlements are met in a radius of 3km. Closest village (with no residents) is 3 km away from the location toward S. Nikole. Moreover, no cultivation activities have been identified. In the cadastre the area is registered as pasture, however it was noticed that it was not used as pasture in recent period. No surface water flows were observed in the vicinity at the time of the site visit (July 2016). The location has natural gully that can collect water after rains and in the rainy season. In addition, no wetlands are present in the vicinity of the site. Accumulation Mavrovica is 10 km away from the location. There is no electricity on site and the closest low power supply network is found 1.5-2km away. The gas pipeline is passing 6-8km away. The site is located within the boundaries of EMERALD and IBA site of Ovce Pole (close to the northern boundary zone). A small church has been recently renewed 3 km away in the uninhabited village.

- **Kocani, Istibanja, Prevalec:** This site was proposed by the municipality of Kocani. The proposed site is a greenfield area located 2.2 km west-southwest of Istibanja. The area available is between 8 and 10 ha. The ownership of the proposed area is public but occasionally it is used as pastures. The wider area is hilly at the foothill of the Osogovo Mountain, above the Kocani valley. The site's average altitude is about 450 m.a.s.l. There are no settlements or individual houses in a radius of at least 1km from the site, and only small private vineyards are met. Officially, this area is registered in the cadastre as pasture land. Rice growing is one of the main agricultural activities in Kocani valley, and rice fields are met approximately 3-5km away from the site. A dirt road in poor condition and high inclinations leads to the site. The road is quite narrow, especially for big trucks. The access is made from the regional road Kocani - Istibanja, 1.5 km from the regional road. The site is visible from the road, but not from the closest village in distance of 3 km. No surface water flows were observed in the vicinity at the time of the site visit (July 2016). The proposed site is located 200 m above the valley that can collect water after rains and in the rainy season. The Bregalnica River is the main water flow in the area, running from the Maleshevo Mountains. It runs at about 3 km south of the site. There is no evidence of public or private water sources in the vicinity of the proposed site. The site is not located within the nature conservation areas. However, the site is situated within the protected landscape of the Osogovo Mountain, at its very southern boundary.
- **Krupiste:** The visited area is a green field located at approx. 400 m.a.s.l. The proposed site lies on the slopes of a hilly area immediately above the Bregalnica river valley where the land is intensively irrigated and used for rice fields. The ownership of the area is public, given however for usage to private farmers. The proposed site covers an area of 6.825.000m<sup>2</sup> in 3 parcels divided among the municipalities of Probistip, Karbinci, and S.Nikole (Pisica, Krupiste, G. Balvan). Despite the fact there is no access road to the site, it is visible from the south/south east roads. The closest settlements are located 2km away, (SE- Krupiste with no visual obstacle, and NE-Pisica with a hill to interpose), whereas the wide area is used for farming and small scale agriculture with rice to be the main cultivation. More specifically, about 1 km downhill from the site, the area of rice fields belonging to the Kocani field is located. In addition, there is intensive sheep and cow grazing in the surrounding area on the higher

grounds and on the north side. There are numerous intermittent streams in the area flowing towards the Bregalnica river valley, which is a wetland used for rice growing. The nearest water body is the irrigation canal running about 800 m SE of the site. The artificial water reservoir Pisica is located about 2 km north of the site presenting a part of irrigation system, whereas the large wetland of the Bregalnica River valley is located about 1 km SE of the site. The site is located within the boundaries of EMERALD and IBA site of Ovce Pole (close to the very eastern boundary zone). Semi natural grassland, shrubs and steppe vegetation are the main forms of vegetation met, whilst occasional woodland fragments are found in the vicinity (including evergreen).

## 3.2 Northeast Region

### Sites in Existing Dumpsites

- **Kumanovo:** The proposed site refers to the currently active Kumanovo landfill which is active for the last 40 years. The landfill is located 5 km south from the town of Kumanovo, at about 420 m.a.s.l. The landfill lies on a slightly undulated and hilly terrain on the border of Kumanovo valley. Ownership of the area is public, whereas in terms of operation the landfill has electricity, fence and a gate. In addition, landfill operators hire equipment from GIZ to cover waste, whereas compaction is very limited. There was no evidence of fire onsite but there were scavengers. A very big part of the area is covered with waste but there is still some available space, especially if operators decide to compact the waste. However, it cannot cover the needs of the area and it has to be closed until 2020. The access road to the site is very good. The site is visible from the road and the surrounding areas, whereas there are no residential areas in the vicinity. There are scattered houses at 1km to the north. Right opposite to the site there are large active mines extracting limestone, whereas all over the area there are grasslands and numerous small plots of cultivated land, mostly towards the west of the landfill. There no surface flows but only two intermittent streams coming from eastern hills. Last, it needs to be mentioned that the site is located exactly on the border of the large IBA site “Pcinja – Petrosnica – Kriva reka”.
- **Kriva Palanka:** The proposed site of Kriva Palanka refers to the currently active dumpsite of the area, operating for the last 35-40 years, serving approx. 14-15,000 people. The dumpsite is located at the northern slopes of Osogovo mountain where the Kriva River cuts the narrow valley. The site is located on the left bank, about 10 m above the river (the site is at about 580m.a.s.l.). Ownership of the landfill is public but the surrounding area is private. The site is not guarded and the fence has several holes. No weighbridge was available onsite and no environmental protection system has been installed. Scavengers are available on site, excavating waste to recover recyclables. Access road conditions are very good, with the site to be visible from the adjacent regional road. Forest fragments and riparian vegetation are met in the surroundings and along the river. First scattered houses are located at about 150m southeast and southwest from the site. A textile industry and several warehouses are located close to the landfill; therefore hazardous waste might be found onsite. The site has been



characterized as a high risk landfill that needs to be closed as soon as possible. The site is planned to be closed either in 2017 or 2018 according to the financing availability. Last, the site is quite far from Kumanovo (~60 km) which is the main waste generator of the region.

### Other Sites

- **Staro Nagorichane quarry:** The proposed area is an old mine that needs rehabilitation. Currently it is used for informal disposal of inert and C&D waste. The site is very close to Kumanovo (10 km) and it is accessed very easily. The nearest settlement Vuevci is located about 600 m to the west. The site covers an area of 60,000 m<sup>2</sup> and it is 15 m deep on average (site is at about 430 m.a.s.l.). In general it is isolated and only a part of it is visible from the road. Close to the site there must be a can factory but verification is needed. The area appears to have very limited agricultural activity. There is an electricity network on site and a couple of old buildings that could be used (after renovation or not) as infrastructure. The soil looks impermeable since water has been accumulated on site. No surface water flows in the vicinity of the site. The nearest watercourse is the intermittent stream Garin Dol running at about 700 m north from the site. The site belongs to the Pcinja River watershed. The site is located within the IBA site "Pcinja - Petrosnica – Kriva reka". The lake at the old mine site is identified as a habitat of some bird species (Little grebe – dabchick).
- **Rankovtse quarry:** The proposed area is an old bentonite clay quarry (at about 510-520 m.a.s.l.), probably inactive, at least in its biggest part. It is quite deep and because of the impermeability of the geological formations of the area, a big amount of water has been accumulated on site forming a lake. The site covers an area of 40,000 m<sup>2</sup> and it is located 1.8 km north from the city of Rankovce and approx. 42 km from Kumanovo. The site is quite far from the road and despite the fact that it lies on a flat area, the site is quite deep excavated, providing in that way a good visual isolation. In the surrounding area there are limited to very limited cultivations (mostly wheat) and grassland. Moreover, there are at least another couple of quarries in the area. A stream is running along the eastern boundary of the quarry towards the south (Kriva Reka River is the main surface water in the area). An artificial lake has been formed in the quarry; however it is not clear whether it is a result of groundwater or surface water accumulation. Another thing that needs to be mentioned is that the Hydrogeological map of Macedonia indicates presence of artesian aquifer in the nearby area, east of the open pit with several groundwater wells. Last, it is noted that at least 2 other quarries similar to that have been restored and converted into nice leisure facilities, including cafes, parks, etc.
- **K'sanje 1:** The examined site is located close to the regional road of connecting Kumanovo with Stip, approx. 25 km from Kumanovo and 50 km from Stip. The site was assessed as a potential location to cover the needs of both regions. Alternatively and given its distance from Stip, it can be considered as a potential site for the North-Eastern Region only. The proposed site is located about 1.5 km east of Pavleshenci village, situated on the top of the hill. The site is located on the very border zone of the wide Ovce Polje Basin (at about 500m.a.s.l.). Terrain is undulated, mildly sloped and exceeds 100,000 m<sup>2</sup>. The surrounding area is vacant with only cultivations and grasslands. There is no surface water in the site vicinity. A local road leads to



the proposed area. The site is not visible from the regional road but it is from Pavleshenci village. Being located in an open landscape valley, surrounded by cultivated land, the landfill at this location might present an adverse visual intrusion.

- **K'sanje2:** The examined site is located close to the regional road connecting Kumanovo with Stip, approx. 24 km from Kumanovo and 50 km from Stip. The site was assessed as a potential location to cover the needs of both regions. Alternatively and given its distance from Stip, it can be considered as a potential site for the North-Eastern Region only. The proposed site is located about 2.3 km northeast of Pavleshenci village and 2.3 km southwest of K'sanje. The site is located on the very border zone of the wide Ovce Polje Basin (at about 520 m.a.s.l.). Terrain is undulated, mildly sloped and exceeds 100,000 m<sup>2</sup>. The surrounding area is vacant with some cultivations and grasslands. There is no surface water in the site vicinity. A local road leads to the proposed area. The site is not visible from the regional road but it is from Pavleshenci village. Being located in an open landscape valley, surrounded by cultivated land, the landfill at this location might present an adverse visual intrusion.

## 4 Development of exclusion and selection criteria

It is noted that the international specifications for the waste management infrastructure are strict enough to allow their development close to urban areas, cultural sites, environmental protected areas, etc. However, this is usually avoided in order to reduce potential public opposition. Usually the location of waste treatment and disposal facilities is not:

- In areas of archaeological and cultural interest;
- In traditional areas;
- In protected natural areas (SPA, NATURA 2000, etc);
- Near residential areas;
- In forests;
- In areas with specific land uses such as:
  - Urban development;
  - Sports and leisure infrastructure development;
  - Constantly irrigated areas;
  - Vineyards;
  - Crop land;
  - Industrial zones.

However, besides these general criteria a set of exclusion and selection criteria will be used in order to assess the appropriateness and examine in a comparative manner the alternative locations.

### 4.1 Exclusion criteria

The exclusion criteria reflect minimum acceptable sitting practice and are intended to be applied as minimum standards that must be met by all solid waste management facilities. By excluding from consideration land areas determined to be unsuited for waste management activities and by requiring the screening of non-excluded land areas for preferred attributes, the criteria provide a rational basis for identifying locations that are potentially suitable for such facilities and therefore deserving of further investigation. The main goal in adopting these criteria is to direct site screening activities to the investigation and selection of land areas that appear to be suitable and appropriate for these facilities.

In this respect, exclusion criteria for the sitting of waste management infrastructure (treatment & disposal) are mainly related to the distances from settlements, roads, cultural monuments, areas of high ecological interest, etc.

The endorsed regional waste management plans (RWMP) for the East and Northeast Regions have already identified exclusion criteria which will be the basis of the analysis.

The exclusion criteria included in the RWMPs in accordance with guidelines of the World Health Organization (Petts & Eduljee, 1994) are:

- Unstable or weak soils (organic, swelling, delicate sands etc.);
- Areas where there are or potential subsidence;
- Saturated soils (e.g., wetlands, coastal zones);



- Groundwater recharge area. Where a protective waterproof layer requires special investigation;
- Areas that flood. You must ensure return period of at least 100 years;
- Areas upstream concentration of surface waters, e.g. reservoirs, water points for drinking or irrigation water or anywhere can decline due to rapid surface water contaminant transport;
- Atmospheric conditions are not conducive to safe dispersion of pollutants from escaping after extraordinary event;
- Major natural hazards: landslides, increased seismic movements;
- Natural ecosystems: Habitat endangered species, parks, forests, nature protection areas;
- Areas of economic or cultural significance;
- Historical and archaeological sites and buildings or areas associated with local traditions. In these positions definitely avoid the destruction or contamination and avert visual, aural and functional disturbance;
- Sensitive locations, such as airports, warehouses flammable or explosive materials etc.;
- Special population concentrations e.g. hospitals, prisons;
- Occupying space that leads to inequality between population groups due to the destruction of cultural traditions or relationships with the area;

Moreover it is prohibited to install SWM facilities within the following areas:

- Areas of archaeological cultural interest, i.e. officially proclaimed and statutory archaeological sites;
- Traditional Settlements;
- Statutory protection areas and individual elements of nature and landscape (Natura 2000, National Parks, areas RAMSAR Treaty etc.);
- Residential areas
  - Areas within the project boundaries and within city limits settlements;
  - Areas private urbanization for residential use;
- Areas for which a special or general prohibitory provision, and National Defence and security.

As also stated in the RWMPs, in order to identify areas in principle suitable for the siting of treatment works and disposal of solid waste throughout the area of interest, conditions and limitations of suitability will be laid down in accordance with international practice and the requirements of national legislation. The basic terms and restrictions placed are:

- **Geologic constraints:** Firstly you need to try to avoid areas dominated geological Permeability. In case of difficulty finding areas which geologically constructed of impermeable formations, selecting areas with impermeable bedrock not a criterion for exclusion;
- **Hydrological constraints:** Avoid principle areas which are watersheds where dams exist, but this is not an exclusion criterion;
- **Permanently restricted hunting areas or Wildlife areas:** designated as permanently closed hunting areas, or wildlife sanctuaries are excluded;



- **NATURA 2000:** Excluded areas are part of the Natura 2000 Directive 92/43 and Directive 79/409;
- **Any other protected area under national legislation;**
- **Archaeological sites:** areas declared as archaeological sites are excluded;
- Besides the above mentioned areas, SWM facilities within a zone of 500 m from the statutory settlement boundaries are forbidden.

As discussed in the document prepared in relation to the review of the RWMPs, these exclusion criteria have not been quantified. In this respect, the proposed quantification of the exclusion criteria is presented below:

- **Geological – Hydro geological – Hydrological criteria**
  - **Criterion EC1 – Minimum distance from river bed or large ghylls:** in order to avoid the pollution of surface and groundwater the minimum proposed distances from river and ghyll beds is **1 km**;
  - **Criterion EC2 - Minimum distance from water sources:** in order to avoid the pollution of surface and groundwater the minimum proposed distances from water sources is **0,5 km**;
  - **Criterion EC3 - Minimum distance from lakes:** in order to avoid the pollution of surface and groundwater the minimum proposed distances from lakes is **1 km**;
  - **Criterion EC4 – Distance from seismic fault:** in ideal conditions, no infrastructure should be developed in seismic areas, due to the fact that severe damages could occur. However since the Republic of Macedonia is a seismic area this cannot be the case, however a criterion concerning the minimum distance from earthquake faults is introduced. The minimum proposed distance is **0.5 km**.
- **Environmental criteria**
  - **Criterion EC5 – Exclusion of forests:** all areas characterized as forests are excluded (data from Corine Land Cover);
  - **Criterion EC6 – Exclusion of agricultural areas of high intensity and area with specific land uses:** all such areas characterized as forests are excluded (data from Corine Land Cover);
  - **Criterion EC7 – Exclusion of areas characterized as RAMSAR, SPA, NATURA, National Parks and other protected areas:** all such areas characterized as forests are excluded.
- **Physical planning criteria**
  - **Criterion EC8 - Minimum distance from residential areas:** the minimum proposed distances from residential areas is **0,6 km**;
  - **Criterion EC9 - Minimum distance from archaeological and cultural monuments:** the minimum proposed distances from such areas is **0.5 km**. In addition the waste management infrastructure should not be visible by such areas, in order not to deteriorate the cultural heritage of the area;
  - **Criterion EC10 - Minimum distance from military installations:** the minimum proposed distances from military infrastructure is **1 km**;
  - **Criterion EC11 - Minimum distance from airports 3 km.**



The aforementioned set of exclusion criteria will be used in the assessment of the alternative sites for the waste management infrastructure.

## 4.2 Selection criteria

The selection criteria for the siting of the waste management infrastructure and especially disposal sites (landfill) and treatment plants should include all relevant parameters (technical, environmental, social) which are connected with their operation in order to minimize the possibility of the system to fail. In any case, in order to assess alternative locations for waste management infrastructure, it is not enough to evaluate against **ONE** critical parameter but it is necessary to evaluate against set of specific criteria (multi-criteria analysis). These criteria as well as their relevant significance are the same for all locations the selection of the criteria is as much important as the conclusions they may result in.

The endorsed regional waste management plans (RWMP) for the East and Northeast Regions have already identified selection criteria which will be the basis of the analysis.

### A: GEOLOGICAL - HYDRO-GEOLOGICAL CRITERIA

#### A1. Permeability of the underlying layer of the IWMF:

PERMEABILITY CHARACTERIZATION	GRADE
Very small (tight)	10
Small (semipermeable)	7
Large (permeable)	3
Extremely large (extremely permeable)	1

#### A2. Tectonic structure as a Permeability factor:

DESCRIPTION	GRADE
No fractures	10
Fractured formations with some plasticity	8
Toggle compact and non-compact disrupted formations	5
Fractured unconnected Formations	3
Fractured compact formations / rhegmatogenous selective flow zones	1

### A3. Position of hydrant works- Great water works:

POSITION OF HYDRANT WORKS GREAT WATER WORKS	GRADE	
	Primary porosity *	Karst formation
None in area	10	10
Upstream in distance > 1km and none downstream	9	7
Downstream at > 2 km upstream: 500m – 1 km	7	5
Hydro catchment projects downstream and at > 1 – 2 km	5	3
Hydro catchment projects downstream and distance > 500 m - 1km	3	2
Hydro catchment projects downstream or upstream and less than 500 m	1	1

\* Partition into two types because the permeability of the aquifer and therefore risking the project catchment is characterized by the movement of the contaminant in raw materials or porous karst conduits.

### A4. Usage of underground water:

DESCRIPTION	GRADE
No Use	10
Industrial use	7
Irrigation / Water stock	6
Fodder	3
Drinking	1

### A5. Ground Erosion – Stability of the slope

SLOPES (%)		GRADE
Loose-earthen	Rocky	
0-15	generally	10
15 – 30		7
30 – 50		4
50 - 100	rock falls	3
> 100		1

In rocky terrain throughout the slope range is considered excellent, unless significant rock falls occur. For loose - earthen soils, the scaled escalates.

### A6. Active Tectonics

DISTANCE AREA - ACTIVE RIFT	GRADE
Distance > 1000m	10
Distance 500-1000m	8
Distance 500-300m	6
Distance 100-300m	1
Distance <100m	NO (rejected)



### A.7. Protection of surface waters

This criterion is rated as:

a. The use of the recipient or the use of surface waters downstream of the proposed site. All occurring are taken into account, but have different gravity

b The distance of waste facility- Recipient along the stream

A.7a. Type and use the main recipient

TYPE AND USE OF MAIN RECIPIENT	GRADE
SEA	10
RURAL AREA	8
URBAN AREA	7
RESERVOIR IRRIGATION	6
IRRIGATION	5
RECREATION	5
FORAGE	3
RESERVOIR WATER	2
WATER	1

A.7b. Distance waste facility - Recipient

DISTANCE IWMF – RECIPIENT (m)	GRADE
> 9.000	10
7.000 – 9.000	9
4.000 – 7.000	7
2.000 – 4.000	5
1.000 – 2.000	4
≤ 1.000	3

### A.8. Protecting underground water

A.8a. Due to infiltration

The issue arises from the treatment of hydrogeological characteristics and has been rated (A1, A2). Since the importance of these two criteria are approximately equal, so we accept that  $A8=(A1+A2)/2$ . For the reason that it has already been given special importance to this criterion in the previous criteria even though it is the main mode of transport in groundwater pollution at this point has only 50%.

A.8b. Due to supply via surface waters

DISTANCE IWMF – High Permeability Zone (m)	GRADE
> 9.000	10
7.000 – 9.000	9
4.000 – 7.000	7
2.000 – 4.000	5
1.000 – 2.000	4
≤ 1.000	3

## A.9. Geomorphology of Area

### A.9a. Hydrological characteristics

UPSTREAM BASIN AREA (ACRES)	GRADE
< 100	10
100 – 300	9
300 – 500	8
500 – 700	7
700 – 900	6
900 – 1.100	5
1.100 – 1.300	4
1.300 – 1.500	3
1.500 – 1.700	2
> 1.700	1

### A.9b. Configuring surfaces and slope protection

SLOPE OF AREA AND SIDES	GRADE
0-15% favorable	10
15-30%	7
30-40%	5
> 40% (prohibitive in the main area of development)	3
problematic side slopes to a large extent	1

## A10. Covering demands

WATERPROOFING METHOD	GRADE
Without further waterproofing	10
Simple waterproof layer (Clay or geomembrane)	8
Advanced waterproof layer (A combination of clay and geomembrane)	5
Double waterproof layer	1

## B: ENVIRONMENTAL CRITERIA

### B1. Green areas, Ecological characteristics, Landscape

VEGETATION TYPE AND CHARACTERISTICS	GRADE	
	SEIZURE	APPROACH
Brushwood / Region ordinary ecological features / crops	10	10
Shrubs	5	5
Shrubs with scattered trees / area moderate ecological importance / interest large-scale landscape	4	4
Riverine vegetation	2	2
Forest / Area of special ecological importance / rare landscape	1	1



## B2. Visual Isolation

DESCRIPTION	GRADE	
	Increased eye Contact	Limited sight
Full optical isolation	10	10
Visible from cobbled street	6	8
Visible from primary or secondary roads	2	5
Visible from individual houses	3	5
Visible from highway / places of tourist interest	2	4
Visible from settlements	1	2

## B3. Annoyance by smells

### B3a. Distance recipient

DISTANCE (km)	GRADE
> 3	10
2 - 3	7
1,5 – 2	5
0,5 – 1,5	3
< 0,5	1

### B3b. Winds

WINDS	GRADE
Favorable prevailing winds or settlements located > 3000 m	10
Interim statement	5
Adverse prevailing winds	1

## B4. Annoyance from biogas

### B4a. Dissemination through the air

The behavior is almost similar with that of odors. Therefore in this position sets the degree of annoyance by odors. i.e. B4a = B3

### B4b. Dissemination through the subsurface

The motion of the gas is mainly through the permeable and especially karst formations or disrupted. This raises the level of the liquid permeability of the sub layer of the landfill and fractures. i.e. B4b = (A1 + A2) / 2

## B5. Annoyance during access

### B5a. Annoyance from traffic

FEATURES ROAD	GRADE
Highway (4 lanes)	10
Primary roads (two lanes - asphalt)	8
Secondary roads (one lane - asphalt)	6
Cobbled road passable	4
Cobbled street not passable	2

### B5b. Annoyance settlements

DESCRIPTION	GRADE
Not Crossing from settlements	10
Crossing the ring road settlement	6
Crossing through settlement / primary roads	5
Crossing through the village section / secondary roads	3
Crossing through part settlement / local minor pathway	1

## C: LAND PLANNING CRITERIA

### C1. Distance from settlements

IWMF DISTANCE OF SETTLEMENTS (km)	GRADE
> 5	10
3,5 – 5	8
2 - 3,5	6
0,6 - 2	4
<0,6	Rejected

### C2. Agricultural activity

MAIN AGRICULTURAL ACTIVITY	PROXIMITY	LAND OCCUPATION
pathogenic soil	10	10
Heaths	9	9
Pasture	7	7
Degraded agricultural land	5	5
Mild farming	3	3
Highly productive agricultural land / irrigated	1	0

### C3. Forage activity within < of 1.000m

DESCRIPTION	GRADE
Lack of livestock farming	10
Limited breeding activity	5
Intensive livestock farming	3
Main ranching operation	1

#### C4. Industrial activity

IWMF DISTANCE OF INDUSTRIAL ACTIVITIES (km)	GRADE
> 3	10
2 – 3	8
1 – 2	5
0,5 – 1	3
< 0,5	1

#### C5. Proximity to conflicting uses

	PROXIMITY TO INCOMPATIBLE USES	GRADE		
C5a	Area protection and high forest	< 1000 m	1 – 3000 m	> 3000 m
		1	5	10
C5b	Landscape protection area	< 500 m	500 – 1000 m	> 1000 m
		1	5	10
C5c	Tourist zone	As distance from settlements (Criterion C1)		
C5d	Archaeological site	< 1000 m	1 – 3000 m	> 3000 m
		1	5	10

#### C6. Tendency to residential/ tourist development

TENDENCY TO RESIDENTIAL - TOURISM DEVELOPMENT	GRADE
Low voltage	10
Medium voltage	5
High Voltage	1

#### C7. Network access to the final area

##### C7a. Type of network

DESCRIPTION	GRADE
Freeway - primary roads	10
Secondary roads that requires improvements	8
Street requiring improvement / new opening	5
Requirement opening a new route in difficult terrain	1

##### C7b. Necessary access projects

PARAMETER	GRADE
Access without performing any work	10
Drilling / improvement 0,5 - 1 km	9
Drilling / improvement 1 - 2 km	7
Drilling / improvement 2 - 3 km	5
Drilling / improvement 3 - 4 km	3
Drilling / improvement > 4 km	1

## D: OPERATIONAL CRITERIA

### D1. Climatic conditions

#### D1.a. Elevation

ALTITUDE AREA (m)	GRADE
< 200 m	10
200-300	8
300-500	5
500-700	3
> 700	1

#### D1.b. Exposure to winds

REPORT OF WINDS	GRADE
Small	10
Moderate	5
Great	1

### D2. Adequacy of the available area - Expansion Capabilities

DURING OPERATION	GRADE
Great	10
Moderate	6
Small	3

### D3. Adequate cover material

BORROW DISTANCE	GRADE
within the area	10
<500 m	8
500 – 2.000 m	5
> 2.000 m	1

## E: FINANCIAL CRITERIA

### E1. Size/magnitude of infrastructure works

INFRASTRUCTURE MAGNITUDE	GRADE
Small	10
Moderate	7
Large	5

### E2. Land Value

The surrender value of the land is necessary based primarily on the trend of housing and tourist development and secondarily by the seizure of land from agricultural uses, are examined and rated. Therefore:

E2a = C6: Tendency to residential - Tourism development

E2b = C2: Agricultural activity



### E3. Availability networks of common utilities

DISTANCE FROM COMMON UTILITY INSTALLATION (m)	GRADE
<500	10
500 – 1.000	7
1.000 – 2.000	5
> 2.000	3

### E4. Estimated cost of transport

DISTANCE IWMF – MAIN PRODUCTION AREA (km)	GRADE
<5	10
5 – 10	9
11 - 15	8
16 – 20	7
21 – 25	6
26 – 30	5
31 – 35	4
36 – 40	3
41 – 45	2
> 45	1

The following table presents the selection criteria with their respective gravity as included in the RWMPs:

**Table 1: Waste management facilities site selection criteria**

Criteria	Gravity co-efficient (%)
<b>GEOLOGICAL - HYDRO-GEOLOGICAL CRITERIA (20% - 30%)</b>	
Permeability of the underlying layer of the IWMF	20
Tectonic structure as a Permeability factor	18
Position of hydrant works- Great water works	10
Usage of underground water	10
Ground Erosion – Stability of the slope	5
Active Tectonics	5
Protection of surface waters	7
Type and use the main recipient	50
Distance waste facility - Recipient	50
Protecting underground water	10
Due to infiltration	50
Due to supply via surface waters	50
Geomorphology of Area	10
Hydrological characteristics	60
Configuring surfaces and slope protection	40
Covering demands	5
<b>ENVIRONMENTAL CRITERIA (20% - 25%)</b>	
Green areas, Ecological characteristics, Landscape	20
Visual Isolation	25
Annoyance by smells	20



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Criteria	Gravity co-efficient (%)
Distance recipient	50
Winds	50
<b>Annoyance from biogas</b>	<b>20</b>
Dissemination through the air	40
Dissemination through the subsurface	60
<b>Annoyance during access</b>	<b>15</b>
Annoyance from traffic	30
Annoyance settlements	70
<b>LAND PLANNING CRITERIA (15% - 30%)</b>	
<b>Distance from settlements</b>	<b>30</b>
<b>Agricultural activity</b>	<b>10</b>
<b>Forage activity within &lt; of 1.000m</b>	<b>4</b>
<b>Industrial activity</b>	<b>6</b>
<b>Proximity to conflicting uses</b>	<b>15</b>
Area protection and high forest	25
Landscape protection area	25
Tourist zone	25
Archaeological site	25
<b>Tendency to residential/ tourist development</b>	<b>20</b>
<b>Network access to the final area</b>	<b>15</b>
Type of network	50
Necessary access projects	50
<b>OPERATIONAL CRITERIA (10% - 20%)</b>	
<b>Climatic conditions</b>	<b>10</b>
Elevation	40
Exposure to winds	60
<b>Adequacy of the available area - Expansion Capabilities</b>	<b>60</b>
<b>Adequate cover material</b>	<b>30</b>
<b>FINANCIAL CRITERIA (10% - 20%)</b>	
<b>Size/magnitude of infrastructure works</b>	<b>35</b>
<b>Land Value</b>	<b>20</b>
Tendency to residential - Tourism development	70
Agricultural activity	30
<b>Availability networks of common utilities</b>	<b>15</b>
<b>Estimated cost of transport</b>	<b>30</b>

## 5 Application of exclusion and selection criteria for the sites under investigations

Following the development of the exclusion and selection criteria and the site visits, the assessment of the alternative locations for the development of the waste management infrastructure takes place.

Initially all sites are assessed against the exclusion criteria. In this respect the sites will be indicated in appropriate maps in order to determine the distances from the areas / elements under examination (the ones included in the exclusion criteria). The locations that will not respect the exclusion criteria will be excluded from further evaluation.

The sites that will go forward following the exclusion phase will be comparatively assessed against the selection criteria. The assessment will be based on:

- The data and information collected during the site visit;
- Literature data (Corine Land Cover, geological maps, spatial plans, etc);
- Discussions with stakeholders.

Special attention shall be given to the fact that one of the options that will be examined is to have a common landfill for both regions. In this respect, the operational and financial criteria for each location will be separately examined in relation to the possibility to have a common landfill for both regions.

### 5.1 Implementation of the exclusion criteria

The following table presents the performance of each site in relation to the exclusion criteria.



As indicated in the table above, 10 sites respect the exclusion criteria, while 5 sites need to be excluded from further assessment, since:

- Kočani Dumpsite:
  - the site is located within the Protected landscape of the Osogovo Mountain, at its very southern boundary.
- Kriva Palanka Dumpsite
  - Kriva Reka runs at about 50 m (less than 1 km) north from the area;
  - There are forest fragments in the surrounding areas, on the both side of the river;
  - First scattered houses at about 150 m (less than 600 m) SE and SW from the site.
- Staro Nagorichane (old quarry)
  - The site is located within the IBA site “Pcinja - Petrosnica–Kriva reka”. The lake at the old mine site is identified as a habitat of some bird species (Little grebe – dabchick);
  - The nearest settlements located about 500-600 m (less than 600 m) to the west.
- Rankovtse (old quarry)
  - An artificial lake has been formed inside the open pit;
  - The nearest settlements located about 500-600 m (less than 600 m) to the south.
- Crn Vrv:
  - Forests close to the area.

In addition 3 sites, namely Kumanovo Dumpsite and Sveti Nikole, Meckuevci – Arbasanci and Krupesti, are in the borders of current or future protected areas, and their possible utilization should be proposed after consultation with the authorities responsible for nature conservation.

Based on the above the following sites will be further analyzed:

- East Region (8 sites):
  - Stip;
  - Sveti Nicole;
  - Karbinci;
  - Stip (quarry);
  - Cesinovo (quarry);
  - Sveti Nikole, Meckuevci–Arbasanci;
  - Kocani, Istibanja, Prevalec;
  - Krupesti.
- Northeast Region (3 sites):
  - Kumanovo;
  - K’shanje (2 sites);



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## 5.2 Implementation of the selection criteria

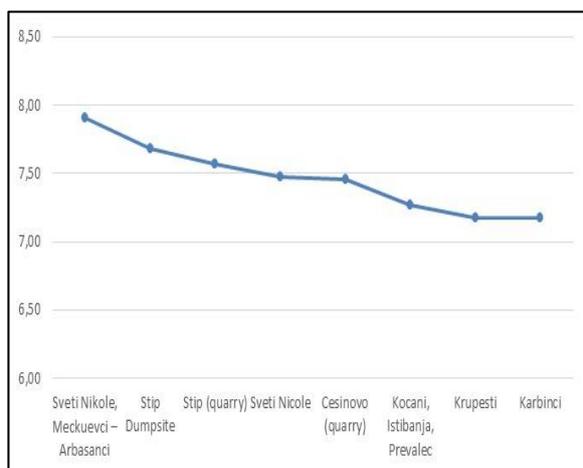
The following table presents the performance of each site in relation to the selection criteria.

The following table presents in hierarchical order the sites under examination according to the results of the comparative analysis as presented above.

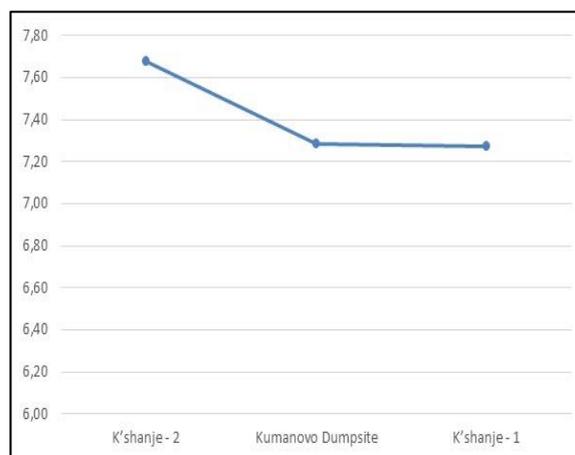
**Table 2: Results of sites comparative evaluation**

Site	Score
<b>EAST REGION</b>	
Sveti Nikole, Meckuevci – Arbasanci	7,91
Stip Dumpsite	7,69
Stip (quarry)	7,57
Sveti Nicole	7,47
Cesinovo (quarry)	7,46
Kocani, Istibanja, Prevalec	7,27
Karbinci	7,17
Krupesti	7,17
<b>NORTHEAST REGION</b>	
K'shanje – 2	7,67
Kumanovo Dumpsite	7,28
K'shanje - 1	7,27

The following figures present the performance of each site



**Figure 2: Performance of sites in East Region**



**Figure 3: Performance of sites in Northeast Region**

With respect to the **East Region**, two sites appear to present the best performance, namely Sveti Nikole, Meckuevci – Arbasanci and Stip Dumpsite. The main advantages of the two sites compared to the rest include:

- Sveti Nikole, Meckuevci – Arbasanci
  - Good geological / hydrogeological characteristics;
  - Far from surface waters;
  - Far from settlements;



- Morphology which is favourable for the development of waste treatment and disposal facilities;
- Small exposure to climatic conditions (winds).
- Stip Dumpsite
  - Good geological / hydrogeological characteristics;
  - Visually isolated;
  - Far from settlements;
  - Good access;
  - Relatively close to main waste generators (Stip and Kocani Municipalities).

It is noted that, as already mentioned before, **the site of Sveti Nikole, Meckuevci – Arbasanci is in the borders of future protected areas, and hence its possible use should be first be discussed with the authorities responsible for nature conservation.** Moreover, as other factors may affect the final selection (public opinion, land ownership issues, etc.), it is considered that all sites that reach a score no more than 5% lower than the highest score may also be selected. Hence the sites of Stip (quarry) and Sveti Nicole are also considered sufficiently suitable of the development of the future waste management facilities.

With respect to the **Northeast Region**, the site in K'shanje – 2 presents significantly better performance than the other sites due to:

- Good geological / hydrogeological characteristics;
- Limited ecological and agricultural importance;
- Land availability.

The other 2 sites of the Northeast Region present similar performance and could be selected if for any reason the site in K'shanje – 2 cannot be used.

## 6 Interregional collaboration

### 6.1 Introduction

This section seeks to examine the possibility for the two regions to collaborate in relation to waste management and be served by common waste management facilities, in principle by a common waste treatment and disposal facilities. The analysis refers to 3 levels:

- Identification of suitable locations;
- Comparative analysis for interregional system vs separate system in financial terms;
- Institutional implications.

### 6.2 Identification of suitable locations

The same locations that were analyzed previously are considered. The sole criterion which is modified compared to the analysis presented in section 5.2, is the one referring to the estimated cost of transport. In this respect, the distance from the 3 main waste generators, namely Kumanovo, Stip and Kocani is examined and the performance of each site is presented below.

**Table 3: Performance of each site in relation to cost of transport**

Site	Score	Comment
Sveti Nikole, Meckuevci – Arbasanci	3	Less than 35 km from Stip and 36 km from Kocani and 56 km from Kumanovo
Stip Dumpsite	1	9 km from Stip and 37 km from Kocani and 70 from Kumanovo
Stip (quarry)	1	Less than 10 km from Stip and 35 km from Kocani and 63 km from Kumanovo
Sveti Nicole	2	Less than 40 km from Stip and 62 km from Kocani and 33 from Kumanovo
Cesinovo (quarry)	1	Less than 38 km from Stip and 13 km from Kocani and 87 km from Kumanovo
Kocani, Istibanja, Prevalec	1	Less than 38 km from Stip and 9 km from Kocani and 97 km from Kumanovo
Karbinci	4	Less than 14 km from Stip and 30 km from Kocani and 76 km from Kumanovo
K'shanje – 2	3	Less than 24 km from Kumanovo 44 km from Stip and 69 km from Kocani
Kumanovo Dumpsite	2	less than 10 km from Kumanovo 69 km from Stip and 94 km from Kocani
K'shanje - 1	3	Less than 26 km from Kumanovo 43 km from Stip and 68 km from Kocani

Based on the performance of each site in relation to the cost of transport from the main waste generators, the following table presents in modified hierarchical order the sites under examination.

**Table 4: Results of sites comparative evaluation for interregional collaboration**

Site	Score
Sveti Nikole, Meckuevci – Arbasanci	7,86
K'shanje – 2	7,54
Sveti Nicole	7,52
Stip Dumpsite	7,46
Stip (quarry)	7,30
Cesinovo (quarry)	7,23
K'shanje - 1	7,18
Karbinci	7,08
Kocani, Istibanja, Prevalec	7,00
Kumanovo Dumpsite	6,97
Krupesti	6,95



Four sites appear to present the best performance, namely Sveti Nikole, Meckuevci – Arbasanci, K’shanje – 2, Sveti Nicole and Stip Dumpsite (within 5% difference from the highest score). For the purposes of the analysis it is considered that **Sveti Nikole, Meckuevci – Arbasanci**, which presents the best performance will be the potential site for the central waste management facility to serve both east and northeast regions.

## 6.3 Comparative analysis for interregional system vs separate system in financial terms

### 6.3.1 Technical elements of alternative scenarios

The integrated waste management system consists of the following stages:

- Waste collection (bins, green points, etc);
- Waste transfer (to transfer station, recycling facility, treatment plant or landfill);
- Waste collection in transfer stations;
- Waste mechanical separation (material recovery and recycling facility);
- Waste treatment (composting plants, MBTs);
- Waste disposal to sanitary landfill (SL);
- Closure of existing non-compliant landfills.

The comparative analysis of the two alternatives, namely interregional system vs separate system, will refer to the elements of the waste management cycle, which are different, namely:

- Transfer station network;
- Capacities of waste recycling and treatment facilities;
- Capacity of waste disposal facilities.

The main indicative elements of each scenario are the presented below.

**It is noted that the technical elements of each scenario are indicative and will be analyzed in detail in the frame of the feasibility study, following discussions with the stakeholders. This analysis just seeks to depict at a preliminary level the main differences between the development of separate system and the development of an interregional system, providing some indicative financial analysis.**

#### Scenario 1: Separate system

- Transfer station network:
  - Transfer station in Kumanovo, serving the whole northeastern region: capacity 52.050 tn/y
  - Transport of waste to CMFW in K’shanje – 2;
- Material Recycling Facility:
  - Sveti Nikole, Meckuevci – Arbasanci serving East region: capacity 12.700 tn/y;



- K'shanje – 2 serving Northeast region: capacity 12.900 tn/y.
- Waste treatment Facility:
  - Sveti Nikole, Meckuevci – Arbasanci serving East region: capacity 36.300 tn/y;
  - K'shanje – 2 serving Northeast region: capacity 38.800 tn/y.
- Landfill:
  - Sveti Nikole, Meckuevci – Arbasanci serving East region: capacity 22.800 tn/y;
  - K'shanje – 2 serving Northeast region: capacity 24.300 tn/y.

### Scenario 2: Interregional system

- Transfer station network:
  - Transfer station in Kumanovo, serving the whole northeastern region: capacity 52.050 tn/y Transport of waste to CMFW in Sveti Nikole, Meckuevci – Arbasanci;
- Material Recycling Facility:
  - Sveti Nikole, Meckuevci – Arbasanci serving East region: capacity 25.600 tn/y.
- Waste treatment Facility:
  - Sveti Nikole, Meckuevci – Arbasanci serving East region: capacity 75.100 tn/y.
- Landfill:
  - Sveti Nikole, Meckuevci – Arbasanci serving East region: capacity 47.100 tn/y.

**It is noted that in relation to the transfer station network, this analysis presents only the transfer stations that differentiate between the two scenarios. Additional Transfer stations may be needed (this will be analyzed in detail in the feasibility study), which would be common for both scenarios (e.g. transfer stations serving the east region).**

### 6.3.2 Financial elements of alternative scenarios

The following table presents the indicative investment and operation costs of the 2 options.

**Table 5: Financial elements of each scenario**

Facility	Capacity (tn/y)	Unit cost (€/tn)	Total cost (€)
<b>INVESTMENT COSTS</b>			
<b>SCENARIO 1: SEPARATE SYSTEM</b>			
Transfer station in Kumanovo	52.050	51 (according to design)	2.632.116
Material Recycling Facility in Sveti Nikole, Meckuevci – Arbasanci	12.700	200	2.538.102
Material Recycling Facility in K'shanje – 2	12.900	200	2.587.884
Waste treatment Facility in Sveti Nikole, Meckuevci – Arbasanci	36.300	100	3.629.278
Waste treatment Facility in K'shanje – 2	38.800	100	3.883.741
Landfill in Sveti Nikole, Meckuevci – Arbasanci	22.800	120 €/m2	4.800.000
Landfill in K'shanje – 2	24.300	120 €/m2	4.800.000
<b>TOTAL</b>			<b>24.871.121</b>
<b>SCENARIO 2: INTERREGIONAL SYSTEM</b>			
Transfer station in Kumanovo	52.050	51 (according to design)	2.632.116
Material Recycling Facility in Sveti Nikole, Meckuevci – Arbasanci	25.600	140 (according to design)	3.589.600
Waste treatment Facility in Sveti Nikole, Meckuevci – Arbasanci	75.100	76 (according to design)	5.705.850
Landfill in Sveti Nikole, Meckuevci – Arbasanci	47.100	115 €/m2 (according to design)	7.475.141
<b>TOTAL</b>			<b>19.402.437</b>

Facility	Capacity (tn/y)	Unit cost (€/tn)	Total cost (€/y)*
<b>OPERATING COSTS</b>			
<b>SCENARIO 1: SEPARATE SYSTEM</b>			
Transfer station in Kumanovo	52.050	11,96	601.188
Material Recycling Facility in Sveti Nikole, Meckuevci – Arbasanci	12.700	25	317.739
Material Recycling Facility in K’shanje – 2	12.900	25	317.913
Waste treatment Facility in Sveti Nikole, Meckuevci – Arbasanci	36.300	13	456.636
Waste treatment Facility in K’shanje – 2	38.800	13	484.713
Landfill in Sveti Nikole, Meckuevci – Arbasanci	22.800	25	556.864
Landfill in K’shanje – 2	24.300	25	585.196
<b>TOTAL</b>			<b>3.320.249</b>
<b>SCENARIO 2: INTERREGIONAL SYSTEM</b>			
Transfer station in Kumanovo	52.050	13,21	664.022
Material Recycling Facility in Sveti Nikole, Meckuevci – Arbasanci	25.600	18,71	475.722
Waste treatment Facility in Sveti Nikole, Meckuevci – Arbasanci	75.100	8,41	608.980
Landfill in Sveti Nikole, Meckuevci – Arbasanci	47.100	14,48	661.481
<b>TOTAL</b>			<b>2.410.205</b>

\* referring to first year of operation

The investment cost includes the following main elements:

- Transfer Stations
  - Construction loading and unloading docks and platforms, Electrical works, Mechanical works, Fire protection, fencing, security, etc;
  - Utilities and connections (toilets and hygienic facilities, sewerage, water and power supply etc.);
  - Waste handling equipment (hauling trucks, containers, etc.);
  - Waste inspection materials and tools;
  - Office and office equipment;
  - PPE and other protective equipment...
- Materials Recycling Facility
  - Construction of building, Electrical works, Mechanical works, Fire protection, fencing, security, loading and unloading docks and platforms etc.;
  - Utilities and connections (toilets and hygienic facilities, sewerage, water and power supply etc.);
  - Waste handling equipment (loader, tractor, shredder, separators, conveyer belts and lines, bailer etc.).
- Waste Treatment Facility
  - Construction of platforms and buildings, Electrical works, Mechanical works, Fire protection, fencing, security, loading and unloading docks and platforms;



- Utilities and connections (toilets and hygienic facilities, sewerage, water and power supply);
- Waste handling equipment (loader, shredder, turning machine, conveyer belts and lines, membranes, etc.).
- Landfill
  - Landfill cell;
  - Internal roads;
  - Leachate collection and treatment system;
  - Construction of buildings (Offices, maintenance, etc.);
  - Electrical works, Mechanical works, Fire protection, fencing, security, weighbridge, etc.);
  - Monitoring system;
  - Utilities and connections (toilets and hygienic facilities, sewerage, water and power supply);
  - Waste handling equipment (Waste compactor, waste loader, Bulldozer, etc.);
  - Waste inspection materials and tools;
  - Office and office equipment;
  - PPE and other protective equipment.

The operating cost includes the following main elements for all facilities:

- Personnel;
- Fuel;
- Energy;
- Maintenance;
- Consumables;
- Insurance;
- Monitoring;
- Wastewater management;
- Administrative cost.

As presented above the initial investment cost of the separate system is 22% more expensive than the interregional system.

Particularly for the first year of the operation of the new system (2020), the separate system is 27% more expensive than the interregional system and the following is noted:

- Scenario 1 - Separate system: 31€/tn or 0,75 €/cap/month
- Scenario 2 - Interregional system: 23€/tn or 0,54 €/cap/month

In order to compare the performance of alternative options the indicator of Financial Net Present Value (FNPV) which depicts the discounted total cost of the system (investment, reinvestment and operation cost) and the Dynamic Prime Cost (DPC), which depicts the total cost in €/tn terms.



**It is noted that the cost elements presented are indicative and are based on experience from similar project in similar countries (i.e. general Balkan area) taking into consideration also the RMWPs. The technical and financial elements of the waste management facilities will be analyzed in detail in the frame of the feasibility study.**

### 6.3.3 Assumptions

The main assumptions used in the analysis are the following:

- Duration of analysis: 2016 – 2045, 30 years;
- Investments are considered to occur in the period 2018 – 2019;
- Operation of the system is expected to initiate in 2020;
- Dimensioning is based on the waste generation estimated for the year 2025;
- Reinvestment costs for machinery are assumed to occur every 12 years and the reinvestment cost is assumed as 80% of the initial investment cost ;
- Reinvestment costs for mobile equipment are assumed to occur every 8 years and the reinvestment cost is assumed as 80% of the initial investment cost ;
- Operation cost is assumed to increase by 1% annually;
- No revenues are considered as these will be common for both scenarios;
- Discount rate assumed at 4%.

### 6.3.4 Investments / Reinvestments

An investment cost table is presented below and includes the temporal profile of the investment and reinvestment costs for both scenarios

**Table 6: Temporal Profile of Investment and Reinvestment Costs (€)**

	Short term (period 2018-2019)	Short term (period 2020-2030)	Long term (period 2031-2045)
<b>SCENARIO 1: SEPARATE SYSTEM</b>			
TRANSFER STATIONS	2.632.116	760.000	19.767.622
MRF	5.125.986	523.200	1.194.700
MBT	7.513.019	1.121.600	1.775.356
LANDFILL*	9.600.000	1.104.000	3.646.287
<b>TOTAL</b>	<b>24.871.121</b>	<b>3.508.800</b>	<b>26.383.965</b>
TRANSFER STATIONS	2.632.116	760.000	1.194.700
MRF	3.589.600	261.600	1.181.600
MBT	5.705.580	921.600	2.836.800
LANDFILL*	7.475.141	552.000	9.112.114
<b>TOTAL</b>	<b>19.402.437</b>	<b>2.495.200</b>	<b>14.325.214</b>

\* the reinvestment cost for the landfill include both the replacement of machinery and equipment after the end of their lifetime and the construction of additional cells in order to cover the

disposal needs until 2045 as the rehabilitation of the initial cells that will be closed as soon as the new cells become operational.

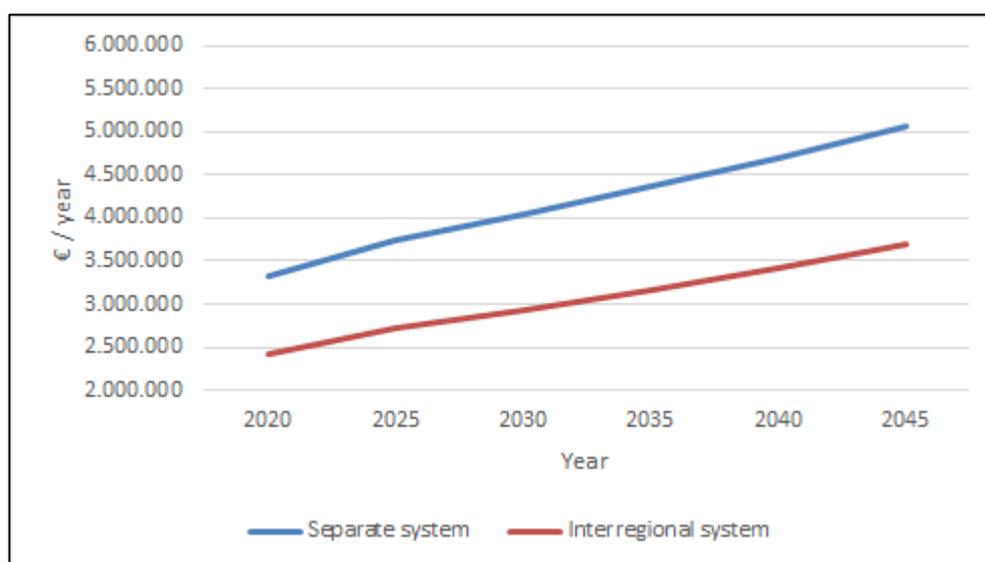
### 6.3.5 Operational cost

The temporal profile of the total operational costs (personnel, fuel, etc) of the scenarios is provided in the following table:

**Table 7: Temporal Profile of Operational Costs (€)**

	2020	2025	2030	2035	2040	2045
<b>SCENARIO 1: SEPARATE SYSTEM</b>						
TRANSFER STATIONS	601.188	680.785	742.686	806.162	875.016	949.701
MRF	635.652	700.777	757.387	814.525	875.971	942.050
MBT	941.349	1.068.194	1.154.740	1.242.140	1.336.153	1.437.277
LANDFILL	1.142.060	1.287.998	1.392.305	1.497.633	1.610.925	1.732.782
<b>TOTAL</b>	<b>3.320.249</b>	<b>3.737.754</b>	<b>4.047.117</b>	<b>4.360.460</b>	<b>4.698.065</b>	<b>5.061.809</b>
<b>SCENARIO 2: INTERREGIONAL SYSTEM</b>						
TRANSFER STATIONS	664.022	751.938	820.308	890.418	966.468	1.048.959
MRF	475.722	524.461	566.828	609.591	655.577	705.030
MBT	608.980	691.039	747.028	803.569	864.388	929.807
LANDFILL	661.481	746.008	806.423	867.429	933.048	1.003.627
<b>TOTAL</b>	<b>2.410.205</b>	<b>2.713.447</b>	<b>2.940.587</b>	<b>3.171.007</b>	<b>3.419.481</b>	<b>3.687.423</b>

The following figure presents the difference of the 2 scenarios in relation to the operation and maintenance cost for a period of 30 years.



**Figure 4: Operation cost for the 2 scenarios under examination**

As it is presented above the operation cost of the separate system is more than 1,1 m€ (on average) on annual basis higher than the interregional system.

### 6.3.6 Results of analysis

An estimate of the FNPV and the DPC of the overall investments (including re-investments) and operation costs is provided in the following table for each scenario.

**Table 8: Results of financial analysis**

	Scenario 1	Scenario 2
Discounted waste (tn)	1.947.994	1.947.994
<b>FNPV Investment Cost (€)</b>	<b>33.758.391</b>	<b>25.645.016</b>
FNPV Transfer Stations (€)	3.315.262	3.315.262
FNPV Material Recycling Facility (€)	5.716.740	3.915.902
FNPV Waste Treatment Facility (€)	9.103.447	6.989.861
FNPV Landfill (€)	15.622.942	11.423.991
<b>FNPV Residual Value (€)</b>	<b>-852.792</b>	<b>-681.237</b>
<b>Investment DPC (€/tn)</b>	<b>16,89</b>	<b>12,82</b>
<b>FNPV Operation Cost (€)</b>	<b>55.464.354</b>	<b>40.312.932</b>
FNPV Transfer Stations (€)	10.199.210	11.265.181
FNPV Material Recycling Facility (€)	10.403.863	7.786.251
FNPV Waste Treatment Facility (€)	15.797.368	10.219.682
FNPV Landfill (€)	19.063.912	11.041.818
<b>Operation DPC (€/tn)</b>	<b>28</b>	<b>21</b>
<b>TOTAL FNPV (€)</b>	<b>88.369.953</b>	<b>65.276.711</b>
<b>TOTAL DPC (€/tn)</b>	<b>45,36</b>	<b>33,51</b>
<b>TOTAL DPC (€/cap/month)</b>	<b>1,15</b>	<b>0,85</b>
DPC for Transfer stations (€/cap/month)	0,18	0,19
DPC for material recycling facilities (€/cap/month)	0,21	0,15
DPC for waste treatment facilities (€/cap/month)	0,32	0,22
DPC for landfills (€/cap/month)	0,45	0,29

As presented in the table above **Scenario 2 referring to the interregional system, presents better financial performance, being more cost effective than the separate system scenario.** The separate system seems around 26% more expensive than the common one. More specifically the overall cost of the separate system (including investment and operation cost) is more expensive by almost 0,3€/cap/month than the interregional system.

## 6.4 Institutional implications

### 6.4.1 Current legal and institutional framework

On a national level, the general waste management policy was established in the Law on Environment ("Official Gazette" No.53/05, 81/05, 24/07, 159/08, 83/09, 48/10, 124/10, 51/11, 123/12), in the National Environmental Programmes (NEAP 1996/2007) and particularly in the Law on Waste Management ("Official Gazette" No.68/04, 71/04, 107/07, 102/08, 134/08, 124/10, 08/11,



51/11 and 123/12). The Law on Waste Management has important links to over ten laws related to tasks and responsibilities regarding administrative, organizational and operational issues in waste management, in particular to the Law on the Environment, which includes basic provisions on environmental permitting, EIA procedure and greenhouse gas emissions. The Law on Waste Management defines in details the responsibilities with regards to waste management planning, waste management activities, permitting and licensing system, rules for specific waste streams, monitoring, data collection and reporting, and financing.

The key institution for implementing the national waste management legislation is the Ministry of Environment and Physical Planning (MoEPP) having the overall responsibility in that respect.

At local level the **main responsibilities are vested with the municipalities**, as local self-government units. For the provision of waste management services, municipalities can establish **public communal enterprises** (communal service providers), or they may **entrust such services to legal entities and natural persons** holding a license for provision of that particular service. The public communal enterprises carry out waste management activities and provide waste collection, transportation and disposal service for the communal waste.

Regional (or inter-municipal) waste management systems are a way for municipalities to jointly provide waste related services (completely or partially), **in order to achieve higher level of economic and financial efficiency and effectiveness**. Planning and implementing certain waste-related services on a regional level is a necessary link between state level planning and competencies, and the planning and provision of specific services on the local level.

Through various forms of inter-municipal cooperation, the local self-governments can **jointly manage tasks which are under LSG competence**, such as planning, investments, public relations, and other waste management activities. The participating municipalities can form joint entities, such as working bodies, committees, joint administrative bodies and services, as well as **joint public communal enterprises** for provision of services on the inter-municipal level.

From the administrative/organisational and financial side, such regional waste management systems can be managed by the **Regional Waste Management Boards (RWMBs)**, as political representative bodies of the participating municipalities.

The municipalities can then **entrust the provision of certain services** (which may include all or just some waste-related services) to their joint public communal enterprise.

Inter-municipal entities formed by municipalities can also function as a central regional agency carrying out various expert tasks like planning, investments, local regulation, organisation, cost recovery and financing executed municipal waste management operations and environmental monitoring.

## Regional Waste Management Boards

The Regional Waste Management Boards have been recently established and are fully operational. The Regional Boards shall be seen as a separate (but complementary) body to the joint public communal enterprise(s), creating a clear distinction between planning/contracting and operations, which will result in greater transparency and potentially higher cost efficiency.



## Northeast Region

During the second half of 2011 and the beginning of year 2012, negotiations were concluded on the approach to setting up regional waste management bodies and the Regional Waste Management Board (RWMB) for the Northeast Planning Region was established on 29 February 2012.

The RWMB is formed by the Mayors of 5 municipalities in the region and 3 staff members have been seconded from various municipalities to work in the Operational Office of the Board. The RWMB is assumed to take responsibility for planning, contracting and monitoring of waste management in the region. The Municipality of Staro Nagorichane decided not to join the RWMB. The Board consists of five members; one member from each municipality. In order to pass a decision a quorum of 2/3<sup>rd</sup> of the members is required. For a decision to be passed, 2/3<sup>rd</sup> of members present must vote in favour of the proposal. Financing of the Board is provided by the member municipalities as a fee paid by each municipality on a proportional basis according to the number of inhabitants.

The RWMB supplements the Joint Waste Management Enterprise “Eko - Zona Kumanovo” established in 2010. The company is established as a **public enterprise** and is assumed to carry out waste management operations to the extent these will be implemented by the public sector under decision by the Board. Municipalities which are members of RWMB agreed about their shares of financing for the Joint Waste Management Enterprise.

On 14 March 2012, the RWMB adopted the Statute of the Board setting out the following responsibilities:

Adoption of a regional plan for waste management for the Northeast Planning Region;
Monitoring of the implementation of the plan;
Carrying out public procurement for works and supplies, as well as selection of operator(s) for the regional system for waste management;
Approval of the unit price for treatment of waste;
Approval of investment programme for development of the regional system;
Supervision of the performance of the regional system;
Amendments of the statute;
Election of the Chairman of the Board;
Adoption of the rules of procedures;
Appointment of staff for the operational office of the RWMB;
Adoption of annual budget, etc.

## East Region

During the second half of 2011 and the beginning of year 2012, negotiations were concluded on the approach to setting up regional waste management bodies and the Regional Waste Management Board (RWMB) for the East Planning Region was established on 23 January 2012. On 23 January 2012



the eleven municipalities of the East Planning Region signed an agreement for establishment of a Regional Waste Management Board (RWMB) in the East Planning Region.

The RWMB is formed by the Mayors of 11 municipalities in the region and 3 staff members have been seconded from various municipalities to work in the Operational Office of the Board. The RWMB is assumed to take responsibility for planning, contracting and monitoring of waste management in the region.

On 26 March 2012 the RWMB adopted the statute of the Board setting out the identical responsibilities as from **Northeast Region**.

The RWMB supplements the Joint Waste Management Enterprise “Deponia Iztok Shtip” established in 2009. The company is established as a **public enterprise** and is assumed to carry out waste management operations to the extent these will be implemented by the public sector under decision by the Board. Municipalities of East Region (members of RWMB) also defined their shares of financing for Joint Waste Management Enterprise.

## 6.4.2 Institutional arrangements

Currently, the (local) public communal enterprises are the main service providers for waste management (within overall competencies of the LSGs), conducting the daily operation of waste collection services and landfill of waste. Some municipalities have established Public-Private Partnerships (PPP) with local firms for collection of recyclables.

Introduction of new services on the regional (or inter-regional) level assumes establishment of joint public communal enterprise (or enterprises), and a decision on which waste management services such enterprise will provide, compared to the services that will stay under the competence of local public communal enterprises.

It is shown in this report that there are clear benefits to inter-regional cooperation, and provided the proposed location(s) for infrastructure is acceptable to the beneficiaries, the inter-regional model might be adopted to serve both regions

Taking into consideration the already established institutional framework based on the signed inter-municipal agreements and the legal framework, it is necessary to thoroughly consider the potential institutional implications that enable the development of inter-regional cooperation.

Clearly, in such a case, the current institutional framework will have to be adjusted, and further developed, which will include the following:

- Political decisions of stakeholders;
- Amendments of intermunicipal agreements or the preparation of a new inter-regional agreement;
- The new sharing of role and responsibilities between municipalities within the region;
- Establishing required changes of operational waste management system (including potentially establishing a **new joint public communal enterprise** to serve both regions);
- Establishing optimal organizational structure of (inter-)regional company.

It is important to note that all of these changes have to be fully compliant with the existing legal framework in the field of waste management, public enterprises, communal issues, balanced regional



Preparation of project studies (FSs, EIAs, CBAs), design and tender documentation for establishing an integrated and financially self-sustainable waste management system in the east and northeast regions



development, as well as practical conditions and requirements for establishing an optimal operational waste management system.

A project implemented by:





## 7 Recommendations and Consultation

According to the analysis that is presented, the following are concluded:

- For the **East Region** two sites are proposed, namely Sveti Nikole-Meckuevci – Arbasanci and Stip Dumpsite. The site of Sveti Nikole, Meckuevci – Arbasanci is in the borders of future protected areas, and hence its possible use should be first be discussed with the authorities responsible for nature conservation. The Stip Dumpsite has limited land for expansions. Moreover, as other factors may affect the final selection (public opinion, land ownership issues, etc), the sites of Stip (quarry) and Sveti Nicole are also considered sufficiently suitable of the development of the future waste management facilities;
- For the **Northeast Region** the site in K’shanje – 2 presents significantly better performance than the other sites, which could be considered in case the K’shanje – 2 site is not cannot be used;
- In case the **interregional approach** is followed, four sites appear to present the best performance, namely Sveti Nikole, Meckuevci – Arbasanci, K’shanje – 2, Sveti Nicole and Stip Dumpsite.
- The financial analysis revealed that the potential **interregional collaboration seems preferable in financial terms** than the development of two separate systems and this option should be carefully considered by the local stakeholders. In the case of interregional collaboration, the site of Sveti Nikole-Meckuevci – Arbasanci seems to be preferable according to the methodology implemented. Other sites that could be used include K’shanje – 2, Sveti Nicole and Stip Dumpsite;
- In case of the inter-regional collaboration, changes would be required to the current institutional framework (incl. existing inter-municipal arrangements), as well as preparation and approval of a set of new documents that would enable the development of one system for both regions.