Modernization of local public services in the Republic of Moldova

- Intervention area 2: Regional planning and programming -

Feasibility study for the Integrated System on Waste Management for the Waste Management Zone 3 in South Development Region

Final report

December 2015

Ministerul Dezvoltării Regionale şi Construcţiilor

cooperare germană
DEUTSCHE ZUSAMMENARBEIT

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

SWEDEN

Published by:

Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH

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Prepared for:

Project “Modernization of local public services in the Republic of Moldova”, implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH on behalf of Federal Ministry for Economic Cooperation and Development (BMZ) and with support of Romanian Government, Swedish International Development Cooperation Agency (Sida) and European Union

Project partners:

Ministry of Regional Development and Construction of the Republic of Moldova
Ministry of Environment of the Republic of Moldova
Agencies for Regional Development

Chisinau, December 2015

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Acronyms and abbreviations

CLO	Compost Like Output
DPC	Dynamic Prime Costs
ETWDS	Enhanced Transitional Waste Disposal Site
EU	European Union
EUR	Euro, currency
GCL	Geo-synthetic Clay Liner
GDP	Gross Domestic Product
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
Ha	Hectares
HDPE	High-Density Polyethylene
IDA	Intercommunity Development Association
ISWMS	Integrated Solid Waste Management System
JSC	Joint Stock Company
LDPE	Low Density Polyethylene
LPA	Local Public Authority
MBT	Mechanical Biological Treatment
MDL	Moldovan Lei, currency
ME	Municipal Enterprise
MLPS	Modernisation of Local Public Services in the Republic of Moldova
MoEco	Ministry of Economy
MoEnv	Ministry of Environment
MoF	Ministry of Finance
MoH	Ministry of Health
MRDC	Ministry of Regional Development and Construction
MRF	Material Recovery Facility
MSW	Municipal Solid Waste
NPV	Net Present Value
NWMS	National Waste Management Strategy
PET	Polyethylene Terephthalate
PWG	Project Working Group
RDA	Regional Development Agency
RM	Republic of Moldova
SDR	South Development Region
WMZ 3	Waste Management Zone 3 (rayons Cahul, Cantemir, Taraclia, Vulcanesti and Ceadir-Lunga)

1 Introduction

Since 2010 and until present the German Development Cooperation through GIZ implements the project, **„Modernization of Local Public Services" (MLPS).** Institutional partner of the project is the Ministry of Regional Development and Construction (MRDC), and key stakeholders that assure implementation of the project are the three Regional Development Agency Centre, North and South.

The overall objective of the project is to improve local public services in the Republic of Moldova by providing support to regional and local stakeholders in order to connect the local needs to regional and national priorities. MLPS covers two interventions areas:

- Intervention Area 1: Providing local public services – support to RDAs and LPAs in planning, development, implementing and managing pilot projects in order to improve local public services;
- Intervention Area 2: Regional planning and programming – support to RDAs and LPAs in regional planning and programing.

Within Intervention Area 2 „Regional planning and programming", MLPS project has provided support to improve regional sector planning and programming in waste management sector for Centre and North Development Regions. Thus, during 2012-2013 within project were elaborated Regional Sector Programmes on Solid Waste Management for North and Centre Development Regions. The Programmes were approved in February 2014 by respective Regional Development Council.

In Development Region South, MLPS project assessed the compatibility of the Solid Waste Management Strategy in South Development Region to MLPS project requirements, and later on was initiated the development of current Feasibility Study for „**Creation of the integrated solid waste management system for waste management zone 3, Development Region South**".

Waste management zone 3 (WMZ 3) initially covered **Cahul, Cantemir** and **Taraclia** rayons from Regional Development South. During executive committee ATU Gagauzia dated 7 August 2015, that took place in Comrat, it was decided to extend WMZ 3, South Development Region with rayons **Vulcanesti** and **Ceadir – Lunga.**

Selection of the two rayons to be part of the project zone was based on proximity principle, on the basis of technical and economic efficiency. Extending of the project zone with the two rayons from ATU Gagauzia it is in accordance with the **"Waste management Strategy from Republic of Moldova for 2013-2027"** approved by Government Decision no. 248/10.04.2013.

The proposed system through the Feasibility Study will assure the management of municipal waste from the zone, which includes the collection, transport, transfer, treatment and disposal of the waste in a regional landfill.

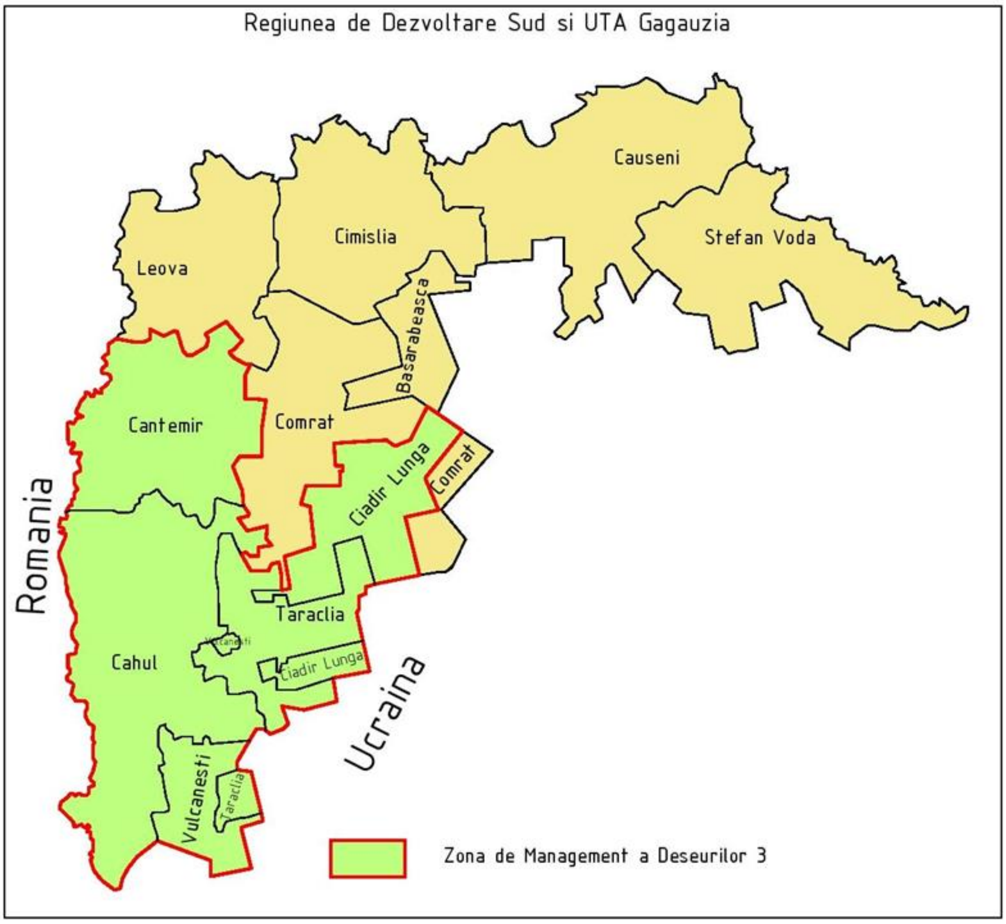
For the elaboration of the Feasibility Study the national legislation and the relevant European directives were taken into consideration.

2 Baseline conditions

2.1 Geographical context

The total area of the South Development Region is 8 054km^2, (out of which the Cahul, Cantemir and Taraclia rayons form 3 087 km^2) and Gagauzia is 1848 km^2 (out of which Ceadir-Lunga and Vulcanesti form 988,16 km^2). Thus, the total area of the WMZ 3 (5 rayons) in SDR is 4075,16 km^2 that represent about 9.12 % of the total area of the Republic of Moldova.

Figure 2-1: SDR map, WMZ 3



Source: National geospatial data fund.
http://geoportal.md/ro/default/map#lat=203822.982011&lon=198658.008481&zoom=0&layers=_base6,_base13

2.2 Geology and hydrogeology

2.2.1 Geological and hydrogeological conditions within WMZ 3

The geological structure of SDR consists of marine and terrigenous formations of different ages - Precambrian, Paleozoic, Mesozoic and Cenozoic. On the surface, we mostly find rocks from the Neogene and Quaternary (Cenozoic) period. These deposits are mostly spread within an Intermediate and Higher Pliocene terrace type formation.

The Quaternary deposits are mainly formed by eluvial-colluvial formations and river terrace alluvials above the floodplain.

Neogen System (N) - neogene deposits are scattered throughout the southern part of the interriveran territory between the Dniester and Prut and entirely cover older formations like a cloak. They are presented by Miocene and Pliocene.

Miocene - the deposits are subdivided into the Sarmatian floor and the unseparated deposits of the Sarmatian superior-méotien.

Sarmatian Floor (N_1S) is represented by a polifacial layer of sedimentary rocks scattered throughout the southern part of the interriveran territory between the Dniester and Prut.

Middle Sarmatian sublevel (N_1S_2) - from a lithological perspective, the formations are shown by gray-green and gray-blue clays with interlayers of micaceus sand with gray-yellow colour. The formations sink in a southerly direction.

Upper Sarmatian sublevel (N_1S_3) - deposits surface in the Prut valley, then suddenly sink in a southerly direction. Deposits are represented exclusively by terrigenous sediments. Bluish-gray and gray-green clay prevail, sand and aleurites are present in smaller quantities. Landslides are very common in these deposits. The sublevel thickness reaches 40 m.

Sarmatian superior-Méotien (N_1S_3 – m) - the deposits are widespread in the watershed, below the Cahul latitude, sinking under Pontian deposits. From a lithologoical perspective, they are represented by continental clays, gray-bluish and greenish gray with interlayers and lenses of sand. The total thickness of the deposits is up to 200 m.

Pont (N_2p) - deposits are widespread throughout the territory up to the Cahul latitude, further north representing a sporadic spread. They surface in the river beds and valleys, in areas between rivers they are overlaid by Middle and Higher Pliocene deposits of significant thickness. From a lithological perspective, they are represented by greenish-gray clays and fine-grained sands. The total thickness of the deposits is 60-70 m.

Middle Pliocene (N_2^2) - is represented by deposits of the Chimerian floor, through the alteration of fine-grained sand and plastic clays with thin intermediate layers of limestone. The layer thickness increases from North to South, up to 30 m.

Upper Pliocene (N_2^3) - is represented by deposits of the Acceagil and Apseron floors, which form the XII - VII terraces above the river Prut meadows and the terraces of smaller rivers of similar age. The terrace structure is typical, it starts in the lower portion with layers of coarse grained sands with lenses of gravel, clay aleurit, and ends in the upper portion with loamy soils and clays. High terraces border the valley of the river Prut and small rivers located on different hypsometric indices. The thickness of the terrace deposits vary within wide limits depending on the degree of preservation of the terraces and constitutes from 10 to 65 m.

Superior Pliocene Quaternary (N_2 – Q) - these eluvial-colluvial deposits are represented by loamy soils with loess, loamy soil, clay soil, sandy-clay soil and sands with interlayers of fossil soils that extend over river slopes and watersheds. The thickness varies from 35 m in the watersheds of up to 5.8 m on the slopes.

Quaternary deposits from superior to inferior (Q_{I-III}). - deposits on valley slopes of river Prut and smaller rivers, including the first six terraces above the floodplain. Deposits are represented by loamy soil, sandy-loam soils, varied grain sand with interlayers of gravel and pebbles. The thickness of the deposits is less than 20 m.

Contemporary deposits (Q_{iv}) - are represented by alluvial deposits in river floodplains and alluvial-diluvial formations on vale bottoms. River floodplain alluvial deposits are represented by loamy soils with mud, sand and aleurite with inclusions of gravel and pebbles. Thickness varies from 14 to 25 m. The alluvial-diluvial formations on vale bottoms consist of loamy soils with layers of sand with gravel and pebbles. Their thickness is 10-14 m.

Throughout the study of the territory at hand, the gas fields of Victorovca and Cantemir rayon were explored, as well as a number of other useful solid mineral deposits.

The hydrogeological conditions in WMZ 3 are quite complicated. The complexity lies in the sudden variation in terms of facial and lithological attributes and in the large number of aquifers, which are widespread over comparatively small territories. In addition, another complicating factor is the wide spread of landslides

The underground waters in the described territory can be divided into two groups: Groundwater (underground water) extending closest to the surface, usually with easy access, and piezometric pressured groundwater, whose rock aquifers overlap with poorly permeable or virtually waterproof rocks.

Despite the low and poor quality of ground water, they are captured by wells and used by the local population.

For centralized water supply in WMZ 3, underground water is used from aquifers in the Pontian, Sarmatian superior-Meotian, upper and middle Sarmatian. Underground water is extracted both by special probes and through water intakes.

Underground water condition is being monitored by the Hydrogeological Expedition of Moldova as part of the MoEnv.

2.2.2 Geological monuments

Table 2-1 presents the geological and paleontological monuments found in the WMZ 3, in accordance with Law 1538 - XII of 25 February 1998.

Table 2-1: List of geological and paleontological monuments in WMZ 3

No	Name	Surface, ha	Location
Cahul rayon			
1	Fossil location	5	Near the village of Pelinei, forestry, plot 11
2	Fossil location	10	Between villages Moscovei and Dermengi, Moscovei village plot 18, subplots 2, 3
3	Ripa Tartaul	2	2 km north of the village Tartaul de Salcie, on the left side of river Salcia
4	Fossil location	5	Near the village of Pelinei, forestry, plot 11
5	Fossil location	10	Between villages Moscovei and Dermengi, Moscovei village plot 18, subplots 2, 3
6	Ripa Tartaul	2	2 km north of the village Tartaul de Salcie, on the left side of river Salcia
7	Outcrop near the Valeni village	3	At 0,5 km from Valeni village, the east slope of the Prut River valley.
Cantemir rayon			
8	Cociulia Quarry	1	1 km north of the village Cociulia
Taraclia rayon			
9	Ripa Budai	5	Western edge of the village Budai, on the right side of the

No	Name	Surface, ha	Location
			river Salcia
10	Ripa Musaitu	5	In the middle of the village Musaitu
11	Outcrops near the town of Taraclia	4,1	South of Taraclia, along the left slope of the dale, forestry Taraclia, Taraclia-II, plot 20, subplot 1
Ceadir-Lunga rayon			
12	Outcrop Baurci	1	On Congaz-Baurci way, at 2 km from the bridge over the Ialpug river, forest district Congaz, plot 38, subplot 12.
13	Cead]r-Lunga ravens	10	East part from Ceadir-Lunga, the forest district Cead]r – Lunga, the plot 46, subplot 2.
Vulcanesti rayon			
14	Outcrop of etuliene clay	10	The left slope of Cahul river valley, behind Etulia village
15	Cismichioi ravene	3	The Cismichioi village, on the left part of the dell of Cahul lace affluent.

Source: Law 1538 - XII of 25 February 1998

2.2.3 Seismic conditions

As throughout the entire interriveran territory between the Dniester and Prut, WMZ 3 refers to a region of high seismic activity, see Figure 7-5. This is due to the proximity of the territory to the geosyncline Alpine region of the East Carpathians, where earthquakes epicentres are located. The territory near the river Prut experiences the influence of high intensity earthquakes (up to 8 degrees), quakes with epicentres in East and South-East of the Vrancea region. The depth of these outbreaks vary from 25 -50 and up to 100-200 meters.

High intensity earthquakes cause damage to the national economy and are often accompanied by activation of landslide processes. It is worth mentioning, that the influence of earthquakes on landslide processes does not have a regular character. A lesser influence have earthquakes, whose epicentres are located in the Epi-Hercyniene platforms (Dobruja) and the region near the Prut. Here the intensity of earthquakes can reach 3-4 degrees.

According to the Centre for Seismology from the Institute of Geology and Seismology ASM, the latest earthquake was felt on the evening of 10/09/2014 and originated in Vrancea, it had a magnitude of 4.8 on the Richter scale at a depth of 107 km. In the SDR, the quake was felt with an intensity of about 4.0 on the Richter scale.

Figure 2-1: Seismic zoning map of Moldova

Source: The Institute of Geology and Seismology, Academy of Sciences of Moldova. http://iges.asm.md/node/124

2.2.4 Underground waters

Groundwater, which extend first from surface soils are limited by sandy-loam, sand, sand and gravel varieties of alluvial, eluvial-colluvial and eolian-diluvial deposits of Quaternary and Pliocene (upper and middle) age. Waters, with rare exceptions, are without water pressure. Their motion takes place by infiltration of precipitation; the Prut river meadows and small rivers are possible locations of leakage from aquifers and rivers downstream. The supply region coincides with the distribution region, and the orientation of the ground water course is conditional on the local relief. Ground water discharge occurs in aquifers that are hypsometrically located below. Discharge to the surface occurs as springs, mesh pond or water evaporation.

The Pontian aquifer (N_2p) is spread throughout the south of Cahul. Fine-grained sands divided into two banks by a layer of clay with a thickness from 1 to 20 m serve as rock aquifers. Where water leakage occurs, the Prut floodplain alluvial deposits of sand and gravel often extend over sands of Pontian age. This part presents Pontian horizon waters without water pressure. The general inclination of the piezometric surface coincides with the sinking Pontian deposits in a South West direction. The horizon's abundance of water also increases with increasing pressure to the southwest. Supply of the aquifer is made from rainfall infiltration, runoff from aquifers located above as well as from the water supply pressure extended below the Sarmatian-Meotian aquifer.

Discharging of the horizon in sections without water pressure is carried out through springs and filtering of deposits in the river floodplain and vale. Within the Prut river meadow, where we find pressured water, there are areas where the Pontian aquifer waters supply alluvial deposits. At the regional level, discharging is carried out into the Black Sea. Waters correspond generally to drinking water requirements, but water quality of drainage areas of alluvial deposits is deteriorating due to increased ammonia concentration (up to 6 mg/l) and nitrates (50 mg/l). Filter coefficients for non-pressure water sections range from 0.3 to 3.73 m/ 24 hours and conductivity between water deposits containing water under pressure is 18,8- 43 m^2/24 hours.

The aquifer complex in the deposits of the upper-Meotian Sarmatian (N_1S_3 – m). Water refers to the interlayers and lenses of fine-grained sands and aleurite with a thickness from 1 to 15 m located in a layer of clay. Lenses and intermediary layers of sand impregnated with water present in a sporadic form, varied in space and poor hydraulic connection. In the northern part of the described territory water can be without pressure, but during immersion in a southwestern direction, the water gains pressure of up to 150-170 m. The base supply region coincides with the region without pressure. Replenishing occurs on account of rainfall infiltration on the areas extending near the groundwaters of the Pontian aquifer. Unloading of the aquifer complex on the examined territory happens partly by way of feeding the Pontian aquifer on sections with high piezometric pressure, and partly through a network of gullies and hollows. To the south, the territory presents a transit location towards the regional discharge point - the Black Sea. Filtration coefficient of rock aquifers is 0.013 to 0.1 m / 24 hours. Groundwater chemical composition is varied, mineralization varies from 1 to 3 g / l.

Middle Sarmatian aquifer (N_1S_2) is spread throughout the entire territory. Intermediate layers and lenses of fine-grained sands and aleurite present aquifer layers with a thickness from 1 to 5-25 m in a layer of a clay. Groundwater is water without pressure on sections where it is unveiled by river valleys and vales. Waters are of the infiltration type. Sections with no pressure are the base of supply. The discharge region is the Black Sea. Partly, the horizon waters described discharge on slopes and river valleys, on some sections the water drains into aquifer complexes of alluvial deposits and aquifer complexes made up of landslide accumulations. Groundwater shows a lower content of salts, mineralization in some sections constitutes 3 g / l.

Aquifer horizons and complexes that extend deeper, contain waters with higher mineral levels (up to 70 g / l, Cahul), in some sections (Gotesti) - mildly thermal temperatures of up to 42C.

Over the years, the described territory's groundwater reserves were explored and approved as for both household use and drinking water.

In places where the selection of groundwater for water supply takes place, sanitary standards must be followed. The size of the zones must be established through hydrogeological calculations.

2.2.5 Underground water levels and flow direction

The surface level of ground water experiences variations related to changes in seasonal precipitation amount fallen to the ground. The abundance of ground water is low. Ground water depth ranges from the first meters in the Prut River meadow and small rivers, and up to 100-120 meters in high watersheds. The regional waterproof rock on the examined territory is represented by a thick layer of clay with interlayers of sand of upper-Meotian Sarmatian, Sarmatian upper and middle Sarmatian age. The total thickness of these deposits is quite significant. In addition, it highlights the local impermeable rocks - Pontian clays and loamy soils of Quaternary age.

Underground water (groundwater) flow direction is conditioned by the local relief. Deep groundwater flow goes to the south, southwest and coincides with the immersion of aquifers.

2.2.6 Underground water quality

The chemical composition of the ground water experiences variations related to changes in seasonal precipitation amount fallen to the ground. The waters are of poor quality, polluted by nitrates, ammonia; a high content of sulphates, chlorides is noted, as well as a high total hardness index.

Groundwater in the Pontian aquifers, the upper Sarmatian-Meotian, the Sarmatian upper and the middle Sarmatian aquifer correspond generally to drinking water requirements, but due to pollution the water drainage areas of alluvial deposits show deteriorating water quality, increased ammonia concentration (up to 6 mg / l) and nitrate (50 mg / l). Groundwater chemical composition is varied with mineralization varying from 1 to 3 g / l.

Aquifer horizons and complexes that extend lower, contain high mineralization (up to 70 g/l, Cahul), in some sections (Gotesti) - low thermal temperature up to 42^{o}C.

2.3 Soils

The WMZ 3 is located in Southern Moldova Plain, called Bugeac Steppe, 7th district pedogeographic, district of carbonate chernozom (calcic) and typical weak humifere of the Southern Bessarabia steppe (Ursu A., 2011), 13th rayon ecopedologic.

The geological structure of the country is relatively homogeneous. Surface sedimentary rocks are presented by loess loams (82.6%) and rarely clay (5%). Loess loams are of Quaternary origin, their thickness is tens of meters. The composition of the rocks is highly dependent on the altitude. On watersheds and high terraces there are clay, loam and rocks, on lower lands there is more dust and sand, which cause poor resistance to erosion.

The rayon is characterized by a picturesque steppe landscape, which contributed to the formation of a coating of pure chernozem soil. Chernozems which prevail show a low humification (normal) and carbonate content. They occupy approx. 70% of the territory. There are rare fragments of leachate (0.4%), typical moderately humifere (1.6%), and vertisoils (1.0%). On the slopes, the soil has different degrees of erosion, in the 13th Ecopedologic district eroded soils occupy 122,800 ha (31.2% of the territory). Linear forms of erosion occupy from 0.5 to 1.5 ha / km^2. The base of the slopes are covered by colluvial layers. In the meadows are widespread alluvial soils (5.2%), mainly stratified often saline.

The 13th Ecopedologic subrayon is part of the 13th Ecopedologic rayon - a specific subrayon of the Lower Prut Valley, located on the left floodplain and terraces of river Prut. Entirely covering the Cahul rayon.

The 13th microrayon includes lands with prevailing altitudes of 40-140 m and the average altitude is 61 m. Geological rocks are represented by loess loams (64%), clay (34%) and sand (30%) on the terraces, alluvial deposits (29.5%) are found in the meadow. On the terraces we find typical chernozems, weak humifere (normal) and carbonate (jointly occupy approx. 60%, including 27.8% eroded) in the meadow - layered alluvial soils, typical fluid vertisoils, often saline.

2.4 Landscape and topography

The plateau and plain forms of relief dominate the Development Region South. The Tigheciului peak with an altitude of 301 m may be found to the east of Cantemir Rayon and the Prut River meadow with widths of 1 – 1.5 km in the west. The land is crossed by a series of small valleys with widths between 100 to 300 de m. Cantemir Rayon is crossed from north-west to south-west by two small valleys with flanks inclined 3- 5º to la 5- 7º. Cahul Rayon includes to the north the Tigheciului Hills, the Cahulului Plain in the centre. The depressions of rivers Cahul, Salcia and Ialpug may be found to the east of Cahul Rayon and in the Taraclia Rayon.

The “Prutul de Jos” scientific reservation may be found in the region; it was declared a natural protected area. Furthermore, Beleu natural lake may be found here, the largest in the Republic of Moldova, as well as a network of ponds, which form a unique ecosystem.

The Development Region South is dominated by altitudes between 120-180 m. the minimum altitude, 10 m, may be found in the meadows of Prut, Cahul and Ialpug rivers and the maximum altitude, 301 m, may be found in the Tigheci forest. The flanks are mainly facing west and east (31%), the ones facing the south 22% and those facing north 16%. The average length of the flanks does not exceed 1,200 m.

2.5 Climate and air quality

2.5.1 Temperature and precipitation

The climate in Development Region South, as in the rest of the country is moderate continental and is characterized by short and mild winters with little snow and long hot summers with low amount of precipitation. Along with the positive climate - long warm period of the year, mild winter, with plenty of light and heat, there are also some downsides: dry periods and a changing nature of the weather.

As a result of frequent exchange of air masses, air temperature recorded during the cold season shows considerable oscillations, large anomalies are signalled during a single month.

The average annual air temperature is 10.3 - 12.3°C, and the soil surface - 10-12°C. The frost-free period is 190 days on average in the south, but in some years its duration may reach 200-230 days.

Table 2-2: Air temperature (monthly and annual average) recorded at the Cahul station

Month	Air temperature, Degrees Celsius and the years recorded				
	2009	2010	2011	2012	2013
January	-0.1	-4.2	-2.2	-2.0	-1.7
February	2.0	0.1	-2.9	-7.8	2.1

Month	Air temperature, Degrees Celsius and the years recorded				
	2009	2010	2011	2012	2013
March	4.8	4.8	4.4	5.0	3.8
April	11.8	11.6	10.1	13.7	12.9
May	16.8	17.2	16.6	18.7	19.3
June	21.6	20.7	20.3	23.3	21.1
July	24.4	23,2	23.4	26.4	21.9
August	22.7	24.9	22.2	24.0	22.9
September	18.4	17.1	19.9	19.7	15.6
October	12.3	8.6	10.0	13.9	11.4
November	7.1	11.1	3.0	7.3	8.8
December	0.0	-0.7	2.8	-2.0	0.4
Annual average	**11.8**	**11.2**	**10.6**	**11.7**	**11.5**

**Source: State Hydrometeorological Service. http://www.statistica.md/category.php?l=ro&idc=99& Accessed on 20.10.2014*

The duration of insolation during the year ranges from 1940 to 2500 hours, 60-70% in summer and 20-30% in winter. Solar energy reserves, expressed through the radiation balance sheet size, constitute about 2100 MDJ / m^2 per year. It is the basic energy source which provides soil heating, evaporation and an average air temperature.

Rainfall presents in a very irregular form, heavier during hot periods, manifested mainly in the form of heavy rain. Monthly and annual average for the period 2009 - 2013 is shown in Table 2-3. Only about 10% of the annual rainfall occurs in the form of snow. Relative humidity is 69% on average. During the year rainfall occurs in approximately 109 days with 0.1mm and more

Table 2-3: Rainfall (monthly and annual amount) recorded at the Cahul station

Month	The amount of precipitation, mm and years of observation				
	2009	2010	2011	2012	2013
January	32	35	36	60	58
February	21	43	14	46	32
March	48	29	11	14	33
April	18	23	53	30	40
May	49	82	47	77	48
June	20	121	92	29	79
July	34	146	41	45	50
August	20	25	25	57	21
September	41	31	3	30	288
October	35	80	33	46	40
November	13	20	0	23	22
December	74	64	16	138	5
Annual average	**405**	**699**	**371**	**595**	**716**

** Source: State Hydrometeorological Service. http://www.statistica.md/category.php?l=ro&idc=99& Accessed on 20.10.2014*

The State Hydrometeorological Service of Moldova, based on several years of detailed analysis of the hydrothermal coefficient (HTC), states that a HTC of 1.0 characterizes sufficient humidity; a HTC of 0.7 indicates a dry climate, a HTC of 0.6 a mild drought, a HTC of 0.5 a strong and very strong drought.

Snow usually falls in late November - early December. Snowfall is low in the southern region of Moldova, reaching 20-30 cm only during 10% of winters. Winter storms are possible (average 5-10 days) and ice phenomena - frost (average 10-30 days).

2.5.2 Wind conditions, speed and direction

Wind conditions, formed under the influence of baric centers, is characterized by a high frequency of winds from the northwest (12-35% per year) and southeast (15-25%) directions. Average wind speeds during the year, as specified in Table 2-4, range from 2.5 to 4.5 m/s.

Table 2-4: Average wind speed recorded at the Cahul station

Month	Wind speed, m/s and years of observation				
	2009	2010	2011	2012	2013
January	3.4	3.9	2.4	3.6	3.1
February	4.0	4.3	3.8	3.4	3.9
March	3.9	4.1	3.4	3.5	4.5
April	3.8	3.6	3.7	3.8	3.8
May	3.5	3.1	3.4	3.3	3.2
June	3.1	3.2	3.4	2.9	2.8
July	3.0	2.6	2.2	3.2	2.7
August	3.2	2.9	3.1	3.0	2.7
September	2.9	3.1	2.7	2.9	2.7
October	3.0	3.6	2.8	2.9	2.7
November	3.1	3.4	2.7	2.8	2.7
December	3.2	3.1	3.0	3.8	2.8
Annual average	**3.8**	**3.4**	**3.1**	**3.3**	**3.1**

** Source: State Hydrometeorological Service. http://www.statistica.md/category.php?l=ro&idc=99& Accessed on 20.10.2014*

2.5.3 Natural hazards, hazardous weather

Development Region South by geographical location and natural peculiarities is frequently affected by the following hazards: earthquakes, landslides, floods, torrential rain (sometimes accompanied by hail and storms), long hot summer temperatures, low temperatures in winter, drought, heavy snowfalls, early autumn frosts or late spring frost, excessive frost, epidemics, epizootics and invasions.

For example, between 11 and 15 September 2013 in the region of the Cahul weather station, 271mm of rain fell or half the annual norm, which was recorded for the first time during the entire period of observations and exceeds the maximum amount previously recorded (207 mm, May 1991).

Drought is a natural phenomenon also quite dangerous for SDR. The drought period is characterized by lack of rain for at least 14 consecutive days during the cold period of the year (October to March) and at least 10 days during the warm period. Although droughts can register throughout the year, most of them occur in late summer and early autumn.

2.5.4 Air quality, pollution of existing air

The main sources of pollution in the Development Region South are natural (dust storms) and of anthropogenic character. Sources linked to vital human activity are - road transport, the poor state of the roads, the degree of their unsatisfactory sanitation, especially by failure to remove anti-skid material, technical condition and cleanliness of vehicles, construction sites. Emissions from road vehicles accounts for approximately 90% of the pollutants in the transport sector atmospheric air.

The SHS supervises ambient air quality across the country using the 19 stationary observation stations located in the most industrialized centers (Chisinau, Balti, Tiraspol, Bender, Ribnita), including automatic control station v. Mateuti, Rezina rayon, and the determination of transboundary air quality station in the city of Leova.

The station in the town of Leova is intended for cross border air pollution observations. It operates under the EMEP program (Cooperation Programme for Monitoring and Evaluation of the Long-range transmission of air pollutants in Europe. In the Republic of Moldova the program was initiated in 2008) which provides data on pollutant concentration in Europe, lodging, emission, composition and transmission.

According to Table 2-5 we find that the highest values were recorded for SO_4 - at 1,3 μg/m^3 and NH4$^+$ - 1,5 μg/m^3 in January.

According to the 2013 annual average concentrations at the Leova station, the highest level of air pollution was recorded at 0.69 NH_4 and SO_4 - at 0.88 μg/m^3. The content of inorganic substances in atmospheric air at the Leova station, for 2013, shows a decrease for all compounds monitored in the previous year except for HNO_3, Na^+, Ca^+, K^+, Mg^+, and NH_3 which increased slightly.

In the Development Region South air is polluted by gas which escapes from the illegally deposited waste. No other sources of air pollution are present at the moment. Table 2-5 displays the monthly average concentration of pollutants monitored in aerosols and atmospheric air at the Leova station in 2013.

Table 2-5: Monthly Average of Pollutants at Leova Station in 2013

	No	Pollutant	Average concentration, μg/m^3												Annual average
			For months												
			I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
Air	1	Ammonia (NH_3)	0.41	0.15	0.07	0.17	0.23	0.68	0.55	0.73	0.54	0.73	*	*	0.43
	2	Nitric acid (HNO_3)	0.40	0.32	0.29	0.43	0.54	0.68	0.60	0.27	0.38	0.57	0.38	0.39	0.44
	3	Sulphur dioxide (SO_2)	1.73	1.06	0.82	0.64	0.54	0.36	0.49	0.42	0.22	0.53	0.45	0.84	0.68
	4	NO_3 ions	0.78	0.47	0.42	0.43	0.20	0.12	0.18	0.17	0.12	0.49	0.49	0.59	0.37
Aerosols	5	Cl^-	0.34	0.27	0.33	0.27	0.27	0.15	0.44	0.56	0.16	0.41	0.39	0.40	0.33
	6	SO_4^{--}	1.30	0.85	0.72	0.90	1.27	0.88	0.72	0.79	0.45	1.05	0.86	0.83	0.89
	7	NH_4^+	1.50	0.56	0.67	0.74	0.43	0.87	0.46	0.54	0.51	*	*	*	0.70
	8	K^-	0.19	0.44	0.12	0.06	0.26	0.38	0.17	0.28	0.33	*	*	*	0.25
	9	Na^+	0.11	0.06	0.23	0.04	0.22	0.42	0.26	0.33	0.49	*	*	*	0.24
	10	Ca^{++}	0.38	0.33	0.50	0.35	0.49	0.69	0.58	1.11	1.00	*	*	*	0.60

	No	Pollutant	Average concentration, µg/m^3												Annual average
			For months												
			I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
	11	Mg^{++}	0.13	0.07	0.07	0.05	0.13	0.11	0.07	0.19	0.21	*	*	*	0.11
	12	Solid suspen-sions (PM-10)	33.6	26.0	39.2	39.2	29.9	21.9	38.9	35.0	32.0	23.6	23.6	20.5	30.28

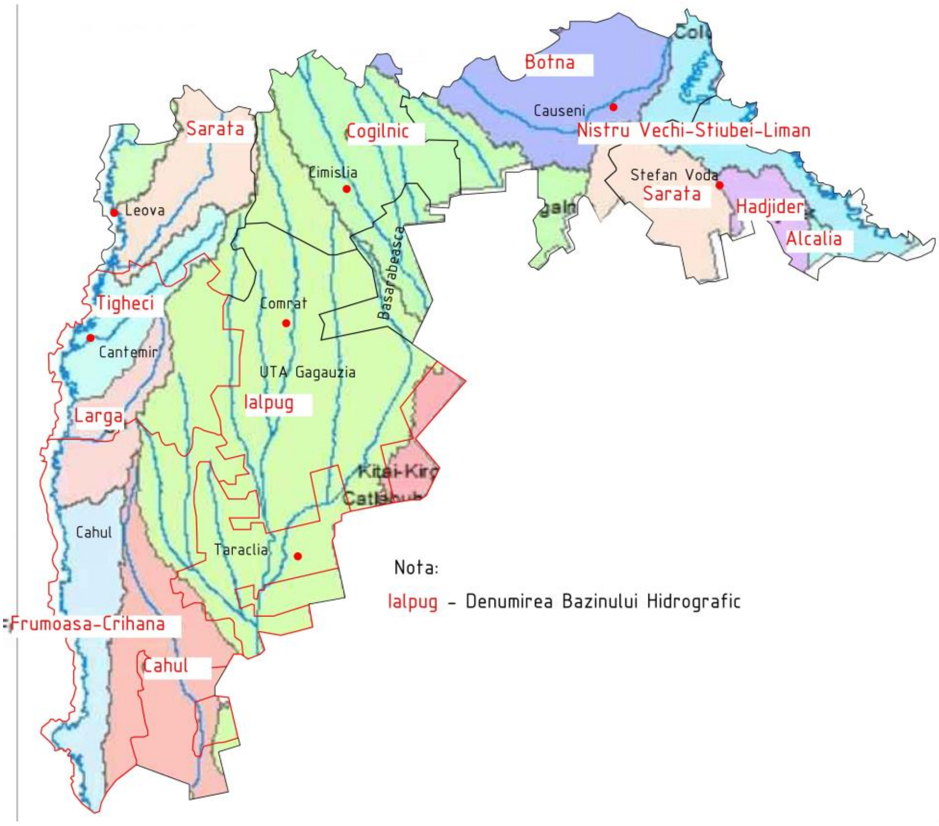
Source: Yearbook. Air quality in Moldova for 2013.
http://meteo.md/monitor/anuare/2012/anuaraer_2012.pdf Accessed on 21.10.2014

2.6 Surface waters, hydrology and drainage

Much of the Development Region South is part of the Prut river basin district with major rivers - Prut (953 km), Cahul (39 km) Salcia Mica (3 7km) Ialpugel (45 km) Lunguta (12 km), Sarata (59) and Tigheci (43 km).

Cahul area is largely part of the Cahul river basin, as well as the Frumoasa Crihana river basin and Larga river basin. Cantemir area is located in the basins of river Tigheci and Larga. The largest basin which lies more in Taraclia is the river Ialpug basin (see Figure 2-2).

Figure 2-2: Map of the main river basins in the SDR



**Source: Moldova's Water Agency. http://www.apelemoldovei.gov.md/pageview.php?l=ro&idc=134&id=439*

Stable water courses on the territory of WMZ 3 are the Prut River with its affluents to the left side, small rivulets and rivers Ialpugul Mare, Ialpugel, Salcia Mare, Salcia Mica, Lunga, Lunguta, Cahul. All refer to the Danube River Basin.

In addition, WMZ 3 contains several natural lakes Beleu, Dracele, Manta, Rotunda, and reservoirs Taraclia and Salcia.

River Prut is the second largest river in Moldova and is one of the affluents of the Danube River. The total length of the river is 989 km, on the territory of the Republic of Moldova it is 695 km, 27,500 km^2 basin, in Moldova – 8,200 km^2. The monthly drain norm is 50,9 m^3/s, the absolute maximum was 468 m^3/s (19/11/1995), the absolute minimum was 11,2m^3/s (11/30/1993). The average monthly water flow ranges from 17.6 m^3/s, up to 96.8 m^3/s (1998).

Water flowing on the surface of the earth performs a significant activity, resulting in coastal valleys, there is a number of other phenomena, such as washing the river banks and bed, forming gullies, washing the topsoil.

The masses of soil accumulate in the thalweg of the ravine and, under favourable conditions (torrential rains) form torrents of mud. Torrents of mud were observed in the region of villages Slobozia-Mare, Valeni, Chrihana Veche, and the city of Cahul. Given that the described territory is characterized by loess argil-sandy soils, landslides are common.

2.6.1 Water quality

According to the Ministry of Environment and Natural Resources, Prut river water is assessed as moderate and less polluted. Chemical and organic contamination is observed. At the Cahul observation point, increased content of copper and phenols is indicated. Water salinity increases with decreasing distance to the confluence with the Danube River. The annual average concentration of oxygen varies 7-10mg/l, dry residue of water 330-500 mg/l, hardness 4,5-6 mmol/l.

According to hydro zoning, water in small rivers and streams contains sodium sulfate and magnesium sulfate - sodium chloride and magnesium mineralization of 2480 mg/l, water hardness is 17.1 mmol/l. The water in the Cahul hydrographic basin is carbohydrated with calcium and magnesium with a mineralization of up to 1162mg/l, hardness is 11.9mmol/l. The chemical composition of river water is affected by the climate and human activities.

2.6.2 Water protection zones

Water protection zones are established along river banks and water bodies, at a distance of at least 500 feet from the edge of the river bed slope on the sides, but no further than the watershed. For streams (with permanent or temporary water flow) protection zones are set along the banks of water, with a width of 15 meters on both sides. The width of water protection zones of the Prut River is at least 1000 meters. Construction on strips bordering the perimeter of water protection will be allowed only after establishing the exact dimensions of such strips and their arrangement.

2.7 Biodiversity and protected areas

2.7.1 Landscapes in the Republic of Moldova

Moldova is characterized by a high degree of capitalization of the natural ecosystem (about 2/3 of the land is used for agricultural needs). The surface of ecosystem, mainly steppe and meadow, is heavily reduced and damaged, especially in the country's SDR.

Forest ecosystems (forests) covers 365,000 ha (11.4% of the country). Forest area is:

- Cahul rayon – 18,313 ha;
- Cantemir rayon – 13,127 ha;
- Taraclia rayon – 5,467ha.

The SDR forest communities are made up of downy oak (Q. pubescens) and pedunculate oak. In the floodplains of the river Prut and in the upper reaches of small rivers, we find meadow forests (water meadows), white poplar (Populus alba) and willow (Salix alba).

Steppe ecosystems

The SDR prato steppes are located at the bottom of the slopes with various exhibitions of the Bugeac steppe, characterized by higher productivity than in other steppe ecosystems. Main plant species are fescue (Festuca valesiaca), cockle (Stipa capillata), meadow grass (Poa angustifolia) and tarsac (Bromopsis inermis).

Very rarely encountered, are the European ground squirrel (Spermophilus citellus) and polecat (Mustela eversmanni) - species listed in the Red Book.

Subdesert Steppes occupy small areas in the south of Moldova, on the slopes of southwest exhibition, on sandy-loam soil surface. Prevailing plants are: barboasa (Bothriochloa ischaemum), wormwood (Artemisia austriaca), jugarelul (Teucrium chamaedrys, T. polium).

Marsh ecosystems

Marsh ecosystems in SDR are also found in the meadows of river Prut, where fragments of herbaceous vegetation are preserved. These resorts are covered with a vegetation cover with a small number of plant species. About 724 plant species make up the meadows. A growing number of ruderal Asteraceae species was found here, which helped to reduce the diversity and forage value of grassland (genus Poa, Alopecurus, Glyceria, Carex, Medicago and Trifolium).

Agricultural ecosystems

In the southern region of the country many pastures have low productivity and the grass carpet is damaged considerably due to abundant pasture. Pasture capacity is reduced to 0.2-0.3 animal heads per hectare.

A characteristic feature of agricultural landscapes in the SDR is the presence of protection strips, which are areas of refuge for many species of plants and animals. Many of the protective strips were destroyed in recent decades, but after expansion initiatives and programs to improve forest areas they are to be restored.

In the rayon of Cahul, the surface of protection strips is 2,238.7 ha, Cantemir - 320.69 ha and Taraclia - 77 ha.

2.7.2 Vegetation types found in WMZ 3

The animal and plant diversity was determined by the location of Moldova at the crossroads of three biogeographical zones (Central European deciduous forests, Mediterranean steppe, Eastern European steppe) forming a transition zone between the European steppe fauna elements and Asian continental steppe fauna. The territory between the Dniester and Prut represents the western and eastern boundry for the spreading areas of many species of animals, and this makes them particularly vulnerable to change. On the once vast areas of southern Moldova, grass and fescue steppe prevails, home to a mix of plants typical of the Mediterranean Sea and the mid-Danube (Pannonia). The fauna also experienced a transition. The specific combination of elements from Eastern Europe and the Balkans was preserved in the terrestrial coating: ordinary chernozem, chernozem similar to the Ukrainian steppes and the North Caucasus, and compact black soils - such as black clay land from Bulgaria and Yugoslavia, but also brown forest soils and dry forest soils, like those near the Mediterranean. This interaction between western and eastern influences was not identical in all parts of Southern Moldova. In the upper Northern and Southern Codri and choline Tigheci, representatives of woody vegetation entered from the North and Dobrogea. As a result, a garnet steppe was formed. The garnet steppe presents as regular steppe, but it is crossed by strips of pubescent oak and hornbeam forests. Further south, on the lower land the true steppe takes over, that has been called Bugeac since the times of nomadic Tatars. On modern botanico-geographical maps the territory is referred to as steppes of fescue.

The intensive use of natural ecosystems (steppe, meadow, water, forestry) led to the disjunction of biotopes and habitats of various animal species, isolation during the

2.7.3 Flora

Moldova's flora includes 5,568 species of plants. More than 30 species of woody plants are an important source of livelihood for the rural population, approx. 200 species are medical plants and approx. 700 species of wild plants serve as food for wild and domestic animals.

In the SDR region of Moldova (particularly the region selected for SL Cahul, TS Cania and TS Taraclia) about 320 species of higher plants are encountered. Places of high concentration of aquatic and marsh plant species are the scientific reserve "Lower Prut", lakes Manta and Branza. 170 species (main families Poaceae - 20, Cyperaceae and Lamiaceae) were found in the scientific reserve "Lower Prut".

Bush plants (xerophytes semi-shrub) predominate in the steppes of the area. On sandy-loam soil slopes we find species such as "barboasa" (Bothriochloa ischaemum) involving semi-shrub "jugarel" (Teucrium polium, T. chamaedrys), Austrian wormwood (Artemisia austriaca), grooved milk (Euphorbia seguieriana) and others.

2.7.4 Fauna

Over 15,000 species are found in the Republic of Moldova, of which 474 vertebrate species (75 species of mammals, 281 species of birds, 14 species of reptiles, 14 species of amphibians and 90 species of fish), others being invertebrates (mostly insects).

88 species of terrestrial vertebrate animals were identified in the SDR' biotope of marsh ecosystems.

The relatively high number of aquatic and marsh species is represented by birds (92%) and is determined by migration. In recent years, both the number of species of waterfowl and nesting puddle has decreased considerably due to droughts and the degradation of coastal lakes and pond emersed vegetation (reed, rush, sedge). The diversity of mammals in the aquatic and marsh ecosystem, already quite small (H = 0.2-0.5), has dropped during summer in recent years due to drought, regardless of the anthropogenic influence, and are some of the most vulnerable in the country.

The SDR (specifically the region selected for the location of SL Cahul, TS Cania and TS Taraclia) is an area of spreading for reptile species: common lizard, viper and yellow stripe snake, which are rare species included in the Red Book of Moldova. According to preliminary estimates, places of living and breeding of specified animals have not been established in the project estimated territories.

2.7.5 Biodiversity

Biological diversity in the Republic of Moldova is conditioned by its geographical position and its territory is located at the confluence of three biogeographical zones:

- **Central-European:** represented by the Moldovan Central Plateau (alt. 430 m maximum) with the largest forest cover in the country (Codru forests), where important plant communities and wildlife were preserved.
- **Euroasian:** represented by forest steppe and steppe.
- **Mediterranean:** represented by fragments of xerophiilous forest steppe in the south of the country.

Many populations are considered to be located at the extremes of their natural spreading areas, which increases their vulnerability to climate change and anthropogenic factors.

2.7.6 State protected natural areas

In the Republic of Moldova, the SPNA total area is 189,400 ha (5.61 % of the country) and includes 312 objects and complexes. The average area of a protected natural area is 607.0 ha. The national legal framework sets out 12 categories of SPNA.

The "Moldsilva" agency manages most SPNAs (about 50% of the total), others are managed by local authorities. Arrangements for the protected areas are provided by territorial entities subordinated to "Moldsilva", local authorities do not have management plans for SPNAs.

Protection of cultural and archaeological objects and complexes located on SPNAs and relevant activities is accomplished through coordination with the Ministry of Culture, in accordance with the legislation in force.

The most important SPNAs in Region Development South are the following:

- Cahul rayon:
  - Scientific Reserve "Lower Prut" with total area of 1755.4 ha. land owner is SE "MoldSilva";
  - Lower Prut Lakes (nr.1029 on the Ramsar List), 19152.5 ha, different owners;
  - Forest reserves, land owner ISC "Manta - V": "Baurci" - 93.1 ha; "Vadul lui Isac" - 68 ha; "Flamanda" - surface of 71 ha;
  - Medical plants reserve (Ocolul Silvic Larga) - surface 343 ha;
  - Danubian forest xerophytic Chernozem soil resource reserve - surface 200 ha;
  - "Tartaul" ravine, located 2 km north of the village of Taraclia de Salcie, on the left side of the river Salcia, surface 2 ha, primary owner - the village of Taraclia de Salcie;
  - Outcrops near the village of Valeni, located 0.5 km south of the village of Valeni, on the eastern slope of the river Prut valley, the surface 3 ha. Satisfactory environmental status. Owner - the village of Valeni, Cahul rayon.
- Cantemir rayon:
  - Forest reserve "Ciobalaccia", 13.4 ha, forestry Baimaclia Iargara GS;

  - Landscape reserve "Lunca inundabila de linga Antonesti". 93.6 ha, west of the village Antonesti.
- Taraclia rayon:
  - Outcrops near the town Taraclia, 4.1 ha, GS Cahul;
  - Steppe section in the southern Bugeac, 50 ha, near the village Vinogradovca.

No state protected areas, architectural monuments or objects of cultural, paleontological and archaeological are found within the land selected as the location for the Cahul landfill or the transfer stations Cantemir and Taraclia.

2.7.7 Red Book endangered species in the Republic of Moldova

The 2nd edition of the Red Book of Moldova includes 116 species of animals and 117 species of rare, vulnerable and endangered plants. The most endangered animals are reptiles, so out of the total of 14 species existing in the country - 8 species (57.1%) are included in the Red Book of Moldova.

Found in the SDR, are about 7 rare plant species including 5 species of plants included in the Red Book of Moldova: white waterlily (Nymphaea alba), water thistle (Trapa natans), pestisoara (Salvinia natans) , forest vine (Vitis sylvestris), telipteris pond (Thelipteris palustris). Sporadically such rare species as: ash (Fraxinus pallisae), arrowhead (L. Sagitataria sagittifolia.L), have also been encountered.

Also found in the SDR, and considered territories are endangered and vulnerable species of animals, especially birds (eagle, kestrel, small pigeon scorbioara, eared owl, green woodpecker, black woodpecker, canary) and reptiles (serpent of Aesculapius (Elaphe longissima), yellow-bellied snake (Coluber jugularis), field frog (Pelobates fuscus).

No rare plant species were found within the land selected as the location for the Cahul landfill or the transfer stations Cantemir and Taraclia.

2.8 Socio-economic data

2.8.1 Methodology

In preparing this chapter were used as secondary sources of information directories statistical data of the National Bureau of Statistics, Database Statebank, State Land Cadastre and other data sources available. This information was supplemented and adjusted using data from primary sources such as interviews of key persons, mainly representatives of LPAin the area. Field visits were conducted in Cania, Cantemir, Taraclia; working meetings were held with representatives of the following institutions: Cahul, Cantemir and Taraclia municipalities and representatives of the municipal sanitation operator "GCL Gahul". The discussions were guided by a previously developed questionnaire, they were referred questions on the general socio-economic situation in the regions concerned, the current situation in waste management and development prospects in this area. An important source of primary information and focus groups were organized in rural districts from WMZ 3.

Also, some of the information was represented by completed questionnaires by sanitation operators and LPAs where there are currently sanitation service, and information gathered in meetings conducted in the period of direct collection of information on the current situation.

2.8.2 Project area settlements

The project area includes three rayons: Cahul, Cantemir and Taraclia, Ceadir-Lunga and Vulcanesti, with six cities and 140 villages. Rural areas in the project area are organized into 77 communes. Cahul, Cantemir and Taraclia rayons are part of the SDR, Moldova but Ceadir-Lunga and Vulcanesti are part of Gagauzia (GTAU).

Table 2-6: The number of settlements in the selected regions, project area, SDR and RM, 2014

	Cahul rayon	Cantemir rayon	Taraclia rayon	Ceadir-Lunga rayon	Vulcanesti rayon	WMZ 3
Municipalities	-	-	-			-
Cities	1	1	2	1	1	6
Localities within towns	1	0	0	0	0	1
Villages residences of local council	36	26	13	8	3	86
Localities within communes	17	24	11	0	1	53
Total	**55**	**51**	**26**	**9**	**5**	**146**

Source: NBS

The total area of rayons in WMZ 3 is about 4075 km^2, of which Cahul - 1545.3 km^2, Cantemir - 867.9 km^2 and Taraclia - 673.8 km^2 , Ceadir-Lunga – 661,2 km^2 and Vulcanesti – 327 km^2.

2.8.3 Economic profile of the area

2.8.3.1 Gross domestic product analysis

Current Situation of GDP

Official statistical sources do not provide data on GDP in territorial format. Respectively GDP development trend analysis will be conducted at the country level. Thus, the volume of Moldovan GDP in comparable prices in 2012 was about 81.755 Mil. MDL, an increase of about 2.75 compared to 2004. From 2004 to 2012 the volume of GDP at comparable prices had an average annual increase of about 15% per year.

Figure 2-3: GDP in comparable prices and annual growth of GDP, 2004-2012, lil. MDL,% compared to the previous year

Source: GOPA calculation based on NBS data

Aspects of GDP forecast

The latest adjustments in the GDP growth rate due to changes in regional economic conjuncture involve a more moderate growth in the volume of GDP in the next period of about 4.5% annually. This increase of about 4.5% per year was taken as the basis for the period up to 2040.

However, based on field studies it can be assumed that the regional annual GDP growth will be uneven. Respectively, in urban areas with a population of over 50 thousand inhabitants, which currently include the municipalities of Chisinau and Balti, and in the future will probably include other urban centres, it will be about 5% annually. In other urban areas with a population of under 50,000 inhabitants it is assumed that this would be about 3.75%, while in rural areas the annual GDP growth in the period up to 2040 will be 2.5%.

This forecast assumes that in 2040 the GDP volume will increase by 3 times compared to 2015 and reaching 302.6 billion MDL (see Table 2-7).

Table 2-7: GDP forecast at current and comparable prices, 2015

	2015	2020	2025	2030	2035	2040
Current prices	100,683	125,469	156,357	194,849	242,817	302,595
Comparable prices	93,284	116,249	144,868	180,532	224,975	280,360

Source: GOPA calculation based on NBS data

2.8.3.2 Industry

The industrial sector of rayons from WMZ 3 in SDR is represented mainly by processing industry of agricultural raw materials produced in the region, including companies producing wine, dairy, baked goods, but also the textile industry. The total production value in the rayons of WMZ 3 was about 958 mil. MDL (in current prices) in 2012, increasing by about 26% compared to 2008. In Gagauzia, which includes also Ceadir-lunga and Vulcanesti rayons the value of goods produced in 2012 was about 1156,6 thousands MDL, that was with 30% more that in 2008.

However, this increase was not uniform in all three rayons. In the rayon of Cahul a decrease in production volume was registered during this period, of about 12,7%; in the rayon of Cantemir an increase of approximately 33.6% was registered; and an increase of 84.7% was registered in Taraclia.

The share of industrial output produced in the rayons of WMZ 3 is quite low, amounting to only about 5% of country's total in 2012 (see Table 2-8).

Table 2-8: Production value (current prices) in the project area, 2008-2012

	2008		2009		2010		2011		2012	
	Mil. MDL	%	Mil. MDL	%	Mil. MDL	%	Mil. MDL	%	Mil. MDL	%
Cahul	415.2	1.5	335.1	1.5	351.2	1.2	357.1	1.0	362.3	1.0
Cantemir	80.4	0.3	82.1	0.4	85.9	0.3	78.2	0.2	107.4	0.3
Taraclia	264.6	0.9	204	0.9	189.4	0.7	306.9	0.9	488.7	1.3
Gagauzia	887,8	3,1	746,4	3,3	919,8	3,3	1026	3,0	1156,5	3,2
RM	**28,540.4**	**100**	**22.643,9**	**100**	**28,140.1**	**100**	**34.194,4**	**100**	**36,362.2**	**100**

Source: GOPA calculation based on NBS data

Among the most important industrial enterprises in the WMZ 3 rayons may be mentioned: "Tricon" JSC - Cahul, " Laboratorio Tessile Mold " JV LLC - Cahul, "Cahul Pan" JSC - Cahul, "Imperial Vin" JSC - Cantemir, "Ciumai-Vin " LLC - Taraclia, brewery "Unitanc" JSC - Cahul, Cahul dairy factory, JSC “Aur Alb”, LLC “Jemciujina”, JSC “Kazaiak Vin” – Ceadir-Lunga and “DK Intertrade” – Vulcanesti. Apart from these, in the WMZ 3 rayons also activate a large number of mills, oil mills and bakeries.

2.8.3.3 Agriculture

A main branch in the rayons of WMZ 3 is agriculture. Thus the project area average about 75% of the land is for agricultural activities, including in Cahul - 75%, in Cantemir - 71%, in Taraclia - 81% and in Gagauzia – 79%. Most of the land is occupied by arable land, the average holding in the project area accounts for about 53% of all land fund, including Cahul 55% in Cantemir - 48%, in Taraclia and Gagauzia - 56%. These lands are cultivated mainly with cereals and industrial crops.

Large areas are occupied by perennial plantations, mainly active, which on average contain about 9% of the project area, with small variations in Cantemir and Gagauzia (7%) and Cahul (11%). About 9% of the land fund of the WMZ 3 is covered by pasture. Woodlands occupy about 10% of the land area of the project, and about 4% of the total land area is covered by water and wet areas (see Table 2-9).

Table 2-9: Land structure in WMZ 3 based on use, 2012

Indicators	WMZ 3 (%)	Cahul (%)	Cantemir (%)	Taraclia (%)	Gagauzia
Total agricultural lands	76.8	75.0	71.3	81.4	79,1
Arable land	54.5	55.1	48.0	56.1	56,4
Perennial plantings, including	11.2	13.6	10.4	12.1	9,4

Indicators	WMZ 3 (%)	Cahul (%)	Cantemir (%)	Taraclia (%)	Gagauzia
Orchards	1.9	1.7	2.8	1.5	1,8
Vineyards	9.0	11.4	7.3	10.1	7,3
Pastures	9.0	6.5	11.3	10.2	9,7
Forest plantations	10.3	11.7	14.6	8.4	7,8
Wetlands	4.1	5.2	5.4	2.5	3.1
Other land	8.8	8.1	8.6	7.7	9.9
Land total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: GOPA calculations based on data from the State Land Cadastre

Most of the land is privately owned, which in the project area is on average about 67% of the total land, including Cahul - 67%, in Cantemir - 62%, in Taraclia - 70% and Gagauzia – 68%. The remaining lands are public property - 10% and administrative territorial units - 23% (see Table 2-10).

Table 2-10: Land structure in WMZ 3 and rayon based in accordance to ownership, 2012

Indicators	WMZ 3 (%)	Cahul (%)	Cantemir (%)	Taraclia (%)	Gagauzia (%)
Public property land	10.5	11.6	12.9	8.1	9.3
Public property land under administrative-territorial units	22.6	21.0	25.4	22.0	22.8
Privately owned land	66.9	67.4	61.7	69.9	67.9
Land total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: GOPA calculation based on NBS data

Livestock production in the project area is represented differently. The largest herds of sheep and goats in WMZ 3 are in Gagauzia that is followed by the rayons of Cahul, Cantemir and Taraclia.

The largest businesses that operate in the project area's agriculture are: CF "Elita-Alexandrfeld" - Cahul, CF "Glia" - Cantemir, CF "Ciobalaccia" - Cantemir, "Ceteronis" LLC - Cantemir, LLC “Kumnuk Agro” – Ceadir –Lunga, JSC “Vulagroplus” and “Agroadem CD” – Vulcanesti.

2.8.3.4 Services

The service sector is growing both in terms of absolute values and its share at regional and national levels. The contribution is higher in trade, telecommunications and financial services and those of transport, which is a strategic sector both in the project area and the entire country. Thus the Giurgiulesti International Free Port (GIFP) is the only river-sea transshipment and distribution point in Moldova and a major regional logistics hub at the EU border with access to the road network, rail, river and sea. A potential point of development is the Cahul International Airport.

2.8.3.5 Existing transport infrastructure

The transport network in the project area is present in all four types of transport: by air, road, river and rail. Cahul International Airport offers opportunities for air accessibility in the South Development Region, including Gagauzia, but currently it is not used. Maritime and river accessibility is ensured by the Giurgiulesti International Free Port. The region has the most diversified network of railways.

Transport services primarily rely on road transportation, which provides vital economic links with other localities in the country, as well as foreign countries. The territory of the project area is crossed by the international road Chisinau - Giurgiulesti - Romania (M-3), as well as national roads: Reni - Giurgiulesti - Galati, Chisinau - Leova - Cantemir, Cahul - Giurgiulesti (R-34), Vulcanesti - Cahul - Taraclia (R- 38), Cahul - Cantemir (D-56) and Chisinau - Taraclia - Ciadir Lunga.

The maximum distance between localities in the WMZ 3 is about 58km, maximum distance being 82 km, the minimum distance – 28 km. The most far from Chisinau is Vulcanesti town – 184 km, the closest is Cantemir town - 119 km (see Table 2-11).

Table 2-11: The matrix of distances between localities in the project area, km

	Chisinau	Cahul (km)	Cantemir (km)	Taraclia (km)	Ceadir-Lunga (km)	Vulcanesti (km)
Chisinau	**-**	**167**	**119**	**156**	**136**	**184**
Cahul	167	-	50	49	75	35
Cantemir	119	50	-	72	78	82
Taraclia	156	49	72	-	28	42
Ceadir-Lunga	136	75	78	28	-	70
Vulcanesti	184	35	82	42	70	-

Source: GOPA calculation based on NBS data

The density of public roads in the South Development Region is 0,28.8 km/100 km^2 , being equal with average for the Republic of Moldova . The highest density of the network of public roads in the project area is in Taraclia, and Cantemir with 0,31 km/km^2 in each while in Cahul rayon this indicator is 0,25 km/km^2 and in Gagauzia is 0,22 km/km^2.

The total length of roads with rigid pavement in WMZ 3 rayons is of about 548 km, including Cahul rayon – 179 km, Cantemir – 99 km, Taraclia – 69 km, and in Gagauzia – 201km. . Also 12 settlements in the rayon of Cantemir, two settlements in the rayon of Taraclia and one settlement in the rayon of Cahul have no access roads with rigid coating.

Railway transport. The density of the railway networks in the South Development Region is 4.7 km/100 km^2 compared to the national average of 3.3 km/100 km^2.

The length of the railway crossing the Development Region South is 1/3 of the national network. The Basarabeasca railway node - Cahul connects settlements at the extremes of the SDR, and at the same time is a gateway to the river port Reni and settlements in the region with a high economic and industrial potential.

The main transregional railway route runs through the region and connects the following cities: Cahul - Cantemir - Tigheci (Leova) - Bugeac (Gagauzia) -Basarabeasca - Selemet (Cimislia) - Ialoveni territorial sector - Cainari (Causeni) - Bender (Transnistria) - Merenii Noi (Anenii Noi) - Chisinau - Straseni - Calarasi - Cornesti (Ungheni) - Ungheni - Iasi (Romania). Two other networks of local importance are: Basarabeasca - Ceadar Lunga - Taraclia - Vulcanesti - Etulia (Vulcanesti) - Reni (Ukraine) and Cantemir - Falciu (Romania), the latter is not used.

River transport. SDR is the only region that is not landlocked and has access to the sea by way of the coastal portion of the Danube. Giurgiulesti International Free Port has a preferential tax and customs regime, and has potential for access to the Black Sea - Mediterranean - Suez Canal - Red Sea - Indian Ocean. Also, to the Russian market.

Air transport. Cahul International Airport, the only regional airport in the country with the status of international airport, is a currently untapped opportunity for the development of SDR. Airport activity has been suspended since 2004 and currently there is no air traffic in SDR.

2.8.3.6 Power supply

Electricity. Supply of electricity to the rayons within the WMZ 3 is performed by the "Union Fenosa" Group's south distribution company, which provides 100% of the electricity.

To reduce the Republic of Moldova's energy dependence a connection to the European national energy system through the Falciu- Gotesti (Cantemir) line is planned.

Thermal energy. Thermal energy supply is a problem for people and institutions in the WMZ 3. Many of the apartment buildings that previously received heat from thermal power plants, currently are no longer heated since the thermal power plants ceased to function. In apartment buildings that are connected to the gas supply, many of the inhabitants mounted autonomous boilers on their own. A considerable part of the apartment buildings are heated with stoves or electric heaters. A similar situation is observed in public institutions.

In the private sector (courtyard houses) both in urban and rural areas, heating is primarily based on stoves and autonomous boilers fuelled by natural gas. One solution to improve consumption efficiency is harnessing renewable energy by installing solar batteries, biomass boilers and wind generators.

The access to gas pipe in Gagauzia is better than in adjacent rayons and in the whole Republic of Moldova. At the same time, despite the physical access to gas, lately its consumption decreased.

2.8.3.7 Water supply and sanitation services

Water supply to the urban population of WMZ 3 is provided mainly by the Prut river and groundwater (artesian wells, springs, wells), but in Gagauzia only from groundwater

For industrial use and in agriculture, the primary water source is the river Prut, as well as other smaller rivers in the region, artesian wells and springs.

Compared to other developing regions of Moldova, the SDR registered the highest share of municipalities that have a drinking water network, which is about 54%. In the Central Development Region this indicator is about 41% and in the North Region it is about 34%. However in the SDR, including WMZ 3, significant disparities exist between urban and rural localities. Thus in urban areas 80% of households are connected to the centralized water supply, while in rural areas this figure is only 13%.

Water consumption per capita in the WMZ 3 varies from 7.7 m^3/day in Taraclia and 7.6 m^3/day in Cahul, and up to 1.9 m^3/day in Cantemir. The average consumption of water in the SDR is about 6.6 m^3/day, and the regional average in Moldova is about 14.4 m^3/day.

On the WMZ 3 territory there are 75 water supply systems, including 20 systems in Cahul, 19 in Taraclia 12 and in Cantemir – 8, in Gagauzia – 35. However 6 of the 19, or about 31 percent, water supply systems in Taraclia are not functional. The main cause of failure of water supply systems both in WMZ 3 and in the SDR is their degree of wear.

Most urban areas in WMZ 3 (Cahul, Cantemir, Taraclia, Ceadir-Lunga and Vulcanesti) have centralized sewerage and wastewater treatment plants. The degree of wear of these systems is high and requires considerable investment for renovation. In rural areas of WMZ 3 there are virtually no centralized systems.

Water supply and sewerage services in the rayons of the WMZ 3 are managed by localized service providers in each rayon, JV "Water Canal" - Cahul, JV "Water Canal" - Cantemir and JV "Water Canal" – Taraclia, JSC “Apa-Termo” Ceadir-Lunga and JV “ Apa Canal” Vulcanesti.

2.8.3.8 Telephone services

Landline telephone services in the WMZ 3 are provided by three branches of the state enterprise JSC "Moldtelecom". The number of telephones per one hundred inhabitants is highest in Taraclia – 2 positions, which is followed by Ceadir-Lunga - 25 positions, Cantemir - 24 positions, but in Cahul and Vulcanesti – 18 positions of landline telephone per hundred inhabitants.

Mobile telephony networks are "Orange", "Moldcell" and "Unite", which serve the entire SDR area, including WMZ 3. In the last three years an increasing trend in the number of users was recorded. Now every third household in WMZ 3 has at least one mobile phone.

Access to Internet in WMZ 3 is quite limited. Thus, only about 20% of the population has computers connected to the Internet. The share of legal entities that have computers connected to the Internet is about 60%.

2.8.3.9 Social infrastructure

All localities in the rayon of Cahul and most of the localities in Cantemir, Taraclia, Ceadir-Lunga and Vulcanesti are equipped with pre-school education, primary education and secondary education institutions. There is potential for workforce training in WMZ 3, represented by two universities in Cahul and Taraclia (see Table 2-12).

Table 2-12: Endowment in rayons in WMZ 3 with educational institutions, 2012

Rayon	Preschool education institutions	Primary and secondary education institutions	Higher education institutions
Cahul	54	54	1
Cantemir	47	35	-
Taraclia	23	19	1
Ceadir-Lunga	20	18	-
Vulcanesti	13	6	-
WMZ 3	157	132	2

Source: GOPA calculation based on NBS data

The statistical data show that during the last ten years the differences in enrolment of boys and girls in general secondary education have reduced. Men represent the majority of students enrolled in secondary vocational education. Women represent 56% of university students and over 55% of college students. There are gender discrepancies at the level of specialties; significant feminization of the teaching staff (over 80%). Even if women constitute the majority in education, men still hold high-ranking positions being in charge of making important decisions. Exclusive domination of primary education by women confirms that there are stereotypes, according to which women are those who must educate and take care of children. It is also worth mentioning poor remuneration in education and exodus of teachers abroad. (The National Strategy on Gender Equality 2009-2015, 2008).

A hospital is present in each rayonal centre of the WMZ 3. Other primary care and specialized, mainly private institutions activate in the rayons of WMZ 3 (see Table 2-13).

Table 2-13: Endowment in rayons in WMZ 3 with medical and sanitary institutions

Rayon	Hospitals	Institutions of primary and specialized care, including	Private healthcare institutions
Cahul	1	24	22
Cantemir	1	6	4
Taraclia	1	6	3
Gagauzia	3	17	11
WMZ 3	6	53	40

Source: GOPA calculation based on NBS data

At the same time the endowment of these institutions with medical staff is uneven. After the total number of physicians, family doctors and dentists per 10,000 people, the Gagauzia surpasse the other rayons in WMZ 3 and the average level in SDR. Gagauzia is followed by Cahul and Taraclia rayons, where the endowment with medical staff is higher than the average RDS. The rayon that has the least medical staff is Cantemir (see Table 2-14).

Table 2-14: Endowment in rayons in WMZ 3 with medical staff per 10,000 inhabitants, 2012

Rayon	Total physicians	Family physicians	Stomatologists, Dentists
Cahul	17.9	4.8	1.5
Cantemir	11.1	2.2	0.8
Taraclia	15.9	5.0	1.4
Gagauzia	19.7	5.5	1.4
RDS	14.9	4.0	1.4

Source: GOPA calculation based on NBS data

Despite substantial measures undertaken within the last years in order to improve health of women and men, there is still a number of economic, health and social problems that affect health of the population. Thus, women from rural areas have a more limited access to quality reproductive health services, which increases the magnitude of health problems. One of the health and social problems that seriously affect maternal health is a high frequency of abortions, the majority being done by outdated methods or in unsafe conditions. Maternal mortality is still a priority issue. Social diseases are in the foreground as well. Addictive behaviour, and namely alcohol abuse, constitutes a health and social problem of increasing importance, which, according to WHO, is the most important risk factor out of the 10 factors identified in the Republic of Moldova. (The National Strategy on Gender Equality 2009-2015, 2008).

2.8.4 Demographics and age based structure

2.8.4.1 Current situation

To assess demographic trends indicators of present population and resident population in the rayons of WMZ 3 were used. The number of present population is the number of people who were in that territory at the time of the census, including those temporarily domiciled and resident population is the number of people resident in the territory, including persons temporarily absent.

According to the NBS, the population present in WMZ 3 as of January 1, 2013 was 312,400 people, including that in Cahul - 119,300 people, in Cantemir - 62,300 people, in Taraclia - 43,000 people, in Ceadir-Lunga – 63,000 people and in Vulcanesti – 24,700 people. The population of WMZ 3 is about 7.54% of Moldova's population as of January 1 2013. On average, in the WMZ 3 only about 31 % of the total population lives in urban space, the other 69 % are rural inhabitants.

The highest percentage of urban population was registered in Vulcanesti rayon - approx. 62% and the lowest in Cantemir - approx. 10%. The average population density present in WMZ 3 as of January 1 2013 was approx. 79 people per square km, including Cahul - 81 people, Cantemir - 72 people, Taraclia - 66 people, in Gagauzia – 87 persons per square kilometre. This indicator is significantly lower than the average population density present in Moldova of about 17 people per square kilometre (see Table 2-15).

Table 2-15: Socio-demographic indicators, 2013

Indicators	Republic of Moldova	WMZ 3	Cahul Rayon	Cantemir Rayon	Taraclia Rayon	Gagauzia
The number of people present on January 1 2013 (thousands)	3,413.2	219.1	119.2	60.6	39.3	161.2
The percentage of urban population on January 1 2013,%	40.5	27.2	30.2	8.4	24.7	40.3
Population density, persons / km^2	117	70.9	81	72	66	87

Source: GOPA calculation based on NBS data

Demographic trends in the project area show a stabilization of number of the stable number of population and a light decreasing of present population. Thus in 2013 compared to 2007, the present population of WMZ 3 fell by 1%, 1.1% in Cantemir, and in Taraclia by about 8.4%. Note that the present population of Cahul and Gagauzia in 2007-2013 remained almost stable, recording even a small increase of 0.1% and 0,3% accordingly. Also according to the stable population indicators, number of inhabitants in WMZ 3 in the same period increased with 0,2%. In Cantemir and Taraclia rayons the stable population number decreased with 1,7% and 1,8% accordingly, while in Cahul rayon and Gagauzia was noticed the population growth was 0.6% and 1,2% (see Table 2-16).

Table 2-16: Stable and present population dynamics in the rayons of WMZ 3, 2017-2013

Rayon	Number of population							
	2007	2008	2009	2010	2011	2012	2013	2013 / 2007
Cahul (stable)	124,1	123,8	124,4	124,4	124,8	124,9	124,9	100.6
Cahul (present)	119,1	118,9	118,9	118,9	119,3	119,4	119,2	100.1
Cantemir (stable)	63,6	63,4	63,2	63,1	62,8	62,5	62,5	98.3
Cantemir (present)	61,3	61,3	61,4	61,2	61,7	60,6	60,6	98.9
Taraclia (stable)	44,9	44,6	44,5	44,4	44,2	44,1	44,1	98.2
Taraclia (present)	42,9	42,8	42,6	42,4	42,3	42,2	39,3	91.6
Gagauzia (stable)	159,8	159,7	159,9	160,1	160,7	161,2	161,7	101,2
Gagauzia (present)	155,7	155,6	155,5	155,8	156,7	157,2	156,2	100,3
WMZ 3 (stable)	**392,4**	**391,5**	**392, 0**	**392,0**	**392,5**	**392,7**	**393,2**	**100.2**
WMZ 3 (present)	**379,0**	**378,6**	**378,4**	**378,3**	**379,3**	**379,4**	**375,3**	**99.0**

Source: GOPA calculation based on NBS data

Analysing the trends of population growth and decline in the project area, urban / rural profile, certain specifics were discovered. Thus in 2007-2013 urban population increased by about 0.5% in WMZ 3, which is primarily due to the strengthening of the urbanization process in Cahul, cEadir-Lunga and Vulcanesti. At the same time the overall rural population in the project area, but also in the selected rayons is decreasing. Exception makes Ceadir-Lunga town were the number of people in rural area increased in this period with 0,3%. For comparation, in Cahul rayon population in rural area in this period decreased with 4,5%, in Cantemir rayon –with 1,3%, in Taraclia rayon – with 11,3% and in Vulcanesti rayon – with 2,2%. Thus, during the given period the rural population decreased by of about 2.0%.

Table 2-17: Population dynamics, urban and rural, in the selected rayons and WMZ 3, 2007-2013, thousands persons, %

Indicator	2007	2008	2009	2010	2011	2012	2013	2013 / 2007, %
Cahul	119.1	118.9	118.9	118.9	119.3	119.4	119.2	100.0
Urban	35.5	35.5	35.5	35.5	35.8	35.9	36.0	101.3
Rural	83.6	83.5	83.4	83.4	83.5	83.6	83.2	99.5
Cantemir	61.3	61.3	61.4	61.2	61.0	60.6	60.6	98.8
Urban	5.1	5.1	5.2	5.2	5.2	5.1	5.1	99.0
Rural	56.2	56.2	56.2	56.1	55.8	55.5	55.5	98.7
Taraclia	42.9	42.8	42.6	42.5	42.3	42.2	39.3	91.5
Urban	13.7	13.7	13.6	13.6	13.5	13.5	13.4	97.5
Rural	29.2	29.1	29.0	28.9	28.8	28.7	25.9	88.7
Ceadir-Lunga	62,4	62,4	62,4	62,6	62.9	63.0	62.8	100.6
Urban	19.4	19.3	19.3	19.3	19.4	19.5	19.6	101.3
Rural	43.1	43.1	43.1	43.3	43.5	43.5	43.2	100.3
Vulcanesti	24.7	24.7	24.6	24.5	24.6	24.7	24.5	99.3
Urban	15.4	15.4	15.4	15.4	15.4	15.4	15.5	100.2
Rural	9.2	9.3	9.2	9.2	9.2	9.3	9.0	97.8
Total WMZ 3	310.4	310.1	309.9	309.7	310.1	309.9	306.4	98.7

Indicator	2007	2008	2009	2010	2011	2012	2013	2013 / 2007, %
Urban	89.1	89.1	89.0	89.0	89.3	89.4	89.6	100.5
Rural	221.3	221.1	220.9	220.9	220.8	220.6	216.8	98.0

Source: GOPA calculation based on NBS data

The gender distribution of the population in the country is kept practically the same for the long period of time, with small deviations: around 52% of women and 48% of men. In 2013 in the Republic of Moldova were registered 51.9% of women and 48.1% of men. In WMZ 3 the gender distribution was the following: women – 51.1% and men – 48.8%. 46.9% men and 53.1% women live in urban area and 49.6% men and 50.4% women – in rural area (Statistica teritoriala, 2013).

The analysis of the statistical data shows that the gender distribution in Moldova is in favour of women despite the fact that traditionally more boys are born annually than girls. In 2010 more than half (51.3%) of the children born alive were boys, masculinity ratio being 105 boys to 100 girls. In the regional profile, this report was as follows: mun. Chisinau and North - 107; Centre - 103; South (including the rayons of interventions) – 109, the TAU Gagauzia has been an absolute equality between the sexes - 50/50 (Femei si barbati in Republica Moldova -2012).

The situation could be explained by the both: the short life expectancy at birth of men and the men high mortality rate comparatively to women. In 2012, the average life expectancy at birth constitutes 67.2 years for men and 75 years for women, gender discrepancies being evident. In the South Development Region the life expectancy at birth is a little bit lower than the average per the country (men – 65.9 years and women-73.5 years). Regarding the WMZ 3, the situation is slightly different. In Cahul rayon, the life expectancy at birth for men is a little bit higher comparatively to the country and SDR indicators (67.4 years) and for women- is less, comparatively to the country, and – higher, comparatively to the SDR indicators (74.9 years). In case of Taraclia rayon, the life expectancy at birth for men is higher, comparatively to the country and to the SDR (67.5 years) and the life expectancy at birth for women is less comparatively to the country indicators, but higher comparatively to the SDR indicators (74.9 years). In Cantemir rayon, the life expectancy at birth for the both: men and women is less comparatively to the country and SDR indicators (men – 63.8 years and women – 72.1 years).

The population continue to age, and this trend is characteristic for all rayons, including those from the WMZ 3. The average age of the Moldova population increased from 36.5 years in 2011 to 37 years in 2013. In the SDR the average age of population is less comparatively to the average indicator per country, but continued to increase during the last years (from 35.6 years in 2011 to 36.1 years in 2013). In the WMZ 3 the situation is the following: in Cahul rayon the average age of population increased from 35.3 years (2011) to 36 years (2013); in Cantemir – increased from 34.2 years (2011) to 34.7 years (2013), in Taraclia rayon – increased from 37.2 years (2011) to 37.7 years (2013) and in Gagauzia from 35.8 years in 2011 to 36.2 years in 2013. Based on gender, the average ages of women in RM (38.5 years) is higher than the average ages of men (35.3 years). This tendency is characteristic for rayons in WMZ 3: Cahul – (men -34.4 years and women – 37.8 years), Cantemir – (men – 33.3 years and women -36.0 years), Taraclia – (men – 35.9 years and women – 39.4 years) and in Gagauzia – (men – 34,4 years but women – 37.8), (according the territorial statistic, 2013),

Table 2-18: Stabile population structure dynamics, in three age groups, urban and rayonal in WMZ 3, 2007-2013, %

	2007	2008	2009	2010	2011	2012	2013
Cahul							
0-15 years	17.5	16.8	16.1	15.7	15.2	14.8	14.7
16-65 years	75.2	75.7	76.5	76.7	77.2	77.5	77.7
over 65 years	7.3	7.4	7.5	7.6	7.6	7.6	7.7
Total Cahul	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Cantemir							
0-15 years	17.8	16.7	15.6	15.0	14.5	13.8	13.5
16-65	79.6	80.6	81.6	82.1	82.5	82.9	83.1
over 65	2.5	2.7	2.8	3.0	3.0	3.3	3.4
Total Cantemir	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Taraclia							
0-15 years	19.8	18.9	18.2	17.7	17.3	17.1	16.8
16-65	71.9	72.8	73.5	73.9	74.4	74.9	75.4
over 65	8.3	8.4	8.3	8.4	8.3	8.0	7.8
Total Taraclia	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Gagauzia							
0-15 years	18.7	18.3	17.9	17.8	17.6	17.5	17.5
16-65 years	71.8	71.9	72.5	72.8	73.2	73.3	73.4
Over 65 years	9.5	9.8	9.5	9.4	9.2	9.2	9.1
Total Gagauzia	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: GOPA calculation based on NBS data

The economically active population of the Republic of Moldova is in constant decline for the last ten years. In 2013 it was about 1235.8 thousand people. The activity rate of the population aged 15 and over was 41.4% in 2013, with higher values for men (44.5%) than women (38.6%). In the SDR, including the Project intervention area the economically activity rate constituted 33.7%. The economically activity rate for men was higher than the economically activity rate for women (men – 34.6% and women – 32.9%). (Forta de munca in Republica Moldova: ocupare si somaj, 2014)

The activity rate of population of the RM aged 15 years and over was 39.3% in 2013, down to registried values in 2011 (39.4%). For men this rate was higher (41.8%) comparative with women (37.0%).

Table 2-19: Population structure dynamics, in three age groups, rural and rayonal in WMZ 3, 2007-2013, %

	2007	2008	2009	2010	2011	2012	2013
Cahul							
0-15 years	23.4	22.6	21.9	21.1	20.6	20.2	19.9
16-65 years	67.3	68.0	68.7	69.6	70.3	70.8	71.2
over 65 years	9.3	9.3	9.5	9.3	9.1	9.0	8.9
Total Cahul	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Cantemir							
0-15 years	24.8	24.1	23.1	22.3	21.8	21.3	21.2

	2007	2008	2009	2010	2011	2012	2013
16-65	66.9	67.8	68.6	69.5	70.2	70.7	70.9
over 65	8.3	8.2	8.2	8.2	8.0	7.9	7.9
Total Cantemir	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Taraclia							
0-15 years	19.9	19.5	19.0	18.6	18.2	17.9	17.5
16-65	68.6	69.0	69.4	69.8	70.1	70.6	71.1
over 65	11.5	11.5	11.6	11.6	11.7	11.6	11.4
Total Taraclia	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Gagauzia							
0-15 years	22.2	21.4	21.0	20.6	20.2	20.0	19.8
16-65 years	69.5	70.6	71.5	72.2	72.7	73.2	73.5
Over 65 years	8.3	8.1	7.5	7.2	7.0	6.8	6.7
Total Gagauzia	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: GOPA calculation based on NBS data

The employment rate increases for both: men and women with the increasing of the level of education. Thus, the employment rate among the men and women with highest level of education is higher (men – 64.7% and the women – 55.3%) than the employment rate among the men and women with gymnasium education (men – 30.8% and women – 25.8%). In the SDR, the employment rate of population aged 15 and over constituted 31.8%, with higher values for men (32.2%) than for women (31.5%). (Forta de munca in Republica Moldova: ocupare si somaj, 2014).

The analysis of employment activities in function of gender shows that there are significant discrepancies in the employment of women and men in different spheres. Thus, the women mostly are employed in health, education, social protection and public administration (70% women and 30% men), in hotels and restaurants (58% women and 42% men). The men mostly are employed in construction (91% men and 9% women), transport and communications (76% men and 24% women), industry (54% men and 46% women). (Forta de munca in Republica Moldova: ocupare si somaj, 2014.

The same tendency is characteristic for all development zones of Moldova. As per their occupation and work status, the women are mostly employed in low-paying jobs and occupy lower positions in the job hierarchy where they are employed. The statistical data show that the women are dominant in the group of specialists with higher level of qualification (64% women and 36% men), in the group of specialists with medium qualification (67% women and 33% men), in the group of workers in services, trade (62% women and 38% men). Meantime the men predominate in the group of managers and senior officials (61% men and 39% women), in the group of qualified workers (72% men and 28% women). (Forta de munca in Republica Moldova: ocupare si somaj, 2014).

According to the survey done by the National Bureau of Statistics in 2013, 81.5 thousands of women comparatively with 16.5 thousands of men manifested the willingness to change their situation at the job place, in order to use in a more adequate way their level of capacities and qualification. (Forta de munca in Republica Moldova: ocupare si somaj, 2014).

The size of households in the Development Region South shows some typical trends, similar to other developing regions, which allows us to make some conclusions on the structure of households in the project area. Thus, in 2007-2013 there is a 45% increase in the share of families with one member, and 9% for the families of two people. This means an increased share of families who do not have children. Simultaneously significantly decreases the share of families with three or more persons involving the presence of at least one child (see Table 2-20).

Table 2-20: Structure dynamics of households by size in SDR, 2007-2013, %

	2007	2008	2009	2010	2011	2012	2013	2013/2007
1 person	19.1	22.1	21.9	19.4	23.7	24.4	27.6	1.45
2 persons	29.1	28.6	25.6	29.3	30.3	31	31.6	1.09
3 persons	20.4	18.7	19.6	21.6	19.5	16.5	17	0.83
4 persons	17.6	17.5	17.5	15.5	14.9	15.5	12.9	0.73
5 persons and more	13.7	13	15.4	14.1	11.7	12.6	11	0.80

Source: GOPA calculation based on NBS data

The data on the average size of households in WMZ 3 with an urban/rural profile was obtained from the Census of 2004. Thus it can be seen that the average household size is greater than the average for the SDR and Moldova. At the same time, in rural areas the average household size is higher than in urban areas (see Table 2-21). The largest household was registered in Gagauzia while the smallest – in Cahul rayon.

Table 2-21: Household size in rural and urban areas in the rayons of WMZ 3 and the Republic of Moldova, 2004, persons

	Republic of Moldova	SDR	WMZ 3	Cahul Rayon	Cantemir Rayon	Taraclia Rayon	Gagauzia
Total	**3.0**	**3.2**	**3.3**	**3.2**	**3.4**	**3.4**	**3.5**
Urban	2.8	3.0	3.0	2.8	2.9	3.3	3.1
Rural	3.1	3.3	3.5	3.4	3.5	3.5	3.8

Source: GOPA calculation based on population census data from 2004

2.8.4.2 Population forecast in the WMZ 3

The comparative analysis of demographic data obtained from NBS and data from interviews with LPA representatives from the rayons of the WMZ 3 shows that the real population (de facto) living in these regions show lower values than the present population. Thus to provide demographic forecasts for WMZ 3 with a higher degree of credibility the number of people present for the base year 2013 was reduced by approximately 3% to bring them closer to the de facto population living in these rayons.

To determine forecasts of population development, the average annual growth rate of population from the rayons in the project area was calculated, which was then extrapolated for the period 2014-2040. After calculating the average annual rate of population growth in settlements in the project area for 2007-2013 and assuming a stable population trend was obtained, forecasts were created for trends and demographics in WMZ 3's selected districts for the period 2014-2040. This generally implies a decrease of about 4% or about 13 thousand people, from 299,000 people in 2014 to 28,000 persons in 2040 in WMZ 3. The demographic forecasts for Cahul, Cantemir, Taraclia, Ceadir-Lunga and Vulcanesti are presented in Annex 1.

To establish some minimum and maximum limits of forecasting demographic development in the rayons of the project area, an analysis was performed on the pessimistic and optimistic scenarios for the project area and for each rayon separately.

Optimistic and pessimistic scenario analysis, taking as a basis the extreme values of standard variation implies a increase in total for WMZ 3 of about 22% or about 68,000 people in the period from 2015 to 2040 in the optimistic scenario, and a decrease of about 19% or about 56 thousand in the same period in the pessimistic scenario for WMZ 3.

Demographic trends in the rayons of WMZ 3 have certain peculiarities. Thus in the rayon of Cahul during 2015-2040 a very moderate increase in population is assumed, based on population forecast a moderate reduction in rural areas and a slight increase in urban population.

The population of the rayon of Cantemir, beside the fact that it has a much lower share of urban population than the other rayons of WMZ 3, it is assumed that the population will uniformly decrease in both urban and rural areas, about 5-6% during the years 2014-2040.

In forecasts the rayon of Taraclia shows the greatest decrease in population in WMZ 3, approx. 22% in urban areas and approx. 33% in rural areas, and beginning with 2030 the share of rural population will be greater than that of the urban areas. In Ceadir-Lunga rayon there is predicted a dynamic increase of population of about 4 % in period 2015-2040, including in urban area with 8% and in rural area with 2%.

The forecast for Vulcanesti rayon anticipate a slight decrease of population number with about 2% in the analysed period, but which foresee an increase of urban population with 2% and a decrease of rural population with 8%, specific of this rayon being a higher share of urban population than rural.

Table 2-22: Population forecast in the rayons of WMZ 3, optimistic and pessimistic scenarios, urban and rural profile, 2015-2040

	2015	2020	2025	2030	2035	2040
Cahul						
Rural optimistic	77,190	77557	77,927	78,298	78,670	79,045
Rural pessimistic	76,590	75,467	74,360	73,269	72,195	71,136
Urban optimistic	36128	37,521	38,968	40,470	42,031	43,652
Urban pessimistic	35,188	34,214	33268	32,347	31,452	30,528
Cantemir						
Rural optimistic	52,244	53,790	55,381	57,019	58,706	60,442
Rural pessimistic	50,831	48,868	46,980	45,166	43,421	41,744
Urban optimistic	6,261	6,416	6,575	6,737	6,904	7,075
Urban pessimistic	6,080	5791	5,515	5,253	5,003	4,765
Taraclia						
Rural optimistic	22,810	26,035	29,716	33,918	38,713	44,187
Rural pessimistic	19,247	14,367	10,725	8,006	5,976	4,461
Urban optimistic	20,286	22,348	24,619	27,122	29,879	32,916
Urban pessimistic	18,069	14,907	12,298	10,145	8,369	6,904
Ceadir-Lunga						
Rural optimistic	43,922	44,913	45,926	46,963	48,022	49,106
Rural pessimistic	43,244	42,535	41,838	41,152	40,477	39,813

Urban optimistic	20,040	21,223	22,475	23,802	25,206	26,694
Urban pessimistic	19,367	18, 831	18,310	17,804	17,311	16,832
Vulcanesti						
Rural optimistic	9,398	9,760	10,137	10,528	10,934	11,356
Rural pessimistic	8,989	8,355	7,765	7,217	6,707	6,234
Urban optimistic	15,550	15,931	16,321	16,720	17,129	17,548
Urban pessimistic	15,298	15,045	14,796	14,551	14,310	14,073

Source: GOPA calculation based on NBS data

As a basis for future demographic forecasting the neutral scenario was chosen, allowing for more robust calculations on the cost of the project.

2.8.5 Sources of income

2.8.5.1 Current situation of revenue

As per the statistical data, the average monthly income per person in Moldova increased from 1188.8 lei in 2008 to 1508.8 lei in 2012. The analysis of the monthly income per person in regional aspects, reveal big discrepancies in the size of income. The income per person in Chisinau municipality exceed the overall country average by 1.4 times and in all the other regions the income level, although increased compared to the previous period, is placed below the national average. In the SDR, the monthly income per person was with 17% less than the average income per country. (Statistica teritoriala, 2013).

Note that regional differences in the size of wages, social benefits and remittances exist. Thus the average disposable income per person in the Southern Region in 2013 was the lowest (1419 MDL) vs. Northern Region (1573 MDL) and Central (1438 MDL). The same trend is observed in the profile rural / urban. Some differences can be observed in the structure of disposable income. Thus the income from employment in the South Development Region in 2013 (437 lei) was lower than in the North Region (464 MDL) and Central (512 MDL). At the same time payments and social benefits from remittances in the South developing region is higher than in the Central Development Region, but lower than in the North Development Region.

The analysis of the available income in different regions of development in the Republic of Moldova shows similar trends of increasing available revenue in all areas of development during the years 2007-2013. There are also some differences. Thus in the North region the recorded revenue growth was greater than in the Central and South regions (see Table 2-23).

Table 2-23: Available income dynamics in different areas, 2007-2013, monthly average lei per one person

	2007	2008	2009	2010	2011	2012	2013	2013 / 2007
North	917.8	1,079.0	1,037.2	1,194.9	1,320.9	1,412.6	1.572.6	171.3
Centre	896.8	1.045,8	990.1	1,086.5	1,254.4	1,317.2	1,437.9	160.3
South	881.3	974.0	973.6	1,106.7	1,208.1	1,247.2	1,419.1	161.0

Source: GOPA calculation based on NBS data

There are differences in the amount of available revenue in rural and urban areas. Thus, in 2013 a resident of a village had an average disposable income which was 16.4% lower than the average in the country. At the same time urban dwellers had an average disposable income which was 21.7% higher than the average for the country (see Table 2-24).

Table 2-24: Available income dynamics in urban and rural areas, 2007-2013, average monthly lei per one person, % of the country average

	2007	2008	2009	2010	2011	2012	2013	2013 / 2007
Total RM	**1,018.7**	**1,188.6**	**1,166.1**	**1,273.7**	**1,444.7**	**1,508.8**	**1,681.4**	**165.1**
Urban	1,210.0	1,463.3	1,477.1	1,574.7	1,792.8	1,869.0	2,046.2	169.1
% of the total in RM	118.8	123.1	126.7	123.6	124.1	123.9	121.7	
Rural	878.9	987.0	939.2	1,054.7	1,186.4	1,242.8	1,406.1	160.0
% of the total in RM	86.3	83.0	80.5	82.8	82.1	82,4	83.6	

Source: GOPA calculation based on NBS data

Based on the values of disposable income across regions and urban and rural areas, estimates of income in urban and rural areas of the SDR were calculated.

Thus according to our estimates the amount of income available to rural SDR was about 1,187 lei, while in rural areas about 1727 lei in 2013.

There are significant differences between different levels of disposable income. Thus in 2013, RM lowest average level of disposable income was 918 MDL and the highest was 2920 MDL. In urban areas the differences between the bottom (963 MDL) and top (3072 MDL) were more pronounced, while in rural areas the differences between the bottom (909 MDL) and top (2611 MDL) were less notable.

Table 2-25: Available income dynamics in the development region south, urban /rural profile, 2007-2013, average monthly lei per one person, %

	2007	2008	2009	2010	2011	2012	2013	2013 / 2007
SDR	881.3	974.0	973.6	1,106.7	1,208.1	1,247.2	1,419.1	161.0
Urban	1,046.8	1,199.1	1,233.3	1,368.2	1,499.2	1,544.9	1,727.0	165.0
Rural	760.4	808,8	784.2	916.4	992.1	1,027.3	1,186.7	156.1

Source: GOPA calculation based on NBS data

There are significant differences between different levels of disposable income. Thus in 2013, RM lowest average level of disposable income was 918 MDL and the highest was 2920 MDL. In urban areas the differences between the bottom (963 MDL) and top (3072 MDL) were more pronounced, while in rural areas the differences between the bottom (909 MDL) and top (2611 MDL) were less notable.

Analysis of data on disposable income in 2007-2013 allows certain conclusions. The lowest level of income (I quintile) increased in 2007-2013 to about 87%, while the highest (V quintile) in the same period increased only by 59%. Similar trends are observed in the profile urban / rural. Thus, the urban area of the I quintile income in the period 2007 - 2013 increased by 69% and 54% for the V quintile, while in rural areas during the same period the income level at I quintile increased by 95% and the V quintile by 63% (see Table 2-26).

Table 2-26: Average monthly disposable income per person by quintiles, 2007-2013, MDL

	Quintile	2007	2008	2009	2010	2011	2012	2013
Total RM	I	491.4	608	544.9	624.4	754.3	812.6	917.9
	II	727.8	814.5	832.4	942.9	1,047.5	1,071.1	1,218.2
	III	899.9	1,055.9	1,055.4	1,174.7	1,292.8	1,371.5	1,479.1
	IV	1,143.5	1,366.9	1,375.2	1,453.1	1,638.4	1,669.8	1,872.3
	V	1,830.7	2,097.8	2,021.2	2,173.3	2,490.6	2,623.6	2,919.6
Urban	I	569.7	682.3	622.3	699.4	855.2	865.6	962.8
	II	730.9	869.2	883.6	977.4	1,097.2	1,168.8	1,296.6
	III	934.4	1,106.5	1,122.4	1,203.9	1,392.7	1,414.2	1,504.7
	IV	1,187.2	1,495.2	1,445.9	1,474.8	1,717.6	1,771.2	1,972.5
	V	1,989	2,226.2	2,165.3	2,297.9	2,630.0	2,741.9	3,072.3
Rural	I	465.3	589.7	529.3	609.8	734.4	800.2	908.6
	II	726	786.2	810.8	930	1,025.4	1,035.0	1,183.5
	III	875.6	1,017.1	1,010.0	1,155.0	1,223.8	1,341.6	1,460.5
	IV	1,099.9	1,242.2	1,291.0	1,425.4	1,535.8	1,549.5	1,732.7
	V	1,604.6	1,858.7	1,691.0	1,874.4	2,187.0	2,331.0	2,610.9

Source: GOPA calculation based on NBS data

In function of gender, the average female salary represented only 87.1 percent of the average male salary per country in 2012. The gap persists because women, most often, either work in lower-paid sectors – education, healthcare or services - or occupy lower-paid positions. (Statistica teritoriala, 2013).

In the SDR, the situation is slightly different, the average female salary representing 94.5% of average male salary. In WMZ 3 there are some peculiarities in the remuneration of women and men. NBS data for 2011-2012 show that on average in the Republic of Moldova and the regions North, Central and South wages are higher for men than for women by about 6-15%. While in Cantemir, Taraclia and Gagauzia during 2011-2012, women had a higher salary on average than men of up to 5%, but in the coming years this discrepancy has disappeared (see Table 2-27).

Table 2-27: Gender specific gross average monthly earnings per specified areas and rayons, 2011-2012, MDL

	2011			2012		
	Women	Men	Men vs. Women, %	Women	Men	Men vs. Women, %
Total RM	**2856.6**	**3252.9**	**87.8**	**3459.6**	**3913.8**	**88.4**
North	3359	3916.8	85.8	4112.2	4560.1	90.2
Center	2530.9	2700.7	93.7	3039.5	3306.2	91.9
South	2417	2581.2	93.6	2839.8	3221.1	88.2
Cahul	2254.7	2418.4	93.2	2727.4	2959.5	92.2
Cantemir	2307.4	2711.9	85.1	2879.7	3164.2	88.2
Taraclia	2165.5	2115.6	102.4	2550.5	2625.2	97.2
Ceadir-Lunga	2357.1	2233.8	105.5	2711	2976.4	91.1

	2011			2012		
	Women	Men	Men vs. Women, %	Women	Men	Men vs. Women, %
Vulcanesti	2313.6	2303.4	100.4	2826.7	2984.7	94.7

Source: GOPA calculation based on NBS data

The inequality in income of men and women became more evident when analyzing the unremunerated household work done by men and by women. As per the statistical data, the unremunerated household work in Moldova constitute in average 3.9 hours per day per person (in urban area – 3.8 hours, in rural area – 4.9 hours). The women spend in average 4.9 hours for household work per day (in rural area – 5.9 hours and in urban area – 4.4 hours) and the men – 2.8 hours per day (in rural area – 3.9 hours and in urban area – 2.7 hours). (Utilizarea timpului in Republica Moldova, 2013).

The monthly expenditures are the reverse of the monthly incomes and show the same discrepancies among Chisinau municipality and the regions, the larger expenditures being characteristic for the Chisinau municipality (2243.2 lei) and the smallest expenditures - for the SDR(1,348.2 MDLx).

2.8.5.2 Aspects of revenue forecast

To estimate changes in the level of disposable income in the South Development Region and WMZ 3, forecasts were made under the assumption that income level in rural areas of South Development Region will increase by 2.5% and in urban areas by 5,0%, while the average in the region by 4.5%. These presumptions are correlated with the level of GDP growth forecasts for the country during 2015-2040.

These forecasts show that in 2040 the disposable income in rural areas of South Development Region will increase by about 94% compared to 2013 and will reach 2.626 lei. In urban areas of the region disposable income will increase by 3.7 times in 2040 compared to 2013 and will be 5.919 lei, while the average level of disposable income for the region will be 4,658 lei by 2040 (see Table 2-28).

Table 2-28: Available income forecast in the rayons of WMZ 3, urban/rural profile, 2015-2040

	2013	2015	2016	2017	2018	2019	2020	2025	2030	2035	2040
SDR	1,419.1	1,549.7	1,619.4	1,692.3	1,768.5	1,848.0	1,931.2	2,406.6	2,999.1	3,737.4	4,657.5
Urban	1,585.3	1,747.8	1,835.2	1,926.9	2,023.3	2,124.5	2,230.7	2,847.0	3,633.5	4,637.4	5,918.6
Rural	1,348.5	1,416.8	1,452.2	1,488.5	1,525.7	1,563.8	1,602.9	1,813.6	2,051.9	2,321.5	2,626.6

Source: GOPA calculation based on NBS data

2.8.6 Unemployment

The average unemployment rate in the Republic of Moldova decreased in 2013 comparatively to 2011 with 1.6% and was 5.1%. The number of officially registered unemployed in the rayons of WMZ 3 is relatively high and in 2012 it was 2,4897 persons, of which in Cahul - 737 people, Cantemir - 334 people, Taraclia - 687 people and in Gagauzia – 1139 persons. In relation to % of working age population, these figures show that in Cahul only 0.9% of people of working age are officially registered as unemployed. In Cantemir this indicator is 0.8%, in Taraclia - 2.4%, in Gagauzia -1.1% and the average in the South development region is 0.9%. In relation to the number of persons employed, the unemployment is slightly higher and reaches 3.6% in Cahul, 4.8%

in Cantemir, 10.5% in Taraclia, 4.1% in Gagauzia and the average for the SRD is 4.7% (see Table 2-29).

Table 2-29: The number of unemployed in the rayons of WMZ 3 and their share of the total fit for work and employed population, 2012

	2012	% of working age population	% of the employed population
SDR	3,348	0.9	4.7
Cahul rayon	737	0.9	3.6
Cantemir rayon	334	0.8	4.8
Taraclia rayon	687	2.4	10.5

Source: GOPA calculation based on NBS data

The number of officially registered unemployed in the rayons of the WMZ 3 increased quite dynamic in 2008-2012. The annual average rate increased by 18.4% in Cahul, 9.9% in Cantemir, 13.0% in Taraclia, WMZ 13.5% and 7.1% in SDR (see Table 2-30).

At the same time official data about the number of unemployed does not include temporary or seasonal unemployment, and also people who are unemployed, but do not want to be officially registered as unemployed.

Table 2-30: Unemployed dynamics in the rayons of WMZ 3 and the average annual increase in the number of unemployed, 2008-2012

	2008	2009	2010	2011	2012	2012 / 2008, %	Average annual growth %
SDR	3,022	5,313	5,206	4,735	3,348	110.8	107.1
WMZ 3	1,218	2,287	2,438	2,533	1,758	144.3	113.5
Cahul	477	938	1109	1361	737	154.5	118.4
Cantemir	288	534	593	366	334	116.0	109.9
Taraclia	453	815	736	806	687	151.7	113.0

Source: GOPA calculation based on NBS data

2.8.7 Social aspects of project implementation

Observations made by experts during field visits have identified activity on the waste accumulation polygon in the city Cahul, by a group of collectors sorting waste for processing.

Figure 2-2: Waste collectors at the Cahul existing landfill, 12, September 2014

Further research, conducted during in-depth interviews with representatives of the LPA, people in charge of waste management companies in Cahul and other key individuals, demonstrated that the given group of collectors consists of 4 persons (3 men and a woman), natives from the village of Cotihana.

These persons are employed by a private company, which in turn has signed a contract with the landfill operator or garbage collection from the city of Cahul. Earlier, this sorting and collection of plastic containers and other plastic items was organized by the operator, but begining with this year, after some calculations showed that this activity is not profitable for the company, this activity was subcontracted to a private company.

This company pays the landfill operator, a monthly payment of 2,000 MDL, for the right to collect plastic containers from the landfill in the city of Cahul. The containers are collected in big bags (see Figure 2-2) to be transported to the processor in the village of Peresecina, rayon of Orhei.

3 Current situation on waste generation and prognosis

The assessment of the current situation regarding the generated waste quantities and the way waste is managed in WMZ 3 has been carried out based on the information provided by the public local authorities and the existing sanitation operators.

The data and information collection process has been carried out in many stages:

- During April – May 2014 – for rayons Cahul, Cantemir and Taraclia:
    - Questionnaires were developed; they were sent to be filled out by the public local authorities where there is a sanitation service, as well as to the existing sanitation operators. The representatives of the Regional Development Agency South have provided support both in terms of sending the questionnaires to the LPAs and Operators and collection of the answers;
    - Meetings with the representatives of the LPAs and sanitation operators took place during which the questions of the questionnaires were clarified and additional information was collected;
- September 2015 – for rayons Vulcanesti and Ceadir-Lunga:
    - Questionnaire was developed; it was sent to the public local authorities where there is a sanitation service;
    - Meetings with the representatives of the LPAs took place during which the questionnaires were filled out;
- October 2015 – for rayons Cahul, Cantemir and Taraclia:
    - Discussions with the representatives of the public local authorities and the sanitation operators regarding the projects implemented during May 2014 – October 2015.

The following data and information were requested through the questionnaires:

- From the public local authorities:
    - Number of population in each locality allocated to the public local authority;
    - Population per locative structure;
    - Data regarding the locative structure;
    - Information regarding the sanitation service;
    - Municipal waste collection method and frequency;
    - Endowment with collection vessels for mixed and separately collected waste;
    - Information regarding the collection and transport vehicles, including type, capacity, year of fabrication; average fuel consumption;;
    - Information regarding the coverage rate with sanitation services;
    - Information regarding waste treatment and disposal;
    - Information regarding the payment for the sanitation service;
    - Information regarding the on-going projects in the field of waste management;
- From the sanitation operators:
    - Data regarding the operator – legal status, number of employees, average age and tenure of the employees, etc.;
    - The served public local authorities (service area);
    - Municipal waste collection method and frequency;

- Endowment with collection vessels for mixed and separately collected waste;
- Information regarding the collection and transport vehicles, including type, capacity, year of fabrication; average fuel consumption;
- Estimated municipal solid waste generation per sources;
- Information regarding waste treatment and disposal;
- Information regarding the payment for the sanitation service;
- Financial information regarding the activity of the operator.

The data and information for rayons Cahul, Cantemir and Taraclia, received during April – May 2014, were presented and discussed within the second meeting of the Project Work Group which took place in Cahul on 2 July 2014, meeting organized by the Ministry of Regional Development and Construction and the Regional Development Agency South.

All the collected data and information were summarised in a data base. The results of the collected data and information analysis are presented below in this chapter, as well as in chapter 4.

3.1 Waste amounts

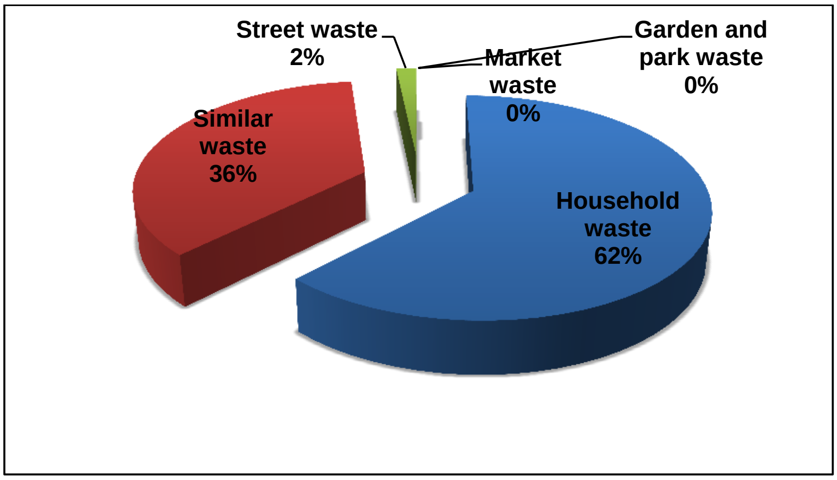
The scope of the Feasibility Study is the management of the municipal waste in the waste management zone. Municipal waste comprises the following types of waste:

- Household waste – waste generated by households;
- Similar waste – waste in nature and composition comparable to household waste, excluding production waste and waste from agriculture and forestry;
- Green waste – garden and park waste;
- Street waste – street cleaning residues;
- Bulky waste;
- Market waste.

In 2015, in WMZ 3 there were 15 sanitation operators (information regarding the existing operators are presented in chapter 4.1). According to the data provided by the operators, the coverage rate with sanitation services was of approximately 31% of which 74 % in urban areas and 10 % in rural areas.

The total municipal waste quantity collected in 2013 in Cahul, Taracalia and Cantemir rayons, as per the estimation of the operators, was of 17,200 tonnes. The structure of the municipal waste collected in these three rayons per source of generation is presented in Figure 3-1.

Figure 3-1: Structure of municipal waste collected in Cahul, Taraclia and Cantemir rayons, per source of generation, 2013



Source: GIZ/MLPS, based on data reported by the waste management operators

According to the information provided by the operators, most of the quantity of waste collected in 2013 was collected in Taracilia Rayon (approximately 45 % of the total in the WMZ), the quantity collected in Cantemir Rayon represents 30 %, and the quantity collected in Cahul Rayon represents 25 %.

The analysis of the data and information provided by the sanitation operators and the public local authorities led to the following conclusions:

- In LPAs with sanitation operators, the sanitation service does not cover the entire population within the jurisdiction;
- Since the collected waste is taken to non-compliant landfills, which are not equipped with weighbridges, the reported data on collection and disposal of waste are approximate, most often expressed in m^3;
- There is no separate record of the quantities of municipal waste collected per source of generation.

For Vulcanesti and Ceadir-Lunga rayons data regarding the waste generation was not available for each municipal waste category.

Due to the fact that currently only approximately 31 % of the population of the zone receives waste collection service, it is necessary to estimate the quantity of municipal waste currently generated in the entire zone.

The estimation of the quantity of household waste is carried out based on the following waste generation indicators, which have been established in the Report *"Analysis of household waste in urban and rural areas"*, July 2014, elaborated by GIZ/MLPS and presented in Annex 2:

- Rural area – 0.4 kg/inhabitant x day;
- Urban area, towns with population up to 15,000 inhabitants – 0.5 kg/inhabitant x day; applies to Cantemir, Taraclia and Tvardita towns;
- Urban area, towns with population between 15,000 and 40,000 inhabitants – 0.7 kg/inhabitant x day, applies to Cahul, Ceadir-Lunga and Vulcanesti towns.

The quantities of other types of municipal waste were estimated taking into account the following assumptions, based on European Union statistical data and the experience from other countries similar to the Republic of Moldova:

- Similar waste – 25% of the total household waste in urban areas and 10 % in rural areas;
- Green waste (garden and park) – 0.05 kg/capita/day in urban areas;
- Street waste, bulky waste and market waste – total of 10% of household waste in urban areas.

The waste quantity generated in 2013 is estimated based on these assumptions and considering the population of the zone.

Table 3-1: Estimated quantities of municipal waste generated in WMZ 3 in 2013

Type of municipal waste	Estimated quantity of generated municipal waste (tonnes/year)
Municipal waste from urban area, out of which:	**32,462**
Household waste	22,746
Similar waste	5,686
Garden and park waste	1,756
Street waste, bulky waste and market waste	2,274
Municipal waste from rural area, out of which:	**32,584**
Household waste	29,621
Similar waste	2,963
Total municipal waste generated in the zone	**65,046**

Source: GIZ/MLPS

3.2 Waste composition

The estimation of the household waste composition in urban area has been carried out based both on analyses carried out during May – June 2014, as well as based on the results of the analyses carried out in the Republic of Moldova, the results being presented in the Report *"Analysis of household waste in urban and rural areas"*, July 2014, elaborated by GIZ/MLPS and presented (Annex 2).

Table 3-2: Estimated composition of household waste

Type of waste	Composition of household waste in urban area (%)	Composition of household waste in rural area (%)
Plastic	10	5
Paper & cardboard	5	2
Glass	4	4
Metal	3	1
Organic	55	35
Textile	3	3
Inert	5	35
Other	15	15

Source: GIZ/MLPS

The estimation of the composition of similar household waste was carried out based on the experience of countries similar to the Republic of Moldova, for example Romania, and is presented in Table 3-3.

Table 3-3: Estimated composition of similar waste

Type of waste	Composition of similar waste in urban area (%)	Composition of similar waste in rural area (%)
Plastic	20	10
Paper & cardboard	40	40
Glass	10	10
Metal	5	5
Organic	7	15
Textile	8	8
Inert	3	5
Other	7	7

Source: GIZ/MLPS

The composition of municipal waste, presented in Table 3-4, has been estimated based on the estimated compositions of household waste and similar waste and taking into account the share of these types of municipal waste.

Table 3-4: Estimated composition of municipal waste

Type of waste	Composition of muncipale in urban area (%)	Composition of municipal waste in rural area (%)
Plastic	12.00	5.45
Paper & cardboard	12.00	5.45
Glass	5.20	4.55
Metal	3.40	1.36
Organic	45.40	33.18
Textile	4.00	3.45
Inert	4.60	32.27
Other	13.40	14.29

Source: GIZ/MLPS

3.3 Waste prognosis

The municipal waste projection is calculated using the reference year 2013 based on:

- Population projections;
- Forecasts of the municipal waste generation indicators.

The population projection in WMZ 3 is presented in Chapter 2.8.

The municipal waste generation indicators estimated for 2013 are presented in Chapter 3.1. In terms of the forecast of municipal waste generation indicators, the following assumptions are considered:

- Municipal waste generation indicators increase in ratio with the GDP growth rate until 2025 (an increase rate of 20 % of the GDP increase rate), after which remain constant;

- In towns with populations above 15,000 inhabitants (Cahul, Vulcanesti and Ceadir-Lunga) an annual increase of GDP of 5 % is considered; in towns with a population up to 15,000 inhabitants an increase of 3.75 % is considered and in rural areas an annual increase of 2.5 % is assumed.

Based on the assumptions above, the municipal waste projection for 2013 – 2042 was calculated for each LPA in the five rayons of the WMZ 3, as well as for the total waste in the zone; the forecast is presented in Annex 3. The estimated municipal waste quantities in each rayon, as well as the total in WMZ3, are presented in Table 3-5 for the following reference years:

- 2013 – calculation basis for the prognosis;
- 2018 – year in which the integrated waste management system is assumed to be operational;
- 2020 – year in which the recyclable waste separate collection rate is considered to increase; and
- 2025, 2030, 2035 and 2040.

Table 3-5: Municipal waste generation prognosis in the reference years

Rayons/WMZ 3	Quantity of municipal waste						
	2013	2018	2020	2025	2030	2035	2040
Cahul Rayon	25,297	26,273	26,676	27,507	27,516	27,525	27,535
Cantemir Rayon	9,934	10,101	10,168	10,284	10,178	10,073	9,969
Taraclia Rayon	8,639	8,424	8,341	8,086	7,638	7,217	6,821
Ceadir- Lunga Rayon	14,104	14,639	15,056	15,664	15,813	15,966	15,966
Vulcanesti Rayon	16,123	7,073	7,411	7,545	7,821	7,821	7,821
TOTAL WMZ 3	**65,046**	**66,985**	**67,787**	**69,362**	**68,966**	**68,603**	**68,269**
Total urban	**32,463**	**33,974**	**34,594**	**35,867**	**35,817**	**35,781**	**35,756**
Total rural	**32,584**	**33,011**	**33,193**	**33,495**	**33,149**	**32,822**	**32,513**

Source: GIZ/MLPS

The table shows a total increase of 1 % of the quantity of municipal waste generated at the end of the forecast period compared to the reference year 2013. Furthermore, it may be noticed that the waste generated in rural areas has a similar share with the waste generated in urban areas.

4 Status of current arrangements

4.1 Collection and transport of municipal waste

Based on the analysis of data provided by local authorities and operators, 15 LPAs have an organised waste management service. In the table below the existing waste management operators are presented.

Table 4-1: LPAs with waste management service, 2015

Rayon	LPA	Waste management operator
Cahul	Cahul	ME GCL Cahul
	Manta	Primaria Manta
Taraclia	Tvardita	ME Tvardisan
	Taraclia	ME Apa Canal Taraclia
Cantemir	Cantemir	ME GCL Cantemir
	Baimaclia	ME Baimac-Serv
	Cania	ME Primcan
	Cociula	ME Codrii Cociuliei
	Gotesti	ME Prosper Gotesti
	Tiganca	ME Colser Servicii
Ceadir-Lunga	Ceadir-Lunga	ME GCL Ceadir-Lunga
	Cazaclia	ME Supacservice
	Besghioz	ME Temiz SU
	Tomai	ME Tomai Berecheti
Vulcanesti	Vulcanesti	ME GCL Vulcanesti

Source: GIZ/MLPS, based on data reported by the waste management operators and LPAs

According to the data reported by the operators, the coverage rate with sanitation services was approximately 31 % in 2015, of which 89 % in urban areas and 4.9 % in rural areas.

Household waste collection is carried out as follows:

- In towns – door-to-door collection in areas with single-family dwellings and using centralised collection points areas with multi-unit dwellings;
- In rural areas – door-to-door, except Manta Commune, where waste is collected using centralised collection points. In the Baimaclia and Cania communes in Cantemir Rayon, plastic bags are used for waste collection. In the rest of the localities, bins are used for waste collection.

In accordance with the information provided by the sanitation operators, the collection frequency for household and similar waste in 2015 was as follows:

- In areas with single-family dwellings both in urban and rural areas – once / week, except Vulcanesti, Manta and Cazaclia where the collection frequency is twice / month;
- In area with multi-unit dwellings in urban areas – daily in Cahul town, 3 times / week in Cantemir town and once / week in Taraclia and Tvardita towns;

- For institutions and economic agents in urban and rural areas – once / week in Taraclia, Tiganca, Gotesti and Tomani, twice / week in Tvardita and the rest of the localities upon request.

Table 4-2 presents the number of household waste collection vessels in 2015, as per the data reported by the waste management operators.

Table 4-2: Number of household waste collection vessels by operator and locality, 2015

Name of the Operator	LPA	Type of vessels	Capacity of the vessels	Number of vessels
IM GCL Cahul	Cahul	metal containers	0.75 m^3	110
		metal containers	1.1 m^3	319
		bins	240 l	2,000
		bins	120 l	100
Primaria com. Manta	Manta	bins	120 l	120
		plastic containers	1.1m^3	30
IM Gospodaria Comunal-Locativa Cantemir	Cantemir	metal containers	1.1 m^3	61
		metal containers	0.8 m^3	25
		bins	120 l	450
IM Codrii Cociuliei	Cociula	bins	240 l	280
IM Tvardisan	Tvardita	metal containers	1 m^3	30
IM "Apa Canal Taraclia"	Taraclia	euro containers	0.66 m^3	6
		euro containers	1.1 m^3	46
		euro containers	1.8 m^3	15
		bins	120 l	1,700
IM GCL Ceadir-Lunga	Ceadir - Lunga	metal containers	1 m^3	260
IM Vulcanesti	Vulcanesti	metal containers	0.7 m^3	45
Total vessels, of which:				**5,597**
Containers				**957**
Bins				**4,650**

Source: GIZ/MLPS, based on data reported by the waste management operators

The data analysis shows that only eight of the fifteen LPAs that have waste management services also have household waste collection vessels. The existing collection vessels are either containers (957 metal or plastic containers with capacities between 0.66 m^3 and 1.8 m^3), or bins (4,650 bins with a capacity of 120 l, respectively 240 l). In the other seven public local authorities, household waste collection is carried out using plastic bags (Bailaclia and Cania), or vessels improvised by the population (Gotesti, Tiganca, Cazaclia, Besghioz, Tomai).

Table 4-3 presents the number of collection vessels for the collection of similar household waste from institutions and economic agents in 2013, as per the data reported by the sanitation operators.

Table 4-3: Number of waste collection vessels for waste similar to household waste, by operator and locality, 2015

Name of the Operator	LPA	Type of vessels	Capacity of the vessels	Number of vessels
IM GCL Cahul	Cahul	metal containers	0.75 m^3	88
		metal containers	1.1 m^3	20
IM Gospodaria Co-	Cantemir	metal containers	1.1 m^3	2

Name of the Operator	LPA	Type of vessels	Capacity of the vessels	Number of vessels
munal-Locativa Cantemir		metal containers	1.1 m^3	19
IM Codrii Cociuliei	Cociula	bins	240 l	18
IM “Apa Canal Taraclia”	Taraclia	euro containers	0.66 m^3	5
		euro containers	1.1 m^3	43
		euro containers	1.8 m^3	20
IM GCL Ceadir-Lunga	Ceadir-Lunga	metal containers	1 m^3	20
IM GCL Vulcanesti	Vulcanesti	metal containers	0,7 m^3	15
Total vessels, of which:				**250**
Containers				**232**
Bins				**18**

Source: GIZ/MLPS, based on data reported by the waste management operators

For the collection of waste similar to household waste, only in six of the fifteen LPAs that have waste collection services also have collection vessels; the existing collection vessels are either containers (232 metal or plastic containers with capacities between 0.66 m^3 and 1.8 m^3), or bins (18 bins with a capacity of 240 l). In the other nine LPAs, the waste generators themselves provide vessels for the temporary storage and collection of waste similar to household waste.

The separate collection of recyclable waste is carried out only in Cahul, Cantemir, Taraclia and Ceadir-Lunga towns and Copceac commune as follows:

- Separate collection of PET in all four towns – the collection is carried out in 174 collection points equipped with 174 cages (105 in Cahul, 20 in Cantemir, 34 in Taraclia, and 15 in Ceadir-Lunga);
- Separate collection of PET in rural area, Copceac commune – the collection is carried out in 10 collection points equipped with 10 cages;
- Separate collection of paper and cardboard waste in Cahul and Taraclia – the collection is carried out in 46 collection points equipped with 46 vessels (25 containers in Cahul and 21 cages in Taraclia).

Recyclable waste is collected daily in Cahul town, once/week in Cantemir and Taraclia and twice/week in Ceadir-Lunga.

In Cahul and Cantemir towns, the waste management operators conduct the separate collection of waste, while in Taraclia, Ceadir-Lunga and Copceac, the private companies conduct separate recyclable waste collection.

All fifteen existing waste management operators are equipped with municipal waste collection vehicles (Table 4-4). There is a total number of 34 collection vehicles of which only 8 are specialised collection vehicles manufactured between 2002 – 2012. The rest of the collection vehicles are either of Russian origin – mainly GAZ type trucks (15 pieces), or tractors (11 pieces).

Table 4-4: Number of household waste collection vehicles by operator and locality, 2015

Name of the Operator	LPA	Type of collection vehicle	Collection capacity [m^3]	Number	Build
IM GCL Cahul	Cahul	GAZ - 5204	3.5	1	1988
		GAZ- 5314	7	1	1988
		ZIL-MMZ-4505	7	1	1980

Name of the Operator	LPA	Type of collection vehicle	Collection capacity [m^3]	Number	Build
		Ford - Cargo 1826	14	1	2011
		GAZ -483213309	7.5	1	2003
		GAZ - 483213307	7.5	1	2003
		GAZ- 5314	3.5	1	1987
		GAZ - 3309	7.5	1	2006
Primaria com. Manta	Manta	Truck	5	1	2002
IM Baimac-Serv	Baimaclia	Tractor MTZ 82-1	4	1	1995
IM Codrii Cociuliei	Ciciula	Truck	10	1	2000
IM Colser Servicii	Tiganca	Tractor XTZ 35	1.5	1	2007
		Truck	7	1	2012
IM Gospodaria Comunal-Locativa Cantemir	Cantemir	Tractor T40 (currently faulty)	4	1	1987
		Truck GAZ 1353	4	1	2006
		Truck GAZ 33, 01553	6	1	2014
		Truck IVECO (currently faulty)	4	1	2006
IM Primcan	Cania	Tractor MTZ 82 (leased)	4	1	-
IM Prosper Gotesti	Gotesti	Tractor NMZ 6	6	1	1998
IM Tvardisan	Tvardita	Truck GAZ 1353	5	1	2005
		Tractor MTZ-80	4	1	1989
IM “Apa Canal Taraclia”	Taraclia	Ford Cargo DCE 5	20	1	2011
		Iveco ML - 120	15	1	2005
		Tractor DT-75	-	1	2005
		Tractor MTZ-80	4	1	2006
IM GCL Ceadir-Lunga	Ceadir-Lunga	Truck	6	1	2004
		Truck GAZ 53	6	1	1980
		Tractor MTZ-80	7	1	1975
IM Supacservice	Cazaclia	Tractor T40	4	1	1985
IM Temiz SU	Besghioz	Truck GAZ 52	18	1	1995
IM Tomai Berecheti	Tomai	Truck GAZ 53	4	1	1981
		Tractor T40	4	1	1976
IM GCL Vulcanesti	Vulcanesti	Truck KO 413	7.5	1	1996
		Truck GAZ 53	6	1	1989
Total vehicles, of which				**34**	
Collection vehicles				**23**	
Tractors				**11**	

Source: GIZ/MLPS, based on data reported by the waste management operators

4.2 Waste treatment

Currently, there are no waste treatment facilities in WMZ3.

4.3 Waste disposal

Currently in WMZ 3, waste is disposed only in dumpsites. According to the database of the Ministry of Environment and information collected by GIZ/GOPA, currently there are 117 dumpsites in the area (51 in Cahul Rayon, 23 in Taraclia Rayon, 29 in Cantemir Rayon, 9 in Ceadir-Lunga Rayon and 5 in Vulcanesti Rayon).

While some of the dumpsites are authorised, none of them are compliant with any environmental requirement. Instead, this only confirms that the land under the dumpsite was designated as a place where waste can be deposited, based on a local council decision.

In Annex 6 are presented all the dumpsites in the zone.

4.4 Financial aspects

For waste management operators, revenues are primarily derived from charges to service users (population, legal entities, etc.) for the waste management services provided. The tariff must ensure full cost recovery but also to be affordable for the clients. The tariff for waste management services is approved by each individual LPAs council in compliance with the existing regulations.

The tariff varies from rural to urban areas and by user group. For the population in urban areas, the tariff level varies from 5 MDL/person/month in Tvardita to 18 MDL/person/month in Vulcanesti, as follows:

- Tvardita - 5 MDL/person/month;
- Taraclia – for the areas with single-family homes 8.3 MDL/person/month and for areas with multi-unit dwellings 6.3 MDL/person/month;
- Ceadir-Lunga – 24 MDL/household/month;
- Cantemir - 9 MDL/person/month;
- Cahul – for the areas with single-family homes 15 MDL/person/month and for areas with multi-unit dwellings 11 MDL/person/month;
- Vulcanesti - for the areas with single-family homes 18 MDL/person/month and for areas with multi-unit dwellings 9 MDL/person/month.

In rural areas, the tariff level varies from 1.6 MDL/person/month to 7.5 MDL/person/month, as follows:

- Manta – 1.6 MDL/person/month;
- Cazaclia – 4 MDL/person/month
- Besghioz - 12 MDL/household/month
- Tomai - 16 MDL/household/month;
- Baimaclia – 5 MDL/person/month;
- Gotesti – 5.42 MDL/person/month;
- Cociula – 6.25 MDL/person/month;
- Tigana – 7.25 MDL/person/month;
- Cania – 7.5 MDL/person/month.

The tariffs for public institutions and companies are similar varying from urban to rural areas. In urban areas, the tariff varies from 132 MDL/cubic meter in Vulcanesti to 217 MDL/cubic meter in Taraclia. In rural areas, the tariffs for the public institutions and companies vary from 5 to 30 MDL/cubic meter. In Ceadir-Lunga, Cazaclia, Besghioz and Tomai the tariffs for public institutions and companies are in MDL/month (30 MDL/month in Beschioz, 50 MDL/month in Cazaclia and Tomai and 54 MDL/month in Ceadir-Lunga).

Tariff payments are either made directly to the operator’s office or via bank transfer. In Taraclia there are 3 special agents hired to collect payments from household to household.

The next table shows the current waste management tariffs as a percentage of average income per capita. According to the National Bureau of Statistics of the Republic of Moldova, the average income in DR South was 1,419.1 MDL/person/month. According to the international benchmarks, the maximum affordability level for solid waste management services is assumed to be between 1-1.5 % of average household income per capita.

Table 4-5: Current waste management tariff as a percentage of average household income per capita

Operator	Share of the tariff from the average income per capita (%)	User type
IM GCL Cahul	0.78	Block of flats
	1.06	Block of flats
Primaria com. Manta	0.11	All users
IM GCL Cantemir	0.63	All users
IM Codrii Cocului	0.44	All users
IM Prosper Gotesti	0.38	All users
IM Baimac-Serv	0.35	All users
IM Primcan	0.53	All users
IM Colser Servicii	0.51	All users
IM Tvardisan (Tvardita)	0.35	All users
IM Apa Canal Taraclia	0.58	Private houses
	0.44	Block of flats
IM GCL Ceadir-Lunga	0.56	All users
IM Supacservice	0.28	All users
IM Temiz SU	0.28	All users
IM Tomai Berecheti	0.38	All users
IM GCL Vulcanesti	0.63	Block of flats
	1.27	Block of flats

Source: GIZ/MLPS, based on data reported by the waste management operators

Except for the tariff for the areas of single-family homes in Vulcanesti and Cahul towns, all the other existing tariffs are lower than 1 % of the average household income per capita.

4.5 Projects implemented / under implementation

Until now different investment projects have been conducted in Cahul, Manta, Cantemir and Taraclia.

Table 4-6: Projects implemented or under implementation

Municipality	Project description
Cahul	The project “Increasing the capacity of waste management for a cleaner environment in cities Vaslui and Cahul” signed in 2014 is under implementation until 2015. Within the project the Cahul town hall benefit of a new truck Mann

Municipality	Project description
	with capacity of 18 m^3. Project conducted through the Joint Operational Programme Romania-Ukraine-Republic of Moldova 2007-2013 Total project value of EUR 1.5 million out of which around EUR 0.5 mil will be allocated to the municipality of Cahul. Following the project 3 vehicles will be purchased The project “Local Government support” financed by USAID, within the project have been procured 200 euro containers of 1,1 m^3 **,** 2000 bins of 240 l and 100 bins of 120l.
Manta	A pilot project for the sanitation of communes Manta and Crihana Veche has been implemented in 2010 Following the project 1 compactor truck and 1 tractor has been purchased Total value of the project around MDL 4 million
Cantemir	The project "Equipping waste management services" implemented in 2010 through GIZ and RDA South Following the project a baling press for plastic and cardboard, 54 containers (1 cubic meter), 21 platforms and a bulldozer DT 75 have been purchased; Within the project “Local Government support” financed by USAID have been procured 450 bins of 120l, a truck GAZ 33 and 27 euro-containers of 1,1 $m^{3.}$
Taraclia	In 2005, USAID provided a truck GAZ 53, 12 collection platforms were built, 100 containers (1 cubic meter capacity) purchased Total investment value: around USD 400,000 In 2011, RDA South acquired a truck IVECO, 210 containers 1 cubic meter and 60 platforms Total investment value: around MDL 2.5 million Within the project “Local Government support” financed by USAID have been procured 1.700 bins of 120 l.

Source: GIZ/MLPS, based on data reported by the waste management operators

5 Objectives and targets

5.1 National and regional objectives and targets

In 2013, the Government of Moldova approved the National Waste Management Strategy (Government Decision no. 248/2013). The National Waste Management Strategy covers the period 2013 – 2027 and sets the following general objectives:

- Development of integrated municipal waste management systems by harmonising the legal, institutional and regulatory framework with the EU standards based on regional approach (geographical location, economic development, existing access roads, soil and hydrogeological conditions, number of population, etc.), and territorial division of the country into eight waste management regions;
- Regional infrastructure development for solid household waste landfill and transfer stations;
- Development of collection systems and treatment of specific waste flows (packaging, WEEE, tires, batteries, etc.) by promoting and implementing the principle of „producer responsibility". One collection point at regional level shall be developed for hazardous waste (medical waste, waste oils, etc.).

Beside the general objectives, the National Waste Management Strategy has also set specific objectives for different waste streams, which are presented in Table 5-1.

Table 5-1: Specific objects of the National Waste Management Strategy

Type of waste	Specific objectives
Municipal waste	Promotion and implementation of separate collection systems in all areas, both in the domestic sector and production, as well as sorting, composting and recycling facilities; Improvement of waste transportation system and development of transfer stations (4-7 transfer stations per rayon); Development of municipal waste disposal capabilities (construction of 7 regional landfills and 2 mechanical biological treatment plants); Improvement of institutional governance in municipal waste management by creating regional LPA associations (8).
Packaging waste	Increasing the degree of reuse and recycling of packaging waste by 20% of the total packaging waste flow in 2027 Development of schemes of material and energy recovery from packaging waste, which cannot be recycled.
Green waste, animal manure, waste from wood processing	Encouraging recovery by aerobic and anaerobic processes and building at least one composting plant and one anaerobic digestion plant per rayon; Encouraging energy recovery where material recovery is not technically and economically feasible, under conditions safe for the health of the population and environment protection.
WEEE	Assurance of a collection/recovery network for end of life electrical and electronic equipment; Assurance of the possibility that the last owner of electrical and electronic equipment could deliver it for free to a collection/recovery entity; Extension of the reuse and recycling of materials from end of life electrical and electronic equipment

Source: National Waste Management Strategy

Currently, a new waste management law is under approval procedure in Moldova. Article 14 of the draft law foresees the following targets for waste recycling:

- By 2015, separate collection systems shall be set up for paper, metal, plastic and glass;
- By 2020, the preparing for re-use and the recycling of waste materials such as at least paper, metal, plastic and glass from households and possibly from other origins as far as these waste streams are similar to waste from households, shall be increased to a minimum of overall 30 % by weight;
- By 2020, the preparing for re-use, recycling and other material recovery, including backfilling operations using waste to substitute other materials, of non-hazardous construction and demolition waste excluding naturally occurring material shall be increased to a minimum of 55 % by weight.

In 2011, the South Regional Development Council approved the *Integrated Solid Waste Management Strategy for South Development Region*, which became the guiding document for modernization of waste management services in the region.

The Strategy foresees targets both for urban and rural area for waste collection, disposal and recycling/treatment for recyclable waste, biodegradable waste (including manure), bulky waste and construction and demolition waste. The targets established for the reference years 2015, 2020 and 2025 are presented in Table 5-2.

Table 5-2: Objectives and targets for Development Region South

Target description	Year	Urban area	Rural area
Municipal waste collection	2015	90%	15 - 20 km around cities
	2020	100%	75%
	2025	100%	100%
Transfer stations and landfill	2015	Development of waste transfer stations (medium and small) and rehabilitation of transitional dumpsites (three per rayon)	
	2018	Reduction of the total number of the dumpsites from 200 to maximum 7	
	2023	Waste disposal in maximum three regional compliant landfill	
Recycling of municipal waste (the share of recycled municipal waste – glass, PET and paper - from the total generated quantity of recyclable municipal waste)	2015	10 – 20%	
	2018	20-30%	
	2023	30-40%	
Biodegradable municipal waste diverted from landfilling	2015	25%	
	2018	50%	
	2023	75%	
Bulky waste adequately treated	2015	40%	
	2018	55%	
	2023	70%	
Construction and demolition waste diverted adequately treated	2015	40%	
	2018	55%	
	2023	70%	
Waste electrical and electronic equipment	Correlated with the national legislation regarding the extended producer responsibility		
Hazardous waste (waste batteries and accumulators, waste tyres, pesticides, waste oils, lamps)	Correlated with the national legislation regarding the extended producer responsibility		

Source: Integrated Solid Waste Management Strategy for Development Region South

5.2 Objectives and targets for the design of the integrated waste management system in WMZ 3

In order to design the integrated waste management system for WMZ 3, objectives and targets have been established for 2018, which is the year in which it is assumed the integrated waste management system will be implemented[1].

When establishing the objectives and targets, the following have been considered:

- National objectives and targets – established through the National Waste Management Strategy, as well as those envisaged by the national legislation, including the draft waste law;
- Regional objectives and targets – established through the Integrated Solid Waste Management Strategy for Development Region South;
- Current waste management situation.

The objectives and targets which are the basis of the design of the first phase of the integrated waste management system in WMZ 3 are presented in Table 5-3. The objectives and targets for the management of specific waste flows are presented in Chapter 6. After the implementation of the first phase, new targets shall be established for the development of the integrated waste management system also considering the in force legislation at that time.

Table 5-3: Objectives and targets for WMZ 3 for 2018

Objectives	Targets			Observations
	Description	Urban Area	Rural Area	
Increasing the area covered by waste management services	Coverage area by waste management services	100%	100%	The target in rural area is 100 % because it is assumed that the integrated waste management system in the zone will be in operation in 2018 and the municipal waste disposal shall be carried out only on the new compliant landfill
Reducing the environmental impact produced by waste disposal	Compliant disposal facility in place and ceasing the activities of the non-compliant facilities	one compliant regional landfill in operation		
		Ceasing of the activities of all the dumpsites		Dumpsites shall be closed as the activity shall be ceased and correlated with the commissioning of the regional compliant landfill
Increasing the recycling rate of munici-	Recycling of municipal waste (the share of	10%		The recycling target shall increase gradually after the

[1] The actual start of the integrated waste management system will depend on a number of factors, including: adequate financing or co-financing has been identified and is available, institutional and organisational solutions have been agreed and implemented, and construction has begun by the end of 2016. Regardless of when the system is actually implemented, the waste management targets – including dates for their achievement – are required in order to identify the configuration of the most cost-effective waste management service.

Objectives	Targets			Observations
	Description	Urban Area	Rural Area	
pal waste	recycled municipal waste from the total generated quantity of recyclable municipal waste)			implementation of the integrated waste management system (shall be 30 % starting with 2020). It is estimated that the extension of the separate collection system shall be carried out as a result of the implementation of the “extended producer responsibility” principle
Increasing the recovery / treatment of biodegradable municipal waste to ensure diversion from landfilling	Biodegradable municipal waste diverted from landfilling and adequately treated (the share of biodegradable municipal waste diverted from landfilling from the total quantity of generated biodegradable municipal waste)	pilot projects regarding biological treatment of municipal waste		During the development of the integrated waste management system new capacities for the biological treatment of municipal waste shall also be developed

Source: GIZ/MLPS

The objectives and targets established for WMZ 3 were presented, discussed and agreed within the second meeting of the Project Working Group, which took place at Cahul on 2 July 2014, meeting organised by the Ministry of Regional Development and Construction and the Regional Development Agency South.

6 Management of special waste streams

6.1 Hazardous household waste

In accordance with the European Waste List, the following separately collected household waste flows are considered as hazardous waste:

- Solvents;
- Acids;
- Bases;
- Photographic chemical substances;
- Pesticides;
- Fluorescent tubes and other waste containing mercury;
- Abandoned equipment containing CFC (Chlorofluorocarbons);
- Oils and greases, other than edible oils and greases;
- Paints, inks, adhesives and resins containing dangerous substances;
- Detergents containing dangerous substances;
- Cytotoxic and cytostatic medicines;
- Batteries and accumulators with lead, Ni-CD and mercury content and unsorted batteries and accumulators containing these batteries;
- Electrical and electronic equipment disposed of, other than fluorescent tubes and other than waste containing mercury and abandoned equipment containing CFC, containing dangerous components;
- Wood with a low content of dangerous substances.

The *Waste Management Strategy in the Republic of Moldova* includes in its general objectives an objective regarding specific waste flows, namely: the development of collection and treatment systems for specific waste flows (packaging, WEEE, tyres, batteries, etc.) by promoting and implementing the “producer responsibility” principle and for hazardous waste (medical waste, used oils, etc.) it is foreseen to develop one collection point for each at regional level.

The *Integrated Solid Waste Management System in Development Region South* envisages, as mentioned in chapter 5, that the targets for hazardous waste (batteries, accumulators, pesticides, used oils, light bulbs) shall be established in correlation with the national legislation regarding the producer responsibility. The regional strategy includes a specific provision regarding municipal hazardous waste mentioning the necessity to separate the hazardous flows from the municipal waste, thus limiting the negative effects at the landfills. It is also mentioned the fact that in accordance with the increase of the recycling plants in the region, it is needed to develop collection points which should be available for the hazardous waste flows (batteries, tyres, mercury lamps, etc.) in order for these waste flows to be treated separately.

The *draft Law on waste* also has specific provisions regarding hazardous waste. In terms of waste control, it is envisaged that the production, collection and transport of hazardous waste, as well as their storage and treatment to be carried out in accordance with the specific provisions envisaged by the law, based on the environmental permit, under conditions ensuring the protection of the environment and the health of the population, and guaranteeing the tracking and control of hazardous waste starting from their production and ending with their final destination.

Furthermore, the draft law also includes provisions regarding the interdiction to mix hazardous waste and their labelling. In terms of hazardous household waste, the draft law specifies the fact that the provisions regarding the control, interdiction to mix and label hazardous waste does not apply to mixed waste from private households. The provisions regarding hazardous waste labelling and evidence do not apply to separate hazardous waste flows from private households as long as their collection, disposal or recovery has not been accepted by a unit or company who obtained a permit or has been registered in accordance with the legislation.

The draft law envisages at art. 54 that in order to facilitate a rapid implementation of the provisions regarding hazardous waste management, the Government of the Republic of Moldova shall establish a waste management centre. The hazardous waste management centre shall include in its activities the treatment of used oils, batteries and accumulators and persistent organic pollutants but it may also receive other types of hazardous waste.

Considering the provisions of the planning documents, as well as of the draft Law on waste, it is requisite that the integrated waste management system for WMZ3 also includes the management of hazardous household waste.

Nonetheless, when establishing the measures it must be borne in mind that the separate collection of hazardous household waste cannot be implemented prior to the existence of the possibility to treat and dispose of such types of waste. Thus, considering the fact that at national level there are no hazardous waste treatment and disposal facilities as of yet, no investments for the near future regarding the separate collection of hazardous household waste can be included in the investment plan. In addition, hazardous household waste collection and transport are carried out with specialized vehicles for the collection of this waste flow. Having in view the low quantity of hazardous household waste generated, such a vehicle should be used for several collection zones.

Thus, the investments which are within the scope of this Feasibility Study shall include collection points and temporary storage spaces for hazardous waste, one space per rayon, which shall be located on the site of the transfer stations, the regional landfill, respectively.

As soon as hazardous waste treatment / disposal capacities shall be reached, the vehicle for the separate collection and transport of hazardous household waste must be purchased and temporary storage spaces must be established. These investments shall be carried out either by the future operator or from other sources.

6.2 Bulky waste

Bulky waste is the type of municipal waste which either due to its large mass or because of its high volume cannot be taken over by the regular waste collection system. The main examples of bulky waste are furniture and mattresses.

The *Waste Management Strategy in the Republic of Moldova* envisages no specific objectives or measures regarding bulky waste management.

Instead, the *Integrated Solid Waste Management Strategy in Development Region South* envisages, as mentioned in chapter 5, targets regarding bulky waste, namely:

- 2015 – 40 % of bulky waste shall be treated adequately;
- 2020 – 55 % of bulky waste shall be treated adequately;

- 2025 – 70 % of bulky waste shall be treated adequately.

No additional investments are needed for the collection and transport of bulky waste. The collection of this type of waste shall be carried out based on a schedule established at the beginning of the year by the sanitation operator and which shall be communicated both to the domestic and non-domestic users. The inhabitants will take out the waste and place it in front of their houses or in the case of the blocks of flats will take it to the bulky waste collection points, in accordance with the collection schedule. Spaces for the temporary storage and treatment of bulky waste are envisaged at the transfer stations and landfills.

The sanitation operator shall transport the collected bulky waste to these spaces using the existing transport means (for example tractors).

Specific provisions regarding the management of bulky waste shall be included in the contract with the sanitation operator.

6.3 Waste electrical and electronic equipment and waste batteries and accumulators

The *Waste Management Strategy in the Republic of Moldova* includes in its general objectives an objective regarding specific waste flows, namely: the development of collection and treatment systems for specific waste flows (packaging, WEEE, tyres, batteries, etc.) by promoting and implementing the “producer responsibility” principle. Furthermore, specific objectives for waste electrical and electronic equipment and waste batteries and accumulators are envisaged, namely:

- Waste electrical and electronic equipment:
    - Ensuring a network for the collection / recovery of waste electrical and electronic equipment;
    - Ensuring the possibility that the last owner of the electrical and electronic equipment is able to hand it in free of charge to a collection / recovery unit;
    - Extending the reuse and recycling of the materials from the electrical and electronic equipment.
- Waste batteries and accumulators:
    - Ensuring a network for the collection of waste batteries and accumulators from the users / population through automobile service stations;
    - Ensuring the fact that the waste batteries are managed adequately or they are recycled or landfilled.

The *Integrated Solid Waste Management System in Development Region South* envisages, as mentioned in chapter 5, that the targets for waste electrical and electronic equipment but also for hazardous waste, which include the used batteries and accumulators shall be established in correlation with the national legislation regarding the producer responsibility. The regional strategy also mentions the fact that in accordance with the increase of the recycling plants in the region, it is needed to develop collection points which should be available for the hazardous waste flows, including batteries, in order for these waste flows to be treated separately.

The *draft Law on waste* also has specific provisions regarding waste electrical and electronic equipment and waste batteries and accumulators, as well as provisions regarding the extended responsibility of the producers.

Furthermore, currently, there are draft pieces of legislation for these waste flows, namely:

- Draft Regulation on waste electrical and electronic equipment, which shall be approved by governmental decision and facilitates the mechanism for the enforcing of the relevant provisions of Directive 2012/19/UE of the European Parliament and Council dated 4 July 2012 on waste electrical and electronic equipment;
- Draft Regulation on batteries and accumulators and waste batteries and accumulators, which shall be approved by governmental decision and transposes the relevant provisions of Directive 2006/66/CE of the European Parliament and Council dated 6th September 2006 on batteries and accumulators and waste batteries and accumulators and Directive 2013/56/UE of the European Parliament and Council dated 20 November 2013 amending Directive 2006/66/CE.

The *Draft Regulation on Waste Electrical and Electronic Equipment* envisages that in order to separately collect the WEEE from private households, the producers in mutual agreement with the public local authorities of the administrative – territorial units may organize, manage and coordinate the separate collection of WEEE from private households and their transport to the collection points using the sanitation service, in compliance with the provisions of the legislation in force. Furthermore, the producers in mutual agreement with the public local authorities must ensure the existence and operation of at least one separate collection point for WEEE from private households in localities with at least 10,000 inhabitants. For the smaller localities, the WEEE collection shall be carried out during the WEEE collection campaigns, organised twice a year by the sanitation service.

The *Draft Regulation on batteries and accumulators and waste batteries and accumulators* envisages that in view of the separate collection of waste portable batteries and accumulators from private households, the public local authorities of the administrative – territorial units have the following obligations:

- To organize, manage and coordinate the separate collection of waste portable batteries and accumulators from private households and their transport through the sanitation service to the collection points established by the producers in accordance with the legal provisions;
- To hand over the collected waste portable batteries and accumulators to the producers or their collective systems in view of treatment. The public local authorities of the administrative – territorial units may request the producers / collective organizations to cover the real costs for the collection, transport to the collection and temporary storage points of waste portable batteries and accumulators, without exceeding the unitary tax established for the sanitation service for the population;
- To ensure the existence and operation of at least one separate collection point for waste batteries and accumulators from private households for localities with at least 10,000 inhabitants. For smaller localities, the collection of waste portable batteries and accumulators shall be carried out during the collection campaigns, organized by the sanitation service.

Due to the fact that the National Waste Management Strategy, as well as the draft Law on waste and the draft Regulations envisage the promotion and implementation of the "producer responsibility" principle, the Feasibility Study does not envisage specific investments regarding the collection of waste electrical and electronic equipment and waste batteries and accumulators. The collection points for these waste flows from the population shall be established in cooperation with the producers or collective organizations.

Specific provisions regarding the collection, transport and handover in view of recovery/ disposal of waste electrical and electronic equipment and waste batteries and accumulators from private households shall be included in the contract with the sanitation operator.

6.4 Construction and demolition waste

The construction and demolition waste, which in accordance with the European Waste List, are a particular waste category, may result from industrial and commercial construction and demolition activities, from infrastructure development activities or from construction and demolition activities carried out by the population.

The *Integrated Solid Waste Management Strategy for Development region South* envisages, as mentioned in chapter 5, targets regarding construction and demolition waste, namely:

- 2015 – 40% of the construction and demolition waste shall be treated adequately;
- 2020 – 55% of the construction and demolition waste shall be treated adequately;
- 2025 – 70% of the construction and demolition waste shall be treated adequately.

The Regional Strategy recommends the use of construction and demolition waste for landfill closure, as well as for the daily cover of the compliant landfills. Furthermore, it is recommended to develop landfills for inert non-recoverable waste, envisaging on the sites zones for waste treatment, respectively for the temporary storage of separate recoverable waste flows.

The Regional Strategy envisages that in order to increase the construction and demolition waste treatment efficiency the authorities may ask the large construction companies to separate the recyclable materials on site in the areas where the works are carried out. The construction permits should include clear provisions regarding the responsibility of the constructors to manage the construction and demolition waste adequately.

Furthermore, the Regional Strategy envisages that in urban area is imperative to place 4 m^3 or larger containers for the collection of construction and demolition waste from households.

The draft *Law on waste* envisages the same target as the Framework Directive on waste, namely that by 2020 to prepare for reuse and other material recovery, at least 70 % by mas, the non-hazardous waste from construction and demolition activities, except for the natural geologic materials.

For the management of construction and demolition waste from private households, the Feasibility Study proposes 4 m^3 collection containers to be purchased. The collection of these types of waste from the population shall be carried out upon request, by providing the collection container / containers. The landfill is envisaged with space for the temporary storage of construction and demolition waste which may be used for the daily cover or for the closure of the cell.

The sanitation operator shall transport the construction and demolition waste using the existing equipment (for example tractors).

Specific provisions regarding the management of construction and demolition waste shall be included in the contract with the sanitation operator.

Specific provisions regarding the management of construction and demolition waste from the population shall be included in the contract with the sanitation operator.

6.5 Manure and agriculture waste

In compliance with the European Waste List, the agricultural waste, including animal waste is a distinct waste category, not being included in the municipal waste category. Due to this, the Feasibility Study does not include investments regarding the management of these types of waste.

The *Report on the analysis of household waste in urban and rural area, July 2014*, shown in Annex 2 includes an estimation of the quantity of animal waste currently being generated in WMZ3, estimation carried out based on the existing live stock in each rayon and the generation indicators used when developing the *Feasibility Study for the inter-municipal solid waste management centre in Soldanesti*, February 2014. Thus, the quantity of animal waste generated is of approximately 220,000 tonnes/year.

The *Waste Management Strategy in the Republic of Moldova* includes in its specific objectives ones regarding vegetal waste, animal waste and waste from wood processing:

- Encouraging the recovery through aerobe and anaerobic processes and construction of capacities for waste composting and fermentation, at least one per rayon;
- Supporting energy recovery, where material recovery is not feasible from a technical – economic point of view under safety conditions for the population and environment.

The *Integrated Solid Waste Management Strategy in Development Region South* specifies that agricultural waste also includes animal waste, which is a significant part of the agricultural waste. The Strategy envisages that by the end of 2013 no animal waste should reach the existing landfills, that these should be collected and treated separately. The most popular treatment method is composting, either using the individual composting system or the centralized composting plants.

The information gathered during the elaboration of the study on the analysis of household waste in urban and rural area show that the sanitation operator is not permitted to collect the animal waste together with the household waste. The animal waste is separately collected, on a certain day and it is still landfilled on the dumpsite of the village.

Considering all of the above, this Feasibility Study does not envisage investments for the management of animal waste and agricultural waste, which are, as previously mentioned, not municipal waste. This waste flow must be separately collected from household waste and financing sources must be identified for their separate treatment, as envisaged by both the National and Regional Strategies.

7 Option analysis

7.1 Assumptions and methodology

Options for development of the integrated waste management system in WMZ 3 (Region South) have been analysed with regard to:

- Collection and transport of residual waste;
- Collection and transport of recyclables;
- Transfer and long distance transport;
- Sorting of waste;
- Treatment of biodegradable waste;
- Disposal of waste.

The methodology used for developing the options for establishment of integrated waste management system in WMZ 3 is based on the following main criteria:

- Analysis of the existing waste management situation;
- Assessment of current and future needs in waste management;
- Identification of measures, compliant with the existing legislation, and in line with measures set in the National Waste Management Strategy (2013-2027) and the Regional Waste Management Strategy for Region South;
- Analysis of technically applicable options based on best practices available and EU standards;
- Analysis of technically applicable options with regard to their affordability and local applicability;
- The perspectives of the stakeholders, expressed during site visits and meetings.

The options analysis is based on the main assumption that waste management services in WMZ 3 are going be delivered on regional basis, instead of provision of waste services by each local public authority.

The specific assumptions related to the different technical options are included in the sections of the separate system elements.

7.2 Technical options for collection and transport of residual waste

The options for collection of residual waste are based on the analysis of the existing situation and practices and are developed with regard to:

- Target to extend the waste collection service to the entire population of WMZ 3;
- Size and number of waste storage containers needed to extend the collection coverage;
- Frequency of collection;
- Size and number of collection vehicles;
- Relief of the region and roads condition;
- Location of the selected site for future regional landfill.

7.2.1 Current situation

Waste collection services are provided to all towns and to only 10 villages. The frequency of waste collection is different for blocks of flats and for individual households and varies from operator to operator. The waste generated by persons living in the blocks of flats are collected from once per week up to daily, while the waste generated by persons living in individual houses are collected mostly once per week. For public institutions and companies the waste collection services is offered by request or once per week.

The waste management operators in WMZ 3 have different collection bins. The operators are using metal containers, plastic containers with a capacity varying from of 0.12 to 1.8 m^3. The most widely spread waste recipients are 1.1 m^3, 240 l and 120 l. A total number of 456 containers of 1.1 m^3 are available in WMZ 3 along with 2,280 bins of 240 l and 2,370 bins of 120 l. These are used for servicing the households. Another 235 different size of containers are used for public institutions and businesses.

7.2.2 Containers for residual waste collection

With regard to desirability to extend the waste collection service to the entire area, the following types and waste containers have been analysed and compared:

- 1.1 m^3 containers;
- 0.11 m^3 individual metal bins;
- 0.12 m^3 individual plastic bins; and
- 4 m^3 skip containers.

The table below presents the advantages and disadvantages of the different type of containers.

Table 7-1: Analysis of different types of containers

Options	Advantages	Disadvantages
1.1 m^3 container 	• Lower operational costs for waste collection; • Require less time for servicing; • Local acceptance and experience; • Side loading vehicles can be adapted to load such containers; • Suitable for separate collection of recyclables (when coloured).	• More expensive than individual bins; • Tendency to be filled in with green, bulky and construction waste rather than household waste; • Although less expensive, such containers made of plastic should be avoided due to high incidence of burnt out bins during winter.
110 litre waste bin 	• Most convenient way to individual households for waste collection; • Reduced odour due to frequent service; • Due to its convenience, least probability of illegal dumping outside the village; • Due to their assigning to individual households, almost no occurrence of bulky and construction wastes; • Suitable for separate collection of recyclables (when coloured).	• Similar investment costs to bring containers; • Increased operational costs; • Require more time for emptying due to lack of wheels (increase operational costs).

Options	Advantages	Disadvantages
120 litre waste bin 	• Most convenient way to individual households for waste collection; • Reduced odour due to frequent service; • Due to its convenience, least probability of illegal dumping outside the village; • Due to their assigning to individual households, almost no occurrence of bulky and construction wastes; • Very suitable for separate collection of recyclables.	• Similar investment costs to bring containers; • Increased operational costs; • High rate of burnt out bins during winter months.
4.0 m^3 skip container 	• Lowest operational costs for waste collection; • Suitable for less densely populated settlements; • Suitable option for villages without paved roads; • Suitable for mountainous areas.	• Suitable only for small-size villages; • Require special truck for its loading; • Inconvenience for the residents as such skip containers are usually placed at the outskirts of the villages; • Increased tendency to be filled in with green, bulky and construction waste rather than household waste; • Increased odour due to lower frequency of emptying such containers.

Based on the above analysis it can be concluded that:

- The *1.1 m^3 metal containers*, which are wheeled and covered with lid, are often referred as “euro” containers for their common use in many EU countries. Because of their applicability to different situation they are manufactured in many countries and their supply price could be negotiated / lowered. Their main advantage is the quick loading and the sufficient capacity. This leads to reduction of the operating costs;
- The *door-to-door containers (110 l and 120 l waste bins)* are very suitable for waste collection from individual houses, which is the predominant type of housing in the project area. As shown in the table above, such individual containers bring more advantages than disadvantages. However, having in mind the current socio-economic situation in the region and the necessity to invest in both containers and vehicles in order to cover the whole area with collection service, the door-to-door collection option could prove to exceed the affordability level;
- *Skip containers* are suitable option for servicing small-size villages. However, the villages in WMZ 3 are predominantly large. In fact there are only 6 villages with population less than 100 residents. Moreover, there are more than 60 villages in the region with population above 1,000 residents. With such density of population, the use of this option becomes not expedient.

Based on the analysis above, three types of containers are retained for further assessment of options for collection of residual waste – 1.1 m^3 metal containers; 0.11 m^3

metal bins; and 0.12 m^3 plastic bins. Skip containers are considered as not applicable to the size of the settlements.

7.2.3 Frequency of waste collection

About 200,000 residents in the project area live in rural settlements. Only few of those have organised waste collection. This means that extending the waste collection service to entire rural area will necessitate considerable investments in waste collection equipment. Minimisation of investment cost is possible at higher frequency of servicing as a trade-off of investment and operational cost; i.e. the more often the containers are emptied, the fewer the number of containers are required, whereas larger number of containers are required if they are emptied less often. From other side, in order to reduce the operational costs, it may become more cost-efficient to increase the number of containers and thus to reduce the number of work shifts.

In defining the frequency of collection the following assumptions are used:

- The frequency of collection should not be less than once per two weeks in villages for sanitary and odour purposes;
- Waste collection frequency in villages could be adjusted to the respective seasons; higher frequency in summer months and lower frequency in the winter months;
- In urban areas, collection frequency could not be lower than once per week (for individual bins) and once per 3 days (for bring containers).

7.2.4 Waste collection vehicles

Currently 38 waste collection vehicles are used in WMZ 3. Most of the available trucks are based on Russian and Belarussian chassis. In most cases the superstructures have a capacity of 4-7 m^3. There are also some newly acquired trucks with larger capacities, including with Western type of chassis. The rest are tractors with trailers.

The vehicles based on Russian and Belarussian chassis have certain advantages: lower price compared to Western trucks; easy maintenance and repair; and suitability for unpaved roads due to the high structure of their chassis. Their main disadvantage is the low compaction rate.

On the contrary, Western waste collection vehicles produce higher efficiency through higher compaction rate. Besides their higher operational efficiency, their higher acquisition price will be compensated by the lesser number of vehicles needed based on larger volumes of waste collected per run.

Therefore, the analysis of options for enhanced waste collection envisages two types of waste collection vehicles:

- Large 16 m^3 waste collection vehicles for servicing the large metal 1.1 m^3 containers and for servicing the rural areas. Based on the existing road network it is assumed that vehicles larger than this (e.g. 18 m^3 or 22 m^3) will be too heavy and not appropriate;
- Small 6 m^3 waste collection vehicles suitable for door-to-door collection in urban areas.

7.2.5 Options for collection and transport of residual waste

On the basis of all considerations above, the following five options have been analysed and cost detailed with regard to their applicability to local conditions and desirability to extend the waste collection service to the entire area:

- **Option 1**: waste collection is organised in the entire WMZ 3 by the so-called “bring system”, meaning through use of containers of 1.1 m^3 containers intended to serve large number of households; it assumes that all the waste will be collected as residual waste and separate waste collection is not in place;
- **Option 2**: same as Option 1 but the difference is that the quantities of residual waste for collection are reduced due to implementation of separate waste collection;
- **Option 3**: waste collection is organised in the entire WMZ 3 by “bring system” in urban settlements, and the so-called “door-to-door” collection in villages (meaning with 110 l metal bins assigned to individual households);
- **Option 4**: waste collection is organised in the entire WMZ 3 by “bring system”, while the individual houses in the whole urban area are served by “door-to-door” collection (with 110 l metal bins assigned to individual households);
- **Option 5**: individual houses in the towns of Cahul, Taraclia, Cantemir, Ceadir-Lunga and Vulcanesti are served by “door-to-door” collection (with 120 l plastic bins assigned to individual households), while the rest settlements are served by “bring system”.

The following table presents the five options with details in terms of number of waste equipment needed without taking into consideration the existing equipment.

A paragraph regarding the main assumptions should be included here:

- Density of the waste in the receptables;
- Average filling of the containers;
- Etc. see chapter 7.3.3.

Table 7-2: Waste collection equipment needed

Type of waste collection equipment	№ of waste collection equipment				
	Option 1	Option 2	Option 3	Option 4	Option 5
containers needed, 1.1m^3	7,949	7,534	2,465	6,464	6,366
containers needed, 110 l	0	0	54,840	21,572	
containers needed, 120 l	0	0	0	0	16,307
vehicles needed, 16 m^3	28	27	7	25	24
vehicles needed, 6 m^3	0	0	53	17	17

7.2.6 Cost comparison of the options for collection of residual waste

The following table presents the unit costs for residual waste collection assumed for the options analysis.

Table 7-3: Unit cost of waste collection equipment

Equipment	Capacity, m^3	Purpose	Unit price, EUR
Container	1.1	Bring system collection	285
Container	0.11	Door-to-door collection	30
Container	0.12	Door-to-door collection	25

Equipment	Capacity, m^3	Purpose	Unit price, EUR
Truck	16	Bring system collection	100,000
Truck	6	Door-to-door collection	45,000

The table below the analysis of costs related to implementation of the different options (2018 used as a reference year).

Table 7-4: Cost comparison of options for collection and transport of residual waste

Costs	Costs in EUR				
	Option 1	Option 2	Option 3	Option 4	Option 5
Investment cost	5,065,000	4,847,000	5,432,000	5,754,000	5,386,000
Containers	2,265,000	2,147,000	2,347,000	2,489,000	2,221,000
Vehicles	2,800,000	2,700,000	3,085,000	3,265,000	3,165,000
O&M costs	**986,000**	**996,000**	**2,709,781**	**1,349,000**	**1,342,000**
Total annual costs	1,590,000	1,572,000	3,354,000	2,031,000	1,976,000
Quantities collected, tonne	63,000	58,000	58,000	58,000	58,000
Annual unit cost, EUR/tonne	**25**	**27**	**58**	**35**	**34**

The operational and maintenance costs (O&M) include costs for personnel, fuel, oil and maintenance costs for equipment. The annual costs include O&M costs and costs for annual depreciation of containers and vehicles. The depreciation for containers is estimated at 7 years; annual amortisation of waste collection trucks is estimated at 10 years.

7.2.7 Conclusion

As seen from the table above, Options 1 and 2 bring lowest cost for waste collection in the region. Since these are the lowest-cost options, they are retained for further analysis of the options for establishment of waste management system in the region (see section 7.8). The preference for one of the two would depend on the design of the overall system for solid waste management in WMZ 3, i.e. whether separate waste collection would be implemented.

Option 3 is with highest both investment and O&M costs especially. It should be noted however that once the waste collection system is established in the project area and cost recovery mechanisms are in place, the future upgrade of the system should again reconsider the implementation of this option as the most customer-friendly one. This is based on the fact that the population in WMZ 3 live predominantly in individual houses. Still, as a highest cost option, this option will not be further assessed in the analysis of possible system options.

Options 4 and 5 are comparable in terms of service costs. However, Option 5 is slightly less expensive than Option 5. Therefore, it is recommended that houses in the largest towns of Cahul, Taraclia, Cantemir, Ceadir-Lunga and Vulcanesti continue to be served by door-to-door waste collection. Thus, Option 5, like Option 1 and Option 2, is retained for further analysis of the options for establishment of waste management system in the region.

7.3 Technical options for separate waste collection and transport

7.3.1 Current situation

As noted before, separate collection of recyclables has already been initiated in the project region. Plastic and cardboard are collected both in Cahul and Taraclia. In

Cantemir and Ceadir-Lunga only plastic is being collected. The figure below shows the type of container used for collection of plastic. Paper and cardboard is collected in Euro-bins.

Figure 7-1: Container for plastic packaging used in the project area

Source: photo taken from Cahul City

7.3.2 Waste storage equipment and systems for collection

The system of separate collection of recyclables includes identification of the type of separate waste collection system. Basically, there are two main forms of collection – door-to-door collection and bring system. With regard to the type of collection system (door-to-door collection or bring system), different types of waste storage equipment can be used. The different collection systems are associated with different quality of the collected recyclables and with different costs.

The figures below show the options with regard to the types of separate waste collection systems.

Figure 7-2: Individual bags and bins (door-to-door collection)

Coloured plastic bags

Individual bins (120 l)

Figure 7-3: Larger containers for recyclables and buy back centres (bring system)

Containers for different recyclables (bring system)

Buy back recycling centre

The table below presents analysis of the advantages and disadvantages of the different options for separate collection of recyclables.

Table 7-5: Advantages and disadvantages of separate waste collection systems

Collection system		Collected volumes	Content of residues	Costs	Remarks
Door-to-door collection (plastic bags)		Average to high	Low	High	Collection schedule for plastic bags and collection of plastic bags shall be defined. Difficult compatibility with individual collectors and potential problems with stray dogs
Door-to-door collection (individual bins)		High	Low to average	High	Suitable mainly to areas with individual houses or where container can be designated to a specific building
Bring system (containers for separate collection)		Low	Average to high	Average	The system results can be significantly influenced by type of containers used and awareness campaigns implemented.
Bring system (buy-back centres)		Low	Low	Low to average	The collected amounts can be higher if material is delivered to recycling centres from individual collectors. Suitable for paper and glass, less suitable for plastics

Based on the above analysis it can be concluded that:

- The option with *plastic bags* is the highest cost option of all as it necessitates a significant investment in purchasing and distributing bags to households. Taking into consideration that significant investments are needed for procurement of equipment for general waste collection, the higher overall cost for plastic bags make them an inexpedient choice at present;

- As noted before, the plastic *120 l waste bins* are very suitable for waste collection from individual households, and certainly for separate collection of dry recyclables. However, like with plastic bags, their high overall investment and operational costs make them an inexpedient choice at present too. Once the waste collection system is established in the project area and cost recovery mechanisms are in place, the future upgrade of the system should reconsider the implementation of this option as a most customer-friendly one and as a high collection rate choice. Moreover, waste collection vehicles can easily be adjusted to serve such bins, no additional investment will be necessary;
- The main advantage of the *bring system with larger containers* is the quick loading and the sufficient capacity. This leads to reduction of the operating costs. When located appropriately in the residential areas and in proximity to the main commercial/administrative centres, the collection rates could be increased;
- *Buy-back centres* are an efficient way of materials recovery as the quality of materials collected is of highest rate. This system however is usually implemented by private sector initiative and not by municipalities.

Taking into consideration the significant investments needed for provision of waste collection service to the entire rural population of WMZ 3, it is recommended that the expansion of the separate waste collection system is based on bring system as a lower cost option.

7.3.3 Options for separate waste collection

On the basis of all considerations above, the following four options have been identified, analysed and cost detailed with regard to their applicability to local conditions and target to extend the separate waste collection and increase the resource recovery rates in WMZ 3:

Table 7-6: Options for separate collection of recyclables

Bring collection system			Description
Option 1	 The “bring system”, is organised by 2 containers of 1.1 m^3; one for plastic, metal, paper and cardboard, and one for glass.		Separate waste collection is organised in the entire urban area of WMZ 3 and in all villages above 1,000 residents.
Option 2	 Recyclables will be collected in one container of 1.1 m^3	 Glass will be collected only in Cahul in a separate container.	Collection of plastic, metal, paper and cardboard is organised in the entire urban area of WMZ 3 and in the larger villages south of Cahul and east of Taraclia.

Bring collection system			Description
Option 3	  The "bring system", is organised by 2 containers of 1.1 m^3; one for plastic and metal, and one paper and cardboard.	 Glass will be collected only in the city of Cahul in a separate container.	Separate waste collection is organised in the entire urban area of WMZ 3 and in the larger villages south of Cahul and east of Taraclia.
Option 4	 Plastic and metal is collected in all urban settlements in a net container.	  Paper and cardboard are collected only in Cahul and Ceadir-Lunga. Glass is collected only in Cahul.	Separate waste collection is organised only in the urban area of WMZ 3.

In order to define the equipment needed for separate waste collection, the following assumptions are used:

- The numbers of containers and vehicles needed are calculated based on the quantities of waste separately collected;
- The density of materials in the containers are assumed to be 0.1 tonne/m^3;
- The average filling of the container is assumed to be 85%;
- The average filling of the collection trucks is assumed to be 90%;
- The number of containers are calculated assuming 7% reserve;
- Time for loading of container for paper, plastic and metal is 1 minute per container, and 3 minutes per container for glass;
- Travelling speed of collection trucks to the sorting facility is assumed at 35 km/hour;
- Maintenance costs for trucks are estimated at 5% of their investment costs;
- Maintenance costs for containers are estimated at 1% of the their investment costs;
- The collection frequency varies between the different options: between 26 and 52 times per year;
- Collection rate of about 50% of the recyclables. This is a relatively high collection rate but the assumption is based on the fact that collection of plastic has already been implemented in the project area and the population is already involved. However, continuous efforts will be needed to increase the public awareness and involvement.

The table below presents the four options with details in terms of equipment needed (without taking into consideration the existing equipment), population cover and quantities of recyclables collected.

Table 7-7: Equipment needed and service cover, 2018

Type of waste collection equipment	№ of waste collection equipment			
	Option 1	Option 2	Option 3	Option 4
Containers for plastic, paper and metal	3,520	2,269	2,269	1,512
Containers for glass	376	62	62	62
Trucks for plastic, paper and metal	6	5	5	4
Trucks for glass	4	1	1	1
Population covered	267,200	132,500	132,500	96,000
Quantities collected (tonnes)	7,900	5,500	5,500	4,250

7.3.4 Cost comparison of the options for separate waste collection

The following table presents the unit costs for separate waste collection assumed for the options analysis.

Table 7-8: Unit costs for separate waste collection equipment

Equipment	Capacity, m^3	Purpose	Unit price, EUR
Container	1.1	Paper and cardboard	220
Container	1.1	Paper, cardboard, plastic and metal	220
Container	1.1	Plastic and metal	80
Container	1.1	Glass	440
Truck	16	Collection of recyclables	100,000

The table below the analysis of costs and the recovery rates related to implementation of the different options (2018 used as a reference year).

Table 7-9: Cost comparison of the options for separate waste collection

Costs and recovery rate	Costs in EUR			
	Option 1	Option 2	Option 3	Option 4
Investment cost	**2,166,000**	**1,274,000**	**1,276,000**	**771,000**
Containers	1,166,000	674,000	676,000	271,000
Vehicles	1,000,000	600,000	600,000	500,000
O&M costs	**474,000**	**239,000**	**429,000**	**225,000**
Total annual costs	741,000	395,000	532,000	335,000
Annual unit cost, EUR/tonne	11	6	8	5
Recovery rate (from total waste)	11.8%	8.2%	8.2%	6.3%

The O&M include costs for personnel, fuel, oil and maintenance costs for equipment. The annual costs include O&M costs and costs for annual depreciation of containers and vehicles. The depreciation for containers is estimated at 7 years; annual amortisation of waste collection trucks is estimated at 10 years.

7.3.5 Conclusion

As seen from the table above, Option 3 brings the same recovery rate as Option 2 but at much higher cost, due to inclusion of an additional container for separate collection of paper and cardboard. Therefore, Option 3 will be excluded from further analysis. Despite being a lower cost alternative to Option 3, Option 2 is neither lowest cost option, nor highest recovery rate one.

Although leading to lowest recovery rate, Option 4 brings also lowest implementation costs. Similar rationale is applied to Option 1, which is more expensive than Options 2 and 4, but it brings the highest resource recovery rate. Therefore, for the analysis of the system options both Options 1 and 4 are retained as options of higher recovery rate (Option 1) and lower implementation costs (Option 4).

7.4 Technical options for transport and transfer of waste

Transfer stations (TS) are justified when the cost to transport waste directly from the point of generation to a disposal site is greater than the cost to transport the waste from the source of generation to a point where the waste is transferred onto a larger container and then transported to a landfill. Economical expediency of transfer stations is influenced by several factors:

- Distances;
- Quantities of waste;
- Road conditions and topography;
- Low density of population in the service areas; and
- Technology of transfer.

7.4.1 Transfer station types

Transfer stations can be basically divided into two types:

- Transfer station with compaction; and
- Transfer station without compaction.

Transfer stations without compaction are used when distances are not large and then the higher investment costs of transfer stations with compaction cannot be justified. With larger distances the operational costs of TS without compaction become higher compared to those of TS with compaction. The choice of TS is in fact a tradeoff of investment and operational cost.

Transfer stations with compaction

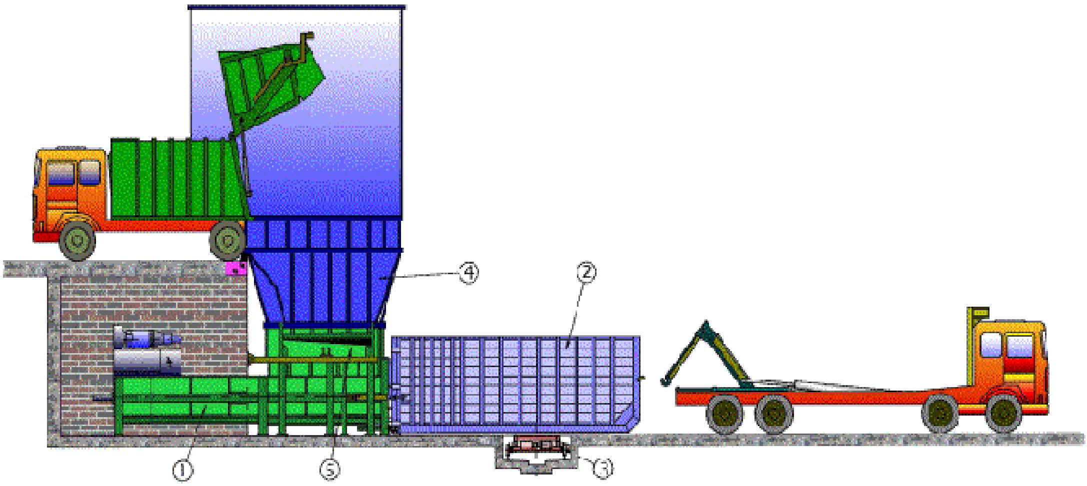
The purpose of transfer stations with compaction is to increase the density of the waste and thus the quantities of waste to be transported in one run. As shown in the figure below, such transfer stations are equipped with a ramp with discharging point, reception bunker (of about 45 m^3), compacting device, large transportable containers (between 27 m^3 and 32 m^3), railing system for shifting the containers, and vehicles for long distance transportation.

Equipment of such transfer stations is designed to minimize the loading time from collecting trucks and to minimize the compacting time for the waste. An automatic railing system for shifting the containers is installed also to reduce the operation time. While a long distance transport vehicle is being loaded with a full container, another container may receive new wastes.

The static compacting device can be substituted with large self-compacting transportable containers, between 25 and 32 m^3, able to store between 15 and 19 tons[2].

[2] Waste density after compaction is $t/m^3 = 0.6$

Figure 7-4: Transfer station with compaction



Transfer stations without compaction

In most cases this transfer station uses open containers, as shown in the left picture below, where waste is being unloaded direct from the collection truck. Instead of containers, waste can be unloaded onto trailers. In fact hauling vehicles can take two, even three trailers, depending on the topography and the payload regulations in the respective countries.

Depending on the compaction ratio of the incoming waste, a container of 35 m^3 can transport between 4 and 10 tons.

Transfer stations like this can be seen even without discharging ramp, which can make them occupy much smaller space. They are being operated with electric hoist and electrically operated lifting frame, as shown on the right figure below.

Figure 7-5: Transfer stations without compaction

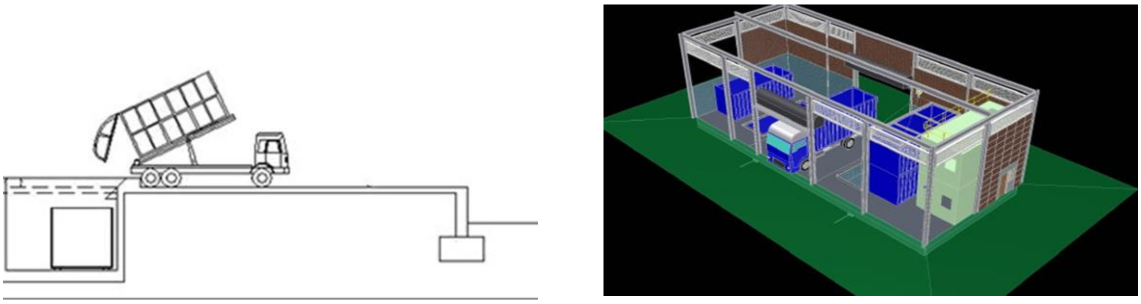


Table 7-10: Comparison of the technical options for transfer station

Item	Waste transfer without compaction	Waste transfer with compaction
Invest for transfer station	Lower	Higher (additional costs for hydraulic compaction system)
Invest for waste transfer	Higher (additional waste transfer trucks and waste containers)	Lower
Operation and	Lower	Higher (energy consumption for

Item	Waste transfer without compaction	Waste transfer with compaction
maintenance for transfer station		compaction)
Operation and maintenance for waste transfer	Higher (energy consumption for waste transport)	Lower

As seen from the table above, both options have their advantages and disadvantages. For the purposes of the current analysis TSs with and without stationary compaction press are considered. The main reason for TS without compaction is the fact that the predominant population in the WMZ 3 is rural (70%) and the waste composition in the rural areas indicates that the main fraction of household waste generated is inert (earth, stones, ash etc.). Inert waste is not subject to compression and use of more expensive equipment, like compaction press, is not justified.

Besides, the distance between the town of Cantemir and the future regional landfill is not so large. Cantemir is located at 54 km away from the landfill. In Cantemir Rayon, the waste generation amounts to 10,100 tonnes in 2018.

Taraclia Rayon generates about 8,500 tonnes in 2018. The town is located at 42 km away from the landfill.

Ceadir-Lunga Rayon generates about 14,800 tonnes (in year 2018). The town itself is located at a larger distance to the future landfill, at distance of 62 km, but its proximity to Taraclia indicate that the optimal solution would be a transfer station to be used by both Taraclia and Ceadir-Lunga rayons. The combined quantities of municipal waste are significant – more than 23,000 tones per year. Larger distances and quantities of waste in the region justify the use of transfer station with compaction.

Vulcanesti is located fairly close to the landfill in Cahul – less than 30 km – and generates about 7,000 tonnes annually, which cannot justify the use of transfer station.

7.4.2 Options for transfer stations

Analysis of distances and applicability of transfer stations in WMZ 3 has been performed within the scope of the current project and the results have been presented in a “Delineation of micro-zones in WMZ 3” Report. Detailed summary of these results are presented in the current Feasibility Study Report in Annex 4.

The section below presents an analysis of the two main options for transfer stations:

- **Option 1**: Establishment of 3 transfer stations - one in each of Cahul, Cantemir and Taraclia rayons. Taraclia TS will serve also Ceadir-Lunga Rayon;
- **Option 2**: Establishment of 2 transfer stations - one in Cantemir and one in Taraclia Rayons due to the fact that the regional landfill will be located near the town of Cahul (and centrally for the entire Cahul Rayon and in proximity to Vulcanesti Rayon).

Option 1

Some of the largest villages are located south of Cahul, on R34 road. These communities are also located fairly far from the future landfill, ranging from 30 to 60 km distance. The quantities of waste generated by those 6 communities (Colibashi, Brinza, Vaeleni, Slobozia Mare, Chishlita-Prut and Giurgiuleshti) amount to about 3,300 tonnes (in 2018), which represents 60% of the waste generated by communities, located more than 30 km away from the future landfill. Other large rural communities, which are located at significant distance are situated in such a way that they cannot be grouped in order to be served by one transfer station. Therefore, the analysed option envisages that a transfer station is established between the villages of Valeni and Slobozia Mare.

Option 2

The transfer station needs to be located as close to the town of Cantemir as possible. Due to its central location of Cantemir, the transfer station will serve the entire Rayon population, with the exception of the two southern most communities of Gotesti and Constantinesti which are located about 35 km from the future landfill.

Similarly for Taraclia Rayon, the transfer station needs to be located at proximity to the main urban settlement. The administrative characteristic of the Rayon shows that majority of the communities are located west of Taraclia town and close to the future landfill. Therefore, the transfer station in Taraclia could potentially serve the town itself and 6 other communities - Tvardita, Valea Perjei, Cairaclia, Corten, Novosiolovca and Aluatu.

Besides, due to their location, all settlements in Ceadir-Lunga could be served by the transfer station in Taraclia.

The table below presents the main criteria used for the analysis of establishing potential transfer stations in WMZ 3.

Table 7-11: Criteria for establishment of potential transfer stations in WMZ 3

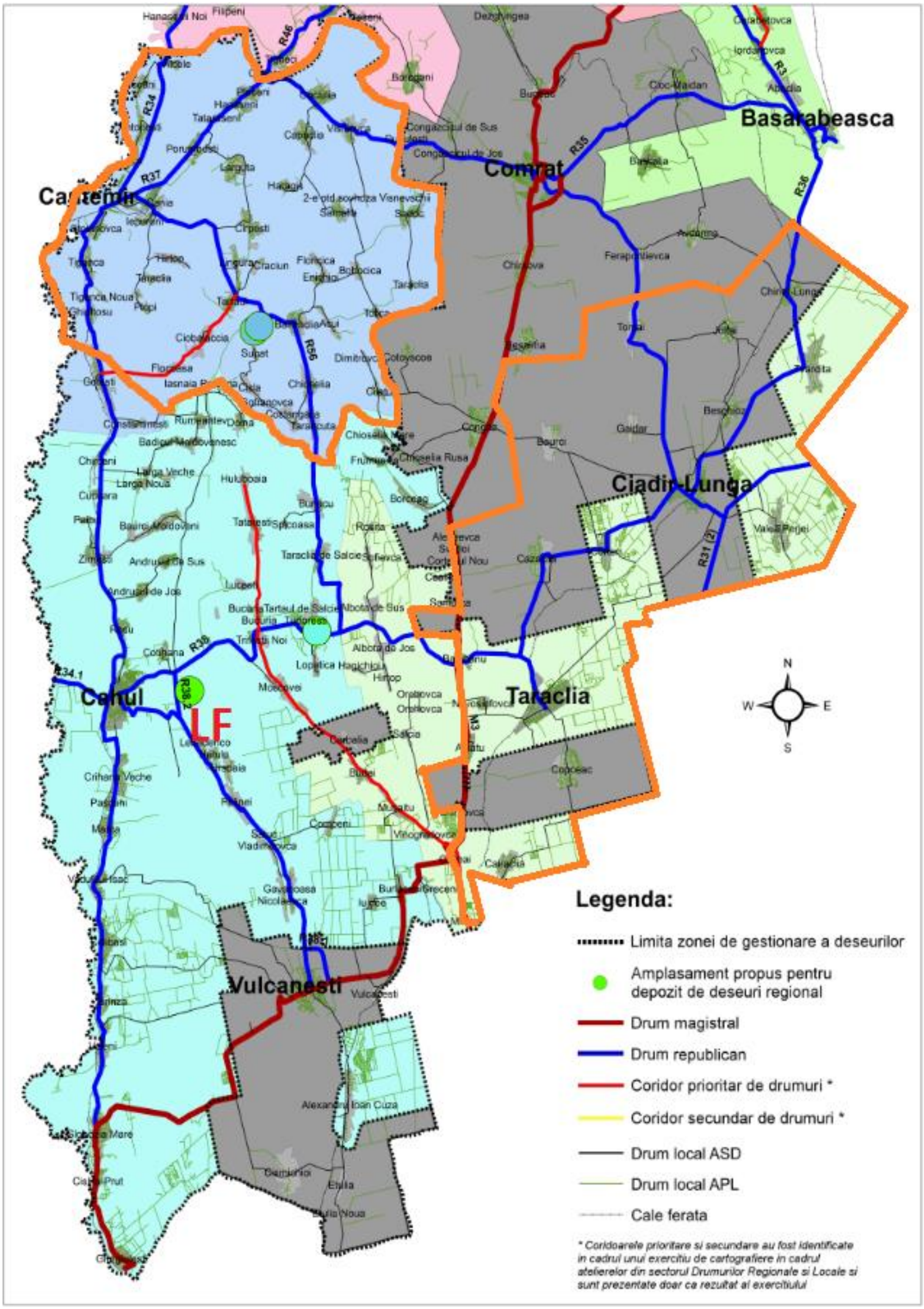
Criterion	Unit	TS in Slobozia Mare	TS in Cantemir	TS in Taraclia
Population covered	№	20,000	57,200	52,400
Waste transferred	tonne	3,300	10,100	20,500
Distance to the landfill	km	40	57	42
Break-even point	km	53	43	28

As seen from the table above, the population served and the quantities of waste are significant in Cantemir and Taraclia/ Ceadir-Lunga. Thus the transfer stations are justified. At the same time, the proximity of the potential transfer station near Valeni and Slobozia Mare and the quantities of waste to be transferred are not significant and establishment of a transfer station cannot be justified.

Therefore, the recommended option is Option 2 – establishment of 2 transfer stations, which will serve the population of Cantemir and Taraclia/ Ceadir-Lunga Rayons.

The figure below outlines the zones (marked in colour), for which it is recommended to use a transfer station. For the rest of communities it would be more cost efficient to transport their municipal waste directly to the future landfill.

Figure 7-6: Zones in WMZ 3 to be served by transfer stations



7.4.3 Conclusions

The tables below present the expected investment and operational costs for the transfer stations.

Table 7-12: Estimation of investment costs of the transfer stations

Description of works and equipment	Cantemir Rayon	Taraclia Rayon
	EUR	EUR
Works and buildings	**358,000**	**383,000**
Site preparation	140,000	150,000
Fence with gate	15,000	18,000
Greening	5,000	5,000
Drainage	8,000	15,000
Sewage	15,000	15,000
External connections	20,000	20,000
Reception and security building	50,000	50,000
Discharge system	45,000	50,000
Transfer ramp	40,000	40,000
Weighbridge	20,000	20,000
Equipment	**224,000**	**385,000**
Stationary press	0	100,000
Feeding bunker	0	10,000
Railing system	0	25,000
Containers, 35 m^3	35,000	0
Containers, 32 m^3	0	60,000
Hook-lift truck with trailer	190,000	0
Hook-lift truck	0	190,000
Total investment costs	**582,000**	**768,000**

As seen from the table above, the proposed solution for Cantemir Rayon is establishment of transfer station without compaction, whereby the waste from the collection trucks is transferred to larger containers and transported with a hook-lift truck with trailer.

Due to the significantly larger quantities generated by Taraclia and Ceadir-Lunga rayons combined, the more economically efficient way is to establish a transfer station near the town of Taraclia with a stationary press for higher compaction of the waste to be transported.

The total investment needed for construction of the two transfer stations with equipment amounts to about 1.4 Mio EUR. The annual investment unit cost per tonne of waste is 3.6 EUR for Cantemir TS and 2.7 EUR for Taraclia TS.

The table below presents the assumed operational cost for transfer and transport of municipal waste for the two transfer stations.

Table 7-13: Estimation of annual operational and maintenance costs of the transfer stations

Description	Cantemir Rayon	Taraclia Rayon
	EUR	EUR
Maintenance	22,000	28,000
Electricity	2,000	15,000
Administrative costs	8,000	8,000
Transport costs (100 km)	90,000	120,000
Total O&M costs	122,000	171,000
O&M unit cost per tonne	**12.1**	**8.3**

Depreciation of buildings is calculated for the entire planning period – 25 years. Depreciation of equipment is calculated at 10 years as it needs to be replaced. Thus the annual specific costs for transfer is estimated as 15.7 EUR/tonne for Cantemir TS and 11.0 EUR/tonne for Taraclia TS.

7.5 Technical options for sorting of waste

Sorting of municipal waste could be implemented in basically two ways:

- Separation of recyclables at the sorting station from the collected mixed municipal waste, i.e. the whole municipal waste stream is subject to sorting;
- Separation of recyclables at the sorting station from the separately collected waste streams, i.e. collected residual waste is not subject to further separation.

The table below presents advantages and disadvantages of these two alternatives.

Table 7-14: Advantages and disadvantages of sorting alternatives

Alternative	Main advantages	Main disadvantages
Sorting facilities for mixed solid waste	• Does not require additional collection cost and change of practice; • Flexibility in sorting greater number of materials depending on market potential; • Flexibility to potentially adapt it to MBT technology.	• Recyclables are contaminated, of less value, paper and cardboard could hardly be recycled; • Higher investment costs; • Limited in terms of resource recovery (between 5 and 10% of total waste quantities); • It does not lead to development of recycling system and does not change consumer behaviour.
Sorting station for separately collected recyclables	• Lower investment costs; • Cleaner recyclables with higher market value; • Provides for further development of the recycling system and increase of public involvement.	• Lower implementation costs; but combined with higher collection efforts lead to similar overall costs; • It requires change of attitude and practice of residents; • It necessitate continuous efforts for public involvement and costs for public awareness raising.

As it can be seen, both alternatives have advantages which depend on the type of the overall waste management system and mainly on the type of (separate) waste collection system.

7.5.1 Identification of options for sorting of waste

The possible technical options for sorting of municipal waste shall be based both on the possible options for collection of residual waste and on options for separate waste collection. Taking into consideration the analysis of the above two waste management elements, four options for sorting of municipal waste are identified:

- **Option 1**: Sorting of mixed collected municipal waste at one centralised sorting facility;
- **Option 2**: Sorting of separately collected waste at one centralised sorting station, based on Option 4 – Separate collection of recyclables;
- **Option 3**: Sorting of separately collected waste at one centralised sorting station, based on Option 1 – Separate collection of recyclables;
- **Option 4**: Decentralised sorting of separately collected waste at two sorting stations (one at the landfill and another one at Taraclia transfer station).

The four sorting options are described in more details in the section below.

7.5.2 Description of the sorting options

Option 1

Option 1 envisages sorting of total mixed collected waste from entire WMZ 3. The collected mixed waste will be transported to the sorting facility with the aim of extraction of those recyclable fractions that have market value. The location of the sorting facility shall be at the future landfill near Cahul.

The process of waste sorting includes the following main steps:

- *Visual control and manual separation of bulky and hazardous waste at the entry of the sorting facility*. At the tipping floor, a front loader spreads the waste out for inspection. At this stage, hazardous items and appliances are separated;
- *Feeding of processing line*. The loader transports the solid waste to the feeding bunker with devices for dosing the material flow for opening refuse bags. In this way the waste flow can be managed through the process;
- *Sifting out of fine fraction*. The sifting is performed in rotary sieves with size of holes 60-80mm. The fine fraction is of organic or inert character and is diverted for disposal;
- *Separation of recyclables*. Separation of recyclables after the rotary sieve includes magnetic separation of ferrous materials, manual separation of paper, cardboard, plastic and glass, plus non-ferrous metals separation by eddy current separator. The residual waste is transported for disposal to the landfill.

Sorting is conducted at the designated sorting area, and recovered recyclables are dropped into the appropriate segregated collection bins. Further processing typically includes baling for paper, steel cans, and plastic bottles, flattening or compacting for aluminium cans; granulating or perforating for plastic bottles; and crushing for glass bottles. The separated materials are then sold to the identified buyers.

Safety issues for the equipment operators and sorting workers include protection for the operation of power equipment, as well as eye, ear, respiratory and dermal protection. Therefore, proper personal protective equipment including gloves, eye protection, respiratory protection, and hearing protection should be used. Operators should be specifically trained in the use of all machinery. The facility needs to operate the same number of working days as the general waste collection system.

The following assumptions are made regarding the facility performance and operations:

- Rate of recycling: 25% of plastics and glass; 12% of paper and cardboard, and 35% of metals are assumed to be separated;
- In total, about 5% of waste is expected to be segregated as valuable recyclables.

As a result of the sorting process, about 3,500 tonnes of recyclables could be expected to be recovered.

Option 2

Option 2 is based on the identified option 4 for separate waste collection, which envisages the following:

- Separate waste collection is organised only in the urban area of WMZ 3;
- Plastic and metal is collected in Cahul, Cantemir, Taraclia, Tvardita, Ceadir-Lunga and Vulcanesti in a net container;
- Paper and cardboard are collected in Cahul and Ceadir-Lunga;
- Glass is collected only in Cahul.

The technological features of the sorting facility do not differ from Option 1. Apparently, the capacity of the sorting station shall be much lower – it needs to be able to process about 6,000 tonnes of separately collected waste.

Like with Option 1, the location of the sorting station shall be at the future landfill, which is close to the main waste generator in WMZ 3 – the city of Cahul.

Option 3

Option 3 is based on the identified option 1 for separate waste collection, which envisages the following:

- Separate waste collection is organised in the entire urban area of WMZ 3 and in all villages above 1,000 residents;
- The “bring system”, is organised by 2 containers of 1.1 m^3; one for plastic, metal, paper and cardboard, and one for glass.

The technological process is identical with Option 1. The capacity of the sorting station needs to be able to process about 11,000 tonnes of separately collected waste.

Option 4

Option 4 envisages that two sorting stations are established - one at the landfill and another one at Taraclia transfer station. The sorting station at the landfill will be identical with the one envisaged under Option 2. The difference would be the smaller capacity needed due to reduced quantities from Taraclia and Ceadir-Lunga rayons.

In the Taraclia sorting centre (to serve both the urban settlements of Taraclia and Ceadir-Lunga rayons) the quantities to be processed are about 2,000 tonnes per year. These quantities are not significant and cannot justify establishment of a sorting station with stationary sorting line and permanent structure (building).

Therefore, it is assumed that a type of mobile sorting line will be sufficient to process the incoming separately collected recyclables.

This mobile sorting line is with total length of 10 m and width of 1.1 m. It has the capacity to process about 1 tonne/hour. For processing the daily quantities, four manual sorters will suffice. The mobile sorting line could be placed in a closed tent, which will provide satisfactory working conditions for the workers.

The table below presents the main assumptions and parameters of the four identified options.

Table 7-15: Assumptions and parameters of the four sorting options, 2018

Indicators	Unit	Option 1	Option 2	Option 3	Option 4
Capacity of sorting line	tonne	70,000	6,000	11,000	6,000
Manual sorters	№	107	18	32	16
Additional staff	№	7	4	4	3
Plastic extracted	tonne	1,340	2,038	2,790	2,038

Indicators	Unit	Option 1	Option 2	Option 3	Option 4
Paper and cardboard extracted	tonne	670	1,274	2,790	1,274
Glass extracted	tonne	804	355	1,517	355
Metal extracted	tonne	536	578	765	578
Total recyclables extracted	tonne	3,349	4,245	7,861	4,245
Recovered from total waste	%	5.00%	6.06%	11.23%	6.06%

7.5.3 Cost assessment of the options for sorting of waste

The table below presents the costs associated with the implementation of each of the four options for sorting of waste (2018 as base year).

Table 7-16: Cost comparison of the sorting options, 2018

Costs	Costs in EUR			
	Option 1	Option 2	Option 3	Option 4
Investment costs	**2,693,000**	**800,000**	**1,094,000**	**676,000**
Buildings and works	1,228,000	410,000	449,000	254,000
Sorting equipment	1,198,000	305,000	535,000	330,000
Other equipment	267,000	85,000	110,000	92,000
O&M costs	**372,000**	**71,000**	**108,000**	**78,000**
Annual costs	538,000	120,000	178,000	122,000
Annual specific cost				

Depreciation of buildings is calculated for the entire planning period – 25 years. Depreciation of equipment is calculated for half of this period as it needs to be replaced.

The table below present the average current market prices of recyclables.

Table 7-17: Prices of recyclables, EUR/tonne

Recyclable material	EUR/tonne
Plastic	180
Paper & cardboard	70
Glass	14
Metal	450

Based on the quantities of recyclables to be recovered and the current market prices, the following table shows the expected revenues from sale of recyclables for the four options (2018 as base year).

Table 7-18: Expected revenues from recyclables, EUR/year

Recyclable materials	Option 1	Option 2	Option 3	Option 4
Plastic	241,000	367,000	435,000	367,000
Paper & cardboard	47,000	89,000	170,000	89,000
Glass	11,000	5,000	19,000	5,000
Metal	241,000	260,000	298,000	260,000
Total	**540,000**	**721,000**	**922,000**	**721,000**

7.5.4 Conclusion

As seen from the assessment of the four options, Option 1 is the most expensive option whereby the high costs are not expected to be compensated by revenues from sale of recyclables.

Option 3 is only marginally more expensive than Options 2 and 4. It is also expected that this option will bring higher revenues than the other options. However, the combined costs of both sorting and separate collection of waste make it more expensive option than Options 2 and 4.

Option 4 is more expensive than Option 2, due to implementation of a small-scale sorting line at Taraclia transfer station. These higher sorting costs are however going to be compensated with the reduced transport cost. Therefore, Options 2 and 4 are retained for further assessment of the possible system options.

7.6 Technical options for reduction of the disposed quantity of the biodegradable waste

The treatment of MSW can achieve the following three main objectives:

- *To reduce the negative impact of waste on the environment.* Because of its capacity to degrade, biodegradable waste is the main source of pollution in landfills, by creating carbon dioxide and methane emissions. Waste treatment aims to ensure that waste has the least negative impact on the environment;
- *To increase resource efficiency*. Waste is a potential resource for re-usable materials and energy;
- *To increase the lifetime of landfills.* By extracting valuable materials from waste, using it as an energy resource, and/or by stabilizing the biodegradable fraction, the quantities of waste to be landfilled will be decrease significantly. Although waste treatment can reduce requirements for a landfill, it cannot remove the need for a landfill.

Several waste treatment technologies are available. Most important technologies are:

- Incineration of waste;
- Waste to Energy technologies;
- Mechanical biological treatment (MBT) linked with centralized composting;
- Green waste composting; and
- Home composting.

The sections below present an analysis of these possible options.

7.6.1 Incineration of waste

Waste incineration refers to the controlled, high-temperature treatment of waste, coupled with extensive treatment/filtering of the air emissions and residual ashes. Typically the heat energy is utilized to generate electricity, in which case this constitutes a type of waste-to-energy facility (see section below).

The main advantage of waste incineration is that the process leads to significant reduction of the quantities of waste to be disposed – and about 95% of the waste is combusted. Although such reduction decreases significantly the need for construction of landfill for non-hazardous waste, the resulting 5% output from the incineration is qualified as hazardous waste in the EU and needs to be disposed safely on special landfills for hazardous waste.

Incineration of waste is an activity associated with highest investment costs for waste treatment and can only be justified with significant amounts of waste generated within the project area. Costs associated with MSW incineration in EU countries are within the range of 25-45 €/t (operational and maintenance costs) or 100-200 €/t (total costs)[3]. It is commonly accepted that incineration of waste can be justified only when quantities of waste exceed 100,000 tons per year, and even then incineration is seldom a preferred technology. Since the quantities of generated municipal waste in WMZ 3 (about 65,000 tons/year) are much lower than those above, the associated unit costs will be even higher and utterly unaffordable. Therefore, the implementation of MSW incineration in WMZ 3 is not considered further in this report.

7.6.2 Waste-to-Energy Technologies

Waste-to-Energy (WtE) encompasses methods whereby energy entrapped in waste is extracted for the production of electricity and heat. Globally, about 900 thermal WtE plants are operational, which treat annually 200 million tons of MSW. WtE also has a positive climate change effect because one ton of incinerated rather than landfilled municipal waste reduces emissions of greenhouse gases (GHGs) by about 1.2 tonnes of CO_2. Although WtE plants produce CO_2 as a result of the production process, the greenhouse effect of untreated methane generated in landfills is significantly more damaging.

Apart from waste incineration (as previously described), there are various other technologies available for WtE treatment. These are presented in the table below:

Table 7-19: Waste-to-energy technologies

WtE technologies	Description
Thermal technologies	
Gasification	This is a thermo-chemical process in which the organic input is heated in an oxygen deficient atmosphere to produce a so-called synthetic gas, which can then be used as a fuel in a turbine or combustion engine to produce electricity or heat.
Depolymerisation	The thermal depolymerisation (or oiling) of waste converts it into a diesel type of fuel. In fact this technology is designed to work with various type of throughput - different kinds of organic materials, rubber, fats of all kinds etc. Harmful substances as chlorine, dioxide and furans are neutralized by catalysts and prepared for safe disposal.
Pyrolysis	The technology involves degradation of the organic material in the waste by heat in the absence of oxygen, which results in the production of charcoal, liquid, and gaseous products. If the purpose is to maximize the production of liquid products resulting from pyrolysis of the organic material, a low temperature with high heating rate and short gas residence time process would be required. If the purpose is to maximize the production of high char, then a low temperature with low heating rate process would be required. And for high fuel gas production, a high temperature with low heating rate and long gas residence time process would be chosen.
Plasma arc gasification	This technology is based on a device called plasma converter, which uses electrical energy to reach high temperature whereby waste is broken down to into simple gas and waste slag. The plasma arc gasification allows large quantities of waste to be diverted from landfill and to produce electrical energy, which depends on the composition of the incoming waste.
Non-thermal technologies	
Anaerobic digestion	The organic fraction in the waste is decomposed and partly mineralised in

[3] JASPERS Staff Working Papers, Mechanical Biological Treatment Plants, by Jonas Byström, March 2010 (Revised August 2010)

WtE technologies	Description
	an oxygen-free environment. As result methane is generated and this can be utilised to generate electricity or heat. Depending on the quality of the output from the process it can either be utilised directly as a soil conditioner, or, if still not entirely degraded, to be further composted. Anaerobic digestion does not demand large areas, however practice shows that it is usually a more costly approach than aerobic treatment systems.
Mechanical biological treatment	Several MBT technologies are described in section 7.6.3 below.
Landfill gas utilisation	
Landfill gas utilisation	Although landfill of waste is not a treatment option, methane that is produced from the degradation of organic waste can be used to generate energy. This option rests on the feasibility of technologies to capture landfill gas, extract methane and use it directly as fuel and for electricity generation. This is a relatively low cost method for energy recovery from organic waste. Methane production varies greatly from landfill to landfill depending on the site specific characteristics such as waste disposed, waste composition, moisture content, landfill design and operating practices.

Costs associated with thermal depolymerisation, pyrolysis, and plasma arc gasification are similar to incineration of municipal solid waste. Costs associated with anaerobic digestion in EU countries are within the range of 25-50 €/t (operational and maintenance costs) or 50-90 €/t (total costs)[4], and may not be technologically reliable when applied to mixed MSW. Like incineration of MSW, implementation of thermal WtE technologies in WMZ 3 would prove too costly and the SWM service costs would rise to a level that would make the cost recovery unattainable. Therefore, the implementation of WtE technologies in WMZ 3 is not considered further in this report.

However, as the costs related to non-thermal technologies, especially MBT, are considerably lower than the thermal technologies, the following section will provide analysis of possible options for mechanical-biological treatment in the project area.

7.6.3 Mechanical-Biological Treatment

MBT is a family of technologies with widely varying costs and complexities. MBT technologies are very well established technologies in EU countries. Various technologies are currently in operation as the different processes have been tested and optimised over a long period of time.

The development of MBT technologies was encouraged by changes in the overall EU waste management policy and certain targets imposed. These include:

- Prohibition for disposal of untreated MSW; and
- Reduction of quantities of biodegradable waste for landfill.

MBT could incorporate a number of different process technologies. Some systems include facilities to pre-screen the waste and thus produce a compostable fraction appropriate for outdoor, covered or in-vessel type of composting processes. Another MBT approach includes initial extraction of recyclables, followed by homogenisation of the residual waste prior to its processing in an anaerobic digestion plant or aerobic treatment plant.

[4] Ibid.

Based on the type of biological treatment, MBT can be basically divided into three main technologies:

- *Bio-stabilisation*. This technology involves extraction of recyclable materials followed by bio-stabilisation of the remaining biodegradable waste fraction, done in aerobic environment, prior to disposal in landfill or use in non-agricultural applications such as mine reclamation;
- *Bio-drying*. With this technology a solid refuse fuel (SRF) is produced through intensive aerobic treatment of the municipal waste. The production of this high calorific fraction follows the extraction of recyclable metals and inert materials;
- *MBT with energy recovery*. With this technology a different high calorific fraction (refuse derived fuel – RDF) is produced. Following the extraction of recyclable materials and inert materials, the lighter fraction is prepared for production of RDF with parallel aerobic/anaerobic treatment of the heavier fraction.

Where the outputs of MBT include a fuel product, it is very important that plastics are removed for the purpose of recycling prior to the manufacture of the fuel (either SRF or RDF). Plastics have a high calorific value, and are therefore attractive for their fuel value. However, the burning of plastics may be highly polluting, and may produce both dioxins and furans as well as other pollutants and for this reason should be avoided in the production of SRF or RDF.

The table below presents the costs associated with the above presented MBT technologies in EU countries[5].

Table 7-20: Costs related to MBT technologies

MBT type	Operational costs (EUR/t/y)	Total costs (EUR/t/y)
Bio-stabilisation	10 - 25	20 - 40
Bio-drying	20 - 35	40 - 70
Energy recovery	25 - 45	60 - 90

As shown on the table above bio-stabilisation is the least costly method. Having in mind the current socio-economic situation in the region, possible implementation of the advanced waste treatment should envisage the lowest-cost solutions.

Bio-stabilisation process can be done in several ways. One of the well tested technologies is treatment of biodegradable fraction in in-door tunnels (so called in-vessel aerobic treatment). This process allows for fully controlled process of stabilisation and takes between 18 and 28 days, which allows for larger number of aerobic treatment cycles and thus needs considerably less area for treatment and stabilisation.

The in-vessel aerobic treatment is a fairly sophisticated method of treatment of biodegradable waste. It leads to production of a stabilised output, which can be landfilled or used in different productive applications, depending on its quality, while reducing in the process the quantities to be disposed, compared to the input amounts. More importantly this compost-like-output (CLO) can be used for rehabilitation of sand quarries or other disturbed lands. The process is conducted in aerobic environment and fully automated. For the purposes of the current analysis, the design capacity of the plant is 70,000 tons of mixed MSW per year.

[5] Ibid.

Mechanical treatment of the mixed waste stream

Following the registration of the incoming waste trucks, the waste is directed to the facility for mechanical waste treatment, where waste is unloaded at a reception area, where preliminary examination and sorting of bulky waste is conducted. After that, a front loader feeds the appliance for shredding the oversized fractions and opening the plastic bags. Through conveyor belt waste is transported to a trommel/drum sieve. This trommel has a three section sieve, which separates the throughput into three main fractions:

- Between 0 and 60 mm, which contains maximum quantity of biodegradable fraction mixed with quantities of small plastics, pebbles, wood chips etc.;
- From 60 to 250 mm, which contains maximum quantity of recyclable fractions – PET, PE, foils, ferrous and non-ferrous metals, paper and cardboard. This fraction will be transported to a ballistic separator, which additionally separates the throughput into: organic fraction for biological treatment and recyclable fractions for manual sorting and baling; and
- Above 250 mm, this contains oversized packaging and large foils. This fraction will be transferred to the station for manual sorting and subsequent baling.

The figure below shows some of the main mechanical treatment steps:

Figure 7-7: Main mechanical treatment steps

Reception hall where waste is unloaded

Three-section drum sieve

Station for manual sorting

Baler for recyclable fractions

The residual from the middle-sized and the oversized fractions is transferred to the landfill for disposal.

Biological treatment of the remaining output

Following the mechanical separation of the recyclable fractions, the biodegradable fraction is transferred to the in-vessel composting facility, comprising of closed tunnels, where the input material falls in an entirely controlled environment. The process is automated to control the oxygen content, temperature and humidity.

The aeration appliance is installed in the concrete floor. The input material stays in the tunnels for 20 days. The organic material is subjected to several phases of treatment, each of which occurs “naturally” provided that adequate conditions of temperature, moisture and oxygen are maintained:

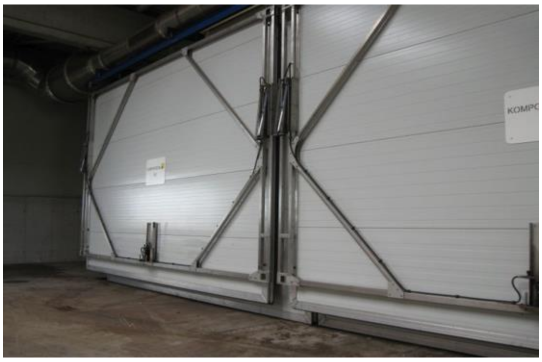
- First phase: Stabilization, which is happening at 30ºC;
- Second phase: Hygienisation, which takes place at 60ºC;
- Third phase: Composting, which takes at 55ºC; and
- Fourth phase: Cooling, at 35-40ºC.

The malodorous air will be captured in bio-filters, prior to releasing it into the open air. The bio-filters consist of a concrete reservoir, which has two beds. The malodorous air is insufflated into the lower bed, below the bio-filter, and from there it is dispersed evenly to the bio-filter material.

The biological treatment phase is completed in a separate zone for further maturation of the treated output; this may require 6-8 weeks.

The figure below shows some of the main biological treatment steps:

Figure 7-8: Main biological treatment steps



Outside look of the composting tunnels

Inside the composting tunnels

Cooling process

Maturation process

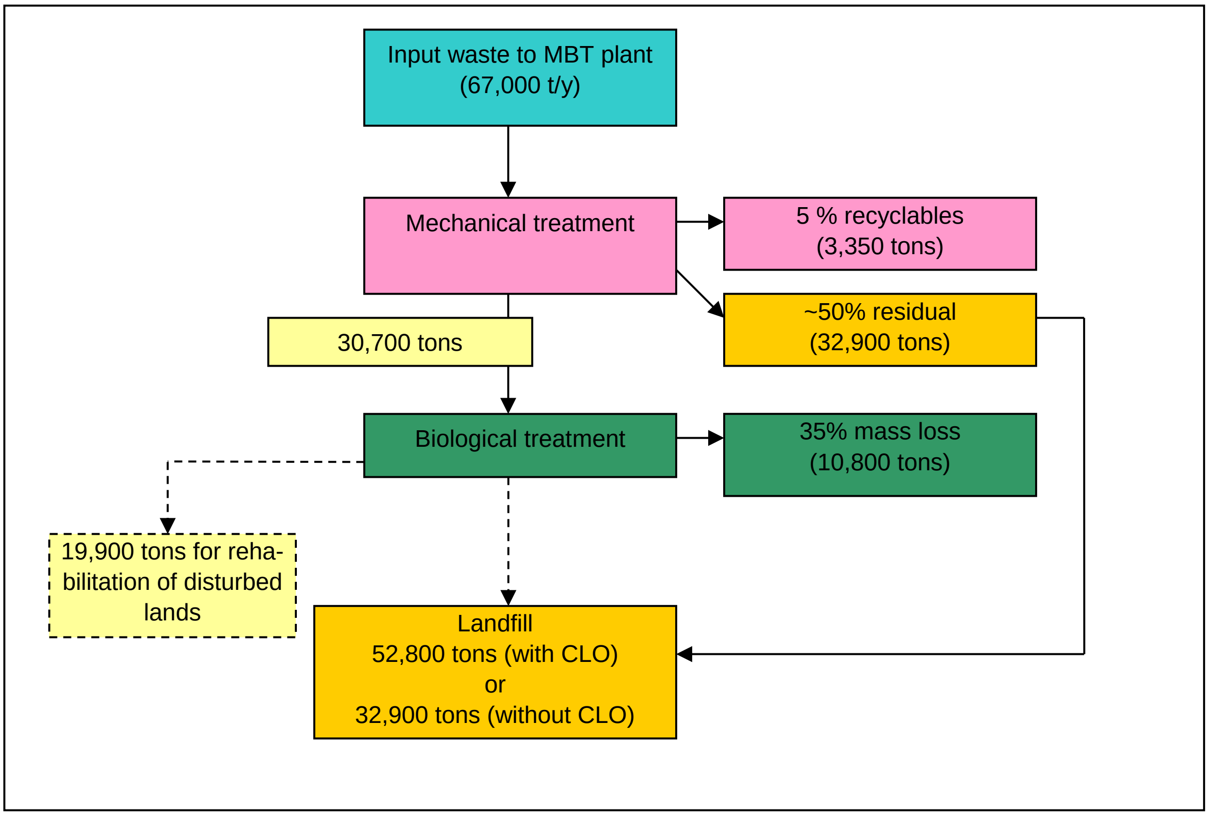
In the table below are presented the key design parameters, used for dimensioning the MBT plant.

Table 7-21: Parameters for dimensioning the MBT plant

Parameter	Unit	Value
Capacity (design)	tonnes	67,000
Daily input	tonnes	216
Recyclables extracted	%	5%
Yearly input for biological treatment	tonnes	30,800
Daily input for biological treatment	tonnes	98
Residual for landfill	tonnes	33,000
Residual for landfill	%	49%
Time needed for a composting cycle	day	20
Cycles per year	№	18
Assumed density	t/m^3	0.2
Capacity of one tunnel	tonnes	120
Aerated tunnels	№	14
Loss during biological treatment	%	35%
Loss during biological treatment	tonnes	11,000
CLO produced	tonnes	20,000
Total waste for landfill (if CLO landfilled)	tonnes	53,000
Landfilled waste with CLO (of total)	%	79%

The figure below presents the inputs and outputs of the analysed MBT system for 2018 (values are rounded).

Figure 7-9: Mass balance of the analysed MBT technology



Options for additional sources for utilisation of CLO should be further explored. As seen from the figure above, a possible utilisation of CLO will reduce the quantities of waste landfilled considerably.

With regard to a possible energy recovery from this MBT option, the stabilised output can be further treated (dried), which will result in production of high-calorific fraction as refuse-derived fuel (RDF). The production of RDF will certainly require adjustment of the mechanical treatment stage. Following adoption of appropriate regulations in accordance with EU norms, this RDF can be utilised in the existing cement industries in the country.

Cost estimation

The total investment costs associated with the construction of this MBT plant amount to about 14.7 million EUR. The investment breakdown is presented in the table below (figures are rounded).

Table 7-22: Estimation of investment costs for the MBT

Investment	Value, EUR
Sorting facility	**2,693,000**
Works and building	1,228,000
Equipment	1,465,000
In-vessel treatment	**12,000,000**
Works and building	5,000,000
Equipment	7,000,000
Total investment cost	**14,693,000**
Annualised investment costs	926,000
Annual unit treatment cost, EUR/tonne	13.8

Depreciation of buildings is calculated for the entire planning period – 25 years. Depreciation of equipment is calculated for half of this period as it needs to be replaced. Costs associated with the operation and maintenance of the facility are given in the table below.

Table 7-23: Estimation of O&M costs for the MBT

Operational costs	Value, EUR
Sorting facility O&M costs	371,000
In-vessel composting O&M costs	462,000
Total O&M cost	**833,000**
Unit cost/ton	12.4

The total annual costs for treatment of one tonne of MSW in such a MBT facility are estimated at about 26 EUR. These costs do not include the expected revenue from recycling, which are estimated to reduce the annual costs by 4 EUR/tonne.

Conclusion

Although the implementation of MBT in South Region brings rather high costs, this option will be retained for further analysis of the options for establishment of waste management system in WMZ 3. Reduced quantities of waste to be landfilled will lower the investment costs for construction of new sanitary landfill for the region.

7.6.4 Centralised composting of green waste

The treatment of organic waste in WMZ 3 could be initiated with relatively simple methods, like composting of green organic waste (i.e. landscaping waste, waste from gardens etc.) that requires a minimum of pre-processing and which will result in the highest quality of final compost product which can be used as a soil conditioner and will be suitable for agricultural and other applications.

The main difference between this method and the bio-stabilisation of mixed organic waste is that in order to produce a high quality compost, which can be applied for various purposes (and be diverted from landfill), the method requires that the input material is separately collected to avoid contamination of the final product.

The composting activities aim at achieving:

- Reduction of organic waste in the total waste flow for landfilling; and
- Return of part of the organic fraction for reuse.

The composting is usually done in so-called windrows. It is a simple and inexpensive solution. It is also adaptable to future expansion (increase of capacity) or update of equipment. Disadvantage is the relatively long period required for compost maturation.

Composting of separately collected green waste includes unloading of throughput in a designated site, shredding it and placing it pyramids. For aeration purposes, the material needs to be regularly turned by a heap turner, or specially designed equipment as shown in the picture below.

Figure 7-10: Heap turner used in centralised composting

Regular tests need to be performed on the temperature, humidity and fertility of the compost. To produce a quality product (compost), which could be used for agricultural purposes, periodic analysis of heavy metal content need to be conducted. Lower qualities of compost are appropriate for land reclamation and construction of sports fields, highway landscaping and other applications.

The composting process includes the following phases:

- Pre-composting phase (about 2 months – characterised by high temperature within the windrows, a process of intense mineralisation and loss of water; turning of the windrows should be conducted twice a week to avoid keeping of humid, anaerobic compounds within the windrow and to allow air flow into the windrow);

- Main composting phase (about 3 months – extensive process of mineralisation, the temperature decreases, normal level of water in the compost);
- Final composting phase (1 month), which puts the compost maturation phase to an end.

This type of composting process usually takes 6 months and due to significant loss of water the material loses about 50% of its initial weight. Thus, it is reasonable to assume that composting of new organic material could be performed over 2 continuous cycles a year on the composting site(s).

The following three options for centralised composting of green waste are analysed:

- **Option 1**: Composting of separately collected green waste from entire project area (both urban and rural). In urban area – green waste is collected only from public areas. In rural area – green waste is collected from households. One composting facility to be established at the future landfill near Cahul;
- **Option 2**: Composting of separately collected green waste only from the urban area. Green waste is collected both from public areas and from households living in private houses. Three composting facilities to be established:
    - One in the regional landfill to serve Cahul and Vulcanesti rayons;
    - One in Cantemir rayon; and
    - A third one located at the TS to serve Taraclia and Ceadir-Lunga rayons.
- **Option 3**: Composting of separately collected green waste only from the urban area. Green waste is collected both from public areas and from households living in private houses. Difference to Option 2 is that instead of three composting facilities in each of the three rayons, one composting facility is to be established at the future landfill near Cahul.

The table below presents the assumptions used for quantities of generated green waste for the above outlined options for centralised composting.

Table 7-24: Assumptions for green waste quantities, 2018

Description	Unit	Option 1	Option 2	Option 3
Urban settlements	kg/cap/year	0.05	0.05	0.05
Houses in urban area	% of organic waste	n.a.	15	15
Rural settlements	% of organic waste	50	n.a.	n.a.
Quantities to be treated	tonne	7,228	3,268	3,268

The cost comparison of the three options is presented in the table below.

Table 7-25: Cost comparison of options for centralised composting of green waste

Description	Costs in EUR		
	Option 1	Option 2	Option 3
Quantities to be treated	7,200	3,300	3,300
Investment costs	**553,000**	**415,000**	**239,000**
Buildings and works	289,000	151,000	129,000
Equipment	264,000	264,000	110,000
O&M costs	**52,000**	**37,000**	**17,000**

Description	Costs in EUR		
	Option 1	Option 2	Option 3
Transport costs	217,000	33,000	99,000
Total annual costs	302,000	97,000	125,000
Annual unit cost, EUR/tonne*	4.5	1.5	1.9

As seen from the table above, Option 2 brings lowest costs of the three options. Option 3 has lowest investment and operational costs. However, due to the need to transport the collected green waste to the central facility at the future landfill, this option is with a bit higher overall costs. Nevertheless, both Options 2 and 3 are retained for further analysis of the options for establishment of waste management system in WMZ 3.

7.6.5 Home composting

Another practical option for reduction of quantities of waste for landfill is introduction of home composting. In the most ordinary way, the process of composting requires simply piling up green waste. The decomposition process is aided by shredding plants and branches from trees. To speed the process of decomposition proper aeration by regularly turning the mixture should be ensured. Kitchen waste could also be added to the process, but only selected food waste. Dairy products and meat should be avoided as they attract vermin and rats. In general, kitchen waste in the rural settlements is primarily used for animal feeding and home composters are expected to treat mainly green waste from yards.

Home composting can be facilitated by use of special devices. These devices (home composters) are stable (usually made of plastic) and have an operational period of 7-10 years. Prices of such containers vary between 25 and 120 EUR (470 – 2,270 MDL). A home composting unit can also be made from wood, or other materials, and can be very simple and less expensive.

The table below presents the design parameters of a potential home composting system for the individual houses in WMZ 3.

Table 7-26: Parameters for home composting system

Parameter	Unit	Value
Organic waste generated in villages (percent of total organic waste)	%	50%
Organic waste generated in urban areas with houses (of total organic waste)	%	15%
Quantities of organic waste	tons/year	6,500
Efficiency of home composting	%	50
Quantities to be home composted	tons/year	3,300
Households covered/composters needed	number	90,000
Price of composters	EUR	25
Investment for devices	EUR	2,250,000
Life of composters	years	7
Annual investment costs	EUR	321,000
Annual unit cost per tonne composted	EUR/tonne	97

As seen from the table above, in order to cover all households living in houses in WMZ 3, an investment of about 2.2 Mio EUR will be needed for a period of 7 years. The quantities to be diverted from landfill cannot be expected to exceed 3,300 tons annually. Therefore, it can be concluded that cost-wise it is not advisable to initiate home composting for all households living in houses at this stage of development the SWM system in WMZ 3.

However, home composting is a recycling method that helps transform quantities of green waste into valuable compost, which can be applied by residents directly into their soil to increase the production of vegetables and flowers. At the same time, home composting results in reduced amounts of waste that require collection, and in this sense it can help reduce costs for waste collection and subsequent management. Therefore, it is advisable that home composting is initiated and tested on a pilot basis.

The table below presents the design parameters of a pilot home composting system based on about 2,000 households in the project region. This number of households represents 2% of the total number of households, living in houses in WMZ 3. It is also recommended that households involved are from the entire project area, both urban and rural.

Table 7-27: Parameters for pilot home composting system, 2018

Parameter	Unit	Value
Organic waste generated in villages (percent of total organic waste)	%	50%
Organic waste generated in urban areas with houses (of total organic waste)	%	15%
Quantities of organic waste	tons/year	124
Households covered/composters needed	number	1,900
Price of composters	EUR	25
Investment for devices	EUR	47,000
Life of composters	years	7
Annualised investment costs	EUR	7,000

As seen from the table above, the investment costs are not significant and the implementation of home composting will contribute for the increase of public awareness and involvement in the regional waste management and particularly in the waste avoidance measures. Therefore, it is recommended that pilot home composting is initiated, with the commencement of the new system, to cover initially 2% of the households and later to be expended following increase of public involvement and awareness.

7.6.6 Conclusion

Based on the analysis of possible options for biological treatment of municipal waste, it can be concluded that the following options shall be retained for further analysis of the system elements of the future waste management system in WMZ 3:

- Development of centralised mechanical-biological treatment of mixed collected municipal waste;
- Development of 3 composting plants for separately collected green waste in each of the three rayons;
- Development of 1 composting plant for separately collected green waste located at the future landfill;
- Introduction of pilot home composting.

7.7 Technical options for waste disposal

Independent of all future measures related to waste avoidance, recycling and waste treatment, a certain amount of residual waste will remain for disposal. Thus, sanitary landfills for safe and environmentally compliant disposal are required in any case.

The assessment of potential regional landfill locations in the WMZ 3 identified the current disposal site of Cahul as the preferable location.

Landfills for municipal waste respond to the requirements for safe disposal of waste that does not have hazardous characteristics, and which is similar to household waste. Therefore, no waste with hazardous characteristics should be accepted for landfilling. Landfilling of industrial non-hazardous waste is usually allowed at landfills for municipal waste. However it has to be taken into account that waste different from household is of different compaction parameters and may take much more of the landfill volume than household waste of the same weight.

The design and the construction of the regional sanitary landfill will be conducted in accordance with the provisions of Directive 1999/31/EC on landfill of waste.

7.7.1 Options for waste disposal

The options for waste disposal in WMZ 3 is based on the following main assumptions:

- The future infrastructure for waste disposal should be based on the EU environmental standards and norms, as defined in both the NWMS (2013-2027) and the Regional Waste Management Programs for Development Region South;
- The current disposal site of Cahul is the location of the future regional landfill, as agreed and approved by the local stakeholders;
- There will be only one sanitary landfill serving the entire WMZ 3.

Based on the above assumptions, a sanitary landfill, located at the current disposal site of Cahul, serving the entire WMZ 3 of South Region, shall be established. Taking into consideration the possible options for recycling and waste treatment, the following two options for waste disposal are analysed:

- **Option 1**: The option envisages that the whole municipal waste collected through the residual waste collection system will be disposed on the landfill for final treatment;
- **Option 2**: The option envisages that the mixed collected municipal waste will be subject to biological treatment at the MBT plant and only intensely treated waste will be landfilled whereby the quantities of disposed waste are reduced as well.

With the inclusion of areas of ATU Gagauzia in the project area and taking into consideration the maximum available area, the landfill is estimated to suffice for 21-years of operation. The landfill construction needs to be executed in phases. The first phase needs to include the following infrastructure:

- First cell with capacity to suffice for 6 years of disposal;
- Collection and treatment systems for leachate and landfill gas;
- Additional infrastructures, like: weighbridge, fence, office and garage buildings;
- The necessary mobile equipment, like compactor, truck, front loader etc.

Prior to the completion of the first cell, the construction of the second cell should start. Each of the cells, which will be constructed following the first phase, should have an operational life of not less than 6 years. Provided that the first cell will be for 6 years, the future development of the landfill can assume that 2 additional cell will be needed; one with a life period of 8 years and a third with 7 years.

7.7.2 Cost comparison of the options for waste disposal

The tables below presents the estimation of costs related to the two options for waste disposal.

Table 7-28: Estimation of investment costs of the two options, 2018, in EUR

	Option 1		Option 2	
Description of costs	**1st phase**	**2nd-3rd phases**	**1st phase**	**2nd-3rd phases**
1.General works	350,000	600,000	300,000	300,000
2. Earth works	250,000	700,000	250,000	600,000
3. Base sealing system	1,280,000	2,000,000	900,000	1,200,000
4. Leachate collection	130,000	180,000	120,000	150,000
5. Surface water	95,000	100,000	86,000	50,000
6. Surface sealing	0	2,500,000	0	2,200,000
7. Access road	160,000	50,000	160,000	50,000
8. Infrastructure	350,000	150,000	350,000	100,000
9. Buildings	135,000	50,000	135,000	50,000
10. Equipment	410,000	410,000	410,000	410,000
11. Leachate treatment	610,000	850,000	300,000	450,000
12. Landfill gas treatment	340,000	500,000	200,000	200,000
Subtotal	**4,110,000**	**8,090,000**	**3,211,000**	**5,760,000**
Contingencies (approx. 10%)	411,000	809,000	321,100	576,000
Total investment cost Option 1	**4,521,000**	**8,899,000**	**3,532,100**	**6,336,000**

The table below presents the expected operational and maintenance costs for the two landfill options.

Table 7-29: Estimation of annual operational and maintenance costs, 2018, in EUR

Cost description	Option 1	Option 2
Salaries	24,000	22,500
Leachate treatment	40,000	10,000
Electric Power	9,000	3,000
Vehicle operation	55,000	47,000
Lubricants	5,500	5,000
Maintenance vehicles	20,500	20,500
Other	10,000	10,000
Total O&M costs	**164,000**	**118,000**
Annual unit cost	**2.45**	**1.76**

As it can be expected, Option 2 is the lower cost option, both as investment and as operational costs.

Since implementation of mechanical-biological treatment is a possible element of the future regional waste management system, both options for waste disposal shall be retained for further comparison of the possible waste system scenarios.

7.8 Option analysis for the waste management system

7.8.1 Introduction

Waste collection and sanitary disposal represents the backbone of an integrated waste management system. Each element of a waste management system has an impact on the other elements and therefore they must be fully assessed as a coherent system. Certain elements (particularly waste treatment options) bring higher costs to the system, but at the same time they bring positive aspects like revenue and reduced landfill investment costs.

This section looks at a range of different options, in order to identify the likely scale of costs and benefits which may result from different scenarios of more intensive recycling and treatment in WMZ 3.

The following table presents the options for different elements of the system, which have been retained for analysis of the system options.

Table 7-30: Description of the potential options for each activity

Activity	Description
Collection	• **Option 1**: waste collection is organised in the entire WMZ 3 by "bring system"; all the waste is collected by the containers for residual waste as no separate collection of waste is implemented; • **Option 2**: same as Option 1, but quantities of residual waste are reduced due to implementation of separate waste collection; • **Option 5**: individual houses in the towns of Cahul, Taraclia, Cantemir, Ceadir-Lunga and Vulcanesti are served by "door-to-door" collection, while the rest settlements are served by "bring system".
Separate collection	• **Option 1**: Separate waste collection is organised in the entire urban area of WMZ 3 and in all villages above 1,000 residents. The "bring system", is organised by 2 containers of 1.1 m^3; one for plastic, metal, paper and cardboard, and one for glass; • **Option 4**: Separate waste collection is organised in the entire urban area of WMZ 3. Plastic and metal is collected in all towns in a net container. Paper and cardboard are collected in Cahul and Ceadir-Lunga. Glass is collected only in Cahul.
Transfer	• **2 TS** – two transfer stations (TS) will be established: one for Cantemir and another one for Taraclia and Ceadir-Lunga rayons.
Sorting	• **1 SS** – one sorting station (SS) will be established at the regional landfill; • **2 SS** – two sorting stations will be established; one at the regional landfill and one at Taraclia TS.
Composting	• **1 CS** – one composting station will be established at the regional landfill; • **3 CS** – three composting stations will established; one at the regional landfill, one at Taraclia TS; and one at Cantemir TS.
Home composting	• **HC** – introduction of pilot home composting (HC) in WMZ 3 for about 2,000 households living in houses.
MBT	• **MBT** – introduction of centralised mechanical-biological treatment at the regional landfill.
Landfills	• **Option 1** – construction of regional landfill for not biologically treated municipal waste prior to landfilling; • **Option 2** - construction of regional landfill for biologically treated municipal waste prior to landfilling.

In the Annex 5 option analysis model is presented.

7.8.2 Identification of system options

The table below presents the grouping of the potential system options.

Table 7-31: Possible waste management system options

System elements	System Option 1	System Option 2	System Option 3	System Option 4	System Option 5	System Option 6
Collection of residual waste	Option 1: organised in the entire WMZ 3 by "bring system"	Option 5: individual houses in the towns of Cahul, Taraclia, Cantemir, Ceadir-Lunga and Vulcanesti are served by "door-to-door" collection, while the rest settlements are served by "bring system"	Option 5: individual houses in the towns of Cahul, Taraclia, Cantemir, Ceadir-Lunga and Vulcanesti are served by "door-to-door" collection, while the rest settlements are served by "bring system"	Option 1: organised in the entire WMZ 3 by "bring system"	Option 2: same as Option 1, but quantities of residual waste are reduced due to implementation of separate waste collection	Option 5: individual houses in the towns of Cahul, Taraclia, Cantemir, Ceadir-Lunga and Vulcanesti are served by "door-to-door" collection, while the rest settlements are served by "bring system"
Separate collection of waste	n/a.	Option 4: organised in the entire urban area of WMZ 3. Plastic and metal is collected in all towns in a net container. Paper and card-board are collected in Cahul and Ceadir-Lunga. Glass is collected only in Cahul	Option 1: organised in the urban area of WMZ 3 and in all villages above 1,000 residents. The "bring system", is organised by 2 containers of 1.1 m^3; one for plastic, metal, paper and card-board, and one for glass	n/a.	Option 4: organised in the entire urban area of WMZ 3. Plastic and metal is collected in all towns in a net container. Paper and card-board are col-lected in Cahul and Ceadir-Lunga. Glass is collected only in Cahul	Option 4: organised in the entire urban area of WMZ 3. Plastic and metal is collected in all towns in a net container. Paper and card-board are col-lected in Cahul and Ceadir-Lunga. Glass is collected only in Cahul
Transfer and transport	Two TS: one for Cantemir and another one for Taraclia and Ceadir-Lunga rayons	Two TS: one for Cantemir and another one for Taraclia and Ceadir-Lunga rayons	Two TS: one for Cantemir and another one for Taraclia and Ceadir-Lunga rayons	Two TS: one for Cantemir and another one for Taraclia and Ceadir-Lunga rayons	Two TS: one for Cantemir and another one for Taraclia and Ceadir-Lunga rayons	Two TS: one for Cantemir and another one for Taraclia and Ceadir-Lunga rayons
Sorting of waste	n/a.	One sorting station at the regional landfill	One sorting station at the regional landfill	n/a.	One sorting station at the regional landfill	Two sorting stations; one at the LF and one at Taraclia TS
Composting of green waste	n/a.	Three composting stations: one at the regional landfill, one at Taraclia TS; and one at Cantemir TS	Three composting stations: one at the regional landfill, one at Taraclia TS; and one at Cantemir TS	One composting station at the regional landfill	One composting station at the regional landfill	Three composting stations: one at the regional landfill, one at Taraclia TS; and one at Cantemir TS

System elements	System Option 1	System Option 2	System Option 3	System Option 4	System Option 5	System Option 6
Home compost-ing	n/a.	Pilot home composting in WMZ 3	Pilot home composting in WMZ 3	Pilot home compost-ing in WMZ 3	Pilot home compost-ing in WMZ 3	Pilot home composting in WMZ 3
MBT	n/a.	n/a.	n/a.	Centralised mechani-cal-biological treat-ment at the regional landfill	Centralised mechani-cal-biological treat-ment at the regional landfill	n/a.
Landfills	Option 1: regional landfill for not treated municipal waste	Option 1: regional landfill for not treated municipal waste	Option 1: regional landfill for not treated municipal waste	Option 2: regional landfill for biologically treated municipal waste prior to land-filling	Option 2: regional landfill for biologically treated municipal waste prior to land-filling	Option 1: regional landfill for not treated municipal waste

System Option 1 is based on a “baseline” scenario with construction of new sanitary landfill next to the current disposal site of Cahul and extended waste collection service. This option assumes that all MSW collected from WMZ 3 will be collected and transported to the landfill for final disposal, either directly or through transfer stations in Cantemir and Taraclia.

System Option 2 introduces separate collection of recyclables in all urban area. The recycling system will be supplemented by a sorting station for separately collected recyclables. In addition, the option envisages biological treatment of separately collected green waste from urban areas and introduction of home composting on a pilot scale.

System Option 3 differs from Option 2 with regard to a more extended separate collection of recyclables, which will cover not only the whole urban area, but also all villages above 1,000 residents. Thus, between 75% and 85% of the total rural population will be provided with separate waste collection service.

System Option 4 envisages a system whereby all municipal waste is collected mixed and is then subject to mechanical-biological treatment (MBT) at a centralised facility at the landfill.

System Option 5 also relies on MBT, but includes also separate collection of recyclables on the same scale as Option 2.

System Option 6 is similar to Option 2; the only difference is the establishment of a second sorting station at Taraclia transfer station for separately collected recyclables from the towns of Taraclia, Tvardita and Ceadir-Lunga.

Also, as shown in the table above, different options differ with regard to number of transfers, sorting and composting stations.

7.8.3 Cost assessment of system options

The table below presents the estimation of the investments needed for each of the six system options.

Table 7-32: Estimation of the initial investments needed for the options, 2017-2018, EUR

System elements	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6
Waste collection	5,065,000	5,381,000	5,381,000	5,050,000	4,838,000	5,381,000
Separate waste collection	0	768,000	2,166,000	0	768,000	768,000
Transfer stations	1,445,000	1,445,000	1,445,000	1,445,000	1,445,000	1,445,000
Sorting facilities	0	815,000	1,094,000	0	815,000	676,000
Composting facilities	0	416,000	416,000	239,000	239,000	416,000
home composting	0	47,000	47,000	47,000	47,000	47,000
MBT	0	0	0	14,693,000	14,693,000	0
Landfills	4,521,000	4,521,000	4,521,000	3,532,000	3,532,000	4,521,000
Total costs	**11,031,000**	**13,393,000**	**15,070,000**	**25,006,000**	**26,377,000**	**13,254,000**

The table below shows the discounted total annual unit costs for collection, treatment and disposal (included are costs for depreciation, future development of the landfill and cells closure, post-closure aftercare and operational and maintenance) of the six system options. The table includes also the expected revenues from recycling (presented as negative values/costs) as well as the total recovery/diversion rate associated with each of the options.

Table 7-33: Estimation of the specific annual costs related to the system options, EUR/tonne

Components	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6
Waste collection	26.2	34.8	34.8	26.2	25.8	34.8
Separate waste collection	0.0	5.3	12.2	0.0	5.3	5.3
Transfer stations	6.7	6.7	6.7	6.7	6.7	6.7
Sorting facilities	0.0	2.1	3.0	0.0	2.1	2.1
Composting facilities	0.0	1.1	1.1	0.6	0.6	1.1
home composting	0.0	0.3	0.3	0.3	0.3	0.3
MBT	0.0	0.0	0.0	30.2	30.2	0.0
Landfills	13.3	13.3	13.3	8.7	8.7	13.3
Sub-total costs	**46.1**	**63.5**	**71.2**	**72.7**	**79.7**	**63.5**
Revenue from recycling	0.0	-11.0	-16.2	-8.1	-11.0	-11.0
Total costs	**46.1**	**52.5**	**55.1**	**64.6**	**68.6**	**52.5**
Recovery/diversion rate, %	**0.0%**	**12.2%**	**17.7%**	**32.8%**	**36.7%**	**12.2%**

From the table above it is clear that Options 4 and 5 (options with MBT) leads to maximum reduction of quantities to be landfilled. It has to be noted that it is assumed that 20% of the produced CLO will not be landfilled, but used for re-cultivation purposes. At the opposite end is Option 1 whereby all of the collected waste will be landfilled.

7.8.4 Affordability level of waste management service costs

In order to assess the system options with regard to their affordability, an analysis of the affordability level of the service costs is performed. For assessment of the affordability level, the following assumptions are used:

- The average disposable income for urban settlements in WMZ 3 in 2013 is 1,585 MDL per person per month[6];
- The average disposable income for rural settlements in WMZ 3 in 2013 is 1,349 MDL per person per month;
- The assumed annual economic growth is assumed at 5%;
- Affordability threshold is assumed at 1% of the average disposable income per person.

Thus the average monthly disposable income for WMZ 3 for 2017 is estimated at 1,616 MDL per person.

The table below presents the forecasted affordability level for service costs in 2017.

Table 7-34: Assessment of affordability level of waste services, 2017

Description	Unit	Value
Average monthly WMZ 3 income, 2017	MDL	1,616
Affordability threshold	%	1%
Monthly affordable tariff	MDL	16.16
Monthly affordable tariff	EUR	0.76
Annual affordable tariff	EUR	9.06
Average WMZ 3 waste generation rate	kg/cap/year	0.224
Affordable service cost	EUR/tonne	40.41

[6] National Bureau of Statistics of the Republic of Moldova

As seen from the table above, even Option 1 could not be implemented within the affordability threshold of 1% of the average disposable income on a full cost recovery principle. All other options exceed this affordability level even further.

7.8.5 Final assessment of the system options. Conclusion

System Option 1 is expectedly the lowest cost option of all six ones. This is due to the lack of costs for waste treatment. From all other options, System Options 2 and 6 are least expensive. As mentioned before, System Options 4 and 5 bring highest rate of diversion of waste from landfill, but the cost associated with treatment of biodegradable waste are rather high – about 30 EUR/tonne annually.

Nevertheless the above considerations, the establishment of integrated solid waste management system in WMZ 3 will be influenced by two other factors as well. These are:

- Compliance with the national principles and objectives in the field of solid waste management;
- Type of financing of the system.

The National Waste Management Strategy 2013-2017 sets the following principles and objectives:

- Implementation of waste management activities in accordance with the hierarchy adopted on EU level where landfilling of waste becomes the least preferable way of waste treatment and is preceded by waste minimisation, reuse and recycling;
- Establishment of resource recovery mechanisms through introduction of separate waste collection and sorting of municipal waste, coupled with implementation of economic instruments which will foster the resource recovery on a national level (like Extended Producer Responsibility).

It is apparent that System Option 1 could not meet these principles and objectives, set on national level. It represents only an option for establishment of the backbone of the future system, which will subsequently need to be upgraded with waste prevention and resource recovery measures. All other system options are in line with the national policy.

Chapter 13 provides details about the project financing. Regardless of the type of financing, it has to be assured that the selected measures are sustainable. This means that the costs for operating the system and its maintenance could be sustained through the waste charges to the population and the business entities.

The table below presents the division of project discounted costs between operating and investment costs of System Options 2 and 6, which are the second lowest cost options of all.

Table 7-35: Division of project costs, EUR/tonne

Components	O&M cost	Investment costs[7]	Total costs
Waste collection	22.2	12.5	34.8
Separate waste collection	3.5	1.8	5.3

[7] Investment costs include 5% financing and reinvestment costs

Components	O&M cost	Investment costs[7]	Total costs
Transfer stations	4.4	2.2	6.7
Sorting facilities	1.1	1.1	2.1
Composting facilities	0.5	0.6	1.1
Home composting	0.0	0.3	0.3
MBT	0.0	0.0	0.0
Landfills	2.6	10.6	13.3
Total costs	**34.4**	**29.1**	**63.5**

The table above shows that the operating and maintenance costs are affordable and could be sustained through the future waste tariffs. It is also apparent that grant financing is needed for the initial investment of the project.

Under the assumption that grant financing would be available for the initial investment of the project and taking into consideration the fact that this option is the lowest cost option of the rest, which are in line with the national principles and objective, the recommendation is that System Option 6 is selected for future development of the integrated solid waste management system in WMZ 3. As noted before the differences between System Options 2 and 6 is that System Option 6 envisages a second sorting station at the TS in Taraclia to serve the collected recyclables from the urban centres of Taraclia, Tvardita and Ceadir-Lunga.

Due to the large distance between Ceadir-Lunga and the landfill in Cahul, if additional transport costs are added for transport of the collected recyclables directly to the landfill then System Option will become slightly more expensive than System Option 6.

The section below presents the recommended system option for implementation – System Option 6.

7.9 Presentation of the preferred option

The table below summarises the preferred system for integrated solid waste management system in details[8].

Table 7-36: Presentation of the preferred system

System element	Description	Capacity
Residual waste collection	Individual houses in the towns of Cahul, Taraclia, Cantemir, Ceadir-Lunga and Vulcanesti are served by “door-to-door” collection, while the rest settlements are served by “bring system”	• 6,366 1.1 m^3 metal containers; • 16,307 120 l plastic bins; • 24 vehicles of 16 m^3; • 17 vehicles of 6 m_3.
Separate waste collection	Separate waste collection is organised in the entire urban area of WMZ 3. Plastic and metal is collected in all towns in a net container. Paper and cardboard are collected in Cahul and Ceadir-Lunga. Glass is collected only in Cahul	• 1,512 containers for plastic, paper and metal; • 62 containers for glass; • 4 trucks for plastic, paper and metal; • 1 truck for glass.
Transport and transfer	Two transfer stations will be established: one for Cantemir and another one for Taraclia and Ceadir-Lunga rayons	• Taraclia TS – capacity of 22,000 tonnes/year; • Cantemir TS – capacity of 11,000 tonnes/year.

[8] The equipment needed related to the identified preferred option. All existing equipment which can be utilized will be taken into consideration while identifying the investment costs needed for the integrated waste management system.

System element	Description	Capacity
Sorting of waste	Two sorting stations will be established; one at the regional landfill and one at Taraclia TS	• Capacity of Cahul facility - 4,000 tonnes/year of separately collected recyclables; • Capacity of Taraclia facility - 2,000 tonnes/year of separately collected recyclables.
Composting	Three composting facilities for separately collected green waste to be established in 3 rayons that will serve for the five rayons. Introduction of pilot home composting for about 2,000 households.	• Cahul composting plant – capacity of 1,700 tonnes/year; • Cantemir composting plant – capacity of 250 tonnes/year; • Taraclia composting plant – capacity of 1,400 tonnes/year.
Waste disposal	Establishment of one regional sanitary landfill for entire WMZ 3	• Disposal capacity of about 1.2 Mio tonnes for 21-year period.

The figures below present the location of the preferred waste management facilities and the waste flows in WMZ 3.

The Report on site selection for the regional landfill is presented in Annex 6 and the Report on site selection for the transfer stations in Annex 7. The result of topographical surveys and hydrogeological and geological study for the selected sites are presented in Annexes 10 and 11.

Figure 7-11: Location of the preferred waste management facilities

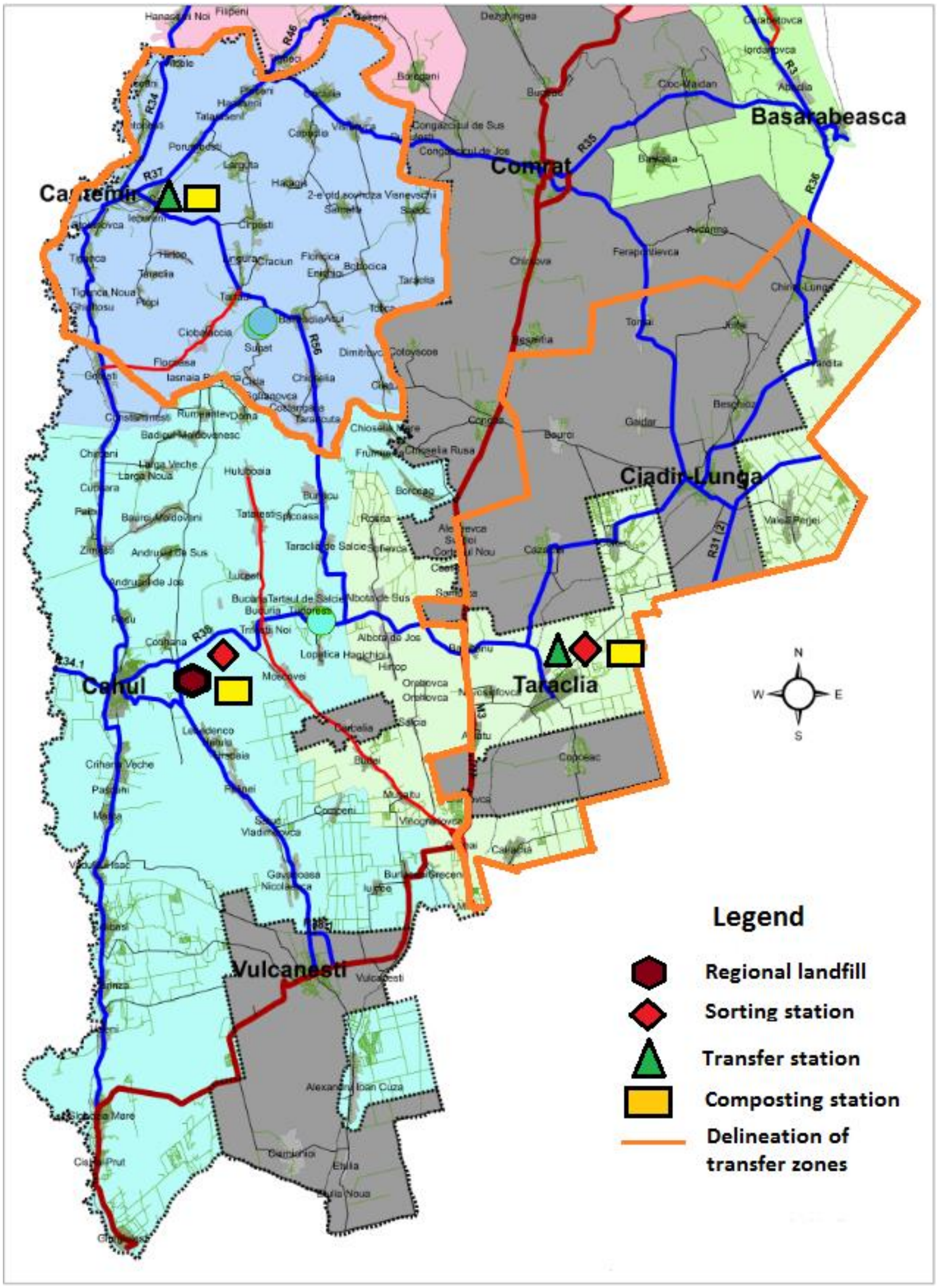
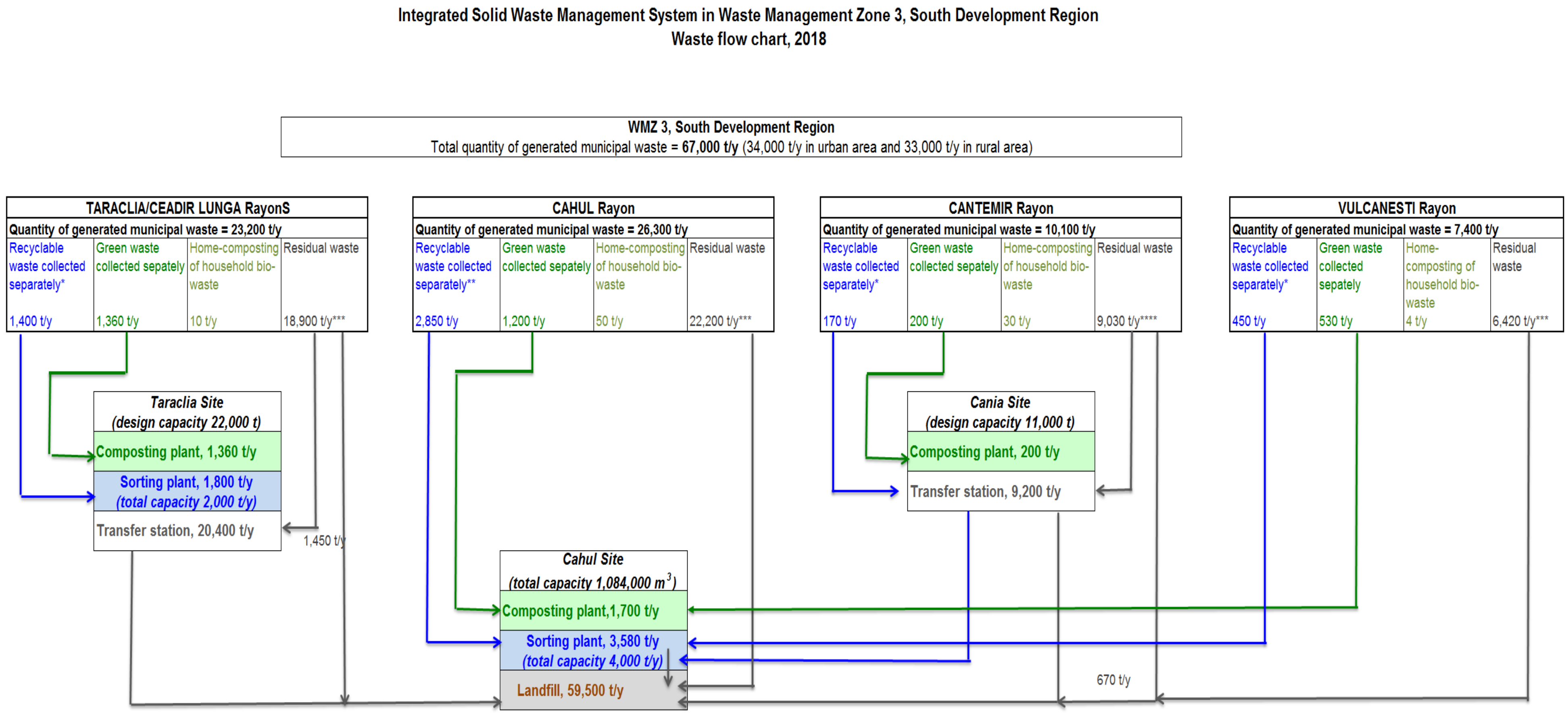


Figure 7-12: Waste flow chart for WMZ 3



* Bring system, separate collection of plastic and metal in urban area
** Bring system, separate collection of plastic and metal; paper and cardboard; glass in Cahul City
*** Door to door system for houses in Cahul, Taraclia, Ceadir Lunga and Vulcanesti cities and bring system for the rest
**** Bring system

8 Closure of the existing dumpsites

8.1 Existing situation with dumpsites in WMZ 3, SDR

The identification of the existing dumpsites in WMZ 3 has been carried out based on the following information:

- Database of the Ministry of Environment regarding the existing dumpsites and non-compliant landfill - the existing data base includes the inventory of the main disposal sites in the Republic of Moldova, being developed in 2012 within a project financed under the National Ecological Fund. The existing database of the MoE could be seen at the following link - http://gismediu.gov.md/ro/default/map#lat=69218.625755&lon=196177.884731&zoom=1&layers=_base4,_base5,_base3. The information from the data base on the disposal sites in Development Region South was elaborated within the EU "Waste Governance" project implemented under the European Neighbourhood and Partnership Region (ENPI East). The data base was expanded and updated for the disposal sites in WMZ 3 and is presented in Annex 8. Information regarding the current waste management system in WMZ 3, SDR gathered during the elaboration of the feasibility study;
- Information gathered during the elaboration of the Report of the identification of transitional waste disposal sites in WMZ 3, the site visits for determination of potential transitional waste disposal sites;
- "Guideline for closure and rehabilitation of disposal sites", elaborated in April 2015 by GIZ (presented in Annex 9).

During the inventory of the current situation for waste management in the WMZ 3 in SDR, were identified that about 31% of the population in zone receives waste collection services, of which 74% in urban area and 10% in rural areas. Based on the waste estimation indicators, the quantity of household waste in project area was estimated about 65,500 tonnes for 2014.

In the waste management zone were identified about 118 dumpsites among which:

- In Cahul rayon – 52;
- In Cantemir rayon – 29;
- In Taraclia rayon – 23;
- In Ceadir-Lunga – 9;
- In Vulcanesti -5.

The collected waste in project area is taken to a non-compliant landfills or better saying dumpsites, which are not fenced, are not monitored, are not equipped with weighbridges, and does not correspond to some requirements for environmental and human health protection,

8.2 Provisions of the guideline for closure of existing dumpsites

In order to fulfil the tasks included in the NWMS in relation with closure of non-complied dumpsites and identification of inter-communal landfills as transitional one, until the regional landfill will be built, the Guideline for closure and rehabilitation of disposal sites (Annex 9) was developed. The main purpose of this document is to provide guidance during the process of categorisation of the existing dumpsites and also to outline the measures needed to be taken for closure and rehabilitation of dumpsites. The guideline was developed in line with the NWMS (2013-2027) and the EU requirements. The disposal sites are classified according several aspects – based on size, type of disposed waste, and environmental conditions. The guideline introduces the 4 type of categories for the disposal sites based on environmental and health impact, as follows:

- Category I – no risk;
- Category II – low risk;
- Category III – medium risk;
- Category IV – high risk.

For closure and rehabilitation of different categories of dumpsites, the guideline suggests several types of activities depending of the size of dumpsite and estimated risk to environment and health, as follows:

- Closure by simply cover;
- Clean up before simple cover;
- Relocation.

Thus, once selected the type of measure for closure/rehabilitation of the dumpsite, it is important to choose the type of technical re-cultivation measure based on data regarding risk to underground water, risk to soil, quantities of gas to be generated and proximity to water source, inhabitant areas.

8.3 Transitional waste disposal sites

The process of evaluation of waste dumpsites in the project area was based on a 4-steps-criteria approach that covered about 130 dumpsites in the WMZ 3, SDR. In the first two steps dumpsites were preliminary evaluated based on the database of the MoE on inventory of existing dumpsites. Within these two steps have been applied the following evaluation criteria; main municipal disposal sites, distances, legal compliances, available waste collection services.

After this preliminary assessment within the first two evaluation steps have been identified about 15 disposal sites with potential to become transitional waste disposal sites (TWDSs).

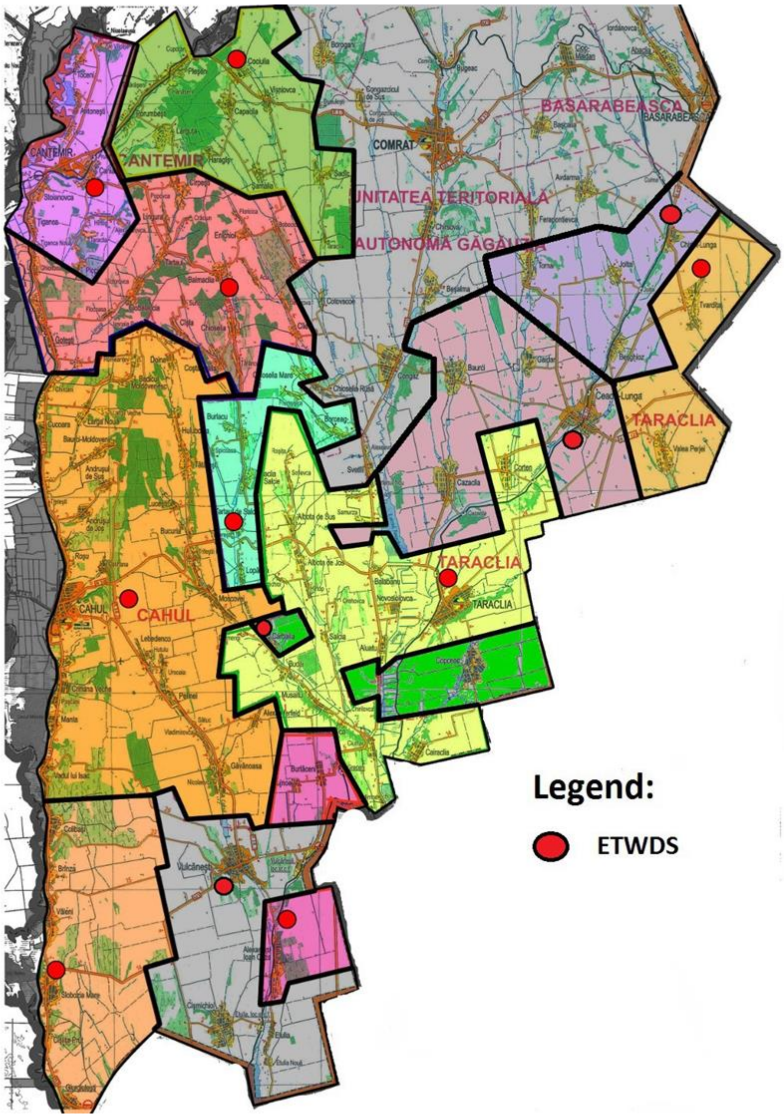
In the second part of evaluation, the identified sites have been visited in two rounds – in period 11-15 May 2015 – sites in Cahul, Cantemir and Taraclia rayons and second round took place in period 8-10 September 2015 that included Ceadr-Lunga and Vulcanesti rayons. The potential of identified dumpsites in these steps were assessed based on other evaluation criteria as - legal compliance, availability of disposal capacity of landfill, existing potential for extension, conditions of the disposal site, proximity to the main waste generation centre, accessibility, availability of infrastructure and waste management equipment and environmental and health risks.

Based on outcomes of the field visits and data analysis undertaken for each rayon in the project area have been identified as sites with potential to become TWDSs about 13 dumpsites as follows:

- Cahul rayon – Cahul Slobozia-Mare, Alexandru Ioan Cuza, Tartaul de Salcie;
- Cantemir rayon – Cantemir, Baimaclia, Cociulia;

- Taraclia rayon – Taraclia, Tvardita (2);
- Ceadir-Lunga rayon – Ceadir-Lunga, Chiriet-Lunga;
- Vulcanesti rayon – Vulcanesti, Carbalia.

Figure 8-1: Selected TWDS and communities to be served



The identified potential TWDS shall be improved in order to reduce the environmental impact by leachate, dust, odour and waste spreading around the site, also, it is important to reduce the costs and efforts for their re-cultivation. The improvement measures comprise technical and operational measures that have to be taken. For example, the technical options shall not be very expensive due to the fact that the ETWDS will be operated only until the regional landfill is built, that is why it is not feasible to have big investment. But, small investments that will improve situation at the dumpsites are needed. Thus, following technical measures are recommended – to install fences around the enhanced dumpsite, gate, information board, dozer and wheel loader, truck hanger with water tank, to build an office, install social container, material storage container.

Regarding the operational measures, it is recommended to hire more staff for the ETWDS (manager, workers, drivers, guard), to develop the operational manual for the dumpsite which will define tasks and responsibilities for all staff, working practices, monitoring and maintenance measures, also obligations for information, documentary records and operation plan.

8.4 Schedule and cost estimation for closure of disposal sites

According the FS document, the new ISWM system for the WMZ 3 in SDR shall be established by the end of 2018 and become operational at the beginning of 2019.

The identified sites as TWDS cannot start immediately to act as transitional dumpsites and to accept larger amounts of waste from more localities, due to the fact that they need to be upgraded from technical and operational point of view, as mentioned in the section above. Also, it is needed to close the existing, non-compliant dumpsites in the project area, in the first wave of closure being included the dumpsites that pose a high risk to the environment and human health, then others. The assumption is that in 2016 it would be possible to get the transitional dumpsite operational.

The duration of closure activities will depend on the selected type of closure and would last for period 2016-2019.

In order to carry out cost estimation, the disposal sites have been divided into the following categories:

- Non-compliant landfills in urban area, one landfill in each urban settlement, which shall be maintained until the implementation of the integrated waste management system – which shall be closed in compliance with the provisions of Directive 1999/31/EC on the landfill of waste;
- Non-compliant landfills in urban area, which should be closed in the next period – for which a simple closure is assumed (surface reduction, compaction and coverage with soil);
- Transitional waste disposal sites – for which a simple closure is assumed;
- Disposal sites in rural area, with high risks for health and/or environment – considered to be relocated to the non-compliant landfill in the nearest town;
- Disposal sites in rural area, other than those specified above.

The following unit costs have been considered for these categories of disposal sites:

- Closure of the non-compliant landfills in urban area in accordance with the provisions of Directive 1999/31/EC on the landfill of waste:
  - The existing landfill Cahul - the cost determined in the Feasibility Study;
  - The other landfills - an average cost of 100,000 EUR/ha, cost estimated based on the closure cost for Cahul landfill.
- Closure of the other non-compliant landfill in urban area and the transitional waste disposal sites – 20,000 EUR/ ha;
- Relocation of the waste from the disposal sites which are a risk to the health and/ or environment – 2,000 EUR/ dumpsite in case the stated surface is smaller than 0.5 ha and 4,000 EUR/ dumpsite in case the stated surface is larger than 0.5 ha;
- Closure of the rural disposal sites, other than those specified above:
  - 1,000 EUR/dumpsite in case the surface is smaller than 0.1 ha and/ or they cover settlements with a population lower than 1,000 inhabitants;

- 5,000 EUR/dumpsite in case the surface is ≤ 0.5 ha;
- 10,000 EUR/dumpsite in case the surface is > 0.5 ha.

The tables below present the estimation of the costs for the closure of the disposal sites in the three rayons: Cahul, Cantemir and Taraclia, Ceadir-Lunga and Vulcanesti. In the tables, the disposal sites are grouped in terms of the estimated closure/rehabilitation method. In terms of the disposal sites written in bold, the information from the data base of the MoE was updated based on the information gathered during the site visits carried out while developing this Report.

Table 8-1: Cost estimation for closure of the existing disposal sites in Cahul Rayon

Dumpsite name	Surface (ha)	Risk to human health	Risk to environment	Proposed type for closure/rehabilitation	Cost estimation (EUR, without VAT)
Cahul	**4.3786**	**Low**	**Low**	**Closure according to EU Directive**	**374,000**
Alexandru Ioan Cuza	**0.5000**	**Low**	**Low**	**Transitional disposal site**	**20,000**
Slobozia Mare	**0.6634**	**Low**	**Low**	**Transitional disposal site**	**20,000**
Tartaul de Salcie	**0.5578**	**Low**	**Low**	**Transitional disposal site**	**20,000**
Pascani	0.2856	Medium	High	Relocation	2,000
Crihana Veche	0.3671	High	High	Relocation	2,000
Cucoara 1	1.1368	Medium	High	Relocation	4,000
Tretesti	0.0200	-	-	Simple cover	1,000
Chircani	0.0300	-	-	Simple cover	1,000
Frumusica	0.0300	-	-	Simple cover	1,000
Greceni	0.0300	-	-	Simple cover	1,000
Rumeantev	0.0300	-	-	Simple cover	1,000
Paicu	0.0400	-	-	Simple cover	1,000
Trifestii Noi	0.0400	-	-	Simple cover	1,000
Spicoasa	0.0500	-	-	Simple cover	1,000
Iasnaia Poleana	0.0600	-	-	Simple cover	1,000
Lopatica	0.2258	Low	Low	Simple cover	5,000
Cavanoasa	0.2294	Low	Low	Simple cover	5,000
Caslita-Prut	0.3477	Low	Low	Simple cover	5,000
Branza	0.4106	Medium	Medium	Simple cover	5,000
Badicul Moldovenesc	0.4301	Low	Low	Simple cover	5,000
Rosu	0.4474	Low	Low	Simple cover	5,000
Huluboaia	0.4889	Low	Low	Simple cover	5,000
Iujnoe	0.5000	Low	Low	Simple cover	5,000
lexandru Ioan Cuza 2	0.5566	Low	Low	Simple cover	10,000
Lucesti	0.5603	Medium	Medium	Simple cover	10,000
Tatarasti	0.5812	Low	Low	Simple cover	10,000
Chioselia Mare	**0.5871**	**Low**	**Low**	**Simple cover**	**10,000**
Bucuria	0.5994	Low	Low	Simple cover	10,000
Giurgiulesti	0.6087	Low	Low	Simple cover	10,000
Borceag	0.6177	Low	Low	Simple cover	10,000
Cucora 2	0.6875	Low	Low	Simple cover	10,000
Manta 2	0.6968	Medium	Medium	Simple cover	10,000
Manta 1	0.8203	Medium	low	Simple cover	10,000

Dumpsite name	Surface (ha)	Risk to human health	Risk to environment	Proposed type for closure/rehabilitation	Cost estimation (EUR, without VAT)
Taraclia de Salcie	0.8423	Low	Low	Simple cover	10,000
Andrusul de Sus	0.9731	Low	Low	Simple cover	10,000
Doina	**1.0000**	**Low**	**Low**	**Simple cover**	**10,000**
Burlaceni	1.0000	Low	Low	Simple cover	10,000
Baurci Moldoveni	1.0420	Low	Low	Simple cover	10,000
Valeni	1.0477	Low	Low	Simple cover	10,000
Pelinei	1.1138	Low	Low	Simple cover	10,000
Lebedenco	1.3027	Low	Medium	Simple cover	10,000
Larga Noua	1.3323	Low	Low	Simple cover	10,000
Colibasi	1.4899	Low	Low	Simple cover	10,000
Vadul lui Isac	1.5609	Low	Low	Simple cover	10,000
Burlacu	1.5972	Low	Low	Simple cover	10,000
Andrusul de Jos	1.6384	Low	Low	Simple cover	10,000
Moscovei	1.8470	Low	Medium	Simple cover	10,000
Zirnesti	2.5716	Low	Low	Simple cover	10,000
Alexanderfeld	2.7871	Low	Medium	Simple cover	10,000
TOTAL					**751,000**

Source: Dumpsites database, Ministry of Environment and GIZ/MSPL

Table 8-2: Cost estimation for closure of the existing disposal sites in Cantemir Rayon

Dumpsite name	Surface (ha)	Risk to human health	Risk to environment	Proposed type for closure / rehabilitation	Cost estimation (EUR without VAT)
Cantemir	**1.600**	**Low**	**Low**	**Closure according to EU Directive**	**160,000**
Baimaclia	**0.800**	**Low**	**Low**	**Transitional disposal site**	**20,000**
Cociulia	**0.500**	**Low**	**Low**	**Transitional disposal site**	**20,000**
Visinovca	**0.180**	**Low**	**Low**	**Simple cover**	**5,000**
Sadic	0.212	Low	Low	Simple cover	5,000
Samalia 2	0.222	Low	Low	Simple cover	5,000
Lingura	0.263	Low	Medium	Simple cover	5,000
Tiganca	0.289	Low	Low	Simple cover	5,000
Stoianovca	0.302	Medium	Low	Simple cover	5,000
Enichioi	0.331	Low	Medium	Simple cover	5,000
Costangalia	0.426	Low	Medium	Simple cover	5,000
Toceni	0.453	Medium	Medium	Simple cover	5,000
Ciietu	0.547	Low	Medium	Simple cover	10,000
Ciobalaccia	0.558	Low	Low	Simple cover	10,000
Cisla	**0.600**	**-**	**-**	**Simple cover**	**10,000**
Antonesti 1	0.663	Medium	Medium	Simple cover	10,000
Samalia 1	**0.667**	**Low**	**Low**	**Simple cover**	**10,000**
Cania	0.677	Low	Low	Simple cover	10,000
Larguta	0.792	Low	Medium	Simple cover	10,000
Haragis	0.811	Medium	Low	Simple cover	10,000
Antonesti 2	0.829	Low	Low	Simple cover	10,000
Cirpesti	0.864	Low	Medium	Simple cover	10,000
Chioselia	0.872	Low	Low	Simple cover	10,000
Capaclia	0.879	Low	Low	Simple cover	10,000
Porumbesti	0.946	Low	Low	Simple cover	10,000
Tartaul	0.947	Medium	Medium	Simple cover	10,000

Dumpsite name	Surface (ha)	Risk to human health	Risk to environ-ment	Proposed type for clo-sure / rehabilitation	Cost estima-tion (EUR without VAT)
Pleseni	0.953	Low	Low	Simple cover	10,000
Plopi	1.138	Low	Low	Simple cover	10,000
Gotesti	**1.500**	**Low**	**Low**	**Simple cover**	**10,000**
TOTAL					**415,000**

Source: Dumpsites database, Ministry of Environment and GIZ/MSPL

Table 8-3: Cost estimation for closure of the existing disposal sites in Taraclia Rayon

Dumpsite name	Surface (ha)	Risk to hu-man health	Risk to envi-ronment	Proposed type for clo-sure/ rehabilitation	Cost estima-tion (EUR without VAT)
Taraclia	**1.613**	**Low**	**Low**	**Closure according to EU Directive**	**161,300**
Tvardita 2	**1.471**	**Low**	**Low**	**Closure according to EU Directive**	**147,100**
Hirtop	-	-		Simple cover	1,000
Hadjichei	-	-		Simple cover	1,000
Budei	0.136	Low	Low	Simple cover	5,000
Musaitu	0.216	Low	Medium	Simple cover	5,000
Salcia	0.265	Low	Low	Simple cover	5,000
Samurza	0.285	Low	Medium	Simple cover	5,000
Novosiolovca	0.522	Low	Low	Simple cover	10,000
Tvardita 1	0.600	Low	Low	Simple cover	10,000
Aluatu	0.672	Low	Low	Simple cover	10,000
Ciumai	0.976	Low	Low	Simple cover	10,000
Cortenul Nou	1.081	Urgent	Urgent	Simple cover	10,000
Svetlii	1.129	Low	Low	Simple cover	10,000
Caraiclia	1.144	Low	Low	Simple cover	10,000
Albota de Sus	1.189	Low	Medium	Simple cover	10,000
Taraclia Sud	1.568	Low	Low	Simple cover	10,000
Albota de Jos	1.634	Low	Low	Simple cover	10,000
Balabanu	2.450	Low	Low	Simple cover	10,000
Sofievca	2.631	Low	Low	Simple cover	10,000
Valea Perjei 2	3.079	Medium	Medium	Simple cover	10,000
Corten	3.327	Low	Low	Simple cover	10,000
Valea Perjei 1	3.369	Low	Low	Simple cover	10,000
TOTAL					**480,400**

Source: Dumpsites database, Ministry of Environment and GIZ/MSPL

Table 8-4: Cost estimation for closure of the existing disposal sites in Ceadir-Lunga Rayon

Dumpsite name	Surface (ha)	Risk to human health	Risk to envi-ronment	Proposed type for clo-sure/rehabilitation	Cost estima-tion (EUR without VAT)
Ceadir-Lunga	**1.029**	**Low**	**Low**	**Closure according to EU Directive**	**103,000**
Chiriet-Lunga	**1.377**	**Low**	**Low**	**Transitional disposal site**	**28,000**
Joltai	0.214	High	Medium	Relocation	2,000
Copceac	3.215	High	Low	Relocation	6,000

Dumpsite name	Surface (ha)	Risk to human health	Risk to envi-ronment	Proposed type for clo-sure/rehabilitation	Cost estima-tion (EUR without VAT)
Baurci	1.911	Low	Medium	Simple cover	10,000
Cazaclia	3.341	Low	Low	Simple cover	10,000
Besghioz	0.557	Low	Medium	Simple cover	10,000
Gaidar	1.006	Low	Low	Simple cover	10,000
Tomai	1.175	Low	Low	Simple cover	10,000
TOTAL					**189,000**

Source: Dumpsites database, Ministry of Environment and GIZ/MSPL

Table 8-5: Cost estimation for closure of the existing disposal sites in Vulcanesti Rayon

Dumpsite name	Surface (ha)	Risk to human health	Risk to envi-ronment	Proposed type for closure/rehabilitation	Cost estima-tion (EUR without VAT)
Vulcanesti	**4.281**	**Low**	**Low**	**Closure according to EU Directive**	**428,000**
Carbalia	**0.642**	**Low**	**Low**	**Transitional disposal site**	**20,000**
Chismichioi	0.700	-	-	Simple cover	10,000
Etulia	1.201	Low	Low	Simple cover	10,000
Chismichioi	1.459	Low	Low	Simple cover	10,000
TOTAL					**478,000**

Source: Dumpsites database, Ministry of Environment and GIZ/MSPL

Within the identification process of the potential TWDS was done the estimation of the costs for the closure of the disposal sites in the three rayons: Cahul, Cantemir and Taraclia, Ceadir-Lunga and Vulcanesti. When doing costs calculation/estimation it was taken into consideration the closure/rehabilitation method, thus for closure of the existing disposal sites in above mentioned rayons is need for the following amount (EUR):

- Cahul rayon – 751,000 EUR;
- Cantemir rayon – 415,000 EUR;
- Taraclia rayon – 480,400 EUR;
- Ceadir-Lunga rayon – 189,000 EUR;
- Vulcanesti rayon – 478,000 EUR.

The total estimated cost for closure of existing disposal sites in the project area is about 2.3 million EUR.

9 Design parameters for the integrated system

9.1 Collection and transport

This section describes the design parameters used for the recommended waste collection system in WMZ-3, including separate collection of waste.

The basic parameters which define the type of waste collection system are:

- Waste quantities and their composition;
- Number of households living in private houses;
- Desirability to extend the waste collection service to the entire population;
- Preferences for frequency of waste collection service to be provided to residents;
- Type of waste storage and collection equipment, like size, capacity, compaction ratio etc.;
- Physical planning parameters such as topography of the area, density of population, existing road network, natural protection areas, etc.;
- Targets for recycling and diversion of biodegradable waste from landfill.

The following table shows the quantities of municipal solid waste that need to be collected from the three rayons in WMZ-3 (in year 2018 as a reference year).

Table 9-1: Quantities and type of generated municipal solid waste, 2018

Waste type	Cahul Rayon	Cantemir Rayon	Taraclia Rayon	Ceadir-Lunga Rayon	Vulcanesti Rayon	Total
Plastic	2,327	661	795	1,303	792	5,878
Paper & cardboard	2,327	661	795	1,303	792	5,878
Glass	1,284	470	416	721	376	3,267
Metal	636	172	219	356	222	1,605
Organic	10,386	3,557	3,421	5,830	3,184	26,378
Other	9,314	4,579	2,778	5,264	2,045	23,980
Total	**26,273**	**10,101**	**8,424**	**14,776**	**7,411**	**66,985**

The table below presents the parameters used for defining the waste service cover.

Table 9-2: Parameters used for defining the waste service cover

Parameter	Unit	Value
Service cover (urban residents)	%	100
Service cover (rural residents)	%	100
Household waste in urban area	%	87.35
Similar to household waste in urban area	%	12.65
Household waste in rural area	%	100
Similar to household waste in rural area	%	0

As outlined in this report, the provision of waste management services will be provided on a regional basis. Therefore, it is assumed that 100% service coverage of rural population is also feasible. Ultimately, all rural communities will benefit from a service which will be provided at lower cost compared to organisation of waste collection service by each community individually. The economy of scale could be achieved only by a regional operator. The regional waste collection operator will have the flexibility to adjust the waste collection routes and ultimately to optimise the waste collection process. This will be done in cooperation with the local authorities, especially with regard to placement of the waste storage equipment.

Apart from the economic considerations, there are also other factors which make the provision of waste collection service to the entire rural population feasible. These are:

- The terrain of WMZ-3 is flat and there are no difficult to access villages;
- Almost all of the villages are located along the road network in the region;
- Most of the villages are large. Out of 139 villages only 12 villages have population of less than 200 residents.

The similar to household waste is defined as waste which has the characteristics of household waste. This waste is generated by commercial entities and institutions.

The following table presents the situation with the housing in the project area used for the calculation of the collection and transport equipment.

Table 9-3: Housing in WMZ-3

Housing in WMZ-3	Location	Unit	Value
Housing in urban areas	Cahul urban (block of flats)	%	55.00
	Cahul urban (houses)	%	45.00
	Cantemir town (block of flats)	%	77.40
	Cantemir town (houses)	%	22.60
	Taraclia town (block of flats)	%	22.00
	Taraclia (houses)	%	78.00
	Tvardita town (block of flats)	%	15.00
	Tvardita town (houses)	%	85.00
	Ceadir-Lunga (block of flats)	%	25.00
	Ceadir-Lunga (houses)	%	75.00
	Vulcanesti (block of flats)	%	50.00
	Vulcanesti	%	50.00
Individual houses in project area	Cahul houses	№	6,700
	Cantemir houses	№	450
	Taraclia houses	№	3,511
	Tvardita houses	№	1,364
	Ceadir-Lunga houses	№	4,920
	Vulcanesti houses	№	3,600

9.1.1 Collection and transport of residual waste

The following assumptions are used to determine the waste collection and transport equipment needed to cover the entire population of the project area.

Table 9-4: Assumptions for assessment of waste collection and transport needs

Equipment	Assumption	Unit	Value
Containers (1.1 m^3)	Frequency of serving per year (urban blocks)	№	104
	Frequency of serving per year (villages)	№	52
	Density in container	t/m^3	0.13
	Container volume	m^3	1.10
	Waste per container	tonne	0.14
	Average filling of container	%	85%

Equipment	Assumption	Unit	Value
	Reserve (containers)	%	5%
containers (120 l)	Frequency of serving per year (urban houses)	№	52
	Density in container	t/m^3	0.11
	Container volume	m^3	0.12
	Waste per container	tonne	0.013
	Average filling of container	%	85%
	Reserve (containers)	%	5%
Trucks	Capacity of collection truck	m^3	16
	Capacity of collection truck	m^3	6
	Compaction	m^3/tonne	0.45
	Degree of truck filling	%	90%
	Average speed	km/h	35
	Time for loading container (urban)	min	1
	Time for loading container (villages)	min	3
	Number of working days	№	260

Based on the distances to the future regional landfill and the transfer stations respectively, calculations are made with regard to the time needed for a single collection trip and the number of trips per day needed.

The tables below show the design parameters of the system for collection and transport of residual waste. The transport equipment includes only the equipment which will be used to transport the collected waste to the transfer stations or directly to the regional facility and not the equipment needed to transport the waste from the transfer stations. The equipment needed also takes into consideration the existing containers and trucks, which can be utilised in the new system.

Table 9-5: Design parameters of the system for collection of residual waste, 2018

Description	Container type	Number
Cahul urban (block of flats)	1.1 m^3	448
Cahul urban (houses)	120 l	7,070
Cahul rural	1.1 m^3	2,058
Cantemir town (block of flats)	1.1 m^3	87
Cantemir town (houses)	120 l	467
Cantemir rural	1.1 m^3	1,405
Taraclia town (block of flats)	1.1 m^3	49
Taraclia (houses)	120 l	3,522
Tvardita town (block of flats)	1.1 m^3	94
Tvardita town (houses)	120 l	0
Taraclia rural	1.1 m^3	521
Ceadir-Lunga (block of flats)	1.1 m^3	117
Ceadir-Lunga (houses)	120 l	1,734
Ceadir-Lunga rural	1.1 m^3	1,194
Vulcanesti (block of flats)	1.1 m^3	147
Vulcanesti (houses)	120 l	3,514
Vulcanesti rural	1.1 m^3	246
Total containers needed (1.1 m^3)	**1.1 m^3**	**6.139**
Total containers needed (120 l bins)	**120 l**	**12,057**

Table 9-6: Design parameters of the system for transport of residual waste, 2018

Description	Unit	Truck type	Value
WMZ-3 urban (blocks)	№	16 m^3	3
WMZ-3 urban (houses)	№	6 m^3	16
WMZ-3 rural (total)	№	16 m^3	20
Total trucks needed	№		39

In order to estimate both the investment and operation and maintenance costs, the following assumptions are used, as presented in the tables below.

Table 9-7: Assumptions for the investment costs

Equipment	Type	Unit	Unit price
Containers	1.1 m^3	EUR	285
Containers	120 l	EUR	25
Trucks	16 m^3	EUR	100,000
Trucks	6 m^3	EUR	45,000

Table 9-8: Assumptions for the operation and maintenance costs, 2018

Description	Unit	Unit value
Economic growth	%	5
Drivers salary	EUR/year	1,717
Loaders salary	EUR/year	1,458
Price of fuel	EUR/liter	1
Consumption,	Liter/hour	16
Oil	% of fuel cost	10
Maintenance trucks	% of investment cost	5
Maintenance containers	% of investment cost	1

The investment costs for collection and transport of residual waste are shown in section 10.2. The operation and maintenance costs are presented in section 10.3.1.

9.1.2 Collection and transport of separately collected recyclables

Separate waste collection will be organised only in the urban area of WMZ-3. Plastic and metal will be collected in all towns of WMZ in a net container. Paper and cardboard will be collected in the towns of Cahul and Ceadir-Lunga. Glass will be collected only in the town of Cahul.

The following assumptions are used to determine the equipment needed for separate collection and transport of recyclables to cover the urban settlements in the project area taking into consideration the existing equipment which can be utilised by the new system.

Table 9-9: Assumptions for assessment of separate waste collection and transport needs

Equipment	Assumption	Unit	Value
Containers for plastic, metal, paper & cardboard	Frequency of serving per year	№	52
	Density in container	t/m^3	0.10
	Container volume	m^3	1.10
	Waste per container	tonne	0.11
	Average filling of container	%	85%
	Reserve (containers)	%	5%
Containers for glass	Frequency of serving per year	№	26

Equipment	Assumption	Unit	Value
	Density in container	t/m^3	0.25
	Container volume	m^3	1.10
	Waste per container	tonne	0.28
	Average filling of container	%	85%
	Reserve (containers)	%	5%
Trucks	Capacity of collection truck	m^3	16
	Compaction	m^3/tonne	0.35
	Compaction (truck for glass)	m^3/tonne	0.25
	Degree of truck filling	%	90%
	Average speed	km/h	35
	Time for loading container (urban)	min	1
	Number of working days	№	260

The tables below show the design parameters of the system for separate collection and transport of recyclable waste.

Table 9-10: Design parameters of the system for separate collection of recyclables, 2018

Containers	Location	№ of containers
Containers for plastic & metal	Cahul town	383
	Cantemir town	57
	Taraclia town	122
	Tvardita town	51
	Ceadir-Lunga town	257
	Vulcanesti town	201
Containers for paper & cardboard	Cahul town	361
	Ceadir-Lunga town	200
Containers for glass	Cahul town	125
Total containers needed		**1,757**

Table 9-11: Design parameters of the system for transport of recyclables, 2018

Description	Type	Value
Truck for plastic, metal and paper	16 m^3	4
Truck for glass	16 m^3	1
Total trucks needed		**5**

In order to estimate both the investment and operation and maintenance costs, the following assumptions are used, as presented in the tables below.

Table 9-12: Assumptions for the investment costs

Equipment	Type	Unit	Unit price
Containers for paper & cardboard	1.1 m^3	EUR	220
Containers for plastic and metal	1.1 m^3	EUR	80
Containers for glass	1.1 m^3	EUR	440
Trucks	16 m^3	EUR	100,000

Table 9-13: Assumptions for the operation and maintenance costs, 2018

Description	Unit	Unit value
Economic growth	%	5
Drivers salary, yearly	EUR/year	1,717
Loaders salary, yearly	EUR/year	1,458

Description	Unit	Unit value
Price of fuel	EUR/liter	1
Consumption, l/hour	Liter/hour	16
Oil cost	% of fuel cost	10
Maintenance trucks	% of investment cost	5
Maintenance containers	% of investment cost	1

The investment costs for collection and transport of recyclables are shown in section 10.2. The operation and maintenance costs are presented in section 10.3.1.

The table below shows the quantity of recyclables expected to be collected by the system for separate collection of recyclable materials.

Table 9-14: Quantity of collected recyclables, 2018

Recyclables	Unit	Quantity
Plastic	tonne	2,038
Paper & cardboard	tonne	1,274
Glass	tonne	355
Metal	tonne	578
Total recyclables collected	**tonne**	**4,245**

The assumed existing market prices for recyclables and the expected revenue from sale of recyclables are presented in the table below.

Table 9-15: Revenue from sale of recyclables

Recyclables	Unit price	Collected recyclables	Revenue from sale
	EUR	tonne	EUR
Plastic	180	2,038	367,000
Paper & cardboard	70	1,274	90,000
Glass	14	355	5,000
Metal	450	578	260,000
Total		**4,245**	**721,000**

9.1.3 Collection of construction and demolition waste

Both transfer stations and the regional landfill will have designated areas and equipment for temporary storage of construction and demolition waste (CDW) as well as bulky waste.

Residents of WMZ 3 will have the possibility to bring their CDW directly to any of the three drop-off centres, free of charge. This could be done during the opening hours of the three facilities.

In parallel to this, municipalities will be able to provide such service to the residents, which will be on-demand. Provided that the residents contact the municipality and request such a service, the former ones will pay the full cost of the service.

No investment will be required as the existing equipment could be utilised for this service.

9.2 Conceptual design for the transfer stations

9.2.1 Design parameters for the transfer stations

The transfer stations in Cania and Taraclia will be operated based on two different systems. Due to the lower waste quantities to be transferred in Cania a non-compaction system with containers of 30 m³ containers is sufficient. For Taraclia TS with higher waste quantities a system with waste compaction is selected. By each trip from the transfer station to the landfill 2 containers of 60m³ of waste can be transported. The following assumptions are the basis for the design of the transfer stations:

Table 9-16: Assumptions for the design parameters for the transfer station

Description	Cania transfer station	Taraclia transfer station
Waste quantity in 2018 (expected max. quantity)	Recyclable waste: 170 tonne/year Residual waste: 9,030 tons/year Total: 9,200 tons/year	Recyclable waste: 1,800 tons/year Residual waste: 18,900 tons/year Total: 20,400 tons/year
Bulk density	0.3 t/m³	0.6 t/m³
Operating days (1 –shift, 5 days a week including public holidays)	260	
Required transport volume:	9,200 / 0.3 = 30,667 m³/year	20,400 / 0.6 = 34,000 m³/a
Required transport volume per day	30,667 m³/year / 260 days = 117 m³/day	34,000 m³/year / 260 days = 131 m³/day
Recommended waste transfer system	Truck with trailer – capacity: 2 x 30 m³ = 60 m³	Truck with trailer – capacity: 2 x 30 m³ = 60 m³; containers able for compaction
Maximum filling grade	90%	
Required truck trips per day	117/60 x 0.9 = 2.17	131/60 x 0.9 = 1.97
Transport distance between transfer station and Cahul landfill	40 km	42 km
Calculation of one tour of the waste transport truck:		
• Loading at TS	20 min	20 min
• Transport TS –landfill	80 min	85 min
• Reception/ Unloading	20 min	20 min
• Retour	80 min	85 min
• Total	200 min	210 min
Daily operation time of a truck considering 1 shift operation 60min per day for fuelling and drivers rest	420 min operation time per truck and day	
Daily trips per truck possible	2.1 tours per day	2.0 tours per day
Number of trucks required	2	2

Assuming that the waste transfer trucks will be parked at the transfer stations every day a maximum of 2 trips are feasible per truck. Hence for Cania and Taraclia two long distance waste trucks are recommended.

9.2.2 Geological conditions for the transfer station sites

9.2.2.1 Geological conditions at Cania transfer station

The high geological section of this area is characterized by the following soil conditions:

- *Artificial soil* which is a layer of construction and domestic waste filled with loam of different content. This layer has very heterogeneous properties;
- *Loam* dry, semi dry, dense, friable, macro porous with disturbed structure and carbonate inclusions;
- *Clay* of quaternary – heogen age, from dry to semi-plastic consistence, friable with disturbed structure.

These layers were separated into tree geotechnical elements (GE) conform GOST-20522-75.

- GE-I, Artificial soil;
- GE-II, Loam;
- GE-III, Clay.

The occurrence of soils is presented at lithology columns of borehole. Loam and clays in boreholes 1 and 2 has a disturbed structure due to landslide . Loam from borehole 3 has natural undisturbed structure. The Physic-mechanical properties are heterogeneous and were not determined in this study. According to the regional study of geotechnical properties of landslide massives this soils are not recommended as a base of long-term construction.

The geological expert comes to the conclusion that “Cania site has conditionally favourable geotechnical conditions for the organization of waste transfer station by the case of the landslide presence. Thus, it is proposed to change location to the neighbouring territory.

Based on this information, the proposed site for the transfer station was moved to the adjacent area in east direction. As preliminary protection measures within the conceptual design a gravel filled ditch along the slope above the transfer station was designed in order to prevent water from entering the transfer station area and to destabilize the soil.

Deeper foundations of the transfer ramp for higher stability are included in the cost estimation.

Figure 9-1: Current situation at Cania site

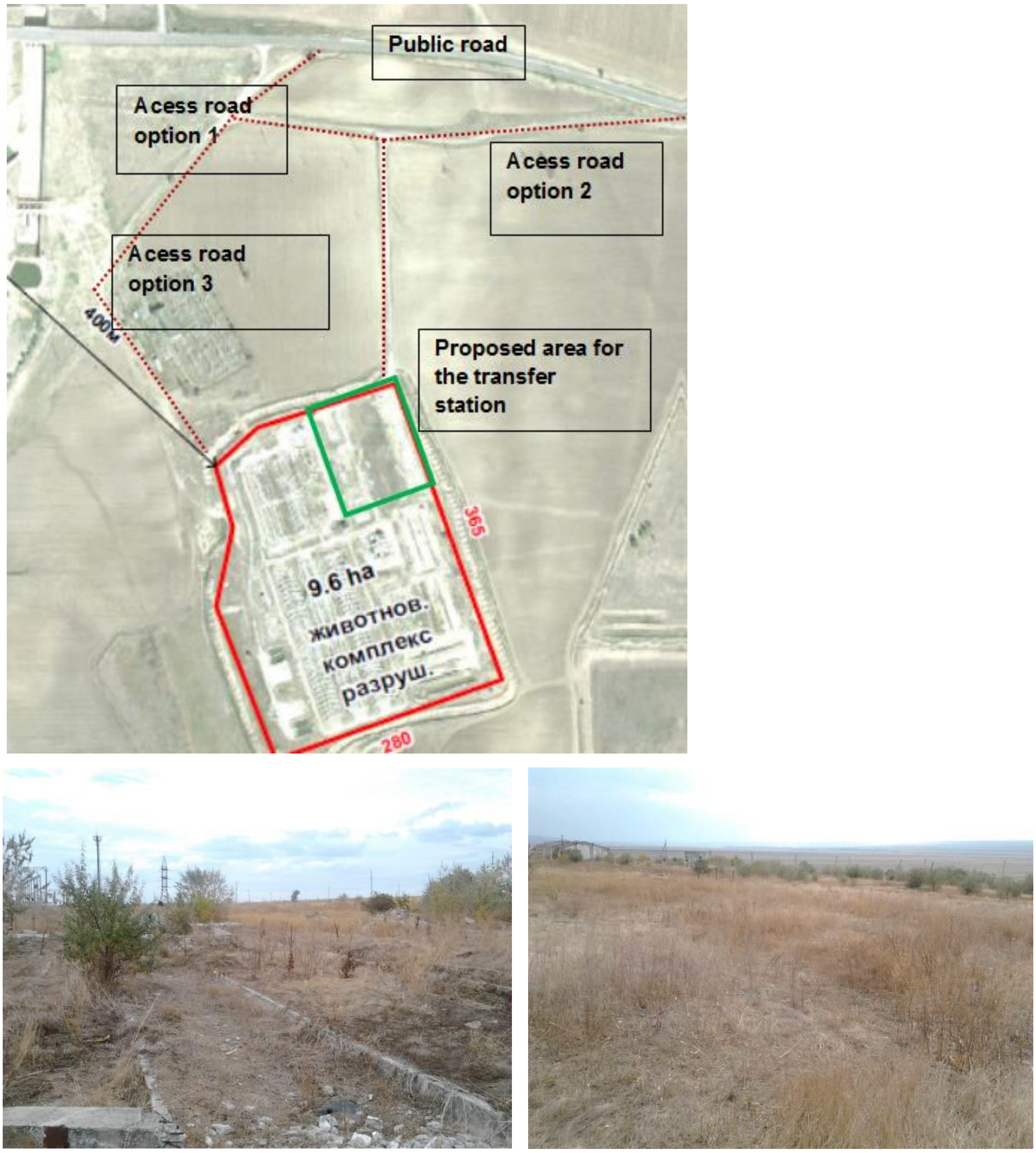
9.2.2.2 Geological conditions at Taraclia transfer station

The selected area was formerly an animal farm. Actually the complete area of 9.6 hectares is waste land and covered with foundations and parts of old constructions including pipes and drainage systems. The area has a constant declination from northeast to southwest.

The area is surrounded by farmland. In a distance of approx. 100 m in northwest direction an electric power transformation plant is located.

There are several possibilities for accessing the site. The best and shortest access would be the rebuild of the former access to the farm (Option 1 or 2).

Figure 9-2: Current situation at Taraclia site



The characteristic of geotechnical properties was taken from regional tables. The high geological section of this area is characterized by the following structure:

- *Artificial* soil which is a layer of construction remains filled with loam of different granulometric content. This layer has heterogeneous properties;
- *Loam* dry, semi dry, dense, friable, macro porous with disturbed structure and carbonate inclusions. This layer has subsidence properties under water contact;
- *Clay* of heogen age (probably Pontian), consistence is rom dry to semi-plastic, friable, middle density.

These layers were separated into tree geotechnical elements (GE) conform GOST-20522-75:

- GE-I, Artificial soil;
- GE-II, Loam;
- GE-III, Clay.

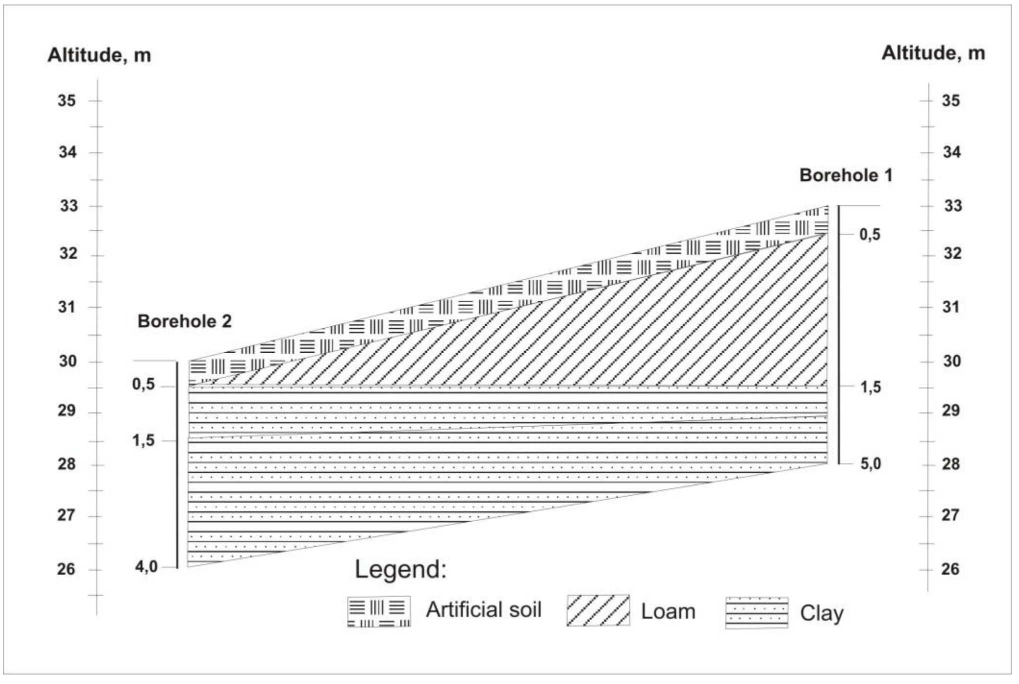
Artificial soil has heterogenous properties and is not recommended as a base for the construction.

Loam has small natural density 1.80–1.65g/cm^3, dry density 1.42–1.57g/cm^3, porosity 42–47% and porosity coefficient 0.720–0.885, humidity 0.12–0.16. This soil can be used for the banking of site by the compaction to the dry density not less 1.64 g/cm^3.

Neogen clay has a natural density in the interval 1.95–2.00g/cm^3, dry density 1.57–1.64g/cm^3, porosity 39–42%, and porosity coefficient 0.710–0.640, humidity 0.22–0.24.

The geological expert comes to the conclusion that Taraclia site has favourable conditions for the construction of a waste transfer station".

Figure 9-3: High geological section of Taraclia site from northwest to south east direction



9.2.3 Layout and equipment for the transfer stations

The transfer stations will consist of:

- Waste reception area;
- Transfer ramp with hopper respectively compaction unit;
- Manoeuvre areas for trucks / truck parking area;
- Temporary storage area for the special waste streams (hazardous household waste, bulky waste and construction/demolition waste).

9.2.3.1 Waste reception area

Both transfer stations will be designed and equipped similar. Modifications are based on topography of the provided area and the waste quantities to be transferred.

Connected to both transfer stations will be small compost plants for composting of separately collected green waste.

All incoming waste deliveries will be weighed and registered. For this reason a weighbridge for trucks of 8x3m (measuring capacity 40 tonnes) will be installed. Directly beside the weighbridge, a weighing office will be constructed. The weighing operator has visual contact to the truck driver and the possibility of a visual inspection of the truck load by using a mirror, outside installed at a mast.

The weighing office is equipped with a computer and special weighing software to collect all data such as the type, characteristics, weight, the origin of the waste, name and address of deliverer and the precise location where the waste is collected. Trucks with residual waste for transfer, separately collected recyclables for the waste sorting plant at Cahul landfill as well as green waste for composting are separated here and sent to their destination point.

Figure 9-4: Example of reception area for transfer stations

Source: (Transfer station in Famagusta, northern part of Cyprus)

A prefabricated office container will be used. It will be equipped with illumination, heating and cooling system and a toilet.

A second pre-fabricated container including showers / toilet and a recreation room will be installed for the staff beside.

Size of each container will be approx. 6.0 m x 2.45 m = 15 m²

Foundations will be constructed in accordance with the requirements of the supplier. Both containers are connected to water and electricity supply as well as to the sewage tank.

A lockable storage container with a size of 3.0 m x 2.45 m = 7.5 m² for storing tools and smaller equipment for transfer station will be placed close to the reception area.

Six fire extinguishers will be placed in the office container, the weighing office and at the transfer ramp.

9.2.3.2 Manoeuvre areas for trucks / truck parking area

The transfer station area will be completely asphalted. Areas for container handling (roll-on/roll-off) will be equipped with concrete structure.

Waste delivery is done during the early evening hours as well. Hence lighting of the reception area must be ensured. It is recommended to install 150 W reflectors on lampposts beside the roads and the platform. The value of the overall lighting should be 80 lux.

The transfer station including the compost facility will be surrounded by a fence of minimum 2.50 m height. The gate at the access is opened only during the opening times of transfer station. The fence is necessary to avoid not allowed access of people, not allowed waste dumping and to hinder bigger animals from entering the area.

9.2.3.3 Transfer ramp with hopper (Cania TS)

The waste transfer unit consists of an asphalted ramp, a turning round area, a roofed hopper for waste unloading and a road at the base level for the waste transfer trucks. Ramp and turning round area are bordered by vertical and reinforced concrete walls. The walls are 30 cm higher than the asphalt road, in order to protect the cars from falling down. On the wall a banister will be constructed to protect the staff also.

At the upper end of the ramp a turning round area for the waste collection trucks is designed, which allows the truck to unload the waste into a hopper of steel sheets. Hence the trucks can enter the ramp in forward direction turn on top of the ramp and unload the waste backwards into the hopper.

The hopper is encapsulated by a roof of trapezoidal sheets, to reduce pollution by dust and to avoid rainwater flowing into the waste. Hopper and roof construction are abode by a steel frame of IPE profiles.

For transport of waste from transfer station trucks with trailers are recommended in order to be flexible. Trucks should be equipped with a hook system. Containers for trucks and trailers should have a size of 30 m³ each.

Figure 9-5: Example for roll –on/ roll-of container system

9.2.3.4 Transfer ramp with compaction unit (Taraclia TS)

A container transfer station with compaction consists of a compactor, a moving system for the compacting containers, a transfer hopper for unloading the waste from the collection trucks, as well as the appropriate number of compacting containers (roll-off containers), which are different from the containers used for the waste transfer without compaction (Cania). However both container types can be transported with the same trucks.

Figure 9-6: Example for waste transfer unit with compaction

Source: Werner & Weber GmbH, Vienna (Austria)

9.2.3.5 Layout of transfer stations

The following layouts for the transfer stations in Taraclia and Cania are considering the special topography and cubature of the land and show the main elements of the transfer station as well as the compost facilities and the sorting plant (Taraclia).

The complete layouts and further details of site installations the can be found in Annex 13.

Figure 9-7: Layout of Cania transfer station

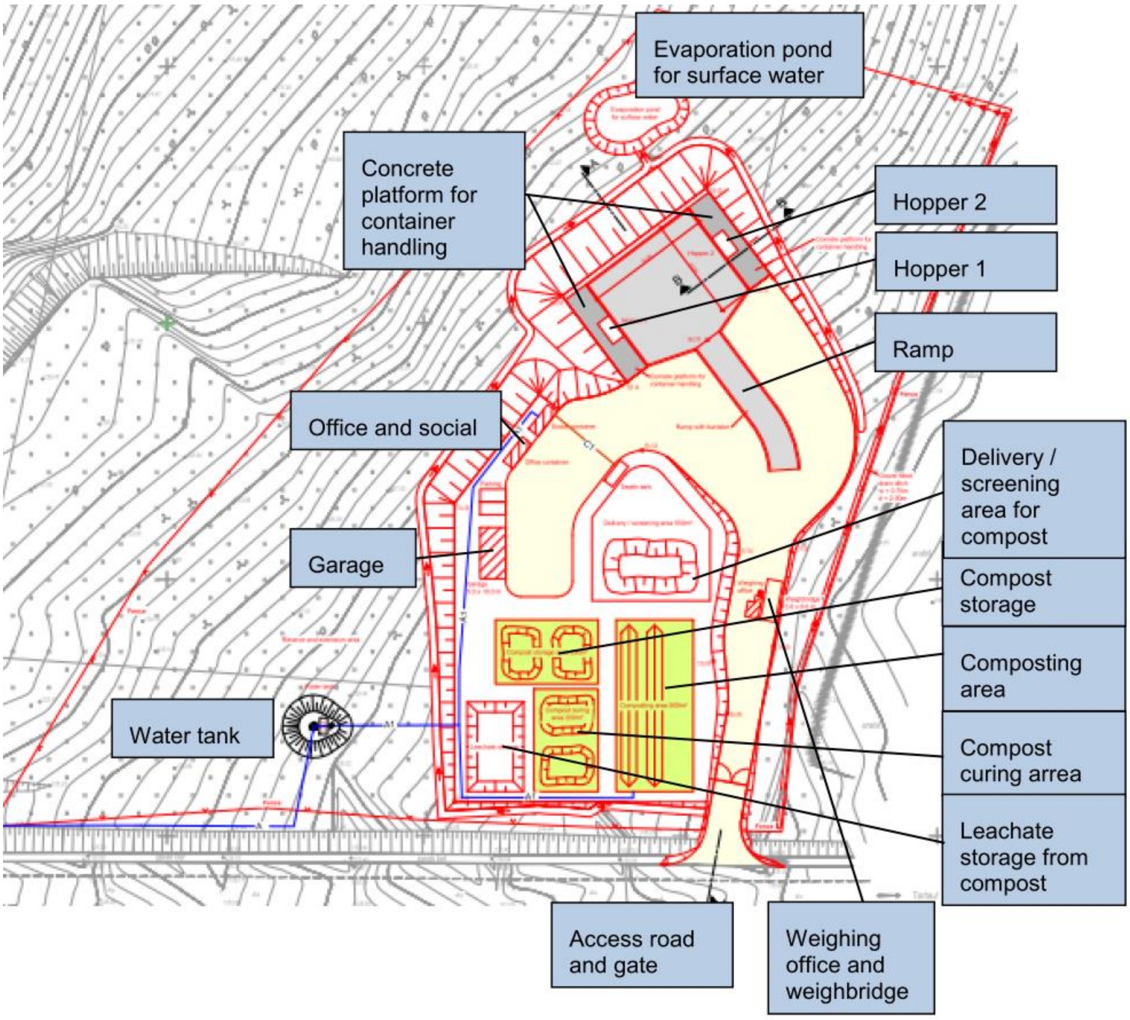
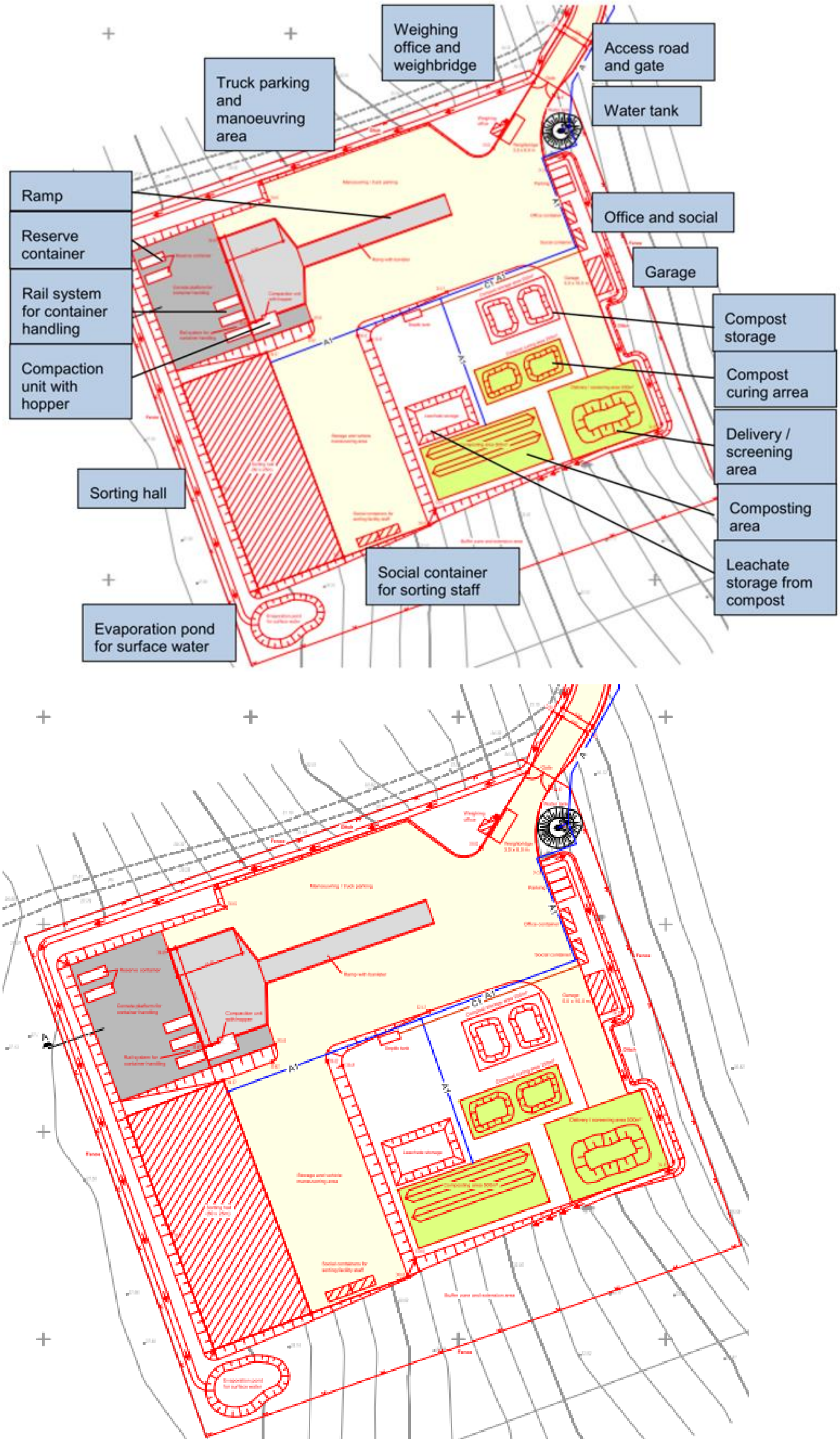


Figure 9-8: Layout of Taraclia transfer station



9.2.4 Utilities and staff requirements

9.2.4.1 Cania transfer station

Water and electricity supply, waste water deviation and fire protection

A 10KV electricity line is located directly beside in a distance of less than 100 m. In this case a transformer is needed. A maximum electricity consumption of 10 KW/hour must be expected.

Alternatively in a distance of 800 m a connection without need of a transformer is available. For further calculations the first option is taken into consideration.

Next connection to public water network is available in a distance of 2 km. A maximum consumption of 30 liters per minute is expected. Due to topographical situation around the transfer station, two pumping stations for the water supply are needed (pumping stat.1 – 2.8m³/h and pumping height 45 m / pumping station 2 – 2.8m³/h pumping height 71m). To assure a stabile water pressure during the operation of the facility a high level water tank with a capacity of 50m³ will be placed within the reception area.

Surface water from the access road at the platforms of the transfer station will be directed through a ditch to a pond for evaporation and infiltration.

Water collected from the concrete platforms of the compost area will be collected in a separate pond and reused for moistening of the compost. Calculated capacity is 400m³.

Waste water from the social container will be collected in a septic tank of 30 m³.

The waste water has to be pumped out from the waste water tank into a tank vehicle and transported to the next waste water treatment plant.

Fire protection

The transfer station will be equipped with water supply with a capacity of approx. 30 litter / min. In emergency case this will be used for firefighting.

In case of small fires fire extinguisher will be placed in the office, weighing and social containers as well at the waste transfer ramp. Number and size of the fire extinguishers will be according to Moldovan standards.

For transfer station operation a minimum of 9 staff is needed based on a one shift operation from Monday to Friday (5 days a week). Some staff will work for both transfer station and compost plant. A detailed list of staff and qualification please find in Table 9-40.

9.2.4.2 Taraclia transfer station

Water and electricity supply, waste water deviation and fire protection

The electricity connection is located directly beside in a distance of 100-200m. A maximum electricity consumption of 10 KW/hour must be expected.

Next connection to public water network is available in a distance of 2 km. A maximum consumption of 40 liters per minute is expected.

To assure a stabile water pressure during the operation of the facility a high level water tank with a capacity of 50 m³ will be placed within the reception area.

Waste water collected from the concrete platforms of the compost area will be collected in a separate pond and reused for moistening of the compost. Calculated capacity is 400m³ .

Waste water from the social container will be collected in a septic tank of 30 m³.

The waste water has to be pumped out from the waste water tank into a tank vehicle and transported to the next waste water treatment plant.

Surface water from the access road at the platforms of the transfer station will be directed through a ditch to a pond for evaporation and infiltration.

Fire protection

The transfer station will be equipped with water supply with a capacity of approx. 30 liter / min. In emergency case this will be used for firefighting.

In case of small fires fire extinguisher will be placed in the office, weighing and social containers as well at the waste transfer ramp. Number and size of the fire extinguishers will be according to Moldovan standards.

Staff requirements

For transfer station operation a minimum of 16 staff is needed based on a one shift operation from Monday to Friday (5 days a week) including staff for composting and sorting facility. Some staff will work for both transfer station and compost plant.

9.3 Conceptual design for the sorting and composting plants

9.3.1 Composting plants in Cahul, Cania and Taraclia

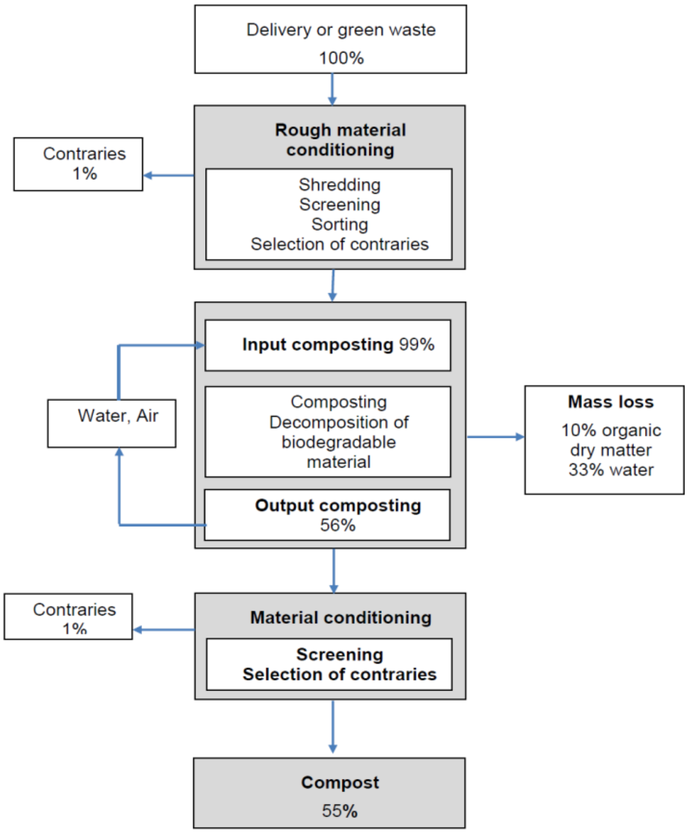
9.3.1.1 Technical process of composting

Due to the small of all three compost plants in Cahul, Cania and Taraclia a fairly simple design is proposed, which in case of extension can be replaced / supplemented by more sophisticated technologies.

The input material for the composting will derive from separately collected green waste from public green areas.

Windrow composting with turning by tractors with front shovel (Cania and Taraclia) and by tractor with sidewise mounted windrow turner (Cahul) will be used. As the entire process is not encapsulated the possibilities of emission control are limited. The windrows will be aerated by regularly turning of waste (once a week) and moistered. The process flow sheet of the compost plants is shown in the next figure.

Figure 9-9: Composting flow sheet



To condition the delivered separately collected biodegradable material, impurities and bulky materials (grain size >500 mm) will be sorted out. While the material >500 mm will be shredded the material of up to 500 mm will not be shreddered in order to allow passive aeration. The primary composting will take place over a period of 60 days. After this time the material will be sieved and allowed to cure for another 20 to 70 days before it can be used as finished compost material. The rejects of the screening process are encircled and used as structural material in new composting windrows

To achieve a proper composting process the water content of the material is essential. A water content of about 50% is most suitable while water content above 70% will reduce the porosity of the heap too much to allow a free flow of air. Below a water content of 20-25%, the biological process will stop. From time to time water has to be added to the heaps to maintain the required moisture content. For this purpose a water basin with a pump will be used.

9.3.1.2 Design parameters for the composting plants

The dimensioning of the compost facilities is based on the following waste / compost densities:

- Density of green waste delivered 0.2 tons / m³;
- Density of green waste after shredding 0.4 tons / m³;
- Density of final compost 0.5 tons / m³.

Table 9-17: Design parameters of the composting plants

Parameter	Explanation	Cania Site	Cahul Site	Taraclia Site
Average Capacity	Green waste will be delivered mainly between April and November (8 months respectively 160 days of delivery)	200 tons/year 1.25 tons/day on average 6.25 m³/day (density 0.2 t/m³) 3.125 m³/day (density 0.4 t/m³ after shredding)	1.700 tons/year 11 tons/day on average 55 m³/day (density 0.2 t/m³) 27.5 m³/day (density 0.4t/m³ after shredding)	1,360 tons/year 8.5 tons/day on average 42.5 m³/day (density 0.2 t/m³) 21.25 m³/day (density 0.4 t/m³ after shredding)
Required Area	Delivery and screening area	500 m²	500 m²	500 m²
	Composting area (Composting is approx. 60 days) Windrow dimensions: • 1.5 m high, 3.0 m wide; • way for tractor 2.0 m (2.25m³/m) Width of windrow including track for windrow turner is 5m	3.125 m³/day x 60days = 188 m³ 188 m³/2.25m³/m = approx. 85 m length of windrows. 425m²	27.5 m³/day x 60days = 1,650 m³ 1,650 m³/2.25m³/m = approx. 735 m length of windrows. 3,675 m²	21.25 m³/day x 60days = 1,275 m³ 1,275 m³/2.25 m³/m = approx. 570 m length of windrows. 2,850 m²
	Curing area (40 days)	500m²	500m²	500m²
	Storage area for finished compost sufficient for 500 m³	500m²	500m²	500m²
Total area required		1,925m²	5,175m²	4,350m²

9.3.1.3 Equipment for the operation of the compost facilities

To achieve a better operating grade of the equipment machines not permanently used will be placed at Cahul compost plant and can be transported to the smaller compost plants in Cania and Taraclia, whenever necessary.

Therefore shredder and sieving drum are mobile and can be transported by the waste transport trucks instead of a hanger.

Small scale equipment like thermometer, pH-meter, CO_2 –meter, is required to control the composting process and shall be present at all 3 compost sites.

Figure 9-10: Composting equipment

TS Cania 200 tons/year	Landfill Cahul 1,700 tons/year	TS Taraclia 1,360 tons/year
1 mobile shredder for all facilities; transport between the facilities by waste transfer trucks		

TS Cania 200 tons/year	Landfill Cahul 1,700 tons/year	TS Taraclia 1,360 tons/year
1 tractor with • Front-end shovel; • Cleaning brush.   	1 tractor with • Front-end shovel; • Windrow turner for tractor.    Cleaning by landfill equipment	1 tractor with • Front-end shovel; • Cleaning brush.   
1 mobile screening drum for all facilities; transport by waste transfer trucks 		
1 manual sack filling 	1 manual sack filling 	1 manual sack filling 

9.3.2 Sorting plant at Cahul landfill

Plastic, paper, cardboard and metals are collected in separate bins in order to transport it to Cahul sorting station and to market it after separation into clean fractions. Glass is also separately collected and transported to the sorting plant for temporary storage.

At the sorting station which will the located at the landfill area in Cahul the pre-sorted materials will be sorted in the fractions:

- Paper;
- Cardboard;
- Metal;
- Green plastic bottles and similar;
- White plastic bottles and similar;
- Other plastics.

The sorting procedure will consist of the following steps:

- The recyclables will be delivered from the waste transfer station in Cania or directly brought from the separate collection in Cahul rayon to the sorting plant. Here it is stored in area of delivered waste for further treatment. A wheel loader will fill the recyclables in a feeding bunker from where it is transported via a belt to a sorting belt for *manual sorting the above mentioned fraction*;
- The workers select and throw the materials into six bunkers, a level below the sorting belt. Residues remain on the belt and will be transported outside the hall to a waste container. Residues will be transported to the landfill for disposal;

- The sorted materials will be transported from the bunker to a baler to reduce the transport volume;
- Afterwards the recycling materials will be stored in the sorting hall to be picked up by the traders.

Based on the option analysis the following waste quantities for sorting can be expected. The quantities are not including the amounts of separately collected glass. This fraction is transported to the Cahul sorting plant for intermediate storage only.

Table 9-18: Input to the sorting station

	Taraclia Sorting Plant	Cahul Sorting Plant	Total quantity of the project area	Fraction in percent
	[tonnes/year]	[tonnes/year]	[tonnes/year]	[%]
Plastic	763	1,276	2,039	40
Paper & cardboard	455	819	1,274	25
Metal	216	362	578	11
Total recyclables without glass	1,434	2,457	3,891	76
Residues in bins	430	772	1,202	24
Total input to sorting station	1,864	3,229	5,093	100
Glass[9]	0	355	355	

Calculation of necessary staff for sorting

According to the assumptions 5,093 tons per year recyclables are delivered to the sorting stations in Cahul and Taraclia including 1,202 tons of residues. These residues will remain on the sorting belt and are not taken into consideration for this calculation.

It is supposed that with every individual sorting operation one piece with an average weight of approx. 100 g will be separated. Based on experience with similar facilities, it is furthermore assumed that every sorter performs 1,200 sorting operations per hour.

It is assumed that the sorting plant will be operated 5 days a week (Monday –Friday) respectively 260 days per year with one shift of 8h hours per day. Hence the facilities are in operation 2,088 hours per year.

Table 9-19: Calculation of necessary sorting staff

	Cahul sorting plant	Taraclia sorting plant
Weight of unsorted recyclables (without residues)	2,457 tons/year	1,434 tons/year
Average weight of each separated piece of recyclables	0.1 kg/piece	
Sorting operations per year needed	24,570,000 pieces per year	14,340,000 pieces per year
Sorting operations per hour	11,767 pieces per hour	6,868 pieces per hour
Operations per sorter	1,200 operations per hour	
Needed number of sorting staff	10 persons	6 persons

[9] Separately collected and separately transported to the sorting plant, but only for temporary storage

Calculation of numbers of sorting lines

The calculation of the number of the necessary sorting lines in particular results from the theoretical material filling height on the sorting conveyor. For an effective manual sorting the dumping height should not exceed 0.15 m.

The calculation of the filling height is based on the throughput, the density of the waste and the speed and the width of the sorting conveyor.

Table 9-20: Calculation of numbers of sorting lines

	Cahul sorting plant	Taraclia sorting plant
Throughput per year including residues	3,229 tons / year	1,864 tons / year
Throughput per hour	3,229/ 2,088 = 1.55 tons/hour	1,864/2,088 = 0.90 tons/hour
Density of delivered waste	0.15 tons / m³	0.15 tons / m³
Resulting conveying volume	15.5 m³ / hour	6 m³ / hour
Speed of the sorting conveyor	0.10 m / second (360 m/hour)	
Effective width of the sorting conveyor	1.2 m	1.2 m
Resulting filling height:	4 cm (15.5m³/h / 360 m / 1.2m)	2 cm (6 m³/h / 360 m / 1.2m)

For both sorting plants one sorting line is sufficient for the sorting procedure.

Basic layout conditions

The following basic layout for the sorting facility is defined:

- The sorting plant is placed in a closed hall;
- The hall is designed with a total size is 25 x 60 m = 1,500 m²;
- The storing area of delivered recyclables is placed in a separate zone of the hall with a size of 450 m² including space for unloading the waste trucks and for the switching of the wheel loader;
- The sorting is carried out on an open sorting platform with 10 sorting stations for Cahul and 6 sorting stations for Taraclia plant;
- The inclination of the conveyors is 20° for the baler and 27° for feeding the sorting conveyor;
- The material bunkers underneath the sorting platform are 4 m high and 3 m wide to allow a trouble free access for the wheel loader.

9.4 Conceptual design for the landfill

9.4.1 Site selection

The selection procedure of the location for the new landfill in the south region with Cahul, Cantemir and Taraclia is considering environmental, social, technical and economic aspects. Based on this evaluation the location in Cahul was finally selected. The site selection report is presented in Annex 13.

At the same place in Cahul the currently operated landfill is located. This has several additional advantages:

- Synergy effects can be achieved by rehabilitation of the existing and construction of a new landfill at one place. Soil management during the construction of the new landfill can be organized in a way that surplus materials can be used for the rehabilitation of the existing landfill. Landfill gas treatment facilities can be used by both landfills;

- Monitoring of groundwater, air and settlements of the landfill bodies can be done for both landfills as well;
- This brings technical and financial advantages and guarantees a short term and significant improvement of the environmental situation on site;

9.4.2 Landfill concept

As mentioned before the current landfill is located directly beside the proposed area for the new sanitary landfill. It is located in a former sand pit. It should be kept in operation until the new landfill is prepared and starts its operation. In this respective, the current landfill operator should be instructed which zone of the existing landfill area shall be filled with waste.

Depending on waste quantities delivered to the landfill and the operation start of the new landfill the cubature of the existing landfill has to be modified. However actually an area of 7,300 m² is filled with waste (within the sand pit), which will increase to 12.100 m² until the new landfill starts operation. This area has to be re-cultivated.

The new landfill has a **waste disposal area** of 62,800m² and will be constructed in three parts (cell 1 – cell 3). Only cell 1 will be implemented with the initial construction. Considering an annual waste volume of 49,250 m³ per year on average of the years 2018 to 2038 and a capacity of 1,034,000 m³ the lifetime of the landfill will be around 21 years. The real capacity of the landfill based on the conceptual design is 1,084,000 m³ including around 5% capacity for intermediate covers.

Table 9-21: Landfill capacity

Cell	Capacity [m³]	Size [m²]	Expected time of operation [years]
1	289,000	19,800	6
2	362,500	17,000	8
3	432,500	26,000	7
Total	**1,084,000**	**62,800**	**21**

Beside the construction of cell 1 which is consisting of earthworks, base sealing system and leachate drainage, several infrastructure facilities have to be constructed before start of operating the new landfill.

The **access road** from the public road to the landfill has to be improved to an asphalted road to make sure that the landfill can be reached by waste trucks all over the year. Cleaning of asphalted roads is easier and reduces the impact by dust and air pollution during the dry season.

The landfill has to be equipped with a **reception area** where each incoming truck is controlled, weighed and registered. All other facilities such as office, social rooms, workshop with garage, wheel washing will be located at the reception area.

In the reception area of the landfill a **composting plant** for green waste and a **sorting plant** for separate collected materials (plastic, paper, cardboard and metals) will be placed. Sorting will take place in a closed hall while the green waste composting is designed as “open composting”.

Leachate produced by disposed of waste is collected in the waste cells and transported to the leachate collection basin. There it is evaporated or surplus leachate will be treated in the **leachate treatment facility**, which is located beside cell 1.

In order to reduce the quantity of leachate produced from waste it is foreseen in unused parts to install a small temporary border in order to separate clean surface water from polluted leachate.

Landfill gas will be collected from old waste of the existing landfill first. Hence a gas treatment facility has to be implemented at least with the rehabilitation of the existing landfill. At the new landfill gas collection wells will be constructed in parallel to the filling of the landfill. After completion of each cell the gas collection wells of this cell can be connected to the gas collection station.

Degassing of the landfill shall be done by an active **degassing (venting) system**. The collected gas will be burned in a high temperature flare. If quantity and quality of the landfill gas allow gas utilization system sufficient space for gas engines is foreseen at the landfill area.

Cells filled with waste will be covered with a temporary soil cover first in order to await the main settlements of the waste before implementing the final cover.

Considering the facts that the final top sealing for the new landfill will be constructed after landfill closure after the year 2042 and the discussion about cheaper but technical equivalent top sealing systems is still running, alternative sealing systems should not be excluded at this stage of the Project. However for technical specifications and cost estimations the standard top sealing system is considered.

9.4.3 Geological and hydro-geological description of the site

The hydrogeological and geotechnical study for Cahul site is presented in Annex 11.

The proposed area of Cahul landfill is situated at the high part of watershed between Prut River and Big Salcia River. This site is located in the valley of a small dry creek which is going to gully “Moranda”. Cahul landfill, which is currently in operation, is situated at an old sand pit. Sands from this pit are characterized by granulometric composition as fine to medium sands. The bottom of these sands lies of clay formation, hypothetically of Pontian age. This clay is characterized by carbonate inclusions, fine sand layers and fissuring in zone of aeration. It was exploited in the hill which forms the left, south slope of dry creek. The right slope of creek is more flat.

The altitude ranges from 110 to 160m. The slope inclination is intensive and ranges from 5 to 25 degree. More intensive inclination is characterized for slope which consists of sandy soil (left part of valley). Groundwater is not determined up to 8.0m of drilling. It can be assumed that groundwater can be found on the depth of more than 20.0m. The temporary water streams can be expected here after the heavy rain events.

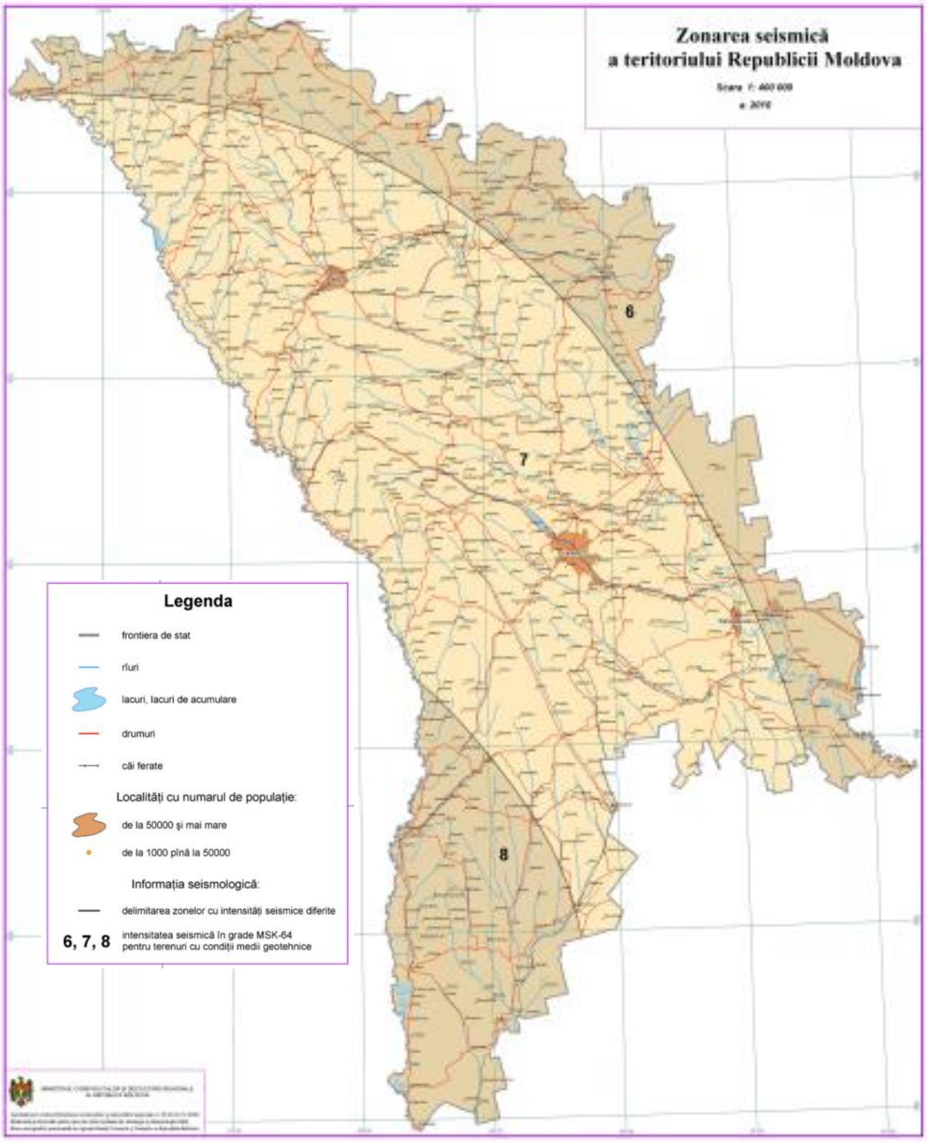
Negative geological processes like landslides or active erosion are not determined within a distance of 300m from the studied site.

Seismic activities in the project area

According to the seismic map of the Republic of Moldova from 2010 the proposed landfill location is located in an area of level 8 out of 9 levels (level 1 = low seismic activities, level 9 = high seismic activities). Furthermore the map shows that the whole project area belongs to level 8 zone. However better locations from the seismic point of view cannot be found in the Rayons Cahul, Cania and Taraclia. Thus there is a risk of earthquakes in the area.

On the other hand there are no international regulations requiring certain improving measures for landfills in zones with an increased risk of earthquake. . Considering the good geological and hydro-geological condition at the site in Cahul, low soil permeability and large distance to groundwater of more than 20m, combined with the technical measures of base and top sealing systems, the Consultant evaluates the local situation combined with the technical and operational measures as sufficient. However, it has to be assured that the construction works are executed according to the quality assurance plan and the operation and maintenance of the landfill follows the landfill operation plans. Strictly monitoring of the landfill (settlements, landfill gas, leachate) during and after the operation is strongly recommended as well.

Figure 9-11: Seismic zones in Moldova



9.4.4 Sealing system

The protection of soil, groundwater and surface water has to be achieved by the combination of geological barrier and a bottom liner during the operational phase and by a combination of a geological barrier and a top sealing system during the passive phase (post closure).

9.4.4.1 Concept for the Base sealing system

Annex I of the Council Directive 1999/31/EC provides the following general requirements for municipal landfills:

Table 9-22: Requirements for Base sealing systems (EC Directive)

Item	Requirements for Non-hazardous Waste Landfills
Geological barrier	Permeability: 1.0 x 10^{-9} m/s Thickness of layer: > 1.0 m
Alternative: Artificial geological barrier	Thickness of layer: > 0.5 m
Sealing system	Artificial sealing system
Drainage layer	> 0.5 m

9.4.4.2 Subsoil / geological barrier

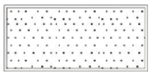
In order to investigate the subsoil under the existing and the new landfill the Consultant has prepared a geological / hydrogeological study which is based on local knowledge of the geological/ hydro-geological situation and own drillings. The typical soil structure at the area can be found in the following figure:

Table 9-23: Soil structure at Cahul landfill (borehole 1)

Borehole 1 Depth 8.0m Altitude 108.0m a.s.l							
Layer no.	Stratig-raphy Index	Lithology	Lithology in-dex	Depth, m		Thick-ness, m	Bottom altitude, m
				Top	Bottom		
1	Q4	Soil agricultural		0.0	0.6	0.6	107.4
2	Q3-4	Loam, light brown, solid consistence, friable, with macro porous		0.6	5.5	4.9	102.5
3	N-Q	Clay yellow, dense, semi solid consist-ence, fractured, with sand layers		5.5	8.0	2.5	100.0

Table 9-24: Soil structure at Cahul landfill (borehole 3)

Borehole 3 Depth 7.0m Altitude 128.0m a.s.l							
Layer no.	Stratig-raphy index	Lithology	Lithology index	Depth, m		Thick-ness, m	Bottom alti-tude, m
				Top	Bot-tom		
1	Q4	Soil agricultural		0.0	0.8	0.8	127.2
2	Q3-4	Loam, brown, light brown, with sandy loam layers, solid consist-ence, friable, macro-porous.		0.8	2.5	1.7	125.5

Borehole 3 Depth 7.0m Altitude 128.0m a.s.l							
Layer no.	**Stratig-raphy index**	**Lithology**	**Lithology index**	**Depth, m**		**Thick-ness, m**	**Bottom alti-tude, m**
				Top	**Bot-tom**		
4	Q3-4	Sand yellow, fine, aver-age density with small clay layers and		2.5	7.0	0.5	26.0

Results relevant for the evaluation of suitability of the soil as geological barrier can be summarized as follows:

- Quaternary loam with light and middle composition according to Attenberg limits, different consistence, from dry to semi dry, friable with high and macro-porosity which can be the cause of additional deformation under water impact (subsidence properties). This loam has an anisotropic filtration characteristic. The filtration coefficient can be changed from 0.01 m/day in horizontal direction to 0.1 m/day in vertical direction (*equivalent to 1.16 x* 10^{-7}*m/s up to 1.16 x* 10^{-6}*m/s*);
- Fine, middle sand of middle density and good filtration characteristics, filtration coefficient can be changed in the interval 0.5 – 5.0 m/day (*equivalent to 5.8 x* 10^{-6}*m/s up to 5.8 x* 10^{-5}*m/s*);
- Clay of Pontian age dense, dry, semi dry, fractured, with fine sand layers and carbonate inclusions. The fracturing of this clay is as a result of drying shrinkage of humidity changing in the past. The filtration characteristic of this clay depends of degree of fracturing and sand layers permeability. It is expected that 1.0–1.5m from the top of clay layer is more fractured. This layer is not waterproof layer. The filtration coefficient can be changed from 0.005 m/day in clay singularity to 0.1 m/day in vertical cleavage (*equivalent to 5.8 x* 10^{-8}*m/s up to 1.16 x* 10^{-6}*m/s*);
- According to the landfill Directive the landfill base and sides shall consist of a geological substratum which satisfies permeability and thickness requirements with a combined effect in terms of protection of soil, groundwater and surface water at least equivalent to $k < 10^{-9}$m/s;
- Soil of required quality is not available on site. Soil that nearly fits to the requirements is placed on the right side of the valley. The quantity available cannot be specified at this stage of the project development;
- Hence it is recommended to install a (technical) geological barrier of 0.5 m thickness. In this case the technical geological barrier has to achieve the equivalency by a lower permeability than 1 x 10^{-9}m/s as required by the EU Landfill Directive for geological barriers of 1.0 m thickness;
- Alternatives are imaginable but for the prepared conceptual design the above described solution was taken into consideration;
- An alternative could be for instance the installation of pre-fabricated geo-synthetic clay liner (GCL) to upgrade the material in place. Advantages are planning reliability, easy construction by high quality and most probably a cost reduction.

9.4.4.3 *Artificial liner*

The major design feature of each landfill site is the liner system. Its purpose is to prevent leachate from entering the ground water or natural drainage systems.

A 2.0 mm thick HDPE geo-membrane will have to be installed on site to provide a continuous lining system. Individual panels of liner are thermally welded together to form a homogenous seam.

A major waste management policy is to provide adequate waste containment at landfill sites. A containment system achieves this objective by ensuring the protection of groundwater quality, subsurface environment and atmospheric quality from landfill pollutants. Geo-membrane liners have the following advantages:

- Highly impermeable (10^{-14}m/s) barrier to gases and liquids, which ensures protection to groundwater quality;
- Resistant to corrosion and most chemicals;
- Resistant to biological degradation;
- Dimensional stability;
- UV stabilized;
- Flexibility allows the ground movement without cracking;
- Unaffected by wet/dry cycles;
- Able to be installed in vertical situations.

The design of the geo-membrane component of the landfill liner has to meet the following criteria:

- HDPE geo-membranes 2.0 mm should be installed in direct and uniform contact with the underlying layer (geological barrier);
- The geo-membrane has to be chemically compatible with leachate, gas and other expected environmental conditions within the landfill;
- The geo-membrane has to be physically compatible with the proposed subgrade and backfill properties;
- The geo-membrane should be capable of withstanding the anticipated short-term and long-term stresses due to facility construction and operation;
- The number of pipe penetrations through the geo-membrane should be minimized to the extent possible;
- The geo-membrane friction properties have to be compatible with other components of the liner system to minimize mechanical stresses on any component.

9.4.4.4 Protection layers

The geotextile layers provide a filtration/separation medium when placed between waste and drainage layer. This prevents the migration of fines, which could cause clogging of the drainage layers.

It also works as protection layer for the geo-membrane. Geotextiles designed and adapted especially for landfill applications:

- High puncture resistance at minimum cost;
- Wide widths for minimum overlap.

9.4.4.5 Drainage layer

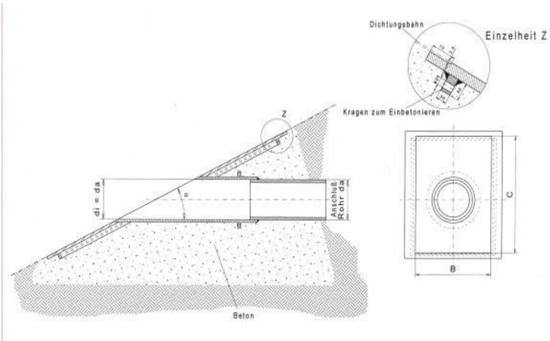
This consists of crushed stones or gravel of size group 0/32 mm or 2/32 mm with a coefficient of permeability k > 10^{-3} m/s and a thickness of layer of 50 cm. The lime content is limited to 10%.

The leachate emerges from the disposed waste into the drainage layer and flows within this under gravity to the leachate collection shaft at the deepest point of the sealed landfill base.

In order to increase the permeability of the drainage around the leachate collection shaft, the size of the leachate drainage material (crushed stones) around the leachate collection shaft should have a size of 16/32 mm. From the leachate collection shaft the leachate is flowing through a non-perforated pipe of HDPE to the leachate storage and evaporation basin.

The pipe will penetrate the base sealing system at the deepest point of the sealed area. As this is always a critical part of the landfill construction, a special construction as shown in the following figure, will be used. Please find additional information in Annex 13.

Figure 9-12: Penetration of Leachate Drainage Pipe through Sealing System



Leachate collection and treatment

9.4.4.6 Leachate Collection and storing

Leachate at landfills is generated from precipitation (rainfall and snow) as well as from the humidity of the waste discharged by compaction and degradation processes after disposal. Leachate contains several pollutants and has to be cleaned before channelling away. Usually a “technical” treatment of the leachate is necessary to clean it, but under certain circumstances (low precipitation and high grade of evaporation) another solution is feasible. Leachate is collected in a storage pond and will be evaporated during the summer time.

The dimensions of the leachate collection, storage and treatment systems are mainly depending on:

- Precipitation and climate-hydrological condition;
- Size of landfill and division into sub-cells with rainwater separation;
- Retention capacity of the waste;
- Capacity of leachate treatment.

The leachate production should be minimized in order to reduce effort and costs for leachate treatment. A system of 3 cells with 19,800 m², 17,000 m² and 26,000 m² is proposed. Based on this assumption the quantity of leachate and evaporation was calculated. The calculation is based on long term meteorological data of the years 1959 - 2012.

It shows that average precipitation is 595 mm/year but varying between 307 (year 2003) and 818 mm/year in 1966.

However the available information does not exactly fit to the required data for the calculation of leachate production. In those cases comparable data are assumed by the Consultant.

Table 9-25: Average meteorological data

Item	Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
Precipitation	mm	32	32	31	38	55	74	61	54	48	32	37	40	45
Average temperature	°C	-2	-1	4	10	16	20	22	21	17	11	5	0	10
Max. temperature	°C	9	11	19	23	28	31	33	33	29	24	17	11	23
Min. temperature	°C	-14	-13	-7	0	5	10	12	11	6	-1	-6	-12	-1

For the estimation of leachate the scenario with the biggest quantity of leachate (critical situation) was investigated: The cells 1 and 2 are filled with waste and covered with soil as temporary cover. At cell 3 waste disposal has started. According to the status of the cells different quantities of leachate will be generated, which is respected in the following table.

Table 9-26: Relevant cell size for leachate production in the critical phase

Cell	Size of cell in [m²]	Assumed degree of leachate reduction to	Leachate quantity in an average year 595mm [m³]	Leachate quantity in an "wet" year 818mm [m³]
Landfill cell 1 with temporary cover (soil)	19,800	30%	3,535	4,860
Landfill cell 2 filled but without temporary cover (soil)	17,000	70%	7,080	9,735
Landfill cell 3 shortly after taking into service	26,000	90%	13,923	19,140
Total	**62,800**		**24,538**	**33,735**

Under these circumstances the leachate quantity produced at the landfill will be between 24,500 and 33,735 m³ as a maximum during the critical period, which is after the start of cell 3.

From the landfill the leachate is flowing to the leachate basin which is located beneath the waste disposal area. It will be used as buffer for the leachate treatment plant and for evaporation also.

At Cahul landfill the evaporation rate is relatively high. Hence the water surface in the leachate basin should be maximized in order to evaporate as much leachate as possible and to reduce the leachate quantity to be technically treated.

The proposed surface of the basin is 1,100 m² and has a storage capacity of 2,800 m³. Water depth is 2.5 m.

Required leachate treatment capacity

It is assumed that the leachate treatment is working 300 days a year (65 days for repair and maintenance). During the critical phase of the landfill operation a treatment capacity of around 5.0 m³ per hour is needed (33,735 m³/year / 300 days x 24 hours = 4.7 m³ per hour).

It is proposed to use a modular leachate treatment system which will be extended in parallel to the landfill extension. For the initial phase (cell 1) leachate treatment capacity will sum up to 2.0 m³ per hour (14,575 m³/year / 300 days x 24 hours = 2.0 m³ per hour).

Table 9-27: Relevant cell size for leachate production at initial phase

Cell	Size of cell in [m²]	Assumed degree of leachate reduction to	Leachate quantity in an average year 595mm [m³]	Leachate quantity in an "wet" year 818 mm [m³]
Landfill cell 1 with temporary cover (soil)	19,800	90%	10,600	14,575

In case that the capacity of the leachate treatment plant is temporary not sufficient due to extraordinary strong rainfalls or longer operation breaks or other emergency cases, the landfill is constructed in a way that the leachate pipe can be closed by a valve and the leachate can be temporary stored in the landfill, which is constructed like a pool.

9.4.4.7 Leachate treatment options

The process of anaerobic digestion of leachate goes through a series of steps, the most important being the acetogenic step followed by the methanogenic step. The following table presents typical concentrations of major components in leachate from these two phases (values are derived from World Bank, German and English sources).

Table 9-28: Typical concentrations of pollutant substances, municipal Solid Waste Leachate

Component	Unit	Acid Phase (0-2 years)		Methane Phase (>2 years)	Limits for waste water discharged in the water body[10]
		Typical Range	Design value	Design Value	
pH	-	5.0-6.5	6.0	7.5	6.5–8.5
COD	mg/L	20,000-40,000	24,000	2,200	125.0
BOD5	mg/L	10,000-30,000	14,000	400	25.0
Ammonia, NH_4-N	mg/L	900-1,500	900	1,000	2.0
Chloride	mg/L	1,000-3,000	1,900	2,000	300.0
Phosphate, PO_4-P	mg/L	5-100	30	8	
Suspended Solids, SS	mg/L	200-2,000	500	250	
Sulphate	mg/L	200-1,000	500	200	400.0
Iron	mg/L	5-1,000	400	10	5.0
Manganese	mg/L	20-30	20	1	
Zinc	mg/L	1-5	3	0.5	0.5

[10] Extract from Annex N°2 of the regulation on requirements to collect, treat and discharge waste water to the water treatment system or to water bodies for rural and urban settlements

Component	Unit	Acid Phase (0-2 years)		Methane Phase (>2 years)	Limits for waste water discharged in the water body[10]
		Typical Range	Design value	Design Value	
Copper	mg/L	0.2-5	1	0.2	0.1
Nickel	mg/L	0.2-5	1	0.2	0.5
Chromium	mg/L	0.2-2	1	0.1	0.9
Lead	µg/L	50-1,000	100	100	0.12
Cadmium	µg/L	1-100	10	5	0.1
Mercury	µg/L	0.2-50	10	10	0.05

The following assumptions are considered to be the basis for the design of the leachate treatment plant:

- The type of waste to be disposed has an impact on leachate quality. It is assumed that the new Cahul landfill only receives ‘municipal solid waste’;
- The leachate treatment process is assumed to meet strict discharge requirements to ‘receiving waters’;
- The treatment plant will be designed in a modular form and will be constructed to serve the first landfill cell only. The treatment plant will be extended when the landfill is extended. Consequently the treatment plant will not be oversized at the beginning of its operation, and excessive investment will be avoided;
- It is assumed that the new landfill module will be sealed (on top), thus limiting the level of infiltration.

The main pollutants to be treated in municipal solid waste leachate are organic matters, ammonia and chlorides. Options for leachate treatment vary widely and depend on the discharge standards, climate conditions, quantity and quality of leachate generated. A combination of treatment methods may therefore be required.

The following table indicates the range of treatment processes to meet specific treatment objectives.

Table 9-29: Range of Treatment Processes Based on Treatment Objective

Treatment Objectives	Range of Treatment Options
Removal of degradable organic substances BOD5	Aerobic processes: • Activated sludge; • Sequencing Batch Reactor (SBR); • Rotating Biological Contactor (RBC); • Aerated lagoon/Extended aeration. Anaerobic processes: • Upflow anaerobic sludge blanket (UASB).
Removal of ammonia NH4-N	Aerobic nitrification: • Activated sludge; • Sequencing Batch Reactor (SBR); • Rotating Biological Contactor (RBC); • Aerated lagoon/Extended aeration; • Constructed wetlands. Air stripping.

Treatment Objectives	Range of Treatment Options
Denitrification (removal of nitrites and nitrates)	Anoxic processes: • Sequencing Batch Reactor (SBR); • Constructed wetlands.
Removal of non-degradable organics and toxics	• Lime/coagulant addition; • Activated carbon; • Reverse osmosis; • Chemical oxidation.
Removal of hazardous trace organics	• Activated carbon; • Reverse osmosis; • Chemical oxidation.
Odour removal	Hydrogen peroxide
Removal of dissolved iron, heavy metals and suspended solids	Lime/coagulant addition, aeration and sedimentation
Final polishing	• Constructed wetlands; • Sand filters.
Disinfection	Hypochlorite
Volume reduction/pre-concentration	• Reverse osmosis; • Evaporation.

Due to the fact that there is no realistic option to transport leachate from the landfill to a waste water treatment plant after pre-treatment a “full treatment “ of the leachate is necessary in order to fulfil the requirements of direct discharge according to Table 9-29. It is recommended to use the reverse osmosis process for cleaning the leachate.

The reverse osmosis (RO) technique aims to extract clean water from the aqueous solution of organic and inorganic contaminants that constitute the landfill leachate. The process exploits the natural phenomenon of osmosis where by, if two aqueous solutions, with different degree of concentration, are separated by a semi-permeable membrane, water from the weakest solution will pass through the membrane to dilute the higher concentration solution on the other side. The process will continue till solutions on both side of the membrane display the same degree of concentration.

With reverse osmosis the process is reversed. Pressure is applied to a water solution, (leachate), against a semipermeable membrane forcing the water molecules to pass through the membrane, thus forming the clean “permeate”. The majority of the solutes or contaminants will be left behind forming the “concentrate”. Reverse osmosis is the finest physical separation method known. In contrast to normal filtration where solids are eliminated from a liquid, reverse osmosis succeeds in removing solutes from a solvent. As a technology, RO is well established in wastewater treatment applications.

Advances in membrane technology, in particular in the last 15 years, have allowed the development of RO systems designed specifically for the treatment of leachate. The retention efficiency is primarily depended upon the molecular weight and polarity of contaminants. Reverse osmosis membranes can result in the retention of more than 98% of large molecules dissolved in leachate. Ions of valance 1 such as Na+, Cl- can also be retained. Most commercially available plants are constructed as two stage plants with contaminant removal rates better than 99.6%. Where unusually high strength leachate is treated or very stringent discharge consents apply, three stage plants can be employed and achieve contaminant removal rates better than 99.98%. Reverse osmosis leachate treatment plants are widely used on landfill sites throughout Europe including Germany, France, Holland, Belgium, Italy, Switzerland, Spain, Portugal and Greece. More than 100 plants are currently operational some of them for longer than ten years (status 2007).

9.4.5 Concept for rainwater collection and discharge

It should be avoided that rainwater is flowing from outside into the waste disposal area. For this reason the ring road around the waste disposal area is equipped with a ditch during the landfill operation. After finalisation of the landfill together with the construction of the top sealing system a second ditch will collect water from the covered landfill surface, see the following figure.

Figure 9-13: Internal access and maintenance road (preliminary)

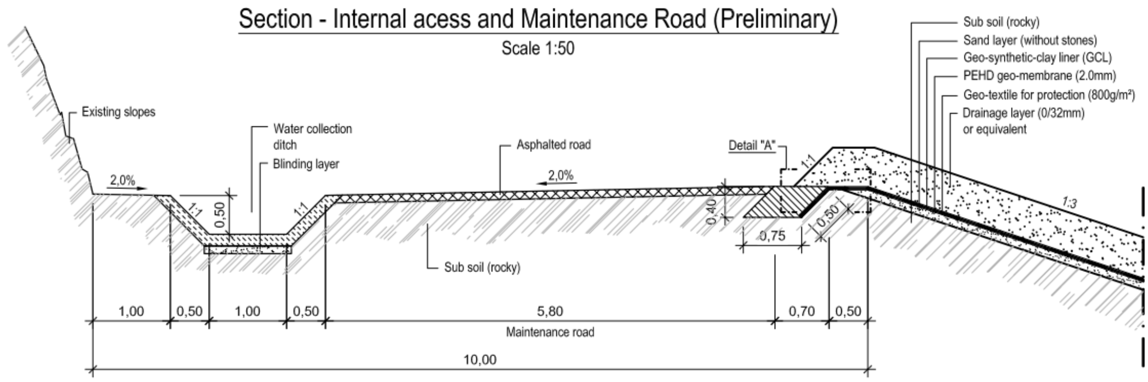
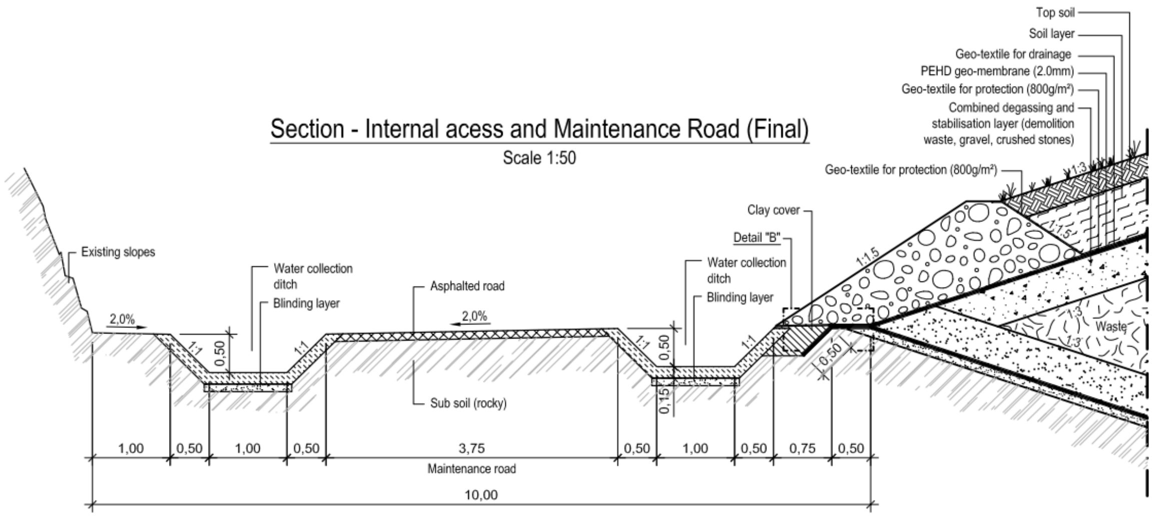


Figure 9-14: Internal access and maintenance road (final)



The ditch will have a length of 950 m and will end up in the surface water storage basin at the deeper side of the landfill. Capacity of the storage basin is 1,400 m³.

In the storage basin water from the following sources will be collected:

- Water from outside the landfill (see description above);
- Cleaned water from Leachate treatment plant;
- Water from waste disposal cell 2 and 3 as long as they are not in operation;
- Water from internal roads.

Rainwater from the asphalted areas and roofs of buildings in the reception area will be directly infiltrated in a ditch around the reception area.

The storage basin is equipped with an overflow and connected to an infiltration ditch of 500 m length in order to store and infiltrate rainwater.

An overview about the water balance is given in the following table:

Assumptions:

- Precipitation - average year: 595mm/year (0.8 m³/m²/year);
- Precipitation - wet year: 800mm/year (0.595 m³/m²/year);
- Evaporation on average: 0.01 m/day.

Table 9-30: Overview water balance

Source of water	Size	Collection rate	Water quantity in wet year	Water quantity in average year
	[m²]	[-]	[m³]	[m³]
Incoming water				
Water from outside the landfill	50,000	0.05	2,000	1,488
Cleaned water from the LTP			14,575	14,575
Water from landfill cell 2	17,000	0.2	2,720	2,023
Water from landfill cell 3	26,000	0.2	4,160	3,094
Water from internal roads*)	6,000	0.5	2,400	1,785
Total			25,855	22,965
Outgoing water				
Evaporation in the surface water basin (70% in a wet year)	770	0.01 x 365	1,967	2,810
Water für operation (road sprinkling etc.)			710	710
Infiltration capacity of the ditch**)			23,652	23,652
Total			26,329	27,172
Balance			474	4,208

**) Water from reception area (asphalted areas and roofs) will be infiltrated directly in an infiltration ditch around the reception area*

***) Capacity of infiltration ditch: 500 m x 1.5 m² x 10-6m/s x 3,600 x 24 x 365:*

With 500 m length;

Infiltration area per m is 1.5 m;

Permeability 10-6 m/s.

Please find more information in the General layout plan, Annex 13.

9.4.6 Fire protection

Water pond

Beneath the waste disposal area, a natural designed water pond for fire protection with a capacity of approx. 1,400 m³ will be placed

The base of the pond, up to the maximum water level will be sealed with clay from the landfill area excavation. The clay is saved upside by a geotextile of 500 g/m² weight. As final cover crushed stones will be used, the thickness of the stone layer will be 10 cm.

The whole area slopes down to the water line must be seeded with grass.

Fire extinguisher

A sufficient number of fire extinguishers will be placed in all buildings of the landfill, due to detail design and local standards.

Soil storage

Experience shows that water is not efficient for firefighting at landfills. Hence the water stored in the basin is only for firefighting in the reception area, the compost and sorting facilities.

Bigger fires within the landfill body can be excluded by good compaction of waste, which is guaranteed by using a waste compactor/dozer. In case of smaller fires on the landfill surface during the dry season, the fire should be covered with cohesive soil. For this a soil storage at the waste disposal area with a minimum capacity of 500 m³ will be placed during the landfill operation.

9.4.7 Water and electricity supply, waste water

The next electricity line is located along the public road in a distance of 1.2 km. A maximum electricity consumption of 100 KW/hour must be expected.

Next connection to public water network is available in direction to Cahul town, close to pumping station No. 5. From the connection point the water has to be pumped. Capacity is 3.0 m³/hour with a pumping height of 120 m. The distance between the connection point and Cahul landfill is 6 km. The water supply pipe should be a PE100 with a diameter of 63 mm.

A maximum water consumption of 150 liter per minute, respectively a daily consumption of 15 m³ is calculated.

To assure a stabile water pressure during the operation of the facility a high level water tank with a capacity of 50m³ will be placed within the reception area.

In practice the water for technological consumption (compost moistening, spraying asphalt for dust reduction and watering of green areas) will be taken from the surface water storage basin (cap. 1,400m³) respectively from the waste water storage of the compost plant (compost moistening).

Waste water is coming from the social area only. It will be cleaned in a small waste water treatment plant with biological cleaning by aeration. Purified waste water will be discharged to the infiltration and evaporation basin for the existing landfill.

The pre-fabricated system should have sufficient capacity for 30 persons and includes decantation and anaerobic treatment, biological treatment and disinfection.

Waste water from the cleaning of equipment and wheel washing is estimated to 100 vehicles per week as a maximum with a water consumption of 100 l per washing process as a maximum. This water will be led to the waste water treatment plant after passing an oil separator.

9.4.8 Landfill gas collection and treatment

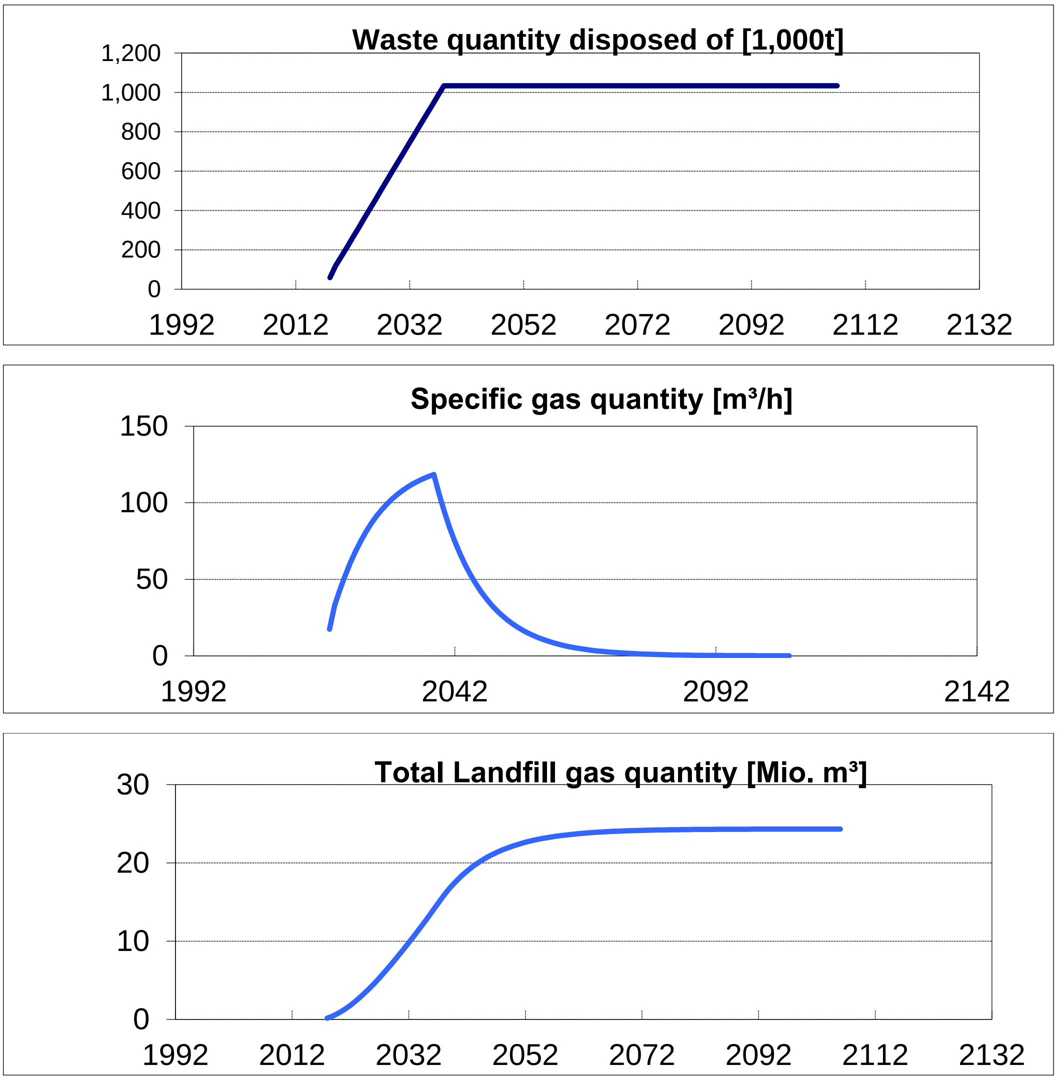
Although there is sorting of recyclables before waste disposal, it is expected that the waste still has a high bio-degradable content. The carbon content (Corg) is estimated to be150 kg/m³ waste.

Gas quantities are calculated in detail for a waste disposal time of 21 years. Calculations considering a time frame of 88 years between 2018 and 2106. During this period a total landfill gas quantity of 24.3 Mio m³ will be generated by the waste, presupposing an adequate landfill operation with high compaction. A maximum gas quantity of 118.5 m³/h will be generated in the year 2038. (see also Annex 12).

Table 9-31: Basic landfill gas emission data

Total waste quantity	1,034,000	Mg	According to forecast
Total waste volume	1,034,000	m^3	Calculated
Waste density (calc.)	1.0	Mg/m^3	(Virtual density)
Maximum gas generation	118.5	m^3/h	In year 2038
Maximum gas generation	118,500	l/h	In year 2038
Total gas quantity	24.335	Mio m³	Until year 2106

Figure 9-15: Gas quantities from new landfill



Technical solution for landfill degassing

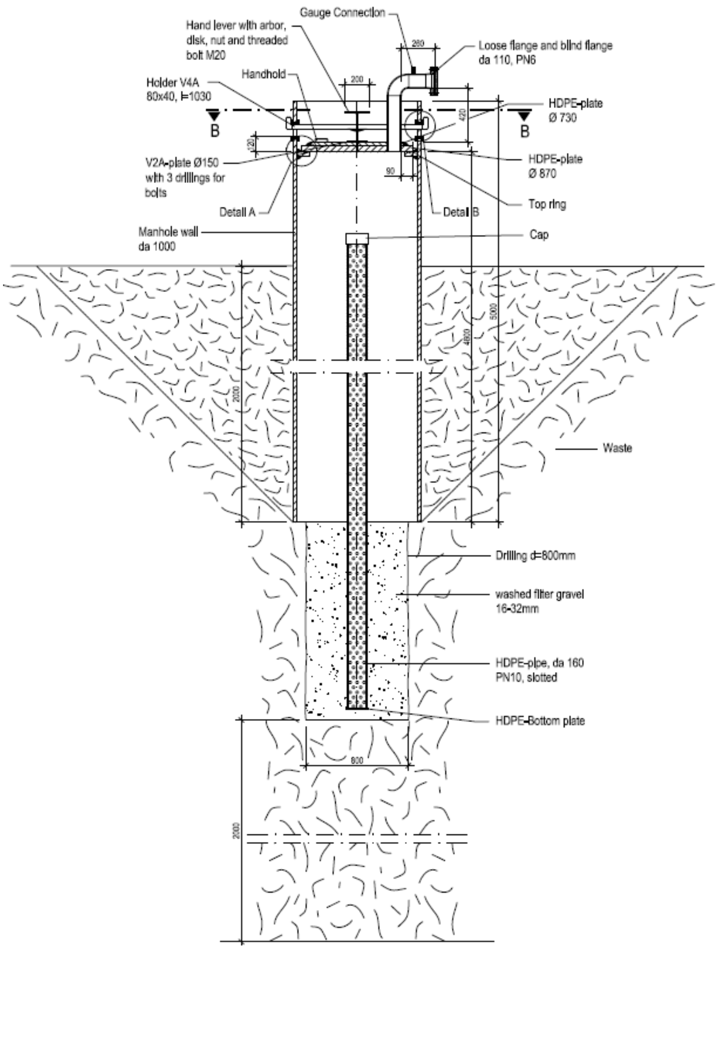
Landfill gas is produced after landfill starts its operation, usually after 6-12 months, depending on type and quantity of waste. To collect landfill gas, so called gas wells are needed, consisting of vertical gravel ducts (diameter 0.6-0.8m), supported by PEHD drain pipes placed in the middle of the gravel. These wells are placed directly in the waste.

Two possibilities are available for the construction of the wells:

- Drilling of the wells after waste disposal is finished;
- Construction of gas wells in parallel to the waste disposal.

Considering the fact that special equipment is needed for drillings in waste with a diameter of 0.8 m, the construction of the gas wells in parallel to the waste disposal according to the following procedure is proposed: Steel pipes with a diameter of 0.8-1.0m and a length of 4.0 m have to be placed on the first waste layer of waste (2.0 m thickness). They have to be filled with gravel (16/32mm). In the middle of the pipes a drainpipe of PEHD (200 mm) shall be placed. The steel pipe can be closed with a removable lid. In parallel to the waste disposal, the area around the pipe will be filled and compacted up to the top of the pipe. Afterwards the pipe will be lifted up 4.0 m by a crane or excavator and the procedure starts again.

Figure 9-16: Gas well - principle



The works described above will be executed by the landfill operator, but the supply of materials and storing at the landfill area according to the following list will be part of the tender.

The blower station is placed in a steel container of 20 feet length with two separate rooms. One room is equipped with the blower technology (drive over belts, sealing gasket, pressure shock proof, installed on a base frame). The maximum gas flow of the ventilation system should be 100m³/h.

Other provisions for working safety and system control are as follows:

- Area air supervision;
- Gas analysis system for the permanent analysis of CH_4, CO_2 and O_2 in the landfill gas;
- Illumination facility inside the container;
- Ventilation inside the container;
- Electric steering control for the flare and blower technology and the security technology.

The control panel has to be installed in the control room. Moreover a schematic circuit diagram showing the main parameters of the degassing system is required:

- Negative pressure before the blower in mbar;
- Methane concentration in the gas collection beam (mixed gas and each single collection pipe in %;
- Quantity of landfill gas in m³/h;
- Revolution indicator for the blower in %;
- Pressure behind the blower in mbar.

The gas flare should be constructed according to the following specifications:

Table 9-32: Gas flare specifications

Maximum gas flow	**about 123 m³/h (Max. 118.5 m³/h from the new landfill and max. 4m³/h from the old site)**
Gas input pressure	Min 20 mbar
Methane in landfill gas	Max 60 Vol. %
Thermal power	about 7,000 kW
Temperature of combustion:	1,200 °C
Total height	about 10,000 mm
Furnace height	about 7,000 mm
Furnace diameter	about 1,700 mm

The degassing system will be constructed in a way that a gas engine for production of electricity can be included at a later stage, after having reliable information about gas quality and long term quantity.

Figure 9-17: Gas venting station and high temperature flare

9.4.9 Infrastructure

9.4.9.1 Access road and traffic concept

Traffic system to and inside the landfill area comprises:

- Access road to the landfill;
- Reception area asphalted;
- Ring road around the landfill;
- Ramp for entering the waste disposal area by waste collection trucks;
- Unpaved roads (temporary) at the disposal area.

The existing access road to the landfill should be improved in a way that regular cleaning by car is possible.

Reception area

The reception will be completely asphalted and should have the following structure:

Structure of the road:

- Concrete-asphalt – wearing course (6 cm);
- Bituminous conglomerate – road base asphalt (5 cm);
- Crushed stones – sub base layer (compaction rate of Trγ >90%) – (20c m);
- Cobbling stone layer – road foundation (compaction rate of Trγ > 90 %) – (30cm);
- Base (compacted original soil).

Ring road

Starting from the reception area a “ring road” is surrounding the landfill area in order to reach every part of the landfill for maintenance. The road will have a width will be 4.0 m and is unpaved.

Internal roads

In order to assure that the waste disposal trucks can enter the waste disposal area all over the year temporary internal roads have to be constructed. The internal roads will be constructed from demolition waste if available. Hence a management of collection and intermediate storage of those wastes at the landfill area is needed.

The construction of those internal roads has to be done by the landfill operator and should follow the requirements of the landfill operation plans.

Street lighting

Waste delivery is done during the early evening hours as well. Hence lighting of the reception area must be ensured. It is recommended to install 150 W reflectors, provided with IP 54 protection, installed on the external wall of the building or on lampposts beside the roads and the platform.

The value of the overall lighting should be 80 lux.

9.4.9.2 Office / social building

For landfill administration as well as to provide social and sanitary facilities to the staff, a site operating and office building is needed.

The following rooms will be provided in the site operating building on one floor:

Table 9-33: Landfill office specifications

1.	Meeting room	49 m²
2.	Landfill manager	16 m²
3.	Secretary office	12 m²
4.	Laboratory, archive for waste samples included	16 m²
5.	Social room with tea / coffee kitchen	15 m²
6.	Locker room, including showers (Men)	16 m²
7.	Locker room, including showers (Women)	16 m²
8.	Central Control Station	15 m²
9.	2 rooms for reserve (2 x 10m²)	20 m²
10.	Services / storage (2 x 8m²)	16 m²
11.	Toilets for men for women (2 x 7m²)	14 m²
12.	Corridors	37 m²
Total		**242 m²**

The required gross plot area of the site operating and staff facilities building is thus approximately 242 m². Next to this building around 10 parking spaces shall be provided for the staff and visitors.

9.4.9.3 Workshop / garage

For vehicles belonging to the landfill and the waste emplacement vehicles, a garage constructed as a closed building with dimensions of 12.5 x 28.0m will be provided for compactor, wheel loader, and dozer.

A workshop for servicing the vehicles belonging to the landfill and storage spare parts and operating supplies will be integrated in the garage.

For fuelling the vehicles belonging to the landfill, a stationary diesel filling station with one filling pump will be erected on the site operating yard.

The diesel tank should be calculated for approx. 2 weeks of landfill operation.

Depending on the machines working hours between 140–250l diesel per day are needed for landfill, composting and sorting facility.

Hence the capacity of the fuel tank should not be less than 3,000 l.

9.4.9.4 Fence and gate

The landfill area is surrounded by a fence of minimum 2.50 m height.

The gate at the access is opened only during the opening times of landfill.

The fence is necessary to avoid not allowed access of people, not allowed waste dumping and to hinder bigger animals from entering the landfill.

9.4.9.5 Wheel washing

The trucks coming from the landfill, having unloaded their waste, will return to the reception area. If necessary, they have to be cleaned in the truck cleaning station. The truck cleaning station of approx. 4 x 18 = 72 m² is placed between reception area and the internal access road and is asphalted. It consists of a flat basin of approx. 10 cm depth to collect the waste water.

After the trucks have stopped in the basin they can be cleaned by a high pressure water washer. The waste water will be collected in a shaft with oil separator and with the possibility for sedimentation of fine waste particles. The tank will be emptied by a tank truck.

It is assumed that 10 trucks a day will be cleaned on 150 days per year. Water consumption per cleaning procedure is calculated with 100 liter. Hence waste water storage for 150 m³ per year is required. Intervals of emptying shall be once per months. A storage tank of 150 m³ / 12 = 15 m³ including 20% safety capacity should be implemented.

9.4.9.6 Weighbridge

All incoming waste deliveries will be weighed and registered. For this reason a weighbridge for trucks of 18 x 3 m will be installed. The weighbridge is located in the reception area. Directly beside the weighbridge, a weighing office will be constructed. The weighing operator has visual contact to the truck driver and the possibility of a visual inspection of the truck load by using a mirror, outside installed at a mast. In addition, a movable and freestanding ladder is placed in front of the weighing office.

The weighing office is equipped with a computer and special weighing software to collect all data such as the type, characteristics, weight, the origin of the waste, name and address of supplier and the precise location where the waste is deposited at the landfill.

Structure of the Weighbridge:

- Measuring capacity: 40 t;
- Load capacity: 50 t;
- Size of the weighbridge: 3.00 m x 18.00 m;
- Scale: 20 kg.

Computer and Software

The secondary equipment such as microprocessor controlled weighing terminal, computer, software, printer and all connections between the weighbridge and the weighbridge office for weighing operation has to be delivered and installed.

Weighing procedure

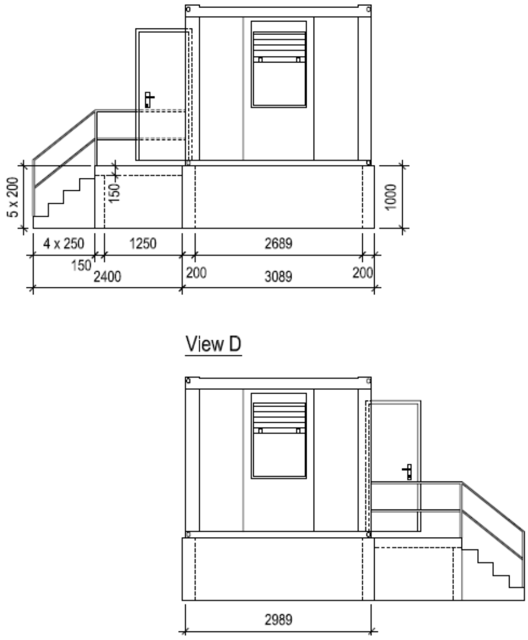
Initial weighing takes place after having entered a function number with intermediate storage of the date, numeric or alphanumeric identification of the initial weight.

A second weighing of the unloaded truck takes place after having entered a function number with calling the data stored under the above mentioned identifier or by manually entering the initial weight by means of the keyboard with automatic calculation of the net weight value.

In addition, a weighing ticket printing facility with connection to the weighing terminal for individual sets of tickets DIN A5 broadsheet print, self-duplicating paper by means of single page take-up or for usual listing prints on endless paper.

Tickets contain the following data: date, time, incremental number of the weighing ticket and initial weight value.

Figure 9-18: Weighing office container



9.4.9.7 Container and container cleaning area

Within the reception area a separate area for storing containers will be constructed. Roll on-roll off containers for transport of cover soil, demolition waste (for internal road construction purposes) and temporary storing of unidentified waste can be placed there.

In addition a small washing place for cleaning waste bins and collection containers will be installed there.

Figure 9-19: Example for landfill reception area (Güngor landfill- northern part of Cyprus)

9.4.10 Closure of the landfill

The Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste requires a surface sealing system for landfills for municipal waste according to the following table:

Table 9-34: Requirements for top sealing systems (EC Directive)

Top Sealing	Requirements for Non-hazardous Waste Landfills
Gas drainage layer	Required
Artificial sealing system	Not required
Impermeable mineral layer	Required
Drainage layer	> 0.5 m
Top soil cover	> 1.0 m

The drainage layer of 0.5 m thickness required in the landfill directive could be substituted by a drain mat in order to save landfill capacity. As both solutions can be evaluated as equivalent the drain mat should be tendered as alternative item and finally decided by the price offered.

Considering the facts that the final surface sealing for the new landfill will be constructed after landfill closure after the year 2042 and the discussion about cheaper but technical equivalent surface sealing systems is still running, alternative sealing systems should not be excluded at this stage of the Project.

9.4.11 Control and monitoring during operational phase and the after-care phase

Annex III of the Directive 1999/31/EC gives detailed instructions about control and monitoring procedures in operation and aftercare phases of landfills:

- Meteorological data;
- Emission data: water, leachate and gas control;
- Protection of groundwater;
- Topography of the landfill, i.e. data on the landfill body.

The control data, parameters and intervals of data collection are described below. All analyses must be carried out by competent laboratories. All data and results of monitoring will be summarized and in yearly reports.

Meteorological data

The following data should be collected:

Table 9-35: Requirements for climate data monitoring

Item	Frequency during Operation Phase	Frequency during Aftercare Phase
Volume of precipitation	Daily	Daily, added to monthly values
Temperature	Daily	Monthly average
Direction and force of prevailing wind	Daily	Daily
Evaporation	Daily	Daily, added to monthly values

A meteorological station will be placed at the landfill area. As an alternative the data request from the nearest meteorological station is possible.

Water, Leachate and Gas Control

The main emissions from a landfill site, leachate as well as landfill gas and smell, use the water or air path to pollute the environment. For this reason it is important to measure the quality and quantity of the emissions' main parameters regularly.

Table 9-36: Requirements for leachate, surface water and landfill gas monitoring

Item	Frequency during operation phase	Frequency during aftercare phase
Leachate volume	Monthly	Every six months
Leachate composition	Quarterly	Every six months
Composition of surface water	Quarterly	Every six months
Potential gas emissions	Monthly	Every six months

A first sample from the surface water should be taken before start of the landfill operation in order to have the possibility to compare the water quality before and after taking the landfill into operation.

It should be highlighted that due to the fact that groundwater is expected in a depth of more than 50 m a groundwater monitoring system is not recommended.

Landfill gas emission must be expected according to the high organic contents of the waste. As required in the EU Directive, the following gas measures should be done, independent from gas collection and treatment systems.

Table 9-37: Requirements for gas monitoring

Location	Interval		Quantity
	Operation Phase	Aftercare Phase	
Landfill surface	Every month[11]	Every six month	In a grid of 25 m x 25 m
Leachate shafts	Every month[12]	Every six month	1 per shaft

[11] In case that no landfill gas is detected the intervals can be enlarged.

[12] In case that no landfill gas is detected the intervals can be enlarged.

Data on the Landfill Body

Table 9-38: Requirements for settlement monitoring

Item	Frequency during Operation and After-care Phases
Settling behaviour of the surface level of the landfill body	Yearly

For measurements of settling behaviour, fix points (e.g. concrete blocks) should be placed at the waste disposal area where no activities are expected for some years.

9.4.12 Operational aspects

9.4.12.1 Opening and Operation times

The landfill will be opened Monday to Friday 07:30 to 18:30 which is directly connected to the waste collection.

The landfill reception (weighing office) should be opened during this time, while the landfill operation could be reduced to a one shift operation of 8.0 hours per day from Monday to Friday.

9.4.12.2 Staff

All staff of the landfill must be reliable and have available relevant expertise and practical experience. Education and further training of the staff for their specific tasks is desirable. Landfill operation is calculated for an extended single shift operation. Minimum number of staff for the operation is 23 persons. As there is overlapping with other facilities the staffing plan is summarized in Table 9-40.

9.4.12.3 Landfill operation equipment

For the operation of the landfill, the following main vehicles and mechanical equipment are needed:

- Landfill compactor: A large landfill compactor (approximately 30 tonnes) would be preferred for crushing of large waste items and for appropriate compaction of the waste layers;
- Bulldozer: A 20 tonnes (200hp) bulldozer is feasible for spreading of waste and application of daily cover layers on top of the compacted waste;
- Wheel loader: A wheel loader is needed for loading of soil and gravel materials; the wheel loader should be equipped with an additional street cleaning brush for cleaning the asphalted reception area of the landfill;
- Dump truck: A dump truck is needed for internal transportation of soil and gravel materials;
- Water tanker: A water tanker truck is needed for watering of internal roads and squares in order to prevent dust problems.

Figure 9-20: Landfill operation equipment

Besides that various small equipment and tools such as movable traffic signs; emergency power generator, walkie talkies, a set of tools for machine repair and a high pressure cleaner should be available for starting the landfill operation.

9.4.12.4 Site regulations for waste deliverers

Prior to the start of landfill operations, site regulations will be drawn up containing the essential instructions for operational safety and orderly operation and in particular rulings to affect that:

- Only designated tracks may be used;
- The waste may only be disposed at the prescribed locations;
- The instructions of the landfill staff must be followed.

9.4.12.5 Operating manual for the landfill staff

Before commencing landfill operations, an operating manual should be prepared. In this manual, working practices will be laid down for normal operation, maintenance and servicing as well as during operational upsets, as necessary for maintaining proper disposal of the wastes and ensuring plant and equipment safety. These measures shall be harmonized with emergency plans and plans of action.

Figure 9-21: Truck with roll-off

The operating manual will define the tasks and responsibilities of each staff, the working practices, monitoring and maintenance measures, as well as obligations regarding information, documentary records and safe keeping of these.

An operation plan will be a part of the operating manual. The plan will contain all key regulations for landfill operation, in particular concerning the structure of the disposed wastes, the collection and treatment of leachate and other wastewater, as well as the nature and extend of internal inspection and monitoring.

9.4.12.6 Daily log

To document that the landfill is being properly operated, a day log should be kept. This log will contain all data and information essential for landfill operation, these are particularly:

- Disposal records for the wastes to be treated and disposed of in the facility;
- Records book for accepted wastes;
- Documentation of discrepancies between the waste as supplied and the declaration of those responsible for the wastes, with the measures subsequently taken;
- Any special occurrences, particularly operational upsets, stating possible causes and remedial measures taken;
- Operating times and outage times of the plant and plant components;
- Results of investigations and measurements for on-site monitoring;
- Nature and extent of maintenance measures;
- Results of functional inspections.

The daily log must be checked by the landfill supervisor and signed off at least once per week. It shall be kept in a safe place, and protected from unauthorized access. The daily log shall be kept in a safe place for at least five years following the cessation of landfill operation.

9.4.12.7 Inspection of wastes at reception

The permissibility of infilling of wastes should be checked before they are delivered to the landfill. Direct inspections of delivered wastes at the landfill site shall concern essentially:

- Suppliers consignment papers, stating type of waste;
- Weight of the waste;
- Stating of disposal sector;
- Visual inspection of the waste (check of its appearance, colour, consistency, odour, degree of mixing and packaging);
- Section of disposal or intermediate storage;
- This inspection measures shall be undertaken by the staff at the weighing scale and during unloading of the delivering vehicles.

If doubts arise concerning the identity of the waste:

- At the reception inspection, acceptance will be refused and this refusal will be recorded in the day log;
- While unloading the vehicle or during waste emplacement, unloading or emplacement will be stopped, the waste already unloaded or emplaced will be secured (to protect, for example, against rainfall and access by unauthorized persons) and samples shall be taken. All involved parties (waste generator, landfill operator, regulatory authorities) shall be informed.

9.4.12.8 Transportation to the emplacement location, traffic rules, emplacement of waste

The landfill shall be operated in a way that persons will not be endangered. For this purpose the following will be designated:

- Incoming and outgoing access routes;
- Vehicle manoeuvring areas;
- Unloading areas;
- Waste emplacement areas.

The incoming and outgoing routes will be signposted. The traffic routes shall be maintained that they will be safe, for delivery trucks especially, even during bad and wintry weather.

Walking at the landfill disposal area must be reduced to a minimum to avoid unnecessary contaminations.

The landfill disposal area will be divided into different sectors, marked by coordinates of length (A-Z), height (0-25) and width (a-z), so that the place of disposal can be specified, waste of similar nature can be disposed in the same sector and wastes that do not harmonize (sludge etc.) can be disposed in several sectors. The sector of disposal for each waste delivery will be stated during reception of waste. The sectors will be clearly signposted.

For the structure of each landfill section, an emplacement plan shall be prepared, and this section split up into a grid not exceeding 2,500 m² in plot area and 2 m in height. The following details shall be documented in the emplacement plan for the waste disposed in each sector:

- Nature of waste / waste code(s) / amount of waste;
- Location of emplacement (stating sector coordinates);

- Time of emplacement;
- Deviations from landfill operation plan.

After unloading at the instructed sector, the emplacement of waste is done by the landfill owned bulldozer and wheel loader.

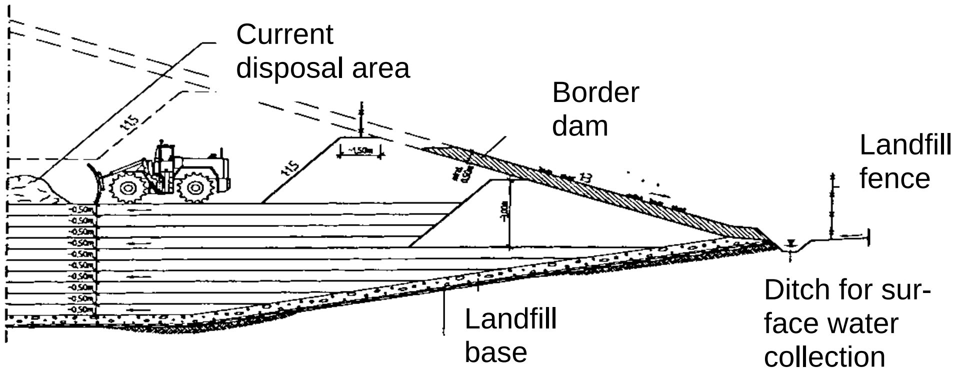
In order to:

- Minimize leachate production;
- Reduce settlements;
- Increase landfill capacity;
- Reduce bad smells, birds and vermin.

It is recommended to organize landfill operation according to the following principles:

- Waste disposal should concentrate on one area only;
- Separate disposal areas for waste collection trucks and bigger trucks and smaller cars (without hydraulic unloading system) should be prepared, to increase safety at the landfill;
- Clear definition of the disposal area by movable signs and barricades;
- Waste compaction has to be done by the compactor in thin layers of 20-30cm and 4-5 overrides, as it shows the best result concerning waste compaction. The layers should have a weak descent to the middle of the landfill, to increase the stability of the landfill and to avoid leach ate outflows at the landfill slopes;
- The waste surface has to be covered at the end of each working day by a thin layer (ca. 10 cm) of inert waste (demolition waste, excavated soil). For these cover materials a temporary storage has to be established close to the waste disposal area;
- Landfill operation should be executed within border dams according to the scheme below in order to reduce dust and the flow of paper and plastic. For this excavation material and demolition waste should be used;
- All waste truck drivers should be introduced, where to unload the waste by landfill operation staff;
- The landfill and the collected waste data should be checked by the person in charge, minimum once per week.

Figure 9-22: Principle Waste disposal in thin layers and within border



9.4.13 Closure and rehabilitation of the existing dumpsite Cahul

The current landfill is located in a former quarry area. Waste is disposed of there in one of the pits since beginning of the 1990's. The composition of waste from that time is unclear as well as the exact quantity of waste dumped at the site since that time. It is assumed that the former pit will be filled with waste completely, when the new landfill starts operation.

Related to the proposed re-cultivation of the old landfill the following key data are assumed by the Consultant for further calculations:

Key parameters of the existing Cahul dumpsite are:

Table 9-39: Key parameters of the existing Cahul dumpsite

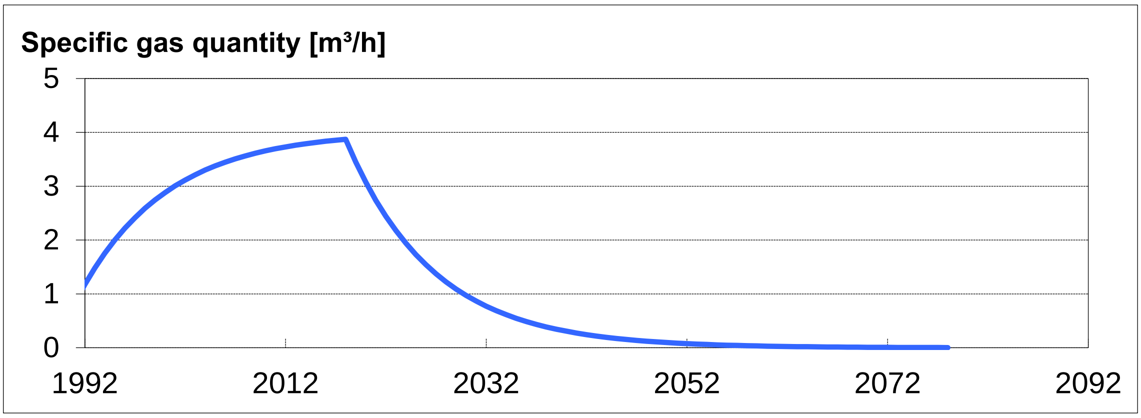
Start of operation	Beginning of 1990
Size of the dumpsite (in 2018)	11,000 m²
Perimeter	450 m
Height of waste on average	6 m
Quantity of waste dumped (estimated)	65,000m³ (11,000m² x 6.0m)

It is assumed that the landfill was exclusively used for household waste.

A rough calculation of landfill gas production shows that 1.02 million m³ will be produced in total (1990-2078). The maximum gas quantity will be 4 m³/ hour.

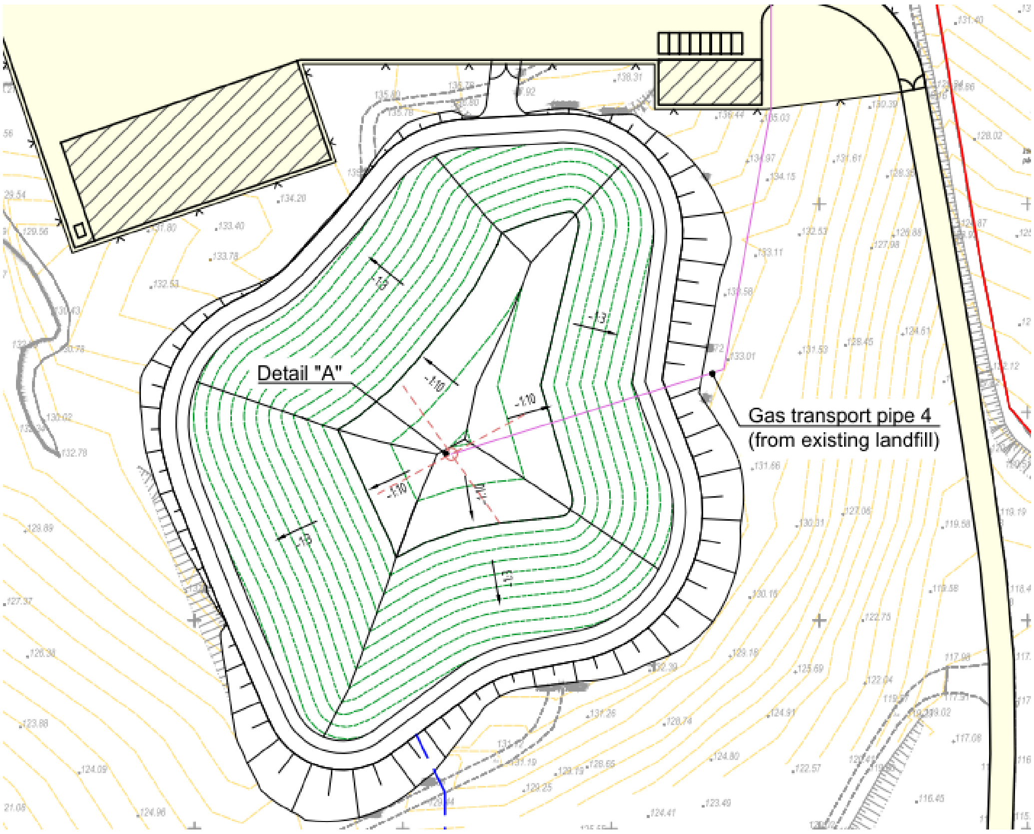
For the remaining time span after landfill closure (2018-2078) approximately 200.000m³ landfill gas can be expected, considering a low carbon content (100 kg/tonne) and an average capture rate over the whole time of gas production (60%).

Figure 9-23: Expected gas quantities from existing dumpsite at Cahul



Due to the existing environmental and health risks caused by dumpsites, the Consultant recommends closure and remediation of the dumpsite after start of operating the new landfill. In this case surplus materials from the construction of the new sanitary landfill (soil, cover soil, sand, gravel) can be used for the re-cultivation work. Transport ways and costs for material supply can be minimized. Furthermore it is recommended to include construction of the new landfill and the re-cultivation of the old landfill in one works contract.

Figure 9-24: Layout for the re-cultivation of the existing landfill



Recommendation of re-cultivation measures for old Cahul landfill

A connected groundwater monitoring system for the old and the new landfill is proposed in order to differentiate possible pollution from old or new landfill. The groundwater monitoring system should be installed before the new landfill starts its operation. The groundwater monitoring system of old and new landfill should consist of minimum three monitoring wells placed in the groundwater up (1) and downstream (2) of the dumpsite. The expected groundwater level is around 30m beneath the surface.

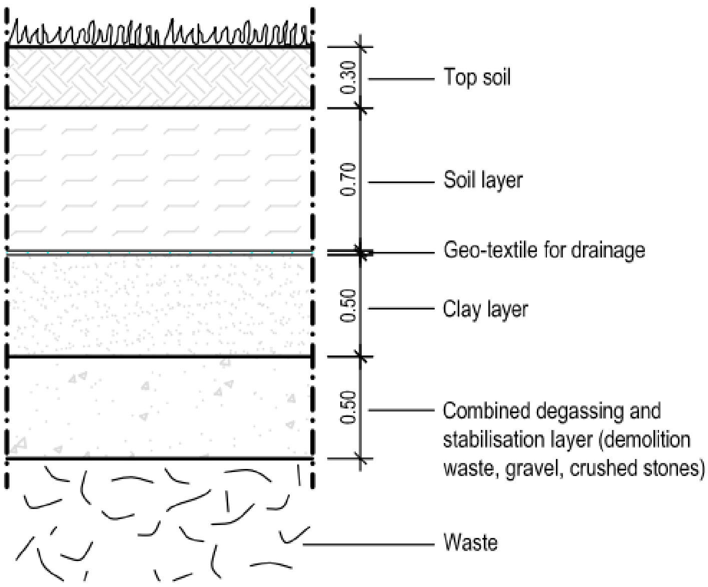
The waste has to be profiled and compacted in order to avoid infiltration of rainwater into the dumpsite. The maximum gradient should be 1:3 in order to avoid sliding and erosion of the cover soil. The flat zone of the area should have a minimum gradient of 10%.

For simplifying maintenance and monitoring works after the remediation, the dumpsite should be surrounded by a simple gravel road.

On top of the profiled and compacted waste a combined landfill gas collection and stabilization layer should be installed.

The complete capping system should consist of:

Figure 9-25: Capping system for the existing landfill in Cahul

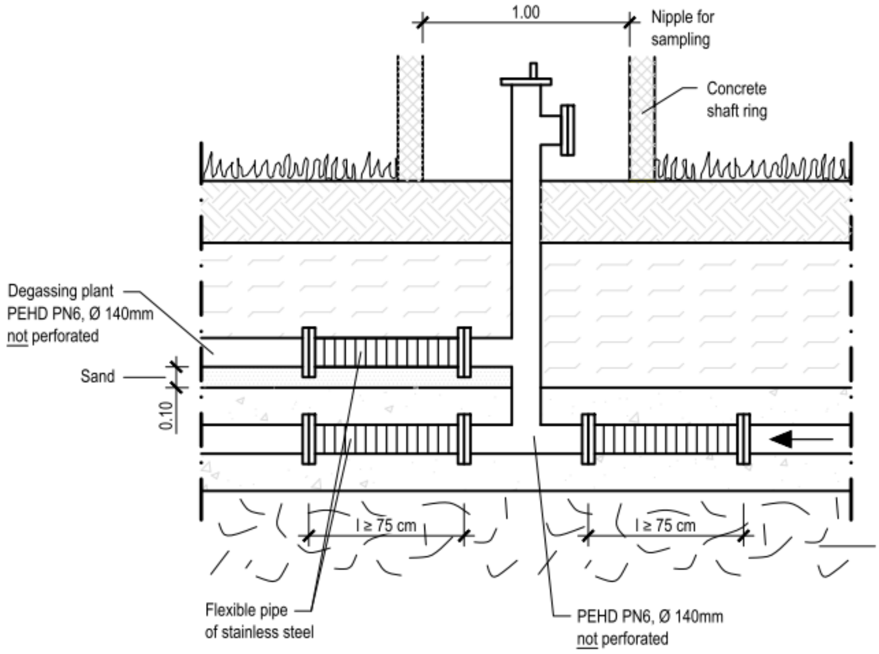


The proposed top sealing system follows the requirements of the EU Directive for the landfill of waste.

The landfill gas collection system will consist of a horizontal gas layer beneath the sealing system. The layer can consist of river gravel, crushed stones or in the best case of recycled materials from construction –and demolition waste. The gas layer has a function as stabilization layer for the sealing system as well and should have a thickness of not less than 30 cm.

The landfill gas collection system of the existing landfill should be connected to the gas venting and flaring system of the new landfill.

Figure 9-26: Principle of landfill gas collection system with horizontal gas drainage layer



9.5 Staff requirements for all waste management facilities in Cahul, Cania and Taraclia

The following table gives an overview about the required number of staff for the landfill, the waste treatment and the transfer stations which is in total 41 persons including 4 drivers for the waste transport trucks between landfill and transfer stations.

Table 9-40: Staffing of the waste management facilities

Title	Cahul			Cania		Taraclia		
	Land-fill	Com-post plant	Sorting facility	Transfer station	Compost plant	Transfer station	Com post plant	Sort-ing fa-cility
Site manager			1		1			1
Weighing officer			2		1			1
Technician – electrical			1					
Technician - process tech-nology	1							
Mechanics			1	1		1		
Driver	2		1	1		1		1
Driver transfer trucks				2		2		
Worker		2	10		1		1	6
Guard			2		2			2
Total			23		9			16

9.6 Temporary storage area for the special wastes at the facilities

At the reception area of the transfer stations and the landfill, areas for drop-off and storage of special waste hazardous waste (batteries, oil, paints etc.) from households and business, bulky waste from households and construction/ demolition waste from households will be prepared to give the possibility of separate disposal those types of waste for private persons. For safety reasons it is recommended not to allow access to the waste disposal area of the landfill, but to bring it to the mentioned drop-off area at the reception areas of the facilities.

Delivery of waste for private persons should be possible during the opening times of landfill and transfer station only.

10 Project description

10.1 Overall project description and investment measures

10.1.1 Collection and transport of municipal waste

10.1.1.1 Collection and transport of residual waste

Collection of residual waste will be organised for the entire population of WMZ-3. Individual houses in the towns of Cahul, Cantemir, Taraclia and Vulcanesti will be served by “door-to-door” collection; while the blocks of flats and the rural settlements will be served by “bring system”. The waste will be collected in containers as presented in the figure below.

Figure 10-1: Containers for collection of residual waste

1.1 m^3 metal container (bring system)

120 l bin for individual houses (door-to-door)

The waste collected in the 1.1 m^3 metal containers will be transported with 16 m^3 trucks while the waste collected from houses will be transported by 6 m^3 trucks. Both are envisaged as rear-loading compaction trucks.

The waste from Cantemir Rayon will be collected and transported to the transfer station near Cania. The waste from Taraclia Rayon will be collected and transported to the transfer station near the town. The waste from Cahul Rayon will be transported directly to the regional landfill.

10.1.1.2 Collection and transport of separately collected recyclables

In order to increase the resource recovery and to decrease the amount of waste for landfill, the separate collection of recyclables will be enhanced in the project area. Separate waste collection will be organised only in the urban area of WMZ-3. Paper, cardboard and glass will be collected only in the town of Cahul. Plastic and metal will be collected in the towns of Cahul, Cantemir and Taraclia in net containers. The envisaged containers are presented in the figure below.

Figure 10-2: Containers for separate collection of recyclable materials

Container for paper & cardboard metal	Container for glass	Container for plastic and

Besides the envisaged dry recyclables to be collected, the integrated system for waste management in the WMZ-3 will include separate collection of green waste from the urban areas. Green waste will be collected from the public areas and from households living in houses. The green waste from Cantemir town will be collected and transported to the composting facility near Cania. The green waste from the towns of Taraclia, Tvardita and Ceadir-Lunga will be collected and transported to the composting facility near the town of Taraclia. The green waste from Cahul town and Vulcanesti town will be transported directly to the composting facility at the regional at the regional waste management centre.

10.1.2 Transfer stations

Due to the long distances between the waste collection areas and the landfill in Cahul two waste transfer stations will be implemented; one TS in Cania for the Cantemir Rayon and one TS in Taraclia for the Taraclia, Ceadir and Lunga Rayons. Both transfer stations are located in a distance of approximately 40 km to the landfill in Cahul.

At the transfer stations the waste will be reloaded from the collection trucks to bigger long distance trucks with a capacity of 60 m³ without compaction for Cania transfer station and with compaction for the Taraclia transfer station due to higher waste amounts from the three connected rayons.

Separately collected recyclables are transferred here as well and transported to the sorting plants at Cahul landfill and Taraclia transfer station in separate containers.

In order to reduce transport costs green waste from public areas in Cantemir and Taraclia, Ceadir and Lunga Rayon will be composted directly at the transfer stations. See chapter 10.1.4 for further information.

The transfer stations are equipped with weighbridge office and social container to assure registration of type and quantity of delivered waste and to supervise all in- and outgoing vehicles permanently. The area of the transfer station is fenced. The site in Cania will be operated by nine persons including two drivers for the waste transport to the landfill and the operation of the compost plant. The site in Taraclia will be operated by 16 persons including the staff for the sorting facility.

10.1.3 Sorting of waste

Based on the option analysis it is expected that 3,580 tonnes of recyclables will be transported to the sorting plant. An amount of 3,200 tonnes consisting of source separated paper, cardboard, plastic and metal will be fine sorted whereas an amount of 380 tonnes of glass will be stored there only.

The sorting plants are located within the area of the landfill respectively the transfer station. Hence weighbridge and infrastructure can be used for operating the sorting plant.

The sorting plant itself consist mainly of storage area, the sorting platform for manual sorting, bunkers for the separated materials and a baler, where the recyclables will be pressed for better transport.

Sorting is located in a closed hall of 60 x 25m. Waste sorting will be done by 10 workers (Cahul), respectively 6 workers (Taraclia); all other works (weighing and driving of machines) will be undertaken by the landfill respectively transfer station staff.

10.1.4 Biological treatment of waste

It is assumed that altogether around 3,250 tonnes of green waste can be collected from the rayons of the projects area. The green waste will be composted in open windrow composting. It is a very simple procedure which justifies composting plants at the two transfer stations and the landfill in Cahul. The composting will be operated by the landfill staff, respectively the staff of the transfer station. For shredding and sieving the raw materials and later on the compost, a mobile sieving drum and a shredder are placed at Cahul landfill (where the highest amount of compost is expected) and transported to the compost plants at the transfer stations whenever necessary.

10.1.5 Construction of a new landfill and closure of Cahul dumpsite

The new sanitary landfill for WMZ 3 with the five rayons Cahul, Cantemir, Taraclia, Ceadir-Lunga and Vulcanesti will be located at the area of the existing Cahul landfill. It is calculated for an operation of 21 years with a waste disposal capacity of approx. 1.0 million m³. The landfill will follow the requirements of the Landfill Directive of the European Commission for non – hazardous waste. At the site a composting and sorting facility will be placed also.

The landfill will be equipped with base and top sealing systems - as shown in Figure 10-3 -, leachate collection and treatment systems as well as collection and treatment systems for the landfill gas.

In order to guarantee an all over the year operation of the landfill it will be equipped with asphalt roads, street lighting and wheel washing.

In- and outgoing vehicles will be weighed, registered and controlled in order to have a basis for correct billing and to avoid disposal of not acceptable waste.

Based on the total quantity of waste of 67,000 tons/year including green waste and recyclables from the five rayons around 31 waste collection vehicles will enter the landfill area per day, not considering seasonal or weekly deviations.

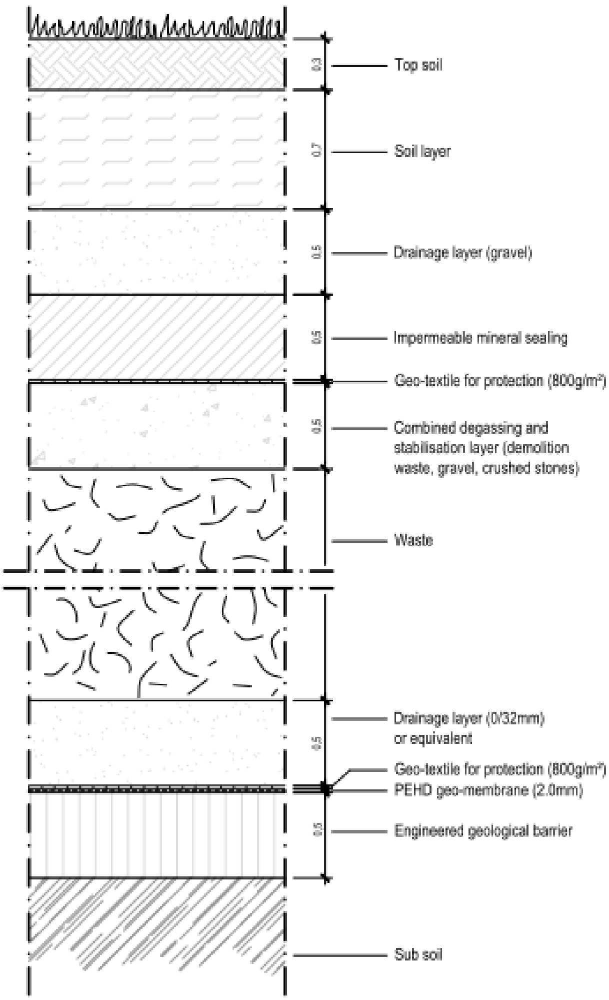
Table 10-1: Waste transports to Cahul landfill

Rayon / waste fraction	Unit	Rayon Cahul	Rayon Cantemir	Rayon Taraclia/ Ceadir-Lunga	Rayon Vulcanes-ti	Remarks
Residues	Trucks per day	19	2	3	4	60m³ waste transport trucks from Cantemir and Taraclia
Recyclables		1	0	0	Less than 1	
Green waste		1	0	0	Less than 1	Green waste from Cantemir and Tara-clia will be compost-ed at the TS
Total		21	2	3	5	31 single trips per day

Mobile equipment such as waste compactor, dozer, wheel loader and truck will assure that the landfill is operated in a way that emission can be reduced to a minimum.

Landfill monitoring considering leachate, landfill gas, surface and groundwater as well as settlements of the waste body are mandatory during the landfill operation phase as well as during the aftercare phase when the landfill is closed and re-cultivated.

Figure 10-3: Base and top sealing system for new Cahul landfill



Currently the location is used as local landfill for Cahul. The area shall be used until the new regional landfill starts it operation. Until then an area of around 12,000m² is expected to be filled with waste. It is recommended to re-cultivate the old landfill directly after starting operation of the new landfill.

For the top sealing system of the old landfill soil from excavating and profiling the new landfill can be used. Impermeable soil is available in parts of the new landfill area. A section of the top sealing system can be found in Figure 10-3. It is identically with the solution or the new landfill and fulfils the requirements of the EU Directive.

The landfill will be constructed in three 3 steps: The initial phase contains waste disposal cell 1 (19,800m²) and the infrastructure needed to operate the landfill including composting and sorting facility. After 5 years a first extension with cell 2 (17,000m²) will be implemented and after another 6 years cell 3 (26,000m²) will be constructed.

10.1.6 Other investment measures

For the implementation of the above mentioned facilities and measures detailed designs and tender dossiers have to be prepared. During the construction works independent works supervision is needed in order to receive “best value for money” and to assure that all requirements are fulfilled.

In addition it is recommended to support the final beneficiary with technical assistance in order:

- To optimize the waste collection and transport;
- To operate the new waste management facilities;
- To develop a marketing system for the recyclables from compost and sorting plant.

Finally local staff should be trained in preparing and realizing public awareness programs as the support of the citizens is the most important aspect for the development of a functioning waste management system.

10.2 Investment costs

Invest costs are allocated to the three locations of the waste management facilities in Cahul, Cania und Taraclia.

Invest cost in table 10-2 to 10-7 are shown without contingencies. However, 10% contingencies are considered in the overall project cost displayed in table 10-8.

Costs for designs, tender procedures, approval, construction supervision are not included in the investment costs. However they can be calculated with 10% of the construction and supply costs, but depending on the number of tender procedures / work contracts.

Bigger Investments will be necessary within four implementation phases.

Initial investment includes (2017 - 2018):

- Supply of Waste collection and transport equipment;
- Construction of Cahul landfill - cell 1;
- Infrastructure of Cahul landfill;
- Sorting and composting at Cahul landfill;
- Construction of transfer stations with composting in Cania and Taraclia;

- Sorting plant at Taraclia transfer station;
- Supply of operation equipment for the facilities in Cahul, Cania and Taraclia;
- Closure / Re-cultivation of the existing dump in Cahul.

Landfill extension (cell 2) at Cahul (2023 - 2024):

- Construction of Cahul landfill - cell 2;
- Extension of the leachate treatment plant.

Landfill extension (cell 3) at Cahul (2031 - 2032):

- Construction of Cahul landfill - cell 3;
- Extension of the leachate treatment plant.

End of operation of Cahul landfill (2038).

Closure of Cahul landfill (2040 - 2041).

Sealing and re-cultivation measures for the whole Cahul landfill.

Aftercare phase of Cahul landfill:

- Leachate, landfill gas and settlement monitoring of the closed landfill.

The tables below present summaries of investment costs related to establishment of integrated solid waste management system in WMZ-3.

The cost in table 10-2 to 10-15 deviates in some cases from the cost given in chapter 7. The cost in chapter 7 is based on average cost from similar projects, while cost in chapter 10 is based on the conceptual design of the facilities. Cost estimation is based on Euro. Cost estimation in MLD considers a conversion rate of 18.5.

Table 10-2 displays the investment costs related to collection and transport of residual waste in WMZ-3. The figures are presented for year 2017 – when the supply of the collection and transport equipment should take place.

Table 10-2: Investment costs for collection and transport equipment for residual waste

Cost item	Type	Cost in EUR	Cost in MLD
Containers	1.1 m^3	1,749,000	32,356,500
Containers	120 l	271,000	5,013,500
Truck	16 m^3	2,300,000	42,550,000
Trucks	6 m^3	730,000	13,505,000
Total		**5,050,000**	**93,425,000**

Table 10-3: Investment costs for separate waste collection and transport equipment

Cost item	Type	Cost in EUR	Cost in MLD
Containers for paper & cardboard	1.1 m^3	123,000	2,275,500
Containers for plastic and metal	1.1 m^3	86,000	1,591,000
Containers for glass	1.1 m^3	55,000	1,017,500
Trucks	16 m^3	500,000	9,250,000
Total		**764,000**	**14,134,000**

Table 10-4: Summary of invest costs for Cahul

Item	Costs in EUR	Costs in MDL
Construction of the new landfill (initial phase)	4,063,000	75,165,000
Construction of composting facility	147,000,	2,720,000
Construction of the sorting facility	434,000,	8,029,000
Landfill operation equipment	568,000	10,508,000
Compost facility operation equipment	172,000,	3,182,000
Sorting facility operation equipment	90,000,	1,665,000
Construction of the new landfill (cell 2)	878,000,	16,243,000
Construction of the new landfill (cell 3)	1,160,000	21,460,000
Closure and re-cultivation of new landfill after operation	1,372,000,	25,382,000
Rehabilitation / Re-cultivation of the old landfill	340,000,	6,290,000
Total invest at Cahul	**9,224,000**	**170,664,000**

Table 10-5: Summary of invest costs for Cania

Item	Costs in EUR	Costs in MDL
Construction of transfer station	770,000	14,245,000
Construction of composting facility	50,000	925,000
Transfer station operation equipment	128,000	2,368,000
Compost facility equipment	63,000	1,166,000
Total invest at Cania	**1,011,000**	**18,704,000**

Table 10-6: Summary of invest costs for Taraclia

Item	Costs in EUR	Costs in MDL
Construction of transfer station	1,289,000	23,847,000
Construction of composting facility	48,000	888,000
Construction of sorting facility	414,000	7,659,000
Transfer station operation equipment	156,000	2,886,000
Compost facility equipment	63,000	1,166,000
Sorting facility equipment	90,000	1,665,000
Total invest at Taraclia	**2,060,000**	**38,111,000**

The table below presents a summary of investment costs for the first phase of the project per investment component.

Table 10-7: Investment cost per investment component (first phase)

	Investment cost item	Cost in Euro	Cost in MDL
1	Landfill construction	4,063,000	75,165,500
2	Landfill equipment	568,000	10,508,000
3	Transfer stations construction	2,059,000	38,091,500
4	Transfer stations equipment	284,000	5,254,000
5	Sorting stations construction	848,000	15,688,000
6	Sorting stations equipment	180,000	3,330,000
7	Composting facilities construction	245,000	4,532,500
8	Composting facilities equipment	298,000	5,513,000
9	Residual waste collection equipment	5,050,000	93,425,000
10	Separate waste collection equipment	764,000	14,134,000
11	Home composting devises	47,000	870,000
12	Closure of existing disposal site	340,000	6,290,000
Total		**14,746,000**	**272,801,000**

The table below presents the total costs for the first phase of the project including costs for construction supervision, technical assistance, public awareness and contingency.

Table 10-8: Project costs (first phase)

	Cost Item	Cost in Euro	Cost in MDL
1	Construction Works and Buildings	7,555,000	139,767,500
2	Plants Equipment	1,329,000	24,586,500
3	Waste Collection Equipment	5,861,000	108,428,500
4	Design (6% of item 1)	454,000	8,399,000
5	Technical Assistance (2% of items 1-3)	295,000	5,457,500
6	Construction Supervision (5% of item 1)	378,000	6,993,000
7	Public Awareness (1 euro per person - residents in 2018)	297,000	5,494,500
8	Contingency (10% of items 1-3)	1,475,000	27,287,500
Total		**17,644,000**	**326,414,000**

10.3 Operation and maintenance costs

Landfill operating costs can be divided into the following main items:

- Staffing costs;
- Operation and maintenance of rolling stock including fuel and lubricants;
- Maintenance of infrastructure;
- Operation of leachate and gas treatment plants;
- Discharge of waste water;
- Costs for consumables. (water, electricity).

An estimate of the total annual operation and maintenance costs has been prepared on the basis of the Consultants' experience from similar projects. The detailed estimate based on quantities and unit prices is presented in Annex 14.

Staff and machines are working overlapping for several facilities (landfill and sorting or landfill and composting or transfer station and composting). Those costs cannot always clearly be allocated to one of the facilities. Hence the operation and maintenance costs are estimated for locations in Cahul, Cania and Taraclia.

Costs are based on the following assumptions:

Table 10-9: Basic assumptions for the cost calculations

Assumed working days/year:	260 days
Cost basis	2015
Unit price Diesel	1.05 EUR / liter
Electricity	0.17 EUR /KWh
Exchange ratio [EUR / MDL]	18.5

10.3.1 Operation and maintenance costs for collection and transport

The tables below present the operational and maintenance costs related to collection and transport of waste in WMZ-3. The tables are presented for the first year of operation – 2018.

Table 10-10: Operation and maintenance cost for collection and transport of residual waste

Cost item	Cost in EUR	Cost in MLD	Remarks
Salary drivers	86,000	1,832,000	n/a.
Salary loaders	146,000	3,110,000	n/a.
Fuel	847,000	18,106,000	Include transport cost only to TS or LF
Oil	85,000	1,811,000	Defined as 10% of the fuel costs
Maintenance trucks	159,000	3,387,000	Defined as 5% of the investment costs
Maintenance containers	23,000	476,000	Defined as 1% of the investment costs
Total O&M costs	**1,346,000**	**28,722,000**	

Table 10-11: Operation and maintenance cost for separate collection and transport of recyclables

Cost item	Cost in EUR	Cost in MLD	
Salary drivers	10,000	210,000	n/a.
Salary loaders	11,000	228,000	n/a.
Fuel	165,000	3,514,000	Include transport cost only to TS or LF
Oil	17,000	352,000	Defined as 10% of the fuel costs
Maintenance trucks	25,000	535,000	Defined as 5% of the investment costs
Maintenance containers	3,000	58,000	Defined as 1% of the investment costs
Total O&M costs	**231,000**	**4,897,000**	

10.3.2 Operation and maintenance costs for transfer station and composting facility in Cania

The costs cover the operation and maintenance of transfer station and composting plant including waste transfer from Cania to Cahul landfill.

Table 10-12: Operation and maintenance costs for TS and composting in Cania in 2018

Item	Costs in EUR / year	Costs in MDL / year	Remarks
Personnel	17,000	314,000	
Electric power	3,000	50,000	
Water, waste water	3,000	50,000	
Transfer and composting vehicle	42,000	800,000	Inclusive costs for waste transfer
Plant and building maintenance, monitoring, laboratory, training	3,000	50,000	
Total costs per year	**68,000**	**1,264,000**	

The cost presented in table 10-11 is based on the year 2015. An increase of 5% per year is calculated for the following years.

10.3.3 Operation and maintenance costs for transfer station and composting facility in Taraclia

The costs cover the operation and maintenance of transfer station and composting plant including waste transfer from Taraclia to Cahul landfill

Table 10-13: Operation and maintenance costs for TS, sorting and composting in Taraclia in 2018

Item	Costs in EUR / year	Costs in MDL / year	Remarks
Personnel	28,000	510,000	
Electric power	3,000	50,000	

Item	Costs in EUR / year	Costs in MDL / year	Remarks
Water, waste water	3,000	50,000	
Transfer, sorting and com-posting vehicle	52,000	965,000	Inclusive costs for waste transfer
Plant and building mainte-nance, monitoring, laboratory, training	3,000	50,000	
Total costs per year	**89,000**	**1,625,000**	

The cost presented in table 10-12 is based on the year 2015. An increase of 5% per year is calculated for the following years

10.3.3.1 Operation and maintenance costs for landfill, compost and sorting plant in Cahul

Table 10-14: Operation and maintenance costs for landfill, sorting and composting in Cahul in 2018

Item	Costs in EUR / year	Costs in MDL / year	Remarks
Personnel	37,000	705,000	
Electric power	34,000	629,000	
Water, waste water	8,000	147,000	
Landfill operation vehicles	72,000	1,335,000	
Composting vehicles	24,000	436,000	
Sorting vehicle	16,000	293,000	
Plant and building mainte-nance, monitoring, laboratory, training	32,000	601,000	
Total costs per year	**223,000**	**4,146,000**	

The cost presented in table 10-13 is based on the year 2015. An increase of 5% per year is calculated for the following years

10.3.4 Total operation and maintenance costs

The operation and maintenance costs for all facilities in Cahul, Cania and Taraclia can be summarized to:

Table 10-15: Total operation and maintenance costs for the waste management system (for 2018)

Item	Costs in EUR / year	Costs in MDL / year	Remarks
Waste collection and transport	1,567,000	28,990,,000	Include both collec-tion/transport of re-sidual and separate-ly collected waste
Landfill, sorting and com-posting facilities in Cahul	229,000	4,237,000	
Transfer station and com-posting plant in Cania	67,000	1,240,000	
Transfer station, sorting and composting plant in Taraclia	93,000	1,721,000	
Total costs per year	**1,956,000**	**36,188,000**	

The cost is forecasted to the year 2018.

11 Socio-economic impact and gender aspects

11.1 Methodology and approach

This chapter incorporates the results of the pilot social and gender assessment of the SWM project in WMZ 3, DR South and the revised tools for social and gender assessment of similar projects. The assignment is based on both primary and secondary data. Primary data included the data collected through the focus group discussions and stakeholder interviews while the analysis of secondary data was based on statistical data, national and local development strategies, and other relevant studies and reports in the field).

The main scope of the assignment was to assess the social and gender dimensions of the SWM sector in WMZ3, DR South and to revise the tools for the social and gender assessment of similar projects. The objectives of the study are to:

- Analyse the social and gender situation in Moldova and in the project zone;
- Analyse the needs and priorities of beneficiaries by sex;
- Study perceptions of men and women regarding the potential impact of the project;
- Analyse stakeholders' capacities and needs to integrate the social and gender dimensions through the project preparation and implementation;
- Develop recommendations for the Social and Gender action plan; and,
- Revise the social and gender assessment tools for SWM projects based on their piloting in the field.

The assessment tools and selection of participants in focus group discussions and of key stakeholders. The main tools used for the assessment were: a) analysis of secondary data (data collected from the national department of statistics, different national and international studies and reports, local public administration first and second levels etc.); b) interviews with key stakeholders; and, c) focus group discussions with potential beneficiaries.

The localities for the assessment were selected based on the following criteria: a) type of locality (urban/rural); b) type of existing solid waste collection system (centralised, ring bell etc); and, c) potential landfill based/transfer stations based communities. Then the Consultant selected for the assessment two urban communities (Cahul and Taraclia) and two rural communities (Cania, Cantemir rayon and Zirnesti, Cahul rayon). The towns Cahul and Taraclia have mixed solid waste collection systems (centralised + door-to-door system), the village Cania has the door-to-door solid waste collection system and the village Zirnesti – has no solid waste collection system at all. According to chapters above, the landfill will be developed in Cahul and one transfer station in Cania village. Zirnesti locality is situated 20 km from Cahul city and is a potential beneficiary of the SWM system to be developed in the region.

The participants for focus groups were selected based on the following criteria: place of residence (urban/rural), sex (men/women), education status (high/low, welfare status (low, medium, high), type of housing (individual /flats).

Eight focus groups discussions were undertaken:

- **Urban areas** – four focus group discussions, including:
  - Two (one with men and one with women) - with low education and welfare status; and
  - Two (one with men and one with women) – with high education and medium to high welfare status that live in individual houses and flats.
- **Rural areas** - four focus group discussions, including:
  - Two (one with men and one with women) - with low education and welfare status; and
  - Two (one with men and one with women) – with high education and medium to high welfare status. In the case of rural communities, two focus group discussions were performed in a village with the solid waste collection system in place and another one in the community with no collection system at all.

A total of 69 persons (40 women and 29 men) participated in the focus group discussions.

The key stakeholders to be interviewed were selected based on the groups interested in the implementation of the project. In total, 14 key stakeholders were interviewed, including: the vice-president of Cahul rayon, two representatives of Cahul rayon council, the mayors of Cania and Zirnesti, the vice-mayor of Taraclia, the chiefs of municipal enterprises responsible for waste collection from Cahul and Taraclia rayons, the chief of Cahul ecological inspection, two representatives of the business community from Cahul, a doctor epidemiologist from Taraclia hospital, the Cania school headmistress, the Executive Director of “Contact-Cahul” NGO.

Key issues studied during the assessment

Interviews with the key stakeholders. The interviews with the key stakeholders were focused on the following issues: a) the interest of the organisation in the implementation of the project; b) the benefits of the organisation as a result of project implementation; c) the integration of gender dimensions in the activity of the organisation; d) the previous experience of the organisation in the implementation of projects requiring gender analysis; e) the existing capacities and the needs of the organisation for training in the integration of gender dimensions in development projects; f) the interest of the organisation to be involved in the preparation, implementation and ensuring the sustainability of the project; g) the level of correspondence of the project to the interests of beneficiaries (men and women); h) the impact of the project on different population groups; i) the social risks during the project implementation and the measures for their mitigation; n) involvement of community members (men and women) in the preparation, implementation and operation phases.

Focus group discussions. The following issues were discussed during the focus groups: a) the management of household waste and recycling (male and female responsibilities in the household waste collection and recycling, satisfaction with the existing waste collection and recycling system, problems with the existing waste management system, preferences in household waste collection); b) male and female roles in the management of community waste; c) the potential impact of the future waste management system on the community; d) male and female roles in waste collection; e) the quality of municipal services; f) male and female employment opportunities; g) gender differentiated access to services; h) the impact of land resettlement on the income of affected households; i) the impact of the new solid waste management system on scavengers; j) the impact of the project on the staff from landfill, and mitigation measures; and, k) male and female attitudes towards affordability and willingness to pay for the services.

11.2 Social and gender issues in Moldova and in project area

In this section, the main social and gender trends and characteristics for the Republic of Moldova, including the rayons covered by the project are presented. Despite the fact, that the National Bureau of Statistics has already started to collect some gender data, the consultant still faced barriers in finding adequate disaggregated social and gender data and indicators. Therefore, to complete the task, statistical data from different sources and national survey data were used.

Social-demographic trends. The analysis of statistical data shows that Moldova's population, including both men and women, is still in decline. In 2013, the population was 3,559,497 inhabitants (999 persons less than in 2011). In the project intervention area rayons – Cahul, Cantemir and Taraclia, the social demographic situation is slightly different. Thus, in the case of Cahul rayon, there was a small increase in the population in 2013 compared with 2011. In the case of Cantemir and Taraclia rayons, the population decreased (. The in-crease in the population in Cahul rayon arises mostly from internal mobility as well as a positive natural growth rate.

- Looking at the geographic distribution and gender composition, in 2013, some 42% of Moldova's population was living in urban areas and 58% in rural areas. In the project intervention area, 29% of the population was living in urban areas and 71% - in rural areas. The gender distribution of the population in the country has held almost steady for a long period of time, with small deviations: around 52% are women and 48% men. In the rayons where the project will be implemented, the gender distribution was: women – 51% and men – 49%. Some 47% men and 53% women live in urban areas and 50% men and 50% women – in rural areas (Statistica teritoriala, 2013).

The population continues to age, and this trend is characteristic for all rayons, including those in the project intervention area. The average age of the population increased from 36.5 years in 2011 to 37 years in 2013. In the DR South the average age of population is less compared to the average for the country, but continued to increase during the last years (from 35.6 years in 2011 to 36.1 years in 2013). The situation in the project intervention areas is the following: in Cahul rayon the average age of population increased from 35.3 years (2011) to 36 years (2013); in Cantemir – it increased from 34.2 years (2011) to 34.7 years (2013) and in Taraclia rayon – it increased from 37.2 years (2011) to 37.7 years (2013).

The average age of women (38.5 years) is higher than the average age of men (35.3 years). The same pattern is characteristic for the project intervention rayons: Cahul (men – 34.4 years, women – 37.8 years), Cantemir (men – 33.3 years, women - 36.0 years) and Taraclia (men – 35.9 years, and women – 39.4 years) (Statistica teritoriala, 2013).

Employment and gender. Moldova's economically active population has been in constant de-cline over the last decade. In 2013, it was about 1,235.8 thousand people. The activity rate of the population aged 15 and over was 41% in 2013, with higher values for men (45%) than women (39%). In the SDR, including the project intervention area, the economically activity rate constituted 34%. The economically activity rate for men was higher than for women (men – 35% and women – 33%) (Forta de munca in Republica Moldova: ocupare si somaj, 2014).

The employment rate of the population aged 15 and over was 39% in 2013, down to levels recorded in 2011 (39%). The employment rate for men was higher (42%) than for women (37%). The higher the level of education, the higher the employment rate is for both men and women. Thus, the employment rate for people with a university degree is higher than the employment rate among men and women with secondary education (men – 31% and women – 26%). In the SDR, the employment rate of population aged 15 and over constituted 32%, with higher values for men than for women.(Forta de munca in Republica Moldova: ocupare si somaj, 2014).

Analysis of employment activities by gender shows that there are significant discrepancies in the employment of women and men in different spheres. Thus, women are mostly employed in health, education, social protection and public administration (70% women and 30% men), in hotels and restaurants (58% women and 42% men). Men are mostly employed in construction (91% men and 9% women), transport and communications (76% men and 24% women), industry (54% men and 46% women). (Forta de munca in Republica Moldova: ocupare si somaj, 2014). The same pattern is also characteristic for Moldova as a whole.

Women are mostly employed in low-paying jobs and occupy lower positions in the job hierarchy where they are employed. Women are dominant in the group of specialists with higher levels of qualification (64% women and 36% men), in the group of specialists with medium qualification (67% women and 33% men), in the group of workers in services, trade (62% women and 38% men). In contrast, men predominate in the group of managers and senior officials (61% men and 39% women), in the group of qualified workers (72% men and 28% women) (Forta de munca in Republica Moldova: ocupare si somaj, 2014). According to a survey done by the National Bureau of Statistics in 2013, 81.5 thousands of women comparatively with 16.5 thousands of men manifested the willingness to change their employment situation in order to take advantage of both their capacities and qualifications (Forta de munca in Republica Moldova: ocupare si somaj, 2014).

The average unemployment rate in the Republic of Moldova decreased in 2013 compared to 2011 from 6.7% to 5.1%. The unemployment rate for men (6.0%) is higher than the unemployment rate for women (4.1%). In the SDR, the average unemployment rate constituted 5.6%, with higher values for men (6.9%) than for women (4.2%) (Forta de munca in Republica Moldova: ocupare si somaj, 2014).

Income and gender. The average monthly income per capita in Moldova increased from MDL 1,189 in 2008 to MDL1,509 in 2012. Regional analysis of monthly income per capita reveals significant differences. The income per capita in Chisinau exceeds the overall country average by 1.4 times. In the SDR, the monthly income per capita was with 17% less than the average in-come per country and constituted MDL 1,247 in 2012 (Statistica teritoriala, 2013).

Salaries continue to be the main source of income for households in all regions of the country (43% in average), but there are big differences between regions. Thus, in Chisinau salaries constitute 64% of income compared with 33% in SDR. The contribution of social benefits to total income increased in recent years (from 15% in 2008 to 19% in 2012) and shows a greater de-pendence of the population on the social protection system. By region, the contribution of social benefits to income is highest in NDR (23%), followed by the SDR (22%) and by the CDR (20%). In Chisinau municipality, social benefits constitute 14% of income.

Transfers from abroad constitutes in average 16% of income. In Chisinau municipality, remittances form 6% of income, while in other regions they constitute a fifth. The SDR is considered the most vulnerable in this sense, with 21% of income from remittances.

Poverty and gender. According to recent GoM data (Nota informativa: saracia si impactul politicilor, 2013), in 2013 poverty in all parts of the country has decreased. In South the poverty rate was 19%, in Centre – 17%, in North – 13% and in Chisinau municipality – 2%. The poorest households are those employed in the agricultural sector (31%), people living on pensions (15%), households with three or more children (35%), households headed by persons with primary and incomplete secondary education (24%). There are no essential differences between the welfare of households headed by men (13%) and by women (12%).

Education and gender. The statistical data shows that during the last decade the differences in enrolment of boys and girls in general secondary education have fallen. Men represent the majority of students enrolled in secondary vocational education. Women represent 56% of university students and over 55% of college students. There are gender discrepancies at the level of specialities; significant feminisation of the teaching staff (over 80%). Even though women constitute the majority in the education sector, men still hold the high-ranking positions. Exclusive domination of primary education by women confirms that there are stereotypes, according to which women are those who must educate and take care of children. It is also worth mentioning poor remuneration in education and the exodus of teachers abroad. (The National Strategy on Gender Equality (2009-2015), 2008).

Health and gender. Despite substantial measures undertaken within the last few years to im-prove health, there are still a number of economic and social problems that affect the health of the population. Thus, women from rural areas have more limited access to quality reproductive health services, which increases the magnitude of health problems. One of the problems that seriously affects maternal health is the high frequency of abortions, the majority being done by outdated methods or in unsafe conditions. Maternal mortality is still a priority issue. Social dis-eases are in the foreground as well. Addictive behaviour, namely alcohol abuse, constitutes a health and social problem of increasing importance, which, according to WHO, is the most important risk factor out of the 10 identified in Moldova (The National Strategy on Gender Equality (2009-2015), 2008).

Social protection and gender. The number of pensioners in Moldova continued to increase during the last five years (from 621,400 in 2008 to 649,909 in 2012). Some 24% of retired per-sons are still employed. The average size of age retirement pension is continuously growing and it reached MDL 987 in 2012, 1.5 times higher than in 2008. (Statistica teritoriala, 2013). However, the living standards of pensioners remains below average living standards. The pension received by men is, on average, 18% higher than that received by women, because of the existing disparities in the average salaries of men and women (Femei si Barbati in Republica Moldova, 2012). The regional differences are also maintained for pensions in favour of Chisinau municipality, where the average pension (MDL1,252) is 25 per cent higher compared to the other regions of the country (South – MDL 898 lei; Centre – MDL 896, North – MDL 948).

The estimated total number of people with disabilities in Moldova is 184,300 people, including 14,000 children aged 0-17 years. In the last 5 years, the number of people with disabilities has increased by 3.8%, and for children it has decreased by 7.9%. People with disabilities represent 5.2% of the total population and children with disabilities constitute 2% of the total number of children in Moldova. On average, per 100,000 inhabitants aged 18 years and above, there are 443 people with disabilities. Regarding the children with disabilities, per 1,000 children aged from 0 to 17, there are 20.4 children with disabilities. Almost every seventh person with disability falls into the category of persons with severe disability (Statistica teritoriala, 2013).

Referring to the development regions, the rate of disability among children is higher in North (22 children with disabilities per 1,000 children), followed by the Centre (21 children) and South (19 children). In the project intervention area, the rate of children with disabilities is higher in Taraclia rayon (27 children), followed by Cantemir (21 children) and by Cahul (18 children). The rate of disability among adults is higher in the Centre region (488 persons per 100,000 inhabitants), followed by North (470 persons) and by South (326). In the project intervention area, the disability rate is higher in Taraclia rayon (583 persons), followed by Cantemir (472) and by Cahul (416) (Statistica teritoriala, 2013).

Despite the fact that the access of households with persons with disabilities to the main facilities increased during the last few years, these households remain disadvantaged in terms of the level of equipment and housing comfort. Thus, only 56% of households with persons with disabilities compared to 57% of regular households have piped water; the bathroom inside the house is available to 34% households of persons with disabilities compared to 39% of regular households; In the rural areas, the situation is even worse: only 36 % of households of persons with disabilities have access to piped water and only 12% have toilets in the house.

Based on the analysis of gender dimensions in the Republic of Moldova, we can conclude that despite the adoption of the legal and regulatory framework with regards to ensuring gender equality, and the relatively high ranking of Moldova in Global GAP Index 2013 (52) (Gender GAP Report 2013), the country still faces many problems in its practical implementation in the country, including employment inequalities, under-representation of women in decision-making positions, discrepancies between the salaries of women and men, the engagement of women in unpaid care of the elderly, children, and the sick, gender discrepancies in retirement, etc. **Given this situation, the social and gender mainstreaming must be one of the main requirements for the implementation of development projects with donors support in Moldova.**

11.3 Social and gender assessment of the project

11.3.1 Beneficiaries needs and priorities by gender

This section summarises the needs and preferences by gender relating to the management of household waste and recycling, management of non-residential waste, needs and priorities for waste collection, concerns about the landfill, transfer stations, employment and willingness to pay. Data and information were collected from consumers through focus group discussions and key informants. Each section includes a box in the end with voices from male and female interviewees.

Management of waste in households. More than 80% of men and women from the project intervention area consider that the management of the waste in households **is in general a female task.** That means that, in the majority of households, women clean and collect the waste and are responsible for taking it to the collection point.

There are some differences in cleaning and collection of the waste between people living in urban and rural areas. Thus, in the case of people living in urban areas in flats, in 1/3 of cases, the women share with men the responsibility for collection of the waste and for taking it to the collection point (to the waste chutes or container). In the case of people living in rural or urban areas in houses, women are mostly responsible for cleaning and collecting the waste in the house, and men are mostly responsible for cleaning and collecting the waste outside the house – in the garden.

If in the community there is door-to-door system for waste collection, in the majority of cases, the women take care of bringing the waste to the lorry. Men rarely perform this task and usually, only when the waste is heavy. In communities that do not have a waste collection system, the men are mostly involved in finding transportation or using their own car to carry the waste to the dumpsite or somewhere outside the community. Even in those cases, women play the main role in reminding them about the need to take away the waste. In households where women are the main income-earners, and men are unemployed or have a part-time job, the responsibility for taking out waste is passed to the men.

Box 1. Voices: managing household waste

- “Usually women take care of cleaning and collecting waste. But men are involved in loading the waste in the car. In general, women worry mostly about everything, they take care of children” (Female, key informant, public sector).
- “Women mostly take care of the cleanliness of the house and of the yard. Men work hard all day long. In the evenings they usually watch TV or play computer games. In 80% of house-holds, the waste collection is the women’s job.” (Female, FG, Cania, Cantemir).
- “This is women’s task. We like men to be involved, but they are too lazy. They would rather prefer to stay with friends, to drink wine or to watch TV than taking care of the waste”. (Female, FG, Cania, Cantemir).
- “In the majority of cases, my wife tells me to take out the waste. My job is to find a tractor or car and to transport the waste to the dumpsite” (Male, FG, Cania, Cantemir).
- “I have a disability pension and work occasionally. My wife works every day. She earns 2,000 lei per month. That is a small amount. But in our community to find a job is a problem. I take care of the waste collection and evacuation” (Male, FG, Cania, Cantemir).

Waste collection. In the project intervention area, there are different forms of waste collection: bring system, waste chutes, door-to-door system and collection and evacuation by the households themselves. The waste chutes is mainly used in Cahul town in multi-storey houses (10% of the population use this system). The waste chutes are integrated into houses.

As per the focus group discussions, the waste chutes in the past seems to have been the preferred way of waste collection for the persons living in multi-story buildings due to the fact that this system allows the possibility of throwing the waste in the waste chutes from all floors, the waste chutes do not require somebody to carry the waste to the containers in the streets and the bunkers can be easily used by children, the elderly, and persons with disabilities. However, women in focus group discussions were worried about the sanitation conditions in houses with the bunker system. They reported bad smells, particularly in the summer time, rats and other rodents. In more than 50% of houses using waste chutes, occupants asked the authorities to close the bunkers and install containers because of insanitary conditions. Both men and women in focus group discussions were against bunkers being installed during the implementation of the new project. However, some retired women said that they would agree with bunkers if the waste collection and transportation is done every day and if people living in the houses change their attitudes and keep the area around the bunker and waste pipes clean.

The majority of the people living in flats, both men and women, now agree that the bring system is best for waste collection in urban areas. However, more than 2/3 of women participants in focus group discussions said that they are not satisfied with the present system of waste collection in containers, mentioning reasons like: not enough containers; the waste is collected only 5 days a week, but the majority of people do their housework during the weekends and the containers are usually overfilled on these days; the containers are not cleaned at all, are very dirty and especially women do not like to open them and to touch their covers and they leave the waste near the container.

Sometimes the containers are placed too far from the houses, and for women, children and the elderly it is difficult to transport the waste to the containers – in some cases, people just throw the waste out the windows. People from neighbourhoods that do not like to pay for waste collection often bring their waste to the containers in other areas. In several cases, the authorities changed the place of the containers to avoid their use by the neighbourhood households that do not pay for waste collection - the waste was then thrown in the previous place and nobody collected it for many months. Often the population throws in the containers both municipal and non-municipal waste, like construction waste, dead animals etc. Men worried about a lack of transportation: the containers are loaded manually into lorries, and the loaders (usually men) are exposed to the risk of contracting diseases. Regarding the type of containers (metal or plastic) they would like to use, the majority of them said that the metal container is more durable, as the plastic containers are frequently burned. Although there was a preference for containers, because of these problems, the majority of the those present in focus group discussions - men and women - scored the container system with the mark of two to three on a ten point scale.

When asked how they envisaged the new improved system of waste collection, both men and women said the following: to have metal containers with no cover or with footswitch to open them; to increase at least twice the number of containers; place the containers as much as possible near the houses; surround the area with the containers with the access of only the sub-scribers to the service; collect waste 7 days per week; clean the containers with disinfectant at least two times a week; buy lorries with an automatic loading system; work with the population to change their attitudes regarding waste collection; establish a complaints system; sanction persons who throw waste everywhere and do not keep the area clean.

The door-to-door system is preferred in single-story buildings and suburbs with narrow roads, in remote urban areas, and in villages. However, some men from the villages would prefer the bring system. The focus group participants benefiting from this type of service told us that they are not satisfied at all with the current door-to-door system due to the following factors: waste is collected once a week and, especially during the summer, there is a bad smell in the households and on the streets; there is no fixed time when the lorry comes and there is a need for somebody to stay at home and waste time, waiting for the lorry; sometimes the loaders are absent and the people load the waste themselves – this is a problem for women and the elderly.

Focus group participants scored the existing door-to-door system of waste collection with only one to two on a scale of ten points. However, both men and women agreed that the ring bell system still remains the best solution in remote areas and in the villages with narrow or poor quality roads: waste collection lorries are not able to access these areas. Additionally, women told us that the door-to-door system helps them to keep the village clean – they put the waste in the streets only on the days when the lorry is coming; with the container system, there is always the risk of a lot of waste lying in the streets, especially if the waste is not collected every day. The majority of female focus group participants said that nobody in the village allows the authorities to install the containers near their houses and that can be a problem. However, around 20% of men, especially those that worked abroad for some time, supported the idea of instalment of the containers on their street and even near their houses with the condition that the waste will be collected every day. Another condition will be to work with other people from the neighbourhood to make them understand the importance of payment for waste collection – because every time there is a risk that they will put their household waste in containers and will avoid paying for waste collection. The population benefiting of the ring bell system of waste collection would prefer that the waste is collected at least twice a week, at a fixed time, and that the waste is loaded in the lorry by the special loaders.

As mentioned above, in the majority of the villages, and in at least 30% of urban areas (suburbs mostly) the population take care of waste collection on their own. This includes: burning paper, leaves, plastic bags; throwing away in the streets the construction waste; and using manure as fertilizer etc. Focus group discussions revealed that the informal burning of waste in lieu of effective waste management is often undertaken by women and girls who are put at risk of inhaling toxic particularities. The waste that cannot be burned or reused, like glass, metal, pampers, some animal waste, is evacuated once every two to three months from households. For this purpose, 2/3 of these households rent a car or a tractor and transport the waste somewhere outside the community – at the existing dumpsite or just throw it in ravines or on rivers banks. Around 1/3 of this population, and especially single women, the elderly, and the poor do not have money to rent a car and deal with the garbage as they can – throwing in neighbours' gardens, on streets, in derelict buildings, and in ravines.

Box 2. Voices: waste collection

- "I deal with it on my own. We burn the paper and the plastic bottles, some of the leaves we use as fertilizers, and some of them we burn. For the other garbage – just a little that remains, we hire a transport once in three months and transport it to the dumpsite…" (FG, woman, Cania).
- "In our village a lot of people burn the plastic, the manure, the leaves. I have asthma and that is suffocating me and other people like me, but nobody care…" (FG. man, Cania).
- "The pampers are one of the big problem, they do not burn and people just throw them in the ravines – the community is very dirty…" (FG, man, Cania)
- "We are not so satisfied with the door-to-door collection system - they collect the waste once a week, but it needs to be done more frequently, especially in the summer time when the waste smells bad" (FG, woman, Cahul).
- "The loaders of the waste in the truck – they are very dirty. They load the waste manually – they risk their health and also can be a source of infection for us. The administration needs to buy trucks with automatic container loading" (FG, man Taraclia).
- "A lot of people in our town put waste on the bank of the river; this is just near my house. I and my family often have to clean the river bank, because of the bad smell in our household. It would be good if somebody can ask people why they are behaving like that" (FG, woman, Taraclia).
- "The containers are very dirty, the women do not like to touch the covers and open them; the majority of containers do not have covers – they are broken off. We would like the containers to have covers, to be cleaned with solutions once a week, and to have a switch pedal" (FG, woman, Cahul).
- "We have eight multi- stories houses, several shops, several administrative buildings and only six containers. In the night, people from the neighbourhood houses bring construction waste to our containers. The waste is transported five days a week. On Monday, the place looks very dirty with a lot of waste thrown around. There is a need to do something, at least to install more containers" (FG, man, Cahul).
- "We would prefer the metallic containers- they are more durable. We had the plastic ones – bad guys burned them" (FG, men, Cahul).

Separate waste collection. Both men and women from urban areas consider that separate waste collection is a very good thing but they would like to be remunerated for it somehow, like in other countries. The elderly women from Cahul town told us that they would separate the waste even if there was no remuneration. They remembered "the good Soviet time" when paper and cartons were collected in a centralised way. However, the women told that not all the people would separate paper, plastic bottles and other waste. In a pilot project in Cahul rayon containers were installed for the separate collection of waste, but it did not work: the containers were burned or stolen and people put the waste all together. The women think that the population was poorly informed and they did not understand the importance of waste separation. Both men and women were worried about the lack of collection points for used batteries, mercury lamps, and old mobile phones.

In rural areas, women told us that they use paper and cartons to light the fire. Regarding plastic bottles, some of them are reused in the households for milk, oil, water. However, many bottles are thrown out and if somebody collects them, women and children, especially from vulnerable families, will be happy to make some additional money.

Box 3. Voices: Separate waste collection

- “We need to have separate containers then people will select the waste. The containers for plastic need to have small holes, just for the plastic bottles, otherwise, people will throw other waste like animal waste” (FG, man, Cania).
- “In the Soviet time, rugs, and waste paper were collected separately. Today, all those things go together with other waste in containers, I think this is not a correct way to do it. (FG, man, Taraclia).
- “People will not separate the waste just for free. It would be good if they will be remunerated somehow for separate collection, like it was before…” (FG, man, Taraclia).
- “We need to have separate collection points for waste paper, cardboard, metal and rugs. And the population needs to be informed where those points are” (FG, woman, Cahul).
- “I know a man that collects cardboard from the shops and sells it. Moldova does not have too many forests; we need to do something to collect and to recycle waste paper” (FG, woman, Cahul).
- “We have in our yard a container for plastic bottles. Before, people used it just for that, but now, the covers are broken and people put in all the waste without any selection” (FG, woman, Cahul).
- “I lived in Germany for several years, returned home and started to separate the waste in different bags. But I saw that the loaders anyway throw the garbage all together in the car and I stopped separating the waste. To change the situation in the whole country, there is a need for every person to separate the waste in the yard.”(FG, man, Cahul).

Waste landfill. Focus group participants, both men and women, worried about the existing dumpsites: the majority of them are not authorised; some of them are placed close to localities (in Cania), with no access roads (in Cahul and Taraclia during the winter time and when raining the transport cannot reach the destination), no water and sanitation facilities for workers, no electricity, a bad smell, a limited number of transportation, no cars with automatic waste loading and unloading, a limited number of containers, no fence and, no protection from wind (the paper and plastic bags fly everywhere).

Men and women from urban and rural areas have very limited information about the content of the solid waste management project and the landfill/ transfer stations to be developed. Some of them, especially in Cahul and Taraclia, thought that the project is about the construction of the sorting plant and started to protest against it, worrying about their health and the health of their children. They told us that several years ago, there was a proposal to build a sorting plant in their area and they protested against it. After they got the information about the content of the project, they agreed with the idea to develop the landfill and the transfer stations (the landfill – in Cahul and the transfer stations – in Taraclia and in Cania, Cantemir). People said that the locations for the landfill and the transfer stations are situated far from the communities and there is a limited risk for the transmission of different infections. They expressed their willingness to close all the existing dumpsites and to have a modern landfill and transfer stations: well equipped with automated transport and other needed equipment, with water and sanitation. The men from rural areas, especially those that do not have a permanent job, hoped to find new jobs when the new solid waste management system is in place.

Box 4. Voices: waste landfill

- "We had a dumpsite in Iepureni. It is not authorised and it is very close to the houses. The whole village is covered with plastic bags, there is a bad smell, the population several times complained to different authorities asking for the dumpsite to be closed. We hope that the project will be a good solution" (Key informant, woman, Cania).
- "The new system will contribute to cleanliness in our village and to reducing pollution. Our village is very dirty." (Key informant, woman, Cania).
- "There is a need for a good, modern landfill in Taraclia, with access roads. Our old dumpsite does not correspond to ecological norms and standards; there is no access road" (Key informant, man, Taraclia).
- "We have a lot of people that do not like to pay for waste collection and transport the waste to the dumpsite on their own. They do that in the night, so as not to be seen, and the majority of waste is thrown on the land around the dumpsite. The new system of collection will help us to stop this practice" (FG, woman, Taraclia).

Willingness to pay. The assessment shows that the tariff for collection of solid waste management varies from rural to urban areas and with the type of household. For the population in urban areas (Cahul, Cantemir and Taraclia), the tariff varies from MDL 5 person/month in Tvardita to MDL 15 person/ months in Cahul. The people that live in private houses pay more than the people that live in multi-story flats. Thus, in case of Cahul, people that live in multi- story flats pay MDL 11 person/ months and people that live in private houses pay MDL 15 person/ month. In Taraclia, people that live in private houses pay MDL 20 household/month and people that live in flats – pay MDL 15 household/month. In rural areas, the tariff level varies between MDL 5 person/month in Baimaclia to MDL 10 person/month in Cania. In Cociula and Gotesti the tariff is set up per household around MDL 13 and MDL 15 MDL per month. (Report on Current situation regarding municipal waste management in Waste Management Zone 3, SDR, 2014).

In both rural and urban areas, the current tariff does not cover all the expenses needed for the sustainable maintenance and development of the waste management system. The local public administrations from both rural and urban areas are in charge of supporting financially, or in kind, the current waste management systems.

Despite the fact, that it is thought that there will not be affordability challenges for the average households (the most tariffs constitute less than 1% of average income per capita in WMZ 3, DR South), the analysis highlights the issue that there are serious affordability concerns with the lowest in-come households. Such households include: households with more than three children; households headed by women; households with retired persons; households that have at least one person with disability. Women in rural areas with the lowest incomes said that for their families to pay MDL 10 person/month for the collection of solid waste it is a burden now. The affordable price for them is MDL 5 person/month). Retired single women from urban areas are also very concerned with the high price for the waste collection and suggested that the local public administration establishes a commission and assesses the quality of life of vulnerable groups, including pensioners. They expect the local public administration to adjust the price based on the level of income. The focus group discussions show that currently there are a large number of low-income households that do not pay for waste collection and any attempt to increase the tariff will be a challenge for many people and will increase the number of people not paying.

Men from rural areas were dissatisfied with the level of transparency of the local public administration regarding waste collection. For example, in Cania, people said that LPA increased the cost for services without public consultation. Moreover, people do not have any contract with the mayoralty for service delivery and do not receive any receipts that confirm their payments. Also, they want to be informed how, and for what purpose, the collected money is spent.

However, both men and women with average incomes from urban areas, said that the existing tariff for waste collection is affordable for them and if the quality of service improves, they agree to pay more (10-20%).

Box 5. Voices: willingness to pay

- " 95% of my family income comes from my and my wife's salaries (2300 MDL per month). We have two children. We need to pay for electricity, water, heating, education, and food – and we cannot afford to pay for the collection of the waste." (FG, man, Cania).
- "I have a big family and I need to pay 10 lei per person per month. That is too much for my family." (FG, woman, Cania).
- "We do not have contracts with the mayoralty for services. People pay based on the list. Nobody knows where this money goes" (FG, man, Cania).
- "To rent a car on our own and to transport the waste is more expensive than to pay 10 lei per person per month. A rented car costs 100 lei" (FG, man, Cania).
- "20 lei per household for pensioners is too much. Half the population of Taraclia do not pay for waste. They take care of waste on their own." (FG, woman, Taraclia).
- "I am single and paid in the past 10 lei. Now the tariff is 20 lei per household - that is very expensive for me." (FG, woman, Taraclia).
- "There is a need to change the legislation - people need to be forced to pay for waste col-lection." (Key informant, Cahul).
- "Our people do not understand that the quality services cost more money. All our services are at the subsistence level and the tariffs have to be adjusted." (Key informant, Cahul).

11.3.2 The perceptions of men and women regarding the impact of the project

Both men and women consider that, as a result of project implementation, the whole population will benefit. The project will have a positive impact on the following:

- The quality of land, water and air will improve;
- The health of the population, and particularly of children, will improve;
- Communities will became cleaner;
- Unemployment will decrease and more new jobs will be created;
- Communities will became more attractive from the touristic point of view and new businesses will be developed;
- The efficiency of the solid waste management system will increase;
- There will be more transparency in solid waste management system;
- The collection of waste will improve; and,
- Waste will be collected selectively and the people, especially the vulnerable, will get a possibility to be remunerated for the separation of waste.

However, both men and women said that the implementation of the project can cause social problems and social conflicts in communities, including the following:

- Vulnerable groups (pensioners, single women, households with many children, households with persons with disabilities) will still have limited access to waste collection services, because of limited financial resources;

- Beneficiaries will not be willing to pay an increased tariff for waste collection. They do not understand the tariff, or the factors that influence the tariff calculations;
- The majority of households from the suburbs, and from rural areas, will refuse to sign the contract for waste collection because of the need to pay for services and the lack of in-formation regarding the positive impact of the project on their health;
- Closing the dumpsites, the scavengers, predominantly men, will lose their income based on selling waste (plastic, metal, glass, etc.);
- The limited possibilities of local people to get jobs during the development/ construction process. Sometimes the companies employ the persons even for the non-qualified jobs from outside the beneficiary communities;
- The development of new management units will contribute to the development of new jobs. There is a risk that qualified persons, especially women, will have limited opportunities to apply for the new jobs. The selection could be done in a non-competitive way, based on relationships with the local public administration.

To avoid the social conflicts and risks, the participants in focus groups suggested the following measures:

- Information given to Project beneficiaries regarding the content of the project, the impact and the risks;
- Consultation of all problems regarding project development and implementation with the community members, including women;
- Support the development of small community initiative groups in each beneficiary com-munity with the involvement of men and women that will serve as a complaint mechanism for the local beneficiaries and meantime will monitor the processes related to project development and implementation. The LPA will then become more accountable to local people;
- Finding ways of supporting vulnerable families, including single women, households with persons with disabilities, and households with pensioners to improve their access to improved waste collection services. In this regard, the LPA can support the connection of the vulnerable households to the service through the Local Fund of Population or through the social provision. One of the ways can be to support those persons to get a job, including during the project implementation;
- Encourage the selected construction firm to hire more local people for the unqualified job during the project implementation;
- Require the local public administration and the Project Implementation Unit to hire the specialists on a competitive basis, by encouraging the women to apply for the announced positions;
- Organise public health information events for the population with the scope of increasing their knowledge regarding the impact of modern solid waste management systems on their health. Encourage more women to participate in those information events with the scope of their further involvement in local community awareness activities related to project implementation and sustainability.

11.3.3 Employment in waste management

This section outlines the current formal and informal employment opportunities for women and men and how they are likely to be affected through the project.

Waste management services. According to the data provided by the local public administrations, in the WMZ 3 there are 15 waste management services.

In all 15 WM services, 257 persons are employed, 72 % of which are men and 28 % - are women. Around 22 % out of the total number of employees are involved in administration and 78 % in other activities.

Table 11-1: Distribution of employees per WM services, number

Operator	Total number of employees	Women	Men	% of women to total staff	Administrative staff	Other categories
ME Cahul	98	43	58	44%	21	77
Primaria Manta	3	-	3	0%	-	3
ME Cantemir	20	1	19	5%	4	16
ME Codrii Cociuliei	2	1	1	50%		2
ME Prosper Gotesti	2	-	2	0%	-	2
ME Baimac-Serv	1	-	1	0%	1	-
ME Primcan	2	1	1	50%	-	2
ME Colser Servicii	7	1	6	14%	3	4
ME Tvardisan	26	5	21	19%	2	24
ME Apa- Canal Taraclia	24	10	14	42%	5	19
ME GCL Ceadir-Lunga	23	3	20	13%	5	18
ME Supacservice	13	2	11	15%	5	8
ME Temiz SU	16	1	15	6%	4	12
ME Tomai Berecheti	8	1	7	13%	2	6
ME GCL Vulcanesti	12	4	8	33%	4	6
Total	**257**	**73**	**187**	**28%**	**56**	**199**

Source: Elaborated by GIZ/MLPS

In 20 % of enterprises, there are no women employed in waste management services, in 47 % of enterprises employed women comprise 5% to 19%, in the remaining 33 % of enterprises, women constitute from 40 to 50% of those employed.

The analysis of the employment of women in waste management enterprises shows the following tendencies:

- The majority of women are employed in two positions: women work in administration and as street sweepers. There are some differences in female employment in WM services between rural and urban areas. Thus, in the case of enterprises functioning in rural areas, women in 100% of cases are employed as accountants. In the case of enterprises functioning in urban areas, more than half of women are employed as sweepers, around 35%-40% - in administration positions and the rest (from 5% to 8%) – in other activities. For example, in the case of Cahul municipal enterprise, women constitute 44% of the total workforce; 58% of them are employed as sweepers, 34% of them in the administration and the other 8% in other activities. In the case of Taraclia municipal enterprise, women constitute 42% of total employees: 50% of them are employed as sweepers and the other 50% in the administration;

- Women make up more than 90% of sweepers (in Cahul and Taraclia they constitute 100%). According to key informants, this is a typical task for women. Regarding men, the majority of them are employed as drivers, watchmen, loaders, locksmiths;
- Women represent about 60% of the workforce in administration (accountants, human resource specialists, public relations etc.), but all decision-making positions (director, chief engineer etc.) are occupied by men;
- As per the key informants' opinion, there are no differences between men and women's salaries if they occupy the same positions, but due to the fact that the majority of women work in lower paid positions, their salaries are usually less.

Private enterprises for waste separation. In Cahul there are two private enterprises for waste separation: "Romconsjur" and "Вторсырье". "Romconsjur" is subcontracted by Cahul Municipal Enterprise to separate the waste at the landfill and has 7 employees, all of them are men. "Вторсырье" is collecting plastic, cardboard, batteries directly from the enterprises and has 6 employees; also, all of them are men. The employees at the both enterprises are paid per kg of collected waste (MDL 1 per kg of plastic, 50 bani per kg of cardboard) and their monthly salary is on average less than the minimum salary. This work is considered to be very dirty and women do not wish to be employed in waste separation.

11.4 Stakeholder Analysis

Social and gender mainstreaming requires identification of project stakeholders with the aim of including them throughout the project cycle. The stakeholders are individuals or groups with a direct, significant and specific interest in the project, who can be either positively or negatively affected by the project outcomes. The main goal of the stakeholder analysis in this assignment was to identify the stakeholders in the preparation, development and implementation of the SWM project from WMZ 3, to examine their perspectives on gender issues and consider whether, and how, they can be involved in supporting the integration of social and gender dimensions through the project cycle.

11.4.1 The Project stakeholders and their role in the project

The main project stakeholders are:

- Donors, lenders, project team:
  - Potential donors;
  - The GIZ project team.
- Central and local government:
  - Ministry of Regional Development and Construction;
  - Ministry of Environment;
  - Regional Development Agencies;
  - Local Public administration/rayon councils;
  - Local primaria;
  - Ecological Agency of the rayon;
  - Municipal enterprises for WM;
  - Enterprisers for Waste separation.
- NGOs:
  - Contact Cahul;

  - Centrul Pro-European;
  - Asociatia scoutilor;
  - Agentia de Cooperare transfrontaliera;
  - Asociatia Pro-lumina;
  - Asociatia Perspectiva;
  - Other local NGOs.
- Local population:
  - Local population from Cahul rayon;
  - Local population from Cantemir rayon;
  - Local population from Taraclia rayon;
  - Local population from Vulcanesti rayon;
  - Local population from Ceadir-Lunga rayon.

Donors, lenders, project team. Their role consists in providing grants and technical assistance for the implementation of SWM projects. They would have a great interest in successful project implementation within the planned timeframe and budget. All donors have requirements regarding gender mainstreaming in the SWM project, targeting at promotion and ensuring of gender equity.

The GIZ technical team and has the objective of supporting the Ministry of Regional Development and Construction to develop the Integrated Strategy for Solid Waste Management, to pre-pare the Ready to Go Projects, and to help to find potential donors to support project implementation. GIZ has an interest in developing the capacities of both the RDA and local public administration for the preparation, fundraising and implementation of viable projects in SWM. GIZ also has interest in gender mainstreaming throughout the SWM Project cycle.

Central and Local Government. The Ministry of Regional Development and Construction (MRDC) is the authority responsible for the correct use of financial resources, procurement and handover of goods, services and works, and coordination and monitoring of project implementation. The MRDC is interested in the development of a modern solid waste management system. Gender equality as a strategic aim is not an objective supported directly by the MRDC. However, due to the both Moldovan legal framework and donor requirements regarding gender dimensions, the MRDC is likely to support gender mainstreaming through the project cycle.

The Ministry of Environment, like the MRDC, is involved in coordination and monitoring of project preparation and implementation through the working group. The Ministry of Environment is interested in the development and implementation of projects with a positive impact on the environment. Gender mainstreaming is not likely the main priority of the ministry; however, it is supportive of promoting gender equity, if it is for the best interest of the project.

The Regional Development Agency is the authority responsible for co-ordination of project design. Its role is to coordinate project planning, the procurement procedure, the construction works and the intermediary and final handover of the construction works. Key informants said that the RDA would be open to the implementation of infrastructure projects that took into account gender dimensions.

The local public administration/rayon council is the primary beneficiary of the project. Its role consists of involvement in project development and implementation through the participation in the working group. The rayon council is responsible for the monitoring of the implementation of the construction works. The rayon council is interested in the development of a quality solid waste management service in accordance with the population needs, in the development of new jobs, in improving the health of the local population, and in getting economic benefits as a result of project implementation. The rayon council has limited knowledge and understanding of gender issues, but if the donors require mainstreaming gender aspects into the project, and if they get training in this field, they would comply with the requirements to get financial resources for waste management.

The local *primaria* is the final beneficiary, that is in charge of the preparation of all documents for approval of the landfill (Cahul primaria) and transfer stations (Cania and Taraclia primaria), starting with the construction works and for the ensuring the timely implementation of the project activities. The local *primaria* do not indicate any understanding and interest in gender main-streaming in solid waste management projects.

Rayon Ecological Agency – is an organisation involved in the coordination of project documents, including the decisions on the development of landfills and transfer stations. The Rayon Ecological Agency will be involved also in monitoring the correspondence of the construction works to the ecological requirements and in handover. The Agency is interested in the improvement of the rayon ecological situation and in making sure the construction works comply with ecological requirements. They expressed no interest in gender mainstreaming and in the promotion of gender equity and have limited capacities in this field.

Municipal enterprises for waste management (15 entities) are not directly involved in the project. However, they have an interest in project, expecting an improvement in working conditions, the application of new techniques, the procurement of new containers and cars etc. They expect to have more new well-paid jobs at the landfill. They have limited knowledge about the project con-tent and their role in the project and no gender interest and knowledge.

Enterprises for the waste collection were not involved at all in the project development, have limited knowledge regarding the content of the project, expect to get more economic benefits as a result of project implementation and have very limited interest and knowledge regarding gen-der mainstreaming.

NGOs. In the project intervention area, there are several NGOs active in community development and social issues: Contact Cahul, Centrul Pro-Europa, Asociatia scoutilor, Agentia de cooperare transfrontaliera, Asociatia Pro-Lumina, Asociatia Perspective etc. As per the discussions with key informants, Contact – Cahul is the most pro-active NGO in the social and com-munity development field. Contact Cahul was involved in the development of Regional Development Strategies and in the development of the component related to solid waste management. In the SWM project, the NGO does not yet have any role or responsibilities. The NGO staff have some knowledge in gender dimensions and promotion of gender equity, being involved in the implementation of several projects that have an integrated gender component. However, they need more training in gender equity.

Each local public administration in the area shall approve the participation to the project through a local council decision.

The population of Cahul, Taraclia, Cantemir, Vulcanesti and Ceadir-Lunga rayons will be in-formed regarding the project during the EIA procedure. The population has little awareness of gender equality.

11.4.2 Stakeholders' capacity to support gender equality

Donors, lender, project team. Stakeholder analysis shows that the donors and lenders have great interest in social and gender mainstreaming in the project cycle. GIZ, EU and SIDA have social policies related to gender mainstreaming and requirements to project developers and implementers to mainstream social and gender aspects into the project cycle management. The GIZ technical team has a cross-cutting gender consultant who is responsible for the integration of gender dimensions in projects. Some of the GIZ technical team staff have some expertise in social and gender dimensions acquired through their past working experiences. However, the majority of them need further training on how to integrate gender dimensions into different types of infrastructure projects, including SWM projects.

Central government. As per the discussion with the Head of the Department for Equal Opportunities and Prevention of Violence at the Ministry of Labour, Social Protection and Family, that serves as a secretariat to the Governmental Committee for equality between women and men, Gender Focal Points are established in all ministries. These include the project partner ministries - the Ministry of Regional Development and Construction and the Ministry of Environment. However, the stakeholder analysis shows that the position of Gender Focal Point in the ministries is mostly a formality. The position is not paid, the persons are performing the duties on a voluntarily basis, they have very limited roles and responsibilities on tracking gender dimensions, and they have only had occasional training on gender issues. The discussions with key informants show the need for Gender Focal Points to have specialised training on how to integrate gender dimensions into the infrastructure projects, including the SWM project.

Regional Development Agencies and Local Government. Some of the staff from the RDAs have benefited from one training on gender dimensions and gender equity and can serve as regional focal points for the facilitation and supervision of the integration of gender dimensions through the project cycle. However, as discussed with key informants, it would be necessary to appoint a gender focal point at each RDA who would be trained in the integration of gender in different types of infrastructure projects, including the SWM. The gender focal point at the RDA level will support the local public administration to integrate gender dimensions in all infrastructure projects, will support the project teams to develop the Social and Gender Action Plan (SGAP), and will monitor the implementation of the SGAP through the project preparation, implementation and post-implementation phases.

Rayon councils/local primaria. Despite the fact, that the rayon councils and local primaria were involved in the implementation of some projects with the MCA/MCC support and with the World Bank MSIF support (those donors have gender policy and require integration of gender dimensions in infrastructure projects), the rayon counsel and local primaria staff still have very limited understanding of gender equity principles. Taking into consideration their role as primary and final beneficiaries of the SWM project, it is important to develop their capacities in gender equity through specific training on those issues, and through their active involvement in project preparation and implementation.

Local NGOs. As per the discussions with key informants, several local NGOs, like Contact Cahul, have some expertise in gender issues, have been involved in the development of different local strategies and projects with gender requirements. These NGOs can be involved in communication and information campaigns related to the SWM project. The interview with the Contact Cahul NGO Director, showed that, despite the training received in gender issues, they still need further training in the integration of gender dimensions in infrastructure projects, including the SWM projects.

The stakeholder analysis shows that the capacity of regional and local stakeholders to under-stand and integrate gender differences, particularly in infrastructure projects, is low overall. This means that training will need to be an important part of the Social and Gender Action Plan.

11.5 Social and gender action plan

In this chapter is presented a summary of social and gender issues for the SWM project in WMZ3 and a Social and Gender Action Plan for the project based on the evidence in the field and needs and priorities of the both men and women.

11.5.1 Summary of social and gender issues for the project

The section is based on the fieldwork findings in described above. Beneficiaries' needs and priorities by gender, including issues, evidence, needs and priorities and the possible mitigation measures are summarised in the table below.

Table 11-2: Summary of social and gender issues for the project

Issue	Evidence	Needs and priorities	Possible mitigations measures
Management waste in households	WMZ3 is characterised by an unequal distribution of roles between men and women in household waste management, especially in rural areas and suburbs. In 80% of households, women are responsible for household waste collection and evacuation.	To change the attitudes and behaviour of men and women regarding waste collection in order to ensure a more equal distribution of roles reduce the burden of housework for women.	Communication/information campaigns on gender equality and gender distribution of roles in households that will target both men and women.
Waste collection	Women and men have different opinions regarding the type of containers, location of containers, and waste collection times. The majority of women and men from the urban areas prefer the container waste collection system. However, elderly women and the persons with disabilities living in multi-story houses prefer the waste chutes. Both men and women from urban areas prefer increasing the numbers of containers and to have containers in closed areas with access only to service subscribers. Women from rural areas and suburbs with narrow streets prefer the ring bell system to the container system, to keep the streets clean, while men prefer the container system. The women were against the idea of installing containers near their houses, while men agreed with this option with the condition of increasing the frequency of waste collection. Women from urban areas prefer metal containers with a footswitch to open them, placed near the house and washed at least two times a week, while for men the opening system of the containers does not have such a big importance. Both men and women from urban areas prefer waste collection to be done 7 days a week. Women from rural areas and suburbs (door-to-door system) prefer waste collection to be done two times a week at fixed times.	Acceptability, accessibility and relevance of waste collection system.	Consultation on the design of separate waste collection system with women and men, according to the type of locality (urban/rural) and with respect to disability and age. Capacity development of local public administration on gender equity in SWM systems.

	Men from urban areas want to improve the transportation for the waste collection: to have lorries with the automatically waste loading- to decrease the possibility of loaders (mostly men) to get infected with different diseases. Women from rural areas prefer to have at least special loaders that will load the waste in the car (sometimes they are in the position to load the waste by themselves).		
Separate waste collection	Women from rural areas and suburbs are more involved in household waste recycling than men (burning plastic bottles, pampers, leaves and other types of waste) and have less information on the impact of burning on their health and on the health of their children. Vulnerable women with less income (elderly women from urban areas and women from rural areas) are more interested than men in the separation of waste for remuneration. They propose more collection points for paper, cardboard, plastic bottles etc. Men are worried more than women about the separate collection of batteries, mobile phones, and other dangerous household waste.	Change attitudes and behaviour of women regarding the dangerous types of recycling. Open collection points for household waste that can be recycled and inform the population.	Communication/information campaigns on dangerous types of recycling targeted at women. Building waste separation into project design. Consultation of the design of waste separation with men and women. Capacity development of LPA and municipal enterprises for waste collection staff in waste recycling. Supporting the LPA to encourage local entrepreneurs to develop waste collection points.
Waste landfill and resettlement	Both men and women from urban and rural areas have limited or wrong information regarding the SWM project concept and the majority of them where against the project, believing that it would have a negative impact on the health of the population. Several years ago, some organisations tried to convince them to build a waste recycling plant in their area and they do consider that the SWM project has the same objective. Elderly women came prepared with the information from mass media regarding the negative health impact of the recycling plants. After getting information about the content of the project, all of them changed their minds and appreciated positively the SWM project. The Cahul local council approved the decision on increasing the area for the landfill without the prior agreement of the owners of the land to be re-	Inform the population regarding the concept of SWM project and its impact on the quality of life. Involve the potential beneficiaries, especially women, in the development and implementation of the project. Inform and negotiate with land owners the possibility of their resettlement and the conditions for the resettlement as soon as possible.	Communication/information campaigns with the participation of both men and women (at least 40% of participants to be women). Establish a community-based monitoring mechanism on a voluntarily basis, that will make the local public administration accountable for the concept and on the progress of project implementation. LPA from Cahul will inform as soon as possible the landowners about the extension of the landfill and will start the negotiation regarding

	settled. Despite the fact that the LPA is convinced that they will not have problems with resettlement, there is a risk of a rise a social conflict. Women and men have different perspectives regarding the new landfill and transfer station construction. Women have very limited information regarding the landfill and transfer station concept, and regarding the possibility of getting a qualified job (other than sweepers) within the new SWM system. Men, especially those from rural areas and suburbs expect to find employment in the new SWM system. Men would prefer the modern landfill, with access to electricity, water and heating system, with means of transportation, and good accessibility (better good roads etc.).		the conditions of resettlement. LPAs from Cahul, Taraclia and Cantemir will inform both men and women regarding employment in the new SWM system. The LPA will develop a transparent procurement mechanism and will encourage both men and women to apply for the positions in the new SWM system Capacity development of the LPAs from Cahul, Cantemir and Taraclia rayons on the development of a high quality, affordable and accountable SWM system.
Willingness to pay	Households headed by women with more than three children, with retired persons and with at least one household member with disabilities cannot afford to pay for the existing solid waste collection service. Men from rural areas are more worried than women regarding the low level of transparency and accountability of the local public administration with respect to the management of the existing solid waste management system. They do not know how the charges are estimated, nobody consulted with them with regard to increasing of the cost for services, and they do not receive receipts confirming payment for the service. Around 30% of households in urban areas and 80% of households in rural areas do not have access to a SWM system. With the development of new SWM system, the majority of them will get the access to services, but will be in the new conditions to pay for the services. The social and gender assessment shows that at least 30 per cent of households especially from rural areas are not willing to pay for the SWM service.	Inform LPAs on the affordability problems of some of the groups and on the possible solutions based on international experiences Inform the population regarding the process of the establishment of the cost for SWM services and regarding the responsibility of the LPA to develop an accountable and high quality SWM system. Increase the knowledge regarding the need for a modern SWM system in their communities and the impact of the service on their health.	Support the LPA to develop an equitable, affordable and accountable SWM system. Communication/information campaigns regarding both: the impact of the SWM system on their quality of life and on their health, and how the cost for services is calculated. Develop extracurricular activities in the schools focused on ecological education, impact of SWM systems on health, entrepreneurship based on recycling materials etc.

11.5.2 Social and gender Action Plan

The Social and Gender Action Plan is based on the summary of findings during the social and gender assessment of the SWM project in the WMZ3 and provides measures that aim to in-crease equality in the participation of men and women during all phases of the Project. The Social and Gender Action Plan is based on the following guiding principles:

- The existing project stakeholders will assume the responsibility for ensuring the gender equality through the project development and implementation. In this regards, *GOPA will be responsible for* integration of gender dimensions into the feasibility study, in the Project technical design and in all TORs and contracts related to development of the SWM Project. *The Regional Development Agency will be responsible for* integration of gender dimensions through the implementation of the SWM Project. In this regards, the RDA will appoint a gender focal point for the both: assisting the LPA to support the gender equality and monitoring the implementation of the SGAP at the local level. *The Local public administration will be responsible and accountable to the SWM project beneficiaries for* the implementation of the gender equity at the local level and for the communication and information campaign to increase the knowledge of local population regarding the project concept, impact, roles and responsibilities of LPA, costs of services, procurement procedures for employment of qualified specialists for the new SWM system. The LPA will also develop an accountable mechanism (local monitoring group) at the local level for monitoring the progress of the implementation of the project and of the SGAP;
- The recommendations include the both practical and strategic social and gender needs. In this regards they are focused also on intra-household distribution of roles; education of population, including the young generation, regarding the SWM and ecological and health problems; development of accountable mechanism at the local level for the qualitative delivery of SWM services;
- Capacity development of all project stakeholders involved in project development and implementation in social and gender issues, including gender mainstreaming in SWM project throughout the Project cycle.

The Social and Gender Action Plan includes the action, the detailed description, the indicators, the responsible institution and timeframe and the supervision of the actions.

Table 11-3: The social and gender Action Plan for WMZ 3

Outputs	Description	Indicators	Responsibility (timeframe)	Supervision
• GIZ technical team consultants are aware of findings of social and gender assessment and stakeholders' interest and incorporate those in the project implementation plan.	The SWM consultants will be informed on the findings of the social and gender assessment and stakeholders analysis	The project implementation plan reflects the findings of the social and gender assessment and stakeholders analysis.	GIZ technical team consultants (four weeks after the approval of the SGA report).	National gender consultant
• GIZ technical team consultants have improved capacities regarding the integration of social and gender dimensions into the SWM project.	The national gender consultant will conduct training for the GIZ technical team in the integration of gender dimensions throughout the project cycle.	GIZ staff have improved knowledge on integration of gender dimensions into the project cycle.	The GIZ technical team and focal point (four weeks after the approval of the SGA report).	National gender consultant GIZ gender focal point
• The findings of social and gender assessment are incorporated into the feasibility study.	GIZ technical team will integrate the findings of social and gender assessment into the feasibility study of the SWM Project.	The feasibility study has a chapter on social and gender dimensions of the project.	GIZ SWM consultants (four weeks after the approval of the SGA report).	National gender consultant
• RDA staff are aware of findings of the social and gender assessment and SWM stakeholder analysis and incorporate findings in the RDA plan of activities.	The RDA staff informed on the findings of the social and gender assessment and stakeholder analysis.	The RDA plan of activities includes the findings of SGA.	RDA South Development Region (in four weeks after the approval of the SGA report).	National gender consultant
• Gender focal point appointed at the RDA level.	The RDA from the South region will appoint a gender focal point at the RDA level	The gender focal point is appointed.	RDA (within six weeks after the approval of the SGA report).	GIZ gender focal point
• RDA staff have improved capacities regarding the integration of social and gender dimensions into the SWM project	The national gender consultant and GIZ gender focal point will conduct training for the RDA staff in the integration of gender dimensions throughout the project cycle.	The RDA staff have improved knowledge on the integration of gender dimensions into the project cycle.	GOPA Gender focal point (to be determined).	National gender consultant GIZ Gender focal point

Outputs	Description	Indicators	Responsibility (timeframe)	Supervision
• The findings and recommendations of the SGA are incorporated in the TOR of the design company who will undertake the project	The TOR (task notebook) will address the recommendations of social and gender assessment.	The recommendations are included in the TOR of the design company	GIZ SWM staff	GIZ Gender focal point
• The technical design of the waste collection system is consulted separately with women and men, per types of localities (urban/rural) and with respect to disability and age.	The design company will consult on the design of the waste collection system separately with men and women, by type of localities (urban/rural) and with respect to disability	At least 40% of participants at consultations are women	Design company	GIZ gender focal point
• The LPAs (rayon councils and local *primaria*) have improved knowledge on the following issues: gender equity, integration of gender dimensions into the project cycle, building an accountable, affordable and modern SWM system, and communications/information.	The RDA gender focal point will provide training for rayon councils and local *primaria* on the following issues: gender equity; development of an accountable, affordable and qualitative SWM system; and on community communication/information.	Improved capacities of rayon councils and local *primaria* on gender equity, a high quality, affordable SWM system and communications /information. Integration of gender dimensions into the project implementation	RDA gender focal point	GOPA gender focal point
• Local monitoring committees established at beneficiary level and capacity developed in gender issues and communication/information.	The RDA gender focal point will support the LPA to establish the local monitoring committees at the local level and to develop capacity in gender issues and communication/information.	Monitoring committees established (at least 40% of members are women) and capacity developed in gender issues and communications/information	RDA gender focal point, LPA	GIZ gender focal point
• Communications/ information campaigns targeted to men/ women /persons with disabilities about the SWM project, including information on SGAP conducted at local level.	The local monitoring committees will provide information campaigns at the community level regarding the SWM project, including the information on SGAP that will be targeted to men/women/persons with disabilities.	Local communication campaigns conducted (at least 40% of participants at meetings are women and 5% - persons with disabilities)	Local primaria	RDA gender focal point

12 Environmental impact

Integrated Solid Waste Management System in WMZ 3 it is subject to Environment Impact Assessment regarding the planned activity for preliminary assessment, by Decision no. 29 from 19 June 2015 issued by competent authority – Ministry of Environment.

EIA procedure is developing in accordance with Law no 86 from 29.05.2014 on Environment Impact Assessment and includes the following stages:

- Submission the letter to the competent authority with the request for an opinion regarding the need to include the planned activity „Creating an integrated waste management system" in the EIA process. Development of EIA for integrated waste management system, WMZ 3, RDS is not a requirement according to Law no 86 from 29.05.2014 on Environment Impact Assessment and is not included in the List of activities subject to compulsory EIA, Annex 1 nor in the list of the planned activities, for which should be established the need to develop a EIA procedure (Annex 2). However according to European Directive 2011/92/EU assessment of the effects of certain public and private projects on the environment (EIA Directive) for the landfills, as in the case of regional landfill which follows to be constructed in Cahul, should be established the need for environment impact assessment;
- Based on the response in May 2015 from the Ministry of Environment, the request on the planned activities was submitted to the competent authority;
- The elaboration of the EIA Program was initiated based on Decision no. 29 of 19 June 2015 on preliminary assessment of the planned activities issued by the competent authority;
- The draft EIA Program of the planned activity was submitted for examination to the competent authority on 12 October 2015;
- Program for carrying out environment impact assessment for the planned activity was coordinated by Notice no. 03 of 11 November 2015 issued by competent authority;
- Based on Notice to the Program, the EIA Report is elaborated;
- The central public authorities will organize public debates.

The EIA Report was developed based on the following studies, data and information:

- Analysis of existing information on the condition of environment components (ground and underground water, soil and subsoil, flora, fauna, air); condition of natural and cultural monuments, landscape and situation regarding socio-economic aspects;
- the Feasibility Study;
- Site visits;
- Meeting with LPA representatives;
- Providing information to the public through various methods: publications on websites, working group meetings, consultations and public debates.

Environment impact aspect was developed for the preferred option, selected for the feasibility study, and related to transport, transfer, treatment and disposal of waste.

At EIA stage the assessment and analysis of environment factors were based on quality indicators that can reflect the overall condition. The quality of an environment factor or element it is included in the EIA documentation with the allowed limits of national r/standards or the impact of the "project" on environment are estimated based on the "size" which is determined taking into account the level of some quality indicators characterizing the impact.

The result of the EIA final phase will be to obtain the environment permit issued by the competent authority.

13 Financial and economic analysis

The objective of the Financial and Economic Analysis (Cost Benefit Analysis-CBA) was to assess the financial and economic viability and sustainability of the Project over the entire project lifetime.

The CBA has considered all relevant data and information made available from the various sources and especially the reports, financial statements and operational/ demand/ O&M data provided by the local stakeholders. It takes further into account the socio-economic data, background information, technical concepts, demand projections and cost estimates, as detailed in the respective chapters of the Feasibility Study.

The Financial and Economic Analysis (CBA) has taken into account all the relevant existing guidance for preparing the analysis:

- The requirements laid down in the Term of Reference for the present project;
- “Guide to Cost-Benefit Analysis of Investment Projects. Economic Appraisal Tool for Cohesion Policy 2014-2020”, Issued by the European Commission in December 2014;
- “COMMISSION IMPLEMENTING REGULATION (EU) 2015/207 laying down detailed rules implementing Regulation (EU) No 1303/2013 of the European Parliament and of the Council as regards the models for the progress report, submission of the information on a major project, the joint action plan, the implementation reports for the Investment for growth and jobs goal, the management declaration, the audit strategy, the audit opinion and the annual control report and the methodology for carrying out the cost-benefit analysis and pursuant to Regulation (EU) No 1299/2013 of the European Parliament and of the Council as regards the model for the implementation reports for the European territorial cooperation goal”, Annex III;
- COMMISSION DELEGATED REGULATION (EU) No 480/2014 supplementing Regulation (EU) No. 1303/2013 of the European Parliament and of the Council laying down common provisions on the European Regional Development Fund, the European Social Fund, the Cohesion Fund, the European Agricultural Fund for Rural Development and the European Maritime and Fisheries Fund and laying down general provisions on the European Regional Development Fund, the European Social Fund, the Cohesion Fund and the European Maritime and Fisheries Fund, Section III.

According to EU standards the CBA, and thus also the financial and economic analysis has to use the “incremental method”: that means, the project is evaluated on the basis of the differences between the scenario “with the project” and an alternative scenario “without the project”. For the “With Project” scenario, the cost and revenues considered must be those of a scenario of efficient operation. For the “Without Project” scenario, the cost and revenues considered are those of a “business as usual” without any major new investments or replacements.

The financial analysis contains the following components:

- Projection of basic project relevant development data:
    - Population;
    - Service levels;

  - Waste generation;
  - Waste collection;
  - Recycled waste;
  - Composted waste, as estimated in the Feasibility Study for the period 2015 – 2044, estimate and projection of corresponding development data for the “without project case”.
- Projection and allocation of overall investment and reinvestment cost for the proposed waste project measures and cost of additional further investment measures required; as estimated in the Feasibility Study for the period 2015 – 2044;
- Projection of annual O&M cost as required for adequate operation and maintenance of the proposed solid waste management system, to assure the envisaged service standards and the full technical lifetimes of the investment under the prevailing conditions in the study area; as estimated in the Feasibility Study for the period 2015 –2045; estimate and projection of appropriate annual O&M cost for the “without project case”;
- Tariff strategy for the development of appropriate solid waste tariffs, taking into account both full cost coverage and affordability issues; appropriate assumptions for tariff development in the “without project case”;
- Projection of revenues from waste collection and treatment services to the connected domestic and non-domestic customers in the project area for both “with project case” and “without project case”;
- Projection of the financial performance of the future potential operator over the evaluation period 2015 to 2044;
- Elaboration of an appropriate Financing Plan.

The financial and economic analysis is based on the data of the base year 2014 and is carried out for the period 2015 to 2044 which comprises the envisaged project implementation period 2017 to 2018 and an operation period of 26 years from 2019 to 2044.

13.1 Investment costs

13.1.1 Investment costs

The estimated investment costs contain primarily the Project investment cost to be implemented during the period 2017 to 2019 and in addition replacement cost and additional investment cost as required up to the design horizon 2044. The investment costs are separately estimated for residual and separate waste collection, as well as for all the individual areas included in the operation area.

The investment cost is allocated on an annual basis in line with the implementation schedule. Considering the implementation experience of similar investment project and the type and nature of the current investment, we have considered in the CBA the following implementation schedule (as percentage from the total value of the investment):

- 2017: 56.7%;
- 2018: 41.0%;
- 2019: 2.3%.

The breakdown of the investment costs is presented in the following table.

Table 13-1: Breakdown of project investment costs

Investment cost	EUR
Residual Waste Collection Investment	5,097,000
Separate Waste Collection Investment	764,000
Cahul specific investment	6,111,606
Cania (Cantemir) specific investment	1,061,327
Taraclia specific investment	2,165,068
Overheads	970,000
Contingencies	1,475,000
Total investment	**17,644,000**

All Project investment costs as determined in the Feasibility Study are considered as eligible cost for financing support. The detailed calculation and scheduling of the investments costs are presented in the CBA Financial Model, Sheet "Investments".

13.1.2 Replacement costs

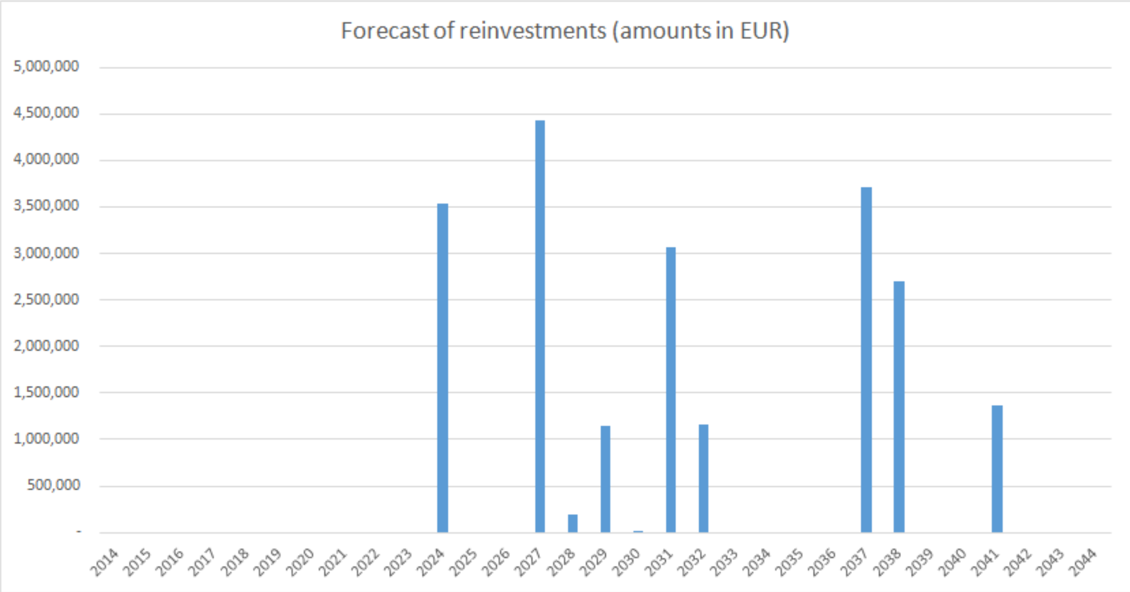
The replacement costs include costs occurring during the reference period to replace short-life machinery and/or equipment. The replacement costs were calculated considering the following category of investments:

- Residual Waste Collection Investment;
- Separate Waste Collection Investment;
- Cahul specific investment;
- Cania (Cantemir) specific investment;
- Taraclia specific investment.

The reinvestment costs forecast over the years were calculated considering the average useful life of each asset category. The total reinvestment cost considered for the analysis over the entire period of analysis of 30 years (2015-2044) represents 21.3 million Euro.

The detailed forecast of the level of reinvestment costs over the years is presented in the following figure.

Figure 13-1: Forecast of reinvestment costs (amounts in EUR)



The detailed calculation and scheduling of the investments costs are presented in the CBA Financial Model, Sheet "Investments".

13.1.3 Residual value

The residual value reflects the capacity of the remaining service potential of the fixed assets whose economic life is not yet completely exhausted. Thus, for projects assets with economic lifetime in excess of reference period, their residual value shall be determined by computing the net present value of cash flow in the remaining life years of the operation (according to the CBU Guide).

For the present analysis, we have calculated the residual value considering the discounted cash flow for the remaining life of assets by considering the cash flow from the last year of forecast (year 2044). The residual value of the investment will differ for each scenario analysis considering the affordability principle that will be used.

The detailed calculation of the residual value is presented in the CBA Financial Model, Sheet "Investments".

13.2 Operating costs

13.2.1 Operating costs – "With project scenario"

The Operating and maintenance costs (O&M) are forecasted aggregated for the service area of the project. The O&M cost are based on the O&M cost as provided by the waste companies for the years 2012- 2014 (in MDL and then translated into EUR considering the average exchange rate) and forecasts these costs until the entry into functioning of the new projected system 2019. As such, after this point the costs are taken from the technical study and then projected on an annual basis in line with the implementation schedule for the period 2019 to 2044 in Euro (constant prices).

As outlined in the general approach the particular O&M cost categories are assumed to increase in real terms with the annual increase rates as presented in the CBA Financial Model, sheet "Input". With the assumed increase rates the different cost categories will increase in real terms over the period 2015 to 2044.

In the following table we will present the costs for the existing system up to 2018, the moment when the system will be replaced.

Table 13-2: Operating costs forecast (2015-2018) – "With Project" Scenario

Operating Costs for Existing System (EUR)	2015	2016	2017	2018
Salaries	105,510	107,778	110,149	112,628
Social insurance	16,774	17,134	17,511	17,905
Gas	91,780	92,697	93,624	94,561
Spare parts	5,221	5,273	5,326	5,379
Depreciation	44,396	44,396	44,396	44,396
Other direct expenditures	6,233	6,296	6,359	6,422
General and administrative expenditures	154,301	155,844	157,403	158,977
Other activities operational expenditure	347,473	350,948	354,457	358,002
Total operating costs	**771,688**	**780,367**	**789,226**	**798,270**

As it can be seen the operating costs for the existing costs range between 771.7 thousand EUR in 2015 and 798.3 thousand EUR in 2018. However, the situation will change significantly when the new system will be introduced.

Starting with 2019, the proposed investment will become operational and the new operating costs related to the new system were used from this moment on. The forecast of the operating costs related to the collection activity are presented synthetically in the following table:

Table 13-3: Operating costs forecast – collection costs (2019-2044) (amounts in EUR) – "With Project" Scenario

Operating collection costs for the proposed system (EUR)	2019	2024	2029	2034	2040	2044
RESIDUAL COLLECTION						
Salaries	263,078	294,036	328,637	367,311	410,535	458,846
Fuel	898,083	943,895	992,043	1,042,647	1,095,832	1,151,731
Oil	89,808	94,389	99,204	104,265	109,583	115,173
Maintenance trucks	167,986	176,555	185,561	195,026	204,974	215,430
Maintenance containers	23,586	24,789	26,054	27,383	28,780	30,248
RECYCLABLES COLLECTION						
Salaries	19,250	21,515	24,047	26,876	30,039	33,574
Fuel	174,263	183,153	192,495	202,314	212,634	223,481
Oil	17,426	18,315	19,250	20,231	21,263	22,348
Maintenance trucks	26,538	27,892	29,314	30,810	32,381	34,033
Maintenance containers	2,873	3,020	3,174	3,336	3,506	3,685
Total collection costs	**1,682,892**	**1,787,558**	**1,899,779**	**2,020,199**	**2,149,529**	**2,288,549**

The forecast of the operating costs related to the transfer, processing and disposal activities are presented synthetically in the following table:

Table 13-4: Operating costs forecast –transfer and processing costs (2019-2044) (EUR)[13]

Operating transfer and processing costs for the proposed system (EUR)	2019	2024	2029	2034	2040	2044
CANIA OPERATION						
Personnel	16,669	18,631	20,824	23,274	26,013	29,074
Electric power	2,900	3,124	3,365	3,625	3,906	4,207
Water, waste water	2,606	2,739	2,879	3,026	3,180	3,342
Transfer and composting vehicle	43,899	46,138	48,492	50,966	53,565	56,298
Plant and building maintenance, monitoring, laboratory, training	3,397	3,570	3,752	3,944	4,145	4,356
TARACLIA OPERATION						
Personnel	31,463	35,166	39,304	43,929	50,204	54,877
Electric power	2,900	3,124	3,365	3,625	3,964	4,207
Water, waste water	2,733	2,873	3,019	3,173	3,369	3,505
Transfer and composting vehicle	55,459	58,288	61,261	64,386	68,347	71,123
Plant and building maintenance, monitoring, laboratory, training	3,397	3,570	3,752	3,944	4,186	4,356
CAHUL OPERATION						
Personnel	41,860	46,787	52,292	58,446	65,324	73,011
Electric power	37,145	40,015	43,108	46,439	50,028	53,895
Water, waste water	8,439	8,870	9,322	9,798	10,297	10,823
Landfill operation vehicles	76,605	80,512	84,619	88,936	93,472	98,240
Composting vehicles	24,975	26,249	27,588	28,995	30,474	32,029
Sorting vehicle	16,776	17,632	18,531	19,477	20,470	21,514
Plant and building maintenance, monitoring, laboratory, training	34,499	36,259	38,109	40,053	42,096	44,243
Total transfer and processing costs	**405,723**	**433,547**	**463,584**	**496,035**	**531,125**	**569,100**

The total operating costs of the proposed system are presented in the table below, comprising both the collection and the transfer and processing costs.

Table 13-5: Total operating costs forecast (2019-2044) (EUR), “With Project” scenario

Operating Collection Costs for Proposed system (EUR)	2019	2024	2029	2034	2040	2044
Collection costs	1,682,892	1,787,558	1,899,779	2,020,199	2,176,531	2,288,549
Transfer and processing costs	405,723	433,547	463,584	496,035	531,125	569,100
Total collection costs	**2,088,615**	**2,221,105**	**2,363,362**	**2,516,234**	**2,680,654**	**2,857,649**

It can be seen that the total operation costs for the new proposed systems increase gradually from 2,088.6 thousand EUR in 2019 to 2,857.6 thousand EUR in 2044.

[13] “With Project” scenario

13.2.2 Operating costs – “Without project scenario”

The O&M costs for the “without project” scenario for the project are calculated starting from the existing operating costs in the operated areas, projected up to the time horizon of 2044 with the increase factors for materials, staff and fuel & energy. This is the above mentioned approach, “business as usual”, without any major new investments or replacements being foreseen.

The forecast of the operating costs for the without project scenario is presented in the table below.

Table 13-6: Operating costs forecast (2015-2044) (EUR), “Without Project” scenario

Operating Costs for Existing System (EUR)	2015	2019	2024	2029	2034	2044
Salaries	105,510	115,162	128,714	143,861	160,790	200,859
Social insurance	16,774	18,308	20,463	22,871	25,562	31,932
Gas	91,780	95,506	100,378	105,498	110,880	122,480
Spare parts	5,221	5,433	5,710	6,001	6,307	6,967
Depreciation	44,396	44,396	44,396	44,396	44,396	44,396
Other direct expenditures	6,233	6,486	6,817	7,165	7,531	8,318
General and administrative expenditures	154,301	160,566	168,757	177,365	186,412	205,915
Other activities operational expenditure	347,473	361,582	380,026	399,412	419,786	463,704
Total operating costs	**771,688**	**807,440**	**855,261**	**906,569**	**961,664**	**1,084,573**

It can be seen that the costs in the without project scenario will increase from 771.7 thousand EUR in 2015 to 1,084.6 thousand EUR in 2044.

13.3 Tariff setting

The tariff system proposed for the “With Project” scenario will assume the application of a unified tariff across the entire area of the project. As such, an average tariff was calculated across the operating area.

The assumptions regarding the level and evolution of the tariffs represent a compromise between:

- Achieving cost recovery;
- Ensuring tariffs are affordable.

In practice the method adopted for estimating suitable tariffs was the following:

- Calculate the theoretical full cost-covering tariff for the waste management system by the ‘levelised unit cost’ (LUC) method, also referred to as the dynamic prime cost (DPC) method. This involves taking the discounted value of all the net costs of the system (disregarding tariffs) over the reference period – investments, replacement investments, O&M costs less income earned from sale of recyclable waste and compost – and dividing this by the discounted tons of waste collected over the reference period. The discounted value of all the net costs is in fact corrected for the residual values of the existing assets at the start and the investments at the end of the reference period, and the costs of fixing historical problems (i.e. closing existing landfills) are not included. The index so obtained (units €/ton) is in fact the full cost-covering tariff which should be achieved by the waste management system as soon as is feasible. The calculation of the LUC is carried out in the sheet “Revenues” from the financial model;

- The tariffs charged to households are increased up to the LUC level as soon as possible, having regard to constraints of affordability and financial sustainability. The regard to affordability was that a household should never pay more than 1% of its revenues for solid waste management (best practice threshold). This level was calculated starting from data gathered from statistical sources.

It was considered that the suitable approach would be to apply systematically the affordable tariff and to always compare it with the DPC calculated in order to ensure long term sustainability.

The results of the DPC (LUC) calculation are presented in the following table.

Table 13-7: Dynamic Prime Costs (DPC) calculation

DPC Calculation	Unit	NPV @ 4%
Discount rate	4.0%	
Residual value of existing assets (estimation)	EUR	1,066,006
Investment Cost Total	EUR	17,644,000
Reinvestments	EUR	21,308,571
Residual value of investments	EUR	-
OM&A Cost	EUR	67,626,884
Revenues from recyclables and compost	EUR	(18,948,737)
Total Cost (Inv+O&M)	EUR	88,696,724
Total Waste input into system	tone/year	1,926,642
DPC, Investment	EUR/tone	20.77
DPC, OM&A	EUR/tone	25.27
DPC, Total	**EUR/tone**	**46.04**

According to this approach, a full cost recovery tariff on long-term is around 46 EUR/tone.

Regarding the second approach based on the domestic consumers' ability to pay, we have considered, at first stage, an affordability ratio of 1% for the entire period of analysis (we have assumed that the average household will pay 1% of their household revenues for the solid waste invoice) as the base case scenario. However, for the purpose of the analysis and due to the uncertainty of the financing sources available for the project, we have considered different levels of affordability. Considering this approach, we have obtained the following tariff levels for each affordability level.

Table 13-8: Affordable tariff levels

Affordability principle	Tariff paid by population		
%	EUR/t	MDL/pers./month - urban	MDL/pers./month - rural
1.00%	31.54	13.8	8.30
1.10%	34.69	15.2	9.13
1.15%	36.27	15.9	9.55
1.20%	37.85	16.6	9.96
1.30%	41.00	18.0	10.79

The analysis show that until 2037, the affordable tariff is not covering the DPC, however this is compensated afterwards when the affordable tariff will overrun the DPC and as such will ensure long term sustainability, as well as the affordability of the proposed tariff.

The sustainability will be pointed out in the financial statements which will presented in the subsequent chapters of this report.

The tariff proposed for the “without project” scenario is set based on the operating costs of the without project scenario and on the quantities of this scenario. On top of a cost covering tariff a profit margin of 10% was added to ensure sustainability of the operation in this case.

13.4 Project revenues

13.4.1 Project revenues – “With project” scenario

The project recognizes three types of revenues: revenues from collection, revenues from compost and revenues from recycling.

The estimate of the collection operation revenues are performed considering the demand forecast for the “With Project” scenario and the proposed tariff scenario presented in the previous chapters.

The revenues from collection activity are presented in the following table, based on the demand forecast and tariff forecast presented in the previous chapters.

Table 13-9: Revenues form collection – “With Project” scenario

Revenues from collection (EUR)	2015	2019	2024	2029	2034	2044
Household	271,607	1,702,826	1,904,614	2,124,297	2,383,543	3,009,765
Similar (institutions and commercial companies)	65,210	284,323	321,287	361,022	405,851	513,890
Park/garden	19,587	58,347	66,413	74,667	83,986	106,414
Other (street waste, bulky, waste from markets)	25,366	75,767	86,519	97,510	109,939	139,795
Total collection revenues	**381,771**	**2,121,263**	**2,378,832**	**2,657,497**	**2,983,318**	**3,769,863**

It can be seen that the collection revenues increase from 381.8 thousand EUR in 2015 to 3,769.9 thousand EUR in 2044.

The revenues from composting activity were determined using the output quantities from the composting activity provided by the technical team, presented in the demand section of the Feasibility study, and a minimum price assessed by the consultant in the absence of an active compost market in Moldova. The revenues from recycling activity were determined using the output quantities from the recycling activity provided by the technical team, presented in the demand section of the Feasibility study, and a reference price from the recyclables market agreed with the technical team.

The table below highlights the revenues from recyclables and compost for the “With Project” scenario.

Table 13-10: Revenues from recyclables and compost, “With Project” scenario

Revenues from compost and recyclables (EUR)	2015	2019	2024	2029	2034	2044
Plastic	-	366,919	366,919	366,919	366,919	366,919
Paper and cardboard	-	89,202	89,202	89,202	89,202	89,202
Glass	-	4,969	4,969	4,969	4,969	4,969

Revenues from compost and recyclables (EUR)	2015	2019	2024	2029	2034	2044
Metal	-	259,901	259,901	259,901	259,901	259,901
Revenues from compost	-	7,713	7,864	7,837	7,814	7,771
Total compost and recyclables revenues	**-**	**720,991**	**720,991**	**720,991**	**720,991**	**720,991**

The total revenues are presented in the following table for the projection period.

Table 13-11: Total revenues – "With Project" scenario

Total revenues (EUR)	2015	2019	2024	2029	2034	2044
Revenues from collection	381,771	2,121,263	2,378,832	2,657,497	2,983,318	3,769,863
Revenues from recyclables and compost	-	720,991	720,991	720,991	720,991	720,991
Total collection revenues	**381,771**	**2,849,967**	**3,107,687**	**3,386,325**	**3,712,123**	**4,498,625**

It can be seen that the total revenues for the "With Project" scenario increase from 381.7 thousand EUR in 2015 to 4,498.6 thousand EUR in 2044.

13.4.2 Project revenues – "Without project" scenario

The forecast for the "without project" scenario revenues is built on the same assumptions as for the 'with project" scenario. There are no revenues from composting or recycling and as such the only revenues are those generated from the collection activity.

The revenues from the collection activity for the "without project" scenario are presented below.

Table 13-12: Total revenues – "Without Project" scenario

Revenues from collection (EUR)	2015	2019	2024	2029	2034	2044
Household	271,607	286,030	305,726	327,329	350,949	405,110
Similar (institutions and commercial companies)	65,210	68,739	73,560	78,784	84,496	97,582
Park/garden	19,587	20,606	21,998	23,509	25,159	28,962
Other (street waste, bulky, waste from markets)	25,366	26,758	28,658	30,701	32,934	38,048
Other activities revenues	454,208	472,651	496,761	522,100	548,733	606,142
Total collection revenues	**835,979**	**874,783**	**926,703**	**982,423**	**1,042,272**	**1,175,845**

It can be seen that the total revenues for the "without project" scenario increase from 835.9 thousand EUR in 2015 to 1,175 million EUR in 2044.

13.5 Project potential grant intervention level

The financing structure of the project and any potential needed grant intervention level was calculated considering the funding gap method from the European Cost Benefit Analysis Guide for investment projects. All issues related to "Grant Intervention Level" are determined and calculated with the Excel CBA model, sheet "Funding Gap".

As according to EU standards the CBA has to use the "incremental method" all data are stated as far as relevant separately for the "With Project Case", the "Without Project Case" and as "incremental data".

The cost and revenue figures related to grant Intervention are stated in real EUR.

13.5.1 Financing gap

The financing gap is calculated based on the methodology as provided by the “Guide to Cost-Benefit Analysis of Investment Projects. Economic Appraisal Tool for Cohesion Policy 2014-2020”, issued by the European Commission in December 2014.

According to “Commission Regulation Implementing Regulation 2015/2007, Annex III, “Methodology for carrying out the cost-benefit analysis” it is mentioned that “the determination of the level of grant is based on the “funding gap” rate of the project, i.e. “the share of the discounted cost of the initial investment not covered by the discounted net revenue of the project”. This implies an exclusion of the Working Capital and Replacement Cost as part of the Discounted Investment Cost (DIC) in the funding gap calculation. The residual value of the investment at the end of the analysis period is treated as revenue in the calculation of the Discounted Net Revenue (DNR). This confirms that some „investment related” cost can be excluded of the DIC calculation and considered instead as cash-flow contribution to the DNR.

More over in that particular example, the DIC calculation is based on the total project investment and not the eligible investment component only. This implies that recognized ineligible investment costs can be included in the value of the DIC in the calculation of the funding gap.

The calculation of the financing gap is performed in sheet “Funding Gap” and presented in the table below.

Table 13-13: Funding gap calculation (potential grant intervention level)

Funding Gap Calculation	Unit	NPV @ 4%
Calculation of Discounted Investment Cost (DIC)	EUR	
Investment cost (w/o contingencies)	EUR	14,121,386
Non-eligible investment cost (w/o contingencies)	EUR	-
DISCOUNTED INVESTMENT COST (DIC)		14,121,386
Calculation of Discounted Net Revenues (DNR)	EUR	
Revenues	EUR	33,595,932
O&M costs	EUR	(20,090,345)
Decrease / (Increase) in working capital	EUR	(944,773)
Replacement costs	EUR	(10,973,672)
Residual value of investments	EUR	2,473,116
Income tax on operations	EUR	(241,418)
DISCOUNTED NET REVENUES (DNR)	EUR	3,818,840
ELIGIBLE COST (EC, from project cost table)	EUR	17,644,000
PRO-RATA OF ELIGIBLE EXPENDITURES	%	100.00%
ELIGIBLE EXPENDITURE (EE = DIC-DNR)		17,644,000
FUNDING GAP RATE (R = EE / DIC)		**72.96%**

The level of the financing gap calculated with a discount rate of 4% and considering an affordability limit of 1.0% for the average household is 72.96%. Under this assumptions and results, the financing structure of the project is the presented in the following table.

Table 13-14: Potential financing structure of the investment project

Total value of the project (Total cost = eligible + ineligible costs)	Eligible cost	Funding Gap (grant level)			
17,644,000	17,644,000	12,873,062.7			
100.0%	100.00%	72.96%	of 1.1		
	of 1				
		Non Funding Gap (debt level)			
		4,770,938			
		27.04%	of 1.1		
	Ineligible cost (others categories than eligible)	Operator or local authorities		VAT	Reclaimed
					0
		0		0	n/a
	0	n/a	of 1.2	n/a	Nonreclaimed
	0.00%				0
	of 1				n/a
				Noneligible	
				0	
				n/a	

13.5.2 The net present value and the rates of return with and without grant assistance

The Financial Net Present Value on costs (FRR/C) and the Internal Rate of Return on costs (FRR/C) before grant intervention level and the Financial Net Present Value on capital (FRR/k) and the Internal Rate of Return on capital (FRR/K) after the grant intervention level is presented in the following table.

Table 13-15: Financial performance indicators of the investment project

Main Elements and Parameters	Before Grant		After Grant	
Financial rate of return (%)	-11,591,975	(FRR/C)	-8,013,621	(FRR/K)
Net present value	-1.58%	(FNPV/C)	-2.05%	(FNPV/K)

13.6 Financial Statements

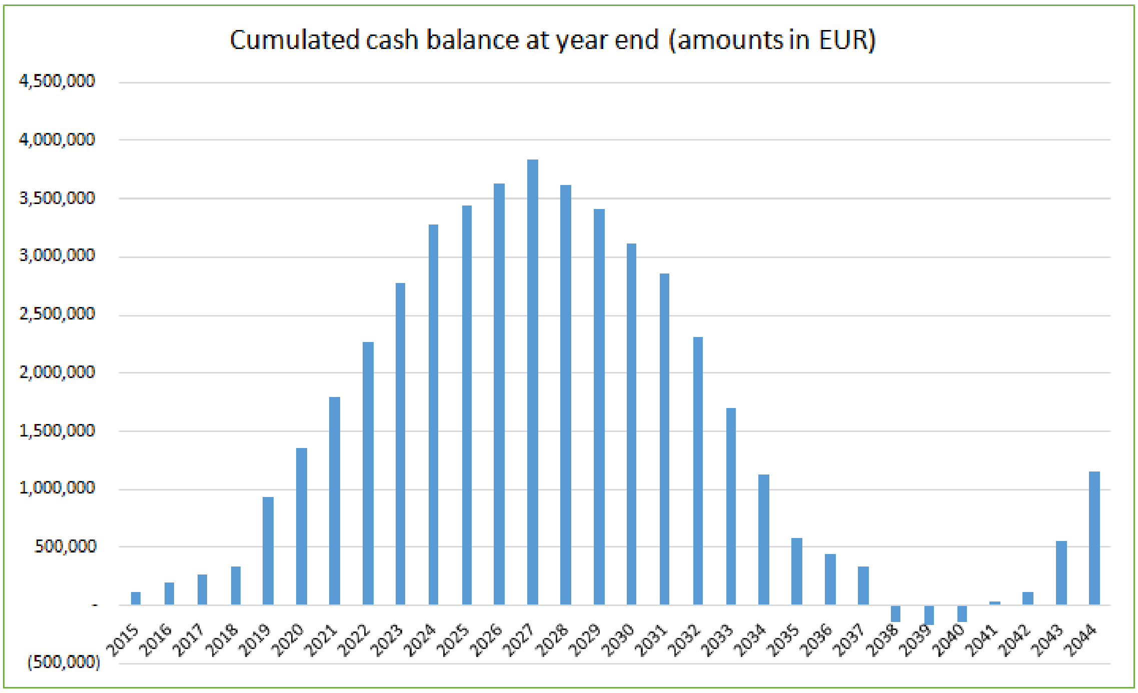
In order to assess the long-term sustainability of the future operator of the Project Investment, the Consultant has elaborated the following financial statements in constant Euro:

- **Balance Sheet**: The Balance Sheet of the future operator for the period 2015 to 2044 is presented in constant prices (Euro), with the following simplified structure:
  - Total assets;
  - Net fixed assets;
  - Current assets;
  - Total Equity and Liabilities;
  - Equity;
  - Liabilities.

- **Income Statement**: The Income Statement of the Operator for the period 2012 to 2044 is presented in constant prices (Euro) in Annexes of the CBA, with the following simplified structure:
  - Revenues;
  - Operating expenditures;
  - EBITDA;
  - EBIT;
  - EBT;
  - Net income.
- **Cash Flow Statement**: The Cash Flow Statement of the Operator for the period 2012 to 2044 is presented in constant prices (Euro) the Annexes of the CBA, with the following simplified structure:
  - Funds from operation;
  - Free cash flow;
  - Cash flow before debt service;
  - Surplus / deficit for the year;
  - Net cash flow.

The detailed forecast of the financial statements both for the "With Project" and "Without Project" scenarios are presented in the financial model, sheet "Financial Statements".

Figure 13-2: Cumulated cash flow balance at year end (amounts in EUR)



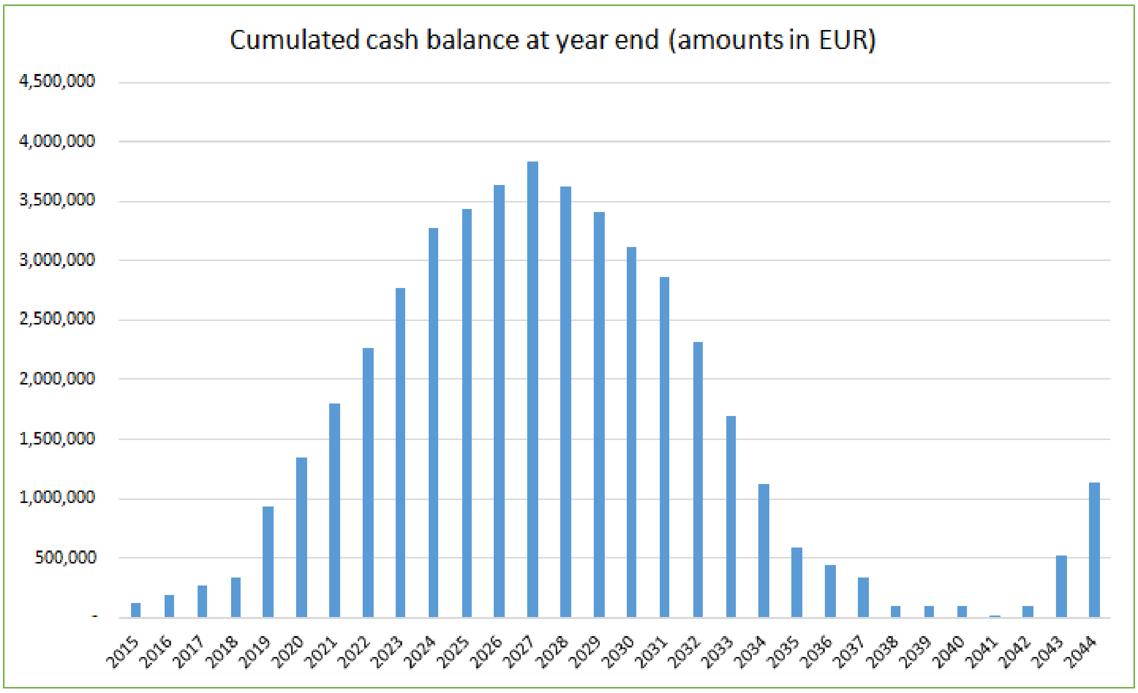
The forecast of the cash flow balance for the "With project" scenario shows positive cash balances at year end from 2015 until 2037 and then some temporary negative cash balances due to the high level of reinvestments that need to be financed from the cash flow of the system. In the cash flow statement we have considered that the reinvestment will be financed by contracting loans and starting with 2038 the cumulated loans that need to be repaid due to several reinvestments stages are higher than the cash flow generated in that year leading to some temporary cash flow problems.

These temporary cash flow shortages can be financed in 2 ways:

- The local authorities assume the financing of part of the reinvestments with investment subsidies;
- The operator contracts loans over a larger period of time or contract additional short term loan to cover the cash shortage.

The following chart shows the situation in which the future operator will take a credit line in order to cover the temporary cash shortages.

Figure 13-3: Cumulated cash flow balance at year end considering a temporary credit line (amounts in EUR)



Under this scenario, the cash balance is positive in all years of analysis showing the long term sustainability of the project.

13.7 Alternative financing scenarios

In the base case scenario that was presented in the following chapters, the results are based on the assumption that the affordability ratio used for analysis is 1% for the average household (that an average household will pay 1% of their revenues for the solid waste invoice). This scenario leads to a need of grant of 74%.

However, considering the experience of previously municipal infrastructure projects financed in Moldova, we can conclude that it will be very difficult to find a donor that will assure such a high percentage of grant. The experience of previous projects showed that the level of the grant was 33% of the investment value, 50% in some limited cases and maximum 66% in the case of an EBRD financed water project.

In case that for the proposed investment project, the grant level available will be lower, the only element that can assure the sustainability of the project and the coverage of the debt repayment component is to use a higher affordability rate policy leading to higher tariffs. Considering this, we have run a series of simulation to see the affordability level scenario that needs to be used in order to cover different percentages of debt financing.

Table 13-16: Correlation between affordability ratio and debt financing

Affordability ratio level	Debt financing percentage of the investment costs
1.00%	27.04%
1.10%	53.14%
1.15%	65.45%
1.20%	77.48%
1.30%	100.00%

The best practice in the Eastern Europe mentions that a reasonable level of the affordability limit for the solid waste sector should be 1.0% of the average household disposable income. However, depending of the financing structure available for the investments, a higher pressure can be put on the customers in order to assure significant improvement of the qualities of the services and compliance with the environmental requirements.

13.8 Economic Analysis

13.8.1 Methodology

As set out in Article 101 of Regulation (EU) no. 1303/2013, an economic analysis must be carried out to appraise the project's contribution to welfare. There are two main reasons why CBA is required for major projects:

- To assess whether the project is worth co-financing;
- To assess whether the project needs co-financing.

The economic analysis addresses the first task. If the project's economic net present value (ENPV) is positive, then the society (region/country) is better off with the project because its benefits exceed its costs.

For this purpose the financial project cost have to be transferred into economic cost by appropriate conversion factors and to be compared to the economic project benefits by means of a present value approach.

The assumptions and the method of calculating the economic indicators (ENPV, ERR and Cost/Benefit Ratio) is presented in the CBA Financial Model, sheet "Economic Analysis".

The economic analysis is based on the following assumptions:

- The period for the economic evaluation is 2015 to 2044;
- The base year for evaluation is 2014;
- All cost and benefit figures are stated in constant prices;
- Discount rate used for calculation of NPV is 5%.

13.8.2 Economic Project Costs

The cost components considered in the economic evaluation are:

- Project investment cost;
- Replacement cost;
- Project OM&A costs;
- CO_2 emissions.

Within the economic evaluation for the Project Measure there is only one conversion factor applied. It is a conversion factor for labour cost, used to exclude the transfer payments included in labour cost (like taxes and social security payments) and to establish a shadow price for labour considering unemployment. As suggested in the "Guide to Cost-Benefit Analysis of Investment Projects. Economic Appraisal Tool for Cohesion Policy 2014-2020" (December 2014), the following factor is applied:

SW = FW*(1-u)*(1-t)
where SW = the shadow wage
W = the financial (market) wage
u = the regional unemployment rate
t = the rate of income taxation, social security payments and other relevant taxes

The conversion factor (1-u)*(1-t) is applied for all costs with a labour component for each year of the evaluation period.

According to the Consultant's estimate taxes and transfers on labour components are about 38.33% of labour cost while the unemployment rate in the Southern part of Moldova is 8.9%. The resulting shadow price of labour is 56.43%. In order to transfer financial cost into economic cost the labour cost components have to be multiplied by a factor of 0.5602.

13.8.3 Anticipated Impacts / Benefits of the Project

The project economic benefits for waste management projects can be grouped into three main categories:

- Resource cost savings;
- Reduction of visual disamenities, odours and direct health risks; and
- Reduction of greenhouse gas emissions.

The specific details and suggestions for the quantification for each category are the following:

13.8.3.1 Resource cost savings

Potential resource cost savings are of two types, namely:

- The recovery of recyclable products and the production of compost and energy;
- The reduction of the total amount of waste finally going to final disposal, which extends the economic life of the landfills.

Recovery of recyclable materials

The sale values of the recyclable materials are taken as a proxy for the resource cost saving due to the recycling. The prices of recyclable materials were taken to be as shown in the respective chapter from the financial analysis.

Production of compost

As a result of the project, rural households and municipal parks will generate a compost of good quality which can be used in situ, i.e. in the gardens of the households or in the municipal parks which produced them. For the compost we have used the same revenues as used for the financial analysis.

Recovery of energy

Incineration is not proposed as a disposal technique, and it is proposed that the landfill gas collected at landfills will be flared, as its distribution and sale to energy consumers would not be economic. No energy will therefore be recovered.

Extension of life of landfills

The reduction of the total waste quantity reaching final storage, leading to the increased lifetime of the county's landfill. This cost reduction will be quantified based on the incremental waste flow that reaches the landfill (waste reaching the landfill in the scenario „without project" minus waste reaching the landfill in the scenario „with project") multiplied with the cost for storage of one ton of waste.

13.8.3.2 The reduction of visual disamenities, odours and direct health risks

The reduction of visual disamenities, odours and direct health risks is due to:

- The elimination of uncontrolled dump sites;
- The avoidance or proper collection and treatment of waste leachate.

The quantification of these benefits was done based on:

- Increase in land values in the areas surrounding the rehabilitated dump sites (which can be estimated at a certain amount per hectare of rehabilitated dumpsite);
- Avoided cleaning costs for not having to treat impact of uncontrolled discharges of leachate and/or the cost to develop alternative water sources when applicable (which was estimated at a certain standard amount per tonne of waste either diverted from the landfill).

13.8.3.3 Reduction of greenhouse gas emissions

The reduction of greenhouse gas emissions is due to:

- The avoidance (or proper col-lection) of methane and carbon dioxide emissions, which typically account for 64% and 34% in volume, respectively, of all gas generated from decomposing waste; and
- The emissions saved when the project results in the generation of heat and/or electricity and the alternative source for this heat and/or energy implies the use of fossil fuels.

The quantification of these benefits was done based on estimation of the annual expected reduction in tonnes of methane and carbon dioxide (CO_2) due to the project, transformation of the methane quantities into CO_2-equivalent using a standard conversion factor and monetization of the resulting quantities of CO_2 and CO_2-equivalent using a standard value of EUR per tonne of CO_2. The CO_2 emission per ton of waste included in the CBA Guides prepared by JASPERS for different countries and used in the analysis are presented in the following table:

Table 13-17: CO_2 emission quantities

Type of waste	M.U.	Tons CO_2
Not collected or collected and not disposed of properly	kg	833
Mixed waste going directly to compliant landfill	kg	250
Mixed waste going directly to incineration	kg	181
Mixed being transformed into RDF and going to incineration	kg	236
Bio-waste collected separately and composted -aerobic	kg	26
Bio-waste collected separately and composted -anaerobic	kg	8
Packaging waste collected separately and recycled	kg	-1037
Mixed waste to MBT for compost, with landfilling of rejects	kg	161
Mixed waste to MBT for compost, with incineration of rejects	kg	272

13.8.4 Results of Economic Analysis

The assessment of the economic viability of the project is based on the assumptions outlined above and the anticipated project benefits as outlined in the previous section. The net present value of the main economic costs and benefits are presented in the following table.

Table 13-18: Economic benefits and costs

Economic benefits and costs		NPV@5.0%	%
Project cost			
Resulting overall economic capital costs	Euro	24,151,417	65.01%
Incremental economic operation cost	Euro	12,998,916	34.99%
Overall economic project cost	Euro	37,150,333	100.0%
Project Benefits			
Recovery of materials and energy	Euro	9,050,085	23.5%
Extension of economic life of landfills	Euro	-	0.0%
Avoidance or proper collection and treatment of waste leachate	Euro	5,794,391	15.1%
Total benefits from avoided C02 emissions	Euro	23,636,275	61.4%
Overall economic project benefits	Euro	38,480,752	100.0%

The main economic analysis indicators are presented in the following table:

Table 13-19: Economic Analysis Indicators

Economic Analysis Indicators		
Economic Net Present Value (ENPV)	Euro	1,330,419
Economic Rate of Return (ERR)	Euro	5.84%
Benefit-Cost Ratio	Euro	1.036

The project shows satisfactory economic indicators with economic benefits significantly exceeding economic cost proving that the Project is worth co-financing.

14 Risk analysis

As set out in Article 101 (Information necessary for the approval of a major project) of Regulation (EU) No 1303/2013, a risk assessment must be included in the financial and economic analysis of investment projects. This is required to deal with the uncertainty that always permeates investment projects, including the risk that the adverse impacts of climate change may have on the project.

All assumptions made regarding the basic variables used in the models are subject to uncertainties, so that a certain variation (both positive and negative) of the variables is always possible. The sensitivity and risk analysis deals with the evaluation of the impact of given percentage changes in a variable on the performance of the project and the assessment of the probability that a project will perform successfully, as well as the variability of the outcome compared to the best estimate (or base case) previously made.

The objective with risk analysis is to identify and assess factors that may jeopardize the success of a project. There are several techniques that may help to define preventive measures to reduce the probability of these factors from occurring and identify countermeasures to successfully deal with these constraints when they develop to avert possible negative effects on the competitiveness of the company. Reference class forecasting was developed to increase accuracy in risk analysis. The outcome of a risk analysis is to demonstrate the robustness of the project where the weak spots are identified. There are several variables that could be tested like implementation of a project but in this case it will only assess the financial implication.

A qualitative risk analysis was carried out to provide an evaluation of the risks arising from the implementation of the project, in particular for the short-term but also long-term financial sustainability of the project, and to identify possible risk prevention and mitigation measures.

A Probability (P) or likelihood of occurrence is attributed to each adverse event. Below, a recommended classification given in the "Guide to Cost-Benefit Analysis of Investment Projects. Economic Appraisal Tool for Cohesion Policy 2014-2020":

- A: Very unlikely (0–10% probability);
- B: Unlikely (10–33% probability);
- C: About as likely as not (33–66% probability);
- D: Likely (66–90% probability);
- E: Very likely (90–100% probability).

To each effect a Severity (S) impact from, say, I (no effect) to VI (catastrophic), based on cost and/or loss of social welfare generated by the project, is given. These numbers enable a classification of risks, associated with their probability of occurrence. Below is presented the classification recommended in the "Guide to Cost-Benefit Analysis of Investment Projects (Economic Appraisal Tool for Cohesion Policy 2014-2020").

Table 14-1: Risk severity classification

Rating	Meaning
I	No relevant effect on social welfare, even without remedial actions
II	Minor loss of the social welfare generated by the project, minimally affecting the project long run effects-

Rating	Meaning
	However, remedial or corrective actions are needed.
III	Moderate: social welfare loss generated by the project, mostly financial damage, even in the medium-long run. Remedial actions may correct the problem
IV	Critical: High social welfare loss generated by the project; the occurrence of the risk causes a loss of the primary function(s) of the project. Remedial actions, even large in scope, are not enough to avoid serious damage.
V	Catastrophic: Project failure that may result in serious or even total loss of the project functions. Main project effects in the medium-long term do not materialize

Source: "Guide to Cost-Benefit Analysis of Investment Projects. Economic Appraisal Tool for Cohesion Policy 2014-2020"

The Risk level is the combination of Probability and Severity (P*S).

Table 14-2: Risk levels considering the severity and probability

Severity/ Probability	I	II	III	IV	V
A	Low	Low	Low	Low	Moderate
B	Low	Low	Moderate	Moderate	High
C	Low	Moderate	Moderate	High	High
D	Low	Moderate	High	Very High	Very High
E	Moderate	High	Very High	Very High	Very High

A number of individual risks were identified which are assessed in the following risk matrix.

Table 14-3: Risk prevention matrix

Adverse effect	Variable	Causes	Effect	Timing	Effect on Cash Flow	Probability (P)	Severity (S)	Risk level (=P*S)	Prevention and/or Mitigation measures	Residual risk after prevention/mitigation measures
Implementation risk										
Delays in preparation of tender documents	Not applicable	Low capacity of the technical assistance consultant	Delay in commencement of works	Short	No direct impact on the cash flow of the company. Delay in absorption with potential problems in losing part of the financing due to decomitment.	A	II	Low	A technical assistance consultant for preparing the tender documents will be selected in order to perform the tender documents rapidly allowing the launch of the tender immediately after the financing approval.	Low
Delays in the tendering process	Not applicable	Appeals by the not selected companies	Delay in commencement of works	Short	No direct impact on the cash flow of the company. Delay in absorption with potential problems in losing part of the financing due to decomitment.	D	III	High	Appropriate time contingencies have been factored in into the ten dering procedure. Support during the tendering process is to be provided by the Technical Assistance consultant.	Medium
No bids are received	Not applicable	The construction companies from the market does not have enough working capacity	Delay in commencement of works	Short	No direct impact on the cash flow of the company. Delay in absorption with potential problems in losing part of the financing due to decomitment.	B	II	Low	Cost estimates for individual project components have been established with consideration of the current market situation. Adequate communication and tendering process to attract possible bidders Procurement strategy designed to make the contract attractive	Low
Delayed obtainment of permits	Not applicable	Low political commitment; Mismanagement of the licensing procedure process	Delay in commencement of works	Short	Delay in establishing a positive cash flow including benefits materialization	A	II	Low	Close monitoring	Low
Construction delay	Investment	Low contractor capacity	Delays in compliance	Medium	Delay in establishing a positive cash flow including	C	III	Moderate	Appoint project managers for each works contract inside the	Medium

Adverse effect	Variable	Causes	Effect	Timing	Effect on Cash Flow	Probability (P)	Severity (S)	Risk level (=P*S)	Prevention and/or Mitigation measures	Residual risk after prevention/mitigation measures
	costs		to EU directives and national legislation		benefits materialization				PIU to closely monitor the activity of the constructors in order to prevent delays.	
Project cost overrun	Investment costs	Inadequate design cost estimates	Investment costs higher than expected	Short	Higher (social) costs in the first phase of the project	B	V	High	The design of the project must be revised. The project costs were estimated based on current market conditions.	Low
Financial risk										
Lower tariff levels	Tariffs	Low political commitment toward implementation of the tariff strategy.	Lower revenues leading to sustainability problems.	Medium	Lower revenues decreasing the capacity to cover operating costs, repay debt service and make investments in infrastructure.	D	IV	Very High	The tariff strategy will be communicated and discussed with the political decision makers in the approval phase of the project. The tariff strategy should be included as covenant in the Financing Contracts.	Medium
Decommitment of funds for investments	Not applicable	Delays in implementation	Lower financial resources for investment financing	Low	Significant impact because investment will have to be financed by the operator or by the Local Authorities.	A	III	Low	Appoint project managers for each works contract inside the PIU to closely monitor the activity of the constructors in order to prevent delays.	Low
Lower number of contracts with customers than expected	Demand	Lower connection of customers	Lower revenues leading to possible sustainability problems.	Long	Lower revenues decreasing the capacity to cover operating costs, repay debt service and make investments in infrastructure.	D	III	High	Awareness campaigns to convince customers to sign contracts with waste management operator. Support from local authority to increase connection level. Additional tariff increases to cover the revenues gap.	Medium

Adverse effect	Variable	Causes	Effect	Timing	Effect on Cash Flow	Probability (P)	Severity (S)	Risk level (=P*S)	Prevention and/or Mitigation measures	Residual risk after prevention/mitigation measures
Low level of collection	Collection rate	Lower collection of revenues from customers	Lower revenues leading to possible sustainability problems.	Long	Lower revenues decreasing the capacity to cover operating costs, repay debt service and make investments in infrastructure.	D	III	High	Awareness campaigns to convince customers to pay the invoice on time. Support from local authority to increase collection level and impose penalties for belated payment. Additional tariff increases to cover the revenues gap.	Low
Low level of recyclables collection	Not applicable	Lower collection of revenues from recyclables sale	Lower revenues leading to possible sustainability problems.	Long	Lower revenues decreasing the capacity to cover operating costs, repay debt service and make investments in infrastructure.	C	II	Moderate	Awareness campaigns to convince customers to sort waste. Support from local authority to increase selective collection. Additional tariff increases to cover the revenues gap.	Low
Lack of market opportunities for collected recyclables	Not applicable	Lower collection of revenues from recyclables sale	Lower revenues leading to possible sustainability problems.	Long	Lower revenues decreasing the capacity to cover operating costs, repay debt service and make investments in infrastructure.	D	II	Moderate	Market scanning and networking in order to identify possible opportunities within the country and abroad. Additional tariff increases to cover the revenues gap.	Low
Deterioration of assets	Maintenance and replacement level	Advanced deterioration of existing assets as well as poor state of the existing infrastructure	Higher operating costs or possible reinvestments needed leading to possible sustainability issues	Long	Higher costs decreasing the capacity to cover operating costs, repay debt service and make investments in infrastructure.	D	III	High	Support from local authority to improve infrastructure (roads) condition. Identify alternative sources to replace obsolete assets. Additional tariff increases to cover the costs gap.	Moderate

Adverse effect	Variable	Causes	Effect	Timing	Effect on Cash Flow	Probability (P)	Severity (S)	Risk level (=P*S)	Prevention and/or Mitigation measures	Residual risk after prevention/mitigation measures
Political and social risk										
Opposition of local political decision makers to the regionalization process	Not applicable	Low political commitment for allowing to "loose" the control over the local existing operators	Delays in investment implementation Delays in regional operation and implementation of economies of scale	Medium	Lower funds available for assuring a sustainable operation (no economies of scale).	D	III	High	Extensive discussion with the local authorities to explain the advantages of the project and of the operation at regional level	Moderate
Public opposition	Not applicable	Inadequate communication strategy Political interference Underestimation of threats	Delays in implementation of investment	Medium	No direct impact on the cash flow of the company.	A	II	Low	Awareness raising activities and campaigns to raise the level of social acceptance	Low

Considering the above mentioned elements, low residual risks remains for the project that would question its overall viability.

15 Institutional arrangements

15.1 Legal Framework applicable to Integrated Waste Management Systems in the Republic of Moldova

Waste management legislation of the Republic of Moldova (RM) is outdated and a legislative initiative on a new regulation was already submitted to the Moldovan Parliament and, for this reason, our assessment will focus both on the existing legal framework and the draft law on waste management.

In order to assess the national legal framework on waste management, we agreed to group them in the following categories:

- General framework - includes the laws that establish the general provisions on waste management;
- Regulatory (administration) framework – includes specific provisions for the management and organization of waste management at community level;
- Operating framework - includes laws and regulations that regulate the relations between service operator and service delegating party (LPA).

15.1.1 General Legal Framework

The Waste Management Strategy of the Republic of Moldova for 2013-2027, adopted by Government Decision No. 248 on 10 April 2013, stipulates that "...an important issue contributing to the establishment of an integrated waste management system at **regional** level is the promotion of **inter-rayonal cooperation**, aimed at establishing **regional waste management associations**, defining distinct roles within the institutional system".

At the institutional level, the Strategy also sets specific objectives for each type of waste. For household waste, item d) states the **improvement of institutional governance in household waste management by establishing associations of local public authorities at the regional level**.

The legal framework in force: Law on Environmental Protection No. 1515-XII of 16 June 1993 and Law No. 1347-XIII of 9 October 1997 on Production and Household Waste regulate: the way of cooperation of specialized central public authorities in environmental protection, including the competence and duties of local public administration and the competence and specific duties of specialized central public authorities and local public administration in the management of production and household waste.

According to *Law No. 1347-XIII of 9 October 1997 on Production and Household Waste*, Local Public Authorities (LPA) have a number of duties (Articles 4-7), such as: coordinate and organize, in economic and organizational terms, the waste management actions of individuals and legal entities from the subordinated territories...; pass decisions on assignment of land that should be used for waste disposal and the development (extension) of waste processing and neutralizing facilities...; organize the collection and disposal of household waste, as well as those belonging to small producers, affecting places for storage; and other.

It should be noted that, at the time of assessment, the Ministry of the Environment was in the process of repeated endorsement of the new draft Law on Waste. This draft law provides the LPA and CPA specific duties of waste management. The provision that (Article 11) - *LPA shall contribute to the establishment of an integrated waste man-*

agement system at the regional level and ensure the inter-rayonal cooperation in order to establish regional waste management associations, is innovative.

15.1.2 Regulatory Legal Framework

Regarding the regulation (management) of services, the following were taken into consideration: Following its last amendment by Law No. 37 of 19 March 2015, the *Law No. 1402/2002 on Public Utility Services* recognizes that "*sanitation*" is a public utility service (PUS) - Article 3 and that "LPA have exclusive *competence for the establishment, organization, coordination, monitoring and controlling the operation of PUS* and *the establishment, management and operation* of public property assets that are part of the municipal infrastructure of the respective administrative-territorial units" (*Article 14*). *Law No. 435/2006 on Administrative Decentralisation* also supports the need for institutionalization of the waste management and provides in Article 5 that PUS can be conducted through cooperation and shall be set in the agreements signed between the parties, under the law, in strict compliance with budget resources and responsibilities assumed by them. This would be the first step taken to launch regional initiatives in this area (see the Waste Management Strategy), e.g. starting the development/implementation of project proposals on waste management, rather than direct provision of this service. Article 5 (3) provides that the concluded agreements shall establish clearly the funding sources, the limits of decision-making power separately for each level of public authority, and the deadlines for agreement implementation, considering that the waste management service is not performed in a specified period.

15.1.3 Operating Legal Framework

This category of regulatory acts also includes some provisions of Law No. *1402/2002 on Public Utility Services* that stipulates that public utility services (PUS) shall be delivered/provided by specialized operators (municipal and individual enterprises, joint stock companies, partnerships, limited liability companies, companies with other legal forms of organization), which can be the following:

- Specialized departments of local public administration authorities;
- Business operators, irrespective of their legal form of organization;
- Individuals and/or their associations.

The law also sets out conditions that shall be met by operators during service provision that shall ensure the provided services, as well as obligations that operators have towards consumers.

The law specifies that the management of public utility services shall be organized and performed through:

- Direct management - LPA authorities assume all duties and responsibilities for the organization, conduct, administration and management of public utility services. Direct management is performed by specialized departments within LPA authorities;
- Delegated management - through public-private partnership agreement, LPA authorities can appoint one or more operators to whom waste management was entrusted, under that agreement, to manage the delivery/provision of public utility services, as well as to administer and operate the public municipal technical infrastructure.

The operators shall be delegated to manage PSCC under conditions of transparency, by public tender. The only exception are the operators of public water supply and sewerage services, founded by local public or central specialized administration authorities with a majority public shareholding. In this case, the service management can be delegated directly to them (Article 21).

15.2 Current Situation with Sanitation Management

Sanitation management is organized and performed by:

At the present time, there are two forms of waste management in the Republic of Moldova: *direct management* - when LPA developed a specialized department (it may be the Municipal Enterprise if it operates within a PLA's department/division); and *delegated management* - by service agreement.

Experience of inter-municipal cooperation in the Republic of Moldova:

- Joint stock company responsible for the provision of collection, transport and disposal services of municipal waste in Soldanesti, Floresti and Rezina rayons;
- Waste Management Association in the South Development Region.

15.2.1 Joint Stock Company responsible for Provision of Municipal Waste Collection, Transport and Disposal Services in Soldanesti and Rezina rayons

23 LPAs and one Rayon Council (Soldanesti) joined together and created a joint stock company responsible for the provision of municipal waste collection, transport and disposal services (operation services). The service is delegated by each administration under a Service Delegation Agreement. Company's capital was supplied by contribution in kind, i.e. equipment owned by each LPA and financial contributions.

The LPAs made the following steps to establish this Joint Stock Company:

- Prepared and made official decisions in each local (rayon) council to be a founding member on the willingness and availability for inter-municipal cooperation by association in a Joint Stock Company;
- Signed a Memorandum of Association between the founding members, setting up the conditions of the new company foundation and the contributions of each LPA;
- Prepared the foundation documents - company statute;
- Signed the statute and registered it with the State Chamber of Registration.

According to its Statute, the newly-established Company performs the following activity, inter alia: the "Company shall carry out activities related to sanitation, de-pollution and other similar activities The Company may carry out any other activity that is not prohibited by law" (Article 4 of the Company Statute).

When the Joint Stock Company is established, each LPA shall sign with the new Company an agreement of waste management delegation. The agreement will be signed for a period of 25 years. The object of this agreement consists of the following activities: "a) the collection, transport and storage of municipal waste; b) street cleaning (sweeping and washing public roads); c) maintenance, cleaning of green areas that are situated in areas with public roads; d) street cleaning during the cold season." (Article 2, Chapter 2 of the Delegation Agreement).

The Joint Stock Company was established at the recommendation of experts who supported these LPA when starting pilot activities on solid waste management. This is an innovative company for the Republic of Moldova and is in compliance with the provisions of the existing laws regarding public service delegation to an economic operator, this operator being founded by authorities that benefit from this service. This pilot project gives us an example of a potential waste management operator.

15.2.2 Waste Management Association in the South Development Region

In the South Development Region, the Regional Waste Management Strategy stipulates that an association of LPAs is the most relevant model of inter-municipal cooperation. Thus, in 2012 a Waste Management Association was established in the South Development Region.

According to the statute of this association (registered with Ministry of Justice of the Republic of Moldova under No 5932 of 4 January 2013), the cooperation between LPAs is "an union of legal entities, which is nongovernmental and apolitical, without a lucrative purpose (not-for-profit), established by administrative-territorial units, organized according to the law, as towns (municipalities), rayon councils and villages (settlements), and by associations specialized in waste management, further members of the Waste Management Association in the South Development Region, under the Civil Code of 6 June 2002 (Articles 180, 181), European Charter of Local Self-Government of 15 October 1985 ratified by Parliament Decision of 16 July 1997 (Article 10), Law No 438 of 28 December 2006 on Local Public Administration (Articles 14, 43)".

The association is a form of voluntary cooperation without any legal enforcement to participate. At present, not all LPAs from the Development Region are part of the association. About 50 LPAs are fully fledged members and other 35 submitted an application to became members. Due to lack of funds, the Association has failed to carry out more activities listed in its statute so far.

The Association also took over from member LPAs the responsibility to delegate the sanitation service and to lease the LPA's goods in public and/or private ownership that constitute the technical municipal infrastructure.

The Waste Management Association in South Development Region covers a geographical area that includes three Waste Management Areas. Thus, this association monitors and coordinates the implementation of Regional Waste Management Strategy. A regional committee of the association will coordinate each management area.

This association was also established at the recommendation of the experts involved in the development of the Regional Waste Management Strategy. Such an Association is a good example for the regulatory function. Currently, the following LPAs from the management area 3 (Cahul, Cantemir and Taraclia rayons) are members in South IDA:

- Cahul rayon – Manta;
- Cantemir rayon - Antonesti, Chioselia, Cietu, Cirpesti, Cisla, Costangalia, Porumbesti, Enichioi, Haragis, Toceni, Sadic, Tiganca, Gotesti;
- Taraclia rayon - Taraclia town, Albota, Cairaclia, Tvardita, Valea Perjei, Musaitu, Corten, Vinogradovca, Salcia and Novosiolovca.

15.3 Options of Sanitation Operation Delegation

Four possible options regarding the sanitation service delegation were identified during the analysis. For each role assumed by stakeholders involved in these systems, there are several options, which are presented below. These identifications are based on the criterion of service delegating party and that of potential operator.

Table 15-1: Strengthened Options

Option	Service delegating party	Operator
Option A	LPAs (Memorandum of Understanding)	Public operator
Option B	IDA	Public operator
Option C	IDA	Public operator and private operator
Option D	IDA	Private operators

All options are analysed in details below.

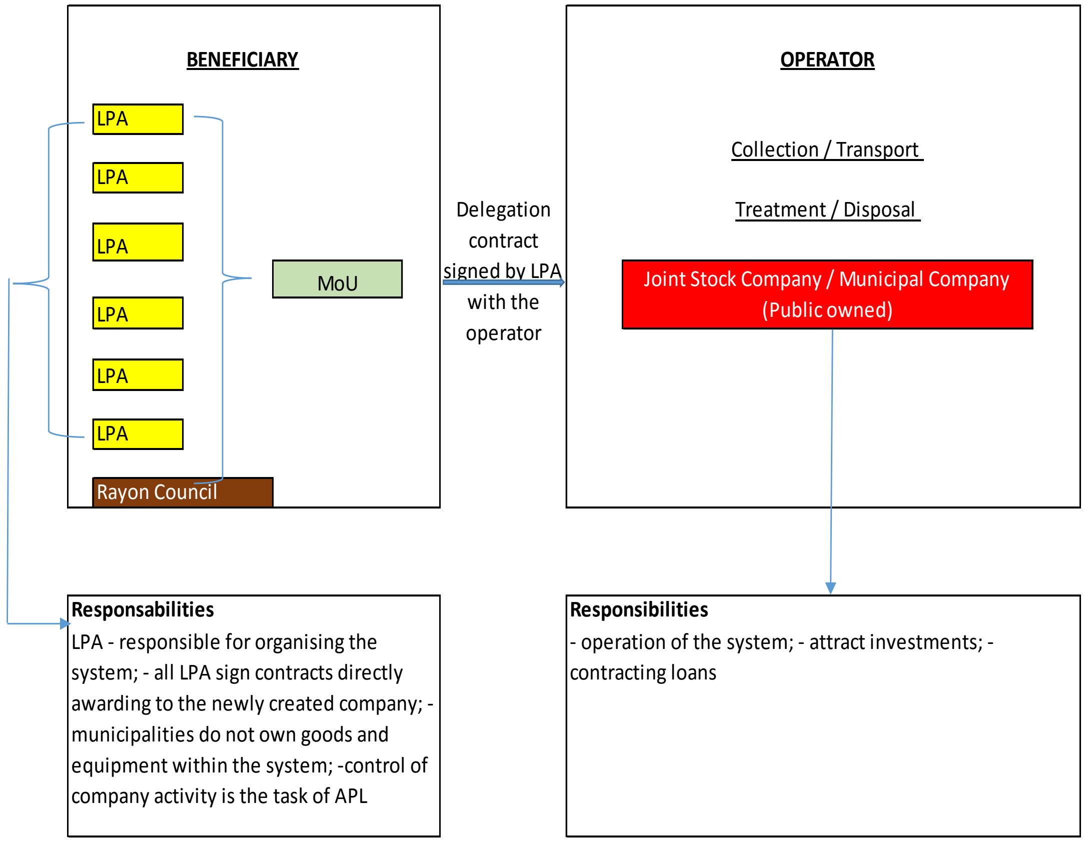
15.3.1 Option A

Option A is an option that is currently being tested in Soldanesti and Rezina rayons on the basis of a Joint Stock Company (JSC) that has 23 LPAs and a Rayon Council as shareholders, which delegate the collection, transport and disposal services to the Company. JSC will be established by signing a memorandum of understanding between the LPAs becoming shareholders.

This option has approximately the same elements as option B, except that in this case the LPAs do not form a waste management association. In this context, each LPA delegates the waste management service directly to the company established by all LPAs from a waste management area. The diagram below pictures the relations between the stakeholders involved in this institutional organization option.

This option is supported by the Law on Public Utility Services, which stipulates that these services can be provided by a joint stock company.

Figure 15-1: Organization of Regional Waste Management Systems – Option A



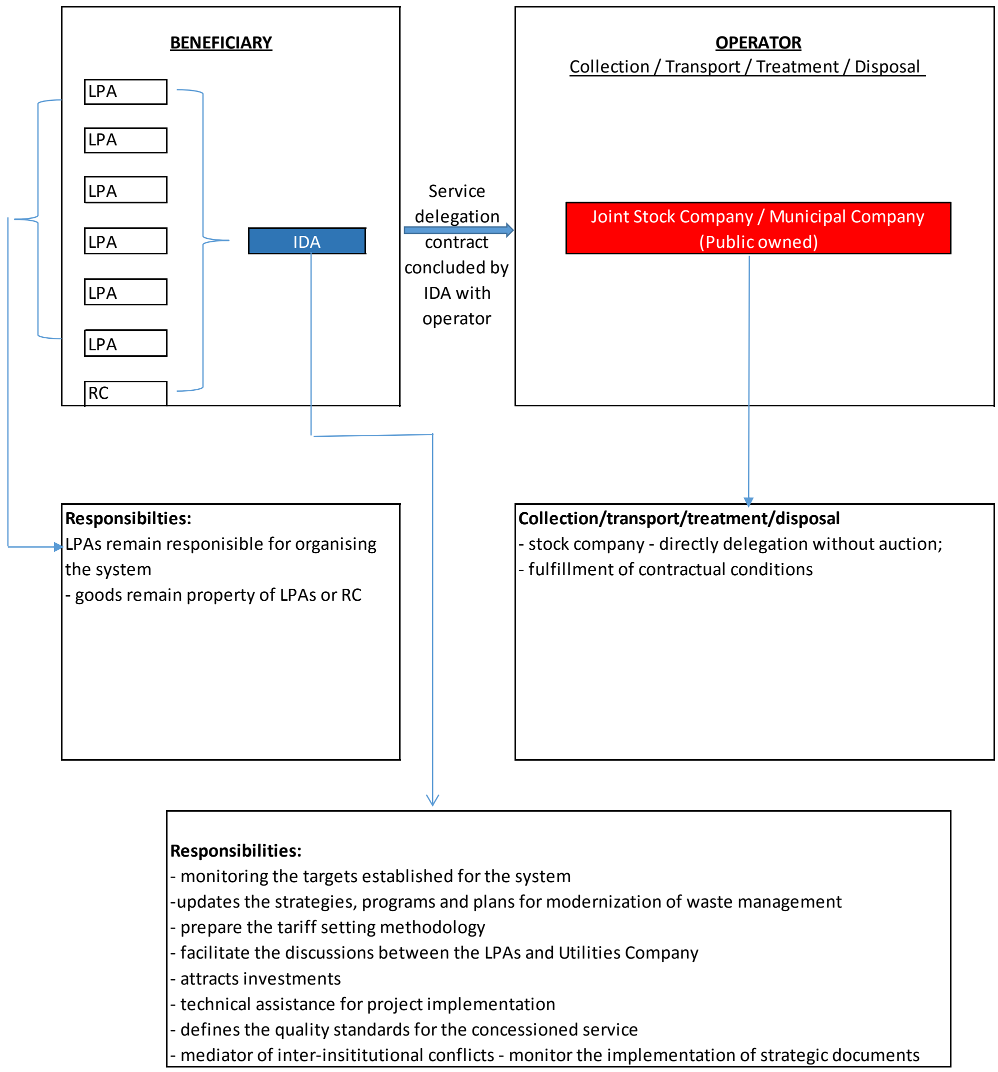
15.3.2 Option B

Option B is supported by national legislation, National Wastes Management Strategy and national regional development programmes and plans, policies that encourage the establishment of regional associations of LPAs to improve the institutional governance in the area of municipal waste management.

At the same time, **Law No. 1402-XV of 24 October 2002 on Public Services in Community Centres** provides for partnerships and inter-municipal association for systems and services establishment and operation. Priority is given to public-private partnerships, associations of local public administration authorities and private operators, regarding municipal service financing.

This option contains the following elements: a beneficiary who is represented by an Association of LPAs, a regional operator for all waste operations (collection, transport, treatment and storage). In this option, the operator is a state-owned company of public utility, established as a JSC where LPAs are shareholders, in accordance with the statute of the Intercommunity and Intermunicipal Development Association (IDA). The diagram below presents a brief description of the relations between the stakeholders involved.

Figure 15-2: Organization of Regional Waste Management Systems – Option B

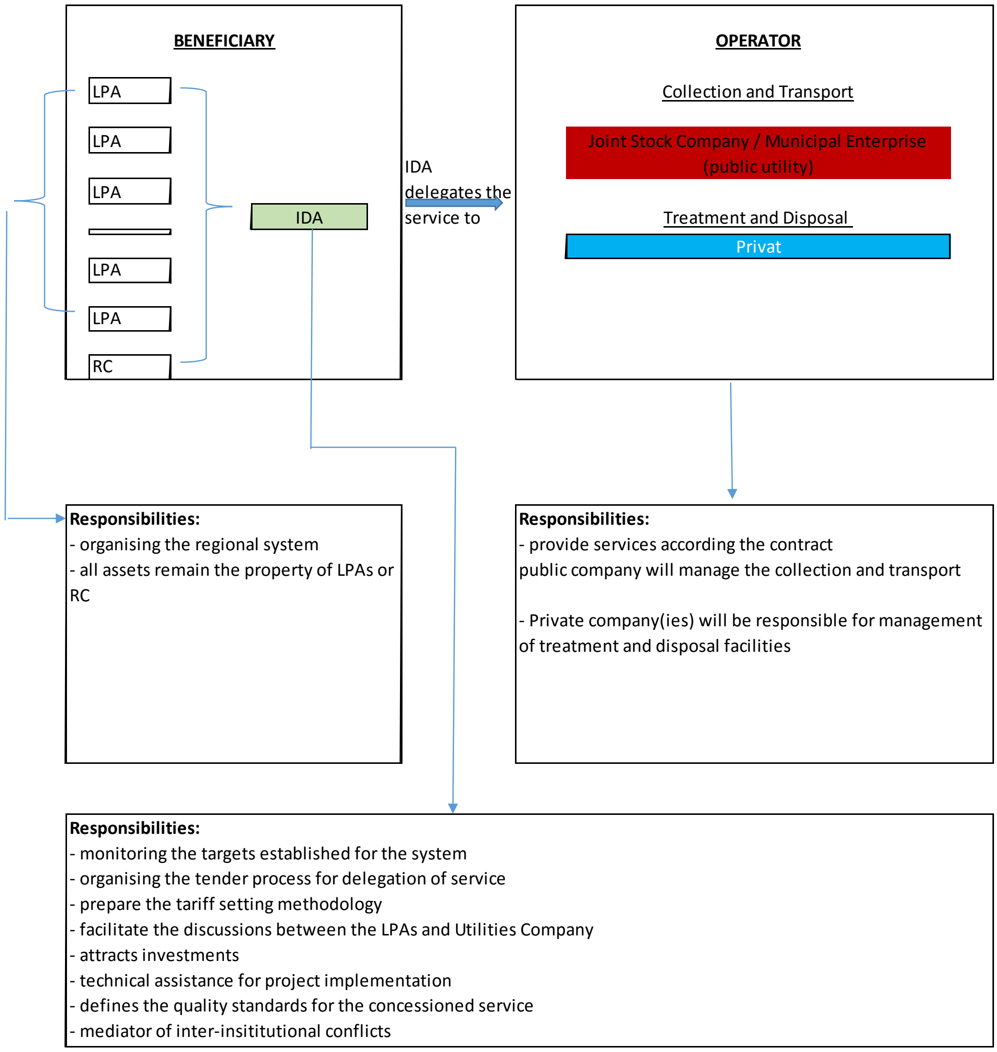


The legislation of the Republic of Moldova allows for the establishment of associations of LPAs, but it does not stipulate expressly specific types of associations, specific ways of their foundation or functioning. These associations are subject to some general provisions of the Civil Code, with regards to associations and legal entities.

15.3.3 Option C

Option C is a model similar to Option B at the beneficiary level, having specific traits for operators, particularly the combination of public operator and one or more private operators. The association of LPAs is the beneficiary. The division between the operation of the system and the two segments (collection and transport on the one hand, and storage on the other hand) aims at making the costs more efficient and lightening the financial burden of LPAs. According to the legislation of the Republic of Moldova, such an option is possible. There is no legal or administrative impediment that would interfere with the implementation of this option. This option is pictured in the diagram below.

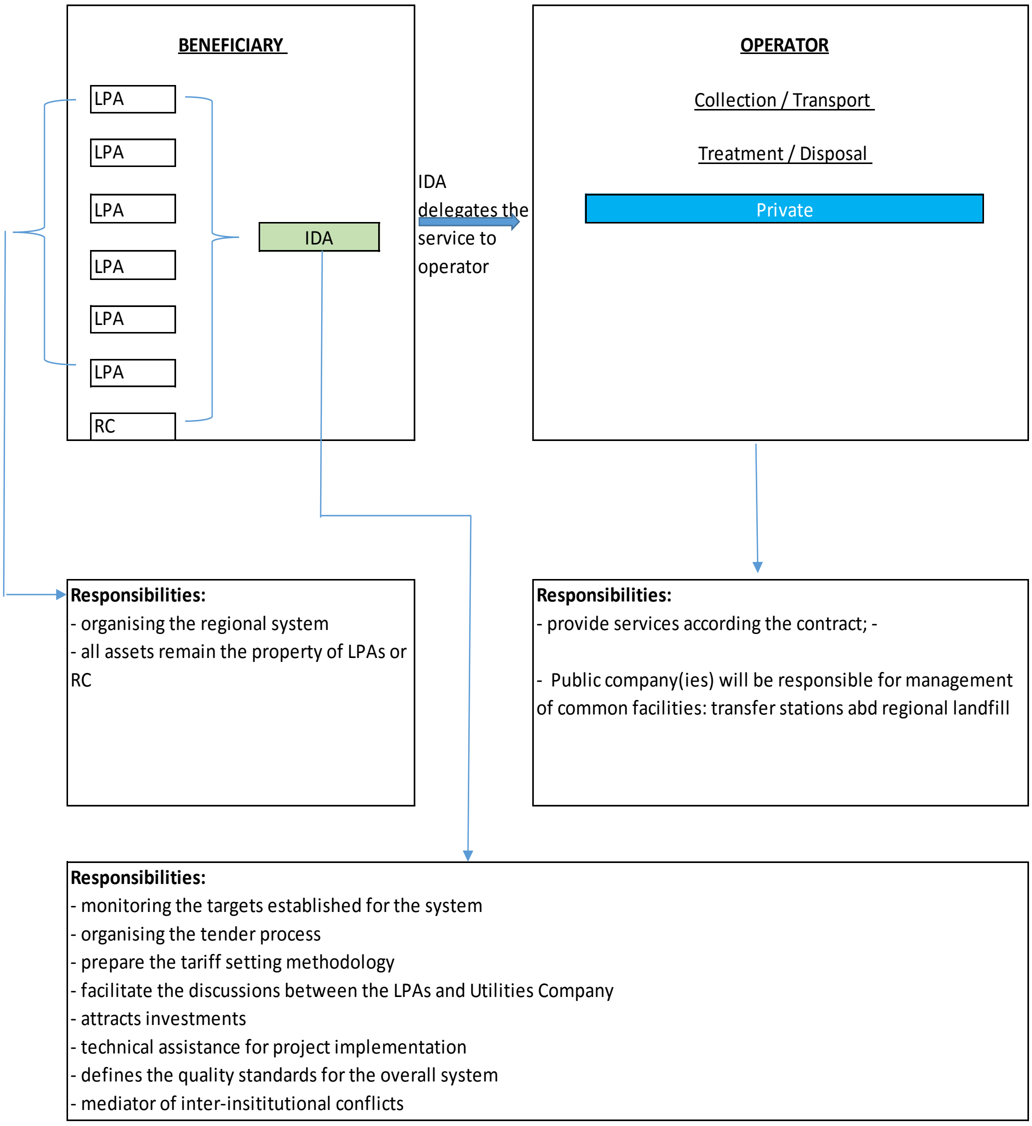
Figure 15-3: Organization of Regional Waste Management Systems – Option C



15.3.4 Option D

Option D is underlain by a liberal economic model, with a waste management market open to private operators for the collection, transportation, transfer and storage of waste. This model includes, though, an association of LPAs at the beneficiary level, establishment of IDA in order to ensure representativeness and system coordination. Like the previous opinion – the existing legal framework allows for the provision of public services by business operators, regardless of their legal organization form. The diagram below pictures the relations between the stakeholders involved in this institutional organization option.

Figure 15-4: Organization of Regional Waste Management Systems – Option D



The tables below contain the advantages and disadvantages found during the assessment of the four identified options. Both advantages and disadvantages are grouped according to the service delegating party (also referred to as IDA) and to the operator. As for Options B, C, D the service delegating party is one and the same “IDA”, therefore the advantages are also the same. The options were also assessed against the five criteria included in the assessment of the current situation in the Republic of Moldova, namely: client’s capacity, operator’s capacity, economic, political and socio-cultural conditions.

Table 15-2: Advantages of the Options Identified for the Delegation of Sanitation Service Operation

Option A Delegating party LPAs Public operator	Option B Delegating party – IDA Public operator	Option C Delegating party IDA Public and private operators	Option D Delegating party IDA Private operators
Less time and lower cost to organize institutional cooperation; Transfer of the existing experience into the development of the operator.	Representation of LPAs at the system level; Systemic approach towards the entire process; Coordination of investments; Organization and management of PIU; Smaller risk of conflict between LPAs; Fair division of costs and beneficiaries per LPAs.		
	Transfer of the existing experience into the development of the operator.	Transfer of the existing experience into the development of the operator; The private operator has experience in using the equipment.	A institutional model focused on performance and economic efficiency; Transparency in decision making; Private operators can have experience in using IWMS.

There are several advantages to *Option A*, but the main one is the following: organization of institutional cooperation between LPAs would take less time because the institutions are already parties to the Memorandum of Understanding (MoU). The parties know one another. All main aspects were discussed at the stage of negotiations, which enabled the parties to get involved quicker in decision-making, which shall reduce, thus the costs. Attention should be paid to the fact that the LPAs that are parties to the MoU have experience in waste management at the local level, and this experience can be invested in the development of the operator.

As it was previously mentioned, the other three options – B, C, D – have a common trait– the Intercommunity/Inter-rayonal Association of LPAs (IDA) and their advantages in this respect will be presented together. As IDA is an organized and registered structure, one of the main advantages is that the institution will take part in the public and civil relations as one single entity, representing the interests of the LPAs at the system level. We ought to highlight that the legal entity created by LPAs will have a systemic approach towards the entire waste management process – collection, transportation and storing of municipal waste. Besides the aforementioned, it would have knowledge of the issue, system, and infrastructure of the involved communities. Another important role of the IDA is to coordinate investments, since a great focus should be put on attracting the investments needed for the development of the system. As far as attracting and coordinating investments are concerned, IDA has the advantage that it has the possibility of, and experience in organizing and managing the Project Implementation Unit. The IDA type of organization is also advantageous as there would be smaller risks of conflicts between LPAs, because they would have had already agreed on and countersigned the main conditions on its functioning upon the submission of the decision to the Local Councils to accept the status of member of IDA. Being a structure that will have had all its operation matters negotiated, another advantage would be the preliminary approval of the scheme on the division of costs, and thus, of beneficiaries between LPAs in a pre-established and fair manner.

The analysis identified several advantages, and namely: as the use of the existing experience for the development of the operator and the equipment is an advantage for the beneficiary, because it is presumed that the beneficiary already had the experience before the establishment of IDA – this is, in essence, an advantage for the operator as well. This is explained by the fact that the operator gets some experience/knowledge of the matter and situation from a local stakeholder. The private or public operator that was selected transparently and on the basis of principles of competition will focus its entrepreneurial activity on achieving performance, providing quality services and, and on economic efficiency. There's the other side of the coin, i.e. that the market of these services is liberalized and private operators that have experience in working with IWMS can also register for the contest.

Table 15-3: Disadvantages of the Options identified for the Delegation of Sanitation Service Operation

<table>
<tr><th>Option A
Delegating party
LPAs
Public operator</th><th>Option B
Delegating party –
IDA
Public operator</th><th>Option C
Delegating party
IDA
Public and private operators</th><th>Option D
Delegating party
IDA
Private operators</th></tr>
<tr><td rowspan="2">Delegating party = Operator;
The system is mainly controlled by one single LPA;
There are risks that conflict might occur between LPAs;
The MoU does not provide a complete legal framework for the management of IWMS;
The LPAs will not be able to participate as shareholders if they do not have a budget/goods;
Operator's lack of experience in IWMS operation.</td><td colspan="3">There is no specific legislation on the establishment of IDAs;
Greater efforts are need to establish an IDA;
Difficulties in making decisions;
Dependence on the financial allocations from local budgets.</td></tr>
<tr><td>Operator's lack of experience in IWMS operation.</td><td>Long-time need for the delegation process.</td><td>Long-time need for the delegation process.</td></tr>
</table>

For *Option A* there's the disadvantage of LPA's role overlapping. On the one hand it appears as the service delegating party when it countersigns the MoU, and then on the other hand it appears as Operator, because the JSC assumes the role to operate services and equipment. Since the MoU does not contain anything on the management of gains, the role of leader will be gradually taken on by the strongest LPA (from financial point of view, and/or the one that has equipment and machines). Obviously, once leaders emerge and the powers are divided, there will appear the risk of conflicts between LPAs.

The theory of law says that the Memorandum of Understanding is in its essence the act that merely regulates parties' intention to start an activity, and does not provide, thus, the complete legal framework for the management of IWMS. As for the establishment of a JSC there is the requirement that LPAs must have budgets/goods in order to be able to join as shareholders – the disadvantage is that not all LPAs will enter on equal conditions, or will not be in as shareholders of the company at all. We must take the risk that once a new company is created, it will not have much experience with IWMS.

The disadvantages of options B, C, and D were examined jointly and are the following: although the legislation of the Republic of Moldova is developed enough with regards to the regulation of legal entities' organizational forms, the fact that there is no specific legislation for the organization of IDAs is noticeable. Another disadvantage is the big number of LPAs at rayon level that would come under a waste management region, this implying greater efforts for the creation of IDAs, which entails another disadvantage – i.e. difficulty in making decisions.

As for operators, the disadvantages would be the following: as mentioned earlier – a newly-created operator has little experience or even none at all with IWMS operation. Since many LPAs are involved in this activity, delegating takes longer and needs to be improved as experience is being gained.

Considering the aforementioned, every option comes with advantages and disadvantages. The main conclusions of the analysis are the following:

- National Wastes Management Strategy recommends to LPAs to join in order to organize regional waste management services. LPAs decide on the form of association. The level of representation and control of regional systems will determine the future associations. IDA associations are forms commonly found in Europe and beyond, ensuring a greater level of representation and control than other forms of association;
- The experience of the South in LPAs association by organizing an integrated waste management system reveals that it is possible to establish IDA association in the Republic of Moldova;
- The lack of an institution that would regulate waste management services could lead to a low performance in this area. IDAs could take over, at least temporary, the role of regulatory actor in this area, fundraising, contracting (organize, prepare tenders, participate in negotiations, discuss common approaches for the served region);
- The lack of specific legislation in the Republic of Moldova to organize intercommunity development associations prove the fact that the legal framework needs to be improved in order to achieve a better conduct of activities. The new legal framework should provide clearly the institutional system at the regional level and divide the roles and functions between stakeholders;
- Given the lack of resident private companies in waste management area (for collection, transport and storage) and the lack of work experience with investors in this field, options A, B or C are currently the most optimal for the organization of regional systems of integrated waste management in the Republic of Moldova;
- Due to lack of experience at the national level regarding the operation of waste sorting, composting stations and waste storage facilities, delegation of the operation of these facilities to a private operator will bring a technical advantage.

15.4 Activities Performed to date on the Establishment of the Institutional Installation in WMZ 3, RDS

During August-September 2015, activities were conducted to identify the appropriate option for waste management institutional structure within the Integrated Waste Management System (IWMS) at the regional level. Thus, on 26 August, the State Chancellery held a meeting with representatives of the Ministry of Regional Development and Constructions and GIZ, where possible institutional options for IWMS at the regional level were discussed. Following these discussions, the State Chancellery submitted a letter to the Ministry of Regional Development and Constructions, No 1006-33 of 8 September 2015, mentioning that an important issue contributing to the establishment of an integrated waste management system at regional level depends on the promotion of rayon cooperation in order to establish regional waste management associations, defining distinct roles within the institutional system. Also, the State Chancellery (SC) recommends to the local public authorities to establish rayon waste management associations in order to ensure the proper operation of this system and to bring investment in this sector, according to pt. 5 of GD No 248 of 10 April 2013 approving the Waste Management Strategy for 2013-2027. At the same time, it is noted that the recommendations on the intercommunity waste management associations should be approved by order of Ministry of Environment, institution responsible for this sector. The letter also stated that other elements on the institutional framework of integrated waste management systems would be established by local public authorities from the project area together with central public administration and donors.

Given this decision, on 22 and 29 September 2015 the experts of "Modernization of Local Public Services" Project organized meetings with the representatives of local public authorities from WMZ 3, as follows:

- 22.09.2015 - Cahul, meeting with representatives of LPAs from Cahul rayon;
- 22.09.2015 - Cantemir, meeting with representatives of LPAs from Cantemir rayon;
- 29.09.2015 - Taraclia, meeting with representatives of LPAs from Taraclia rayon;
- 29.09.2015 - Ceadir-Lunga, meeting with representatives of LPAs from Ceadir-Lunga and Vulcanesti rayons.

During the meeting, technical aspects were presented regarding the integrated waste management system in WMZ 3, RDS, and institutional waste management options at the regional level.

Another main activity undertaken during the meetings was to start joining the project. Thus, project experts developed a sample decision on joining the project "Integrated Waste Management System in Waste Management Zone 3, South Development Region (Cahul, Cantemir, Taraclia, Ceadir-Lunga and Vulcanesti rayons)", which was discussed and supported by participants.

92 decisions to join the project on IWMS establishment in WMZ 3 from SDR were issued by 22. December 2015, namely:

- Cahul rayon - 35 decisions from 37 LPAs (95 %);
- Cantemir rayon - 27 decisions from 27 LPAs (100 %);
- Taraclia rayon - 15 decisions from 15 LPAs (100 %);
- Ceadir-Lunga rayon – 1 decisions from 9 LPAs (11 %);
- Vulcanesti rayon – 2 decision from 4 LPAs. (50 %).

16 Procurement strategy and implementation plan

16.1 Financing options

The procurement strategy takes into account that the following options for financing of the investment are available:

- **Grant funds**. Grant financing could be available either through the state budget or through external sources, like the EU or foreign donor organisations;
- **Investment loan**. Financing of all investments through loan obtained from International Financing Institutions (IFI);
- **Combination of grant funds and investment loan**. International practices show that a possible way of financing of such investments is a combination of grant funding of certain part of the investment with loan financing from IFI for the rest part of the investment.

Regardless of the type of financing, the project should be implemented in accordance with the existing procurement procedures. Furthermore, regardless of the type of financing, there will be a need for project implementation support. This implementation support is needed with regard to procurement, preparation and evaluation of tenders, contract award and administration, financial control, project management and reporting of project expenditures.

16.2 Public procurement process

The standard public procurement process involves the following steps:

- Notification of opportunities for tendering;
- Prequalification where appropriate;
- Invitation to tender and issuance of tender documents;
- Receipt of tenders, evaluation of tenders and contract award; and
- Administration of contract.

General Procurement Notice is issued that informs the business community about the nature of the project. This notice includes the amount and purpose of the loan and/or investment grant and the overall procurement plan, including:

- The goods, works and services to be procured;
- The expected timing; and
- Name and address to contact to express interest and obtain additional information.

This notice is published on the Client’s own procurement web site and on official government procurement portal. In addition, the notice shall be submitted to the International Financing Institution(s) (IFI), which will arrange for publication of the notice. The notice shall be published not later than 45 days before invitations to tender are issued in the procurement section of the IFI.

Prequalification of Tenderers may be applied. The prequalification criteria include: experience and past performance on similar contracts; capabilities with respect to personnel, equipment, and construction or manufacturing facilities; financial position.

16.3 Main procurement procedures

The main principle governing the award of contracts is to achieve competitive tendering. The purpose of competitive tendering is twofold:

- To ensure the transparency of selection of contract awardee; and
- To ensure the desired quality of services, supplies and works at the best possible price.

The available procurement procedures are:

- **Open tender** - takes place in a single stage and any interested party may submit a bid;
- **Restricted tender** - consists of two stages, and only the bidders selected by the contracting authority at the first stage will be invited to submit bids at the second stage;
- **Competitive dialogue** - any interested party may submit a bid. The contracting authority may have a competitive dialogue only with the accepted candidates. Only the candidates selected by the contracting authority are invited to submit a final offer;
- **Negotiation –** the contracting authority discusses and negotiates the contractual clauses, including the price, with the selected candidates from amongst suppliers, contractors and providers. The contracting authority may, or may not publish a notice for invitation to negotiations;
- **Request for offers** – a simplified procedure according to which the contracting authority requests offers from several suppliers, contractors, and providers.

Open Tendering provides the greatest opportunity for competition and satisfies the needs for economy and efficiency, giving adequate notification of contract requirements to all tenderers. Therefore, it is recommended that the procurement process for WMZ 3 is based on open tendering.

16.4 Procurement strategy

16.4.1 General considerations

The present Feasibility Study has identified that the following investments are needed for establishment of integrated solid waste management system in WMZ-3 RDS:

- Supply of equipment for waste collection and transport, including equipment for separate collection of recyclables;
- Construction of two transfer stations: one for Taraclia and Ceadir-Lunga Rayons and one for Cantemir Rayon;
- Construction of new sanitary landfill in Cahul;
- Construction of two sorting stations: one in Cahul and a one at Taraclia transfer station;

- Construction of three composting plants of green waste for reduction of biodegradable waste for landfilling;
- Supply of home composting devices as a waste minimisation measure.

The project costs for the initial phase have identified as presented in the following table.

Table 16-1: Identified project costs

	Cost Item	Value in Euro	Value in MDL
1	Construction Works and Buildings	7,555,000	139,767,500
2	Plants Equipment	1,329,000	24,586,500
3	Waste Collection Equipment	5,861,000	108,428,500
4	Design[14]	454,000	8.399,000
5	Technical Assistance	295,000	5,457,500
6	Construction Supervision	378,000	6,993,000
7	Public Awareness	297,000	5,494,500
8	Contingency	1,475,000	27,287,500
Total		**17,644,000**	**326,414,000**

With regard to implementation of the investments needed for WMZ 3, the table below presents the type of contracts envisaged.

Table 16-2: Type of contracts envisaged

Investment cost item	Location	Type of contract
Landfill construction	Cahul	WORKS
Landfill equipment	Cahul	SUPPLY
Transfer stations construction	Taraclia and Cantemir	WORKS
Transfer stations equipment	Taraclia and Cantemir	SUPPLY
Sorting stations construction	Cahul and Taraclia	WORKS
Sorting stations equipment	Cahul and Taraclia	SUPPLY
Composting facilities construction	Cahul, Taraclia and Cantemir	WORKS
Composting facilities equipment	Cahul, Taraclia and Cantemir	SUPPLY
Residual waste collection equipment	All 5 rayons	SUPPLY
Separate waste collection equipment	All 5 rayons	SUPPLY
Home composting devises	All 5 rayons	SUPPLY
Closure of existing disposal site	Cahul	WORKS
Construction Supervision	Cahul, Taraclia and Cantemir	SERVICE
Technical Assistance	All 5 rayons	SERVICE
Public Awareness	All 5 rayons	SERVICE

The sections below present the different type of contracts which will be needed for implementation of the project.

16.4.2 Works contracts

The Works Contract will be tendered as Open Tender according to the Moldovan Public Procurement Law. The Open Tendering shall take place in a single round and any interested party may submit a bid. The time period between the date of the procure-

[14] Design of the project facilities will be provided within the frame of Gopa-implemented project

ment notice being sent to the Official Journal of the European Union and in the ESPP (Electronic System Public Procurement) for publication and the deadline for submitting offers shall be at least 52 days (calendar days).

For construction works two main type of FIDIC contracts are internally used – Red Book and Yellow Book:

- **The Red Book** – "*Conditions of contract for construction for building and engineering works designed by the employer*".
  The Red Book is the FIDIC recommended form of contract for building or engineering works where the employer has been responsible for almost all of the design. According to this type of contract, payment is made according to bills of quantities. In certain cases payment can also be made on the basis of agreed lump sums for scope/items of work. The Red Book is administered by a third party - an engineer. The engineer is responsible for monitoring the construction work on behalf of the employer. The engineer also certifies the outputs achieved and the payments to be made to the contractor;
- **The Yellow Book** – "Conditions of contract for plant and design-build for electrical and mechanical plant and for building and engineering works, designed by the contractor".
  This type of contract is used on projects where the contractor carries out the detailed design of the project based on performance specification prepared by the employer. The Yellow Book is therefore used predominantly for the provision of plant and for building or engineering works on a design/build basis. The Yellow Book is a lump sum contract whereby payments are made according to achieved initially specified outputs. Like the Red Book, these outputs are certified by an engineer. The contractor is also subject to a "fitness-for-purpose" obligation in respect of the completed project.

The FIDIC Yellow Book is particularly useful for construction of installations, where the contractor will be responsible for the design of the buildings and structures which will accommodate the envisaged equipment/installation, and specifically the electrical part. Besides, as mentioned above, all risks will be borne by the contractor (since he will build based on his own design) and not by the employer (due to faults/unfitness in the design).

It is however assumed that the design of all new facilities in WMZ 3 will be executed prior to commencement of the current project. Thus, the conditions of the Yellow Book will be practically inapplicable.

Therefore, FIDIC Red Book conditions will be used for all works contracts, since the employer will be responsible for the detailed designs.

The tables below present the works contracts envisaged.

Table 16-3: Construction of landfill and waste management centre in Cahul

Item	Details
Contract subject	Construction of landfill, sorting station, composting plant and temporary storage area
Employer	Cahul Rayon administration
Contract budget	EUR 5,108,245.85
Type of contract procedure	International Open Tender – FIDIC Red Book
Tendering process	From 12/01/2016 until 02/28/2017

Table 16-4: Construction of transfer station for Taraclia and Ceadir-Lunga Rayons

Item	Details
Contract subject	Construction of transfer station, sorting station, composting plant and temporary storage area
Employer	Taraclia Rayon administration
Contract budget	EUR 1,926,427.77
Type of contract procedure	International Open Tender – FIDIC Red Book
Tendering process	From 12/01/2016 until 02/28/2017

Table 16-5: Construction of transfer station for Cantemir Rayon

Item	Details
Contract subject	Construction of transfer station, composting plant and temporary storage area
Employer	Cantemir Rayon administration
Contract budget	EUR 901,145.27
Type of contract procedure	International Open Tender – FIDIC Red Book
Tendering process	From 12/01/2016 until 02/28/2017

16.4.3 Supply contracts

The tables below present the supply contracts envisaged.

Table 16-6: Supply of waste collection equipment

Item	Details
Contract subject	Supply of: • Containers for general waste collection – 1.1m^3 metal, wheeled, with lid – 6.139 units; • Containers for general waste collection – 120l plastic, wheeled, with lid – 12,057 units; • Containers for separate collection of paper and cardboard – 1.1m^3 plastic, wheeled, with lid – 561 units; • Containers for separate collection of plastic and metal – 1.1 m^3 net – 1,071 units • Containers for separate collection of glass – 1.1m^3 Igloo type – 125 units; • Home composting devises – 1,877 units; • Trucks for servicing 1.1 m^3 containers – 28 units; • Trucks for servicing 120 l containers – 16 units.
Employer	Waste Management Association
Contract budget	EUR 5,861,000, which includes: • EUR 1,749,000 • EUR 271,000 • EUR 123,000 • EUR 86,000 • EUR 55,000 • EUR 47,000 • EUR 2,800,000 • EUR 730,000
Type of contract procedure	International Open Tender
Tendering process	

Table 16-7: Supply of equipment for landfill and waste management centre in Cahul

Item	Details
Contract subject	Supply of landfill equipment, sorting station equipment and composting plant equipment
Employer	Cahul Rayon administration
Contract budget	EUR 913,000.00, of which: • Landfill equipment – 624,250.00; • Sorting station equipment – 99,000.00; • Composting facility equipment - 189,750.00.
Type of contract procedure	International Open Tender
Tendering process	

Table 16-8: Supply of equipment for transfer station for Taraclia and Ceadir-Lunga Rayons

Item	Details
Contract subject	Supply of transfer equipment, sorting station equipment and composting plant equipment
Employer	Taraclia Rayon administration
Contract budget	EUR 339,350.00, of which: • Transfer station equipment – 171,600.00; • Sorting station equipment – 99,000.00; • Composting facility equipment - 68,750.00.
Type of contract procedure	International Open Tender
Tendering process	

Table 16-9: Supply of equipment for transfer station for Cantemir Rayon

Item	Details
Contract subject	Supply of transfer station equipment and composting plant equipment
Employer	Cantemir Rayon administration
Contract budget	EUR 209,550.00, of which: • Transfer station equipment – 140,800.00; • Composting facility equipment - 68,750.00.
Type of contract procedure	International Open Tender
Tendering process	

16.4.4 Services contracts

In order to implement a project of such magnitude, A Consultant will be needed to provide technical assistance to the Beneficiary communities for management of the project.

The responsibilities of the Consultant will consist of at least the following:

- Coordination of project activities among the different partners (PIU of the Beneficiary, contractors, executive agencies etc.);
- Monitoring of the project performance of contractors in respect of approved components in the work plan;
- Support the Beneficiary in the preparation of Terms of References and tender dossier for procurement of contracts;

- Planning of cash flow requirements and setting of priorities for the implementation of activities in close cooperation with the Beneficiary;
- Preparation of regular reports on the status of projects activities as agreed in the Work Plan;
- Representation of the Beneficiary in Steering Committee and Technical Committee Meetings.

The table below presents the technical assistance service contract envisaged.

Table 16-10: Technical assistance service contract for project implementation

Item	Details
Contract subject	Selection of Consultant for providing technical assistance for project management
Employer	Waste Management Association
Contract budget	EUR 297,000.00
Type of contract procedure	International Open Tender
Tendering process	

Besides the technical assistance service, three other service contracts will be needed for project implementation. These are:

- Construction supervision;
- Increase of public awareness; and
- Project audit.

The tables below present the service contracts envisaged.

Table 16-11: Service contract for construction supervision

Item	Details
Contract subject	Selection of Engineer to supervise the construction of: regional landfill in Cahul; two transfer stations in Taraclia and Cantemir; two sorting stations in Cahul and Taraclia; three composting facilities in Cahul, Taraclia and Cantemir
Employer	Waste Management Association
Contract budget	EUR 378,000.00
Type of contract procedure	International Open Tender
Tendering process	

The Engineer will be responsible for supervising the implementation of the works contracts in respect of construction of the envisaged regional facilities.

Table 16-12: Service contract for increase of public awareness

Item	Details
Contract subject	Selection of Consultant for implementation of public awareness activities
Employer	Waste Management Association
Contract budget	EUR 297,000.00
Type of contract procedure	International Open Tender
Tendering process	

The main tasks of a qualified public awareness Consultant will consist of increasing the public support for the introduction of the new integrated waste management system in WMZ 3.

Table 16-13: Service contract for project audit

Item	Details
Contract subject	Selection of Consultant for audit of project activities
Employer	Waste Management Association
Contract budget	EUR 36,000.00
Type of contract procedure	International Open Tender
Tendering process	

16.5 Implementation plan

The tables below present the project implementation schedule.

Table 16-14: Project implementation schedule

Project activity	mm/dd/yy	mm/dd/yy
Design	03/01/2016	08/31/2016
Preparation of tender dossier	09/01/2016	11/30/2016
Tender process	12/01/2016	02/28/2017
Construction	05/01/2017	05/31/2018
Supplies	01/01/2017	05/31/2018
Supervision	05/01/2017	05/31/2018
Technical assistance	03/01/2016	03/31/2019

Table 16-15: Project implementation schedule

			2016												2017												2018												2019
	Title of tender	Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	**Technical Assistance**																																						
1.1	*Technical assistance for project management to PIU*																																						
1.2	*Implementation of public awareness raising*																																						
2	***Preparation of tender dossier***																																						
2.1	*Preparation of tender dossier for detailed designs*	service																																					
2.2	*Preparation of tender dossier for construction and supervision*	service																																					
2.3	*Preparation of tender dossier for public awareness*	service																																					
2.4	*Preparation of tender dossier for closure of existing site*	service																																					
2.5	*Preparation of tender dossier for project audit*	service																																					
3	***Tender Process***																																						
3.1	*Tender process for Works*	n/a																																					
3.2	*Tender process for Supplies*	n/a																																					
3.3	*Tender process for Supervision of new facilities*	n/a																																					
3.4	*Tender process for Supervision of closure of old site*																																						
4	**Detailed designs**																																						
4.1	*Waste management center (Cahul)*	service																																					
4.2	*Transfer station (Taraclia)*	service																																					
4.3	*Transfer station (Cantemir)*	service																																					
4.4	*Closure of Cahul existing disposal site*																																						
5	**Construction**																																						
5.1	*Waste management center (Cahul)*	works																																					
5.2	*Transfer station (Taraclia)*	works																																					
5.3	*Transfer station (Cantemir)*	works																																					
5.4	*Closure of Cahul existing disposal site*	works																																					
5.5	*Construction of access roads*	works																																					
6	**Supervision**																																						
6.1	*Supervision of works on Cahul WMC*	service																																					
6.2	*Supervision of works on Taraclia TS*	service																																					
6.3	*Supervision of works on Cantemir TS*	service																																					
6.4	*Supervision of closure of existin disposal site*																																						
7	**Supply of equipment**																																						
7.1	*Supply of containers*	supply																																					
7.2	*Supply of waste collection trucks*	supply																																					
7.3	*Supply of equipment for regional facilities*	supply																																					
7	**Project audit**	service																																					

(pink)	*Preparation of tender dossier*
(blue)	*Tender process*
(green)	*Implementation*
(purple)	*Defect Notification Period*

Annexes

Annex 1	Demographic forecast for WMZ 3 (neutral, optimistic and pessimistic scenarios), 2013-2040
Annex 2	Analysis of household waste in urban and rural areas
Annex 3	Prognosis of municipal waste generation
Annex 4	Report on delineation of micro-zones in WMZ 3
Annex 5	Option analysis model
Annex 6	Identification of the potential transitional waste disposal sites
Annex 7	Guideline for closure and rehabilitation of disposal sites
Annex 8	Report on site selection for the regional landfill
Annex 9	Report on site selection for transfer stations
Annex 10	Topographical surveys
Annex 11	Hydrogeological and geotechnical study
Annex 12	Calculation of landfill gas
Annex 13	Drawings
Annex 14	Investment and operation costs
Annex 15	CBA model

** All the annexes to be found under the “Anexe SF” folder*