



## **ANALYSIS OF ILLEGAL LANDFILLS IN THE NORTH-WEST PART OF BARLINEK MUNICIPALITY**

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### ***Abstract***

During the conducted study, 18 objects of illegal dumping of waste were inventoried. All inventoried objects are located in the north-west part of the Barlinek municipality. Each found illegal landfill was measured with measuring tape and its length, width and height of the deposited waste was recorded. For each location, percentage content of waste deposited, as well as its surface area and volume were calculated. All located waste landfills were divided into spot waste landfills, multi-point landfills, area landfills and linear landfills. Spot landfill is the dominant type of illegal waste landfills – 12 objects, multi-point landfills were found in three locations and area landfills in two locations. Only one linear landfill was located. Waste disposal sites were located at different distance from residential areas. It has been determined, that the formation of illegal waste landfills is very often linked to the ease of availability of the local residents to the locations of waste disposal in the form of access roads or good location of the site. It has been determined, that despite the reforms of the waste management, abandonment of waste on undesignated sites is still observed – at six places the new wastes has been added after the 4 years from first observation and only 2 places were cleared.

**Keywords:** Illegal landfills, waste, waste management

## INTRODUCTION

The environment in its nature does not contribute to the production of waste, and decaying plant and animal remains sustain the entire life cycle of earth. All waste on earth have been produced by man and the consumerism that continues to grow (Łuniewski, 2011; Kaszubkiewicz et. al. 2011; Brach and Wiśniewski 2012; Pradziadowicz 2013). Despite the changing law on the maintaining of cleanliness and order, illegal waste landfills can still be found in Polish municipalities. The increase of the number of these sites causes elevation of anthropogenic admixtures in soils (construction and ceramic waste, slag, glass, plastics, textile waste) (Niedźwiecki et al., 2004; Bogajewski 2007; Jurkowska et al. 2000; Lubecki 2008). These sites are of particular threat to the surface layers of soils, due to the penetration of harmful substances accumulated in the deposited waste into the soil (Nowak et al., 2004; Mizgajski and Łankiewicz, 2007; Błaszczuk and Górski 1996; Kultys et al., 2008; Malinowski et. al. 2015).

According to Mizgajski and Łankiewicz (2007), permanent removal of illegal waste landfills does not consist only in the removal of the deposited waste, but also in land use of the previous landfill. The sole removal of deposited waste without the management of the site results in a short-time effect. Illegal waste landfills are very common in natural or artificial land depressions. The contact of waste with water may result in an increased migration of heavy metals in soil (Niedźwiecki et al., 2003a; Jerzmański 2005; Staszczuk 2009). According to Niedźwiedzki et al. (2003b), illegally deposited waste is common alongside roads, on edges of forests or within mid-field a forestations.

The objective of the study was inventory of illegal waste landfills in the north-west part of the Barlinek municipality (West Pomeranian voivodeship).

## MATERIAL AND METHODS

### Field investigations

Prior the field work, the area of Barlinek municipality was studied and potential sites of illegal waste landfills were marked. During the field work of 2011, 18 sites of illegal waste disposal were inventoried. The study was repeated in 2015 in order to check, whether the illegal waste landfill still exists and if new waste is being deposited.

Each illegal landfill found was measured with measuring tape and its length [m], width [m] and height [m] of the deposited waste was recorded. The level of ground was assumed as a zero level for measurements. A subsequent action consisted in the enumeration of all types of waste found on a landfill. It was also determined, with 5% accuracy, the percentage contribution of waste in each waste group: household waste; renovation and construction waste; organic

waste, high volume and electronic waste. The area and volume of each individual illegal waste landfills were calculated basing of previous (mentioned above) measurements.

### **Study work**

For each location, percentage content of waste deposited, as well as its surface area and volume were calculated. The surface area of each individual illegal waste landfill was calculated basing of previous (mentioned above) measurements by applying mathematical formulas for calculating the surface of various shapes (e.g. square, oval).



**Photo. 1.** Fragment of spot waste landfill  
(photographer: K. Szydłowski)



**Photo. 2.** Fragment of multi-point waste landfill  
(photographer: K. Szydłowski)



**Photo. 3.** Fragment of landfill area  
(photographer: K. Szydłowski)

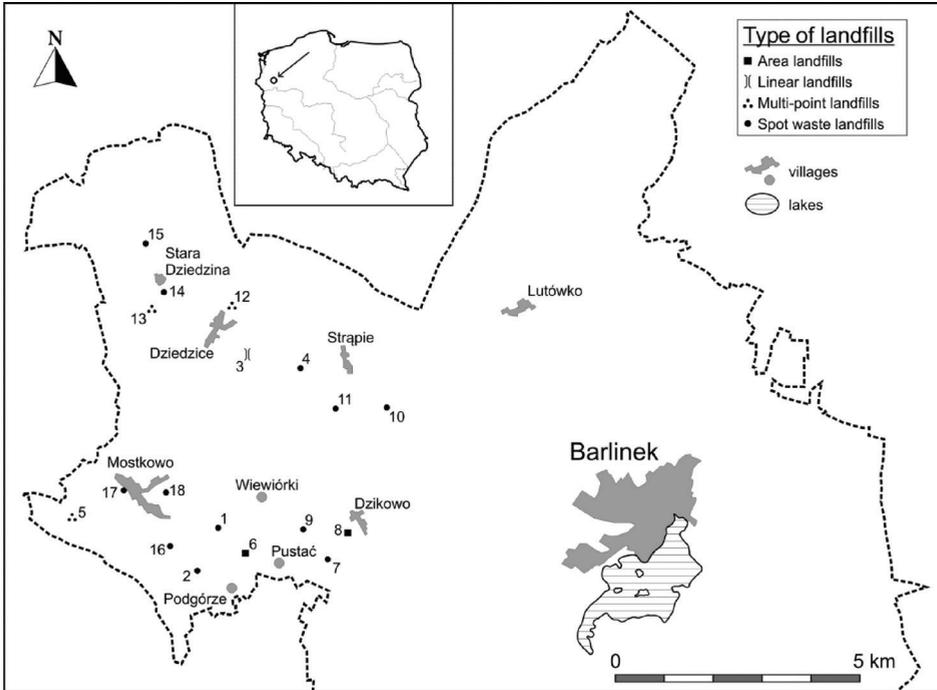


**Photo. 4.** Fragment of linear waste landfill  
(photographer: K. Szydłowski)

All located waste landfills were divided into spot waste landfills, multi-point landfills, area landfills and linear landfills (Photo 1-4; Fig. 1), following the guidelines proposed by Kurnicki and Mularz (1998). The waste was classified following the assumptions presented in the work of Mizgajski and Łankiewicz (2007) as:

- I class –household waste
- II class –renovation and construction waste,
- III class –organic waste,
- IV class –high volume and electronic waste.

All numeric and percentage data were ordered in Tables 1–2.



**Figure 1.** Location of illegal waste landfills in the north-west part of the Barlinek municipality

## STUDY RESULTS AND DISCUSSION

The conducted inventory of the north-west part of the Barlinek municipality demonstrated existence of 18 sites of illegal waste deposition. Also, the inventory work of Piniarski and Macias (2015) in the Town and Municipality Po-biedziska showed a similar number of analyzed objects of research (28). While the inventory carried out in the forestry Stankowizna by Brach and Wisniewski (2012) and Gajda and Plaza (2008) showed the higher number of illegal waste shipments, amounting to respectively 66 and 250 places of illegal waste disposal.

In our research the spot landfills are the dominant type of the illegal landfills– 12 objects. Multi-point landfills were found in three locations and area

landfills – in two locations (Tables 1, 2; Fig. 1). Only one linear landfill was found – object No. 3.

Household waste (I class) is the dominant type of waste illegally deposited on these landfills. The total area of the deposited waste was 23,526 m<sup>2</sup> and it was a much greater surface area than the area of illegal dumps in the forest Stan-kowizna, which was 4445 m<sup>2</sup> (Brach and Wisniewski 2012). Out of this number, 1,843 m<sup>2</sup> was taken by spot landfills, multi-point landfills covered – 22,000 m<sup>2</sup>, area landfills – 850 m<sup>2</sup>, and linear – 30 m<sup>2</sup>. The largest area was covered by the illegal waste Dziedzice I (20,000 m<sup>2</sup>), and the smallest Dzikowo II (2 m<sup>2</sup>). The total volume of deposited waste was 15,363.77 m<sup>3</sup>. Out of this number, spot landfills contained 2,704 m<sup>3</sup>, multi-point landfills 1 3800 m<sup>3</sup>, area landfills 650 m<sup>3</sup> and linear 9 m<sup>3</sup>. Waste deposited on the illegal waste landfill Dziedzice I had the largest volume (10,000 m<sup>3</sup>), and the lowest – Pole tory (0.4 m<sup>3</sup>). The waste was primarily deposited on a meadow (5) or field (4) at a roadside (4). Waste was deposited least frequently in bushes or afforestations (3) or on railway tracks. The main land formation, on which the waste was deposited was flat terrain (11), overgrown with relatively high herbaceous vegetation. Approximately 30% of all found illegal landfills were located in land depressions (5 objects), and around 15% on escarpments near roadsides, as well as railway tracks (2 objects).

Waste disposal sites were located at a different distance from residential areas. Three objects were located at a lowest distance – up to 50 m (Mostkowo II, Strąpie I, Dziedzice I), six objects were found at a slightly further distance – to 150 m (Podgórze – Dzikowo I, Dziedzice – Stara Dziedzina, Mostkowo III, Dzikowo II, Strąpie II, Dziedzice II), one object was further still – to 250 m (Mostkowo I) and three objects – to 500 m (Wiewiórki, Dzikowo – Pustać, Stara Dziedzina). One object was found at a furthest distance – over 500 m to 1 km (Dziedzice – Strąpie I), and one (Pustać – Podgórze) at a distance of 3–4 km. The work carried out in the Ojców National Park also showed that the largest number of illegal waste dumps were found with the distance of over 100 meters from the buildings (Gajda and Plaza 2008).

Objects, on which waste was abandoned in the vicinity of roads constituted considerable majority – up to approximately 15 m (Dziedzice – Stara Dziedzina approx. 10 m, Dziedzice – Strąpie I approx. 2 m, Dzikowo II approx. 10 m, Strąpie II approx. 2 m, Stara Dziedzina ok. 5 m, Pustać – Podgórze approx. 2m, Dzikowo I approx. 15m). Only the object no. 1 – Wiewiórki, was located at a distance of approximately 300 m from the road.

It has been determined, that the formation of illegal waste landfills is very often linked to the ease of availability of the local residents to the locations of waste disposal in the form of access roads or good location of the site. Road-sides or railway tracks are very commonly becoming the potential areas of illegal waste deposition. During the conducted work it was observed, that illegal landfills are formed at low distances from residential areas, in vegetated areas

or in land depressions. It is easy to deduce where such sites can be located, all that is necessary to do is to take a map of the area, locate traffic routes and land depressions and in 100% of the majority of these places illegal landfills can be found. The most common type of waste on illegal landfills, independent of their area of formation, is household waste, which occurred in 80% of all areas of illegal waste deposition. Renovation and construction waste occurred in 35% of all inventoried sites, and they usually were abandoned within a short distance from buildings and more commonly on a flat area. Organic waste occurred in approximately 15% of all located illegal landfills, and in the majority of cases it was abandoned near allotment gardens or backyard gardens, and were usually overgrown with herbaceous vegetation. High-volume waste occurred in approximately 35% of located sites of illegal landfills. They were usually found in land depressions, overgrown with high vegetation or bushes.

After four years of first inventory the new wastes were found at 6 places and 2 were closed down and the areas has been cleared (Table 1). The amount of deposited wastes increased slightly (Table 1 – 2).

**Table 1.** Classification of inventoried objects of illegal dumping of waste in the North-west part of Barlinek municipality

No.	Settlements:	After 2015 year	Volume [m <sup>3</sup> ]		Area [m <sup>2</sup> ]		Wastes class		Site location	Land layout
			2011	2015	2011	2015	2011	2015		
1.	Wiewiórki	Exists / with new wastes	12.37	12.38	25	26	I, IV	IV	Ploughland	Flat ground
2.	Podgórze	Exists / no new wastes	48	-	120	-	I, II, IV	-	Meadow	Natural depression
3.	Dziedzice – Strąpie II	Exists / no new wastes	9	-	30	-	I, IV	-	Roadside	Flat ground
4.	Dziedzice – Strąpie I	Exists / no new wastes	0.9	-	3	-	I	-	Roadside	Flat ground
5.	Mostkowo I	Exists / no new wastes	2000	-	800	-	I, IV	-	Ploughland	Flat ground
6.	Pustać – Podgórze	Exists / with new wastes	450	-	450	-	I, IV	-	Roadside	Natural depression
7.	Dzikowo – Pustać	Exists / no new wastes	1	-	30	-	I	-	Afforestations	Flat ground
8.	Dzikowo I	Closed down – cleared	200	-	400	-	I, IV	-	Afforestations	Flat ground
9.	Dzikowo II	Closed down – cleared	0.5	-	2.25	-	I	-	Bushes – Ploughland	Natural depression

No.	Settlements:	After 2015 year	Volume [m <sup>3</sup> ]		Area [m <sup>2</sup> ]		Wastes class		Site location	Land layout
			2011	2015	2011	2015	2011	2015		
10.	Strąpie II	Exists / no new wastes	23	-	15	-	I, II	-	Roadsite	Escarpment
11.	Strąpie I	Exists / no new wastes	56	-	37	-	II	-	Meadow	Flat ground
12.	Dziedzice I	Exists / no new wastes	10000	-	20000	-	I, II, III, IV	-	Meadow	Natural depression
13.	Dziedzice II	Exists / with new wastes	1800	2000	1200	1400	II	II	Meadow	Flat ground
14.	Dziedzice – Stara Dziedzina	Exists / with new wastes	120	130	120	125	I, III, IV	I, III, IV	Meadow	Natural depression
15.	Stara Dziedzina	Exists / with new wastes	3	3	9	10	I	I	Bushes	Flat ground
16.	Pole tory	Exists / no new wastes	0.4	-	4	-	I	-	Railway tracks	Escarpment
17.	Mostkowo II	Exists / with new wastes	400	600	160	230	II	II	Herbaceous vegetation	Flat ground
18.	Mostkowo III	Exists / with new wastes	240	260	120	130	I, III	I, III	Ploughland	Flat ground
Total			15267	2993	23461	1895	-	-	-	-

Explanations: I class –household waste, II class –renovation and construction waste, III class –organic waste, IV class –high volume and electronic waste.

**Table 2.** Share of wastes in individual classes [% per m<sup>3</sup>] deposited on illegal waste dumping sites within the area north-west part of Barlinek community

Settlements:	Household waste		Organic waste		Renovation and construction waste		High volume and electronic waste		Other type	
	2011	2015	2011	2015	2011	2015	2011	2015	2011	2015
Spot waste landfills										
<b>Wiewiórki</b>	15	10					80	85	5	5
<b>Podgórze</b>	70				15		5		10	
<b>Dziedzice-Stara Dziedzina</b>	70	75	5	5			20	15	5	5
<b>Dziedzice-Strąpie I</b>	100									

Settlements:	Household waste		Organic waste		Renovation and construction waste		High volume and electronic waste		Other type	
	2011	2015	2011	2015	2011	2015	2011	2015	2011	2015
Spot waste landfills										
<b>Dzikowo-Pustać</b>	95								5	
<b>Dzikowo II</b>	90								10	
<b>Strąpie I</b>					100					
<b>Strąpie II</b>	5				95					
<b>Stara Dziejzina</b>	95	80							5	10
<b>Mostkowo II</b>					100	100				
<b>Mostkowo III</b>	5		90	100					5	
<b>Pole – tory</b>	100									
<b>mean</b>	<i>53,8</i>	<i>13,8</i>	<i>7,9</i>	<i>8,8</i>	<i>25,8</i>	<i>8,3</i>	<i>8,8</i>	<i>8,3</i>	<i>3,8</i>	<i>1,7</i>
Multi-point landfills										
<b>Dziejzice II</b>					100	100				
<b>Mostkowo I</b>	50				15				5	
<b>Dziejzice-Stara Dziejzina</b>										
<b>mean</b>	<i>12,5</i>				<i>43,1</i>	<i>25,0</i>			<i>1,3</i>	
Area landfills										
<b>Pustać-Podgórze</b>	40						20		40	
<b>Dzikowo I</b>	40						40		20	
<b>mean</b>	<i>40,0</i>						<i>30,0</i>		<i>30,0</i>	
Linear landfills										
<b>Dziejzice-Strąpie II</b>	40,0						30,0		30,0	

All located areas of illegal waste abandonment were not selected by the perpetrators coincidentally. After the conducted fieldwork, it can be concluded, that each site of illegal waste deposition is carefully selected for the size of deposited waste, and the main reason for its potential deposition is primarily the proximity and accessibility of these sites.

The occurrence of illegal waste landfills in the area of the Barlinek municipality may deteriorate its tourist and recreational values and landscape values, from which the inhabitants of the municipality benefit so much. The glass, metal or cans found in the landfills pose considerable threat to forest animals searching for food within them. The contamination penetrating to soil may cause soil degradation and pose threat to soil-dwelling organisms.

Despite the reforms of waste management of 2013, the inventory area is still the site of illegal landfills, what is more, waste is still being deposited there (Act 2013). This is corroborated by Szydłowski (2015a; 2015b), in his study conducted on the area of the city of Szczecin. These studies demonstrated, that illegal landfills are still present in cities. They are deposited in the proximity of residential areas (bushes, land depressions) (Szydłowski 2015a and 2015b).

## CONCLUSIONS

As a result of the conducted inventory work in the north-west part of the Barlinek municipality, the following conclusions can be drawn:

1. Eighteen sites of illegal waste disposal were found in the north-west area of the Barlinek municipality. The total surface area of the landfills is 23,525 m<sup>2</sup>, and their volume – 15,364 m<sup>3</sup>. The largest area is the illegal waste landfill Dziedzice I (20,000 m<sup>2</sup>), which also has the largest volume of deposited waste (1,000 m<sup>3</sup>).
2. Found landfills were dominated by the spot landfill type – 12 objects. The majority of waste was abandoned on a flat terrain (60% of all objects). The sites of illegal waste disposal are usually found in natural land depressions, on slopes or on a flat, vegetated area, which demonstrates the awareness of the perpetrators that they act against the law.
3. Over a half of the objects (13) is located at a small distance from the residential areas (up to 500 m), which may demonstrate, that the waste originated from the local residents.
4. The individual waste classes deposited on the inventoried illegal waste landfills (18 objects) can be ordered for the frequency of occurrence as follows:
  - household waste (I class) – 16 objects.
  - high volume waste (IV class) – 6 objects;
  - renovation and construction waste (II class) – 6 objects;
  - organic waste (III class) – 3 objects.
5. Despite the introduction of new regulatory framework governing the waste management, waste is still deposited on the analyzed area – at six objects from inventoried eighteen illegal waste landfills.

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