

4. Vakuumsūkņu salīdzinājums pēc to īpatnējām iegādes izmaksām, Ls uz 1 l/min, var noderēt galvenokārt orientējošām vajadzībām, jo tas neatbilst salīdzinājumam pēc ekspluatācijas izmaksām, Ls/govi gadā.
5. Salīdzinot Latvijā izplatītos vakuumsūkņus ar darba ražīgumu 800–1000 l/min, var secināt, ka vismazākās ekspluatācijas izmaksas ir firmas MEEDA (Igaunija) ražotiem ūdensgredzena tipa vakuumsūkņiem. Firmas DeLaval ražotajiem eļļojamiem sūkņiem tās ir par aptuveni 7 % lielākas, firmas Westfalia Landtechnik ūdensgredzena tipa sūkņiem – par 22 % lielākas, bet Krievijā ražotiem UVU–45/60A markas sūkņiem ar eļļas tiešo caurplūdi – par aptuveni 30 % lielākas.

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EVALUATION OF ENVIRONMENTAL QUALITY IN PANEVĒŽYS ACCORDING TO CONTAMINATION LEVEL OF DUG WELLS PANEVEŽAS VIDES KVALITĀTES NOVĒRTĒŠANA, IZMANTOJOT AKU PIESĀRŅOJUMA LĪMENUS

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Abstract. Part of inhabitants of Panevėžys, living in the city and near Liūdynė municipal waste landfill, still consumes water from dug wells. The aim was to investigate whether they are much polluted by toxic chemical elements and what is the main reason of their pollution. Geochemical monitoring data of dug wells in 3 industrial and 2 residential districts, as well as near Liūdynė municipal waste landfill were used. Water samples were analysed by AAS for V, Co, Ni, Cr, Cu, Pb, while sediment samples – by DC arc ES and XRF for total content of wider spectrum of elements and by AAS for speciation of the above mentioned 6 elements. Water quality was controlled in comparison with limit values of water for consuming, while the danger of sediment pollution – according to recommended total contamination index levels for sediments and hygienic norms for mobile forms in soil. Sediments from dug wells can be effectively used as indirect indicator of their water pollution over longer period. Contamination from point sources in Panevėžys is not the main reason of dug well pollution, the leading role belongs to local pollution in their sanitary zones. Therefore good care must be taken of them.

Introduction

The inhabitants of Panevėžys are mostly using rather clean water from centralised supply. Still part of them, living in the city and near Liūdynė municipal waste landfill, consumes water from dug wells. At the first stage dug wells in 3 industrial heavily polluted districts of the city and in 2 residential almost unpolluted were investigated. The aim was to find out whether the wells in industrial districts were much more polluted. Population living near Liūdynė was especially worried if the contaminants from the landfill have much

influence on the quality of their dug wells. The goal of the second stage was to find out the level and main reason of their pollution.

Methods

Geochemical monitoring was done in 29 dug wells in the city (water and sediments analysed) and 18 dug wells near Liūdynė landfill (only sediments). Sediment samples were taken where possible. Water samples were analysed by AAS for the content of V, Co, Ni, Cr, Cu, Pb, while sediment samples – for the total content of Li, B, Ga, P, Mn, Ti, V, Cr, Co, Ni, Cu, Zn, Pb, Mo, Ag, Sn, Zr, Y, La, Sc, Ba (Nb, Yb, Al) by DC arc ES and Sr, As, U (Th, Rb) by XRF. Before analysis all sediment samples were air-dried, sieved through nylon sieves taking fraction <1 mm, mineralised at 450⁰ C and pulverised. International reference materials OOKO 153 and OOKO 151 were used for quality control of spectral analysis results. Speciation of V, Co, Ni, Cr, Cu, Pb was also determined by AAS in 44 samples of sediments from wells in the city. The quality of water was controlled in comparison with limit values for heavy metals given in hygienic norm of water for consuming [1]. Fine sediments, which accumulate in wells (though are periodically removed), were used as indirect indicator of drinking water pollution. They are a good sorbent of elements, therefore indicate the general ecological state of the well over longer period. There are no official highest allowable concentrations for element content in them, however, the danger of their pollution can be evaluated according to total contamination index (Z) levels recommended for sediments in different water systems [2]. This index (Z) was calculated by summing up concentration coefficients (CC) of main toxic elements, which are accumulating in dug well sediments (taking into account the toxicity class and level of accumulation): Mn, Cr, Co, Ni, Cu, Zn, Pb, Mo, Ag, Sn and Ba. These CC were calculated dividing the amount determined in each sample by local background values – the 10th percentile value of polluting element concentration in corresponding sample group, i.e. town or Liūdynė surroundings (Table 1). These values are very similar to local background values in topsoil. Geohygienic state of sediments was also evaluated in comparison with the highest allowable element concentrations for mobile forms in soil according to hygienic norms [3].

Table 1. Comparison of element content in dug well sediments

Ele- ments	TC	Background values, ppm			Median values in well sediments, ppm							Median/Background			
		City	Liūdynė	Topsoil	City	Liūdynė	E	W	S	R	N	City	Liūdynė		
Zn	1	59	32	32	292	92,0	240	295	733	448	390	Zn	4,93	Zn	2,86
Pb	1	19,7	13,5	13	60,8	23,4	50,0	63,0	71,3	91,0	222,2	Pb	3,08	Sn	1,41
Cu	2	9,9	6,9	8,3	27,4	12,8	42,0	35,8	85,2	18,8	80,4	Cu	2,77	Pb	1,73
Mo	2	0,79	0,40	0,59	1,54	1,10	1,57	1,11	1,95	0,85	1,35	Mo	1,95	Ni	1,50
Ba	3	301	306	340	532	463	566	427	631	1008	469	Ba	1,77	Mo	2,75
Ag		0,050	0,030	0,071	0,087	0,050	0,098	0,080	0,117	0,142	0,081	Ag	1,75	Mn	1,62
Cr	2	35,9	26,6	28,0	58,0	37,4	72,11	62,99	50,66	54,33	67,23	Cr	1,61	Cu	1,85
Sn		1,95	1,55	1,80	3,11	2,18	3,36	2,79	4,96	2,95	4,30	Sn	1,59	Cr	1,41
Co	2	4,45	5,10	3,60	6,96	7,85	7,27	7,96	9,57	5,21	4,88	Co	1,56	Co	1,54
Ni	2	11,7	11,8	8,8	16,7	17,7	21,5	20,2	17,4	15,9	18,6	Ni	1,42	Ba	1,51
Mn	3	323	268	260	433	435	375	439	582	436	366	Mn	1,34	Ag	1,64

Notes: E – eastern, W – western, S – southern industrial districts, R – Rožės, N – Nemunas residential districts, TC – toxicity class (3).

Results and discussion

All investigated wells are recharged with groundwater. In the city wells heavy metal content in water does not exceed the limit values, except Pb in some cases (Table 2).

Table 2. Element content in water of dug wells of Panevėžys and number of samples with mobile forms in sediments exceeding the limit values

Elements	Periods	Maximum values (mkg/l) in districts of Panevėžys					Control samples (mkg/l)		Limit values	
		E	W	S	R	N	Unpolluted well	Water-supply	For water	For mobile forms
V	1	6,0	8,0	1,5	1,8	1,2	1,0		100 mkg/l	-
	2	1,8	0,5	0,5	2,1	0,5	0,5			
Co	1	0,8	1,1	0,1	2,5	0,1	0,1		100 mkg/l	5 mg/kg Exceeded in 1 sample from 44
	2	0,7	0,5	0,6	0,6	0,5	0,5			
	3	0,5	0,5	0,7	0,8	0,7		0,6		
	4	0,4	0,5	0,4	0,4	0,4		0,6		
Ni	1	4,1	5,0	2,7	2,1	1,4	0,5		20 mkg/l	4 mg/kg Exceeded in 4 samples from 44
	2	2,7	1,9	2,8	1,9	1,0	0,5			
	3	7,3	4,0	9,0	4,4	4,8		5,1		
	4	4,6	4,6	2,9	5,4	5,7		2,9		
Cr	1	6,4	1,3	1,0	8,0	1,4	0,3		50 mkg/l	6 mg/kg Exceeded in 4 samples from 44
	2	3,2	0,8	1,3	1,0	0,2	0,2			
	3	3,5	3,0	1,8	0,4	1,0		1,0		
	4	2,1	1,2	0,7	1,5	1,0		1,3		
Cu	1	15,5	13,6	7,2	6,1	7,0			1000 mkg/l	3 mg/kg Exceeded in 41 sample from 44
	2	25,0	20,0	3,9	3,8	3,9	6,2			
	3	18,0	16,0	6,0	7,0	9,0		2,4		
	4	5,0	1,0	1,0	2,0	1,0		2,1		
Pb	1	12,7	2,5	4,9	37,1	26,9	0,5		30 mkg/l	6 mg/kg Exceeded in 3 samples from 44
	2	4,9	4,6	2,0	2,1	32,4	1,1			
	3	1,5	1,3	1,2	1,3	1,0		1,1		
	4	2,0	2,0	1,9	1,9	1,8				

This is because the aquifer is usually covered by till – natural barrier protecting it from contaminants infiltration. However, the content of mobile element forms in well sediments sometimes exceeds the highest allowable concentrations. Though significant correlation among element content in water and well sediments was not observed, but monitoring results in the city show that in those wells, which are characterised by dangerous or extremely dangerous pollution of sediments, the maximum in the district content of elements is usually found in water, too (Fig.1).

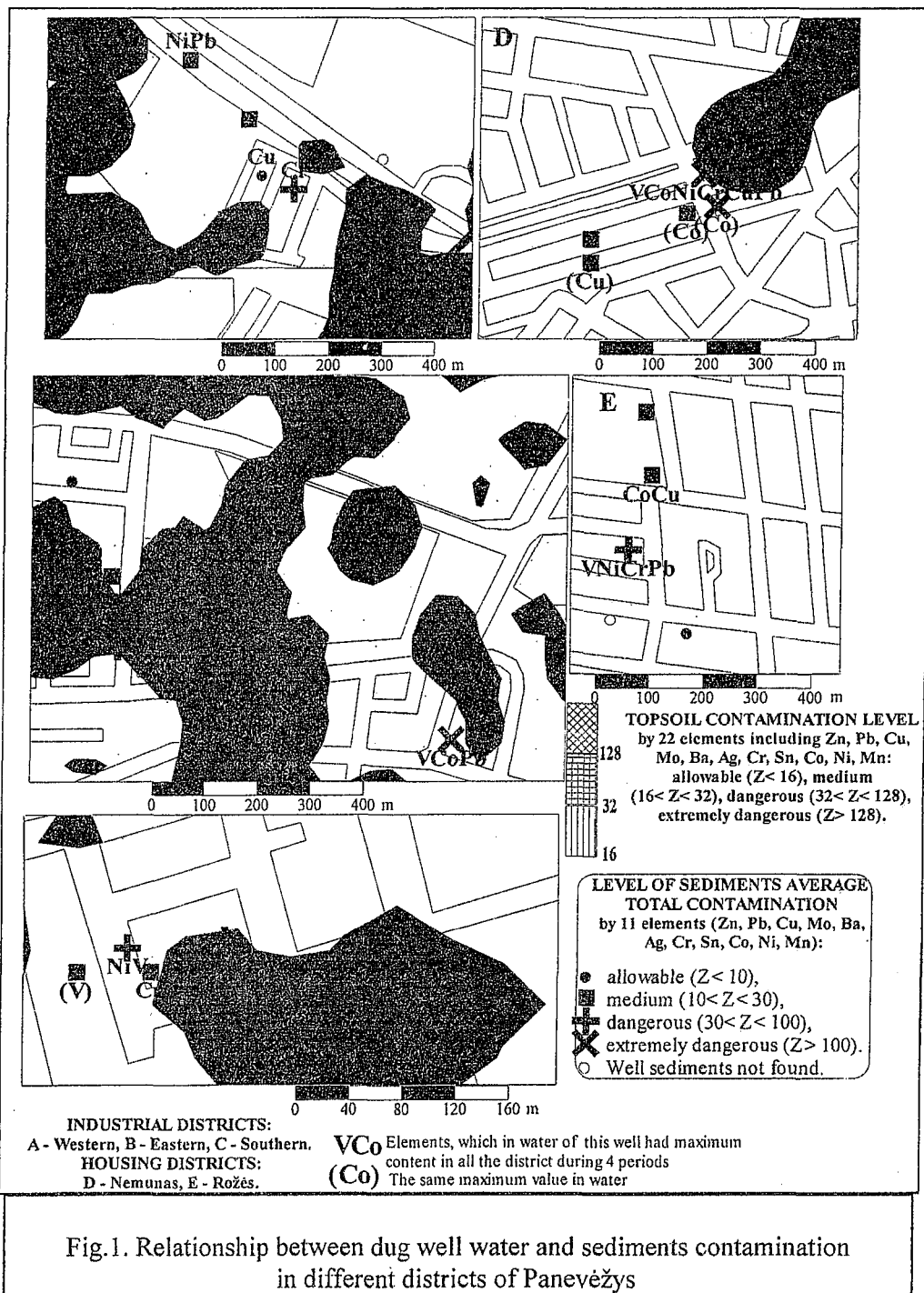


Fig.1. Relationship between dug well water and sediments contamination in different districts of Panevėžys

Though the sediments of dug wells are a good geochemical barrier, where toxic elements from water are sorbed, but sometimes they might become a secondary pollution source of drinking water. This could happen if pH decreases and the content of mobile forms increases, if water becomes muddy or water table level lowers. Therefore monitoring of sediments is indispensable (Fig.2).

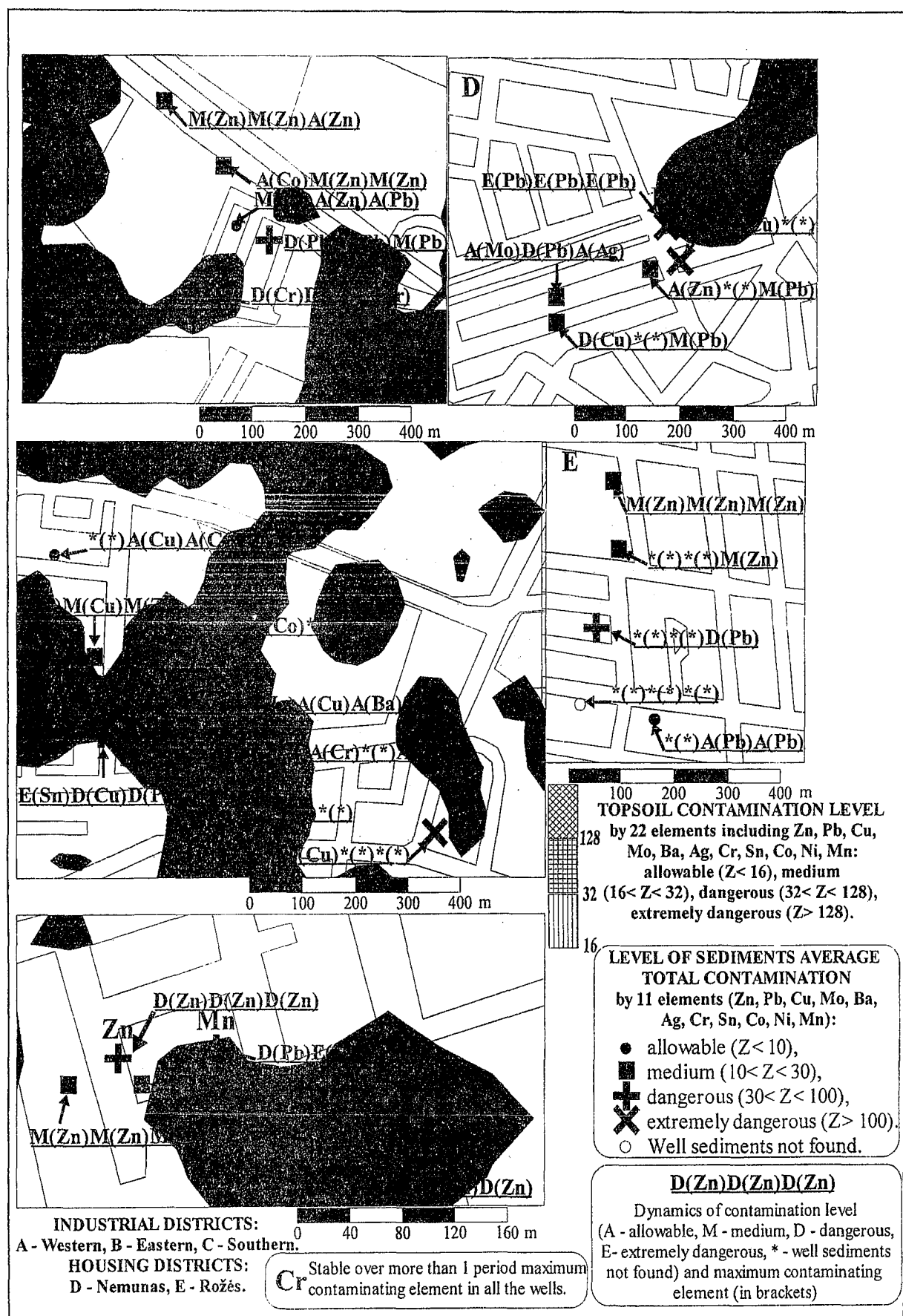


Fig.2. Results of dug well sediments monitoring in different districts of Panevėžys

Such monitoring in the city showed that dangerous and extremely dangerous level of sediment pollution is observed not only in industrial, but also in residential districts of Panevėžys. Comparison of median values of total contamination indices and concentration coefficients in well sediments of 5 districts in the city with corresponding characteristics of topsoil contamination on the territories of 3 metal processing plants, near which the wells are located in industrial areas, enabled to reveal some regularities (Table 3). According to median Z values all 3 plants are unallowably contaminating, but the greatest pollution source is "Metalistas" (in the eastern industrial district), while the least dangerous is the plant with galvanic shop (in the southern industrial district). Meanwhile the greatest content of most elements and Z in well sediments is observed namely in the southern industrial district, despite of the least median Z in topsoil of the territory of metal processing plant situated there. However, the highest content of Cr and Ni in the eastern district of the city is observed both in well sediments and on the territory of "Metalistas". The highest median CC values of some elements (Ba, Ag, Pb) are found even in non-industrial districts. Such contraversive facts indicate that emission from various plants, as pollution sources of the atmosphere, is not always the most important factor influencing the contamination level of dug well sediments. It means that pollution of sediments (and therefore also water in dug wells) not always depends on topsoil contamination in surrounding district but is predominantly related with local pollution of their sanitary-hygienic zones.

Table 3. Relationship between contamination of dug well sediments and topsoil of nearest plants in different districts of Panevėžys (CC of elements)

Districts	Z	Zn	Cu	Sn	Mo	Co	Mn	Cr	Ni	Ba	Ag	Pb	V
Southern (G)	52,42	12,39	8,61	2,55	2,47	2,15	1,80	1,41	1,48	2,10	2,36	3,62	2,46
Nemunas	29,38	6,60	8,13	2,21	1,71	1,10	1,13	1,87	1,58	1,56	1,64	11,28	1,29
Rožės	22,64	7,57	1,90	1,52	1,08	1,17	1,35	1,51	1,35	3,35	2,86	4,62	2,24
Eastern (M)	16,38	4,06	4,24	1,72	1,99	1,63	1,16	2,01	1,83	1,88	1,98	2,54	1,69
Western (A)	13,74	4,98	3,61	1,43	1,41	1,79	1,36	1,75	1,72	1,42	1,62	3,20	2,84
"Metalistas" (M)	114,67	24,74	15,90	2,51	8,15	1,32	1,69	13,31	18,21	1,34	3,59	5,07	1,15
"Aurida", II site (A)	53,15	10,44	14,37	3,90	4,44	1,13	4,34	3,85	3,16	1,19	1,78	3,27	1,10
Plant with galvanic shop (G)	16,07	2,41	2,50	1,42	1,53	1,10	1,19	1,60	4,84	1,16	1,23	2,01	1,04

The same conclusions can be drawn according to geochemical monitoring data of sediments in wells near Liūdynė municipal waste landfill. According to unpublished geochemical investigations of stream sediments near Liūdynė (accomplished by V.Kadūnas, J.Valiūnas and B.Karmaza) the Aulamas stream, which is draining the landfill, is polluted by its elements-contaminants. The descending row of maximum concentration coefficients in stream sediments is the following: Ni>Mo>Co>Zn>Pb>Mn>Cu>Sn>Cr>Ag>Ba, i.e. Ni is the main pollutant. Its greatest concentration is observed in Aulamas sediments downstream of the landfill (Fig.3). Meanwhile in well sediments of this area the main pollutants are Zn, Pb and Sn, partly Mo. Moreover, one of the dug wells with dangerously contaminated sediments is in the eastern part and obviously could not have been contaminated by pollutants from the landfill. Besides, there are no extremely dangerously polluted well sediments near Liūdynė and median values of all contaminants, except Co and Ni, are lower than corresponding median values in Panevėžys (Table 1). This indicates that in Panevėžys the level of dug well contamination is much greater than near the landfill. Moreover, local transport, intensive fertilising with liquid organic wastes, enriched with Zn, as well as bad hygienic conditions in sanitary-protective zones of the wells have much greater influence than pollutants from the landfill.

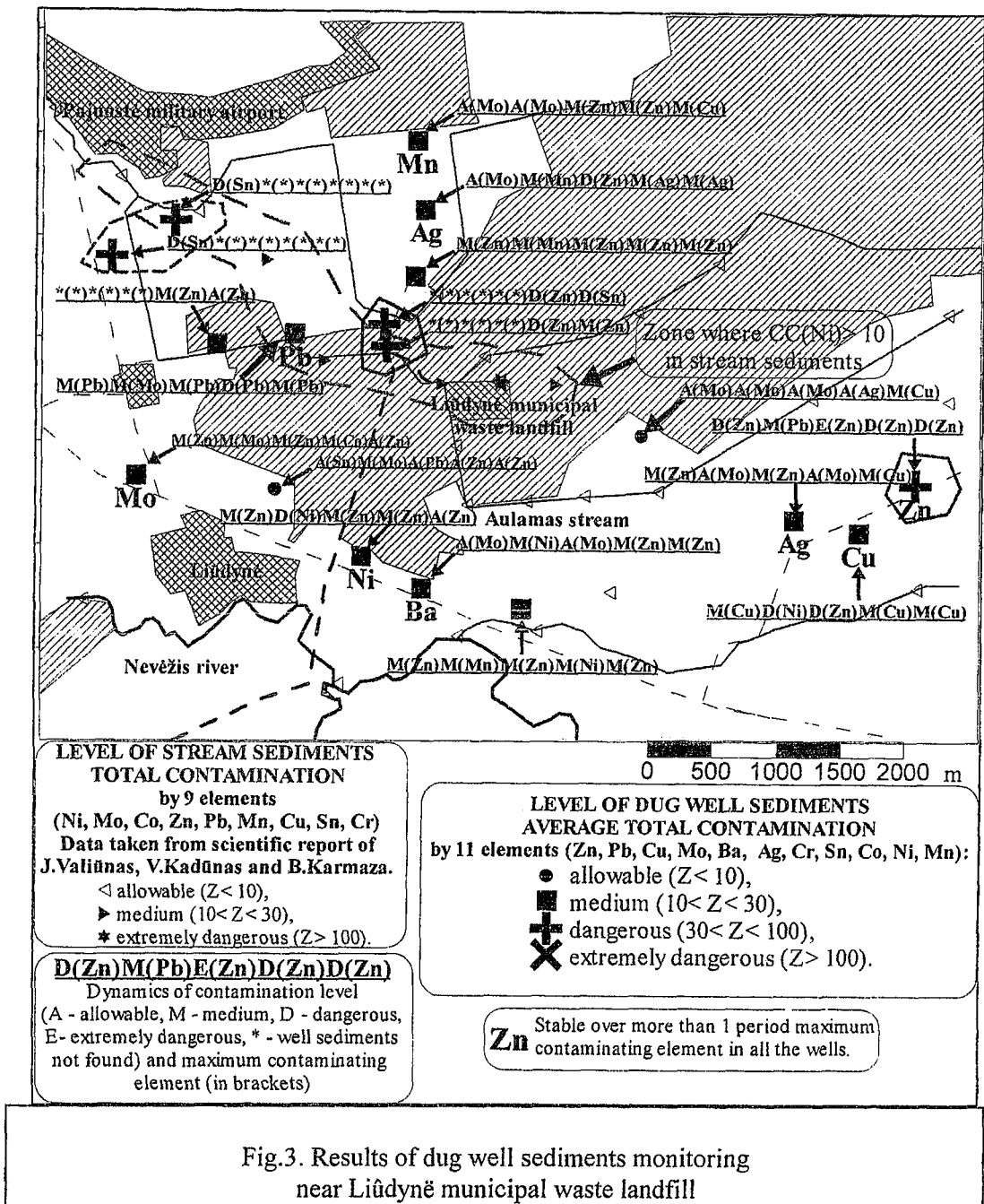


Fig.3. Results of dug well sediments monitoring near Liūdynė municipal waste landfill

Conclusions

Dug well sediments are a good sorbent of elements getting into water and therefore can be effectively used as indirect indicator of dug well water pollution over longer period. Contamination from point sources (industrial enterprises, municipal waste landfill) in Panevėžys is not the main reason of dug well sediments pollution, as the aquifer is well protected by impermeable aeration zone. The leading role in contamination of dug wells belongs to local pollution in their sanitary protection zones. Therefore good care must be taken of them: they must be hermetic and their sediments should be regularly cleaned.

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ILGTSPĒJĪGAS ATTĪSTĪBAS NODROŠINĀŠANAI NEPIECIEŠAMĀIS RSEZ SABIEDRISKO ATTIECĪBU MODELIS KĀ ORGANIZĀCIJAS VIDES SAKĀRTOŠANAS UN VADĪŠANAS INSTRUMENTS THE RSEZ SUSTAINABLE DEVELOPMENT NECESSITY DRIVEN PUBLIC RELATION MODEL—AN INSTRUMENT FOR ENVIROMENT REGULATION AND MANAGEMENT

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***Abstract.** Sustainable development supposes harmonic development of all spheres – in ecological, economic, social areas – and is aimed at satisfaction of society's both existing and future needs. Company "Rezekne Special Economic Zone" (RSEZ) is established to endorse development of favorable business environment. RSEZ's recommendations for production and services development proposes use of various existing local resources that would lead to sustainable development in the Rezekne region. However successful accomplishment of development propositions is possible if it is supported by effective corporate communications within RSEZ organizational environment. An article provides analysis of main elements of RSEZ organizational environment and proposes PR (public relations) actions to promote organizational communications with target audiences.*

Ilgtspējīga attīstība iespējama sakārtotā vidē. Ilgtspējīgas attīstības mērķis ir sakārtota vide. Ilgtspējīga attīstība īstenojama, sakārtojot vidi. Dažādi autori ilgtspējīgu attīstību definē dažādi, tomēr galvenā doma paliek nemainīga. Visbiežāk citētā ir 1987.gadā "WCED" (World Commission on Environment and Development) formulētā definīcija, kurā skaidrots, ka ilgtspējīga attīstība ir tāda attīstība, kas nodrošina patreizējās vajadzības, nenonākot nekādos kompromisos (konfliktos) ar nākamo paaudžu vajadzībām [3,172]. Ar to jāsaprot gan ekoloģiskā, gan ekonomiskā, gan sociālā ilgtspējība. Tā iespējama vienīgi savstarpējā harmonijā. Raksta mērķis – izmantojot A/S "Rēzeknes speciālā ekonomiskā zona" piemēru, uzsvērt organizācijas vides elementu saskares nozīmi jeb sabiedrisko attiecību realizēšanas svarīgumu ilgtspējīgas attīstības nodrošināšanā.

RSEZ uzņēmējdarbības vide un ilgtspējīga attīstība

A/S "Rēzeknes speciālā ekonomiskā zona" (RSEZ) nodibināta 1997. gadā ar mērķi radīt uzņēmējdarbībai labvēlīgu vidi, izmantojot priekšrocības, ko likums "Par Rēzeknes speciālo ekonomisko zonu" piešķir uzņēmējsabiedrībām, kuras iegūst RSEZ statusu.

RSEZ piedāvā realizēt iespējas, kas pamatojas uz vietējo resursu – dabas, darbaspēka, ražošanas resursu, kā arī infrastruktūras pilnvērtīgu izmantošanu. Seminārā, kurā piedalījās ekspertu darba grupa, tika veikta SVID analīze, kuras rezultātā izvirzīta virkne priekšlikumu uzņēmējdarbības (ražošanas, pakalpojumu) attīstībai RSEZ teritorijā.