Summary in English

This Ph.D. dissertation presents the results of research on the accumulation and distribution of selected heavy metals (HMs) (Zn, Cu, Pb, Cd, Ni, Cr) in the bottom sediments of retention tanks (RTs) located in two Gdansk streams – Oliwski Stream and Strzyza Stream. The contamination assessment of the sediments relied on descriptive classifications and calculation methods (pollution indices). Potential health risks from dermal contact with contaminated sediments were determined. This Ph.D. thesis presents a number of methods for assessing HM sources – from simple static analyses to more complex and modern methods such as factor analysis, the flag element ratio approach, and the analysis of stable isotope ratios of lead (Pb). Novel methods of tracing HM sources were used for sample sets of bottom sediments, road sweeping waste (RSW), and mechanical waste (MW) generated by motor vehicles. The final element of the work was to verify the potential of common reed (*Phragmites australis*) seedlings for the remediation of dredged sediments at their initial stage of growth. In order to assess the initial state, the first step involved evaluating vegetative reed seedlings growing at two different sites (a lake – L and a roadside ditch – RD). Then, using common reed seedlings, a six-month mesocosm experiment was carried out, in which sediments dredged from RTs were applied.

It has been shown that the distribution of HMs in individual RTs is variable – an upward trend in HM concentrations in sediments was recorded for the RTs in the Strzyza Stream, which was related to increased urbanization of the catchment area along with the analyzed RTs. No consistent distribution dependence was recorded for the RTs in the Oliwski Stream. The Potokowa (Strzyza Stream) and Grunwaldzka (Oliwski Stream) RTs were indicated as the most polluted ones. Preliminary analyzes of HM sources revealed possible HM supplementation from automotive sources. The presence of paved surfaces within the catchment area of the RTs correlated with a higher content of HMs in bottom sediments. Possible Cu supplementation from roof runoff in the Oliwa district was indicated for nearby RTs (including the Grunwaldzka RT). The health risk assessment as a result of dermal contact with the most polluted sediments did not reveal any risk but indicated Cr as an element that should be monitored and controlled in the future.

Modern methods of source tracing used to verify the thesis related to the supplementation of HMs to the environment as a result of vehicle traffic proved the validity of this thesis, at the same time pointing to coal combustion as a separate source of HMs (Pb and correlated with Pb: Zn, Ni, Cr) within urbanized areas in Gdansk. Tyre scrap waste was shown to be a source of significant amounts of Zn (8444 mg/kg dw). During operation, the suspension system generates up to 3308 mg/kg d.w. of Zn and 3210 mg/kg d.w. of Cu. The analysis of Pb isotopes determined

the ranges of isotope ratios for MWs from 1.152 to 1.165 for $^{206}Pb/^{207}Pb$, from 2.050 to 2.085 for $^{208}Pb/^{206}Pb$, and from 2.350 to 2.418 for $^{208}Pb/^{207}Pb$.

Research on vegetative common reed seedlings has proved their ability to be highly tolerant and adaptable to various initial states of the environment. This proclaims the high plasticity of the mother clones, which is also reflected in different levels of HM concentrations in the tissues of plants collected from L (low metal content) and from RD (higher metal content in plant tissues and sediments than in the L site). Additionally, it has been shown that the phytoextraction abilities are based on the underground parts of the plant in the initial phase of growth. The response to different environmental conditions has been demonstrated by limiting the number of root hairs, the presence of a smaller cell nucleus in the leaf tissues, and a decreased number of chloroplasts in the case of a seedling taken from the RD site. Application of seedlings for mesocosm setup with the use of bottom sediments from RTs determined different behaviors of L and RD common reed seedlings. The *Phragmites australis* seedlings from the L site showed an ability to accumulate HMs in their tissues, while in the case of seedlings coming from the RD site, leaching (phytoexclusion) of HMs from plant tissues was noted. The initial state of the HM content in the tissues of common reed seedlings is important in planning phytoremediation technology. In the case of adaptation and acclimatization, the processes of HM absorption in the initial phase of *Phragmites australis* growth focus on phytostabilization and demonstrate phytoextraction capabilities.