NEW ITEMS IN THE NBMA RESOURCE LIBRARY

Fully Restored April 2016

TITLE: Greening a steel mill slag brownfield with biosolids and sediments: A case study

Author: Brose, D.A., L.S. Hundal, O.Oladeji, K. Kumar, T.C. Granato, A. Cox and Z. Abedin
Source: J. Environ. Qual. 2016 45:53-61
Abstract: The former US Steel Corporation's South Works site in Chicago, IL, is a 230-ha bare brownfield consisting of steel mill slag fill materials that will need to be reclaimed to support and sustain vegetation. We conducted a case study to evaluate the suitability of biosolids and dredged sediments for capping the steel mill slag to establish good quality turfgrass vegetation. Eight study plots were established on a 0.4-ha parcel that received biosolids and dredged sediment blends of 0, 25, 50, or 100% biosolids (v/v). Turfgrass was successfully established and was thicker and greener in biosolids-amended sediments than in unamended sediments. Concentrations of N, P, K, and micronutrients in turfgrass tissues increased with increasing biosolids. Soil organic carbon, N, P, and micronutrients increased with increasing biosolids. Cadmium, Cu, Ni, and Zn concentrations in biosolids-amended sediments also increased with increasing biosolids but were far below phytotoxicity limits for turfgrass. Lead and Cr concentrations in biosolids-amended plots were comparable to concentrations in unamended sediments. Groundwater monitoring lysimeters and wells below the study site and near Lake Michigan were not affected by nutrients leaching from the amendments. Overall, the results from this case study demonstrated that blends of biosolids and dredged sediments could be successfully used for capping steel mill slag brownfield sites to establish good quality turfgrass vegetation.
Document#: BIN.RC.MM.5.5

TITLE: Restoring ecosystem function in degraded urban soil using biosolids, biosolids blend, and compost

Author: Basta, N.T., D.M., Busalacchi, L.S. Hundal., K. Kumar, R.P. Dick, R.P. Lanno, J. Calson, A.E. Cox, and T.C. Granato
Source: J. Environ. Qual. 2016 45:74-83
Abstract: Many soils at former industrial sites are degraded. The objective of this research was to determine the ability of compost, biosolids, and biosolids blends to improve soil ecosystem function with minimal potential impact to surface water. Treatments rototilled into the top 12.5 cm of soil were biosolids at 202 Mg ha^{-1}; biosolids at 404 Mg ha^{-1}; compost at 137 Mg ha^{-1}; or a blend consisting of biosolids applied at 202 Mg ha^{-1}, drinking water treatment residual, and biochar. Rainfall runoff from experimental plots was collected for 3 yr. One year after soil amendments were incorporated, a native seed mix containing grasses, legumes, and forbs was planted. Soil amendments improved soil quality and nutrient pools, established a dense and high-quality vegetative cover, and improved earthworm reproductive measures. Amendments increased soil enzymatic activities that support soil function. Biosolids treatments increased the Shannon–Weaver Diversity Index for grasses. For the forbs group, control plots had the lowest diversity index and the biosolids blend had the highest diversity index. Biosolids and compost increased the number of earthworm juveniles. In general, biosolids outperformed compost. Biosolids increased N and P in rainfall runoff more than compost before vegetation was established. Several microconstituents (i.e., pharmaceutical and personal care products) were detected in runoff water but at concentrations below the probable no-effect levels and therefore should pose little impact to the aquatic environment. Future restoration design should ensure that runoff control measures are used to control sediment loss from the restored sites at least until vegetation is established.
Document#: BIN.RC.MM.5.6

TITLE: Bacterial populations within copper mine tailings: long-term effects of amendment with Class A biosolids

Author: Pepper, I.L., H.G. Zerzghi, S.A. Bengson, B.C. Iker, M.J. Banerjee, and J.P. Brooks
Source: J. Applied Microbiology 2012 113:569-577
Abstract : *Aim*: This study evaluates the effect of surface application of dried Class A biosolids on microbial populations within copper mine tailings.
Methods and Results: Mine tailing sites were established at ASARCO Mission Mine close to Sahuarita Arizona. Site 1 (December 1998) was amended with 248 tons ha^{-1} of Class A biosolids. Sites 2 (December 2000) and 3 (April 2006) were amended with 371 and 270 tons ha^{-1}, respectively. Site D, a neighbouring native desert soil, acted as a control for the evaluation of soil microbial characteristics. Surface amendment of Class A biosolids showed a 4 log10 increase in heterotrophic plate counts (HPCs) compared to unamended tailings, with the increase being maintained for 10-year period. Microbial activities such as nitrification, sulphur oxidation and dehydrogenase activity were also sustained throughout the study period. 16S rRNA clone libraries obtained from community DNA suggest that mine tailings amended with biosolids achieve diversity and bacterial populations similar to native soil bacterial phyla, 10 years post application.
Conclusion: Addition of Class A biosolids to copper mine tailings in the desert south-west increased soil microbial numbers, activity

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and diversity relative to unamended mine tailings.
Significance and Impact of the Study: The amended tailings resulted in a functional soil with respect to microbial characteristics, which were sustainable over a 10-year period enabling the development of appropriate vegetation.
Document#: BIN.RC.MM.5.7

TITLE: A comparison of the efficacy and ecosystem impact of residual-based and topsoil-based amendments for restoring historic mine tailings in the Tri-State mining district

Author: Kurunthachalam, K., S. Corsolini, J. Falandysz, G. Fillmann, K. S. Kumar, B.G. Loganathan, M.A. Mohd, J. Olivero, N. Van Wouwe, J.J. Yang, and K. M. Aldous.
Source: Sci. Total Environ. 2014 485-486: 624-632
Abstract: A long-term research and demonstration site was established on Pb and Zn mine wastes in southwestern Missouri in 1999. Municipal biosolids and lime and composts were mixed into the wastes at different loading rates. The site was monitored intensively after establishment and again in 2012. A site restored with topsoil was also included in the 2012 sampling. Initial results including plant, earthworm and small mammal assays indicate that the bioaccessibility of metals had been significantly reduced as a result of amendment addition. The recent sampling showed that at higher loading rates, the residual mixtures have maintained a vegetative cover and are similar to the topsoil treatment based on nutrient availability and cycling and soil physical properties in- cluding bulk density and water holding capacity. The ecosystem implications of restoration with residuals versus mined topsoil were evaluated. Harvesting topsoil from nearby farms would require 1875 years to replace based on natural rates of soil formation. In contrast, diverting biosolids from combustion facilities (60% of biosolids generated in Missouri are incinerated) would result in greenhouse gas savings of close to 400 Mg CO_2 per ha.
Document#: BIN.RC.MM.5.8

TITLE: Use of amendments to restore ecosystem function to metal mining impacted sites: tools to evaluate efficacy

Author: Brown, S.L. and R.L. Chaney
Source: Current Pollut. Reports 2016 *In Press*
Abstract: As in situ use of amendments for restoration of metal contaminated mining sites becomes increasingly accepted, the expected level of ecosystem function at these sites will increase. Use of appropriate tools to measure both the level and value of that function is critical to expand use of this approach. For these sites, amendment mixtures must reduce metal availability in situ and restore ecosystem function. Combinations of mixtures, typically consisting of a material with high metal binding capacity (cyclonic ashes, municipal biosolids, or other materials rich in Fe, Al or Mn oxides), material to adjust soil pH (sugar beet lime, cement kiln dust, dolomitic limestone), and an organic residual to provide soil structure and nutrients (composts, animal manures, municipal biosolids) have been tested in multiple lab and field trials on metal contaminated sites. This review focuses on field tests of this approach with the goal of providing methods to quantify reduction of hazard and restoration of functional systems. Methods to evaluate success of amendments including extractions to measure changes in metal availability, microbial function and diversity, phytoavailability of metals, and earthworm and small mammal assays are discussed. In most cases, measures of metal availability and ecosystem function are related. For example, surveys of small mammals on restored sites provide information on metal availability as well as suitability of restored habitat. Additional measures of ecosystem function including soil fertility, physical properties and diversity of habitat are described. Finally, measures of the value of this approach for restoring ecosystems are detailed.
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