

NTKN Libguides

Contaminants in Roadside Soils: Remediation and Control

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Home

Purpose of this guide

This LibGuide was created to compile resources discussing roadside contaminants and pollutants including trace metals such as lead, and polyaromatic hydrocarbons (PAH). Because this review focused on soils, little attention was given to stormwater runoff, except in cases where road runoff was also seen as affecting the roadside soil. Because Oregon does not use traditional salt solutions for winter road maintenance, most of the studies dealing with salt contamination were excluded, although some that looked at the effect of snowmelt and certain deicers were added.

When electronic descriptions were available, titles link to either full text, or to the abstract in an electronic database. Most of these databases require subscriptions to access content; articles and papers can be requested through interlibrary loans. The American Society of Civil Engineers (ASCE) journals and conference proceedings, as well as content from TRB journals (NCHRP reports, TRR journals, annual conferences, etc.) are available either from ODOT machines or from the ODOT Library.

The LibGuide platform is provided through the FHWA Pooled Fund Study TPF 5(237), Library Connectivity and Development. It is part of a collaborative effort among transportation librarians to provide a broader range of information and resources to our customers.

Original Compiler

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ODOT Library

The ODOT Library collaborates with transportation information networks throughout the US and internationally. LibGuides are sponsored through the Library Connectivity & Development Pooled Fund Study and are being coordinated and shared through the Transportation Knowledge Networks.

Soil Contamination

Roadside soil absorbs contaminants from various sources, including road construction, traffic, and structural materials.



General

Contaminants in roadside soil

[Micro Pollution Along Motorways: An Evaluation](#)

- Summarizes a number of research reports on the micro pollution, mainly caused by road traffic, along motorways in the Netherlands. Micro pollution implies pollution of the soil, surface water, and groundwater by micro contaminants such as heavy metals and polycyclic aromatic hydrocarbons (PAH). (1995)

[Importance of automobile exhaust catalyst emissions for the deposition of platinum, palladium, and rhodium in the Northern Hemisphere](#)

- An estimated 500 million vehicles worldwide are equipped with an exhaust catalyst that uses platinum group elements (PGE) as the main active components and thus contribute to global PGE emissions. Although PGE emitted from automobile exhaust catalysts were first believed to remain in the roadside environment, we propose here that fine PGE-containing particles in automobile exhaust have resulted in a widespread distribution of emitted PGE (2005)

[Diagnosing the traffic impact on roadside soils through a multianalytical data analysis of the concentration profiles of traffic-related elements](#)

- The road traffic has become one of the most serious environmental problems in many cities and the main source of pollution of urban soils. To diagnose properly the magnitude of such impacts on roadside soils, eight urban and metropolitan soils were selected as a function of traffic density, distance to the road and years of operation, for which the concentration of 60 elements (major, minor and trace elements) were measured by semi-quantitative ICP-MS after acid digestion, as a first step in assessing the traffic impact. (2013)

[Evaluation of heavy metal and total petroleum hydrocarbon contamination of roadside surface soil](#)

- The present study was conducted along three major highways namely State Highway (SH49), National Highway (NH66 and 45A) connecting Puducherry (India) for assessing heavy metals and total petroleum hydrocarbon contamination from surface soils in close proximity at a depth of 0–15 cm into automobile repair workshops and agricultural fields located beside the highways. (2014)

[Investigation of Heavy Metal Contents of Road-Deposited Sediment in Expressways](#)

- Road-deposited sediment (RDS) is an important carrier of heavy metal contaminants. Understanding the contribution of RDS and its potential to runoff pollution is essential for pollution control. 2015

[Contamination of roadside soil and vegetation with cadmium, nickel, lead, and zinc](#)

- Concentrations of Cd, Ni, Pb, and Zn in roadside soil and grass samples from several locations decrease with distance from traffic. These concentrations also decrease with depth in the soil profile. 1970

Chemical associations of lead, cadmium, copper, and zinc in street dusts and roadside soils

1981.

Pollution retention capabilities of roadside soils

- Runoff from highways contains significant loads of heavy metals and hydrocarbons. According to German regulations, it should be infiltrated over embankments to support groundwater-recharge. To investigate the decontaminating effect of greened embankments, soil-monoliths from highways with high traffic densities were taken. 1999

Magnetic susceptibility mapping of roadside pollution

- The aims of our study are to trace the distribution and concentration of contaminants in soils along roads and highways carrying appreciable traffic by using magnetic proxies. In addition, the concentration gradients and possible accumulation of pollutants in deeper soil layers are investigated. 1999

Platinum and Lead Markers as Indicators of Transportation Impact

- The intent of this study was to provide information necessary to characterize the present concentrations of an emerging transportation related contaminant, the platinum group metals (PGM), and to provide background information necessary to explore the potential uses of these metals as a specific marker of transportation related contamination that results from the discharge of road runoff into streams. 2009

EFFECT OF TRANSPORTATION-GENERATED POLLUTANTS ON HIGHWAYSIDE SOIL

- The soil adjacent to highways is exposed to hazardous heavy metals from vehicle emissions and various other transportation-generated wastes. These pollutants may be washed out by the rain, penetrate and accumulate in the highway side soil, and hence contaminate the soil environment.

[PCDD, PCDF, PCB, PAH, cadmium and lead in roadside soil: relationship between road distance and concentration](#)

- PCDD, PCDF, PCB, PAH, cadmium and lead were measured in soil samples taken at several distances from the road. The concentrations of all these pollutants markedly decreased within about 20 metres from the carriageway. A significant correlation appeared between lead and the other pollutants. These data indicates that traffic is the major source of roadside environmental pollution, not only for lead and cadmium, but for several organic pollutants too. 1992

[Real time and in situ determination of lead in road sediments using a man-portable laser-induced breakdown spectroscopy analyzer](#)

- In situ, real time levels of lead in road sediments have been measured using a man-portable laser-induced breakdown spectroscopy analyzer. 2009

[Lead in grain size fractions of road-deposited sediment](#)

- Road-deposited sediment (RDS) is an important environmental medium for assessing contaminant levels in urban systems. 2003

[Identification of particles containing chromium and lead in road dust and soakaway sediment by electron probe microanalyser](#)

- Individual particles containing Cr and/or Pb and other major components were identified in road dust from a heavily used road (hereinafter 'heavy traffic road dust'), road dust from a residential area and soakaway sediment by electron probe microanalyser to locate their sources and carrier particles. 2007

[A review of the contamination of soil with lead: II. Spatial distribution and risk assessment of soil lead](#)

- Contamination of soil with lead has occurred on a global scale. Exposure to lead may cause adverse effects to human health and the environment. It is therefore desirable to obtain a quantitative estimate of the potential risk of lead contamination. Numerous studies have been conducted collecting lead concentration data from both natural and contaminated soil on a range of scales. Very few of these studies have made serious attempts to spatially describe the data. 2001

[New Metal Emission Patterns in Road Traffic Environments](#)

- The increased awareness of traffic as a major diffuse metal emission source emphasizes the need for more detailed information on the various traffic-related sources and how and where the metals are dispersed. 2006

[Comparison of Source Identification of Metals in Road-Dust and Soil](#)

- Source identification of toxic metals is very critical for pollution prevention and human health protection. Many studies only use either road dust metal data or soil metal data to evaluate metal contamination and identify pollution sources, and this may lead to the exclusion of some important information. In this study, the differences of metal spatial distribution and source identification between road dust and associated soil in an industrial area were investigated. 2009

[Sources and transport pathways of common heavy metals to urban road surfaces](#)

- The study presented in this paper investigated the sources and transport pathways of manganese, lead, copper, zinc and chromium, which are heavy metals commonly present in urban road build-up. It was found that manganese and lead are contributed to road build-up primarily by direct deposition due to the re-suspension of roadside soil by wind turbulence, while traffic is the predominant source of copper, zinc and chromium to the atmosphere and road build-up. 2015

[Soil Lead Accumulation Alongside a Newly Constructed Roadway](#)

- Accumulation of lead (Pb) in soil along a new north-south section of Interstate 95 at Beltsville, Md., was monitored annually between 1971 and 1977. 1980

[Contamination of roadside soil and grass with heavy metals](#)

- The concentrations of heavy metals were determined in roadside soil and grass from different locations in Ibadan metropolis and two highways. 1997

[Characteristics of current roadside pollution using test-monitoring plots](#)

- The aim of the study was the qualitative recognition of the existing roadside pollutants deposited in topsoils located close to roads with high traffic volume. 2015

[Heavy Metals and Polycyclic Aromatic Hydrocarbons in Roadside Soil Samples: A Review](#)

- Diverse contaminants released into the environment through progress of urbanization and industrialization adversely affect human health. Among various sources of contaminants, especially, in big cities, automobiles play a significant role in aggravating the pollution. 2014

[Assessment of Heavy Metal Pollution of Urban Roadside Soil with Set Pair Analysis and Geoaccumulation Index](#)

- The assessment of pollution levels of heavy metals soil contamination is significant to the health of human kind. Two methods, Set Pair Analysis (SPA) and Geoaccumulation Index (Igeo), are applied to assess the urban roadside soil heavy metals pollution levels and compare the assessment results with Fuzzy Comprehensive Analysis (FCA). 2010

Contaminants from Specific Sources

Leaching from road materials

[Contaminants in Soil as a Result of Leaching from Asphalt](#)

- Significant concentrations of PAHs and HCs were recorded in soil, beneath an asphalt cover. The site had not received significant inputs from internal combustion vehicles and the contaminants would appear to have come from leaching of the asphalt surface. (1999)

[Evaluation of backfill corrosivity around steel road culverts](#)

- Corrugated steel plate culverts in connection with the location in the soil environment are exposed to risk of soil corrosion. The paper characterizes the most important factor affecting formation of corrosion in the soil, i.e. resistivity. The obtained results indicate the peril of the soil corrosion occurrence in the corrugated steel plate culverts, especially located on the national and provincial roads.(2013)

Leaching of Arsenic, Lead, and Antimony from Highway-Marking Glass Beads

- Glass beads embedded in pavement markings provide retroreflectivity to ensure safe driving. Recently, elevated concentrations of arsenic (As), antimony (Sb), and lead (Pb) have been observed in glass beads imported to the US. After an initial assessment of total concentrations in glass beads, a factorial study was conducted to determine the impact of environmentally relevant factors on leaching: pH (4, 7, and 10), chemicals applied on roadways (NaCl, CaCl₂, KCH₃COO, and KCl), ionic strength (10⁻²–10⁻¹ M), particle size (>100 and <37 μm), and time (18 h to 160 days). 2013

Heavy Metal Contamination in Highway Marking Glass Beads

- This research was undertaken to study the implications of using glass beads containing elevated concentrations of metals and metalloids on roadways. 2011

Screening Level Assessment of Arsenic and Lead Concentrations in Glass Beads Used in Pavement Markings

- Retroreflective glass beads used in pavement markings are a critical component of highway safety. However, reclaimed glass cullet may contain elevated levels of arsenic and lead that can be passed through to the final product. 2014

Environmental assessment of construction with recycled materials

- This thesis addresses the environmental implications of using recycled materials in road and landfill cover constructions. The focus is primarily on the leaching of inorganic constituents from six types of materials: incineration ashes, copper smelter slag, blast-furnace slag, recycled concrete, natural rock and contaminated soil. 2008

Use of recycled materials / fly ash

Geoenvironmental Impacts of Using High Carbon Fly Ash in Structural Fill Applications

- Fly ash produced by power plants in the United States occasionally contains significant amounts of unburned carbon due to the use of the increased prevalence of low nitrogen-oxide and sulphur-oxide burners in recent years. This ash cannot be reused in concrete production due to its reactivity with air entrainment admixtures, so it is largely placed in landfills. Highway structures have high potential for large volume use of high carbon fly ashes (HCFAs). However, in such applications, even though mechanical properties of the fly ash-amended highway base layers and embankments are deemed satisfactory, a key issue that precludes such highway embankments built with fly ash is the potential for negative groundwater effects caused by metals in the fly ash.

Leaching Behavior of Aluminum, Arsenic, and Chromium from Highway Structural Fills Amended with High-Carbon Fly Ash

- Coal combustion byproducts such as high-carbon fly ash (HCFA) are commonly used in highway construction as a stabilizing agent or soil amendment. Reuse of HCFA in geotechnical structures, particularly in road embankment construction, keeps these materials out of landfills. However, it is important to determine the environmental suitability of HCFA as a soil amendment because it poses a great potential for metal leaching. (2013)

Environmental assessment of construction with recycled materials

- This thesis addresses the environmental implications of using recycled materials in road and landfill cover constructions. The focus is primarily on the leaching of inorganic constituents from six types of materials: incineration ashes, copper smelter slag, blast-furnace slag, recycled concrete, natural rock and contaminated soil. 2008

Use of Adsorption Mechanism to Decrease Heavy Metal Mobility in Soil

- The objective of this project is to reduce the toxic heavy metal leaching from coal fly ash so that the fly ash may be used for road surface or related applications.

Leaching Behavior of Coal Combustion Products and the Environmental Implication in Road Construction

- This project assessed the physical and chemical characteristics of fly ashes produced from trona injection plants (used for SO₂ emission control), and investigated the leaching of a group of concerned inorganic contaminants from these fly ashes. A protocol was developed to quantify the availability and stability of As and Se in raw bituminous fly ash under various field conditions. The effectiveness of EDTA-washing in remediating fly ash was also studied. 2011

Deicing and effects of winter conditions

Potential Impacts of Different Chemical Deicing Salts on Soil Health along Roadsides

- After runoff from melting snow, deicing salts accumulate in soils along roadsides, impacting the properties of soil matrix and soil water, and suppressing road vegetation growth. To estimate the adverse effects of different types of chemical deicers such as chloride, nitrate, glycerin and industrial salt on soil health, 0.1%, 0.3% and 0.5% concentrations of deicer solutions are sprinkled on a soil surface at seven-day intervals for two months. (2012)

Effects of Road Salts on Heavy Metal Mobility in Two Eastern Washington Soils

- Heavy metals deposited on road surfaces and transferred to roadside environments by rainfall and snowmelt runoff can have serious impacts on receiving ecosystems. Infiltration is an effective best management practice for controlling metal contamination in runoff, although metals retention within infiltration facilities depends on a number of factors. In cold climates, deicing compounds have been shown to mobilize heavy metals putting receiving waters at risk.

Speciation of Heavy Metals in Road Runoff and Roadside Total Deposition

- The concentrations of Cd, Co, Cu, Pb, W and Zn were measured in road runoff and total deposition at two Swedish field sites during one year. It was found that the concentrations of most elements increased significantly during the winter, up to one order of magnitude. It was found that the increased concentrations were due to more intense wearing of the pavement during the winter because of the use of studded tires in combination with the chemical effects caused by the use of deicing salts. 2003

[Concentration and fractionation of heavy metals in roadside soils receiving de-icing salts](#)

- Soil was sampled along two lines of a highway, 0.5 m and 2.5 m from the asphalt surface, and in an infiltration pond for highway runoff. 1998

[Accretion and Partitioning of Heavy Metals Associated with Snow Exposed to Urban Traffic and Winter Storm Maintenance Activities. II](#)

- Compared to storm water runoff, urban roadway snow exposed to traffic and winter maintenance practices has a much greater capacity to accumulate and retrain heavy metals and other anthropogenic constituents. Heavy metals once released in the environment are not degraded and partition between the dissolved and particulate-bound fractions. 2002

[Particle Size Distribution and Metal Content in Street Sediments](#)

- Sediments that had accumulated during the winter season, and which were left at the surface when the snow had melted, were studied with regard to physical and chemical characteristics. The investigation was carried out in the city of Luleå, which is located in northern Sweden. 1998

Effect on plant and animal life

[Cadmium, nickel, lead, and zinc in earthworms from roadside soil](#)

- 1973.

[Integrated assessment of heavy metal \(Pb, Zn, Cd\) highway pollution: bioaccumulation in soil, Graminaceae and land snails](#)

- To assess the contamination induced by traffic at the vicinity of a highway (A31, France), several complementary studies were carried out on two sites, with different profiles and traffic intensity. 2004

[An important use of Raman spectroscopy to help understand the impact of traffic on roadside soils and plants](#)

- Road transport emissions have become one of the most serious environmental problems in many cities and their contribution to the global emission of atmospheric pollutants is increasing every year. The dispersion of these contaminants is determined by weather conditions, and metals may be deposited in surrounding areas such as roadside soil and building facades. 2012

International Studies

Europe and the UK

Assessment of Heavy Metals Remobilization by Fractionation: Comparison of Leaching Tests Applied to Roadside Sediments

- The pollution emitted by traffic activities and road maintenance is an area of great interest as contaminants can be transported to roadside sediments and pose a risk to environmental and human health. In the present work, deposited pollution in roadside sediments has been assessed by sampling along a highly traveled highway in Barcelona and the surrounding area. (2008)

Dispersal and effects of heavy metals from roads and road traffic: Literature survey (Swedish with English Summary)

- The review primarily concerns palladium, platinum, rhodium, antimony, lead, cadmium, cobalt, copper, chromium and zinc but also cerium, iridium, iron, mercury, manganese, molybdenum, nickel, thallium, tin, vanadium, bismuth and tungsten. Gaps in knowledge have been identified. (2005)

ENVIRONMENT AND CONSTRUCTION ROAD PROJECTS

- In July 1997, an inquiry has been sent to all PIARC member countries. It dealt with the five major topics identified by the Working Group: soil and water protection; how to deal with contaminated land; recycling of used materials; how to take account of flora; archaeology; water and noise; and work sites. (2000)

The Peculiarities of Fine Particles Dispersion over the Roadside

- A physical model of ground-level mathematical distribution was developed for determining pollutant dispersion peculiarities on freeways. Correlation of Lithuanian and foreign studies of ultrafine particles and transition metal measurements data was used for model reasoning. (2007)

Metals in European roadside soils and soil solution – A review

- This review provides a summary of studies analysing metal concentrations in soils and soil solution at European roadsides. The data collected during 27 studies covering a total of 64 sites across a number of European countries were summarised. (2014)

[Heavy Metal Pollution of Road Dust and Roadside Soil near a Major Rural Highway](#)

- The concentrations of lead, copper, cadmium, zinc, nickel and chromium were measured in road dust and roadside soils from a French major highway. The profiles of total levels in the soil as a function of distance from the road edge and as a function of depth were investigated. 2001

[Heavy metal contamination in street dust and roadside soil along the major national road in Kavala's region, Greece](#)

- A total of 96 street dusts and 96 roadside soils have been sampled from three different localities (urban, industrial, peripheral) of the city of Kavala (Greece) and analyzed for Pb, Cu, Zn, Ni, Cr, Cd, As and Hg using the atomic absorption spectrophotometric method. Results showed that dust and soil samples from the urban and industrial area contained significant levels of the metals studied compared to the values from the control site. 2009

[Platinum metal concentrations in urban road dust and soil in the United Kingdom](#)

- Concentrations of Pt, Pd, Rh and Au in soils and road dusts taken from areas of high and low traffic flows in the London Borough of Richmond and from a section of the Kingston bypass (A3) at New Malden, Surrey, have been measured. High concentrations of platinum are associated with high traffic densities. 1996

[Spatial and temporal variations in Pb concentrations and isotopic composition in road dust, farmland soil and vegetation in proximity to roads since cessation of use of leaded petrol in the UK](#)

- Results are presented for a study of spatial distributions and temporal trends in concentrations of lead (Pb) from different sources in soil and vegetation of an arable farm in central Scotland in the decade since the use of leaded petrol was terminated. 2011

[Distribution of Road Salt Residues, Heavy Metals and Polycyclic Aromatic Hydrocarbons across a Highway-Forest Interface](#)

- Automobile traffic pollutes roadside environments with a range of contaminants. In this study, we investigate the distribution patterns of different contaminant classes in topsoils across a highway-forest interface north-east of Vienna, Austria, in order to assess spatial pollutant distribution and evaluate the filtering effect of roadside forests. 2009

[A study of trace metals and polycyclic aromatic hydrocarbons in the roadside environment](#)

- A study has been conducted of the concentrations of a range of inorganic elements and polycyclic aromatic hydrocarbons during a winter period at a roadside location in Birmingham, UK. Particle number and NO_x concentrations were also determined continuously during the study. 2003

[Levels, Distribution and Source Characterization of Polycyclic Aromatic Hydrocarbons \(PAHs\) in Topsoils and Roadside Soils in Esbjerg, Denmark](#)

- A soil survey was performed to determine the levels, distributions and sources of 6 polycyclic aromatic hydrocarbons (PAHs) in 9 selected soil environments in Esbjerg, Denmark. 2011

[Trace metals in Stockholm sediments](#)

- Trace elements typically occur at low concentrations ($\leq 0.1\%$) in the environment. However, many trace elements are found at elevated concentrations as a result of human activities. Contaminated areas include cities where populations are exposed to contaminants . 2010

[Multielement contamination of British motorway environments](#)

- The multielement content of vegetation, surface soil and dust samples collected along the M1, M6 and M25 motorways and analysed by inductively coupled plasma-source mass spectrometry (ICP-MS) is presented. 1990

[A comparative study of heavy metal concentration and distribution in deposited street dusts in a large and a small urban area: Birmingham and Coventry, West Midlands, UK.](#)

- Results are presented from a study of the distribution of heavy metals in street dusts of two cities in Midland England. The first (Birmingham) is a large urban area (population of 2.3 million), the second, Coventry, a small one (population of 0.3 million). 2003

[The influence of a large city on some soil properties and metals content](#)

- Urban soils differ from the rural ones by the fact that they are more strongly influenced by anthropogenic activities. This influence is often reflected by a high degree of contamination. To investigate the influence a large city can have on its soils and on the surrounding ones, samples within the city of Torino, Italy were compared with a set of surrounding soils developed from the same alluvial parent material. 2006

[Micro Pollution Along Motorways: An Evaluation](#)

- Summarizes a number of research reports on the micro pollution, mainly caused by road traffic, along motorways in the Netherlands. Micro pollution implies pollution of the soil, surface water, and groundwater by micro contaminants such as heavy metals and polycyclic aromatic hydrocarbons (PAH). (1995)

[Metal leaching in a highway embankment on field and laboratory scale](#)

- This paper aims to analyse metal leaching in a highway embankment using both field and laboratory experiments. Soil, soil solution and road runoff were collected along one of the oldest highways in the world to characterize leaching of the metals Cd, Cr, Cu, Ni, Pb and Zn. 2014

Asia and the Middle East

[Long-term behavior of particulate matters at urban roadside and background locations in Seoul, Korea](#)

- The concentrations of particulate matter, PM_{2.5}, PM₁₀, and TSP at an urban roadside and an urban background station are analyzed. Data collected over a 10 year period are analyzed. (2010)

[Accumulation of metals in roadside soil, dust and pine needles in different characteristic traffic areas](#)

- Heavy metal levels and sources of contamination were investigated in different roadside locations from Ankara and Bursa metropolitan cities in Turkey. (2014)

[Assessment of trace metal distribution and contamination in surface soils of Hong Kong](#)

- An intensive investigation was conducted to study the distribution of trace metals in surface soils of Hong Kong and to assess the soil environmental quality. In general, trace metal pollution in soils of the industrial areas and Pb pollution in the soils of the commercial and residential areas were obvious. 1997

[Evaluation of heavy metal and total petroleum hydrocarbon contamination of roadside surface soil](#)

- The present study was conducted along three major highways namely State Highway (SH49), National Highway (NH66 and 45A) connecting Puducherry (India) for assessing heavy metals and total petroleum hydrocarbon contamination from surface soils in close proximity at a depth of 0–15 cm into automobile repair workshops and agricultural fields located beside the highways. (2014)

[Heavy metal contamination of urban soils and street dusts in Hong Kong](#)

- Due to rapid urbanisation and scarcity of land, most of the urban parks and recreational areas in Hong Kong are built close to major roads or industrial areas, where they are subject to many potential pollution sources, including vehicle exhaust and industrial emissions. An extensive soil survey was conducted in urban parks of Hong Kong to study the current conditions of heavy metals contamination in soils. 2001

[Metal contamination in urban, suburban, and country park soils of Hong Kong: A study based on GIS and multivariate statistics](#)

- The urban environment quality is of vital importance as the majority of people now live in cities. Due to the continuous urbanisation and industrialisation in many parts of the world, metals are continuously emitted into the terrestrial environment and pose a great threat on human health. 2006

[Determining contamination level of heavy metals in road dust from busy traffic areas with different characteristics](#)

- This study identified the levels and sources of heavy metal contamination in road dust from busy traffic areas in a typical industrial city in Korea. 2011

[Influence of Traffic Activity on Heavy Metal Concentrations of Roadside Farmland Soil in Mountainous Areas](#)

- Emission of heavy metals from traffic activities is an important pollution source to roadside farmland ecosystems. However, little previous research has been conducted to investigate heavy metal concentrations of roadside farmland soil in mountainous areas. 2012

[Relationships between heavy metal concentrations in roadside topsoil and distance to road edge based on field observations in the Qinghai-Tibet Plateau, China](#)

- This study investigated the spatial distribution of copper (Cu), zinc (Zn), cadmium (Cd), lead (Pb), chromium (Cr), cobalt (Co), nickel (Ni) and arsenic (As) in roadside topsoil in the Qinghai-Tibet Plateau and evaluated the potential environmental risks of these roadside heavy metals due to traffic emissions. 2013

[Enrichment pattern of leachable trace metals in roadside soils of Miri City, Eastern Malaysia](#)

- This article presents the results on distribution and enrichment pattern of acid-leachable trace metals (ALTM) from roadside soil of Miri city, Sarawak, East Malaysia. 2014

[Distribution, Composition Profiles and Source Identification of Polycyclic Aromatic Hydrocarbons in Roadside Soil of Delhi, India](#)

- Distribution, composition profiles and sources of polycyclic aromatic hydrocarbons (PAHs) were evaluated in roadside soils from Delhi, India. 2012

State or Province Specific Studies

United States

[Construction Activity, Emissions, and Air Quality Impacts: Real-World Observations from an Arizona Road-Widening Case Study](#)

- A field study was conducted of emissions and air quality impacts generated from a road widening project to gain insight into construction-related emissions of particulate matter (PM), the near-road pollutant concentration impacts that result from those emissions, and opportunities to mitigate potential impacts. (2010)

[Investigation of Roadside Particulate Matter Concentration Surrounding Major Arterials in Five Southern Californian Cities](#)

- In order to study the influence of urban building form on flow and dispersion of vehicular emissions, field measurements were performed on major arterials in five Southern Californian cities with different building geometries. Local mean wind, turbulence, virtual temperature, roadside fine particulate matter concentration, and traffic flow data were collected. (2010)

[Integrated Management of Roads and Roadsides: Long-term Research Framework for Road Effect Zones in California \(Ongoing Project\)](#)

- The local environment affected by the road surface and traffic has been termed the "road effect zone". The objectives of the proposal are: 1) To develop a long-term integrated experimental site at the newly-established University of California, Davis Advanced Transportation Infrastructure Research Center, and 2) To establish a modeling framework for future research on the road effect zone, with special emphasis on defining parameters of relevance for California road systems, but with methodologically broader applicability.

[Heavy metal contamination in highway soils. Comparison of Corpus Christi, Texas and Cincinnati, Ohio shows organic matter is key to mobility](#)

- Heavy metal content of roadside soil samples from along the interstate highway systems in Corpus Christi, Texas and Cincinnati, Ohio was measured to assess the degree of contamination such soils contain and the likelihood that this contamination can be remobilized. 2003

[Lead Concentrations, Isotope Ratios, and Source Apportionment in Road Deposited Sediments, Honolulu, Oahu, Hawaii](#)

- Anthropogenic contributions of lead to the urban environment have been dominated by combustion of leaded gasoline. A number of studies have used lead concentrations in road deposited sediments (RDSs) to infer automobile contributions. However, few studies have combined concentration data, enrichment ratios, and lead isotope ratio data into a comprehensive picture of lead contamination of road sediments. 2003

[Pilot study of the relationship of regional road traffic to surface-soil lead levels in Illinois](#)

- Leaded gasoline has been used as fuel for trucks and automobiles in the United States since 1924; it has been implicated as a source of lead that is deposited on the soil and eventually can be ingested by small children, contributing to their burden of this toxic metal. The lead content of 667 surface-soil samples (taken at depths of 0-5 cm) and 159 subsurface-soil samples (from depths of 25-30 cm) collected from Illinois play areas near roads was measured and related to traffic variables 1987

[Ecological Effects of Highway Construction Upon Michigan Woodlots and Wetlands: Soil Relationships](#)

- Ecological effects of recent highway construction on soils, hydrology, vegetation, and wildlife have been cooperatively evaluated for some common woodland and wetland types in central lower Michigan. A report on the soils portion of those Michigan Department of State Highways-sponsored studies follows. 1977

[Lead content of soils along Chicago's Eisenhower and Loop-terminal Expressways](#)

- The lead content of soils along Chicago's two expressways, the Chicago Loop-terminal Expressway and the Eisenhower Expressway, have been determined in various seasons of the year and at various distances from the roadway. 1973

[Responses of roadside soil cation pools to vehicular emission deposition in southern California](#)

- Roadside soils are heavily loaded with reactive nitrogen due to vehicular emissions, and these loadings likely acidify near-road soils. Cationic metals are mobilized from acidified soils during exchange reactions. 2015 (Article in press at time of compiling)

[Soil Lead Accumulation Alongside a Newly Constructed Roadway](#)

- Accumulation of lead (Pb) in soil along a new north-south section of Interstate 95 at Beltsville, Md., was monitored annually between 1971 and 1977. 1980

[Monitoring of Contaminants in Delaware Street Sweeping Residuals and Evaluation of Recycling/Disposal Options](#)

- DelDOT's street sweeping program recently was upgraded, and the amount of waste generated by these operations has increased significantly. Our monitoring program includes physical/chemical analyses of sweeper wastes in order to assess the effectiveness of street sweeping as a stormwater best management practice and to determine disposal and/or recycling options for these residuals. 2006

Canada

[Assessment of metal pollution in urban road dusts from selected highways of the Greater Toronto Area in Canada](#)

- Over the last several decades, there has been increased attention on the heavy metal contamination associated with highways because of the associated health hazards and risks. Here, the results are reported of an analysis of the content of metals in roadside dust samples of selected major highways in the Greater Toronto Area of Ontario, Canada

[Trace metal composition and speciation in street sediment: Sault Ste. Marie, Canada](#)

- Street sediment collected in Sault Ste. Marie, Ontario was examined for trace element composition (As, Cd, Cr, Cu, Fe, Pb, Hg, Ni and Zn) and the metal partitioning to various sediment properties was determined by sequential extraction. 1996

[Traffic-related trace element fate and uptake by plants cultivated in roadside soils in Toronto, Canada](#)

- This research examines traffic-related trace element emissions and their uptake by plants grown in urban roadside environments in Toronto, Canada. Oregano (*Origanum vulgare*), beets (*Beta vulgaris*) and eggplants (*Solanum melongena*) were cultivated at four locations with variable traffic-related metal inputs in 2010. 2013

Remediation and Control

Techniques for remediation and control of pollutants

Because most of the studies, articles and papers dealing with remediation and control focus on pollutants entering nearby water sources and stormwater flows, only resources that appear to compare contaminants filtered through roadside swales, buffers, and other vegetation barriers to roadside soils are included.

Percolation through soil is an effective treatment for road runoff

- The broad drainage of runoff and its infiltration into the road bank with a percolation through planted natural soil is the most common treatment for road runoff from roads and countryside highways. In this presentation, the efficiency of several treatments is compared. Input and output of heavy metals, mineral oil and polycyclic aromatic hydrocarbons (PAH) were measured in roadside soils, lysimeters in road banks and two types of basins receiving road runoff. (2006)

Storm Water Pollutant Removal in Roadside Vegetated Buffer Strips

- Objectives of the study were to generate design criteria and to determine whether standard roadway design requirements result in buffer strips with treatment equivalent to those specifically engineered for water quality performance. The quantity and quality of the runoff discharged from the buffer strip were compared with freeway runoff collected at the edge of pavement. (2007)

Pollution retention capabilities of roadside soils

- Runoff from highways contains significant loads of heavy metals and hydrocarbons. According to German regulations, it should be infiltrated over embankments to support groundwater-recharge. To investigate the decontaminating effect of greened embankments, soil-monoliths from highways with high traffic densities were taken. 1999