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Coal-Tar-Based Pavement Sealcoat—Potential Concerns for Human Health and Aquatic Life

Sealcoat is the black, viscous liquid sprayed or painted on many asphalt parking lots, driveways, and playgrounds to protect and enhance the appearance of the underlying asphalt. Studies by the U.S. Geological Survey (USGS), academic institutions, and State and local agencies have identified coal-tar-based pavement sealcoat as a major source of polycyclic aromatic hydrocarbon (PAH) contamination in urban and suburban areas and a potential concern for human health and aquatic life.[1]

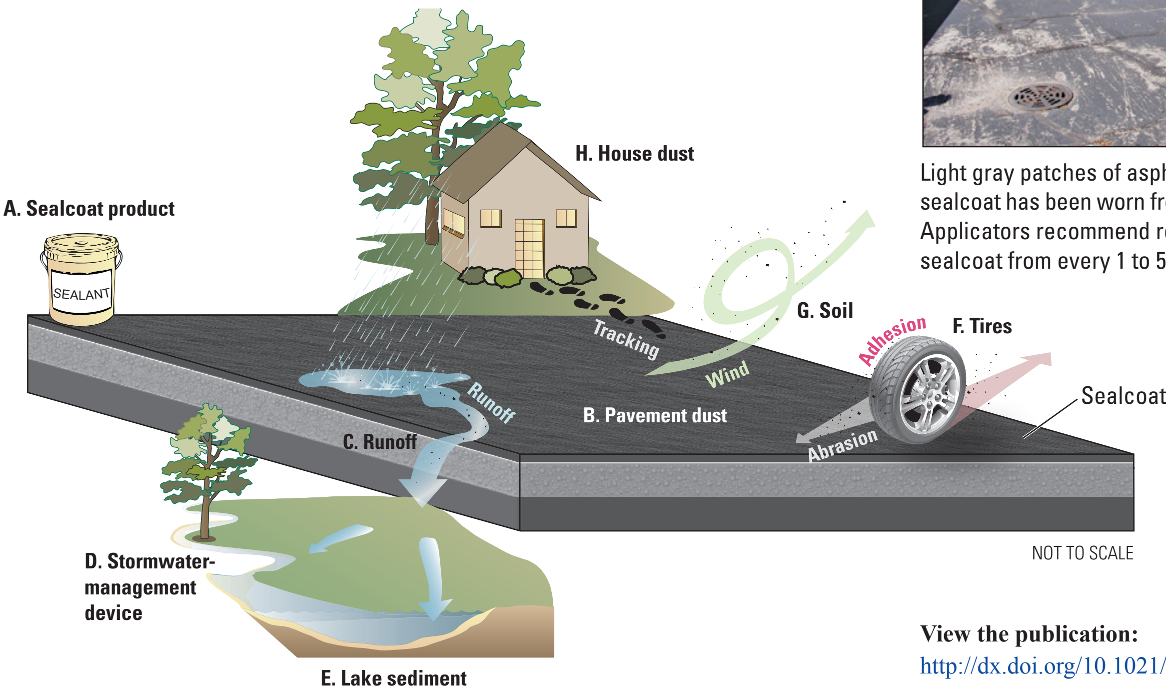
Key Findings:

Human Health Concerns—As coal-tar-based sealcoat ages, it wears into small particles with high levels of PAHs that can be tracked into homes and incorporated into house dust. For people who live adjacent to coal-tar-sealcoated pavement, ingestion of PAH-contaminated house dust and soil results in an elevated potential cancer risk, particularly for young children. Exposure to PAHs, especially early in childhood, has been linked by health professionals to an increased risk of lung, skin, bladder, and respiratory cancers.[2]

Aquatic Life Concerns—Runoff from coal-tar-sealcoated pavement, even runoff collected more than 3 months after sealcoat application, is acutely toxic to fathead minnows and water fleas, two species commonly used to assess toxicity to aquatic life. Exposure to even highly diluted runoff from coal-tar-sealcoated pavement can cause DNA damage and impair DNA repair. These findings demonstrate that coal-tar-sealcoat runoff can remain a risk to aquatic life for months after application.

Coal-tar-sealcoat, which contains elevated levels of PAHs, is commonly applied to parking lots, driveways, and some recreational areas across the central and eastern parts of the United States. Friction from vehicle tires abrades sealcoat into small particles that can be tracked indoors or washed down storm drains and into streams, potentially harming human and aquatic life.

As Sealcoat Wears Off, Where Does It Go?



Light gray patches of asphalt show where sealcoat has been worn from the pavement. Applicators recommend reapplication of sealcoat from every 1 to 5 years.[1]

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http://dx.doi.org/10.1021/es203699x

Worn particles of coal-tar-based sealcoat containing high concentrations of PAHs and related chemicals are transported by rain, wind, tires, and even our feet from pavement to other environmental settings. Sealcoat product (A), after it dries, gradually abrades to a powder and becomes part of the dust on the pavement (B). Pavement dust is transported by rainfall runoff (C) to stormwater-management devices (D) or to receiving streams and lakes (E). Pavement dust also adheres to tires (F) that track it onto unsealed pavement, and wind and runoff transport the dust to nearby soils (G). Sealcoat particles tracked into residences can become incorporated into the house dust (H). Associated PAH concentrations for these settings, from studies by the USGS, other government agencies, and academic institutions, are given below.

Setting	PAH concentration* (milligrams per kilogram)	
	Coal-tar-sealcoat settings	Non-coal-tar-sealcoat settings
(A) Sealcoat products	66,000	50
(B) Pavement dust	2,200	11
(C) Runoff, particles	3,500	54
Runoff, unfiltered water	62	4
(D) Stormwater-management-device sediment	646	2
(E) Lake sediment	33	0.4
(F) Particles adhered to tires	1,380	3
(G) Soil	105	2
(H) House dust	129	5

*Concentrations are means or medians. References and additional information are provided in Mahler and others (2012).[1]

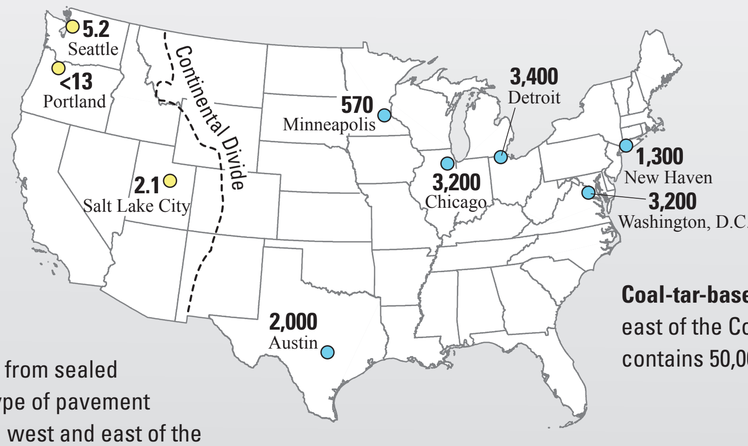
PAH Levels in Asphalt-Based and Coal-Tar-Based Sealcoat

Pavement sealcoat is a commercial product that is applied to many asphalt parking lots, driveways, and playgrounds in North America in an effort to protect and beautify the underlying asphalt. It rarely is used on public roads.

Most sealcoat products are either coal-tar or asphalt emulsion, although some alternative products now are available.[3] Coal tar and coal-tar pitch have extremely high concentrations of PAHs as do coal-tar-based sealcoat products, which typically are 20–35 percent coal tar or coal-tar pitch. Asphalt and asphalt-based sealcoat products have much lower concentrations of PAHs.

For historical and economic reasons, use of asphalt-based sealcoat in the United States is more common west of the Continental Divide and use of coal-tar-based sealcoat is more common east of the Continental Divide, except in States, counties, and municipalities where use of coal-tar-based sealcoat is prohibited.[3]

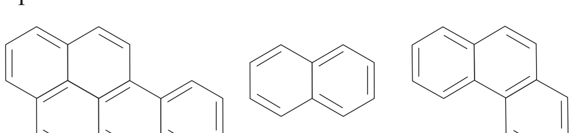
Asphalt-based sealcoat, primarily used west of the Continental Divide, typically contains about 50 mg/kg PAHs.[4]



Coal-tar-based sealcoat, primarily used east of the Continental Divide, typically contains 50,000 to 100,000 mg/kg PAHs.[4]

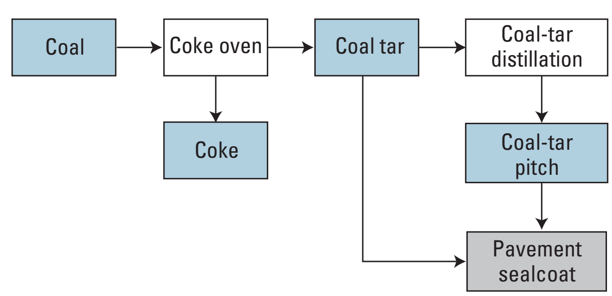
PAH levels in dust swept from sealed parking lots reflect the type of pavement sealcoat commonly used west and east of the Continental Divide.[1] Concentrations, in units of milligrams per kilogram (mg/kg), also referred to as "parts per million" (ppm), shown here are for the sum of the 16 PAHs listed by the U.S. Environmental Protection Agency as Priority Pollutants. Concentrations are for composite samples from multiple parking lots or a median of several individual samples.[5]

Polycyclic aromatic hydrocarbons (PAHs) are a group of chemicals created by heating or burning material that contains carbon. The many sources of PAHs to the urban environment span a wide range of PAH concentrations and include asphalt (2–9 mg/kg), tire particles (84 mg/kg), used motor oil (730 mg/kg), and coal-tar-based sealcoat (34,000–202,000 mg/kg).[6] PAHs are an environmental concern because many cause cancer, mutations, birth defects, or death in fish, wildlife, and invertebrates.[7] Exposure to sunlight greatly intensifies the adverse effects of several PAHs. The U.S. Environmental Protection Agency (EPA) has classified seven PAHs as probable human carcinogens (Class B2) and 16 PAHs as Priority Pollutants. Environmental and health effects depend on which PAHs are present and their concentrations.



PAHs are made up of various arrangements of benzene rings. PAHs commonly occur in the environment as mixtures, which typically include at least some of the PAHs that are classified as probable human carcinogens.

Coal tar is a byproduct of the coking, liquefaction, or gasification of coal and is a complex mixture composed primarily of aromatic hydrocarbons. Coal-tar pitch is the residue that remains after the distillation of coal tar; it is a complex mixture of high molecular weight aromatic hydrocarbons and black carbon solids. The primary use of coal-tar pitch is in electrode manufacturing for the aluminum industry.[8] Coal-tar emulsion pavement sealants contain either crude coal tar (Chemical Abstracts Service [CAS] Registry Number 8007–45–2) or coal-tar pitch (CAS Registry Number 65996–93–2). Coal tar and coal-tar pitch are known human carcinogens.[9]

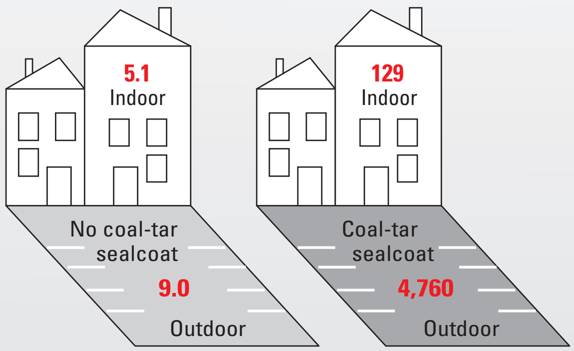


Potential Risks to Human Health

PAHs from coal-tar-based sealcoat contaminate house dust[10]

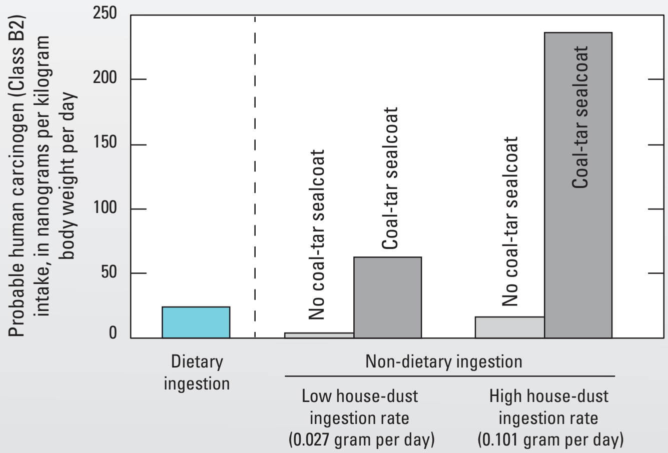
In a study of 23 ground-floor apartments in Austin, Texas, PAH levels in house dust in apartments with parking lots sealed with a coal-tar-based product were 25 times higher than in house dust in apartments with parking lots with other surface types (concrete, unsealed asphalt, and asphalt-based sealcoat). No relation was found between PAHs in house dust and other possible indoor PAH sources such as tobacco smoking and fireplace use.

House dust is an important pathway for human exposure to many contaminants, including PAHs. This is particularly true for small children, who spend time on the floor and put their hands and objects into their mouths.



PAH-contaminated dust on coal-tar-sealcoated pavement (right) is tracked indoors.[10] Concentrations shown are median values for the sum of the 16 Priority Pollutant PAHs, in units of milligrams per kilogram, in house dust and parking lot dust.

View the publication:
http://pubs.acs.org/doi/pdf/10.1021/es902533r



The preschooler living in a residence adjacent to coal-tar-sealed pavement who has relatively low hand-to-mouth activity consumes about 2.5 times more PAHs from house dust than from their diet.[11] For the more active preschooler, whose hand-to-mouth activity is higher, the PAH intake from house dust is nearly 10 times more than the PAH intake from their diet.

Living adjacent to coal-tar-sealed pavement increases cancer risk[12]

The USGS partnered with a human-health-risk analyst to estimate the excess lifetime cancer risk associated with the ingestion of house dust and soil for people living adjacent to parking lots with and without coal-tar-based sealcoat. Excess cancer risk is the extra risk of developing cancer caused by exposure to a toxic substance. The excess cancer risk for people living adjacent to coal-tar-sealcoated pavement (1.1 cancer incidences for every 10,000 individuals exposed) was 38 times higher, on average (central tendency), than for people living adjacent to unsealed pavement. The central tendency excess cancer risk estimated for people living adjacent to coal-tar-sealcoated pavement exceeds the threshold generally considered by the EPA as making remediation advisable.

The assessment used measured concentrations of the B2 PAHs in house dust and soils adjacent to coal-tar-sealed pavement (adjusted for relative potency to the PAH benzo[*a*]pyrene), established house dust and soil ingestion rates, and the EPA-established slope factor to estimate the excess cancer risk. Much of the estimated excess risk comes from exposures to PAHs in early childhood (that is, 0–6 years of age). The study did not consider the excess cancer risk associated with exposure to the sealcoated pavement itself, which has PAH concentrations 10 or more times greater than in adjacent residence house dust or soils.[5, 10]

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http://pubs.acs.org/doi/pdf/10.1021/es303371t

Children ingest house dust and soil when they put their hands or objects into their mouth. Much of the estimated excess cancer risk associated with the ingestion of PAH-contaminated soil and house dust is incurred during early childhood.

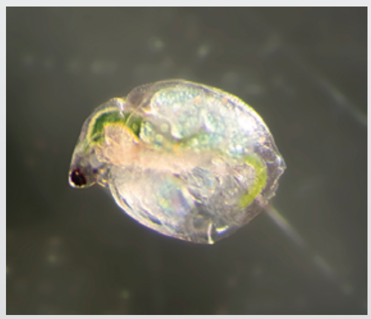
Potential Risks to Aquatic Life

Runoff from coal-tar-sealcoated pavement is acutely toxic to aquatic biota[13]

Exposure to runoff from coal-tar-sealed pavement collected as much as 42 days after sealcoat application resulted in 100 percent mortality to two commonly tested laboratory organisms: day-old fathead minnows (*Pimephales promelas*) and water fleas (*Ceriodaphnia dubia*). In contrast, minnows and water fleas exposed to runoff from unsealed pavement experienced no more than 10 percent mortality. When the minnows and water fleas were also exposed to simulated sunlight, which intensifies the toxicity of some PAHs, runoff collected 111 days (more than 3 months) after sealcoat application caused 100 percent mortality to both species, and caused 100 percent mortality to water fleas even when diluted to 10 percent of its original strength.

The USGS collected samples of runoff from 5 hours to 111 days following sealcoat application to pavement by a professional applicator. Total PAH concentrations varied relatively little, as rapid decreases in concentrations of low molecular weight and nitrogen-substituted PAHs were offset by increases in high molecular weight PAHs.[14] These results demonstrate that runoff from coal-tar-sealcoated pavement continues to contain elevated concentrations of PAHs and related compounds long after a 24-hour curing time.

A subsequent study by researchers at the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Fish and Wildlife Service found that coal-tar-sealcoat runoff is acutely lethal to juvenile coho salmon (*Oncorhynchus kisutch*) and causes a wide spectrum of abnormalities to zebrafish (*Danio rerio*) embryos.[15] They also reported that filtration of the runoff through a biorention system substantially reduced toxicity.



Runoff from coal-tar-sealcoated pavement is acutely toxic to fathead minnows (*Pimephales promelas*; left) and water fleas (*Ceriodaphnia dubia*; right).

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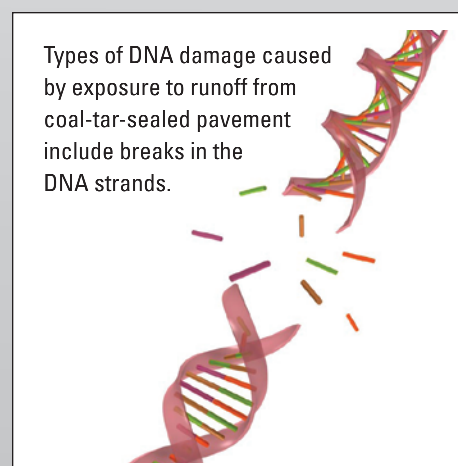
Runoff from coal-tar-sealcoated pavement goes down storm drains to receiving water bodies. The runoff contains high concentrations of PAHs and related chemicals that can harm aquatic life.[16]

Runoff from coal-tar-sealcoated pavement damages DNA and impairs DNA repair[17]

Simultaneous exposure to runoff from coal-tar-sealed pavement and simulated sunlight damaged DNA in rainbow trout liver cells, even when the runoff was diluted to 1 percent of its initial concentration. The cells were from a cell line developed to assess the effects of PAHs on DNA. The test assessed two types of DNA damage: strand breaks and alkylated bases.

Although cells can repair some DNA damage, a second experiment demonstrated that cells exposed to the coal-tar-sealcoat runoff had an impaired capacity to perform at least one type of DNA repair. The combination of DNA damage and impaired repair capacity intensifies the potential for long-term damage to cell health. DNA damage has many possible consequences, including aging, cell death, and mutations. Mutations can affect the function of genes and can potentially lead to cancer.



(Image from Genetic Science Learning Center, http://learn.genetics.utah.edu.)

Air-Quality Concerns[18, 19]

Although unseen, releases of PAHs to the atmosphere (volatilization) from freshly coal-tar-sealed pavement are tens of thousands of times higher than from unsealed pavement. Volatilization is a potential human-health concern because inhalation is an important pathway for human exposure to PAHs. Although volatilization decreases rapidly over the weeks following application, it nonetheless continues long after application—PAH releases to the atmosphere from parking lots sealed from 3 to 8 years prior to sampling were on average 60 times higher than PAH releases from unsealed pavement.

Nationwide, the combined PAH releases each year from newly applied coal-tar-based sealcoat are estimated to exceed annual vehicle emissions of PAHs.[18] PAH releases shown here are in units of micrograms per meter squared per hour (µg/m^2-h).

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For more information

Access publications and learn more about PAHs and coal-tar-based pavement sealcoat at http://tx.usgs.gov/sealcoat.html.

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ISSN 2327-6916 (print)
ISSN 2327-6932 (online)
http://dx.doi.org/10.3133/fs20163017

Environmental Science & Technology

Article

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Cancer Risk from Incidental Ingestion Exposures to PAHs Associated with Coal-Tar-Sealed Pavement

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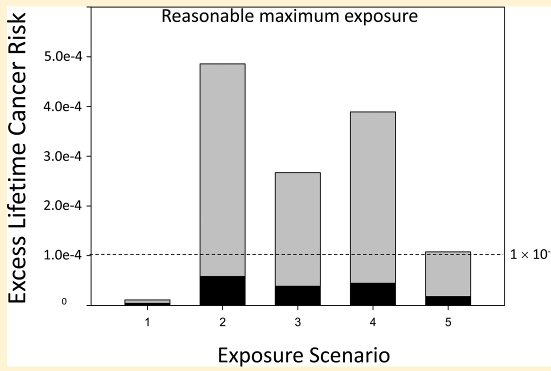
Supporting Information

ABSTRACT: Recent (2009–10) studies documented significantly higher concentrations of polycyclic aromatic hydrocarbons (PAHs) in settled house dust in living spaces and soil adjacent to parking lots sealed with coal-tar-based products. To date, no studies have examined the potential human health effects of PAHs from these products in dust and soil. Here we present the results of an analysis of potential cancer risk associated with incidental ingestion exposures to PAHs in settings near coal-tar-sealed pavement. Exposures to benzo[*a*]pyrene equivalents were characterized across five scenarios. The central tendency estimate of excess cancer risk resulting from lifetime exposures to soil and dust from nondietary ingestion in these settings exceeded 1×10^{-4}, as determined using deterministic and probabilistic methods. Soil was the primary driver of risk, but according to probabilistic calculations, reasonable maximum exposure to affected house dust in the first 6 years of life was sufficient to generate an estimated excess lifetime cancer risk of 6×10^{-5}. Our results indicate that the presence of coal-tar-based pavement sealants is associated with significant increases in estimated excess lifetime cancer risk for nearby residents. Much of this calculated excess risk arises from exposures to PAHs in early childhood (i.e., 0–6 years of age).



INTRODUCTION

The presence of coal-tar-based sealants on asphalt parking lots is associated with elevated concentrations of polycyclic aromatic hydrocarbons (PAHs) in the surrounding environment.[1−6] Sealcoat is a black, shiny substance sprayed or painted on the asphalt pavement of parking lots, driveways, and playgrounds to improve appearance and protect the underlying asphalt. An estimated 85 million gallons (320 million liters) of coal-tar-based sealant are applied to pavement each year,[7] primarily east of the Continental Divide in the U.S. and parts of Canada.[4,8] Coal-tar-based pavement sealants are 15−35% coal-tar pitch, which has been classified as a human carcinogen (IARC Group 1).[9] PAHs are the major constituents of coal-tar pitch,[10] and commercially available coal-tar-based sealants contain on the order of 50 000−100 000 mg/kg PAHs [sum of the 16 U.S. Environmental Protection Agency (USEPA) Priority Pollutant PAHs (ΣPAH_{16})].[7,11] Over time, the dried sealant is abraded from pavement surfaces, and the resulting mobile particles can be transported into nearby environmental compartments.[7,12]

Coal-tar-based pavement sealants are the predominant source of PAHs in the sediment of many urban and suburban lakes, especially areas where population is rapidly growing.[3,13] Coal-tar-based sealants are associated with deleterious effects on local ecosystems, including decreases in species richness and abundance among benthic invertebrates,[14,15] slower growth and impaired swimming behaviors in salamanders,[16] and impaired growth and development of frogs.[17] PAHs from coal-tar-based pavement sealants also contaminate environmental media that are relevant to human exposures. In a study of 23 apartments in Austin, Texas, the median concentration of ΣPAH_{16} in settled house dust (SHD) in residences adjacent to coal-tar-sealed asphalt (CSA) parking lots was 31 times higher than in SHD in apartments adjacent to unsealed asphalt (UA) lots.[18] The presence or absence of coal-tar-based sealants on the adjacent lot explained 48% of the variance in PAH concentrations measured in SHD.[18] Elevated PAH concentrations also have been reported for soil adjacent to CSA lots relative to soil adjacent to UA lots.[2,4] Hereinafter, soil and SHD near CSA or UA parking lots are described as "CSA-affected" or "UA-affected", respectively.

Exposure to PAHs is linked to increased risk for multiple cancer types, including lung, skin, bladder, respiratory, and urinary tract.[19] These studies have mostly examined inhalation exposure at sintering plants, foundries, and similar industrial settings. The carcinogenic properties of tobacco smoke are attributed, in part, to the presence of PAHs.[20] Aside from

Received: August 27, 2012
Revised: November 20, 2012
Accepted: November 23, 2012
Published: November 23, 2012

smoking, nonoccupational exposures to PAHs are believed to occur primarily through dietary ingestion.[21] In the interest of understanding aggregate doses, several studies have characterized the presence of PAHs in a wide array of foodstuffs in different countries, including the U.S., as reviewed in Ramesh et al. (2004).[21] Seven PAHs—benz[*a*]anthracene, benzo[*k*]fluoranthene, benzo[*b*]fluoranthene, benzo[*a*]pyrene (BaP), chrysene, dibenz[*a,h*]anthracene (diBahA), and indeno[123-*cd*]pyrene—have been classified by the USEPA as probable human carcinogens (B2 PAHs).

Nondietary ingestion (incidental ingestion of soil and SHD) is a pathway for exposure to numerous chemicals, including lead, pesticides, polychlorinated dioxins and furans, polybrominated diphenyl ethers, and PAHs, especially in children.[22,23] Many sources and activities are hypothesized to contribute PAHs to SHD, including cooking, smoking, vehicle exhaust, and indoor heating.[24,25] These exposures have been characterized as minor relative to those associated with dietary ingestion;[26,27] however, recent research indicates that in CSA-affected residences, nondietary ingestion of PAHs likely exceeds dietary ingestion.[28]

To date (November 2012), the authors are not aware of any published studies that have assessed the potential risks to human health associated with the elevated concentrations of PAHs measured in CSA-affected environments. The objective of the current study was to examine and compare exposure to and risk arising from ingestion of B2 PAHs in SHD and soil in settings adjacent to CSA and UA parking lots. Standard deterministic risk-assessment techniques were used to estimate B2 PAH doses and associated excess lifetime cancer risk (ELCR) for five exposure scenarios spanning childhood, adolescence, and adulthood, and probabilistic risk calculations were conducted for three of these scenarios.[29]

■ METHODS

This risk assessment focuses on the B2 PAHs. Each of these compounds has been assigned a potency factor (RPF) relative to the potency of BaP, ranging from 0.001 for chrysene to 1 for diBahA and BaP.[30] Ingestion dose estimates are presented for BaP equivalents (BaPEQ), computed as the sum of the product of the concentration of each B2 PAH and its RPF. Bioavailability is assumed to be 100%.

As noted in ref 18, analytical difficulties with diBahA resulted in nondetections in all but one SHD sample collected for that study. Thus, diBahA is not included here in any computations of BaPEQ in SHD or soil. Estimates of dose including diBahA at the limit of detection divided by two (not shown) indicate that it likely accounted for no more than 5−7% of the total dose of BaPEQ. By comparison, BaP accounted for 72−73% of BaPEQ in SHD samples, and 76−77% in soil samples.

Concentrations of BaPEQ in Dust and Soil. Data on PAHs in SHD used for this analysis were published previously.[18] In that study, SHD and parking lot dust were sampled for 23 ground-floor apartments in Austin, Texas. The parking lot surface adjacent to the apartment complexes was CSA (n = 11), UA (n = 7), asphalt-based sealant over asphalt pavement (n = 3), or unsealed concrete (n = 2). For this analysis, doses and risk associated with residences adjacent to UA parking lots were considered relative to those adjacent to CSA parking lots. BaP concentrations in CSA-affected SHD were high (median and maximum of 4.5 and 24.2 μg/g, respectively) relative to those reported in most parts of the U.S. where coal-tar-based sealcoat is not used (e.g., California: median and maximum of 0.04 and 1.0 μg/g, respectively; Arizona: median and maximum of 0.06 and 0.07 μg/g, respectively[25]). We computed BaPEQ for data presented in;[18] concentrations of BaPEQ in SHD in apartments adjacent to CSA parking lots (8.1 μg/g, geometric mean) were significantly higher than those in apartments adjacent to UA lots (0.61 μg/g, geometric mean) (p = 0.002, Mann−Whitney−Wilcoxon). Risk-assessment guidance recommends the use of the 95% upper confidence limit of the arithmetic mean,[29] but high standard deviations in the data sets, normality testing in log-transformed data, and an emphasis on conservatism in dose and risk estimates dictated the decision to use geometric means of these data to represent the BaPEQ exposure concentration in deterministic calculations.

Dust loading was computed for each location sampled in ref. 18 (Supporting Information Table S1). Loading of BaPEQ in the dust is significantly higher in residences adjacent to CSA pavement (medians of 15.7 μg/m^2 CSA vs 0.63 μg/m^2 UA; p = 0.01, Mann−Whitney−Wilcoxon). Total dust loading is higher in the CSA group relative to the UA group (medians of 346 and 72.3 μg/cm^2, respectively), but the difference was not significant (p = 0.365, Mann−Whitney−Wilcoxon). However, one data point in the UA SHD data set is an outlier (884 μg/cm^2) more than 4 times larger than all other data points and after removal of this data point, CSA settings have significantly higher dust loadings than UA settings (p = 0.043, Student's t test; data passed normality testing after elimination of the outlier). One issue that could not be resolved in this analysis is the relative importance of flooring type, because some samples were collected in combinations of bare and carpeted flooring.

Data for PAHs in CSA- and UA-affected soils are available for samples from New Hampshire (UA n = 1, CSA n = 5)[2] and suburban Chicago (UA n = 2, CSA n = 2).[4] Concentrations of BaP in UA-affected soils ranged from below detection limit to 0.7 μg/g. These are consistent with background concentrations reported for U.S. soils of up to 1.3 μg/g,[19] and somewhat higher than those reported for soil samples collected in remote areas around the world (range <0.0001 to 0.386 μg/g).[31] Concentrations of BaP in CSA-affected soils were substantially higher, ranging from 2.98 to 29.2 μg/g.[2,4] Concentrations of BaP in dust on pavement with coal-tar-based sealant are typically in the 100s of μg/g.[2,18] Concentrations of BaP in the 100s of μg/g in soil are typical of those in soils at manufactured gas sites and wood preservative sites,[32,33] some of which have been classified as Superfund sites (http://www.epa.gov/region5/cleanup/mgp.htm). Geometric mean BaPEQ soil concentrations for CSA-affected settings were 12.4 μg BaPEQ/g soil, and for UA-affected settings were 0.19 μg BaPEQ/g soil.

Deterministic and Probabilistic Estimates of Dose and Excess Lifetime Cancer Risk. Doses of BaPEQ were estimated using the standard equation (eq 1) included in the Risk Assessment Guidance for Superfund, Part A.[29] Exposure assumptions for both deterministic and probabilistic risk calculations are given in Supporting Information Table S2.

$$\text{dose} = \frac{\text{Cm} \times \text{CF} \times \text{IR} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT}} \tag{1}$$

where Cm is the concentration of BaPEQ in the dust, soil, or both, CF is the conversion factor, IR is ingestion rate, EF is exposure frequency, ED is exposure duration, BW is body weight, and AT is averaging time.

Table 1. Excess Lifetime Cancer Risk (ELCR) Estimates for Central Tendency (CTE) and Reasonable Maximum (RME) Exposures in Five Scenarios for Carcinogenic Polycyclic Aromatic Hydrocarbons by Ingestion of Settled House Dust, Soil, And Both Media[a]

	age of exposure (years of age)		settled house dust only		soil only		dust and soil	
scenario	UA	CSA	CTE	RME	CTE	RME	CTE	RME
1	0−70	N/A	1.5×10^{-6}	4.4×10^{-6}	1.4×10^{-6}	6.7×10^{-6}	2.9×10^{-6}	1.1×10^{-5}
2	N/A	0−70	2.0×10^{-5}	5.8×10^{-5}	8.9×10^{-5}	4.3×10^{-4}	1.1×10^{-4}	4.9×10^{-4}
3	6−70	0−<6	1.1×10^{-5}	3.8×10^{-5}	2.9×10^{-5}	2.3×10^{-4}	4.0×10^{-5}	2.7×10^{-4}
4	18−70	0−<18	1.4×10^{-5}	4.4×10^{-5}	4.7×10^{-5}	3.4×10^{-4}	6.1×10^{-5}	3.9×10^{-4}
5	0−<18	18−70	8.2×10^{-6}	1.8×10^{-5}	4.3×10^{-5}	9.0×10^{-5}	5.1×10^{-5}	1.1×10^{-4}

[a]UA, unsealed asphalt pavement; CSA, coal-tar-sealed asphalt pavement; N/A, not applicable.

The geometric mean BaPEQ for SHD and soil were used as point estimates for deterministic dose and risk calculations. Lognormal distributions based on data from refs 2,4,18 were developed for probabilistic calculations [UA soil: mean 0.423 μg/g (standard deviation (sd) = 0.523), CSA soil: mean 15.8 μg/g (sd =11.9); UA SHD: mean 1.10 μg/g (sd =1.08), CSA SHD: mean 11.4 μg/g (sd = 9.41)]. Lognormal distributions and corresponding geometric means were chosen to reflect the frequent observation of distributions of this type in environmental contaminant concentrations.

For deterministic calculations of SHD ingestion, we used recently published SHD intake rates for children determined using the Stochastic Human Exposure and Dose Simulation (SHEDS) model for multimedia pollutants.[34] The SHEDS model addresses two pathways of exposure to dust: direct ingestion of SHD from hand-to-mouth contact, and indirect ingestion resulting from mouth contact with inanimate objects such as toys (especially relevant for preschool children). The model takes into account the importance of SHD loading, a strong predictor of blood lead levels related to dust-mediated exposure. The model relies on the Consolidated Human Activity Database, which has activity diaries for over 22 000 individuals.[35] We employed the mean SHD IR estimate from ref. 34 of 27 mg/day (rounded to two significant figures to account for the inherent uncertainty of the model) for children 3−<6 years of age as a central tendency estimate (CTE) of exposure for children 0−6 years of age, and the 95th percentile values from [34] as a reasonable maximum estimate (RME) of exposure. For individuals older than 6 years of age, who are expected to be away from the home for much of the day, we used one-half of the early childhood CTE dust IR (13 mg/day), and 27 mg/day as the RME dust IR. Few data are available for SHD IRs for adults, but previous risk assessments have employed adult SHD IRs of 20 and 50 mg/day,[22,36] higher than the IRs used in this analysis. The distribution of child IRs for SHD was adapted from ref. 34 (mean = 27 mg/day, sd = 40, log-normal) for probabilistic dose and risk calculations, and a similarly shaped distribution was postulated for SHD IR for 6−70 years of age (mean = 13.3 mg/day, sd = 19.6, log-normal).[34]

For deterministic calculations of soil ingestion, default IRs from the Exposure Factors Handbooks and the Child Specific Exposure Factors Handbook,[37,38] with some minor modifications, were used. For persons of all ages, 50 mg/day was used for the CTE soil IR, and the RME IRs used were 400 mg/day from 1−13 years of age and 100 mg/day from 13−70 years of age.

For a distribution for soil IRs for children 0−<13 years of age, we used data generated by the SHEDS model that indicated an arithmetic mean of 60.6 mg/day, sd of 80.5 mg/day.[39] These values are similar to those from a recent review of all published tracer studies on soil ingestion by children, in which the arithmetic mean was estimated at 63 mg/day, with a median of 27 mg/day and a 95th percentile of 195 mg/day.[39] The SHEDS model result was used as the basis for probabilistic calculations of dose and risk in children. For children and adults 13−70 years of age, the arithmetic mean of all available soil ingestion rates from tracer studies was 46 mg/day (rounded to 50 mg/day in deterministic calculations).[39] A distribution similar to that for soil ingestion in children was postulated, and an appropriate standard deviation was calculated for use in a Monte Carlo analysis (http://www.epa.gov/oswer/riskassessment/rags3adt/index.htm). Adult IRs have been updated in the most recent (2011) version of the Exposure Factors Handbook to indicate a central tendency for adults of 20 mg/day for the soil IR and 30 mg/day for the dust IR.[40] These values rely on relative proportions of soil and dust ingestion for children, and thus we have chosen to retain the value of 50 mg/day (i.e., 46 mg/day, rounded to one significant digit) from the previous Handbook, which also is the value indicated in the current Handbook for adults 18−21 years of age.[40] Recalculation of risk estimates using soil and dust ingestion rates in the 2011 version of the Handbook do not change the overall conclusions of this assessment.

Body weight distributions were obtained from a recent (2007) analysis of the National Health and Nutrition Examination Survey (NHANES) data set.[41] Exposure frequency was set at 365 days/year in both deterministic and probabilistic calculations.

Exposure Scenarios. Five scenarios that describe exposures to combinations of UA- and CSA-affected SHD and soil were used (Table 1): exposures in UA-adjacent spaces (UA exposures) during a 70-year lifetime (scenario 1); exposure in CSA-adjacent spaces (CSA exposures) during a 70-year lifetime (scenario 2); CSA exposures during 0−<6 years of age followed by UA exposures during 6−70 years of age (scenario 3); CSA exposures during childhood (0−<18 years of age) followed by UA exposures during adulthood (18−70 years of age, scenario 4); and UA exposures during 0−<18 years of age followed by CSA exposures during adulthood (18−70 years of age, scenario 5). Incremental ELCR values for timeframes of 1 year from 0 to 18 years of age and of 1 year from 18 to 70 years of age were summed to arrive at a lifetime ELCR value for each scenario. Exposure to UA-affected environments during a 70-year lifetime (Scenario 1) was assumed to represent urban background for the purpose of evaluating the potential differences in risks associated with exposure to CSA-affected media. Scenario 1 considers lifetime exposures to SHD and soil not affected by PAHs associated with CSA pavement, and thus represents a reasonable measure of urban background.

dx.doi.org/10.1021/es303371t | Environ. Sci. Technol. 2013, 47, 1101−1109

For the probabilistic calculations, Monte Carlo simulations were performed for 10 000 trials. These simulations were conducted only for scenarios covering lifetime exposures to UA environments (scenario 1), lifetime exposures to CSA environments (scenario 2), and exposures to CSA-affected media in the first 6 years of life (scenario 3).

Estimation of Excess Lifetime Cancer Risk. The ELCR from exposure to a chemical is described in terms of the probability that an exposed individual will develop cancer by age 70 because of that exposure.[42] Estimates of BaPEQ dose were multiplied by the oral cancer slope factor for BaP of 7.3 per mg/kg/day.[43] For single-year calculations of risk (0−18 years of age), the slope factor was divided by 70, and for calculation of risk for adulthood (18−70 years of age), it was divided by (70/52); risk estimates were generated by summing yearly risks from 0−18 years of age and during adulthood (i.e., 18−70 years of age). In general, the USEPA considers excess cancer risks less than 1×10^{-6} so small as to be negligible (i.e., de minimus), and those greater than 1×10^{-4} to be sufficiently large that some sort of remediation is desirable.[42] Excess cancer risks between 1×10^{-6} and 1×10^{-4} generally are considered to be acceptable, although this is evaluated on a case-by-case basis and the USEPA may determine that risks lower than 1×10^{-4} are not sufficiently protective and warrant remedial action.[42]

RESULTS

Deterministic Dose Estimates. Estimated lifetime CTE BaPEQ dose from ingestion of SHD and soil in CSA-affected settings was 38 times greater than that estimated for UA-affected settings (Supporting Information Table S3). Maximum doses occur at young ages (Figure 1), when body weights are lower and ingestion rates are higher than later in life (Supporting Information Table S3). About 50% of the total estimated RME lifetime dose occurs during 0−<6 years of age, and about 80% occurs during 0−<18 years of age. Doses of BaPEQ for ingestion of CSA-affected soil were greater than those for CSA-affected SHD (Figure 1), comprising about 80% of the aggregate (soil + SHD) lifetime dose. The difference arises because BaPEQ concentrations and IRs are higher for CSA-affected soil than for CSA-affected SHD (Supporting Information Table S2). The CTE lifetime dose from CSA-affected SHD alone, however, is not insubstantial, exceeding the lifetime aggregate dose in UA-affected settings by a factor of 7. The RME lifetime aggregate dose estimate for CSA-affected settings is about 4.5 times higher than the CTE lifetime aggregate dose estimate.

Risk Estimates. Deterministic estimates of ELCR were calculated for the five exposure scenarios (Table 1, Figure 2). Under scenario 1 conditions (urban background), soil is estimated to contribute about one-half (48%) of the aggregate (SHD + soil) CTE estimate of ELCR of 2.9×10^{-6} and the majority (61%) of the RME estimate of 1.1×10^{-5}.

Estimated aggregate CTE ELCR for lifetime exposure to CSA-affected settings (1.1×10^{-4}; scenario 2) was 38 times higher than urban background (scenario 1) (Figure 2). About 36% of the increased ELCR attributable to ingestion of CSA-affected SHD and soil occurs during exposures during the first 6 years of life (scenario 3), when IRs are highest and body weights are lowest, and 56% occurs during the first 18 years of life (scenario 4). The RME ELCRs were from 2.2 to 6.8 times higher than CTE ELCRs across all CSA-affected scenarios (2−5), and the difference was greatest for exposure to CSA-affected environments from 0−6 years of age (scenario 3) (Figure 2).

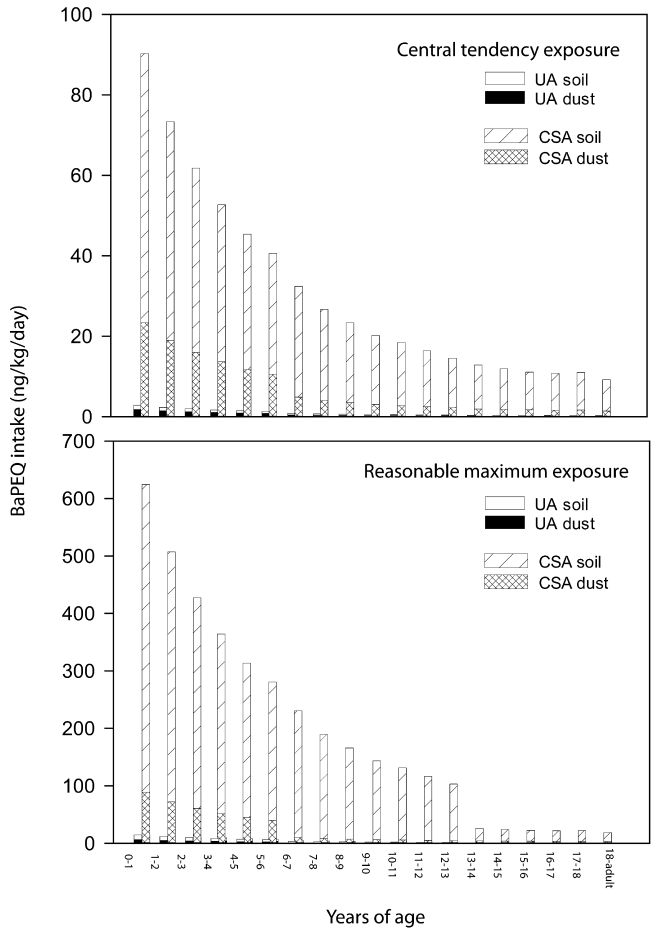


Figure 1. Aggregate doses of benzo[*a*]pyrene equivalents (BaPEQ) (ng/kg/day) from settled house dust and soil in settings adjacent to unsealed asphalt and coal tar-sealed asphalt pavement (UA and CSA, respectively) by year for central tendency and reasonable maximum exposures. Adult years (i.e., 18−70 years of age) are noted as "18-adult.".

In this analysis, ingestion of CSA-affected soil is a more important driver of risk than ingestion of CSA-affected SHD. Ingestion of soil made up about one-half (48%) of ELCR in urban background settings, but made up 72 to 84% of ELCR in CSA-affected settings (Figure 2). Over a lifetime of exposure (scenario 2, CTE), ELCR is estimated to be about 64 times greater for persons who ingest CSA-affected soil relative to their counterparts who are exposed to background concentrations; the comparable difference for CSA-affected and unaffected SHD is a factor of 13. The CTE ELCR for soil alone approaches 1×10^{-4}, and the RME ELCR was estimated at 4.3×10^{-4} (Table 1). Much of the lifetime risk occurs during early childhood (0−<6 years of age, scenario 3) and all childhood (0−<18 years of age, scenario 4) exposures (33 and 53%, respectively). All RME scenarios in CSA-affected environments involving childhood exposure (scenarios 2−4) had ELCR values associated with ingestion of soil exceeding 1×10^{-4} .

Although SHD-mediated exposure to BaPEQ in CSA settings results in less risk compared to soil-mediated exposure, it nonetheless represents a substantial increase in risk over urban background exposure. This is a particularly important pathway of exposure for children. Even more of the lifetime risk

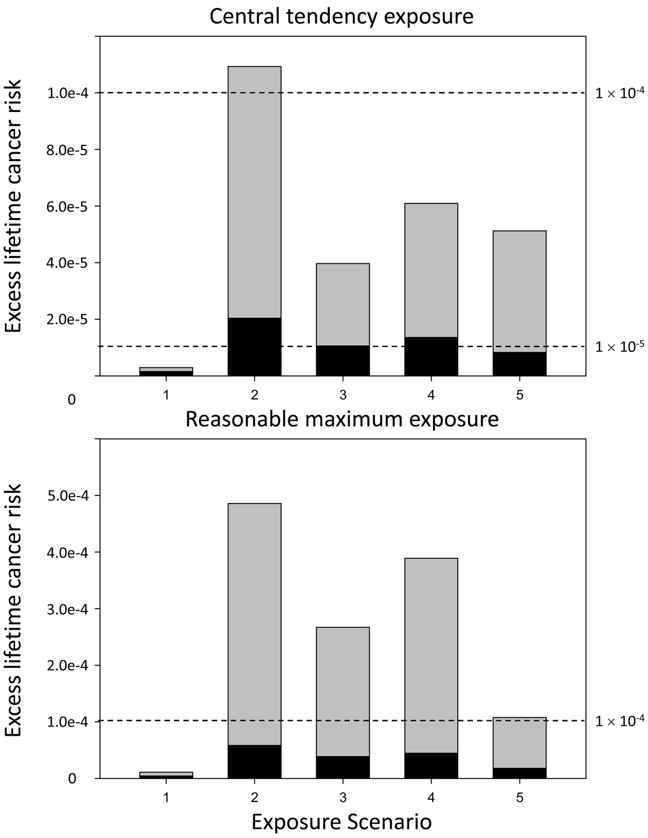


Figure 2. Deterministic excess lifetime cancer risk estimates for the five exposure scenarios described in Table 1 under central tendency and reasonable maximum exposure conditions. Risk attributable to dust is shown in black, and risk attributable to soil is shown in gray.

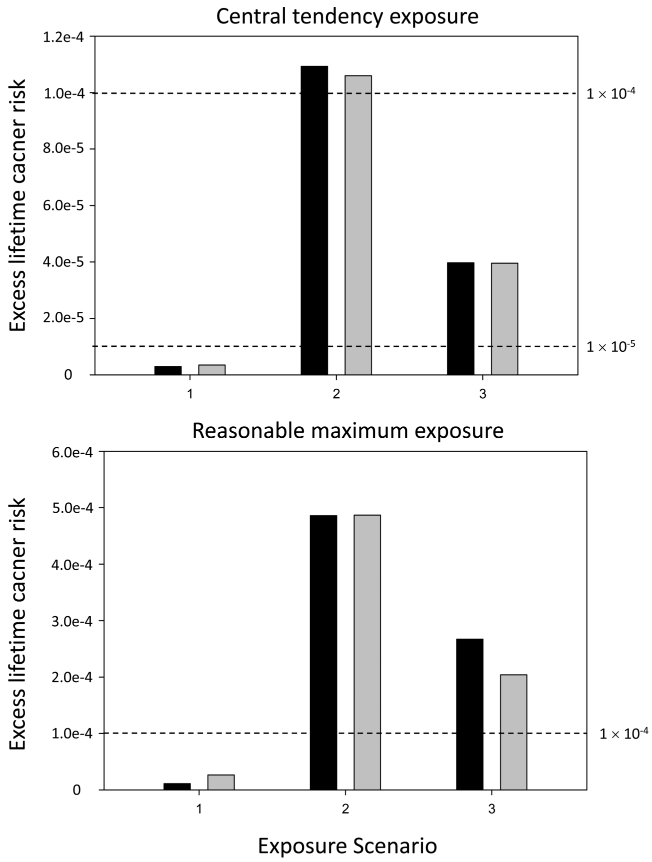


Figure 3. Comparison of deterministic and probabilistic estimates of excess lifetime cancer risk for three exposure scenarios for central tendency exposures (CTE) and reasonable maximum exposures (RME). Deterministic CTE estimates are analogous to 50th percentile probabilistic values, and deterministic RME estimates are analogous to 95th percentile probabilistic values. Black and gray bars depict deterministic and probabilistic risk estimates, respectively.

occurs during early childhood than it does for soil-mediated exposure, with 48 and 64% of the SHD-mediated risk occurring during the first 6 and 18 years of life, respectively. This difference results because the CTE IR for SHD is decreased to one-half its value at age 6 but the CTE IR for soil remains constant from 0−70 years of age (Supporting Information Table S2). All RME scenarios in CSA-affected environments (scenarios 2−5) had ELCR values for ingestion of SHD alone exceeding 1×10^{-5} but none exceeding 1×10^{-4}.

A probabilistic analysis (Monte Carlo) for scenarios 1, 2, and 3 yielded ELCR estimates in a range similar to those estimated deterministically (Table 2, Figure 3), where the 50th percentile statistic is treated as analogous to the CTE and the 95th percentile statistic is treated as analogous to the RME. As with deterministic estimates, probabilistic estimates for ELCR in CSA-affected settings for soil exposures (scenarios 2 and 3) were markedly higher than those for urban background settings (scenario 1) (Table 2). Probabilistic CTE ELCR estimates were very similar to deterministic estimates (Table 1), within 21% for urban background (scenario 1) and identical for 70-year lifespan and the first 6 years of life (scenarios 2 and 3). Probabilistic 95th percentile ELCR estimates differed more from the deterministic estimates, exceeding the deterministic RME for urban background (scenario 1) by a factor of more than 2 and being less than it for the first 6 years of life (scenario 3) by 26%, but the probabilistic and deterministic RME estimates for a 70-year lifespan (scenario 2) were identical.

Sensitivity analyses for the probabilistic ELCR estimates indicate that the proportion of the variability in ELCR contributed by contaminant concentration and IR was different for each scenario (Table 3). For environments where ingestion of UA-affected media only was considered (scenario 1), BaPEQ concentration contributed most of the variability and IR

Table 2. Summary of Probabilistic Estimates (Monte Carlo Simulations, 10 000 runs, 50th Percentile Represents the Central Tendency Exposure and 95th Percentile Represents the Reasonable Maximum Exposure) of Excess Lifetime Cancer Risk for Exposure Scenarios 1−3

	settled house dust only		soil only		dust and soil	
scenario	50th	95th	50th	95th	50th	95th
1	1.2×10^{-6}	1.4×10^{-5}	1.1×10^{-6}	1.6×10^{-5}	3.5×10^{-6}	2.6×10^{-5}
2	1.8×10^{-5}	1.2×10^{-4}	7.3×10^{-5}	4.3×10^{-4}	1.1×10^{-4}	4.9×10^{-4}
3	8.3×10^{-6}	6.1×10^{-5}	2.4×10^{-5}	1.7×10^{-4}	4.0×10^{-5}	2.0×10^{-4}

Table 3. Proportion of the Variability in Estimates of Excess Lifetime Cancer Risk Contributed by Parameters Considered[a,b]

	scenario 1			scenario 2			scenario 3		
	dust alone	soil alone	dust and soil	dust alone	soil alone[c]	dust and soil[c]	dust alone	soil alone	dust and soil
$[\mathrm{BaPEQ}]_{\mathrm{UA\ dust}}$	0.71	--	0.33	--	--	--	0.03	--	
$[\mathrm{BaPEQ}]_{\mathrm{CSA\ dust}}$	--	--	--	0.55		0.07	0.35	--	0.07
$[\mathrm{BaPEQ}]_{\mathrm{UA\ soil}}$	--	0.80	0.42	--	--	--	--	0.01	0.01
$[\mathrm{BaPEQ}]_{\mathrm{CSA\ soil}}$	--	--	--	--	0.50	0.44	--	0.32	0.25
$\mathrm{IR}_{\mathrm{dust,\ 0-6\ years}}$	0.13	--	0.06	0.19	--	0.02	0.59	--	0.12
$\mathrm{IR}_{\mathrm{dust,\ 6-70\ years}}$	0.16	--	0.08	0.24	--	0.04	0.03	--	0.01
$\mathrm{IR}_{\mathrm{soil,\ 0-18\ years}}$	--	0.13	0.07	--	0.30	0.26	--	0.66	0.53
$\mathrm{IR}_{\mathrm{soil,\ 18-70\ years}}$	--	0.06	0.03	--	0.18	0.15	--		

[a][BaPEQ, benzo[a]pyrene equivalents; UA, unsealed asphalt pavement; CSA, coal-tar-sealed pavement; IR, ingestion rate]. [b]-- No contribution to variability is expected from this parameter. [c]Body weight 18−70 years of age contributed ∼1% to variability of estimates.

contributed relatively little. When lifetime exposure or exposure only during the first 6 years of life to CSA environments was considered (scenarios 2 and 3), IR contributed a greater proportion of the variability in estimated ELCR.

■ DISCUSSION

Four exposure scenarios for nondietary ingestion of CSA-affected soil and SHD resulted in estimated BaPEQ doses that are substantially elevated over the dose for urban background (Table 1). BaPEQ doses from nondietary ingestion of CSA-affected soil and dust range from 91 ng/kg/day during the first year of life to 9.1 ng/kg/day for adults. For comparison, Chuang et al. (1999)[26] reported dietary intake for the sum of B2 PAHs for children (2−4 years of age) in North Carolina as 24.8 ng/kg/day. Dietary intakes among adults of B2 PAHs have been estimated at between 1 and 5 μg/day on average (about 12.5−62.5 ng/kg/day).[44] We recently demonstrated that exposures to B2 PAHs in CSA-affected SHD are expected to exceed dietary intakes in children.[28]

ELCRs associated with CSA-affected settings (scenarios 2−5) greatly exceed those for the urban background (scenario 1). To put CSA-associated ELCRs into context, estimated CTE ELCR for lifetime exposure to CSA-affected soils (8.9×10^{-5}) exceeds that for urban soils in Beijing, China (1.77×10^{-6}),[45] and CTE ELCR for lifetime exposure to CSA-affected SHD (2.0×10^{-5}) exceeds that for exposure to urban surface dust (pavement and road dust) in an industrial area in China (1.05×10^{-6}).[46] However, estimated RME ELCR for lifetime exposure to CSA-affected SHD (5.82×10^{-5}) was less than that reported by Maertens et al. (2008)[47] for children in those residences in Ottawa, Canada, with SHD PAH in the top 10th percentile ($>1 \times 10^{-4}$), although the IR and SHD PAH concentrations were comparable to those used here. The difference likely arises because Maertens et al. included an adjustment factor in their risk analysis to account for exposures taking place during early life stages. ELCRs estimated here for CSA-affected settings exceed those for some other types of exposure to PAHs. For example, estimated CTE ELCRs for CSA-affected settings are much greater than those estimated for ingestion of grilled and smoked meat (2.63×10^{-7})[48] and for inhalation of granulates associated with intense 30-year activity on artificial turf (1×10^{-6} for presumed worst case conditions).[49]

The increased cancer risk associated with CSA-affecting settings likely affects a large number of people in the U.S. Use of the product is widespread in the U.S. east of the Continental Divide,[4] and it also is used in some parts of Canada.[8] Sealed parking lots constituted 1−2% of the area of four mixed commercial and residential neighborhoods mapped in Texas; in a suburb of Chicago, IL, sealcoated pavement constituted 4% of the area, and 89% of driveway area was sealcoated.[18]

Uncertainty. The analysis presented here contains several sources of uncertainty, and many of the choices made for the analysis result in conservative (lower) estimates of ELCR. Concentrations of one of the B2 PAH, diBahA, were not included in computation of BaPEQ because analytical difficulties resulted in nondetections in all but one of the SHD samples.[18] The cancer slope factor used was 7.3; Schneider et al., (2002)[50] on the basis of oral carcinogenicity studies with BaP and coal-tar mixtures, recommend use of a slope factor of 11.5, which would increase ELCR reported here by about 50%. No adjustment factor was used to account for increased risk associated with exposure during early life stages, when children are more susceptible to the effects of chemical exposures.[51]

Although seven carcinogenic PAHs, all of which have a RPF ≤ 1, were considered here, the USEPA recently has proposed that 24 PAHs, with RPFs ranging from 0.1 to 60, be used to determine the relative potency of PAH mixtures.[52] At least three of the PAHs with proposed RPFs exceeding 1—benzo[c]fluorene, proposed RPF of 30; dibenz[a,h]anthracene, proposed RPF of 10; and dibenzo[a,l]pyrene, proposed RPF of 30 [52]—are components of coal tar,[53,54] and BaPEQs associated with coal tar are estimated to increase by almost a factor of 10 if the proposed RPFs are adopted.[55]

Other elements of the analysis also contributed to conservative ELCRs estimates. Most importantly, the risk analysis presented here did not consider nondietary ingestion of outdoor dust on parking lots, driveways, and playgrounds with coal-tar-based sealcoat, as no data are available that quantify IR for these settings. PAH concentrations in dust from coal-tar-sealcoated pavement, however, are 10 or more times higher than those measured in CSA-affected SHD and soil: median BaPEQ concentrations reported range from 60 [2] to 392 μg/g.[18] Ingestion of 4−8 mg of dust from CSA parking lots per day in children less than 6 years of age would add 100 ng BaPEQ/kg/day to the overall dose (data not shown). By comparison, the maximum calculated dose in the CTE scenarios is 91 ng/kg/day.

Further, the BaPEQ concentrations for CSA SHD in the analysis presented here might underrepresent typical BaPEQ associated with CSA-affected environments, because the samples used as representative were collected in Austin in 2008, about 2 1/2 years after use of coal-tar-based pavement sealant was banned in that city.[56] It is not known if or how rapidly concentrations of PAH in SHD decrease as sealant on

dx.doi.org/10.1021/es303371t | Environ. Sci. Technol. 2013, 47, 1101−1109

the adjacent pavement ages. Inhalation of gas-phase PAHs also was not considered here, and recent measurements of air concentrations of PAHs indicate relatively high concentrations above old (3.6−8 yr) coal-tar-based sealant[58] and very high concentrations above pavement within hours to weeks following sealant application.[57]

Other sources of uncertainty in this risk analysis include choice of IRs, assumption of 100% bioavailability, sample size, and dust loading. Ingestion rate contributed a large proportion of the variability in estimated ELCR associated with CSA-affected settings. For this analysis we used IRs from.[37,39] Dust IRs recently recommended by the USEPA are higher than those used here, but soil IRs are lower.[40] Recalculation of risk estimates using those in the 2011 updated version of the Handbook slightly changes risk estimates but does not change the overall conclusions of our assessment. The assumption of 100% bioavailability likely causes moderate overstatement of risks from ingestion of CSA-affected SHD and soil. The bioavailability of PAHs in abraded particles of coal tar-based sealant has not been investigated, and thus the relevance of studies of the bioavailability of BaP and other B2 PAHs in soil may or may not be robustly applicable to these calculations. Our calculations indicate that bioavailability on the order of 20% would still be associated with risk in excess of 1×10^{-4} in some exposure scenarios (RME, scenario 2). Bioavailability of PAHs in soil has been observed to range as high as 90%.[21]

The data set available for PAHs specifically associated with CSA- and UA-affected settings was relatively small. In particular, data from only three soil samples were available for soil adjacent to unsealed asphalt. However, these concentrations are consistent with upper ranges of concentrations reported in the literature as "background." Sensitivity analysis indicates that the much of the variability in risk estimates arises from concentrations of BaPEQ in SHD and soil (Table 3).

Finally, the data on dust loading adds some uncertainty to the risk estimates. Recall that one data point in the UA SHD data set is an outlier (883 μg/cm^2, compared to a mean of 85 μg/cm^2 for the remaining 6 data points). Reanalysis of the set without this data point shows that CSA settings had a significantly higher dust loading than the UA settings (p = 0.043, Student's t test). The source of this difference between the sampled settings is unclear.

In this analysis, lifetime estimated ELCRs for deterministic and probabilistic approaches were virtually identical (Tables 1 and 2, Figure 3). This indicates that point estimates for these parameters, as applied here, reasonably represent values in the center and upper reaches of the distributions of these data. Several of the factors contributing to uncertainty associated with the ELCRs presented here could be more fully accounted for with additional data, resulting in less uncertainty. Because the recognition of coal-tar-based pavement sealants as a source of PAHs to the environment is relatively recent (the first study was published in 2004), there are data gaps for such information as bioavailability of PAHs associated with dried sealant particles, IRs for pavement dust, and change in PAH concentrations in CSA-affected soils and SHD with time since sealant application. Additional data on PAH concentrations in CSA-affected soils and SHD will result in more robust ELCR estimates.

Estimates of excess cancer risk arising from exposure to carcinogenic PAHs in settled house dust and soil near coal tar-sealed parking lots exceeded 1×10^{-4} for the central tendency estimate for lifetime exposure, and for reasonable maximum estimates for all exposure scenarios considered. Exposure to these compounds in settled house dust is a particularly important source of risk for children younger than 6 years of age, as they are expected to ingest this material at higher rates. This indicates that the use of coal-tar-based pavement sealants magnifies aggregate exposures to B2 PAHs in children and adults in residences adjacent to where these products are used, and is associated with human health risks in excess of widely accepted standards. Although the analysis presented here is based on a limited data set, the results indicate that biomonitoring might be warranted to characterize the exposure of children and adults to PAHs associated with coal-tar-based pavement sealant.

■ ASSOCIATED CONTENT

Ⓢ Supporting Information

Additional information on dose and exposure assumptions, estimated doses, and dust loading. Table S1. Mass of house dust (<0.5 mm) collected, area sampled, surface dust loading, and benzo[a]pyrene equivalent (BaPEQ) loading for 18 apartments in the Austin, Tex., area. Table S2. Exposure assumptions for deterministic and probabilistic risk calculations. Table S3. Theoretical yearly doses of benzo[a]pyrene equivalents under central tendency and reasonable maximum exposure conditions. This material is available free of charge via the Internet at http://pubs.acs.org.

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Notes

The authors declare no competing financial interest.

■ ACKNOWLEDGMENTS

This work was conducted without the benefit of external funding. Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

■ ABBREVIATIONS:

AT	averaging time
B2 PAH	carcinogenic polycyclic aromatic hydrocarbons (classified B2 by EPA)
BaP	benzo[a]pyrene
CSA	coal-tar-sealed asphalt
CTE	central tendency exposure
BaPEQ	benzo[a]pyrene equivalents
BW	body weight
ED	exposure duration
EF	exposure frequency
ELCR	excess lifetime cancer risk
IR	ingestion rate
PAH	polycyclic aromatic hydrocarbon
RME	reasonable maximum exposure
RPF	relative potency factor
SHD	settled house dust
SHEDS	Stochastic Human Exposure and Dose Simulation
UA	unsealed asphalt

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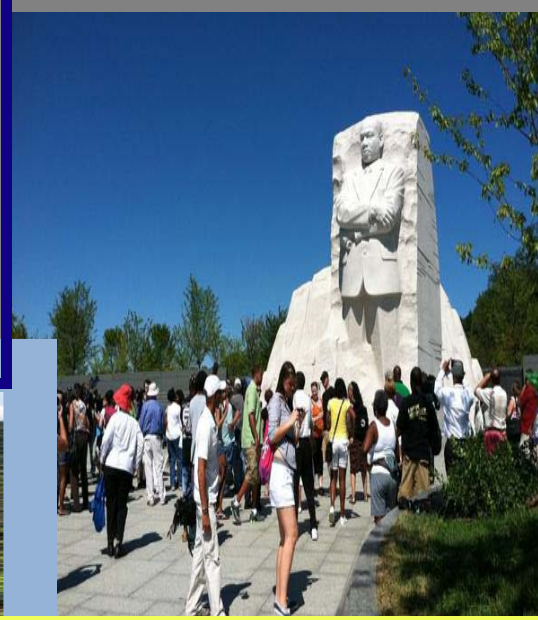
U.S. DEPARTMENT OF THE INTERIOR

ENVIRONMENTAL JUSTICE STRATEGIC PLAN

2012 – 2017



ASSISTANT SECRETARY, POLICY MANAGEMENT AND BUDGET

OFFICE OF ENVIRONMENTAL POLICY AND COMPLIANCE
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Mission

Protecting America's Great Outdoors and Powering Our Future.

The U.S. Department of the Interior protects America's natural resources and heritage, honors our cultures and tribal communities, and supplies the energy to power our future.

Environmental Justice Vision Statement

To provide outstanding management of the natural and cultural resources entrusted to us in a manner that is sustainable, equitable, accessible, and inclusive of all populations.

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MESSAGE FROM THE SECRETARY

Secretary of the Interior Ken Salazar

I am pleased to present the Department of the Interior's Environmental Justice Strategic Plan for the years 2012-2017, which guides the work we do at the Department of the Interior. As custodian of the Nation's natural resources, it is vitally important in our day-to-day activities that we identify and address actions that may have a disproportionately high impact on minority and low-income populations.

Executive Order 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations) outlined an important task for Federal agencies: to ensure no racial, ethnic, cultural or socioeconomic group disproportionately bears the negative environmental consequences resulting from governmental programs, policies, or activities. Executive Order 12898 also asks that these programs, policies, and activities be conducted in a manner that does not have the effects of exclusion or discrimination toward minority, low income, or tribal populations. Executive Order 12898 directed each Federal agency to prepare a plan to integrate environmental justice into its activities.

Every community deserves strong Federal protection against pollution and other environmental hazards. I believe environmental justice is achieved when everyone enjoys the same degree of protection from environmental and health hazards and has equal access to the decision-making process, so they are assured a healthy environment in which to live, learn, work, and play. We will strive to ensure the American people and their communities are always an integral part of the process in the decisions we make, especially when the health of the environment is at stake.

The Department of the Interior is committed to ensuring environmental justice for everyone who may be affected by the Department's management of the resources entrusted to its care in the United States, U.S. Territories, and Insular areas. In particular, as the Department is entrusted with managing the Nation's Indian trust, social services, and self-determination programs, we take seriously our responsibility to ensure American Indians and Alaska Natives are protected from disproportionate environmental and health impacts of agency decisions.

A part of our mission is to protect America's natural resources and heritage, and to honor our cultures and tribal communities. Our mission embodies the special relationship we have with the people of this great Nation. These issues are not remote or abstract, but are part of our everyday activities.

The Department's environmental justice strategy provides a long-term overarching vision, as reflected in our environmental justice goals, which are intentionally broad in scope to guide the bureaus in the development of work plans with specific and measureable targets adapted to their responsibilities and priorities. We have adopted this approach in order to address the complexity of environmental justice in a timely, deliberate, and coordinated manner.

In addition to implementing this strategy, the Department remains committed to actively participating in the Federal Interagency Working Group on Environmental Justice and to collaborating with other Federal agencies on joint efforts to achieve our environmental justice goals.

We look forward to continuing this important work toward the attainment of environmental justice for all Americans.

Sincerely,

Ken Salazar

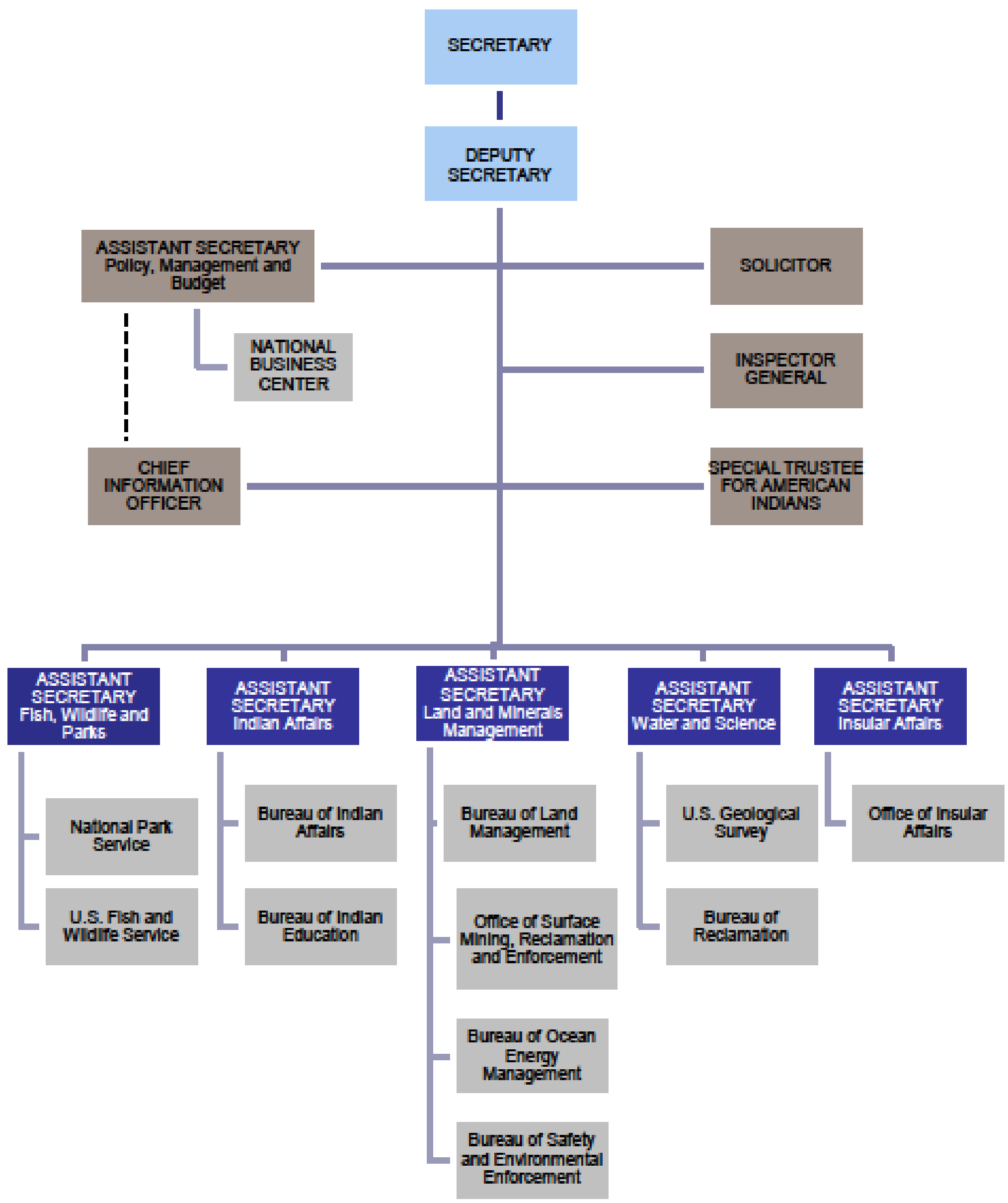
Ken Salazar

HOW ENVIRONMENTAL JUSTICE ACTIVITIES ARE ALIGNED AT THE DEPARTMENT OF THE INTERIOR

The U.S. Department of the Interior (Department) is a multifaceted organization comprised of ten distinct bureaus, each with a unique mission, and several offices all within the Office of the Secretary. The senior appointed official charged with the Department's implementation of Executive Order 12898 (EO 12898) is the Assistant Secretary-Policy, Management and Budget (AS-PMB). AS-PMB responsibilities in part include overseeing compliance with environmental statutes and standards, developing and maintaining internal administrative policy, standards, objectives, and procedures for use throughout the Department. Environmental Justice (EJ) activities are administered within AS-PMB by the Office of Environmental Policy and Compliance (OEPC). Each of the Department's bureaus [Bureau of Indian Affairs (BIA), Bureau of Indian Education (BIE), Bureau of Land Management (BLM), Bureau of Ocean Energy Management (BOEM), Bureau of Safety and Environmental Enforcement (BSEE), Bureau of Reclamation (BR), U.S. Fish and Wildlife Service (FWS), National Park Service (NPS), Office of Surface Mining Reclamation, and Enforcement (OSM), and U.S. Geological Survey (USGS)] has a Primary EJ Coordinator [1] who works directly with OEPC in carrying out the Department's EJ activities. Each bureau has regional and field level offices that assist in local and regional EJ initiatives.

[1] Primary EJ Coordinator is the bureau or office staff person normally at the headquarters level whose duties and tasks may include helping to integrate EJ throughout their particular bureau or office. Duties may also include carrying out day-to-day EJ tasks, internal and external coordination, public outreach, public contact, and acting as the liaison with their field level and regional offices.

U.S. DEPARTMENT OF THE INTERIOR ORGANIZATIONAL CHART



I. Introduction

A. Overview

EO 12898 (http://www.archives.gov/federal-register/executive-orders/pdf/12898.pdf) outlined an important mandate for Federal agencies to "make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories and possessions, the District of Columbia, the Commonwealth of Puerto Rico, and the Commonwealth of the Mariana Islands."

In addition, the EO called for the creation of the Federal Interagency Working Group on Environmental Justice (EJ IWG). The EJ IWG is comprised of Federal agency staff to fact find, receive public comments, and conduct inquiries concerning EJ. EO 12898 also directed Federal agencies to prepare a strategic plan on EJ.

In 1995, the Department assigned to OEPC the coordination of its EJ activities. OEPC established a committee comprised of representatives from each of the Department's bureaus to develop the Department of the Interior's Strategic Plan for EJ. The 1995 plan was adopted and integrated into Departmental policy which increased the visibility of EJ.

In August 2011, the Department joined with other Federal agency members in the signing of the *Memorandum of Understanding on Environmental Justice and Executive Order 12898* (MOU). This MOU reaffirms the Federal government's commitment to EJ. Provisions of the MOU call on each Federal agency to review and update existing EJ strategic plans where applicable and as appropriate. This document is the Department's revised Environmental Justice Strategic Plan (EJ SP).

B. Relationship of Environmental Justice to the Department's Strategic Plan Goals, Initiatives, and Activities

The Department's 2011-2016 Strategic Plan outlines five mission areas that provide the framework for its overarching stewardship responsibilities ("Natural and Cultural Resources, Sustainable Use of Resources, Government-to-Government Relationships, Scientific Foundation for Decision Making, and Building a 21st Century DOI"). Five priority goals have been set forth for achieving near term results ("renewable energy, sustainable water management and conservation, climate change adaptation, youth in natural resources, and efforts to improve the safety of Indian communities"). This draft EJ SP supports and compliments those overarching responsibilities and priority goals, and links the Department's responsibilities under EO 12898 to the Department's 2011-2016 Strategic Plan, (http://www.doi.gov/bpp/data/PPP/DOI_StrategicPlan.pdf). The Department also has several initiatives that further these mission areas and priority goals.

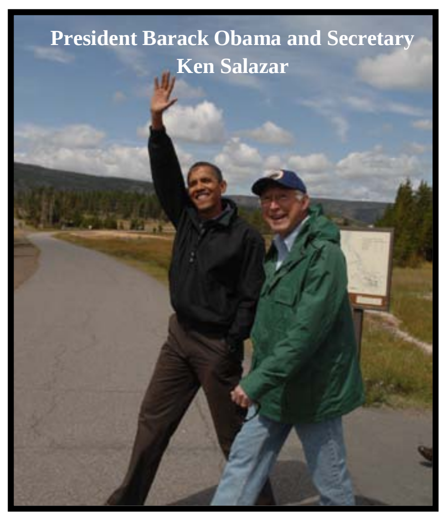
Many of the Department's activities, although not specifically labeled or titled "EJ," embody the spirit and intent of EO 12898 and help in the effort of, "focusing Federal attention on the environmental and human health conditions in minority communities and low-income communities…" Some representative examples of these activities are listed below.

The Department is committed to the sustainable management of natural resources. The *Department's Strategic Sustainability Performance Plan* (http://www.doi.gov/greening/sustainability_plan/index.html*)* of June 3, 2011 sets forth goals and objectives in the achievement of reducing green house gases, and reducing our carbon footprint. This sustainability plan supports the Department's mission area of sustainable use of resources.

Junior Rangers on the trail at Shenandoah National Park in Virginia

Let's Move in Indian Country

The Department is the keeper of national treasures such as national parks, refuges, and historic and natural landmarks. These assets support the First Lady's *Let's Move!* Initiative by encouraging youth and their families to recreate on public lands to improve their health. In collaboration with the White House Domestic Policy Council and other Federal agencies this initiative has been extended to Indian country. This initiative supports the Department's mission area of natural and cultural resources, and government-to-government relationships.



President Barack Obama and Secretary Ken Salazar

The *America's Great Outdoors Initiative* was established by the President in April 2010. The Presidential memorandum called on the Secretaries of the Interior and of Agriculture, the Administrator of the Environmental Protection Agency (EPA), and the Chair of the Council on Environmental Quality (CEQ) to lead the initiative, in collaboration with several other Federal agencies. The initiative supports a 21st century conservation agenda that builds on successes in communities across the country, and has started a national dialogue about conservation that supports the efforts of private citizens and local communities. This initiative seeks the input of communities, including those living in cities and suburbs, as well as more rural areas, and helps to increase public access to parks and open spaces. This initiative supports the Department's mission areas of natural and cultural resources and building a 21st century Department.

The Department's National Environmental Policy Act (NEPA) regulations at 43 CFR Part 46 encourage public participation and community involvement. The Department is using the definition of proposed major Federal actions as found in the CEQ's NEPA regulations.

The Department's EJ SP will be implemented through bureau and Departmental activities. The EJ SP is intended to be a living document and we expect it to evolve over time. As the Department conducts its annual review, the Department may provide alternative measures to those described in this document. In addition, as the Department moves forward and emphasizes EJ, we expect that our strategies will evolve as well. The Department will utilize existing programs and authorities to further the goals of EJ; thereby integrating EJ into all activities of the Department.

C. Previous Environmental Justice Strategy

The *1995 U.S. Department of the Interior Strategic Plan - Environmental Justice*, outlined a plan to ensure the costs and risks of the Department's environmental decisions did not fall disproportionately upon minority, low-income and tribal populations and communities. The plan both built on longstanding partnerships and sought to create new relationships to solve environmental problems. The Department worked in partnership with tribal governments to address their environmental concerns and shared expertise in science and resource management with others when seeking resolution of environmental health and safety problems. The four goals of the 1995 Strategic Plan were:

> Goal 1. The Department will involve minority and low-income communities as we make environmental decisions and assure public access to environmental information.
>
> Goal 2. The Department will provide its employees with environmental justice guidance and with the help of minorities and low-income communities develop training which will reduce their exposure to environmental health and safety hazards.
>
> Goal 3. The Department will use and expand its science, research, and data collection capabilities on innovative solutions to environmental justice related issues (for example, assisting in the identification of different consumption patterns of populations who rely principally on fish and/or wildlife for subsistence).
>
> Goal 4. The Department will use our public partnership opportunities with environmental and grassroots groups, business, academic, labor organizations, and Federal, Tribal, and local Governments to advance environmental justice.

The Department and its bureaus participated in several EJ IWG Demonstration Projects. Bureaus were able to provide technical assistance to communities to obtain their input on project decision making.

The Department's EJ implementation was largely carried out in analyses performed under the NEPA and rulemakings.

The 1995 EJ Strategic Plan did not establish quantitative measures or reporting requirements. Nevertheless, we recognize the value that such tools provide in achieving our goals. Therefore, in order to build upon our past efforts we have included quantitative measures and reporting requirements in this revised EJ SP.

The Department's 2012-2017 EJ SP sets forth five major goals to guide the Department in its pursuit of EJ. In the coming years, we will employ an integrated strategy to:

- Ensure responsible officials[2] are aware of the provisions of EO 12898 and are able to identify and amend programs, policies, and activities under their purview that may have disproportionately high and adverse human health or environmental effects on minority, low-income, or tribal populations;

- Ensure minority, low-income, and tribal populations are provided with the opportunity to engage in meaningful involvement in the Department's decision making processes;

- The Department will, on its own or in collaboration with partners, identify and address environmental impacts that may result in disproportionately high and adverse human health or environmental effects on minority, low-income, or tribal populations;

- Use existing grant programs, training, and educational opportunities as available to aid and empower minority, low-income, and tribal populations in their efforts to build and sustain environmentally and economically sound communities; and

- Integrate the Department's EJ Strategies with its Title VI of the Civil Rights Act enforcement responsibilities to improve efficiencies while preserving the integrity of Title VI and EJ activities.

II. How this Environmental Justice Strategic Plan was Developed

This strategy was developed under the direction of the AS-PMB using a template developed by the EJ IWG. This EJ SP is based on input and review by our bureaus and several selected offices. The draft of this EJ SP was made available on the OEPC web site (http://www.doi.gov/oepc/justice.html) and was provided to the EPA for publication on the EJ IWG web site (http://www.epa.gov/compliance/environmentaljustice/interagency/iwg-compendium.html) and for distribution to members on their EJ list serve. All public comments were reviewed and considered to the extent practicable in the finalization of the Department's 2012-2017 EJ SP. The Department has made several revisions based upon public comments, such as adding language to the Secretary's message regarding exclusion and discrimination, expanding upon our strategies under goals 2, 4, and 5, and adding an explanation for EJ Coordinator in our footnotes. The recommendations specifically related to civil rights have been provided to the Department's Office of Civil Rights for further review. The recommendations

[2] *Responsible Official* is the bureau employee who is delegated the authority to make and implement a decision on a proposed action and is responsible for ensuring compliance with NEPA.

specifically related to the NPS have been provided to the NPS for further review. The Department appreciates the comments received and wishes to reiterate that this is intended to be a living document and we expect it to evolve over time.

III. 2012-2017 Goals, Strategies, and Performance Measures

GOAL # 1

Ensure responsible officials are aware of the provisions of EO 12898 and are able to identify and amend programs, policies, and activities under their purview that may have disproportionately high and adverse human health or environmental effects on minority, low-income, or tribal populations.

Strategies include, but are not limited to:

- Develop and implement EJ training for managers and others.
- Use existing committees, working groups, and forums to champion EJ throughout the Department.
- Require that rules reviewed under Executive Order 13563 "Improving Regulation and Regulatory Review" ensure there is no disproportionate adverse impact on minority, low-income or tribal populations.

Bureaus/Offices Reporting	Performance Measures	2017 Target
All	Percentage of responsible officials Trained.	75% of the target population.
All	Each region of a relevant bureau or office has an individual(s) designated as an EJ coordinator.	100%

Examples of Departmental or bureau specific goals, programs, activities, or policies that currently or potentially could be used to support this strategic goal:

The NPS's A Call To Action: Preparing for a Second Century of Stewardship & Engagement (Call to Action) was released August 25, 2011. A Call to Action charts a path toward that second-century vision by asking NPS employees and partners to commit to concrete actions that advance the mission of the NPS. The report contains actions that the NPS will accomplish by 2016, NPS's 100th anniversary. The first goal is to connect people to parks in the next century. Action 1, "Fill in the Blanks," states: "Identify a national system of parks and protected sites (rivers, heritage areas, trails, and landmarks) that fully represents our natural resources and the nation's cultural experience. To achieve this we will work with communities and partners to submit to Congress a comprehensive National Park System plan that delineates the ecological regions, cultural themes, and stories of diverse communities that are not currently protected and interpreted." http://www.nps.gov/calltoaction/

Action 13 of A Call to Action is entitled "Stop Talking and Listen" and it states, "Learn about the challenges and opportunities associated with connecting diverse communities to the great outdoors and our collective history. To accomplish this we will conduct in-depth, ongoing conversations with citizens in seven communities, one in each NPS Region, representing broadly varied cultures and locations. We will create and implement work plans at each location, which explore new approaches for building and sustaining mutually beneficial relationships with diverse communities."

The FWS co-sponsors the *Environmental Justice in America Conference* which brings state and Federal employees, tribes, academics, business and industry, non-profit organizations, faith-based organizations and others to participate in a dialogue on and training to achieve EJ. http://www.ejconference.net/home.html


2011 EJ in America Conference
Washington, DC

GOAL # 2

Ensure minority, low-income, and tribal populations are provided with the opportunity to engage in meaningful involvement in the Department's decision making processes.

Strategies include, but are not limited to:

- Provide opportunities for the involvement of minority, low-income, and tribal populations as appropriate early and throughout program and planning activities and NEPA processes.

- Establish working partnerships with minority, low-income, and tribal populations.

- Engage in government-to-government consultation with tribal governments consistent with the Department's and applicable bureau's policies on consulting with tribal governments.

- Consistent with law and resources provide the public with information necessary for meaningful participation.

- Conduct public meetings, listening sessions, and forums in a manner that is accessible to and inclusive of minority, low-income, and tribal populations.

- Develop and maintain a list of headquarters and regional EJ contacts, and make it accessible to the public.

- Where appropriate, use alternative dispute resolution (ADR) processes, such as negotiation, mediation, and joint fact-finding, to resolve disputes involving disproportionate adverse impacts of bureau decisions on minority, low-income, and tribal populations.

Bureaus/Offices Reporting	Performance Measures	2017 Target
All	Annual percentage of major Federal actions[3], having a potential for EJ implications that also qualify as Departmental actions with tribal implications[4].	The Department will determine the baseline in 2012 and subsequently establish targets.
All	Annual percentage of environmental impact statements that identify minority and low-income communities and, if they exist, provide opportunities for meaningful involvement.	The Department will determine the baseline in 2012 and subsequently establish targets.

Examples of Department or bureau specific goals, programs, activities, or policies that currently or potentially could be used to support this strategic goal:

The Rivers, Trails, and Conservation Assistance (RTCA) Program supports community-led natural resource conservation and outdoor recreation projects. The RTCA program implements the natural resource conservation and outdoor recreation mission of the NPS in communities across America. RTCA works with nonprofit organizations, community groups, tribes or tribal governments, and local, state, or Federal government agencies. http://www.nps.gov/ncrc/programs/rtca/


Tree Planting Project

The NPS's Land and Water Conservation Fund (LWCF) program provides matching grants to state and local governments for the acquisition and development of public outdoor recreation areas and facilities. The program is intended to create and maintain a nationwide legacy of high

[3] A major Federal action is defined in the Council on Environmental Quality's NEPA regulations found at 40 CFR 1508.18.

[4] For a definition of Departmental actions with tribal implications see the Department's Tribal Consultation Policy at: http://www.doi.gov/news/pressreleases/loader.cfm?csModule=security/getfile&pageid=269697.

quality recreation areas and facilities and to stimulate non-Federal investments in the protection and maintenance of recreation resources across the United States. http://www.nps.gov/lwcf/

The National Center for Preservation Technology & Training (PTT) seeks innovative projects that advance the application of science and technology to historic preservation. The PTT grants program funds projects that develop new technologies or adapt existing technologies to preserve cultural resources. http://www.ncptt.nps.gov/grants/

The Department, including BIA and BR supports tribal self-governance and self-determination. Tribes assume an expanded role in the operation of Indian programs through Public Law 93-638 contracting. The Department's bureaus promote this by entering into a variety of contract, compact, and annual funding agreements with tribes. http://www.bia.gov/WhoWeAre/AS-IA/OSG/index.htm

GOAL # 3

The Department will, on its own or in collaboration with partners, identify and address environmental impacts that may result in disproportionately high and adverse human health or environmental effects on minority, low-income, or tribal populations.

Strategies include, but are not limited to:

- Prepare Department-wide guidance on fish consumption advisories[5].

- Use scientific information to plan effectively for changes that could disproportionately affect minority, low-income, or tribal populations.

- Consider enhancing mitigation and monitoring efforts in the planning processes to lessen any disproportionate environmental, social, and economic impacts on minority, low-income, and tribal communities.

- Establish working relationships or memoranda of understanding/memoranda of agreement with academic institutions, including those serving primarily minority populations, to further EJ goals and further develop special expertise and knowledge to address EJ goals.

- Establish partnerships and collaborate with other Federal agencies to pool resources and assist communities in addressing environmental issues.

[5] When contaminant levels are unsafe, consumption advisories may recommend that people limit or avoid eating certain species of fish caught in certain places.

- Establish partnerships and collaborate with minority, low-income, and tribal populations to share and benefit from specialized expertise that the partnering groups may have about environmental, social, and other issues pertinent to EJ.

- Use internships and other work programs to gain and share expertise or scientific knowledge to further EJ goals.

- Consider consensus-based alternatives in NEPA analyses in accordance with Departmental NEPA regulations at 43 CFR 46.110.

- Develop Department-wide and subsequent bureau-specific criteria for assessing the effectiveness of EJ analyses, to guide periodic effectiveness reviews conducted by each bureau.

Bureaus/Offices Reporting	Performance Measures	2017 Target
All	Number of partnerships with others, including educational institutions and tribes, to share and benefit from specialized expertise in furthering EJ goals.	The Department will determine the baseline in 2012 and subsequently establish targets.
All	Percentage of bureaus that have established a process for periodically assessing the effectiveness of EJ analyses, based on Departmental criteria.	The Department will determine the baseline in 2012 and subsequently establish targets.

Examples of Department or bureau specific goals, programs, activities, or policies that currently or potentially could be used to support this strategic goal:

Water Quality Studies for Tribal Communities

The USGS Oklahoma Water Science Center (OK WSC) has partnered with the EPA and the Army Corps of Engineers in providing critical data to Oklahoma Indian Tribes[6] related to the Tar Creek superfund site. The site is one of the largest superfund sites in the Nation and its environmental effects impact the lands of nine tribes. The site has a 100 year history of lead and zinc mining. With the mining activities comes the risk of subsidence and heavy metal contamination of surface water, groundwater, and sediment. The USGS OK WSC has provided these tribal communities with data related to environmental effects of the metals on the ecology of the area. This information is crucial for tribes in assessing health threats to their communities.

[6] "Indian Tribe" means any tribe, band, nation, or other organized group or community of Indians, including any Alaska Native village (as defined in, or established pursuant to, the Alaska Native Claims Settlement Act), which is recognized as eligible for the special programs and services provided by the United States to Indians because of their status as Indians.

Mining Impacts Workshop for Tribal Communities

The USGS's Office of Tribal Relations, through its Technical Training in Support of Native American Relations Program, and the USGS Midwest Area Mining Initiative, sponsored a tribal workshop on understanding the impacts of mining in the Western Lake Superior region hosted by the Bad River Band of Lake Superior Chippewa Indians in September, 2011. The goal of the workshop was to provide technical information to tribal natural resource managers and others who make decisions or influence decisions regarding proposed mining. Many tribes in the Western Lake Superior region are currently reviewing environmental impact statements for proposed mining and other types of land development activities near lakes and wetlands used by tribes for wild rice production and other vitally important cultural activities. Representatives from 11 tribal government agencies attended the workshop. During this workshop, 24 presenters from Federal, state, and tribal governments, and private organizations and foundations provided technical information on mineral deposits, geology, mineral economics, and mining impacts on the environment (air quality, geochemistry, water quality and sediments and mine permitting).

USGS Urban Waters Initiative

Studies by the USGS have identified coal-tar-based sealcoat, the black viscous liquid sprayed or painted on asphalt pavement such as in parking lots, as a major source of polycyclic aromatic hydrocarbon (PAH) contamination in urban areas for large parts of the Nation. Several PAHs are suspected human carcinogens and are toxic to aquatic life. Based on USGS studies, several jurisdictions, including the City of Austin, Texas; the District of Columbia.; Dane County, Wisconsin; the State of Washington; Sussex County, NY; and several suburbs of Minneapolis, Minnesota, have banned the use of coal-tar-based sealcoat. Similar bans are under consideration in additional jurisdictions. In the District of Columbia the ban was issued to protect human health and the environment. The ban includes the entire District of Columbia, but the EJ relevance is in the Anacostia River watershed. The Anacostia is one of the pilot studies in the Urban Waters Initiative.

The BIA is particularly focused on protection of Indian treaty and subsistence rights and assists tribes in developing effective studies and projects to improve Federal and tribal management of subsistence resources.
http://www.bia.gov/WhoWeAre/BIA/OTS/NaturalResources/FishWildlifeRec/index.htm

Water supply problems are frequently found in Indian Country. Both the BIA and BR offer tribes assistance in managing, conserving, utilizing, and protecting trust water resources through projects and/or programs that support water management, planning, and development. Additional information for BIA and BR can respectively be found at http://www.bia.gov/WhoWeAre/BIA/OTS/NaturalResources/Water/index.htm and www.usbr.gov/native.

The NPS's Federal Lands to Parks Program help communities create new parks and recreation areas by transferring surplus Federal land to state and local governments. This program helps ensure public access to properties and stewardship of the


Rail Trail in Charles County, Maryland, outside Washington D.C.

properties' natural, cultural and recreational resources. http://www.nps.gov/flp/

The NPS administers the Rivers, Trails and Conservation Assistance Program, Land and Water Conservation Fund, National Natural Landmarks Program, National Historic Landmarks Program, the Tribal Preservation Program, Tribal Projects Grants, and the Native American Graves Protection and Repatriation Act Program.

The NPS's Research Learning Centers have been developed to facilitate research efforts and provide educational opportunities. They are places where science and education come together to preserve and protect areas of national significance. They have been designed as public-private partnerships that involve a wide range of people and organizations including researchers, universities, educators, and community groups. http://www.nature.nps.gov/learningcenters/

The NPS's Tribal Preservation Program assists Indian Tribes in preserving their historic properties and cultural traditions. The program originated in 1990, when Congress directed the NPS to study and report on preservation funding needs. The findings of that report, the Keepers of the Treasures: Protecting Historic Properties and Cultural Traditions on Indian Lands http://www.nps.gov/history/crdi/publications/Keepers.htm, are the foundation of the Tribal Preservation Program. Based on that report, Congress has appropriated annual grants for tribal preservation. http://www.nps.gov/history/hps/tribal/

The OSM's Appalachian Coal Country Team (ACCT) works closely with community organizations in some of the poorest regions of the country to restore the health of local watersheds affected by decades of environmental degradation from surface coal mining. Through an innovative partnership between OSM, AmeriCorps Volunteers in Service to America (VISTA), the Citizen's Conservation Corps of West Virginia, and local community sponsors, the ACCT addresses both the environmental and economic consequences of past coal mining. The ACCT encourages environmental stewardship, enhances outreach and education efforts, and builds local capacity for communities to continue restoration efforts independently. In 2007, based on the success of the ACCT, OSM partnered with the Southwest Conservation Corps to establish the Western Hardrock Watershed Team (WHWT) – a coalition of community and watershed improvement groups restoring land and water resources damaged by historic mining in the West. In Fiscal Year 2011 alone, the ACCT and WHWT placed 94 OSM/VISTA volunteers in rural mining communities for year-long service positions. http://www.osmre.gov/aml/vista/vista.shtm

GOAL # 4

Use existing grant programs, training, and educational opportunities, as available, to aid and empower minority, low-income, and tribal populations in their efforts to build and sustain environmentally and economically sound communities.

Strategies include, but are not limited to:

- Develop, implement, and promote communication strategies through outreach to inform minority, low-income, and tribal populations of the Department's programs, policies and activities.

- Provide technical assistance and grants as available to minority, low-income, and tribal populations to identify disproportionately high and adverse human health or environmental effects on minority, low-income, and tribal populations, and to develop methods to reduce these hazards.

- Provide targeted training to minority, low-income and tribal populations to better enable them to achieve EJ for their communities.

- Conduct community-based training to achieve EJ for communities.

- Consult with local community groups to ensure that outreach programs are accessible.

- Assist minority, low-income, and tribal populations in developing and expanding programs that promote healthy ecosystems.

Bureaus/Offices Reporting	Performance Measures	2017 Target
BIA/BIE	Percentage of school facilities which are maintained in an acceptable condition based on a Facility Condition Index rating of "good".	The Department will determine the baseline in 2012 and subsequently establish targets.

Examples of Department or bureau specific goals, programs, activities, or policies that currently or potentially could be used to support this strategic goal:

The FWS offers Tribal Wildlife Grants to provide technical and financial assistance to Federally recognized tribes for the development and implementation of programs that benefit fish and wildlife resources and their habitat. The funds may be used for salaries, equipment, consultation services, subcontracts, and acquisitions and travel. The program has been provided with appropriations of $7,000,000 in each of the past three fiscal years (2009-2011).

The OSM has partnered with the Citizen's Conservation Corps of West Virginia, the Southwest Conservation Corps and AmeriCorps to create two VISTA Teams to help restore land and water resources damaged by past coal mining in rural communities in Appalachia and the Rocky Mountain West. In the summer of 2011, in coordination with the Department's Office of Youth Partnership and Service and other bureaus, OSM provided administrative funding for OSM/VISTA Teams to run a Summer Program, placing 59 full-time youth all across the country in non-profits, community organizations, state agencies, and Department bureaus for 10-week assignments. Participants completed critical projects, such as stream assessments, building community gardens, facilitating civic education, and running youth outdoor programs – many in low-income communities.

The BR has a technical assistance for tribes program, as well as other assistance programs available to tribes. In keeping with BR's mission, all such programs pertain to the area of water and related resources. http://www.usbr.gov/native

The NPS offers exciting employment and volunteer opportunities to help young people ages 5 to 25 learn more about the national parks, to gain some valuable work experience, and to make new discoveries. Some of the opportunities include:

Youth Conservation Corps (ages 15-18)
Public Land Corps (ages 16-25)
Programs for Boy Scouts (ages 7-18)
Programs for Girl Scouts (ages 5-18)
Student Conservation Association (ages 15 and up)
Partner with the National Park Service (for organizations)
http://home.nps.gov/gettinginvolved//youthprograms/

The Pathways Program: The Pathways Program consists of three discrete excepted service internship programs for students and recent graduates: the Internship Program; the Recent Graduates Program; and the Presidential Management Fellows Program. The Pathways Program is expected to be effective April 1, 2012. http://www.opm.gov/HiringReform/Pathways/.

Department Workforce Diversity: The Department wants a workforce that reflects the diversity of America. Potential employees must be a United States citizen to be eligible for consideration for employment. Certain jobs may also have age and physical qualifications. Generally, potential employees must be at least 18 years of age.

NPS Learning Opportunities to Engage Youth and Web Rangers: WebRangers online program for children. The NPS can build volunteerism at an early age by encouraging children to take an interest in their national parks. http://www.nps.gov/webrangers/

September 18, 2009, the Secretary of the Interior announced the 20 Historically Black Colleges and Universities (HBCUs) that will be the beneficiaries of historic preservation grants aimed at providing assistance in the repair of historic buildings on their campuses. These grants will be awarded to HBCUs for the preservation of campus buildings listed in the National Register of Historic Places. http://www.nps.gov/history/hps/hpg/HBCU/index.htm

The BIE seeks to strengthen Indian education, by assessing schools for their Adequate Yearly Progress (AYP) and maintaining school facilities in an acceptable condition.
http://www.bie.edu/

Goal # 5

Integrate the Department's EJ Strategies with its Title VI of the Civil Rights Act enforcement responsibilities to improve efficiencies while preserving the integrity of Title VI and EJ activities.

The Department has Title VI responsibilities for hundreds of recipients of Federal financial assistance. All bureaus have Title VI enforcement responsibilities. Recipients of Federal financial assistance from the Department are required to sign statements assuring they will not discriminate on certain protected bases to include, but not limited to: race, color, and national origin in their programs and activities as a condition of receiving funding from the Department. The Departmental regulations that cover Title VI are found at 43 CFR Part 17, Subpart A. Some bureaus also have regulations applying Title VI standards to programs, activities and facilities of those bureaus (for example: 50 CFR, Part 3 for the FWS).

Since most of the Department's recipients of Federal financial assistance are environmental organizations, allegations about racial/national origin disparities under Title VI have the potential to impact EO 12898 requirements as well. The Department and its bureaus enforce Title VI linked to EJ in two ways. The first is via the public civil rights complaint system. Any member of the public, or a community group, may file a complaint alleging discrimination on the basis of race, color or national origin. These complaints are processed by the Department's Office of Civil Rights, Public Civil Rights Division, and/or the bureau civil rights offices. The second way the Department monitors for Title VI and EJ is via the civil rights review process. This is a systemic analysis of the patterns and practices of recipient organizations to determine how their programs and activities (mostly environmental in nature), impact different racial/national origin communities.

Strategies include but are not limited to:

- Effectively resolve or adjudicate all EJ related Title VI complaints.
- Include EJ as a key component of civil rights compliance reviews.
- Provide technical assistance and training on EJ to recipients of Federal financial assistance.
- Actively monitor recipients' compliance with the signed Title VI statements prior to receiving Federal financial assistance.

Bureaus/Office Reporting	Performance Measures	2017 Target
All	Percentage of Title VI EJ complaints resolved or adjudicated.	The Department will determine the baseline in 2012 and subsequently establish targets.
All	Percentage of civil rights compliance reviews where EJ is a review factor.	The Department will determine the baseline in 2012 and subsequently establish targets.
All	Recipients of Federal financial assistance receiving technical guidance on EJ as linked to Title VI.	The Department will determine the baseline in 2012 and subsequently establish targets.

Examples of Department or bureau specific goals, programs, activities, or policies that currently or potentially could be used to support this strategic goal:

The FWS's Wildlife and Sport Fish Restoration Program provides Federal financial assistance to state and wildlife agencies. The FWS plans to conduct annually at least nine civil rights compliance reviews of these state fish and wildlife agencies. Compliance with EJ will be a major component of those reviews. In particular, the FWS will monitor state's activities in working with minority and low-income communities on environmental assessments conducted. The FWS will monitor the emission of toxins into the air, ground or water by these state agencies. EJ Requirements will be considered on a project by project basis where Federal funds are being spent.

Action 9 of the NPS's *A Call to Action* is "Keep the Dream Alive." The NPS will foster civic dialogue about the stories of the civil rights movement found within the parks. The NPS will conduct a coordinated series of special events to commemorate significant 50th anniversaries of the civil rights movement (Civil Rights Act passage, "I Have a Dream" speech, etc.)."

About this Environmental Justice Strategic Plan:

This EJ SP should not be viewed as a mechanism to provide direct solutions to EJ issues in a particular community. Instead, the EJ SP is intended for the Department to assess different environmental scenarios, identify challenges and opportunities, explore practical application of strategies, and develop recommendations to address EJ issues.

This EJ SP does not confer any legal right and is not a rule requiring notice and comment under the Administrative Procedure Act (Public Law 89-554).

This EJ SP is intended only to improve the internal management of the U.S. Department of the Interior and is not intended to, nor does it create any right, benefit, or trust responsibility, substantive or procedural, enforceable at law or equity by a party against the Department, its bureaus, its officers, or any person. This EJ SP shall not be construed to create any right to judicial review involving the compliance or noncompliance of the Department, its bureaus, its officers, or any person.

Public Involvement

The Department will continue to involve minority and low-income communities as we make environmental decisions and assure public access to our environmental information.

For further information contact**:** Loretta Sutton, Program Analyst; Natural Resources Management Team; Office of Environmental Policy and Compliance; Telephone: 202–208–7565 or email: revised_EJ_strategicplan@ios.doi.gov.

The Department welcomes further comment on its EJ SP and Implementation Progress Report. Comments may be emailed to: revised_EJ_strategicplan@ios.doi.gov or mailed to: U.S. Department of the Interior, Office of Environmental Policy and Compliance (MS-2462), 1849 C Street NW, Washington, DC 20240. Any announcements related to the Department's EJ SP or Annual Implementation Progress Report will be posted at: http://www.doi.gov/oepc/justice.html.

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U.S. DEPARTMENT OF THE INTERIOR

ENVIRONMENTAL JUSTICE STRATEGIC PLAN
2012-2017

ASSISTANT SECRETARY, POLICY MANAGEMENT AND BUDGET

OFFICE OF ENVIRONMENTAL POLICY AND COMPLIANCE
WASHINGTON D.C. 20240
http://www.doi.gov/oepc/justice.html